Draft Study Material

विद्यया ऽमृतमश्नुते

एन सी ई आर टी
NCERT

DOMESTIC BIOMETRIC DATA OPERATOR

(Qualification Pack: Ref. Id. SSC/Q2213)
Sector: Information Technology-Information Technology Enable Services (IT-ITeS)

(Grade XII)

PSS CENTRAL INSTITUTE OF VOCATIONAL EDUCATION
(a constituent unit of NCERT, under Ministry of Education, Government of India)
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Preface

Vocational Education is a dynamic and evolving field, and ensuring that every student has access to quality learning materials is of paramount importance. The journey of the PSS Central Institute of Vocational Education (PSSCIVE) toward producing comprehensive and inclusive study material is rigorous and time-consuming, requiring thorough research, expert consultation, and publication by the National Council of Educational Research and Training (NCERT). However, the absence of finalized study material should not impede the educational progress of our students. In response to this necessity, we present the draft study material, a provisional yet comprehensive guide, designed to bridge the gap between teaching and learning, until the official version of the study material is made available by the NCERT. The draft study material provides a structured and accessible set of materials for teachers and students to utilize in the interim period. The content is aligned with the prescribed curriculum to ensure that students remain on track with their learning objectives.

The contents of the modules are curated to provide continuity in education and maintain the momentum of teaching-learning in vocational education. It encompasses essential concepts and skills aligned with the curriculum and educational standards. We extend our gratitude to the academicians, vocational educators, subject matter experts, industry experts, academic consultants, and all other people who contributed their expertise and insights to the creation of the draft study material.

Teachers are encouraged to use the draft modules of the study material as a guide and supplement their teaching with additional resources and activities that cater to their students' unique learning styles and needs. Collaboration and feedback are vital; therefore, we welcome suggestions for improvement, especially by the teachers, in improving upon the content of the study material.

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Module 1 RDBMS CONCEPTS IN MYSQL

Module Overview

RDBMS stands for Relational Database Management System. It is a type of database management system (DBMS) that stores data in a row-based table structure which connects related data elements. It is called relational because the values within each table are related to each other. This makes it easy to locate and access specific values within the database.

In this unit, you will understand the various data models and various concepts associated with RDBMS. There are various database management software available in the market. Popular examples of RDBMSs include MySQL, Oracle, and SQL Server. The RDBMS concepts using MySQL is covered in this unit.

SQL stands for Structured Query Language, is a special-purpose programming language designed to manage data in a relational database management system (RDBMS) or stream processing in a relational data stream management system (RDSMS). SQL is used to search, store, modify records in database management system. SQL queries are used to retrieve the data needed for specific job functions. It is a standardized way to request information from relational databases. In this unit, you will be able to create database objects, insert data in database and use various types of commands to retrieve the required data from the database.

SQL function is used to perform particular tasks and it returns zero or more values as a result. Functions are useful while writing SQL queries. Functions can be applied to work on single or multiple records (rows) of a table. There are various readily available functions in SQL that can be used in queries. It includes single row functions, multiple row functions, group records based on some criteria. The use of these functions is illustrated in this unit.

Learning Outcomes

After completing this module, you will be able to:

- Understand the fundamental concepts of Relational Database Management Systems (RDBMS), including tables, relationships, normalization, and data integrity.

- Learn the basics of SQL for querying, updating, and managing data within relational databases, including SELECT, INSERT, UPDATE, and DELETE commands.
- Explore and apply various SQL functions for data manipulation and retrieval, including aggregate functions, string functions, and date functions.

Module Structure

Session 1: RDBMS Concepts

Kushaal was playing with his father's mobile phone. Accidentally all the contacts on the phone deleted by him. To recover these contacts his father consulted a technician. The technician recovered all the contacts available using the Google contacts as these contacts are linked with the Google account. Thus, it is possible to save and manage the contacts in smartphone. This is possible with the use of database application available with Google. You can easily understand that the data can be saved and managed through database application.

Fig. 1.1 Illustration

In this session, you will understand the concept of database and how data is organised in the database. The various data models and the various concepts associated with database application such as constraints, primary key, foreign key is also discussed. There is various database management software available in the market. We will discuss about MySQL which is a popular relational database management system (RDBMS).

1.1 INTRODUCTION TO DATABASE SYSTEMS

The word data is taken from *"Datum"*, means raw facts. Datum is a single piece of factual information of interest to us. Data, the plural of datum, is a collection of information. Data is the name given to basic raw facts and entities such as names, numbers and quantity. Data can be defined as a collection of facts and records. Data, representing facts, figures, and ideas, are commonly used in everyday life. Data needs to be managed to use it effectively.

Data items are organised or processed to produce the information. It can be used for processing some useful information from it. The examples of data are weights, prices, costs, numbers of items sold, employee names, product names, addresses, tax codes, registration fees, obtained marks, reservation details, images, sounds, multimedia and animated data. Data can exist in form of text, graphics, sound, video that represents every kind of information. The data items can be stored manually in a diary. But is difficult to retrieve and process the data items when there are large number of data items. Through the relational database systems, users can access a view of data called relations. With relational database management systems (RDBMS), programmers can perform database operations without knowing data storage details.

It is observed that the schools are maintaining the student data and that is stored in the register. After several years of leaving the school, the student can get the duplicate of school leaving certificate. For issuing such certificate the office staff check the student data from the registers which is maintained year-wise and class-wise. By checking the student record, the office staff can easily give the certificate to the student. This is how the schools are maintaining the student data in the register.

The office staff also manually maintain student details who are presently learning. Their Admission number, Name, Date of Birth, Address, Contact Number are stored in the school register.

There are two major types of databases – relational and non-relational. Relational databases are the most commonly used databases today. The following are several types of databases in use.

Flat file databases – Stores data in permanent files that mostly are in text form;

Hierarchical databases – Arranges data in a tree-like structure;

Network databases – Arranges data in network-like structure;

Relational databases – Contains a set of tables in which data are related;

Object databases – Represents information in the form of objects as used in object-oriented programming;

1.2 FILE SYSTEM

Now you must have noticed that maintaining such type of records manually does not allow to correct, modify or delete the data in the register. Also searching the details of the student is difficult. To overcome the hassles faced in manual record keeping, this data can be stored in computer. The student details are stored in computer in the form of separate file.

In computer, any contents are stored in the form of file, which is opened and viewed in the respective software. In computer, file is a container to store data or information. These files are stored on the storage device of computer, such as hard disk drive or pen drive.

The student data can be stored in the document file or spreadsheet file. These files stored on computer can be accessed quickly. To process or manipulate this data, it is required to write the program in computer programming languages. The various operations can be performed through computer programming. It includes searching, sorting, computing the percentage of marks, number of days attendance, retrieving the data.

1.2.1 Limitations of a File System

There are certain limitations to maintain and manipulate such type of data when there are several hundreds or thousands of students. It also becomes difficult to maintain the number of files as it increases the volume when data grows. There are certain limitations of file system to maintain such type of data. The limitations of file system are,

Difficulty in Access – Files themselves do not provide any mechanism to retrieve data. Data maintained in a file system are accessed through application programs. While writing such programs, the developer may not anticipate all the possible ways in which data may be accessed. So, sometimes it is difficult to access data in the required format and one has to write application program to access data.

Data Redundancy – Redundancy means same data are duplicated in different files. For example if we are maintaining students data for the various purpose then data such as student names are maintained in different files. The common data in all such files are required to be maintained number of times. This may cause the data redundancy which is difficult to avoid in a file system. Redundancy leads to excess storage use and may cause data inconsistency also.

Data Inconsistency – Data inconsistency occurs when same data maintained in different places do not match. If a student wants to get changed the spelling in name, it needs to be changed in the number of files where it appears. Likewise, if a student leaves school, the details need to be deleted from these files. As the files are being maintained by different people, the changes may not happen in one of the files. In that case, the student name will be different (inconsistent) in both the files.

Data Isolation – Although these files are maintained for the students of the same class, but there is no link or mapping between these files. The school will have to write separate programs to access these files. This is because data mapping is not supported in file system. In a more complex system where data files are generated by different person at different times, files being

created in isolation may be of different formats. In such case, it is difficult to write new application programs to retrieve data from different files.

Data Dependence – Data are stored in a specific format or structure in a file. If the structure or format itself is changed, all the existing application programs accessing that file also need to be changed. Otherwise, the programs may not work correctly. This is data dependency. Hence, updating the structure of a data file requires modification in all the application programs accessing that file.

Controlled Data Sharing – There can be different category of users like teacher, office staff and parents. Ideally, not every user should be able to access all the data. It means different types of users should be given different types of access, such as read only. It is very difficult to enforce this kind of access control in a file system while accessing files through application programs.

1.3 DATABASE MANAGEMENT SYSTEM

Limitations faced in file system can be overcome by storing the data in a database where data are logically related. A database management systems (DBMSs) is used as an interface to manage databases. (Figure 1.2)

A database is an *organized collection of data*, generally stored and accessed electronically from a computer system. It supports the storage and manipulation of data. In other words, databases are used by an organization as a method of storing, managing and retrieving information. It is possible to store and organise related data in a database so that it can be managed in an efficient and easy way.

A DBMS is a collection of software components designed to create and maintain databases and control all access to them. DBMS allows to create a database, store, manage, update/modify and retrieve data from that database by users or application programs. DBMS is used to provide an effective method of performing database operations, troubleshooting database issues, and restricting data access. Relational Database Management System (RDBMS), which is still popular today, is an advanced version of a DBMS system. Dr. E. F. Codd defined the criterias to determine whether a DBMS is a relational database management system or not. These criteria are knowing as twelve rules Codd's (E. F. Codd, 1985).

Some examples of open source and commercial DBMS include MySQL, Oracle, PostgreSQL, SQL Server, Microsoft Access, MongoDB as presented in Table 1.1.

Table 1.1 Popular DBMS

DBMS	Primary Database Model	License
Oracle	RDBMS	Commercial (restricted free version is available)
MySQL	RDBMS	Open Source
Microsoft SQL Server	RDBMS	Commercial (restricted free version is available)
PostgreSQL	RDBMS	Open Source
MangoDB	Document store	Open Source

Fig: 1.2 Different type of DBMS/RDBMS available in market

Some database management systems include a graphical user interface for users to create and manage databases. Other database systems use a command line interface that requires users to use programming commands to create and manage databases.

A database system hides certain details about how data are actually stored and maintained. Thus, it provides users with an abstract view of the data. A database system has a set of programs through which users or other programs can access, modify and retrieve the stored data.

The DBMS serves as an interface between the database and end users or application programs. Retrieving data from a database through special type of commands is called querying the database. In addition, users can modify the structure of the database itself through a DBMS.

Databases are widely used in various fields. Some applications are given in Table 1.2.

Table 1.2 Use of Database in Real-life Applications

Application	**Database to maintain data about**
Banking	customer information, account details, loan details, transaction details.
Crop Loan	kisan credit card data, farmer's personal data, land area and cultivation data, loan history, repayment data.
Inventory	Management product details, customer information, order details, delivery data.
Organisation Resource Management	employee records, salary details, information, branch locations.
Online Shopping	items description, user login details, users preferences details,

1.3.1 Limitations of DBMS

Increased Complexity – Use of DBMS increases the complexity of maintaining functionalities like security, consistency, sharing and integrity.

Increased data vulnerability – As data are stored centrally, it increases the chances of loss of data due to any failure of hardware or software. It can bring all operations to a halt for all the users.

1.3.2 Application of the DBMS system

Here, are few important applications of the DBMS system:

- Student Admission System, School Examination System, Library Management System.
- Payroll, HR, Sales & Personnel Management System

- Accounting System, Hotel Reservation System and Airline Reservation System
- It is used in the Banking system for Customer information, account activities, Payments, deposits, loans etc.
- Insurance management system
- DBMS system also used by universities to keep all records
- Finance for storing information about stock, sales, and purchases of financial instruments like stocks and bonds.

1.3.2 Advantages of DBMS system

The advantages of DBMS system are:

- DBMS offers a variety of techniques to store & retrieve data
- Uniform administration procedures for data storage and retrieval
- Application programmers never exposed to details of data representation and Storage.
- A DBMS uses various powerful functions to store and retrieve data efficiently.
- Offers Data independence, Data Integrity and Data Security and reduce data redundancy.
- The DBMS implies integrity constraints to get a high level of protection against prohibited access to data.
- Reduced Application Development Time and occupy lesser space

1.3.4 Disadvantages of the DBMS system

The disadvantages of DBMS system are:

- Cost of Hardware and Software of a DBMS is quite high, which increases the budget of your organization.
- Most database management systems are often complex systems, so the training for users to use the DBMS is required.
- The use of the same program at a time by many users sometimes lead to the loss of some data.
- DBMS can't perform sophisticated calculations
- Data-sets begins to grow large as it provides a more predictable query response time.
- It required a processor with the high speed of data processing.
- The database can fail because or power failure or the whole system stops.
- The cost of DBMS is depended on the environment, function, or recurrent annual maintenance cost.

1.3.5 Comparison of Database Management System (DBMS) with File System

The comparative points of DBMS) with File System are given in Table 1.3.

Table 1.3: Comparison of DBMS with File System

File System	DBMS
A file system is a software that manages and organizes the files in a storage medium. It controls how data is stored and retrieved.	DBMS or Database Management System is a software application. It is used for accessing, creating, and managing databases.
The file system provides the details of data representation and storage of data.	DBMS gives an abstract view of data that hides the details
Storing and retrieving of data can't be done efficiently in a file system.	DBMS is efficient to use as there are a wide variety of methods to store and retrieve data.
It does not offer data recovery processes.	There is a backup recovery for data in DBMS.
The file system doesn't have a crash recovery	DBMS provides a crash recovery mechanism

mechanism.	
Protecting a file system is very difficult.	DBMS offers good protection mechanism.
In a file management system, the redundancy of data is greater.	The redundancy of data is low in the DBMS system.
Data inconsistency is higher in the file system.	Data inconsistency is low in a database management system.
The file system offers lesser security.	Database Management System offers high security.
File System allows you to stores the data as isolated data files and entities.	Database Management System stores data as well as defined constraints and interrelation.
Not provide support for complicated transactions.	Easy to implement complicated transactions.
The centralization process is hard in File Management System.	Centralization is easy to achieve in the DBMS system.
It doesn't offer backup and recovery of data if it is lost.	DBMS system provides backup and recovery of data even if it is lost.
There is no efficient query processing in the file system.	You can easily query data in a database using the SQL language.
These system doesn't offer concurrency.	DBMS system provides a concurrency facility.

1.4 Key Concepts in DBMS

It is important to understand the following concepts to efficiently manage data using a DBMS.

1.4.1 Database schema

A database schema is a set of schema for a database's relations. It consists of table with all attributes with their data types and constraints if any. It also represents the relationships among the tables. It is also used to visualize the logical architecture of database and how the data are organized in a database. The schema of a relation may not change, but the relation, which is a variable, changes over time. (Figure 1.3)

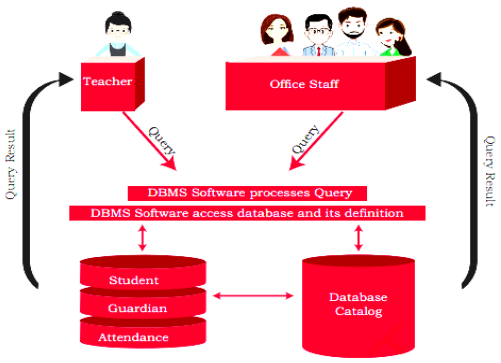


Fig. 1.3 Database schema for Student Attendance system

1.4.2 Data Constraint

Sometimes it is required to put certain restrictions or limitations on the type of data to be inserted in the columns of a table. This is done by specifying constraints on that column(s) while creating the tables. For example, the constraint that the column *mobile number* can only have non-negative integer values of exactly 10 digits. Since each student shall have one unique roll number, we can put the NOT NULL and UNIQUE constraints on the *RollNumber* column. Constraints are used to ensure accuracy and reliability of data in the database

1.4.3 Meta-data or Data Dictionary

The database schema along with various constraints on the data is stored by DBMS in a database catalog or dictionary, called meta-data. A meta-data is data about the data.

1.4.4 Database Instance

When we define database structure or schema, state of database is empty. After loading data, the state or snapshot of the database at any given time is the database instance. We may then retrieve data through queries or manipulate data through updation, modification or deletion. Thus, the state of database can change, and thus a database schema can have many instances at different times.

1.4.5 Query

A query is a request to a database for obtaining information in a desired way. Query can be made to get data from one table or from a combination of tables. For example, *"find names of all those students present today"* is a query to the database. To retrieve or manipulate data, the user needs to write query using a query language called Structured Query Language (SQL).

1.4.6 Data Manipulation

Modification of database consists of three operations viz. Insertion, Deletion or Updation. Suppose Rivaan joins as a new student in the class then the student details need to be added in ***StudentRecord*** as well as in ***ParentRecord*** files of the **STUDENTATTENDANCE** database. This is called Insertion operation on the database. In case a student leaves the school, then student as well as parent data need to be removed from ***StudentRecord***, ***ParentRecord*** and ***AttendanceRecord*** tables, respectively. This is called Deletion operation on the database. Suppose Rivaan's Parent has changed his mobile number, his *Par_Phone* should be updated in ***ParentRecord*** file. This is called Update operation on the database.

1.4.7 Database Engine

Database engine is the underlying component or set of programs used by a DBMS to create database and handle various queries for data retrieval and manipulation.

1.5 RELATIONAL DATA MODEL

A data model describes the structure of the database and represent data. It defines and represents relationships among relations. In database design, first the conceptual data model is designed for non-technical users. Then based on the conceptual data models, the logical data models are designed by the technical users. It represents how to store and retrieve data logically. Finally, the logical design models is converted into physical data models that show all table structures. Relational data model is the most commonly used data model. So here we will focus on relational data model.

1.5.1 Key terms in Relational Data Model

In relational model, tables are called relations that store data for different entities. Each relation in a relational model represents a specific type of entity. An entity is an object and we store data about the object. In other words, a relation is a two-dimensional table used to store data.

Let us consider, the relational database **SCHOOLRECORD** along with the three relations (tables) ***StudentRecord***, ***AttendanceRecord*** and ***ParentRecord***, as shown in Figure 1.4.

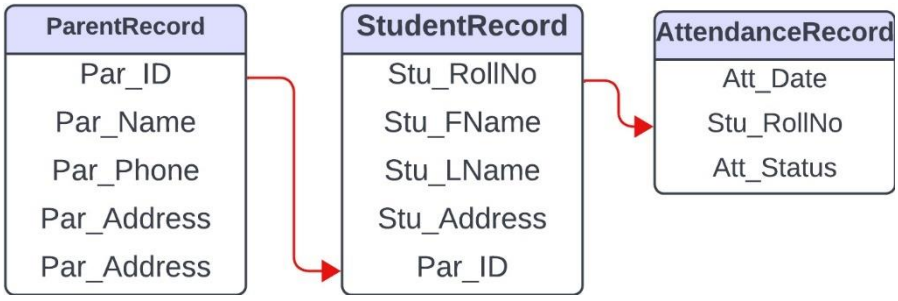


Fig. 1.4 Representing SchoolRecord database using Relational Data Model

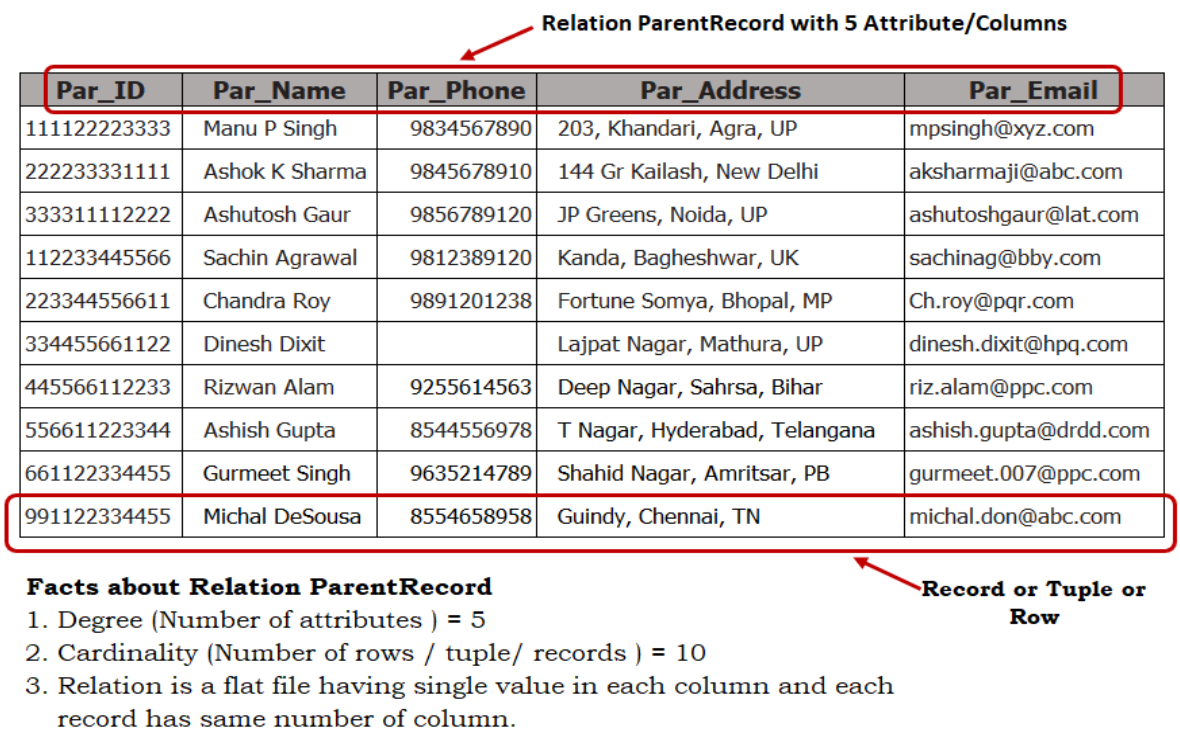
Observe that, a relation ***AttendanceRecord*** has attribute Stu_RollNo which links it with corresponding student record in relation ***StudentRecord***. Similarly, attribute Par_ID is placed with ***StudentRecord*** table for extracting parent details of a particular student. If linking attributes are not there in appropriate relations, it will not be possible to keep the database in correct state and retrieve valid information from the database.

Table 1.4 Relation schema along with its description of Student Attendance database

Relation Schema	Description of attributes
StudentRecord (Stu_RollNo, Stu_FName, Stu_LName, Stu_DOB, Stu_Address, Par_ID)	Stu_RollNo : unique id of the student Stu_FName : First name of the student Stu_LName : Last name of the student Stu_DOB : Student's date of birth Stu_Address : Home address of the student Par_ID : unique id of the parent of the student
AttendanceRecord (Att_Date, Stu_RollNo, Att_Status)	Att_Date : date on which attendance is taken Stu_RollNo : roll number of the student Att_Status : Either P (for present) or A (for absent) **Note :** Combination of Att_Date and Stu_RollNo will be unique in each record of the table
ParentRecord (Par_ID, Par_Name, Par_Phone, Par_Address, Par_Email)	Par_ID : unique id of the parent Par_Name : Name of the parent Par_Phone : Contact number of the parent Par_Address : Address of the parent Par_Email : Email id of the parent

Each tuple (row) in a relation (table) corresponds to data of a real-world entity as in ***StudentRecord***, ***ParentRecord***, and ***AttendanceRecord***. In the ***ParentRecord*** relation (Table 1.4), each row represents the facts about the parent and each column name in the ***ParentRecord*** table is used to interpret the meaning of data stored under that column. A database that is modeled on relational data model concept is called *Relational Database*. Figure 1.5 shows relation ***ParentRecord*** with some populated data.

Let us now understand the commonly used terminologies in relational data model using Figure 1.5.



Par_ID	Par_Name	Par_Phone	Par_Address	Par_Email
111122223333	Manu P Singh	9834567890	203, Khandari, Agra, UP	mpsingh@xyz.com
222233331111	Ashok K Sharma	9845678910	144 Gr Kailash, New Delhi	aksharmaji@abc.com
333311112222	Ashutosh Gaur	9856789120	JP Greens, Noida, UP	ashutoshgaur@lat.com
112233445566	Sachin Agrawal	9812389120	Kanda, Bagheshwar, UK	sachinag@bby.com
223344556611	Chandra Roy	9891201238	Fortune Somya, Bhopal, MP	Ch.roy@pqr.com
334455661122	Dinesh Dixit		Lajpat Nagar, Mathura, UP	dinesh.dixit@hpq.com
445566112233	Rizwan Alam	9255614563	Deep Nagar, Sahrsa, Bihar	riz.alam@ppc.com
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Facts about Relation ParentRecord

1. Degree (Number of attributes) = 5
2. Cardinality (Number of rows / tuple/ records) = 10
3. Relation is a flat file having single value in each column and each record has same number of column.

Fig 1.5 Relation ParentRecord with its attributes (Columns) and tuples (Rows)

Attribute – Characteristic or parameters for which data are to be stored in a relation. Simply stated, the columns of a relation are the attributes which are also referred as fields. For example, Par_ID, Par_Name, Par_Phone and Par_Address are attributes of relation ***ParentRecord***.

Tuple – Each row of data in a relation (table) is called a tuple. In a table with n columns, a tuple is a relationship between the n related values.

Domain – It is a set of values from which an attribute can take a value in each row. Usually, a data type is used to specify domain for an attribute. For example, in ***StudentRecord*** relation, the attribute Stu_RollNo takes integer values and hence its domain is a set of integer values. Similarly, the set of character strings constitutes the domain of the attribute Stu_Fname.

Degree – The number of attributes in a relation is called the Degree of the relation. For example, relation ***ParentRecord*** with four attributes is a relation of degree 5.

Cardinality – The number of tuples in a relation is called the Cardinality of the relation. For example, the cardinality of relation ***ParentRecord*** is 10 as there are 10 tuples in the table.

1.5.2 Three Important Properties of a Relation

In relational data model, following three properties are observed with respect to a relation which makes a relation different from a data file or a simple table.

Property 1: imposes following rules on an attribute of the relation.

1. Each attribute in a relation has a unique name.
2. Sequence of attributes in a relation is immaterial.

Property 2: governs following rules on a tuple of a relation.

1. Each tuple in a relation is distinct. For example, data values in no two tuples of relation ***AttendanceRecord*** can be identical for all the attributes. Thus, each tuple of a relation must be uniquely identified by its contents.
2. Sequence of tuples in a relation is immaterial. The tuples are not considered to be ordered, even though they appear to be in tabular form.

Property 3: imposes following rules on the state of a relation.

1. All data values in an attribute must be from the same domain (same data type).
2. Each data value associated with an attribute must be atomic (cannot be further divisible into meaningful subparts). For example, Par_Phone of relation ***ParentRecord*** has ten digits numbers which is indivisible.
3. No attribute can have many data values in one tuple. For example, any Parent cannot specify multiple contact numbers under Par_Phone attribute.
4. A special value "NULL" is used to represent values that are unknown or non-applicable to certain attributes. For example, if a parent does not share his or her contact number with the school authorities, then Par_Phone is set to NULL (data unknown).

1.6 KEYS IN A RELATIONAL DATABASE

The tuples within a relation must be distinct. It means no two tuples in a table should have same value for all attributes. That is, there should be at least one attribute in which data are distinct (unique) and not NULL. That way, we can uniquely distinguish each tuple of a relation. So, relational data model imposes some restrictions or constraints on the values of the attributes and how the contents of one relation be referred through another relation. These restrictions are specified at the time of defining the database through different types of keys as given below:

1.6.1 Candidate Key

A relation can have one or more attributes that takes distinct values. Any of these attributes can be used to uniquely identify the tuples in the relation. Such attributes are called candidate keys as each of them are candidates for the primary key.

As shown in Figure 1.5, the relation ***ParentRecord*** has five attributes out of which Par_ID and Par_Phone always take unique values. No two parents will have same phone number or same Par_ID. Hence, these two attributes are the candidate keys as they both are candidates for primary key.

1.6.2 Primary Key

Out of one or more candidate keys, the attribute chosen by the database designer to uniquely identify the tuples in a relation is called the primary key of that relation. The remaining attributes in the list of candidate keys are called the alternate keys.

In the relation ***ParentRecord***, suppose Par_ID is chosen as primary key, then Par_Phone will be called the alternate key.

1.6.3 Composite Primary Key

If no single attribute in a relation is able to uniquely distinguish the tuples, then more than one attributes are taken together as primary key. Such primary key consisting of more than one attribute is called ***Composite Primary key***. In relation ***AttendanceRecord***, Roll Number cannot be used as primary key as roll number of same students will appear in another row for a different date. Similarly, in relation ***AttendanceRecord***, Att_Date cannot be used as primary key because same date is repeated for each roll number.

However, combination of these two attributes Stu_RollNo and Att_Date together would always have unique value in ***AttendanceRecord*** table as on any working day, of a student would be marked attendance only once. Hence {Stu_RollNo, Att_Date} will combine to make the of ***AttendanceRecord*** relation composite primary key.

1.6.4 Foreign Key

A foreign key is used to represent the relationship between two relations. A foreign key is an attribute whose value is derived from the primary key of another relation. This means that any attribute of a relation (referencing), which is used to refer contents from another (referenced) relation, becomes foreign key if it refers to the primary key of referenced relation. The referencing relation is called Foreign Relation. In some cases, foreign key can take NULL value if it is not the part of primary key of the foreign table.

The relation in which the referenced primary key is defined is called primary relation or master relation. In Figure 1.6, two foreign keys in **STUDENTATTENDANCE** database are shown using schema diagram where the foreign key is displayed as a directed arc (arrow) originating from it and ending at the corresponding attribute of the primary key of the referenced table. The underlined attributes make the primary key of that table.

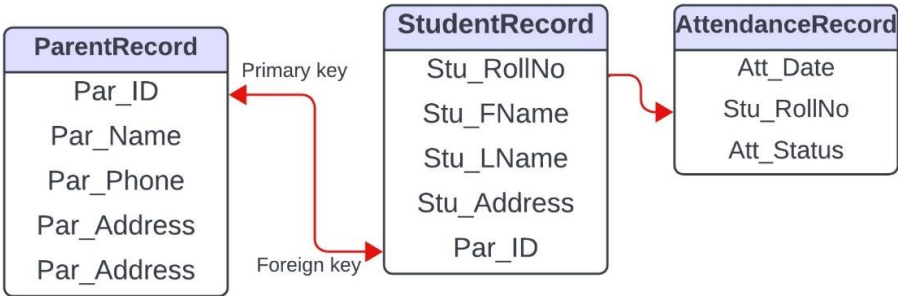

Fig. 1.6 Student Attendance database with the Primary and Foreign keys

Summary

- A file in a file system is a container to store data in a computer.
- File system suffers from Data Redundancy, Data Inconsistency, Data Isolation, Data Dependence and Controlled Data sharing.
- Database Management System (DBMS) is a software to create and manage databases. A database is a collection of tables.
- Database schema is the design of a database
- A database constraint is a restriction on the type of data that that can be inserted into the table.
- Database schema and database constraints are stored in database Catalog. Whereas the snapshot of the database at any given time is the database instance.
- A query is a request to a database for information retrieval and data manipulation (insertion, deletion or update). It is written in Structured Query Language (SQL).
- Relational DBMS (RDBMS) is used to store data in related tables. Rows and columns of a table are called tuples and attributed respectively. A table is referred to as a relation.
- Restrictions on data stored in a RDBMS is applied by use of keys such as Candidate Key, Primary Key, Composite Primary Key, Foreign Key.
- Primary key in a relation is used for unique identification of tuples.
- Foreign key is used to relate two tables or relations.
- Each column in a table represents a feature (attribute) of a record. Table stores the information for an entity whereas a row represents a record.
- Each row in a table represents a record. A tuple is a collection of attribute values that makes a record unique.
- A tuple is a unique entity whereas attribute values can be duplicate in the table.

Check Your Progress

A. Multiple choice questions

1. A database is a (a) organized collection of information that cannot be accessed, updated, and managed (b) collection of data or information without organizing (c) organized collection of data or information that can be accessed, updated, and managed (d) organized collection of data that cannot be updated
2. Which of the following is not a valid SQL type? (a) float (c) numeric (c) decimal (d) character
3. In DBMS, table is known as _____ and row is known as _____. (a) relation, tuple (b) tuple, tuple (c) tuple, relation (d) relation, relation

4. In any table, the data types describe the kind of _____ that it can contain. (a) table (b) data (c) number (d) column
5. The SQL statement used to select data items from the database is (a) SELECT (b) USE (c) ALTER (d) CREATE
6. The database can be renamed using _____ SQL statement (a) CREATE DATABASE (b) RENAME DATABASE (c) DROP DATABASE (d) SELECT DATABASE
7. The syntax used to show all databases is (a) USE DATABASES (b) SELECT DATABASES (c) SHOW DATABASES (d) DISPLAY DATABASE
8. In a database table the field which uniquely identifies each row in the table is known as _____ (a) primary key (b) unique key (c) composite key (d) foreign key
9. Foreign key is a _____ key in another table. (a) primary (b) unique (c) composite (d) candidate key
10. The multiple columns that are used as primary key is known as (a) unique key (b) composite key (c) foreign key (d) candidate key
11. Which of the following key is used to link between two tables (a) primary (b) foreign (c) composite (d) unique
12. A primary key cannot be (a) Zero (b) foreign key (c) duplicate (d) NULL

B. Fill in the blanks

1. In DBMS, table is known as _____and row is known as _____.
2. Organized collection of data or information for accessing, updating and management is known as _____ .
3. A relational database consists of a collection of _____.
4. To see all available databases in MySQL; _____ command is used.
5. Data Definition language is the language which is used to defining the _____of relation.
6. In order to build a link between two tables, _____is used.
7. In order to make multiple columns as a Primary Key, _____ can be used.
8. Foreign key is a field in a table that is _____ in another table.
9. A Key which uniquely identifies each row in the table is known as _____.
10. A foreign key can be _____ or _____. (null, duplicate)

C. State whether True or False

1. DBMS is an interface between Database application and database.
2. Using the SQL statement RENAME DATABASE; a database can be renamed.
3. To see all existing databases; SHOW DATABASES; syntax is used.
4. A Primary Key is basically a Column or Columns.
5. To make a link between two tables, We can use foreign key constraints.
6. A Primary Key can be NULL
7. A Foreign Key can not be Duplicate.
8. If multiple columns are used as Primary Key, it is known as Composite Key.
9. There could be two Primary keys constraints in a single table.
10. A Foreign Key can not have NULL value

D. Short answer questions.

1. What is file system? Write down limitations of file system.
2. Why foreign keys are allowed to have NULL values? Explain with an example.
3. What are the limitations of file system and how that are overcome by DBMS?
4. What is database schema?
5. What is data redundancy and its associated problems?
6. How data redundancy problem is solved in DBMS?
7. What is MYSQL and its features?
8. What are various data types available in MYSQL?
9. Differentiate between: (a) Database state and database schema (b) Primary key and foreign key (c) Degree and cardinality of a relation

10. Explain the terms (a) Relation (b) Domain (c) Tuple (d) Attribute (e) Degree (f) Cardinality (g) Primary Key (h) Foreign Key
11. Describe the various integrity constraints?

E. Practical Exercises

1. Considering the following three tables Student, Teacher and Subject, answer the following questions.

Table Name: Student

Field Name	Description
Reg_No	Student Register Number
First_Name	Name of the Student
Sur_Name	Surname of the Student
Address	Address of the Student
City	City of Student
Pincode	Pincode of city
Birthdate	Date of Birth
Gender	Male or Female
Standard	Studying in which standard
Join_Date	Date of Joining School
Leaving_Date	Date of Leaving School

Table Name: Teacher

Field Name	Description
Teacher_No	Teacher Number
First_Name	Name of the Teacher
Sur_Name	Surname of the Teacher
Address	Address of the Teacher
City	City of teacher
Pincode	Pin code of the city
Phone_no	Phone number of teacher
Email_id	E-mail id of teacher
Mobile_No	Mobile number of teacher

Table Name: Subject

Field Name	Description
Sub_Name	Name of the Subject
Details	Description of the subject

- Write data type for each field in each table.
- Write Primary Key and other key constraints if any in each table.
- Whether it is possible to relate any two tables. If yes, justify your answer.
- What is the degree of each relation.

2. The medical shop wants to maintain a database “Medicos” to keep track of all medicines in the shop. Design a database by answering the following questions.

- Create a realation “medicine” to the medicine details such as medicine name, company, price, batch no, mfd date, qty available and expiry date.
- Assign the appropriate attribute names with their data type.
- Store the medicine and its price at once.

- Assign the contraints if required.

3. Canteen Store Department wants to create a database CSD_Customer to maintain details of all working as well as their dependent family member details.

WORKING_EMPLOYEE(Emp_No, Emp_Name, Address, Aadhar_Number, Dept, DOJ)
DEPENDENT (SNo, Dep_Name, Relationship, Emp_No, Valid_Date)

- Name the attributes of WORKING_EMPLOYEE, which can be used as primary key and candidate keys.
- The CSD wants to retrieve details of dependent of any specific employee. Name the tables and the key which are required to retrieve this information.
- What is the degree and cardinality of WORKING_EMPLOYEE and DEPENDENT relation?

4. Considering the following three tables Student, Project_Assigned Teacher and Project, answer the following questions.

Table: STUDENT

Roll_No	Name	Class	Section	Regi_ID
11	Anshika	XII	B	CS-101-10
12	Hiba	XII	A	CS-103-14
21	Kushaal	XI	B	IP-104-15
22	Manmeet	XII	B	CS-101-14
23	Vibhanshu	XI	A	IP-101-15

Table: PROJECT_ASSIGNED

Regi_ID	Project_No
IP-101-15	101
IP-104-15	102
CS-103-14	103
CS-101-14	104
CS-101-10	105

Table: PROJECT

Proj_No	**Project_Name**	**Sub_Date**
101	Airline Reservation System	12-01-22
102	Library Automation System	12-01-22
103	Employee Management System	15-01-22
104	Student Management System	12-01-22
105	Inventory Management System	15-01-22
106	Railway Reservation System	15-01-22

Answer the following questions:

- Write the name of primary key of each table.
- Write the name of foreign key(s) in table PROJECT_ASSIGNED.
- Is there any alternate key in table STUDENT? Give justification for your answer.
- Can a user assign duplicate value to the field Roll_No of STUDENT table? Justify.

5. Consider the database STUDENT_PROJECT given above and answer the following questions with justification.

- Can you insert a new student record with missing roll number.
- Can you insert a new student record with missing registration id value.
- Can you insert a new project detail without Sub_date.
- Can you insert a new project detail without Proj_no.
- Can you insert a new record with Regi_ID as IP-101-19 and Project_No 206 in table PROJECT_ASSIGNED.

Session 2: Structured Query Language (SQL)

Once the result date is declared, Shyam was eager to see the result on website. (Figure 2.1) He opened the website to enter his Roll number to see the result. After entering Roll number, he pressed the OK button. Immediately score card of Shyam got displayed on the screen and passed with first division marks. Shyam was very happy and also surprised, how a computer searches the Roll number so fast among approximately 5 lacs students records. Later on, Shyam understand that it was possible because of the database query language which is also known as Structured Query Language (SQL). SQL is used to search, store, modify records in data base management system. In this chapter, you will understand to create database objects, insert data in database and various types of commands used to retrieve the required data from the database.

Fig. 2.1 Checking result online

2.1 Structured Query Language (SQL)

In file system it is required to write programs to access data. However in DBMS there exists a Structured Query Language (SQL), is a special kind of query language used to access and manipulate data from the database. SQL is the most popular query language used by major relational database management systems (RDBMS), such as MySQL, Oracle, Informix, PostGre SQL, SQL server, MS Access, and Sybase.

SQL is easy to learn as the statements comprise of descriptive English words. It is possible to interact with a database using SQL very easily. It is simply required to specify what is to be retrieved rather than how to retrieve data from the database. SQL provides statements for defining the structure of data, manipulating data in the database, declaring constraints and retrieving data from the database in various ways, depending on requirement.

2.1.1 Installing MySQL

MySQL is an open source RDBMS software which can be easily downloaded from its official website https://dev.mysql.com/downloads. After installing MySQL, start MySQL service. (Figure 2.2) The appearance of mysql> prompt as shown below. MySQL is ready to accept SQL statements on this prompt.

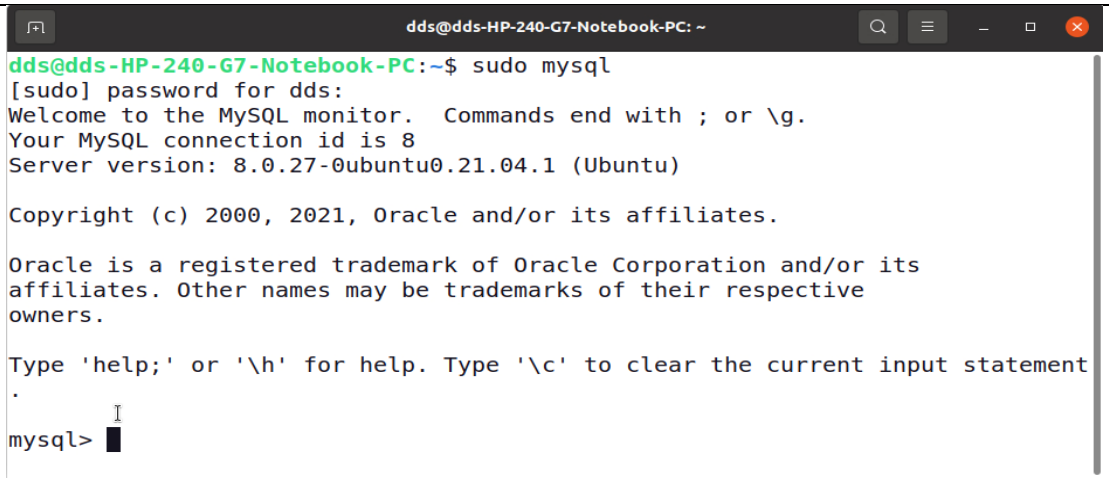

Fig. 2.2: MySQL Shell

Following are some important points to be kept in mind while using SQL.

- SQL is not case insensitive. For example, the column names 'salary' and 'SALARY' are the same for SQL.
- SQL statements terminates with a semicolon (;). In multi-line SQL statements, the ";" is not required after the first line. Just press the Enter key to continue on the next line. The prompt mysql> then changes to "->", indicating that statement is continued to the next line. Only at the end of SQL statement, put ";" and press Enter.

2.2 Data Types and Constraints in MySQL

We know that a database consists of one or more relations and each relation (table) is made up of attributes (column). Each attribute has a data type. It is also possible to specify constraints for each attribute of a relation.

2.2.1 Data type of Attribute

Data type of an attribute indicates the type of data value that an attribute can have. It also decides the operations that can be performed on the data of that attribute. For example, arithmetic operations can be performed on numeric data but not on character data. Commonly used data types in MySQL are numeric types, date and time types, and string types as shown in Table 2.1.

Table 2.1 Commonly used data types in MySQL

Data Type	Description
CHAR (n)	Specifies character type data of length n where n could be any value from 0 to 255. CHAR is of fixed length, means, declaring CHAR (10) implies to reserve spaces for 10 characters. If data does not have 10 characters (for example, 'city' has four characters), MySQL fills the remaining 6 characters with spaces padded on the right.
VARCHAR (n)	Specifies character type data of length 'n' where n could be any value from 0 to 65535. But unlike CHAR, VARCHAR is a variable-length data type. That is, declaring VARCHAR (30) means a maximum of 30 characters can be stored but the actual allocated bytes will depend on the length of entered string. So 'city' in VARCHAR (30) will occupy the space needed to store 4 characters only.
INT	INT specifies an integer value. Each INT value occupies 4 bytes of storage. The range of values allowed in integer type are -2147483648 to 2147483647. For values larger than that, we have to use BIGINT, which occupies 8 bytes.
FLOAT	Holds numbers with decimal points. Each FLOAT value occupies 4 bytes.

DATE	The DATE type is used for dates in 'YYYY-MM-DD' format. YYYY is the 4 digits year, MM is the 2 digits month and DD is the 2 digits date. The supported range is '1000-01-01' to '9999-12-31'.

2.2.2 Constraints

Constraints are the certain types of restrictions on the data values that an attribute can have. Table 2.2 lists some of the commonly used constraints in SQL. They are used to ensure correctness of data. However, it is not mandatory to define constraints for each attribute of a table.

Table 2.2 Commonly used SQL Constraints

Constraint	Description
NOT NULL	Ensures that a column cannot have NULL values where NULL means missing/ unknown/not applicable value.
UNIQUE	Ensures that all the values in a column are distinct/unique.
DEFAULT	A default value specified for the column if no value is provided.
PRIMARY KEY	The column which can uniquely identify each row or record in a table.
FOREIGN KEY	The column which refers to value of an attribute defined as primary key in another table.

2.2.3 Types of Structured Query Language (SQL)

SQL is a standardized language used for making communication with relational databases and performing various operations on it. According to ANSI (American National Standards Institute), it is the standard language for relational database management systems. SQL statements are used to perform tasks such as insert, update delete data in any database. As shown in Figure 2.3. On the basis of different types of operation, SQL commands are divided into five categories.

1. Data Definition Language (DDL)
2. Data Manipulation Language (DML)
3. Data Query Language (DQL)
4. Transaction Control Language (TCL)
5. Data Control Language (DCL)

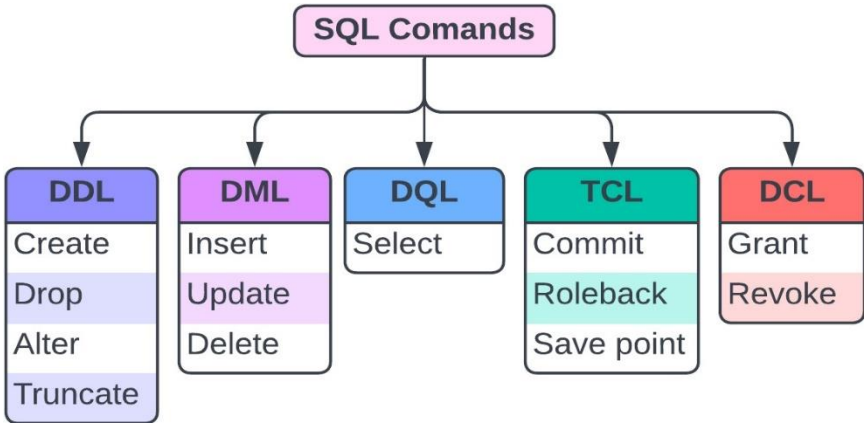

Fig. 2.3: Types of SQL command

2.3 SQL – Data Definition Language (DDL)

It is first necessary to define the relation schema to store data in database. Defining a schema includes creating a relation and giving name to a relation, identifying the attributes in a relation, deciding upon the datatype for each attribute and also specify the constraints as per the requirements. Sometimes, it may require to make changes to the relation schema also. SQL provides commands for defining the relation schema, modifying relation schema and deleting relations. These are called as Data Definition Language (DDL).

As you know that the data are stored in relations or tables in a database. Database is a collection of database object such as tables, queries and views. The CREATE statement is used to create a database and its tables (relations). Before creating a database, it should be clear about the number of tables in the database, the columns (attributes) in each table along with the data type of each column. This is how we decide the relation schema. This category of SQL provides a set of commands to create the database structure or schema.

2.3.1 CREATE Database

This SQL command is used to create various database objects. The syntax and example for creating database is given below.

Syntax:

CREATE DATABASE databasename;

Example 2.1: The following command is used to create a database with the name *"SchoolRecord"*.

mysql> CREATE DATABASE SchoolRecord;

After successful execution of the command a message "Query OK" is displayed on the sql prompt. It is also possible to see the newly created database by using the "show" command. The show command displays the newly created database along with some default databases of MySQL as shown in Figure 2.4.

```
Copyright (c) 2000, 2021, Oracle and/or its affiliates.

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affiliates. Other names may be trademarks of their respective
owners.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql> create database SchoolRecord;
Query OK, 1 row affected (0.23 sec)

mysql> show databases;
+--------------------+
| Database           |
+--------------------+
| SchoolRecord       |
| information_schema |
| mysql              |
| performance_schema |
| sys                |
+--------------------+
5 rows in set (0.00 sec)

mysql>
```

Note: In any RDBMS, it is possible to manage multiple databases on a single computer. USE command is used to select the specific database. After selecting the database, it is possible to create tables or querying data from this database.

To select the database *SchoolRecord*, issue the "USE" command followed by database name.

```
mysql> use SchoolRecord;
Database changed
mysql>
```

Note/Tip: In LINUX OS environment, names for database and tables are case-sensitive whereas in WINDOWS OS, there is no such differentiation. However, as a good practice, it is suggested to write database or table name in the same letter cases that were used at the time of their creation.

2.3.2 CREATE Table

After creating database ***SchoolRecord***, it is required to define relations (create tables) in this database. In each relation specify attribute (column name) for each attribute with their required data types. The syntax for CREATE TABLE statement is as follows.

Syntax:

```
CREATE TABLE tablename (
Col_name1 datatype constraint,
Col_name2 datatype constraint,
:
Col_nameN datatype constraint );
```

Let us understand how to choose attribute names and their respected data types. First identify data types of the attributes in table *"StudentRecord"* along with their constraint, if any. Let us assume that there are total 100 students in a class and values of Roll number are in a sequence from 1 to 100. Since the data values of attribute *"Stu_RollNo"* is stored in digits, the data type integer (INT) is appropriate for this attribute. In the same way total number of characters in student First name and Last name can be upto 20 characters. Since the number of characters can vary for different students, the data type VARCHAR is used for these columns. In the same the data type VARCHAR is used for student address upto 50 characters in length. The specific data type DATE is used for specifying any type of date. So DATE data type is used for attribute *"Date of Birth"*. For student's parent id, Aadhaar number is used which is a 12 digit number. Since Aadhaar number is of fixed length and it is not required to perform any mathematical operation, the character data type with fixed length of 12 character, CHAR (12) is used for this attribute.

Table 2.3 Data types and constraints for the attributes of relation StudentRecord

Attribute	Data expected to be stored	Data type	Constraint
Stu_RollNo	Numeric value consisting of maximum 3 digits	Int	Primary Key
Stu_FName	Variable length string of maximum 20 characters	Varchar (20)	Not Null
Stu_LName	Variable length string of maximum 20 characters	Varchar (20)	Not Null
Stu_DOB	Date value	Date	Not Null
Stu_Address	Variable length string of maximum 50 characters	Varchar (50)	Not Null
Par_ID	Fixed length string of 12 digits for Aadhaar Number	Char (12)	Foreign Key

Table 2.4 Data types and constraints for the attributes of relation ParentRecord

Attribute	Data expected to be stored	Data type	Constraint
Par_ID	Fixed length string of 12 digits Aadhaar number	Char (12)	Primary Key
Par_Name	Variable length string of maximum 20 characters	Varchar (20)	Not Null
Par_Phone	Numeric value consisting of 10 digits	Char (10)	Null Unique

Par_Address	Variable length string of size 30 characters	Varchar (30)	Not Null
Par_Email	Variable length string of size 30 characters	Varchar (30)	

Table 2.5 Data types and constraints for the attributes of relation AttendanceRecord

Attribute	Data expected to be stored	Data type	Constraint
Att_Date	Date value	Date	Primary Key*
Stu_RollNo	Numeric value consisting of maximum 3 digits	Int	Primary Key* Foreign Key
Att_Status	'P' for present and 'A' for absent	Char(1)	Not Null

Table 2.3, 2.4 and 2.5 show the chosen data type and constraint for each attribute of the relations *StudentRecord, ParentRecord* and *AttendanceRecord* respectively.

Example 2.2: The following command is used to create table ***StudentRecord.*** To create the table in SchoolRecord database, first open the database with USE SchoolRecord command. Then create the table under StudentRecord database by using the CREATE TABLE command.

```
mysql> USE SchoolRecord;
Database changed
mysql> CREATE TABLE StudentRecord (
    -> Stu_RollNo INT,
    -> Stu_FName VARCHAR(20),
    -> Stu_LName VARCHAR(20),
    -> Stu_DOB DATE,
    -> Stu_Address VARCHAR(50),
    -> Par_ID CHAR(12),
    -> PRIMARY KEY (Stu_RollNo) );
Query OK, 0 rows affected (3.17 sec)

mysql>
```

Note: "," is used to separate two attributes and each statement terminates with a semi-colon (;). The arrow (->) is an interactive continuation prompt. If we enter an unfinished statement, the SQL shell will wait for us to enter the rest of the statement.

Example 2.3: The following command is used to Create table ***ParentRecord.***

```
mysql> CREATE TABLE ParentRecord (
    -> Par_ID CHAR(12),
    -> Par_Name VARCHAR(20),
    -> Par_Phone CHAR(10),
    -> Par_Address VARCHAR(50),
    -> Par_Email VARCHAR(30) );
Query OK, 0 rows affected (2.57 sec)

mysql>
```

Example 2.4: The following command is used to Create table **AttendanceRecord.**

```
mysql> CREATE TABLE AttendanceRecord (
    -> Att_Date DATE,
    -> Stu_RollNo INT,
    -> Att_Status CHAR(1) );
Query OK, 0 rows affected (2.81 sec)

mysql>
```

2.3.3 DESCRIBE Table

DESCRIBE or DESC command is used to view the structure of an already created table.

Syntax:

DESCRIBE tablename;

Example 2.5: The following SQL command is used to show the structure of *StudentRecord* table.

```
mysql> DESCRIBE StudentRecord;
+------------+------------+------+-----+---------+-------+
| Field      | Type       | Null | Key | Default | Extra |
+------------+------------+------+-----+---------+-------+
| Stu_RollNo | int        | NO   | PRI | NULL    |       |
| Stu_FName  | varchar(20)| YES  |     | NULL    |       |
| Stu_LName  | varchar(20)| YES  |     | NULL    |       |
| Stu_DOB    | date       | YES  |     | NULL    |       |
| Stu_Address| varchar(50)| YES  |     | NULL    |       |
| Par_ID     | char(12)   | YES  |     | NULL    |       |
+------------+------------+------+-----+---------+-------+
6 rows in set (0.01 sec)
mysql>
```

The SHOW TABLES statement is used to display all the table in database. We have created three tables in the database SchoolRecord.

Example 2.6: The following SQL command is used to display the tables created in the database SchoolRecord. It shows all the three tables created so far.

```
mysql> show tables;
+------------------------+
| Tables_in_SchoolRecord |
+------------------------+
| AttendanceRecord       |
| ParentRecord           |
| StudentRecord          |
+------------------------+
3 rows in set (0.01 sec)
mysql>
```

2.3.4 ALTER Table

After creating a table, it is possible to add or remove an attribute or modify the datatype of existing attribute or to add constraint in attribute. ALTER statement is used to change or alter the structure of the table.

Syntax:

ALTER TABLE tablename ADD/Modify/DROP attribute1, attribute2,..

(a) Add primary key to a relation

Example 2.7: The following SQL command is used to add a primary key to the relation *"ParentRecord"*

```
mysql> ALTER TABLE ParentRecord ADD PRIMARY KEY (Par_ID);
Query OK, 0 rows affected (3.91 sec)
Records: 0  Duplicates: 0  Warnings: 0

mysql>
```

A composite primary key is made up of two attributes. The primary key to the *"AttendanceRecord"* relation will be composite primary key of two attributes. *"AttendanceDate"* and *"Stu_RollNo"*.

Example 2.8: The following SQL command is used to add the composite primary key to the relation *"AttendanceRecord"*.

```
mysql> ALTER TABLE AttendanceRecord ADD PRIMARY KEY (
    -> Att_Date, Stu_RollNo);
Query OK, 0 rows affected (4.34 sec)
Records: 0  Duplicates: 0  Warnings: 0

mysql>
```

(b) Add foreign key to a relation

It is also possible to add foreign keys to the relation, if any. A relation may have multiple foreign keys and each foreign key is defined on a single attribute. Note the following points while adding foreign key to a relation.

• The referenced relation must be already created.
• The referenced attribute must be a part of primary key of the referenced relation.
• Data types and size of referenced and referencing attributes must be same.

Syntax:

ALTER TABLE table_name ADD FOREIGN KEY (attribute name)
REFERENCES referenced_table_name (attribute name);

Let us now add foreign key to the table StudentRecord.

In table *"StudentRecord"*, the attribute Par_ID (the referencing attribute) is a foreign key and it refers to attribute Par_ID (the referenced attribute) of table *"ParentRecord"*. Hence, *"StudentRecord"* is the referencing table and *"ParentRecord"* is the referenced table.

Example 2.9: The following SQL command is used to add the foreign key. The ALTER statement change the table StudentRecord.

```
mysql> ALTER TABLE StudentRecord ADD FOREIGN KEY(Par_ID)
    -> REFERENCES ParentRecord(Par_ID);
Query OK, 0 rows affected (5.16 sec)
Records: 0  Duplicates: 0  Warnings: 0

mysql>
```

(c) Add constraint unique to an existing attribute

In *"ParentRecord"* table, attribute *"Par_Phone"* has a constraint **UNIQUE,** means no two values in that column should be same.

Syntax:

ALTER TABLE table_name ADD UNIQUE (attributename);

Example 2.10: The following SQL command is used to add the constraint UNIQUE with attribute *"Par_Phone"* of the table *"ParentRecord"*.

```
mysql> ALTER TABLE ParentRecord ADD UNIQUE(Par_Phone);
Query OK, 0 rows affected (1.56 sec)
Records: 0  Duplicates: 0  Warnings: 0

mysql>
```

(d) Add an attribute to an existing table

Sometimes, it is required to add an additional attribute in a table. The syntax for this is.

Syntax:

ALTER TABLE table_name ADD attribute_name DATATYPE;

Suppose the Principal of the school has decided to award scholarship to some needy students for which income of the parents must be known. But school has not maintained income attribute with table *"ParentRecord"* so far.

Example 2.11: The following command is used to add a new attribute income of data type INT in the table *"ParentRecord"*.

```
mysql> ALTER TABLE ParentRecord ADD Par_Income INT;
Query OK, 0 rows affected (1.38 sec)
Records: 0  Duplicates: 0  Warnings: 0

mysql>
```

The newly added attribute *"income"* with data type INT in the table *"ParentRecord"* can be viewed using DESC command as follows.

```
mysql> desc ParentRecord;
+-------------+-------------+------+-----+---------+-------+
| Field       | Type        | Null | Key | Default | Extra |
+-------------+-------------+------+-----+---------+-------+
| Par_ID      | char(12)    | NO   | PRI | NULL    |       |
| Par_Name    | varchar(20) | YES  |     | NULL    |       |
| Par_Phone   | char(10)    | YES  | UNI | NULL    |       |
| Par_Address | varchar(60) | YES  |     | NULL    |       |
| Par_Email   | varchar(30) | YES  |     | NULL    |       |
| Par_Income  | int         | YES  |     | NULL    |       |
+-------------+-------------+------+-----+---------+-------+
6 rows in set (0.00 sec)

mysql>
```

(e) Modify datatype of an attribute

It is possible to modify the data types of the existing attributes of a table using the following statement.

Syntax:

ALTER TABLE table_name MODIFY attribute DATATYPE;

Suppose, to change the size of attribute *"Par_Address"* from VARCHAR (30) to VARCHAR (40) of the *"ParentRecord"* table.

Example 2.12: The following command is used to change the size of attribute *"Par_Address"* in *"ParentRecord"* table.

```
mysql> ALTER TABLE ParentRecord MODIFY Par_Address VARCHAR(60);
Query OK, 0 rows affected (0.51 sec)
Records: 0  Duplicates: 0  Warnings: 0

mysql>
```

(f) Modify constraint of an attribute

When creating a table, by default each attribute takes null value except for the attribute defined as primary key. It is possible to change an attribute's constraint from NULL to NOT NULL using ALTER statement.

Syntax:

ALTER TABLE table_name MODIFY attribute DATATYPE NOT NULL;

Note: It is required to specify the data type of the attribute along with constraint NOT NULL while using MODIFY.

Example 2.13: The following command is used to associate NOT NULL constraint with attribute *"Stu_FName"* of table *"StudentRecord"*.

```
mysql> ALTER TABLE StudentRecord MODIFY Stu_FName
    -> VARCHAR(20) NOT NULL;
Query OK, 0 rows affected (4.23 sec)
Records: 0  Duplicates: 0  Warnings: 0

mysql>
```

(g) Add default value to an attribute

The syntax to specify the default value for an attribute is,

Syntax:

ALTER TABLE table_name MODIFY attribute

DATATYPE DEFAULT default_value;

To set default value of *"Stu_DOB"* of *"StudentRecord"* to 15th May 2000, write the following statement.

```
mysql> ALter Table StudentRecord MODIFY Stu_DOB DATE
    -> DEFAULT '2000-05-15';
Query OK, 0 rows affected (0.61 sec)
Records: 0  Duplicates: 0  Warnings: 0

mysql>
```

Note: It is required to specify the data type of the attribute along with DEFAULT while using MODIFY.

(h) Remove an attribute

It is possible to remove attributes from a table using ALTER.

Syntax:

ALTER TABLE table_name DROP attribute;

Example 2.14: The following command is used to remove the attribute income from the table *"ParentRecord"*.

```
mysql> ALTER TABLE ParentRecord DROP Par_Income;
Query OK, 0 rows affected (3.91 sec)
Records: 0  Duplicates: 0  Warnings: 0

mysql>
```

(i) Remove primary key from the table

Sometimes it may be required to remove the primary key constraint from the table. In such case, the syntax for ALTER TABLE command is.

Syntax:

ALTER TABLE table_name DROP PRIMARY KEY;

Example 2.15: The following command is used to remove primary key of table *"ParentRecord"*

```
mysql> ALTER TABLE StudentRecord DROP PRIMARY KEY;
Query OK, 0 rows affected (5.61 sec)
Records: 0  Duplicates: 0  Warnings: 0

mysql>
```

Note: The primary key is dropped from StudentRecord table, but each table should have a primary key to maintain uniqueness. Hence, to use ADD command to specify primary key for the StudentRecord table as shown in earlier examples

2.3.5 DROP TABLE Command

Sometimes it may require to remove a table in a database or the database itself. DROP statement is used to remove a database or a table permanently from the system. Since this command will delete the table or database permanently, you have to be cautious while using this statement as it cannot be undone. Let us assume that you have created a table with name *"ParantRecord"* instead of *"ParentRecord"*. DROP command can be used to delete the table created with wrong name.

Syntax :

DROP TABLE table_name;

It is also possible to drop the entire database.

Syntax :

DROP DATABASE database_name;

Example 2.16: The following command is used to delete the table name *"ParantRecord"* from the current database.

Cautions:

- Using the Drop statement to remove a database will ultimately remove all the tables within it.
- DROP statement will remove the tables or database created by you. Hence you may apply DROP statement at the end of the chapter.

2.3.6 TRUNCATE TABLE Command

It is possible to remove all records form a table using TRUNCATE command. Later on, you can insert new records in the same table. This command will delete all records from the table but table structure will exist in database. While using DROP command, all the records with table structure will be deleted from the database. So, care should be taken while using both TRUNCATE and DROP command in SQL.

Syntax:

Truncate Table Table_Name;

Example 2.17: The following command is used to Truncate the table "*StudentRecordBackup*".

```
mysql> Select * from STUDENTBACKUP;
+------------+------------+-----------+------------+-----------------------------+
| Stu_RollNo | Stu_FName  | Stu_LName | Stu_DOB    | Stu_Address                 |
+------------+------------+-----------+------------+-----------------------------+
|          1 | Rajvardhan | Singh     | 2003-05-15 | 203, Khandari, Agra UP      |
|          2 | Trilok     | Sharma    | 2004-08-15 | 144 Gr Kailash, New Delhi   |
|          3 | Aditi      | Gaur      | 2005-06-04 | JP Greens, Noida, UP        |
|          4 | Anshika    | Agrawal   | 2003-05-17 | Kanda, Bagheshwar, UK       |
|          6 | Pawani     | Dixit     | 2004-12-11 | Lajpat Nagar, Mathura, UP   |
|          7 | Hiba       | Rizwan    | 2006-12-03 | Deep Nagar, Sahrsa, Bihar   |
|          8 | Riddhi     | Gupta     | 2005-11-01 | TNagar, Hyderabad, Telangana |
|         10 | John       | DeSousa   | 2005-08-17 | Guindy, Chennai, TN         |
+------------+------------+-----------+------------+-----------------------------+
8 rows in set (0.00 sec)

mysql> TRUNCATE STUDENTBACKUP;
Query OK, 0 rows affected (3.49 sec)

mysql> Select * from STUDENTBACKUP;
Empty set (0.01 sec)

mysql>
```

2.3.7 CREATE TABLE from Existing Table

If you want to create a new table from existing table with partial or additional fields, then you can use the CREATE table command with SELECT statement. The new table is created with the result of SELECT statement with results provided by it.

Syntax:

mysql> Create table NewTableName AS

(Select Field 1, Field 2, Field 3, …Field N from Old_Table_Name)

Example 2.18: The following command is used to Create table *"NewStudentRecord"* from the existing table *"StudentRecord"*.

```
mysql> Create table NewStudentRecord AS (Select Stu_RollNo, Stu_FName, Stu_LName,
 Stu_DOB, Stu_Address from StudentRecord);
Query OK, 9 rows affected (2.40 sec)
Records: 9  Duplicates: 0  Warnings: 0

mysql>
```

It will create a new table named as *"NewStudentRecord"* with only 5 attributes and all the records which are inserted in this table earlier.

```
mysql> Show tables;
+------------------------+
| Tables_in_SchoolRecord |
+------------------------+
| AttendanceRecord       |
| NewStudentRecord       |
| ParentRecord           |
| StudentRecord          |
+------------------------+
4 rows in set (0.00 sec)

mysql>
```

It is possible to create a new table with all attributes and all records available in the existing table.

Example 2.19: The following command is used to create a new table "*StudentRecord1"* with all attributes and all records available in the existing table "*StudentRecord"*.

```
mysql> CREATE TABLE StudentRecord1 AS(Select * from StudentRecord);
Query OK, 9 rows affected (3.39 sec)
Records: 9  Duplicates: 0  Warnings: 0

mysql> SELECT * FROM StudentRecord1;
+------------+------------+-----------+------------+------------------------------+--------------+
| Stu_RollNo | Stu_FName  | Stu_LName | Stu_DOB    | Stu_Address                  | Par_ID       |
+------------+------------+-----------+------------+------------------------------+--------------+
|          1 | Rajvardhan | Singh     | 2003-05-15 | 203, Khandari, Agra UP       | 452695874564 |
|          2 | Trilok     | Sharma    | 2004-08-15 | 144 Gr Kailash, New Delhi    | 252154687451 |
|          3 | Aditi      | Gaur      | 2005-06-04 | JP Greens, Noida, UP         | 362115264625 |
|          4 | Anshika    | Agrawal   | 2003-05-17 | Kanda, Bagheshwar, UK        | 602125125261 |
|          6 | Pawani     | Dixit     | 2004-12-11 | Lajpat Nagar, Mathura, UP    | 268953264578 |
|          7 | Hiba       | Rizwan    | 2006-12-03 | Deep Nagar, Sahrsa, Bihar    | 485466192343 |
|          8 | Riddhi     | Gupta     | 2005-11-01 | TNagar, Hyderabad, Telangana | 521556651761 |
|         10 | John       | DeSousa   | 2005-08-17 | Guindy, Chennai, TN          | 954891122475 |
|          5 | Nandini    | Roy       | 2003-12-19 | Fortune Somya, Bhopal, MP    | 225423344657 |
+------------+------------+-----------+------------+------------------------------+--------------+
9 rows in set (0.00 sec)

mysql>
```

2.3.8 RENAME TABLE command

Sometime it may be required to change the name of existing table. It is possible to do so by using RENAME or ALTER command.

Syntax:

RENAME TABLE old_table_name TO new_table_name;

Example 2.20: The following command is used to rename the table *"NewStudentRecord"* to *"StudentRecord1"*

mysql> RENAME TABLE **NewStudentRecord** TO StudentRecord**1;**

It is possible to rename multiple tables using single command as under.

Syntax:

RENAME TABLE Old_tableA TO New_tableA, Old_tableB TO New_tableB, Old_tableC TO New_tableC;

It is also possible to use ALTER command to rename the table as given below.

Syntax:

ALTER TABLE Old_table_name RENAME TO new_table_name;

Example 2.21: The following is the command to alter the table *"StudentRecord1"* to "*StudentRecord2"*

mysql> ALTER TABLE **StudentRecord1** RENAME TO **StudentRecord2;**

2.3.9 CREATE VIEW command

Like table, view is another database object. It is a special kind of virtual table. It does not hold its own data. A view can has rows and columns just like in table. It is possible to create a view using CREATE VIEW command, by selecting fields from one or more tables present in the database. A View can either have all the rows of a table (s) or specific rows based on certain criteria. The syntax to create a view is as under.

Syntax:

CREATE VIEW view_name AS

SELECT column1, column2 ..... columnN

FROM table_name WHERE condition;

Example 2.22: The following is the command to create a view from single table.

```
mysql> CREATE VIEW EMP_VIEW AS  Select * FROM emp where SAL>10000;
Query OK, 0 rows affected (0.54 sec)

mysql>
```

Now the view named EMP_VIEW will be created with only those employee records who have salary more than 10000. You can use this view similar to Employee table to see all records using SELECT command. To see all records from EMP_VEW, use the SELECT command as under.

```
mysql> CREATE VIEW EMP_VIEW AS  Select * FROM emp where SAL>10000;
Query OK, 0 rows affected (0.54 sec)

mysql> Select * from EMP_VIEW;
+-------+-----------+-----------+------+------------+-------+------+--------+
| empno | ename     | job       | mgr  | hiredate   | sal   | comm | deptno |
+-------+-----------+-----------+------+------------+-------+------+--------+
|  7216 | Jawahar   | Manager   | 7489 | 1995-03-30 | 10975 | NULL |     20 |
|  7348 | Balwinder | Manager   | 7489 | 1995-04-28 | 10850 | NULL |     30 |
|  7432 | Chetana   | Manager   | 7489 | 1995-06-06 | 10450 | NULL |     10 |
|  7438 | Sachin    | Analyst   | 7216 | 1996-12-05 | 11000 | NULL |     20 |
|  7489 | Kushaal   | President | NULL | 1995-11-14 | 13000 | NULL |     10 |
|  7552 | Farhan    | Analyst   | 7216 | 1995-10-27 | 11000 | NULL |     20 |
+-------+-----------+-----------+------+------------+-------+------+--------+
6 rows in set (0.00 sec)

mysql>
```

Activity 1

Practical Activity 2.1 – Create the table "Employee" and "Department" in MySQL with the following attributes specification.

Employee Table

Attribute	Data expected to be stored	Data type	Constraint
empno	Numeric value consisting of 4 digits	Int	Primary Key
ename	Variable length string of max 30 characters	Varchar (30)	Not Null

job	Variable length string of max 15 characters	Varchar (15)	Not Null
mgr	Numeric value consisting of 4 digits	Int	Not Null
hiredate	Date of joining the company	Date	Not Null
sal	Numeric value consisting of 6 digits	Int	Not Null
comm	Numeric value consisting of 4 digits	Int	Not Null
Deptno	Dept no which is Numeric type consisting of maximum 2 digits	Int	

Department Table

Attribute	Data expected to be stored	Data type	Constraint
deptno	Numeric value consisting of 4 digits	Int	Primary Key
dname	Variant length string of max 20 characters	Varchar (20)	Not Null
loc	Variant length string of max 25 characters	Varchar (25)	Not Null

2.4 SQL FOR DATA MANIPULATION LANGUAGE (DML)

In the previous section, we created the database **SchoolRecord** with three relations (or tables) i.e. *StudentRecord, ParentRecord* and *AttendanceRecord*. Creating ab table, creates its structure only. It is required to manipulate the data in the table by entering, deleting and updating the data records. The commands or statements used to insert, delete and update the records comes under SQL Data Manipulation Language (DML).

Data Manipulation means either retrieval (access) of existing data, insertion of new data, removal of existing data or modification of existing data in the database. Updation and deletion of data records are also important in SQL. These data manipulation methods are discussed in the following section.

2.4.1 INSERTION of Records

INSERT INTO statement is used to insert new records in any table or relation.

Syntax:

INSERT INTO tablename VALUES (value 1, value 2,....);

Here, value 1 corresponds to attribute 1, value 2 corresponds to attribute 2 and so on. It is required to specify attribute names in INSERT statement if there are exactly same number of values in the INSERT statement as the total number of attributes in the table.

Caution: *While populating records in a table with foreign key, ensure that records in referenced tables are already populated.*

Let us insert some records in the ***SchoolRecord*** database. First insert the records in *ParentRecord* table first as it does not have any foreign key. A set of sample records for *ParentRecord* table is shown in Table 2.6.

Table 2.6 Records to be inserted into the ParentRecord Table

Par_ID	Par_Name	Par_Phone	Par_Address	Par_Email
452695874564	Manu P Singh	9834567890	203, Khandari, Agra, UP	mpsingh@gmail.com
252154687451	Ashok K Sharma	9845678910	144 Gr Kailash, New Delhi	aksharmaji@mail.com
362115264625	Ashutosh Gaur	9856789120	JP Greens, Noida, UP	ashutoshgaur@gmail.com
602125125261	Sachin Agrawal	9812389120	Kanda, Bagheshwar, UK	sachinag@gmail.com
225423344657	Chandra Roy	9891201238	Fortune Somya, Bhopal, MP	Ch.roy@rediff.com
268953264578	Dinesh Dixit		Lajpat Nagar, Mathura, UP	dinesh.dixit@hp.com

485466192343	Rizwan Alam	9255614563	Deep Nagar, Sahrsa, Bihar	riz.alam@gmail.com
521556651761	Ashish Gupta	8544556978	T Nagar, Hyderabad, Telangana	ashish.gupta@hotmail.com
686113652987	Gurmeet Singh	9635214789	Shahid Nagar, Amritsar, PB	gurmeet.007@ymail.com
954891122475	Michal DeSousa	8554658958	Guindy, Chennai, TN	michal.don@gmail.com

Example 2.23: The following command is used to insert the record in the "*ParentRecord*" table.

```
mysql> INSERT INTO ParentRecord VALUES (45269587456,'Manu P Singh',
    -> 9834567890,'203, Khandari, Agra, UP','mpsingh@gmail.com');
Query OK, 1 row affected (0.25 sec)

mysql>
```

We can use the SQL statement ***"SELECT * from table_ name;"*** to view the inserted record after any statement to see the current changes in table.

```
mysql> select * from ParentRecord;
+-------------+-------------+------------+-------------------------+-------------------+
| Par_ID      | Par_Name    | Par_Phone  | Par_Address             | Par_Email         |
+-------------+-------------+------------+-------------------------+-------------------+
| 45269587456 | Manu P Singh | 9834567890 | 203, Khandari, Agra, UP | mpsingh@gmail.com |
+-------------+-------------+------------+-------------------------+-------------------+
1 row in set (0.01 sec)

mysql>
```

It is also possible to provide values only for some of the attributes in a table by just specifying the attribute name alongside each data value as per the following syntax.

Syntax:

INSERT INTO tablename (column1, column2, ...)

VALUES (value1, value2, ...);

Suppose to insert the sixth record in "*ParentRecord*" table (Table 2.6) keeping the value of *"Par_Phone"* to NULL. Then it is required to insert the values for other four fields. In this case, specify the names of attributes in which the values are to be inserted. The values must be given in the same order in which attributes are written in INSERT command.

Example 2.24: The following command is used to insert the record in "*ParentRecord*" table by specifying the field name and corresponding values.

```
mysql> INSERT INTO ParentRecord(Par_ID, Par_Name, Par_Address, Par_Email)
    -> VALUES(268953264578,'Dinesh Dixit','Lajpat Nagar, Mathura, UP',
    -> 'dinesh.dixit@hp.com');
Query OK, 1 row affected (0.25 sec)

mysql>
```

Now observe that all the four values has been inserted in the table *ParentRecord* except *"Par_Phone"* which is being set to NULL at the time of creating a table.

```
mysql> SELECT * FROM ParentRecord;
+-------------+-------------+------------+-------------------------+--------------------+
| Par_ID      | Par_Name    | Par_Phone  | Par_Address             | Par_Email          |
+-------------+-------------+------------+-------------------------+--------------------+
| 268953264578 | Dinesh Dixit | NULL       | Lajpat Nagar, Mathura, UP | dinesh.dixit@hp.com |
| 452695874564 | Manu P Singh | 9834567890 | 203, Khandari, Agra, UP   | mpsingh@gmail.com   |
+-------------+-------------+------------+-------------------------+--------------------+
2 rows in set (0.00 sec)

mysql>
```

Note: Text and date values must be enclosed in ' ' (single quotes).

Activities

Practical Activity 2.2 – Insert the records in the *ParentRecord* table using INSERT command and check the records inserted in *ParentRecord* as below.

```
mysql> Select * from ParentRecord;
+--------------+----------------+------------+-----------------------------+-------------------------+
| Par_ID       | Par_Name       | Par_Phone  | Par_Address                 | Par_Email               |
+--------------+----------------+------------+-----------------------------+-------------------------+
| 225423344657 | Chandra Roy    | 9891201238 | Fortune Somya, Bhopal, MP   | Ch.roy@rediff.com       |
| 252154687451 | Ashok K Sharma | 9845678910 | 144 Gr Kailsh, New Delhi    | aksharmaji@mail.com     |
| 268953264578 | Dinesh Dixit   | NULL       | Lajpat Nagar, Mathura, UP   | dinesh.dixit@hp.com     |
| 362115264625 | Ashutosh Gaur  | 9856789120 | JP Greens, Noida, UP        | ashutoshgaur@gmail.com  |
| 452695874564 | Manu P Singh   | 9834567890 | 203, Khandari, Agra, UP     | mpsingh@gmail.com       |
| 485466192343 | Rizwan Alam    | 9255614563 | Deep Nagar, Sahrsa, Bihar   | riz.alam@gmail.com      |
| 521556651761 | Ashish Gupta   | 8544556978 | T Nagar, Hyderabad, Telangana | ashish.gupta@hotmail.com |
| 602125125261 | Sachin Agrawal | 9812389120 | Kanda, Bagheshwar, UK       | sachinag@gmail.com      |
| 686113652987 | Gurmeet Singh  | 9635214789 | Shahid Nagar, Amritsar, PB  | gurmeet.007@ymail.com   |
| 954891122475 | Michal DeSousa | 8554658958 | Guindy, Chennai, TN         | michal.don@gmail.com    |
+--------------+----------------+------------+-----------------------------+-------------------------+
10 rows in set (0.00 sec)

mysql>
```

Practical Activity 2.3 – Insert the records in StudentRecord table (Table 2.7).

Table 2.7 Records to be inserted into the StudentRecord table

Stu_ RollNo	Stu_FName	Stu_LName	Stu_DOB	Stu_Address	Par_ID
1	Rajvardhan	Singh	5/15/2003	203, Khandari, Agra UP	452695874564
2	Trilok	Sharma	8/15/2004	144 Gr Kailash, New Delhi	252154687451
3	Aditi	Gaur	4/6/2005	JP Greens, Noida, UP	362115264625
4	Anshika	Agrawal	5/17/2003	Kanda, Bagheshwar, UK	602125125261
5	Nandini	Roy	12/29/2003	Fortune Somya, Bhopal, MP	225423344657
6	Pawani	Dixit	11/12/2004	Lajpat Nagar, Mathura, UP	268953264578
7	Hiba	Rizwan	12/3/2006	Deep Nagar, Sahrsa, Bihar	485466192343
8	Riddhi	Gupta	1/11/2005	T Nagar, Hyderabad, Telangana	521556651761
9	Manpreet	Singh	9/8/2005	Shahid Nagar, Amritsar, Punjab	686113652987
10	John	DeSousa	8/17/2005	Guindy, Chennai, TN	954891122475

Example 2.25: The following command is used to insert the first record in table *"StudentRecord"*.

```
mysql> INSERT INTO StudentRecord VALUES(1,'Rajvardhan','Singh','2003-05-15','203, Khandari,
Agra UP',452695874564);
Query OK, 1 row affected (0.22 sec)

mysql> select * from StudentRecord;
+------------+------------+-----------+------------+-----------------------+--------------+
| Stu_RollNo | Stu_FName  | Stu_LName | Stu_DOB    | Stu_Address           | Par_ID       |
+------------+------------+-----------+------------+-----------------------+--------------+
|          1 | Rajvardhan | Singh     | 2003-05-15 | 203, Khandari, Agra UP | 452695874564 |
+------------+------------+-----------+------------+-----------------------+--------------+
1 row in set (0.00 sec)

mysql>
```

When column names are not mentioned in the INSERT command, then it is necessary to mention the values for all the columns. So if there is no *"ParentID"* for Trilok, then mention the NULL value for the *"Par_ID"*.

Example 2.26: The following command inserts the second record with *"Par_ID"* value as NULL.

mysql>INSERT INTO StudentRecord VALUES (2,'Trilok','Sharma','8/15/2004', '144 Gr Kailash','New Delhi' NULL);

```
mysql> select * from studentrecord;
+------------+------------+-----------+------------+--------------------------+--------------+
| Stu_RollNo | Stu_FName  | Stu_LName | Stu_DOB    | Stu_Address              | Par_ID       |
+------------+------------+-----------+------------+--------------------------+--------------+
|          1 | Rajvardhan | Singh     | 2003-05-15 | 203, Khandari, Agra UP   | 452695874564 |
|          2 | Trilok     | Sharma    | 2004-08-15 | 144 Gr Kailash, New Delhi | NULL         |
+------------+------------+-----------+------------+--------------------------+--------------+
2 rows in set (0.00 sec)
```

Note/Tip: *Please be careful while entering date in INSERT command. Use the 'YYYY-MM-DD' format to write date.*

Practical Activity 2.4 – Use INSERT command

Insert the records in employee table using INSERT command and display it after inserting all record using SELECT statement.

```
mysql> select * from emp;
+-------+-----------+-----------+------+------------+-------+------+--------+
| empno | ename     | job       | mgr  | hiredate   | sal   | comm | deptno |
+-------+-----------+-----------+------+------------+-------+------+--------+
|  7019 | Smita     | Clerk     | 7552 | 1994-12-14 |  8800 | NULL |     20 |
|  7049 | Alam      | Salesman  | 7348 | 1995-02-17 |  9600 | 1800 |     30 |
|  7171 | Wasim     | Salesman  | 7348 | 1995-02-19 |  9250 | 2000 |     30 |
|  7216 | Jawahar   | Manager   | 7489 | 1995-03-30 | 10975 | NULL |     20 |
|  7304 | Manoj     | Salesman  | 7348 | 1995-09-25 |  9250 | 2900 |     30 |
|  7348 | Balwinder | Manager   | 7489 | 1995-04-28 | 10850 | NULL |     30 |
|  7432 | Chetana   | Manager   | 7489 | 1995-06-06 | 10450 | NULL |     10 |
|  7438 | Sachin    | Analyst   | 7216 | 1996-12-05 | 11000 | NULL |     20 |
|  7489 | Kushaal   | President | NULL | 1995-11-14 | 13000 | NULL |     10 |
|  7494 | Tarun     | Salesman  | 7348 | 1995-09-05 |  9500 |    0 |     30 |
|  7526 | Amar      | Clerk     | 7438 | 1997-01-08 |  9100 | NULL |     20 |
|  7550 | Jyoti     | Clerk     | 7348 | 1995-11-30 |  8950 | NULL |     30 |
|  7552 | Farhan    | Analyst   | 7216 | 1995-10-27 | 11000 | NULL |     20 |
|  7584 | Mohan     | Clerk     | 7432 | 1996-01-20 |  9300 | NULL |     10 |
|  7984 | Lalitha   | Clerk     | 7432 | 1998-05-23 | 10300 | NULL |     10 |
+-------+-----------+-----------+------+------------+-------+------+--------+
15 rows in set (0.00 sec)

mysql>
```

Insert the records in Department table using INSERT command and display it after inserting all record using SELECT statement.

```
mysql> select * from dept;
+--------+------------+-----------+
| deptno | dname      | loc       |
+--------+------------+-----------+
|     10 | Accounting | New Delhi |
|     20 | Research   | Banglore  |
|     30 | Sales      | Mumbai    |
|     40 | Operation  | Hyderabad |
|     50 | HR         | Noida     |
+--------+------------+-----------+
5 rows in set (0.00 sec)

mysql>
```

2.4.2 UPDATION of Records using UPDATE and DELETE Command

UPDATE and DELETE are also the part of SQL Data Manipulation Language (DML).

UPDATE command is used to make changes in existing data value(s) of one or more columns of existing records in a table. For example, we may require some changes in address, phone number or spelling of name.

Syntax:

UPDATE table_name

SET attribute1 = value1, attribute2 = value2, ...

WHERE condition;

In ParentRecord table, Phone number is not available for Parent Name Dinesh Dixit. So, it is required to update Phone number of Dinesh Dixit, update the table *ParentRecord* use the command.

Example 2.27: The following command is used to update the Phone number of Dinesh Dixit in *ParentRecord* table.

```
mysql> UPDATE ParentRecord SET PAr_Address = 'WZ-68, Azad Avenue, Boriwali, Mumbai',
    -> Par_Phone = 9988776644 WHERE Par_ID = 485466192343;
Query OK, 1 row affected (0.61 sec)
Rows matched: 1  Changed: 1  Warnings: 0

mysql>
```

The updated data can be verified using the statement.

SELECT * FROM ParentRecord.

It is also possible to update values for more than one column using the UPDATE statement.

Suppose, the ParentRecord with Par_ID 485466192343 has requested to change Address to 'WZ - 68, Azad Avenue, Boriwali, Mumbai' and Phone number to '9988776644'.

Example 2.28: The following SQL statement will update this record.

mysql> UPDATE ParentRecord SET Par_Address = 'WZ - 68, Azad Avenue, Boriwali, Mumbai', Par_Phone = 9988776644 WHERE Par_ID = 485466192343;

The changes affected can be verified by using the SELECT statement as below.

```
mysql> Select * from ParentRecord;
+--------------+----------------+------------+-------------------------------------+-------------------------+
| Par_ID       | Par_Name       | Par_Phone  | Par_Address                         | Par_Email               |
+--------------+----------------+------------+-------------------------------------+-------------------------+
| 225423344657 | Chandra Roy    | 9891201238 | Fortune Somya, Bhopal, MP           | Ch.roy@rediff.com       |
| 252154687451 | Ashok K Sharma | 9845678910 | 144 Gr Kailsh, New Delhi            | aksharmaji@mail.com     |
| 268953264578 | Dinesh Dixit   | 9956895689 | Lajpat Nagar, Mathura, UP           | dinesh.dixit@hp.com     |
| 362115264625 | Ashutosh Gaur  | 9856789120 | JP Greens, Noida, UP                | ashutoshgaur@gmail.com  |
| 452695874564 | Manu P Singh   | 9834567890 | 203, Khandari, Agra, UP             | mpsingh@gmail.com       |
| 485466192343 | Rizwan Alam    | 9988776644 | WZ-68, Azad Avenue, Boriwali, Mumbai | riz.alam@gmail.com      |
| 521556651761 | Ashish Gupta   | 8544556978 | T Nagar, Hyderabad, Telangana       | ashish.gupta@hotmail.com |
| 602125125261 | Sachin Agrawal | 9812389120 | Kanda, Bagheshwar, UK               | sachinag@gmail.com      |
| 686113652987 | Gurmeet Singh  | 9635214789 | Shahid Nagar, Amritsar, PB          | gurmeet.007@ymail.com   |
| 954891122475 | Michal DeSousa | 8554658958 | Guindy, Chennai, TN                 | michal.don@gmail.com    |
+--------------+----------------+------------+-------------------------------------+-------------------------+
10 rows in set (0.00 sec)

mysql>
```

2.4.3 DELETION of Records using DELETE

DELETE statement is used to delete or remove one or more records from a table.

Syntax:

DELETE FROM table_name WHERE condition;

Suppose the student with roll number 2 has left the school.

Example 2.29: The following SQL statement is used to delete that record from the STUDENT table.

```
mysql> DELETE FROM StudentRecord WHERE Stu_RollNo = 9;
```

```
mysql> SELECT * from StudentRecord;
+------------+------------+-----------+------------+-----------------------------+--------------+
| Stu_RollNo | Stu_FName  | Stu_LName | Stu_DOB    | Stu_Address                 | Par_ID       |
+------------+------------+-----------+------------+-----------------------------+--------------+
|          1 | Rajvardhan | Singh     | 2003-05-15 | 203, Khandari, Agra UP      | 452695874564 |
|          2 | Trilok     | Sharma    | 2004-08-15 | 144 Gr Kailash, New Delhi   | 252154687451 |
|          3 | Aditi      | Gaur      | 2005-06-04 | JP Greens, Noida, UP        | 362115264625 |
|          4 | Anshika    | Agrawal   | 2003-05-17 | Kanda, Bagheshwar, UK       | 602125125261 |
|          6 | Pawani     | Dixit     | 2004-12-11 | Lajpat Nagar, Mathura, UP   | 268953264578 |
|          7 | Hiba       | Rizwan    | 2006-12-03 | Deep Nagar, Sahrsa, Bihar   | 485466192343 |
|          8 | Riddhi     | Gupta     | 2005-11-01 | TNagar, Hyderabad, Telangana | 521556651761 |
|         10 | John       | DeSousa   | 2005-08-17 | Guindy, Chennai, TN         | 954891122475 |
|          5 | Nandini    | Roy       | 2003-12-19 | Fortune Somya, Bhopal, MP   | 225423344657 |
+------------+------------+-----------+------------+-----------------------------+--------------+
9 rows in set (0.00 sec)

mysql>
```

The changes affected can be verified by using the SELECT statement as below.

Caution: The WHERE clause should be used in the UPDATE and DELETE statement, otherwise it will apply on all the records.

2.5 SQL FOR DATA QUERY LANGUAGE (DQL)

So far we have learned to create a database, store and manipulate data in the database tables. The data stored in a database can be retrieved using a mechanism called as *Query*. SQL provides efficient mechanisms to retrieve data stored in multiple tables in MySQL database (or any other RDBMS). The SQL statement SELECT is used to retrieve data from the tables in a database and is also called a query statement. One of the most commonly used DQL is SELECT statement.

2.5.1 SELECT Statement

In SQL, the SELECT statement is used to retrieve data from tables in a database and output is displayed as per the specified parameter on successful execution of statement.

Syntax:

```
SELECT attribute1, attribute2,... attribute N
FROM table_name
WHERE condition;
```

Here, attribute1, attribute2, ... attributeN are the names of columns of the table table_name from which data is to be retrieved. The FROM clause is always written with SELECT clause as it specifies the name of the table from which data has to be retrieved. The WHERE clause is optional and is used to retrieve data to meet any specified condition(s).

To select all the columns and rows available in a table, use the following select statement.

```
SELECT * FROM table_name;
```

Here * is used to retrieve all columns/attributes available in the table.

Let us use SELECT statement to retrieve names of the student whose name are starting with alphabet "D".

Example 2.30: The following SQL query statement is used to retrieve the name and date of birth of student whose roll number is 1.

```
mysql> SELECT Stu_RollNo, Stu_DOB FROM studentrecord WHERE Stu_RollNo = 1;
+------------+------------+
| Stu_RollNo | Stu_DOB    |
+------------+------------+
|          1 | 2003-05-15 |
+------------+------------+
1 row in set (0.00 sec)

mysql>
```

In the above query, observe that the Student Roll Number and Date of birth of the of the student whose roll number is 1 is retrieved using WHERE clause.

2.5.2 Querying using database OFFICE

Let us consider an EMP table of employee database with the following fields. The *"empno"* is a primary key and *"deptno"* as foreign key. Table 3.1 shows the data entered in the Emp table.

Table 2.8 Records available in EMP table

empno	ename	job	mgr	hiredate	sal	comm	deptno
7019	Smita	Clerk	7552	12/14/1994	8800	NULL	20
7049	Alam	Salesman	7348	02/17/1995	9600	1800	30
7171	Wasim	Salesman	7348	02/19/1995	9250	2000	30
7216	Jawahar	Manager	7489	03/30/1995	10975	NULL	20
7304	Manoj	Salesman	7348	09/25/1995	9250	2900	30
7348	Balwinder	Manager	7489	04/28/1995	10850	NULL	30
7432	Chetana	Manager	7489	06/06/1995	10450	NULL	10
7438	Sachin	Analyst	7216	12/05/1996	11000	NULL	20
7489	Kushaal	President	NULL	11/14/1995	13000	NULL	10

7494	Tarun	Salesman	7348	09/05/1995	9500	0	30
7526	Amar	Clerk	7438	01/08/1997	9100	NULL	20
7550	Jyoti	Clerk	7348	11/30/1995	8950	NULL	30
7552	Farhan	Analyst	7216	10/27/1995	11000	NULL	20
7584	Mohan	Clerk	7432	01/20/1996	9300	NULL	10
7984	Lalitha	Clerk	7432	05/23/1998	10300	NULL	10

Now if you wish to retrieve the desired data from the table, let us see how to apply the SELECT clause to retrieve the data.

(a) Retrieve selected columns – It is possible to retrieve the data of one column of table.

```
mysql> SELECT empno FROM emp;
+-------+
| empno |
+-------+
|  7019 |
|  7049 |
|  7171 |
|  7216 |
|  7304 |
|  7348 |
|  7432 |
|  7438 |
|  7489 |
|  7494 |
|  7526 |
|  7550 |
|  7552 |
|  7584 |
|  7984 |
+-------+
15 rows in set (0.00 sec)

mysql>
```

Example 2.31: The following SQL query statement is used to retrieve employee number of all employees in the table.

Observe that the above query retrieves *empno* of all the employee from *Emp* table as only one column is specified to retrieve.

Let us see another query that select two columns such as *emp no* and corresponding *employee name*. Modify the same query by specifying two fields of table as *"empno"* and *"ename"*. and observe the desired output as below.

```
mysql> SELECT empno, ename FROM emp;
+-------+-----------+
| empno | ename     |
+-------+-----------+
|  7019 | Smita     |
|  7049 | Alam      |
|  7171 | Wasim     |
|  7216 | Jawahar   |
|  7304 | Manoj     |
|  7348 | Balwinder |
|  7432 | Chetana   |
|  7438 | Sachin    |
|  7489 | Kushaal   |
|  7494 | Tarun     |
|  7526 | Amar      |
|  7550 | Jyoti     |
|  7552 | Farhan    |
|  7584 | Mohan     |
|  7984 | Lalitha   |
+-------+-----------+
15 rows in set (0.00 sec)

mysql>
```

Example 2.32: The following SQL query statement will retrieve the data of employee number and name in two columns.

(b) Renaming of columns – There is specific naming conventions of the fields in table. It is possible to rename any column while displaying the output by using the alias *'AS'*.

Example 2.33: The following SQL query statement selects *Employee name* as "Name" in the output for all the employees.

```
mysql> SELECT ename as Name FROM emp;

+------------+
| Name       |
+------------+
| Smita      |
| Alam       |
| Wasim      |
| Jawahar    |
| Manoj      |
| Balwinder  |
| Chetana    |
| Sachin     |
| Kushaal    |
| Tarun      |
| Amar       |
| Jyoti      |
| Farhan     |
| Mohan      |
| Lalitha    |
+------------+
15 rows in set (0.00 sec)

mysql>
```

Example 2.34: The following SQL query statement will calculate and to display the annual salary of employee. Annual salary is calculated as "sal*12".

```
mysql> SELECT ename as Name, sal*12 FROM emp;
+-----------+--------+
| Name      | sal*12 |
+-----------+--------+
| Smita     | 105600 |
| Alam      | 115200 |
| Wasim     | 111000 |
| Jawahar   | 131700 |
| Manoj     | 111000 |
| Balwinder | 130200 |
| Chetana   | 125400 |
| Sachin    | 132000 |
| Kushaal   | 156000 |
| Tarun     | 114000 |
| Amar      | 109200 |
| Jyoti     | 107400 |
| Farhan    | 132000 |
| Mohan     | 111600 |
| Lalitha   | 123600 |
+-----------+--------+
15 rows in set (0.00 sec)

mysql>
```

Now it doesn't look nice to display the caption as "sal*12" in the table. It is possible to display it with new caption as *"Annual Salary"* for *"sal*12"*. The revised query and its output is given below.

```
mysql> SELECT ename as Name, sal*12 AS 'Annual Income' FROM emp;
+-----------+---------------+
| Name      | Annual Income |
+-----------+---------------+
| Smita     |        105600 |
| Alam      |        115200 |
| Wasim     |        111000 |
| Jawahar   |        131700 |
| Manoj     |        111000 |
| Balwinder |        130200 |
| Chetana   |        125400 |
| Sachin    |        132000 |
| Kushaal   |        156000 |
| Tarun     |        114000 |
| Amar      |        109200 |
| Jyoti     |        107400 |
| Farhan    |        132000 |
| Mohan     |        111600 |
| Lalitha   |        123600 |
+-----------+---------------+
15 rows in set (0.00 sec)

mysql>
```

Observe that *"ename"* is shown with the caption as *"Name"* and *"sal*12"* is shown with the caption as *"Annual Income"*.

Note **–** Annual Income is just the caption to display. It will not add as a new column in the database table. It is just for displaying the output of the query. If an aliased column name has space as in the case of *Annual Income*, it should be enclosed in quotes as ***'Annual Income'.***

(c) Distinct Clause – The SELECT clause retrieves all the data through query as output. There may be a chance of duplicate values such as 2 persons with the same name working in the department. The DISTINCT clause has provision to retrieve the unique records by omitting the duplicate records. The DISTINCT clause is used for this purpose.

Example 2.35: The following SQL query statement shows the different departments available in the "*emp*" table.

```
mysql> SELECT DISTINCT deptno FROM emp;
+--------+
| deptno |
+--------+
|     20 |
|     30 |
|     10 |
+--------+
3 rows in set (0.01 sec)

mysql>
```

Let us understand, how to retrieve different types of jobs available using DISTINCT clause in the following example.

Example 2.36: The following SQL query statement will use DISTINCT clause to retrieve different types of jobs available in the *"emp"* table.

```
mysql> SELECT DISTINCT(job) FROM emp;
+-----------+
| job       |
+-----------+
| Clerk     |
| Salesman  |
| Manager   |
| Analyst   |
| President |
+-----------+
5 rows in set (0.00 sec)

mysql>
```

Observe that there are 5 different job titles although a greater number of records exists.

(d) WHERE Clause – It retrieves data that meet some specified conditions. In our OFFICE database, more than one employee can have the same salary.

Example 2.37: The following SQL query statement will give distinct salaries of the employees working in the department number 10.

```
mysql> SELECT DISTINCT sal FROM emp WHERE deptno=10;
+-------+
| sal   |
+-------+
| 10450 |
| 13000 |
|  9300 |
| 10300 |
+-------+
4 rows in set (0.01 sec)

mysql>
```

Observe in the output that all the records of employee working in dept no. 10 and having the distinct salary are retrieved.

In the above example, = operator is used in the WHERE clause. Other relational operators like (<, <=, >, >=, !=) can also be used to specify conditions as per your requirement. The logical operators AND, OR, and NOT are used to combine multiple conditions.

Let us see, how to compare columns/fields value/s to specific required records or columns.

Example 2.38: The following SQL query statement will display all the details of those employees of 30 department who earn more than 5000.

```
mysql> SELECT * FROM emp WHERE sal > 5000 AND deptno = 30;
+-------+-----------+----------+------+------------+-------+------+--------+
| empno | ename     | job      | mgr  | hiredate   | sal   | comm | deptno |
+-------+-----------+----------+------+------------+-------+------+--------+
|  7049 | Alam      | Salesman | 7348 | 1995-02-17 |  9600 | 1800 |     30 |
|  7171 | Wasim     | Salesman | 7348 | 1995-02-19 |  9250 | 2000 |     30 |
|  7304 | Manoj     | Salesman | 7348 | 1995-09-25 |  9250 | 2900 |     30 |
|  7348 | Balwinder | Manager  | 7489 | 1995-04-28 | 10850 | NULL |     30 |
|  7494 | Tarun     | Salesman | 7348 | 1995-09-05 |  9500 |    0 |     30 |
|  7550 | Jyoti     | Clerk    | 7348 | 1995-11-30 |  8950 | NULL |     30 |
+-------+-----------+----------+------+------------+-------+------+--------+
6 rows in set (0.00 sec)

mysql>
```

Note: Observe the output, two different conditions are being tested separately. First condition tested for Salary is greater than 5000 and second condition is for department number is 10. AND operator used to join both conditions.

Let us make a comparison of salary like who is getting more then 8000 and less than 11000.

Example 2.39: The following SQL query statement will select the name and department number of all those employees who are earning salary between 8000 and 11000 inclusive of both values.

```
mysql> SELECT ename, deptno FROM emp WHERE sal>=8000 AND sal<=11000;
+-----------+--------+
| ename     | deptno |
+-----------+--------+
| Smita     |     20 |
| Alam      |     30 |
| Wasim     |     30 |
| Jawahar   |     20 |
| Manoj     |     30 |
| Balwinder |     30 |
| Chetana   |     10 |
| Sachin    |     20 |
| Tarun     |     30 |
| Amar      |     20 |
| Jyoti     |     30 |
| Farhan    |     20 |
| Mohan     |     10 |
| Lalitha   |     10 |
+-----------+--------+
14 rows in set (0.01 sec)

mysql>
```

The query in example 2.39 defines a range of salary between 8000 and 11000 that can also be achieved using a comparison operator **BETWEEN**, in the query as below. The output of this query will be same as above.

```
mysql> SELECT ename, deptno FROM emp WHERE sal BETWEEN 8000 AND 11000;

+----------+--------+
| ename    | deptno |
+----------+--------+
| Smita    |     20 |
| Alam     |     30 |
| Wasim    |     30 |
| Jawahar  |     20 |
| Manoj    |     30 |
| Balwinder|     30 |
| Chetana  |     10 |
| Sachin   |     20 |
| Tarun    |     30 |
| Amar     |     20 |
| Jyoti    |     30 |
| Farhan   |     20 |
| Mohan    |     10 |
| Lalitha  |     10 |
+----------+--------+
14 rows in set (0.00 sec)

mysql>
```

Note: The BETWEEN operator defines the range of values in which the column value must fall into, to make the condition true.

Example 2.40: The following SQL query statement will select details of all the employees who work in any of the department number 10, 20, or 40.

```
mysql> SELECT * FROM emp WHERE deptno = 10 OR deptno = 20 OR deptno = 40;
+-------+---------+-----------+------+------------+-------+------+--------+
| empno | ename   | job       | mgr  | hiredate   | sal   | comm | deptno |
+-------+---------+-----------+------+------------+-------+------+--------+
|  7019 | Smita   | Clerk     | 7552 | 1994-12-14 |  8800 | NULL |     20 |
|  7216 | Jawahar | Manager   | 7489 | 1995-03-30 | 10975 | NULL |     20 |
|  7432 | Chetana | Manager   | 7489 | 1995-06-06 | 10450 | NULL |     10 |
|  7438 | Sachin  | Analyst   | 7216 | 1996-12-05 | 11000 | NULL |     20 |
|  7489 | Kushaal | President | NULL | 1995-11-14 | 13000 | NULL |     10 |
|  7526 | Amar    | Clerk     | 7438 | 1997-01-08 |  9100 | NULL |     20 |
|  7552 | Farhan  | Analyst   | 7216 | 1995-10-27 | 11000 | NULL |     20 |
|  7584 | Mohan   | Clerk     | 7432 | 1996-01-20 |  9300 | NULL |     10 |
|  7984 | Lalitha | Clerk     | 7432 | 1998-05-23 | 10300 | NULL |     10 |
+-------+---------+-----------+------+------------+-------+------+--------+
9 rows in set (0.00 sec)

mysql>
```

(E) Membership operator IN

The IN operator compares a value with a set of values and returns true if the value belongs to that set. The query given in *Example 2.40* can be rewritten using IN operator as below.

mysql> SELECT * FROM emp WHERE deptno IN (10, 20, 40);

It will give the same output as above.

Example 2.41: The following SQL query statement selects details of all the employees except those working in department number 10 or 20.

```
mysql> SELECT * FROM emp WHERE deptno IN (10, 20, 40);
+-------+---------+-----------+------+------------+-------+------+--------+
| empno | ename   | job       | mgr  | hiredate   | sal   | comm | deptno |
+-------+---------+-----------+------+------------+-------+------+--------+
|  7019 | Smita   | Clerk     | 7552 | 1994-12-14 |  8800 | NULL |     20 |
|  7216 | Jawahar | Manager   | 7489 | 1995-03-30 | 10975 | NULL |     20 |
|  7432 | Chetana | Manager   | 7489 | 1995-06-06 | 10450 | NULL |     10 |
|  7438 | Sachin  | Analyst   | 7216 | 1996-12-05 | 11000 | NULL |     20 |
|  7489 | Kushaal | President | NULL | 1995-11-14 | 13000 | NULL |     10 |
|  7526 | Amar    | Clerk     | 7438 | 1997-01-08 |  9100 | NULL |     20 |
|  7552 | Farhan  | Analyst   | 7216 | 1995-10-27 | 11000 | NULL |     20 |
|  7584 | Mohan   | Clerk     | 7432 | 1996-01-20 |  9300 | NULL |     10 |
|  7984 | Lalitha | Clerk     | 7432 | 1998-05-23 | 10300 | NULL |     10 |
+-------+---------+-----------+------+------------+-------+------+--------+
9 rows in set (0.00 sec)

mysql>
```

Note: Here NOT operator is used in combination with IN to retrieve all records except with deptno 10 and 20.

(F) ORDER BY Clause – It is used to display data in an ordered form with respect to a specified column. By default, ORDER BY displays records in ascending order of the specified column values. The DESC keyword is used to display the records in descending.

Let us arrange the records in ascending or descending order using the ORDER BY clause with DESC clause example 2.42.

Example 2.42: The following SQL query statement selects details of all the employees in ascending order of their salaries.

```
mysql> SELECT * FROM emp ORDER BY sal;
+-------+-----------+-----------+------+------------+-------+------+--------+
| empno | ename     | job       | mgr  | hiredate   | sal   | comm | deptno |
+-------+-----------+-----------+------+------------+-------+------+--------+
|  7019 | Smita     | Clerk     | 7552 | 1994-12-14 |  8800 | NULL |     20 |
|  7550 | Jyoti     | Clerk     | 7348 | 1995-11-30 |  8950 | NULL |     30 |
|  7526 | Amar      | Clerk     | 7438 | 1997-01-08 |  9100 | NULL |     20 |
|  7171 | Wasim     | Salesman  | 7348 | 1995-02-19 |  9250 | 2000 |     30 |
|  7304 | Manoj     | Salesman  | 7348 | 1995-09-25 |  9250 | 2900 |     30 |
|  7584 | Mohan     | Clerk     | 7432 | 1996-01-20 |  9300 | NULL |     10 |
|  7494 | Tarun     | Salesman  | 7348 | 1995-09-05 |  9500 |    0 |     30 |
|  7049 | Alam      | Salesman  | 7348 | 1995-02-17 |  9600 | 1800 |     30 |
|  7984 | Lalitha   | Clerk     | 7432 | 1998-05-23 | 10300 | NULL |     10 |
|  7432 | Chetana   | Manager   | 7489 | 1995-06-06 | 10450 | NULL |     10 |
|  7348 | Balwinder | Manager   | 7489 | 1995-04-28 | 10850 | NULL |     30 |
|  7216 | Jawahar   | Manager   | 7489 | 1995-03-30 | 10975 | NULL |     20 |
|  7438 | Sachin    | Analyst   | 7216 | 1996-12-05 | 11000 | NULL |     20 |
|  7552 | Farhan    | Analyst   | 7216 | 1995-10-27 | 11000 | NULL |     20 |
|  7489 | Kushaal   | President | NULL | 1995-11-14 | 13000 | NULL |     10 |
+-------+-----------+-----------+------+------------+-------+------+--------+
15 rows in set (0.01 sec)

mysql>
```

Observe that the records are displayed in ascending order of Salary of each employee. To arrange records in descending order, use DESC clause with ORDER BY as in example 2.43.

Example 2.43: The following SQL query statement selects details of all the employees in descending order of their salaries.

```
mysql> SELECT * FROM emp ORDER BY sal DESC;
+-------+-----------+-----------+------+------------+-------+------+--------+
| empno | ename     | job       | mgr  | hiredate   | sal   | comm | deptno |
+-------+-----------+-----------+------+------------+-------+------+--------+
|  7489 | Kushaal   | President | NULL | 1995-11-14 | 13000 | NULL |     10 |
|  7438 | Sachin    | Analyst   | 7216 | 1996-12-05 | 11000 | NULL |     20 |
|  7552 | Farhan    | Analyst   | 7216 | 1995-10-27 | 11000 | NULL |     20 |
|  7216 | Jawahar   | Manager   | 7489 | 1995-03-30 | 10975 | NULL |     20 |
|  7348 | Balwinder | Manager   | 7489 | 1995-04-28 | 10850 | NULL |     30 |
|  7432 | Chetana   | Manager   | 7489 | 1995-06-06 | 10450 | NULL |     10 |
|  7984 | Lalitha   | Clerk     | 7432 | 1998-05-23 | 10300 | NULL |     10 |
|  7049 | Alam      | Salesman  | 7348 | 1995-02-17 |  9600 | 1800 |     30 |
|  7494 | Tarun     | Salesman  | 7348 | 1995-09-05 |  9500 |    0 |     30 |
|  7584 | Mohan     | Clerk     | 7432 | 1996-01-20 |  9300 | NULL |     10 |
|  7171 | Wasim     | Salesman  | 7348 | 1995-02-19 |  9250 | 2000 |     30 |
|  7304 | Manoj     | Salesman  | 7348 | 1995-09-25 |  9250 | 2900 |     30 |
|  7526 | Amar      | Clerk     | 7438 | 1997-01-08 |  9100 | NULL |     20 |
|  7550 | Jyoti     | Clerk     | 7348 | 1995-11-30 |  8950 | NULL |     30 |
|  7019 | Smita     | Clerk     | 7552 | 1994-12-14 |  8800 | NULL |     20 |
+-------+-----------+-----------+------+------------+-------+------+--------+
15 rows in set (0.00 sec)

mysql>
```

Note: DESC clause used after the column name on which the records to be displayed in descending order.

(G) Handling NULL Values – SQL supports a special value called NULL to represent a missing or unknown value. For example, the *"Par_Phone"* column in the table *"ParentRecord"* can have missing value for certain records. Hence, NULL is used to represent such unknown values. It is important to note that NULL is different from value 0 (zero). Also, any arithmetic operation performed with NULL value gives NULL. For example, 5 + NULL = NULL because NULL is unknown hence the result is also unknown. In order to check for NULL value in a column, use **IS NULL** operator in particular statement. Example 2.44 illustrates the use of NULL clause.

Example 2.44: The following SQL query statement selects details of all employees who have not been given a bonus. This implies that the bonus column will be blank.

```
mysql> SELECT * FROM emp WHERE comm IS NULL;
+-------+-----------+-----------+------+------------+-------+------+--------+
| empno | ename     | job       | mgr  | hiredate   | sal   | comm | deptno |
+-------+-----------+-----------+------+------------+-------+------+--------+
|  7019 | Smita     | Clerk     | 7552 | 1994-12-14 |  8800 | NULL |     20 |
|  7216 | Jawahar   | Manager   | 7489 | 1995-03-30 | 10975 | NULL |     20 |
|  7348 | Balwinder | Manager   | 7489 | 1995-04-28 | 10850 | NULL |     30 |
|  7432 | Chetana   | Manager   | 7489 | 1995-06-06 | 10450 | NULL |     10 |
|  7438 | Sachin    | Analyst   | 7216 | 1996-12-05 | 11000 | NULL |     20 |
|  7489 | Kushaal   | President | NULL | 1995-11-14 | 13000 | NULL |     10 |
|  7526 | Amar      | Clerk     | 7438 | 1997-01-08 |  9100 | NULL |     20 |
|  7550 | Jyoti     | Clerk     | 7348 | 1995-11-30 |  8950 | NULL |     30 |
|  7552 | Farhan    | Analyst   | 7216 | 1995-10-27 | 11000 | NULL |     20 |
|  7584 | Mohan     | Clerk     | 7432 | 1996-01-20 |  9300 | NULL |     10 |
|  7984 | Lalitha   | Clerk     | 7432 | 1998-05-23 | 10300 | NULL |     10 |
+-------+-----------+-----------+------+------------+-------+------+--------+
11 rows in set (0.00 sec)

mysql>
```

Observe the output and see column mgr and comm where NULL is present.

It is also possible to join NULL statement with any other condition. Example 3.11 shows how to use it in statement.

Example 2.45: The following SQL query statement selects selects emp number, employee names and job of all those employees who have been given a comm (i.e., comm is not null) and works in the department 30.

```
mysql> Select empno, ename, job
    -> FROM emp WHERE comm IS NOT NULL
    -> AND deptno=30;
+-------+-------+----------+
| empno | ename | job      |
+-------+-------+----------+
|  7049 | Alam  | Salesman |
|  7171 | Wasim | Salesman |
|  7304 | Manoj | Salesman |
|  7494 | Tarun | Salesman |
+-------+-------+----------+
4 rows in set (0.02 sec)

mysql>
```

(H) Having clause – It is used in SELECT statement to make group with certain condition in result of query.

Syntax:

SELECT expression1, expression2, ... expression_n,
aggregate_function (expression)
FROM tables
[WHERE conditions]
GROUP BY expression1, expression2, ... expression_n
HAVING condition;

Example 2.45 shows how to use Group by and Having clause jointly. The HAVING clause must follow the GROUP BY clause in any SELECT query and must also preceded by ORDER BY clause if used.

Example 2.45: The following SQL query statement selects jobs, number of employees in that job, their total salary and department number wise list where minimum 3 employee of same type of job are working.

```
mysql> SELECT job, COUNT(*), SUM(sal)
    -> FROM emp GROUP BY job
    -> HAVING COUNT(*)>2;
+----------+----------+----------+
| job      | COUNT(*) | SUM(sal) |
+----------+----------+----------+
| Clerk    |        5 |    46450 |
| Salesman |        4 |    37600 |
| Manager  |        3 |    32275 |
+----------+----------+----------+
3 rows in set (0.00 sec)

mysql>
```

(I) Substring pattern matching – Many times it may require that the query should not retrieve that exact text or value, rather it should retrieve the matching of few characters or values. For example, to find out names starting with "M" or to find out pin codes starting with "11", is called substring pattern matching. Such patterns cannot match using = operator. SQL provides a LIKE operator that can be used with the WHERE clause to search for specified pattern in a column.

The LIKE operator makes use of the following two wild card characters - (%) and (-). The percent (%) is used to represent zero, one, or multiple characters. The underscore (_) is used to represent exactly a single character.

There are several situations when we search data records for some pattern matching. A very common situation when you search any contacts in your smart phone, you just start typing first few characters of the name, then immediately list appears with these characters and you tap on the required name to call. Example 3.46 to 3.51 demonstrates such situations to search some patterns in text values of records using LIKE clause.

Example 2.46: The following SQL query statement selects details of all those employees whose name starts with 'K'.

```
mysql> SELECT * FROM emp WHERE ename like 'K%';
+-------+---------+-----------+------+------------+-------+------+--------+
| empno | ename   | job       | mgr  | hiredate   | sal   | comm | deptno |
+-------+---------+-----------+------+------------+-------+------+--------+
|  7489 | Kushaal | President | NULL | 1995-11-14 | 13000 | NULL |     10 |
+-------+---------+-----------+------+------------+-------+------+--------+
1 row in set (0.00 sec)
mysql>
```

Example 2.47: The following SQL query statement selects details of all those employees whose name whose name ends with 'a', and gets a salary more than 8500.

```
mysql> SELECT * FROM emp WHERE ename like '%a' AND sal > 8500;
+-------+---------+---------+------+------------+-------+------+--------+
| empno | ename   | job     | mgr  | hiredate   | sal   | comm | deptno |
+-------+---------+---------+------+------------+-------+------+--------+
|  7019 | Smita   | Clerk   | 7552 | 1994-12-14 |  8800 | NULL |     20 |
|  7432 | Chetana | Manager | 7489 | 1995-06-06 | 10450 | NULL |     10 |
|  7984 | Lalitha | Clerk   | 7432 | 1998-05-23 | 10300 | NULL |     10 |
+-------+---------+---------+------+------------+-------+------+--------+
3 rows in set (0.00 sec)
mysql>
```

Example 2.48: The following SQL query statement selects details of all those employees whose name consists of exactly 5 letters and starts with any letter but has 'mita' after that.

```
mysql> SELECT * FROM emp WHERE ename like '_mita';
+-------+-------+-------+------+------------+------+------+--------+
| empno | ename | job   | mgr  | hiredate   | sal  | comm | deptno |
+-------+-------+-------+------+------------+------+------+--------+
|  7019 | Smita | Clerk | 7552 | 1994-12-14 | 8800 | NULL |     20 |
+-------+-------+-------+------+------------+------+------+--------+
1 row in set (0.00 sec)
mysql>
```

You can also match a particular character or string in between the text simply by using wild card character as shown in example 2.49.

Example 2.49: The following SQL query statement selects all columns of all employees containing '**ma**' as a substring in name.

```
mysql> SELECT * FROM emp WHERE ename like '%ma%';
+-------+-------+----------+------+------------+------+------+--------+
| empno | ename | job      | mgr  | hiredate   | sal  | comm | deptno |
+-------+-------+----------+------+------------+------+------+--------+
|  7304 | Manoj | Salesman | 7348 | 1995-09-25 | 9250 | 2900 |     30 |
|  7526 | Amar  | Clerk    | 7438 | 1997-01-08 | 9100 | NULL |     20 |
+-------+-------+----------+------+------------+------+------+--------+
2 rows in set (0.00 sec)
mysql>
```

Example 2.50: The following SQL query statement selects all columns of employees containing 'a' as the second character in their names.

```
mysql> SELECT * FROM emp WHERE ename like '_a%';
+-------+-----------+----------+------+------------+-------+------+--------+
| empno | ename     | job      | mgr  | hiredate   | sal   | comm | deptno |
+-------+-----------+----------+------+------------+-------+------+--------+
|  7171 | Wasim     | Salesman | 7348 | 1995-02-19 |  9250 | 2000 |     30 |
|  7216 | Jawahar   | Manager  | 7489 | 1995-03-30 | 10975 | NULL |     20 |
|  7304 | Manoj     | Salesman | 7348 | 1995-09-25 |  9250 | 2900 |     30 |
|  7348 | Balwinder | Manager  | 7489 | 1995-04-28 | 10850 | NULL |     30 |
|  7438 | Sachin    | Analyst  | 7216 | 1996-12-05 | 11000 | NULL |     20 |
|  7494 | Tarun     | Salesman | 7348 | 1995-09-05 |  9500 |    0 |     30 |
|  7552 | Farhan    | Analyst  | 7216 | 1995-10-27 | 11000 | NULL |     20 |
|  7984 | Lalitha   | Clerk    | 7432 | 1998-05-23 | 10300 | NULL |     10 |
+-------+-----------+----------+------+------------+-------+------+--------+
8 rows in set (0.00 sec)

mysql>
```

Example 2.51: The following SQL query statement selects records of all the employees except Alam.

2.6 SQL FOR DATA CONTROL LANGUAGE (DCL)

```
mysql> SELECT * FROM emp WHERE NOT ename= 'Alam';
+-------+-----------+-----------+------+------------+-------+------+--------+
| empno | ename     | job       | mgr  | hiredate   | sal   | comm | deptno |
+-------+-----------+-----------+------+------------+-------+------+--------+
|  7019 | Smita     | Clerk     | 7552 | 1994-12-14 |  8800 | NULL |     20 |
|  7171 | Wasim     | Salesman  | 7348 | 1995-02-19 |  9250 | 2000 |     30 |
|  7216 | Jawahar   | Manager   | 7489 | 1995-03-30 | 10975 | NULL |     20 |
|  7304 | Manoj     | Salesman  | 7348 | 1995-09-25 |  9250 | 2900 |     30 |
|  7348 | Balwinder | Manager   | 7489 | 1995-04-28 | 10850 | NULL |     30 |
|  7432 | Chetana   | Manager   | 7489 | 1995-06-06 | 10450 | NULL |     10 |
|  7438 | Sachin    | Analyst   | 7216 | 1996-12-05 | 11000 | NULL |     20 |
|  7489 | Kushaal   | President | NULL | 1995-11-14 | 13000 | NULL |     10 |
|  7494 | Tarun     | Salesman  | 7348 | 1995-09-05 |  9500 |    0 |     30 |
|  7526 | Amar      | Clerk     | 7438 | 1997-01-08 |  9100 | NULL |     20 |
|  7550 | Jyoti     | Clerk     | 7348 | 1995-11-30 |  8950 | NULL |     30 |
|  7552 | Farhan    | Analyst   | 7216 | 1995-10-27 | 11000 | NULL |     20 |
|  7584 | Mohan     | Clerk     | 7432 | 1996-01-20 |  9300 | NULL |     10 |
|  7984 | Lalitha   | Clerk     | 7432 | 1998-05-23 | 10300 | NULL |     10 |
+-------+-----------+-----------+------+------------+-------+------+--------+
14 rows in set (0.01 sec)

mysql>
```

Data Control Language is the part of SQL, which have commands to manage users for their work permission. The user will be able to work as per the permissions granted to them by DBA (Database Administrator). DCL includes the commands GRANT and REVOKE, which are used to provide rights & permissions to user.

GRANT statement – The GRANT statement is used to give access privileges to a specific user to work with any selected database only.

Syntax:

GRANT SELECT, UPDATE ON Test_Table TO NewUser1, NewUser2;

Example:

GRANT SELECT, UPDATE, DELETE ON carshowroom TO 'WebUser';

Here the user *'WebUser'* will be able to use only three SELECT, UPDATE and DELETE SQL statements when working on carshowroom database.

REVOKE statement – The REVOKE statement is used to withdraw privileges from a specific user so that specific user could not use specific statement on selected database. In other words it is useful to take back the given permission/s from the user.

Syntax:

REVOKE Privilege_Name ON Object_Name FROM User_Name.

Example:

REVOKE DELETE ON carshowroom FROM WebUser;

2.7 SQL FOR TRANSACTION CONTROL LANGUAGE (TCL)

Transaction control language (TCL) is the part of SQL commands that allows to permanently change the databases or undo the databases transactions. It is similar to save the database or undo the current changes. The COMMIT, ROLLBACK and SAVEPOINT statements comes under this category.

COMMIT – Commit command is used to save all the transactions to the database. After completing any operation or SQL statement, you can simply write COMMIT as the next statement to permanently save data in the database.

Syntax:

Commit;

Example: *DELETE FROM ClassStudents WHERE RollNo =25;*

Commit;

Here, after DELETE statement, the COMMIT statement is used. It means the student record whose RollNo is 25 is permanently deleted. Now after COMMIT statement, it is not possible to roll back the record of that student.

ROLLBACK – ROLLBACK command allows to undo transactions that have not already been saved to the database. This statement is useful to restore the database to the state where last commit statement was used. Rollback statement is also used with SAVEPOINT statement to jump to specific Savepoint in the database transactions.

Syntax:

ROLLBACK;

SAVEPOINT – This command helps to sets a Savepoint within a transaction. Basically, SAVEPOINT statement is used to save a transaction temporarily so that user can roll back to that point as and when required.

Syntax: SAVEPOINT Savepoint_Name;

SUMMARY

- SQL is a domain-specific language that is used to manage relational databases.
- Currently almost all RDBMS such as MySQL, Oracle, Informix, SQL server, MS Access, and Sybase uses SQL as their standard database language.
- SQL is easy to learn as the statements comprise of descriptive English words.
- SQL is a open source, interactive, portable, faster query processing, standardized and universal language to work with with RDBMS.
- SQL is divided into five types like DDL, DML, DQL, TCL and DCL.
- DDL (Data Definition Language) includes SQL statements such as, Create table, Alter table and Drop table.
- Create command is used to create database and its further objects like Table, View.
- DML (Data Manipulation Language) includes SQL statements such as, insert, select, update and delete.
- A table is a collection of rows and columns, where each row is a record and columns describe the feature of records.
- DESCRIBE TABLE statement is used to view the structure of an already existing table
- ALTER TABLE statement is used to make changes in the structure of a table like adding, removing column and changing datatype of column(s). It is also used to apply/remove any constraints like Primary Key, Foreign Key etc.
- DROP statement is used to remove a database or a table permanently from the database system.

- TRUNCATE statement is used to delete all records from the table but table structure will exist in database.
- INSERT INTO statement is used to insert new records in any existing table
- UPDATE statement is used to make required changes in records of any table.
- DELETE statement is used to delete/remove one or more records from a table.
- CREATE TABLE statement can also be used to create new table from existing tables/s.
- RENAME statement is used to change the name of existing tables of other database objects.
- Views in any database is a special kind of virtual table that is created from one or more table and having no data of its own.
- WHERE clause in SQL query is used to enforce condition(s).
- DISTINCT clause is used to eliminate repetition and display the values only once.
- The BETWEEN operator defines the range of values inclusive of boundary values.
- The IN operator selects values that match any value in the given list of values.
- NULL values can be tested using IS NULL and IS NOT NULL.
- ORDER BY clause is used to display the result of a SQL query in ascending or descending order with respect to specified attribute values. By default, the order is ascending.
- LIKE operator is used for pattern matching. % and _ are two wild card characters. The per cent (%) symbol is used to represent zero or more characters. The underscore (_) symbol is used to represent a single character.

Check Your Progress

A. Multiple choice questions

1. Which of the following is not a valid aggregate function? (a) COUNT (b) COMPUTE (c) SUM (d) MAX
2. DDL stands for (a) Data Describe Language (b) Definition Data Language (c) Data Definition Language (d) Data Distinct Language
3. Which of the following SQL command is used to remove data from table (a) Collapse (b) Remove (c) Alter (d) Delete
4. The records and structure of a table may be removed or deleted from the database using which command? (a) Remove (b) Delete (c) Drop (d) Truncate
5. SQL ___ statement can be used to delete or drop existing databases in a SQL schema. (a) Create Database (b) Rename Database (c) Drop Database (d) Select Database
6. Using DROP TABLE command in SQL (a) Drop the table structure (b) Drop the Integrity constraints (c) Drop the Relationship (d) All of the above
7. Using DROP TABLE command in SQL (a) Drop the table structure (b) Drop the Integrity constraints (c) Drop the Relationship (d) Noe of the above
8. TRUNCATE TABLE requires (a) Where Clause (b) Having Clause (c) Both A And B (d) None of the above
9. Which of the following clause is used to add a Primary Key constraint after creating table (a) Update (b) Add (c) Alter (d) Join
10. Which of the following clause is used to remove a primary key constraint (a) Delete (b) Drop (c) Alter (d) Remove
11. Which of the following SQL statement is used to give result in sorted order (a) Sort By (b) Order (c) Order By (d) Sort
12. Commands under DCL are (a) GRANT (b) REVOKE (c) Both A. and B. (d) None of the above

13. The SQL command to retrieve table records is (a) RETRIEVE (b) SELECT (c) CREATE (d) ALTER
14. Which of the following operator is used for pattern matching in SQL? (a) BETWEEN operator (b) LIKE operator (c) EXISTS operator (d) None of these
15. Which operator is used to check the absence of data in any column (a) EXISTS operator (b) NOT operator (c) IS NULL operator (d) None of these
16. Which of the following keyword is used to select only unique values from any column (a) DISTINCTIVE (b) UNIQUE (c) DISTINCT (d) DIFFERENT

B. Fill in the blanks

1. SQL is divided in _____ category.
2. The _____ command is used to see the structure of table.
3. The _____ command is used to remove all records.
4. The _____ command is used to add an attribute in an existing table.
5. The _____ command is used to remove all records only from a table.
6. The _____ command is used to remove a attribute from a table.
7. A view is a special kind of _____ table.
8. Views can be created form _____ or more tables.
9. Grant and Revoke are part of _____ in SQL.
10. Commit and Savepoint are part of _____ in SQL.
11. To sort the result of a query in descending order, we can use clause _____
12. To extract unique values from a column, user can use _____ clause.

C. State whether True or False

1. INSERT clause is used to add a Foreign key constraint.
2. ALTER clause is used to add a Primary key constraint after table is created.
3. DROP command is used to delete the structure of a table from the database.
4. Updation and deletion of records are part of DDL.
5. Insert into statement is useful to insert a new field in any table.
6. Aggregate functions are used to perform calculations on multiple values and returns a single value.
7. Aggregate functions are mostly used with the SELECT statement.
8. DML is used to create a new database objects like table and view.
9. A new table can be created from existing table(s).
10. The name of any tables once its created and records are inserted cannot be change.

D. Short answers questions

1. What do you understand by SQL?
2. SQL Statements are classified in how many ways?
3. Differentiate between DDL and DML?
4. Differentiate between DCL and TCL?
5. What is the difference between ALTER and UPDATE command.
6. Differentiate between DELETE and DROP command
7. What is create statement? How many database objects can be created using this?
8. Write the CREATE statement to create the following relations with given constraints.
   Book(ISBN (Text), Title (Text), Author (Text), PubID(Text), Price (Numeric), Pages (Numeric)).
   Here ISBN is Primary Key field and remaining all are Not Null.
9. Modify the Book table in previous question and add one more new field Discount (Numeric).
10. Shyam has created one database name Mycontacts but he is not able to create new table in this database. What command should Shyam be used before creating the table?

11. Mr. Sachin Agrawal created two tables with Course as Primary Key in Table1 and Foreign key in Table2 while inserting new row in second Table2 Mr Agrawal is not able to insert new value in the column City. What could be the possible reason for this?

E. Practical Exercises

1. Based on employee table, write SQL queries to –

- display the list of employee belonging to the department 30.
- display the list of employee number and name of mangers.
- display the list of clerks working in department 10
- display the detailed list of those employees who have joined before the July 1995
- display the the names of employees who are not mangers.
- display the List of employees whose employees numbers are 7438, 7216, 7019 and 7984
- display the employee name and salary whose salary is between 9000 and 10500.
- display the employee name who have joined after 30 June 1995.
- display the List of different job available in the emp table
- display the List of employee who are not getting/eligible commission.
- display the list of employee whose name start with “M”
- display the list of employee whose name has 6 characters.
- display the List of employee having 'a' as second character.
- display the List of all employee in descending order of salary.
- display the List of employee in ascending order of hire date.
- display the employee name, Salary, PF, HRA, DA and Gross; order the result in descending order of gross. Here PF is 10% of Salary, HRA is 50% of Salary and DA is 30% of Salary and Gross is sum of Salary, HRA and DA.
- display the unique jobs available in emp table.
- display the total salary which is sum of salary and commission.
- create new table named NewEmp from existing table emp with all same field and records.
- add a new column address and mobno to the newly created table NewEmp.
- Suppose the DBMS admin forget to make empno as primary key and deptno as foreign key. Write the SQL query to make these changes.
- change emp name with your name for empno=7034 in table NewEmp
- change emp name with your friend name for empno=7550 in table NewEmp.
- insert mob no and address in your record and of and your friend's records.
- delete the column address from the new table NewEmp.
- to delete the newly created table NewEmp.

2. Consider the following table named “Product”, showing details of products being sold in a grocery shop.

PCode	PName	UPrice	Manufacturer
P01	Washing Powder	130	Surf
P02	Toothpaste	58	Colgate
P03	Soap	29	Lux
P04	Toothpaste	75	Pepsodent

P05	Soap	44	Dove
P06	Shampoo	275	Dove
P08	Toothpaste	44	Patanjali
P09	Soap	48	Hamam
P10	Washing Powder	90	Henko

Write SQL queries for the following.

a) Create the table Product with appropriate data types and constraints.

b) Identify the primary key in Product.

c) List the Product Code, Product name and price in descending order of their product name. If PName is same, then display the data in ascending order of price.

d) Add a new column Discount to the table Product.

e) Calculate the value of the discount in the table Product as 10 per cent of the UPrice for all those products where the UPrice is more than 100, otherwise the discount will be 0.

f) Increase the price by 12 per cent for all the products manufactured by Dove.

g) Display the total number of products manufactured by each manufacturer.

3. Consider the following MOVIE table and write the SQL queries based on it.

MID	MovieName	Category	ReleaseDate	ProdCost	BusiCost
1	Hindi_Movie	Musical	4/23/2018	124500	130000
2	Tamil_Movie	Action	5/17/2016	112000	118000
3	English_Movie	Horror	8/6/2017	245000	360000
4	Bengali_Movie	Adventure	1/4/2017	72000	100000
5	Telugu_Movie	Action			100000
6	Punjabi_Movie	Comedy			30500

a) Display all the information from the Movie table.

b) List business done by the movies showing only MID, MovieName and Total_Earning. Total_Earning to be calculated as the sum of ProdCost and BusiCost.

c) List the different categories of movies.

d) Find the net profit of each movie showing its MID, MovieName and NetProfit. Net Profit is to be calculated as the difference between BussCost and ProdCost.

e) List MID, MovieName and Cost for all movies with ProdCost greater than 10,000 and less than 1,00,000.

f) List details of all movies which fall in the category of comedy or action.

g) List details of all movies which have not been released yet.

4. Suppose your school management has decided to conduct cricket matches between students of Class XI and Class XII. Students of each class are asked to join any one of the four teams – Team Titan, Team Rockers, Team Magnet and Team Hurricane. During summer vacations, various matches will be conducted between these teams. Help your sports teacher to do the following:

1. Create a database “Sports”.

12. Create a table “TEAM” with following considerations:

- It should have a column TeamID for storing an integer value between 1 to 9, which refers to unique identification of a team.
- Each TeamID should have its associated name (TeamName), which should be a string of length not less than 10 characters.

13. Using table level constraint, make TeamID as the primary key.
14. Show the structure of the table TEAM using a SQL statement.
15. As per the preferences of the students four teams were formed as given below. Insert these four rows in TEAM table:

    Row 1: (1, Team Titan)

    Row 2: (2, Team Rockers)

    Row 3: (3, Team Magnet)

    Row 3: (4, Team Hurricane)
16. Show the contents of the table TEAM using a DML statement.
17. Now create another table MATCH_DETAILS and insert data as shown below. Choose appropriate data types and constraints for each attribute.

Table: MATCH_DETAILS

MatchID	MatchDate	FirstTeamID	SecondTeamID	FirstTeamScore	SecondTeamScore
M1	7/17/2022	1	2	90	86
M2	7/18/2022	3	4	45	48
M3	7/19/2022	1	3	78	56
M4	7/19/2022	2	4	56	67
M5	7/18/2022	1	4	32	87
M6	7/17/2022	2	3	67	51

Session 3: Functions In SQL

There are various readily available functions in SQL that can be used in queries. It includes single row functions, multiple row functions, group records based on some criteria, and working on multiple tables using SQL.

A function is used to perform some particular tasks and it returns zero or more values as a result. Functions are useful while writing SQL queries also. Functions can be applied to work on single or multiple records (rows) of a table.

3.1 SQL functions

SQL functions are categorized as Single Row functions and Aggregate functions, depending on their application in one or multiple rows.

Single Row Functions are also known as Scalar functions. Single row functions are applied on a single value and return a single value. These are used in SELECT, WHERE, and ORDER BY clause. MATH, STRING and DATE functions are examples of single row functions.

Aggregate functions are also called Multiple Row functions. These functions work on a set of records as a whole and return a single value for each column of the records on which the function is applied. These are used with SELECT clause only. MAX ( ), MIN ( ), AVG ( ), SUM ( ), COUNT ( ) and COUNT (*) are examples of multiple row fun.

To demonstrate the use of SQL function, let us create database called CARSHOWROOM having the schema with four relations as shown in Figure 3.1.

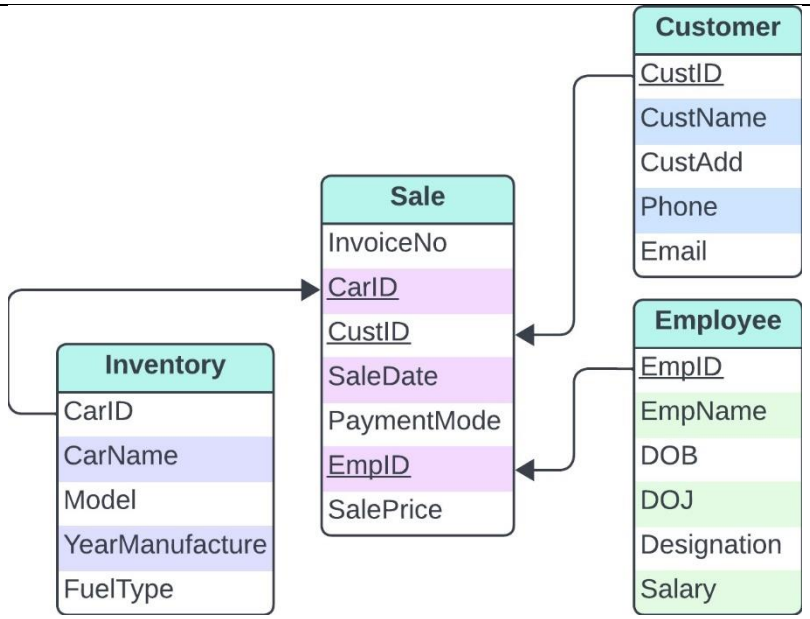


Fig 3.1: Car showroom database schema

Inventory – Stores Car id, Car Name, Price, Model, Year of manufacturing and fuel type for each car in inventory of the showroom.

Table 3.1: Attribute specification of "Inventory" table

Attribute	Data expected to be stored	Data type	Constraint
CarID	Alpha-Numeric value consisting of maximum 4 digits	Varchar (4)	Primary Key
CarName	Variant length string of maximum 20 characters	Varchar (20)	Not Null
Price	Numeric value consisting of car price.	Int	Not Null
Model	Variable length string of maximum 4 characters	Varchar (10)	Not Null
YearManufacturer	Variable length string of maximum 4 characters	Varchar (4)	Not Null
FuelType	Variable length string of max 10 characters	Varchar (10)	Not Null

Customer – Stores Customer id, name, address, phone number and email for each customer.

Table 3.2: Attribute specification of "Customer" table

Attribute	Data expected to be stored	Data type	Constraint
CustID	Alphanumeric value consisting of characters and digits, max 5 chars	Varchar (5)	Primary Key
CustName	Variable length string of max 30 characters	Varchar (30)	Not Null
CustAdd	Variable length string of max 50 characters	Varchar (50)	Not Null
Phone	Numeric value consisting of 10 digits	Char (10)	Not Null
Email	Variable length string of max 50 characters	Varchar (20)	Not Null

Sale – Stores the invoice number, car id, customer id, sale date, mode of payment, sales person's employee id and selling price of the car sold,

Table 3.3: Attribute specification of "Sale" table

Attribute	Data expected to be stored	Data type	Constraint
InvoiceNo	Alpha-Numeric value consisting of Characters and digits, max 6 chars	Varchar (6)	Primary Key

CarID	Alpha-Numeric value consisting of maximum 4 digits	Varchar (4)	Foreign Key
CustID	Alpha-Numeric value consisting of Characters and digits, max 5 chars	Varchar (5)	Foreign Key
SaleDate	Date value	Date	Not Null
PaymentMode	Variant length string of max 20 characters	Varchar (20)	Not Null
EmpID	Alpha-Numeric value consisting of maximum 4 chars only	Varchar (4)	Foreign Key
SalePrice	Car price will be as Numeric Value	Int	Not Null

Employee – Stores employee id, name, date of birth, date of joining, designation and salary of each employee in the showroom.

Table 3.4: Attribute specification of "Employee" table

Attribute	Data expected to be stored	Data type	Constraint
EmpID	Alpha-Numeric value consisting of maximum 4 chars only	Varchar (4)	Primary Key
EmpName	String of max 20 characters	Varchar (20)	Not Null
DOB	Date value	Date	Not Null
DOJ	Date value	Date	Not Null
Designation	String of max 20 characters	Varchar (20)	Not Null
Salary	Numeric value	Int	Not Null

To proceed further, create database CARSHOWROOM and create all four tables as per the above specification.

Insert the records in tables *Inventory, Customer, Sale* and *Employee* using INSERT command. The records of these four relations can be viewed using the SELECT command.

Execute the following query to view the records of *"inventory"* table. After successful execution of the query, the records entered in the "*inventory"* table will be displayed.

```
mysql> SELECT * FROM inventory;
+-------+---------+--------+-----------+------------------+----------+
| CarID | CarName | Price  | Model     | YearManufacturer | FuelType |
+-------+---------+--------+-----------+------------------+----------+
| B001  | Baleno  | 567031 | Sigma1.2  | 2019             | Petrol   |
| B002  | Baleno  | 647858 | Delta1.2  | 2018             | Petrol   |
| D001  | Dzire   | 582613 | LXI       | 2017             | Petrol   |
| D002  | Dzire   | 673112 | VXI       | 2018             | Petrol   |
| E001  | EECO    | 355205 | 5 STR STD | 2017             | CNG      |
| E002  | EECO    | 654914 | CARE      | 2018             | CNG      |
| S001  | SWIFT   | 514000 | LXI       | 2017             | Petrol   |
| S002  | SWIFT   | 614000 | VXI       | 2018             | Petrol   |
+-------+---------+--------+-----------+------------------+----------+
8 rows in set (0.00 sec)
```

Execute the following query to view the records of *"customer"* table. After successful execution of the query, the records entered in the *"customer"* table will be displayed.

```
mysql> SELECT * FROM customer;
+--------+--------------+-----------------------+------------+--------------------+
| CustID | CustName     | CustAdd               | Phone      | Email              |
+--------+--------------+-----------------------+------------+--------------------+
| C0001  | Amit Saha    | L-10, Pitampura       | 4564587852 | amitsaha2@gmail.com |
| C0002  | Rehnuma      | J-12, SAKET           | 5527688761 | rehnuma@hotmail.com |
| C0003  | Charvi Nayyar | 10/9, FF, Rohini     | 6811635425 | charvi123@yahoo.com |
| C0004  | Gurpreet     | A-10/2, SF Mayur Vihar | 3511056125 | gur_singh@yahoo.com |
+--------+--------------+-----------------------+------------+--------------------+
4 rows in set (0.00 sec)
```

Execute the following query to view the records of *"sale"* table. After successful execution of the query, the records entered in the *"sale"* table will be displayed.

Execute the following query to view the records of *"employee"* table. After successful execution of the query, the records entered in the *"employee"* table will be displayed.

```
mysql> SELECT * FROM employee;
+-------+----------+------------+------------+-------------+--------+
| EmpID | EmpName  | DOB        | DOJ        | Designation | Salary |
+-------+----------+------------+------------+-------------+--------+
| E001  | Rushil   | 1994-07-10 | 2017-12-12 | Salesman    |  25550 |
| E002  | Sanjay   | 1990-03-12 | 2016-06-05 | Salesman    |  33100 |
```

```
mysql> SELECT * FROM sale;
+-----------+-------+--------+------------+--------------+-------+-----------+------------+
| InvoiceNo | CarID | CustID | SaleDate   | PaymentMode  | EmpID | SalePrice | Commission |
+-----------+-------+--------+------------+--------------+-------+-----------+------------+
| I00001    | D001  | C0001  | 2019-01-24 | Credit Card  | E004  |    613248 |   73589.76 |
| I00002    | S001  | C0002  | 2018-12-12 | Online       | E001  |    590321 |   70838.52 |
| I00003    | S002  | C0004  | 2019-01-25 | Cheque       | E010  |    604000 |   72480.00 |
| I00004    | D002  | C0001  | 2018-10-15 | Bank Finance | E007  |    659982 |   79197.84 |
| I00005    | E001  | C0003  | 2018-12-20 | Credit Card  | E002  |    369310 |   44317.20 |
| I00006    | S002  | C0002  | 2019-01-30 | Bank Finance | E007  |    620214 |   74425.68 |
+-----------+-------+--------+------------+--------------+-------+-----------+------------+
6 rows in set (0.00 sec)
```

3.2 Single Row Functions

Figure 3.2 lists different single row functions under three categories — Numeric (Math), String, Date and Time.

- Math Functions accept numeric value as input and return a numeric value as a result.
- String Functions accept character value as input and return either character or numeric values as output.
- Date and Time functions accept date and time value as input and return numeric or string or Date and Time as output.

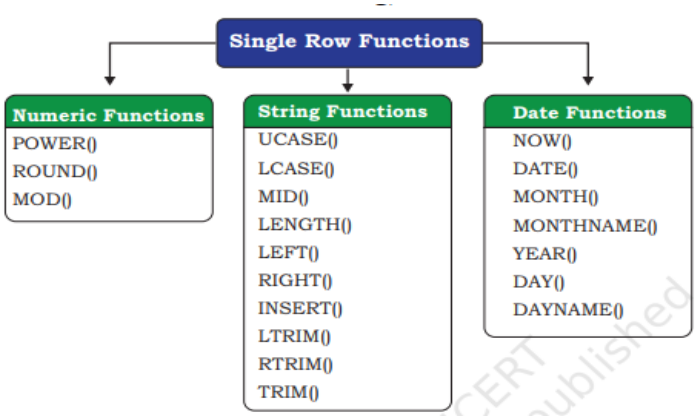


Fig 3.2: Categories of single row functions in SQL

3.2.1 Math Functions

Three commonly used numeric functions are POWER (), ROUND () and MOD (). Their usage along with syntax is given below.

1. POWER (X, Y) or POW (X, Y) – calculates X to the power Y

```
mysql> SELECT POWER (5,3);
+-------------+
| POWER (5,3) |
+-------------+
|         125 |
+-------------+
1 row in set (0.00 sec)
```

2. ROUND (N, D) – Rounds off number N to D number of decimal places. If D=0, then it rounds off the number to the nearest integer.

```
mysql> SELECT ROUND (3412.567, 1);
+---------------------+
| ROUND (3412.567, 1) |
+---------------------+
|              3412.6 |
+---------------------+
1 row in set (0.00 sec)

mysql> SELECT ROUND (412.56);
+----------------+
| ROUND (412.56) |
+----------------+
|            413 |
+----------------+
1 row in set (0.00 sec)
```

3. MOD (A, B) – Returns the remainder after dividing number A by number B.

```
mysql> SELECT MOD (44, 3);
+-------------+
| MOD (44, 3) |
+-------------+
|           2 |
+-------------+
1 row in set (0.00 sec)
```

Practical Activity 3.1 – Demonstrate to use math function ROUND

In order to increase sales, suppose the car dealer offers the customers to pay the total amount in 10 easy EMIs (equal monthly installments). Assume that EMIs are required in multiples of 10000. For that, the dealer wants to list the CarID and Price along with the following data from the Inventory table.

Step 1. Calculate GST as 12 per cent of Price and apply ROUND function to it. Execute the query to round off the GST to one decimal place and display the records with the fields CarID, CarName and GST.

```
mysql> SELECT CarID, CarName, ROUND (12/100*Price,1) "GST" FROM inventory;
+-------+---------+---------+
| CarID | CarName | GST     |
+-------+---------+---------+
| B001  | Baleno  | 68043.7 |
| B002  | Baleno  | 77743.0 |
| D001  | Dzire   | 69913.6 |
| D002  | Dzire   | 80773.4 |
| E001  | EECO    | 42624.6 |
| E002  | EECO    | 78589.7 |
| S001  | SWIFT   | 61680.0 |
| S002  | SWIFT   | 73680.0 |
+-------+---------+---------+
8 rows in set (0.00 sec)
```

Step 2. Add a new column *"FinalPrice"* to the table *"inventory"*. Update the table *"inventory"* with *"FinalPrice"* as the sum of Price and 12 percent of the GST. Apply the ROUND function to round off the GST to one decimal place. Execute the following query to do this.

```
mysql> ALTER TABLE inventory ADD(FinalPrice Numeric(10,1));
Query OK, 0 rows affected (0.09 sec)
Records: 0  Duplicates: 0  Warnings: 0

mysql> UPDATE inventory SET FinalPrice=Price+Round(Price*12/100,1);
Query OK, 8 rows affected (0.02 sec)
Rows matched: 8  Changed: 8  Warnings: 0
```

Display the values of *"FinalPrice"* for all the record by using the SELECT command.

```
mysql> SELECT * FROM inventory;
+-------+---------+--------+-----------+-----------------+----------+------------+
| CarID | CarName | Price  | Model     | YearManufacturer | FuelType | FinalPrice |
+-------+---------+--------+-----------+-----------------+----------+------------+
| B001  | Baleno  | 567031 | Sigma1.2  | 2019            | Petrol   |   635074.7 |
| B002  | Baleno  | 647858 | Delta1.2  | 2018            | Petrol   |   725601.0 |
| D001  | Dzire   | 582613 | LXI       | 2017            | Petrol   |   652526.6 |
| D002  | Dzire   | 673112 | VXI       | 2018            | Petrol   |   753885.4 |
| E001  | EECO    | 355205 | 5 STR STD | 2017            | CNG      |   397829.6 |
| E002  | EECO    | 654914 | CARE      | 2018            | CNG      |   733503.7 |
| S001  | SWIFT   | 514000 | LXI       | 2017            | Petrol   |   575680.0 |
| S002  | SWIFT   | 614000 | VXI       | 2018            | Petrol   |   687680.0 |
+-------+---------+--------+-----------+-----------------+----------+------------+
8 rows in set (0.00 sec)
```

Step 3. Calculate and display the amount to be paid each month in multiples of 1000, which is calculated after dividing the *FinalPrice* of the car into 10 installments. After dividing the amount into EMIs, find out the remaining amount to be paid immediately, by performing modular division. Use SELECT command to display the result. Execute the following query to do this.

```
mysql> SELECT CarId, CarName, FinalPrice,
    -> Round((FinalPrice-Round(mod(FinalPrice,1000),0))/10,0) 'EMI Amt',
    -> mod(FinalPrice,1000) 'Balance Amt' FROM inventory;
+-------+---------+------------+---------+-------------+
| CarId | CarName | FinalPrice | EMI Amt | Balance Amt |
+-------+---------+------------+---------+-------------+
| B001  | Baleno  |   635074.7 |   63500 |        74.7 |
| B002  | Baleno  |   725601.0 |   72500 |       601.0 |
| D001  | Dzire   |   652526.6 |   65200 |       526.6 |
| D002  | Dzire   |   753885.4 |   75300 |       885.4 |
| E001  | EECO    |   397829.6 |   39700 |       829.6 |
| E002  | EECO    |   733503.7 |   73300 |       503.7 |
| S001  | SWIFT   |   575680.0 |   57500 |       680.0 |
| S002  | SWIFT   |   687680.0 |   68700 |       680.0 |
+-------+---------+------------+---------+-------------+
8 rows in set (0.00 sec)
```

Step 4. Execute the following query to display the "*InvoiceNo*" and "*Commission*" value rounded off to zero decimal places.

```
mysql> Select InvoiceNo, round(Commission) from sale;
+-----------+-------------------+
| InvoiceNo | round(Commission) |
+-----------+-------------------+
| I00001    |             73590 |
| I00002    |             70839 |
| I00003    |             72480 |
| I00004    |             79198 |
| I00005    |             44317 |
| I00006    |             74426 |
+-----------+-------------------+
6 rows in set (0.00 sec)
```

Step 5. Execute the following query to display the details of *"sale"* table where payment mode is credit card.

```
mysql> Select * from sale where PaymentMode='Credit Card';
+-----------+-------+--------+------------+-------------+-------+-----------+------------+
| InvoiceNo | CarID | CustID | SaleDate   | PaymentMode | EmpID | SalePrice | Commission |
+-----------+-------+--------+------------+-------------+-------+-----------+------------+
| I00001    | D001  | C0001  | 2019-01-24 | Credit Card | E004  |    613248 |   73589.76 |
| I00005    | E001  | C0003  | 2018-12-20 | Credit Card | E002  |    369310 |   44317.20 |
+-----------+-------+--------+------------+-------------+-------+-----------+------------+
2 rows in set (0.02 sec)
```

Step 6. Execute the query to add a new column *"Commission"* with total length of 7 with 2 decimal places to the *"sale"* table.

Step 7. Execute the query to calculate commission for sales agents as 12% of *"SalePrice"*.

```
mysql> ALTER TABLE sale ADD(Commission Numeric(7,2));
Query OK, 0 rows affected (0.05 sec)
Records: 0  Duplicates: 0  Warnings: 0

mysql> UPDATE sale SET Commission=12 / 100 * SalePrice;
Query OK, 6 rows affected (0.09 sec)
Rows matched: 6  Changed: 6  Warnings: 0
```

Step 8. Execute the following query to insert the values to the newly added column *"Commission"* and then display all records of the *"sale"* table where Commission > 73000.

```
mysql> SELECT * FROM sale WHERE Commission > 73000;
+-----------+-------+--------+------------+-------------+-------+-----------+------------+
| InvoiceNo | CarID | CustID | SaleDate   | PaymentMode | EmpID | SalePrice | Commission |
+-----------+-------+--------+------------+-------------+-------+-----------+------------+
| I00001    | D001  | C0001  | 2019-01-24 | Credit Card | E004  |    613248 |   73589.76 |
| I00004    | D002  | C0001  | 2018-10-15 | Bank Finance| E007  |    659982 |   79197.84 |
| I00006    | S002  | C0002  | 2019-01-30 | Bank Finance| E007  |    620214 |   74425.68 |
+-----------+-------+--------+------------+-------------+-------+-----------+------------+
3 rows in set (0.00 sec)
```

Step 9. Execute the following query to display InvoiceNo, EmpID, SalePrice and Commission such that commission value is rounded off to 0.

```
mysql> SELECT InvoiceNo, EmpID,SalePrice, Round(Commission,0) FROM sale;
+-----------+-------+-----------+---------------------+
| InvoiceNo | EmpID | SalePrice | Round(Commission,0) |
+-----------+-------+-----------+---------------------+
| I00001    | E004  |    613248 |               73590 |
| I00002    | E001  |    590321 |               70839 |
| I00003    | E010  |    604000 |               72480 |
| I00004    | E007  |    659982 |               79198 |
| I00005    | E002  |    369310 |               44317 |
| I00006    | E007  |    620214 |               74426 |
+-----------+-------+-----------+---------------------+
6 rows in set (0.00 sec)
```

d) 3.2.2 String Functions

String functions can perform various operations on alphanumeric data which are stored in a table. They can be used to change the case such as uppercase to lowercase or vice-versa, extract a substring, calculate the length of a string and so on. Some of the string functions with examples are given below.

1. UCASE (string) OR UPPER (string) – converts string into uppercase.

```
mysql> SELECT UCASE ('Vocational Education');
+--------------------------------+
| UCASE ('Vocational Education') |
+--------------------------------+
| VOCATIONAL EDUCATION           |
+--------------------------------+
1 row in set (0.00 sec)

mysql> SELECT UPPER ('Vocational Education');
+--------------------------------+
| UPPER ('Vocational Education') |
+--------------------------------+
| VOCATIONAL EDUCATION           |
+--------------------------------+
1 row in set (0.00 sec)
```

2. LCASE (string) OR LOWER (string) – converts string into lowercase.

```
mysql> SELECT LCASE ('Computer SCIENCE');
+---------------------------+
| LCASE ('Computer SCIENCE') |
+---------------------------+
| computer science           |
+---------------------------+
1 row in set (0.00 sec)

mysql> SELECT LOWER ('Computer SCIENCE');
+---------------------------+
| LOWER ('Computer SCIENCE') |
+---------------------------+
| computer science           |
+---------------------------+
1 row in set (0.00 sec)
```

3. MID (string, pos, n) OR SUBSTRING (string, pos, n) OR SUBSTR (string, pos, n) – Returns a substring of size n starting from the specified position (pos) of the string. If n is not specified, it returns the substring from the position pos till end of the string.

```
mysql> SELECT MID('Vocational', 3, 4);
+--------------------------+
| MID('Vocational', 3, 4) |
+--------------------------+
| cati                     |
+--------------------------+
1 row in set (0.00 sec)

mysql> SELECT MID('Vocational', 7);
+----------------------+
| MID('Vocational', 7) |
+----------------------+
| onal                 |
+----------------------+
1 row in set (0.00 sec)
```

4. LENGTH (string) – Return the number of characters in the specified string.

```
mysql> SELECT LENGTH ('Voc Edu');
+--------------------+
| LENGTH ('Voc Edu') |
+--------------------+
|                  7 |
+--------------------+
1 row in set (0.00 sec)
```

5. LEFT (string, N) – Returns N number of characters from the left side of the string.

```
mysql> SELECT LEFT ('Computer', 4);
+----------------------+
| LEFT ('Computer', 4) |
+----------------------+
| Comp                 |
+----------------------+
1 row in set (0.00 sec)
```

6. RIGHT (string, N) – Returns N number of characters from the right side of the string.

```
mysql> SELECT RIGHT('Practical', 3);
+-----------------------+
| RIGHT('Practical', 3) |
+-----------------------+
| cal                   |
+-----------------------+
1 row in set (0.00 sec)
```

7. INSTR (string, substring) – Returns the position of the first occurrence of the substring in the

given string. Returns 0, if the substring is not present in the string.

```
mysql> SELECT INSTR ('Vocational', 'na');
+-----------------------------+
| INSTR ('Vocational', 'na') |
+-----------------------------+
|                           8 |
+-----------------------------+
1 row in set (0.00 sec)
```

8. LTRIM (string) – Returns the given string after removing leading white space characters.

```
mysql> SELECT LENGTH(' AGRA'),LENGTH(LTRIM(' AGRA'));
+-----------------+------------------------+
| LENGTH(' AGRA') | LENGTH(LTRIM(' AGRA')) |
+-----------------+------------------------+
|               5 |                      4 |
+-----------------+------------------------+
1 row in set (0.00 sec)
```

9. RTRIM (string) – Returns the given string after removing trailing white space characters.

```
mysql> SELECT LENGTH('PENCIL'), LENGTH (RTRIM ('PENCIL  '));
+-----------------+----------------------------+
| LENGTH('PENCIL') | LENGTH (RTRIM ('PENCIL  ')) |
+-----------------+----------------------------+
|               6 |                          6 |
+-----------------+----------------------------+
1 row in set (0.00 sec)
```

10. TRIM (string) – Returns the given string after removing both leading and trailing white space characters.

```
mysql> SELECT LENGTH('MADAM '),LENGTH(TRIM('MADAM '));
+------------------+-------------------------+
| LENGTH('MADAM ') | LENGTH(TRIM('MADAM ')) |
+------------------+-------------------------+
|                6 |                       5 |
+------------------+-------------------------+
1 row in set (0.00 sec)
```

i.

Practical Activity 3.2 – Demonstrate to use string function

Let us use *Customer* relation to understand the working of various string functions.

Step 1. Execute the following query to display customer name in lower case and customer email in upper case from *"customer"* table.

```
mysql> SELECT LOWER(CustName), UPPER(Email) FROM customer;
+-----------------+--------------------+
| LOWER(CustName) | UPPER(Email)       |
+-----------------+--------------------+
| amit saha       | AMITSAHA2@GMAIL.COM |
| rehnuma         | REHNUMA@HOTMAIL.COM |
| charvi nayyar   | CHARVI123@YAHOO.COM |
| gurpreet        | GUR_SINGH@YAHOO.COM |
+-----------------+--------------------+
4 rows in set (0.00 sec)
```

Step 2. Execute the following query to display the length of email and part of the email from the email id before the character '@'.

```
mysql> SELECT LENGTH(Email), LEFT(Email, INSTR(Email, "@")-1) FROM customer;
+--------------+---------------------------------+
| LENGTH(Email) | LEFT(Email, INSTR(Email, "@")-1) |
+--------------+---------------------------------+
|            19 | amitsaha2                       |
|            19 | rehnuma                         |
|            19 | charvi123                       |
|            19 | gur_singh                       |
+--------------+---------------------------------+
4 rows in set (0.00 sec)
```

The function INSTR will return the position of "@" in the email address. So, to print email id without "@" position -1 is used.

Let us assume that four-digit area code is reflected in the mobile number starting from position number 3. For example, 1851 is the area code of mobile number 9818511338.

Step 3. Execute the following query to display the area code of the customer living in Rohini.

```
mysql> SELECT MID(Phone,3,4) FROM customer WHERE CustAdd like '%Rohini%';
+----------------+
| MID(Phone,3,4) |
+----------------+
| 1163           |
+----------------+
1 row in set (0.00 sec)
```

Step 4. Execute the following query to display emails after removing the domain name extension ".com" from emails of the customers.

```
mysql> SELECT TRIM('.com' from Email) FROM customer;
+--------------------------+
| TRIM('.com' from Email) |
+--------------------------+
| amitsaha2@gmail          |
| rehnuma@hotmail          |
| charvi123@yahoo          |
| gur_singh@yahoo          |
+--------------------------+
4 rows in set (0.00 sec)
```

Step 5. Execute the following query to display details of all the customers having yahoo emails only.

```
mysql> SELECT * FROM customer WHERE Email LIKE '%yahoo%';
+--------+--------------+-----------------------+------------+--------------------+
| CustID | CustName     | CustAdd               | Phone      | Email              |
+--------+--------------+-----------------------+------------+--------------------+
| C0003  | Charvi Nayyar | 10/9, FF, Rohini      | 6811635425 | charvi123@yahoo.com |
| C0004  | Gurpreet     | A-10/2, SF Mayur Vihar | 3511056125 | gur_singh@yahoo.com |
+--------+--------------+-----------------------+------------+--------------------+
2 rows in set (0.00 sec)
```

Now let us use the table *"inventory"* from CARSHOWROOM database, write SQL queries for the following:

Step 6. Execute the following query to convert the *"CarMake"* to uppercase if its value starts with the letter 'B'.

```
mysql> SELECT Upper(CarName) from inventory where Carname Like 'b%';
+----------------+
| Upper(CarName) |
+----------------+
| BALENO         |
| BALENO         |
+----------------+
2 rows in set (0.00 sec)
```

Step 7. If the length of the car model is greater than 4 then Execute the following query to fetch the substring starting from position 3 till the end from attribute Model.

```
mysql> SELECT Model, SUBSTR(Model,3) FROM
    -> inventory WHERE Length(Model)>4;
+----------+----------------+
| Model    | SUBSTR(Model,3) |
+----------+----------------+
| Sigma1.2 | gma1.2         |
| Delta1.2 | lta1.2         |
| 5 STR STD | STR STD       |
+----------+----------------+
3 rows in set (0.00 sec)
```

i) 3.2.3 Date and Time Functions

There are various functions that are used to perform operations on date and time data. Some of the operations include displaying the current date, extracting each element of a date (day, month and year), displaying day of the week and so on. Some of the date and time functions with examples are given below.

1. NOW() – It returns the current system date and time.

```
mysql> SELECT NOW();
+---------------------+
| NOW()               |
+---------------------+
| 2022-03-09 10:04:07 |
+---------------------+
1 row in set (0.02 sec)
```

2. DATE() – It returns the date part from the given date/time expression.

```
mysql> SELECT DATE(NOW());
+--------------+
| DATE(NOW()) |
+--------------+
| 2022-03-09  |
+--------------+
1 row in set (0.00 sec)
```

3. MONTH(date) – It returns the month in numeric form from the date.

```
mysql> SELECT MONTH('2022-03-09');
+---------------------+
| MONTH('2022-03-09') |
+---------------------+
|                   3 |
+---------------------+
1 row in set (0.00 sec)
```

4. MONTHNAME(date) – It returns the month name from the specified date.

```
mysql> SELECT MONTHNAME(NOW());
+-------------------+
| MONTHNAME(NOW()) |
+-------------------+
| March             |
+-------------------+
1 row in set (0.00 sec)
```

5. YEAR(date) – It returns the year from the date.

```
mysql> SELECT YEAR('2022-03-09');
+--------------------+
| YEAR('2022-03-09') |
+--------------------+
|               2022 |
+--------------------+
1 row in set (0.00 sec)
```

6. DAY(date) – It returns the day part from the date.

```
mysql> SELECT DAY('2022-03-09');
+-------------------+
| DAY('2022-03-09') |
+-------------------+
|                 9 |
+-------------------+
1 row in set (0.00 sec)
```

7. DAYNAME(date) – It returns the name of the day from the date.

```
mysql> SELECT DAYNAME('2022-03-09');
+-----------------------+
| DAYNAME('2022-03-09') |
+-----------------------+
| Wednesday             |
+-----------------------+
1 row in set (0.00 sec)
```

Practical Activity 3.3 – Demonstrate to use DATE and Time function

Let us use the *"emp"* table of CARSHOWROOM database to illustrate the working of some of the date and time functions.

Step 1. Execute the following query to select the day, month number and year of joining of all employees.

```
mysql> SELECT DAY(DOJ), MONTH(DOJ), YEAR(DOJ) FROM employee;
+----------+-----------+-----------+
| DAY(DOJ) | MONTH(DOJ) | YEAR(DOJ) |
+----------+-----------+-----------+
|       12 |         12 |      2017 |
|        5 |          6 |      2016 |
|        8 |          1 |      1999 |
|        2 |         12 |      2010 |
|        1 |          7 |      2012 |
|        1 |          1 |      2017 |
|       23 |         10 |      2013 |
+----------+-----------+-----------+
7 rows in set (0.00 sec)
```

Step 1. Execute the following query to display the date in the format "Wednesday, 26, November, 1979", if the date of joining is not Sunday.

```
mysql> SELECT DAYNAME(DOJ), DAY(DOJ), MONTHNAME(DOJ), YEAR(DOJ) FROM
 employee WHERE DAYNAME(DOJ)!='Sunday';
+-------------+----------+---------------+-----------+
| DAYNAME(DOJ) | DAY(DOJ) | MONTHNAME(DOJ) | YEAR(DOJ) |
+-------------+----------+---------------+-----------+
| Tuesday     |       12 | December      |      2017 |
| Friday      |        8 | January       |      1999 |
| Thursday    |        2 | December      |      2010 |
| Wednesday   |       23 | October       |      2013 |
+-------------+----------+---------------+-----------+
4 rows in set (0.01 sec)
```

Step 2. Execute the following query to list the Employee Name, date of birth and Salary for all employees whose salary is more than 25000, in *"emp"* table.

```
mysql> Select EmpName, DayName(DOB), Salary
    -> FROM employee WHERE Salary>25000;
+----------+--------------+--------+
| EmpName  | DayName(DOB) | Salary |
+----------+--------------+--------+
| Rushil   | Sunday       |  25550 |
| Sanjay   | Monday       |  33100 |
| Arpit    | Tuesday      |  39100 |
| Sanjucta | Sunday       |  27350 |
| Mayank   | Saturday     |  27352 |
| Rajkumar | Thursday     |  31111 |
+----------+--------------+--------+
6 rows in set (0.00 sec)
```

Step 3. Execute the following query to list the invoice number, customer id and date of sale those payment are done using bank finance in *"Sale"* table.

```
mysql> Select InvoiceNo, CustId,SaleDate FROM sale
    -> WHERE PaymentMode = 'Bank Finance';
+-----------+--------+------------+
| InvoiceNo | CustId | SaleDate   |
+-----------+--------+------------+
| I00004    | C0001  | 2018-10-15 |
| I00006    | C0002  | 2019-01-30 |
+-----------+--------+------------+
2 rows in set (0.00 sec)
```

Step 4. Execute the following query to list all the employee without peon whose salary is more than 30000 in *"emp"* table.

```
mysql> Select * FROM employee WHERE Salary>30000 AND Designation!='Peon';
+-------+----------+------------+------------+-------------+--------+
| EmpID | EmpName  | DOB        | DOJ        | Designation | Salary |
+-------+----------+------------+------------+-------------+--------+
| E002  | Sanjay   | 1990-03-12 | 2016-06-05 | Salesman    |  33100 |
| E004  | Arpit    | 1989-06-06 | 2010-12-02 | Salesman    |  39100 |
| E010  | Rajkumar | 1987-02-26 | 2013-10-23 | Salesman    |  31111 |
+-------+----------+------------+------------+-------------+--------+
3 rows in set (0.00 sec)
```

Step 5. Execute the following query to list all the records without LXI and VXI models in the table *"inventory"*.

```
mysql> SELECT * FROM inventory WHERE  Model NOT IN ('LXI', 'VXI');
+-------+---------+--------+-----------+------------------+----------+------------+
| CarID | CarName | Price  | Model     | YearManufacturer | FuelType | FinalPrice |
+-------+---------+--------+-----------+------------------+----------+------------+
| B001  | Baleno  | 567031 | Sigma1.2  | 2019             | Petrol   |   635074.7 |
| B002  | Baleno  | 647858 | Delta1.2  | 2018             | Petrol   |   725601.0 |
| E001  | EECO    | 355205 | 5 STR STD | 2017             | CNG      |   397829.6 |
| E002  | EECO    | 654914 | CARE      | 2018             | CNG      |   733503.7 |
+-------+---------+--------+-----------+------------------+----------+------------+
4 rows in set (0.00 sec)
```

3.3 Aggregate Functions

In aggregate functions the column must be of numeric type. Some of the aggregate functions are given below.

1. MAX (column) – Returns the largest value from the specified column.

```
mysql> SELECT MAX(Price)FROM inventory;
+------------+
| MAX(Price) |
+------------+
|     673112 |
+------------+
1 row in set (0.02 sec)
```

2. MIN (column) – Returns the smallest value from the specified column.

```
mysql> SELECT MIN(Price)FROM inventory;

+------------+
| MIN(Price) |
+------------+
|     355205 |
+------------+
1 row in set (0.00 sec)
```

3. AVG (column) – Returns the average of the values in the specified column.

```
mysql> SELECT AVG(Price)FROM inventory;
+-------------+
| AVG(Price)  |
+-------------+
| 576091.6250 |
+-------------+
1 row in set (0.00 sec)
```

4. SUM (column) – Returns the sum of the values for the specified column.

```
mysql> SELECT SUM(Price) FROM inventory;

+------------+
| SUM(Price) |
+------------+
|    4608733 |
+------------+
1 row in set (0.00 sec)
```

5. COUNT (*) – Returns number of records in a table. COUNT (*) is used with WHERE clause to display the number of records that matches a particular criteria in the table.

```
mysql> SELECT COUNT(*)FROM inventory WHERE Model='VXI';
+----------+
| COUNT(*) |
+----------+
|        2 |
+----------+
1 row in set (0.00 sec)
```

Practical Activity 3.4 – Demonstrate to use aggregate functions in SQL

Let us explore how can we use various aggregate functions in SQL statements to fulfill various requirements of real-world situations.

Step 1. Execute the following SQL query to display the total number of records from table *"inventory"* having a model as VXI.

```
mysql> SELECT COUNT(*)FROM inventory WHERE Model='VXI';
+----------+
| COUNT(*) |
+----------+
|        2 |
+----------+
1 row in set (0.00 sec)
```

Step 2. Execute the following SQL query to display the total number of different types of Models available from table *"inventory"*.

```
mysql> SELECT COUNT(DISTINCT(Model)) FROM inventory;
+------------------------+
| COUNT(DISTINCT(Model)) |
+------------------------+
|                      6 |
+------------------------+
1 row in set (0.00 sec)
```

Step 3. Execute the following SQL query to display the average price of all the cars with Model LXI from table *"inventory"*.

```
mysql> SELECT AVG(Price) FROM inventory WHERE Model='LXI';
+-------------+
| AVG(Price)  |
+-------------+
| 548306.5000 |
+-------------+
1 row in set (0.00 sec)
```

3.3 GROUP BY CLAUSE IN SQL

Sometimes it may require to fetch a group of rows on the basis of common values in a column. GROUP BY clause is a special clause in SQL to do this. It groups the rows together that contains the same values in a specified column. The aggregate functions (COUNT, MAX, MIN, AVG and SUM) can be used with GROUP BY clause. HAVING Clause in SQL is used to specify conditions on the rows with GROUP BY clause.

Practical Activity 3.5 – Demonstrate to use GROUP BY and HAVING clause in SQL

Consider the *"sale"* table from the CARSHOWROOM database. Display the number of records in the *"sale"* table using the following SQL statement.

```
mysql> Select * from sale;
+-----------+-------+--------+------------+--------------+-------+-----------+------------+
| InvoiceNo | CarID | CustID | SaleDate   | PaymentMode  | EmpID | SalePrice | Commission |
+-----------+-------+--------+------------+--------------+-------+-----------+------------+
| I00001    | D001  | C0001  | 2019-01-24 | Credit Card  | E004  |    613248 |   73589.76 |
| I00002    | S001  | C0002  | 2018-12-12 | Online       | E001  |    590321 |   70838.52 |
| I00003    | S002  | C0004  | 2019-01-25 | Cheque       | E010  |    604000 |   72480.00 |
| I00004    | D002  | C0001  | 2018-10-15 | Bank Finance | E007  |    659982 |   79197.84 |
| I00005    | E001  | C0003  | 2018-12-20 | Credit Card  | E002  |    369310 |   44317.20 |
| I00006    | S002  | C0002  | 2019-01-30 | Bank Finance | E007  |    620214 |   74425.68 |
+-----------+-------+--------+------------+--------------+-------+-----------+------------+
6 rows in set (0.00 sec)
```

In these records, it is observed that, the columns, CarID, CustID, SaleDate, PaymentMode, EmpID, SalePrice can have rows with the same values in it. So, GROUP BY clause can be used in these columns to find the number of records of a particular type (column), or to calculate the sum of the price of each car type.

Step 1. Execute the following SQL query to display the number of Cars purchased by each Customer from SALE table.

```
mysql> SELECT CustID, COUNT(*) 'Number of Cars' FROM sale GROUP BY CustID;
+--------+----------------+
| CustID | Number of Cars |
+--------+----------------+
| C0001  |              2 |
| C0002  |              2 |
| C0003  |              1 |
| C0004  |              1 |
+--------+----------------+
4 rows in set (0.00 sec)
```

Step 2. Execute the following SQL query to display the Customer Id and number of cars purchased if the customer purchased more than 1 car from SALE table.

```
mysql> SELECT CustID, COUNT(*) FROM sale GROUP BY CustID HAVING Count(*)>1;

+--------+----------+
| CustID | COUNT(*) |
+--------+----------+
| C0001  |        2 |
| C0002  |        2 |
+--------+----------+
2 rows in set (0.02 sec)
```

Step 3. Execute the following SQL query to display the number of people in each category of payment mode from the table SALE.

```
mysql> SELECT PaymentMode, COUNT(PaymentMode) FROM sale GROUP BY
Paymentmode ORDER BY Paymentmode;
+--------------+--------------------+
| PaymentMode  | COUNT(PaymentMode) |
+--------------+--------------------+
| Bank Finance |                  2 |
| Cheque       |                  1 |
| Credit Card  |                  2 |
| Online       |                  1 |
+--------------+--------------------+
4 rows in set (0.00 sec)
```

Step 4. Execute the following SQL query to display the PaymentMode and number of payments made using that mode more than once.

```
mysql> SELECT PaymentMode, COUNT(PaymentMode) FROM sale GROUP BY
Paymentmode ORDER BY Paymentmode;
+--------------+--------------------+
| PaymentMode  | COUNT(PaymentMode) |
+--------------+--------------------+
| Bank Finance |                  2 |
| Cheque       |                  1 |
| Credit Card  |                  2 |
| Online       |                  1 |
+--------------+--------------------+
4 rows in set (0.00 sec)
```

3.4 OPERATIONS ON RELATIONS

It is possible to perform certain operations on relations like Union, Intersection and Set Difference to merge the tuples of two tables. These three operations are binary operations as they work upon two tables. Note here that these operations can only be applied if both the relations have the same number of attributes and corresponding attributes in both tables have the same domain.

3.4.1 Union (∪)

This operation is used to combine the selected rows of two tables at a time. If some rows are same in both the tables, then result of the Union operation will show those rows only once. Figure 3.3 shows union of two sets.

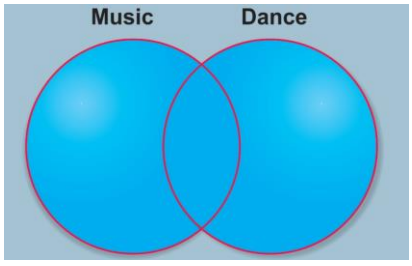


Fig 3.3: Union of two sets

Let us consider two relations DANCE and MUSIC shown in Tables 3.9 and 3.10 respectively.

Table 3.9 DANCE

Sno	Name	Class
1	Astha	7A
2	Pawani	6A
3	Mohit	7B
4	Vibhanshu	7A

Execute the following query to view the records of *"dance"* table. After successful execution of the query, the records entered in the *"dance"* table will be displayed.

```
mysql> SELECT * FROM dance;
+------+-----------+-------+
| Sno  | Name      | Class |
+------+-----------+-------+
|    1 | Astha     | 7A    |
|    2 | Pawani    | 6A    |
|    3 | Mohit     | 7B    |
|    4 | Vibhanshu | 7A    |
+------+-----------+-------+
4 rows in set (0.00 sec)
```

Table 3.10 MUSIC

Sno	Name	Class
1	Mahak	8A
2	Pawani	6A
3	Lavanya	7A
4	Vibhanshu	7A
5	Abhay	8A

Execute the following query to view the records of *"music"* table. After successful execution of the query, the records entered in the *"music"* table will be displayed.

```
mysql> SELECT * FROM music;
+------+-----------+-------+
| Sno  | Name      | Class |
+------+-----------+-------+
|    1 | Mahak     | 8A    |
|    2 | Pawani    | 6A    |
|    3 | Lavanya   | 7A    |
|    4 | Vibhanshu | 7A    |
|    5 | Abhay     | 8A    |
+------+-----------+-------+
5 rows in set (0.00 sec)
```

Step 1. Execute the following SQL query to find the list of students participating in either of events by using UNION operation on relations **DANCE** and **MUSIC**. After execution it will display the union of DANCE and MUSIC relations.

```
mysql> SELECT * FROM dance UNION SELECT * from music;
+------+-----------+-------+
| Sno  | Name      | Class |
+------+-----------+-------+
|    1 | Astha     | 7A    |
|    2 | Pawani    | 6A    |
|    3 | Mohit     | 7B    |
|    4 | Vibhanshu | 7A    |
|    1 | Mahak     | 8A    |
|    3 | Lavanya   | 7A    |
|    5 | Abhay     | 8A    |
+------+-----------+-------+
7 rows in set (0.01 sec)
```

3.4.2 Intersect (∩)

Intersect operation is used to get the common tuples from two tables and is represented by symbol ∩. Figure 3.9 shows intersection of two sets.

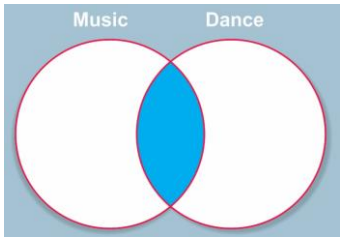


Fig 3.9: Intersection of two sets

Suppose, we have to display the list of students who are participating in both the events (DANCE and MUSIC), then intersection operation is to be applied on these two tables. The output of INTERSECT operation is shown in Table 3.11

Table 3.11 DANCE ∩ MUSIC

Sno	Name	Class
2	Pawani	6A
4	Vibhanshu	7A

3.4.3 Minus (-)

This operation is used to get tuples/rows which are in the first table but not in the second table and the operation is represented by the symbol - (minus). Figure 3.10 shows difference operation between two sets.

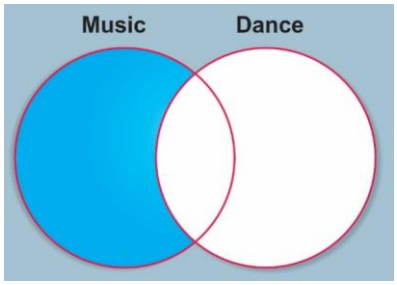


Fig 3.10: Difference of two sets

To find out the list of students who are only participating in MUSIC and not in DANCE event, use the MINUS operation. The output of MINUS operation is given in Table 3.12

Table 3.12 DANCE – MUSIC

Sno	Name	Class
1	Mahak	8A
3	Lavanya	7A
5	Abhay	8A

3.4.4 Cartesian Product (×)

Cartesian product operation combines tuples from two relations. It results in all pairs of rows from the two input relations, regardless of whether or not they have the same values on common attributes. It is denoted as '×'.

The degree of the resulting relation is calculated as the sum of the degrees of both the relations under consideration. The cardinality of the resulting relation is calculated as the product of the cardinality of relations on which Cartesian product is applied. Let us use the relations DANCE and MUSIC to show the output of Cartesian product. Note that both relations are of degree 3. The cardinality of relations DANCE and MUSIC is 4 and 5 respectively. Applying Cartesian product on these two relations will result in a relation of degree 6 and cardinality 20, as shown in the output of the following query.

```
mysql> SELECT * FROM dance, music;
+------+-----------+-------+------+-----------+-------+
| Sno  | Name      | Class | Sno  | Name      | Class |
+------+-----------+-------+------+-----------+-------+
|    4 | Vibhanshu | 7A    |    1 | Mahak     | 8A    |
|    3 | Mohit     | 7B    |    1 | Mahak     | 8A    |
|    2 | Pawani    | 6A    |    1 | Mahak     | 8A    |
|    1 | Astha     | 7A    |    1 | Mahak     | 8A    |
|    4 | Vibhanshu | 7A    |    2 | Pawani    | 6A    |
|    3 | Mohit     | 7B    |    2 | Pawani    | 6A    |
|    2 | Pawani    | 6A    |    2 | Pawani    | 6A    |
|    1 | Astha     | 7A    |    2 | Pawani    | 6A    |
|    4 | Vibhanshu | 7A    |    3 | Lavanya   | 7A    |
|    3 | Mohit     | 7B    |    3 | Lavanya   | 7A    |
|    2 | Pawani    | 6A    |    3 | Lavanya   | 7A    |
|    1 | Astha     | 7A    |    3 | Lavanya   | 7A    |
|    4 | Vibhanshu | 7A    |    4 | Vibhanshu | 7A    |
|    3 | Mohit     | 7B    |    4 | Vibhanshu | 7A    |
|    2 | Pawani    | 6A    |    4 | Vibhanshu | 7A    |
|    1 | Astha     | 7A    |    4 | Vibhanshu | 7A    |
|    4 | Vibhanshu | 7A    |    5 | Abhay     | 8A    |
|    3 | Mohit     | 7B    |    5 | Abhay     | 8A    |
|    2 | Pawani    | 6A    |    5 | Abhay     | 8A    |
|    1 | Astha     | 7A    |    5 | Abhay     | 8A    |
+------+-----------+-------+------+-----------+-------+
20 rows in set (0.00 sec)
```

3.5 USING TWO RELATIONS IN A QUERY

Till now we have written queries in SQL using a single relation only. Now let us see how to write queries using two relations.

3.5.1 JOIN on two tables

JOIN operation combines tuples from two tables on specified conditions. This is unlike Cartesian product which make all possible combinations of tuples. While using the JOIN clause of SQL, specify conditions on the related attributes of two tables within the FROM clause. Usually, such attribute is the *primary key* in one table and *foreign key* in another table.

Let us create two tables UNIFORM (UCode, UName, UColor) and COST (UCode, Size, Price) in the SchoolUniform database. *"UCode"* is *primary key* in table UNIFORM. *"UCode"* and *"Size"* is the *composite key* in table COST. Therefore, UCode is a common attribute between the two tables which can be used to fetch the common data from both tables. Define UCode as *foreign key* in the *"Cost"* table while creating this table. Enter the records in these tables as shown in Table 3.13 and 3.14.

Table 3.13 Uniform table

UCode	Uname	UColor
1	Shirt	White
2	Pant	Grey
3	Tie	Blue

Table 3.14 Cost table

UCode	Size	Price
1	L	580
1	M	500
2	L	890
1	M	810

Practical Activity 3.6 – Demonstrate to join two tables in SQL

Let us consider two tables created, UNIFORM and COST to demonstrate the joining of two tables. The joining of two tables can be done in three different ways – using WHERE clause, JOIN clause and NATURAL JOIN clause

Step 1. Execute the following query to join the two tables using WHERE clause.

```
mysql> SELECT * FROM uniform U, cost C WHERE U.UCode = C.UCode;
+-------+-------+--------+-------+------+-------+
| UCode | Uname | UColor | UCode | Size | Price |
+-------+-------+--------+-------+------+-------+
|     1 | Shirt | White  |     1 | L    |   580 |
|     1 | Shirt | White  |     1 | M    |   500 |
|     2 | Pant  | Grey   |     2 | L    |   890 |
|     1 | Shirt | White  |     1 | M    |   810 |
+-------+-------+--------+-------+------+-------+
4 rows in set (0.00 sec)
```

As the attribute *"UCode"* appears in both *"uniform"* and *"cost"* tables. Hence alias is used to remove ambiguity by specifying qualifier U with attribute UCode in SELECT and FROM clauses to indicate its scope.

Step 2. Execute the following query to join the two tables using JOIN clause.

```
mysql> SELECT * FROM uniform U JOIN cost C WHERE U.UCode = C.UCode;
+-------+-------+--------+-------+------+-------+
| UCode | Uname | UColor | UCode | Size | Price |
+-------+-------+--------+-------+------+-------+
|     1 | Shirt | White  |     1 | L    |   580 |
|     1 | Shirt | White  |     1 | M    |   500 |
|     2 | Pant  | Grey   |     2 | L    |   890 |
|     1 | Shirt | White  |     1 | M    |   810 |
+-------+-------+--------+-------+------+-------+
4 rows in set (0.00 sec)
```

The output of the query is same as that of step 1. In this query the JOIN clause is used explicitly along with condition in FROM clause. Hence no condition is required in WHERE clause.

The output of queries in step 1 and 2 has a repetitive column UCode having exactly the same values. This redundant column provides no additional information. SQL provides the extension of JOIN operation called as NATURAL JOIN, which works similar to JOIN clause in SQL to remove the redundant attribute. This operator can be used to join the contents of two tables if there is one common attribute in both the tables.

Step 3. Execute the following query to join the two tables using NATURAL JOIN clause.

```
mysql> SELECT * FROM uniform NATURAL JOIN cost;
+-------+-------+--------+------+-------+
| UCode | Uname | UColor | Size | Price |
+-------+-------+--------+------+-------+
|     1 | Shirt | White  | L    |   580 |
|     1 | Shirt | White  | M    |   500 |
|     2 | Pant  | Grey   | L    |   890 |
|     1 | Shirt | White  | M    |   810 |
+-------+-------+--------+------+-------+
4 rows in set (0.00 sec)
```

It is clear from the output that the result of this query is same as above in step 1 and 2, except that the attribute UCode appears only once.

It is important to note the following points while applying JOIN operations on two or more relations.

- If two tables are to be joined on equality condition on the common attribute, then one may use JOIN with ON clause or NATURAL JOIN in FROM clause. If three tables are to be joined on equality condition, then two JOIN or NATURAL JOIN are required.
- In general, N-1 joins are needed to combine N tables on equality condition.
- Any relational operators can be used with JOIN clause to combine tuples of two tables.

SUMMARY

- A Function is used to perform a particular task and return a value as a result.
- Single Row functions work on a single row of the table and return a single value.
- Multiple Row functions work on a set of records as a whole and return a single value. Examples include COUNT, MAX, MIN, AVG and SUM.
- GROUP BY function is used to group rows of a table that contain the same values in a specified column.
- Join is an operation which is used to combine rows from two or more tables based on one or more common fields between them.

Check Your Progress

A. Multiple choice questions

1. Which of the following is not an example of single row function (a) MATH (b) STRING (c) DATE (d) COUNT
2. Which of the following is not an example of multiple row function (a) MAX ( ) (b) MIN ( ) (c) STRING (d) COUNT (*)
3. What is the functionality of SQL COUNT? (a) It returns the no of record of table (b) It returns the no of record of database (c) It returns the no of record of row (d) It returns the no of record of column
4. Date and Time functions accept date and time value as input and return output as (a) numeric (b) string (c) Date and Time (d) Any of the above
5. String Functions accept character value as input and return output as (a) either character or numeric values (b) string values (c) numeric values (d) character values
6. Which of the following is aggregate function in SQL (a) LEFT (b) AVG (c) JOIN (d) LEN
7. The SQL statement Select Round (47.956,-1) from Dual; (a) is illegal in SQL (b) prints a garbage value (c) 045.926 (d) prints 50
8. Which of the following SQL operation cannot be performed on relations (a) Union, (b) Intersection (c) Difference (d) Merge
9. Which of the following is used to join two tables on equality condition on the common attribute (a) JOIN with ON clause (b) NATURAL JOIN in FROM clause (c) Any of a or b (d) NATURAL JOIN
10. What will be the Cartesian product of the two relations having 4 rows and 3 columns for first relation and 3 rows and 4 columns in second relation. (a) degree 7 cardinality 12 (b) degree 6 cardinality 16 (c) degree 7 cardinality 16 (d) degree 9 cardinality 16

B. Fill in the blanks

1. Single row functions are applied on a single _____ and return a single value.
2. Aggregate functions work on a _____ as a whole and return a single value.)
3. Math Functions accept numeric value as input and return a _____ value as a result.
4. MONTH (date) returns the month in _____ form from the date.
5. By default, the order by clause lists items in _____ order.
6. INSTR (string, substring) returns the position of the _____ of the substring in the given string.)
7. MID (string, pos, n) returns a substring of size ___ starting from the specified position _____ of the string. (n, pos).
8. LTRIM (string) returns the given string after removing _____ white space characters.
9. TRIM (string) returns the given string after removing both _____ and _____ white space characters.
10. The _____ operation is used to get common tuples from two tables.

C. State True or False

1. Aggregate functions are also called Scalar functions.
2. A function always return a single value.
3. Functions can be applied to work on single or multiple records of a table.
4. INSTR (string, substring) returns 0, if the substring is not present in the string.
5. If n is not specified MID (string, pos, n), it returns the substring from the position 1 till end of the string.
6. RTRIM (string) returns the given string after removing leading white space characters.
7. NOW() returns the current system date and time.
8. Union operation eliminates the duplicate rows.
9. Cartesian product operation combines tuples from two relations.

10. Join statement is used to combine two tables on a specified condition.

C. Short answer questions

1. Differentiate between single row functions and aggregate functions.
2. List the single row functions with example.
3. Differentiate between TRIM( ), LTRIM( ) and RTRIM( ) functions.
4. Demonstrate the use of LCASE( ) and UCASE( ) function with example.
5. List the date functions with example.
6. What is the difference between NOW( ) and DATE( ) function?
7. Demonstrate the difference between SUM( ) and AVG( ) function?
8. A table Student has 4 rows and 2 column and another table has 3 rows and 4 columns. How many rows and columns will be there if we obtain the Cartesian product of these two tables?
9. What will be the output of following SQL functions.
   a) Select pow (3,2);
   b) Select round (342.9234, 2);
   c) Select length ('Vocational Education');
   d) Select year ('1978/08/17'), month ('1978/08/17'), day ('1978/08/17'), monthname ('1978/08/17');
   e) Select left ('Central', 3), right ('Institute', 4), mid ('Vocational', 3, 4), substr ('Education', 3);
10. Write the SQL functions to perform the following operations.
    a) To display the day like "Monday", "Tuesday", from the date when India got independence.
    b) To display the specified number of characters from a particular position of the given string.
    c) To display the name of the month in which you were born.
    d) To display your name in capital letters.

Practical Exercise

Consider the following table named "Product", showing details of products being sold in a grocery shop.

PCode	PName	UPrice	Manufacturer
P01	Washing Powder	120	Surf
P02	Toothpaste	54	Colgate
P03	Soap	25	Lux
P04	Toothpaste	65	Pepsodent
P05	Soap	38	Dove
P06	Shampoo	245	Dov

A. Write SQL queries for the following:

a) Create the table Product with appropriate data types and constraints.
b) Identify the primary key in Product.
c) List the Product Code, Product name and price in descending order of their product name. If PName is the same, then display the data in ascending order of price.
d) Add a new column Discount to the table Product.
e) Calculate the value of the discount in the table Product as 10 per cent of the UPrice for all those products where the UPrice is more than 100, otherwise the discount will be 0.
f) Increase the price by 12 per cent for all the products manufactured by Dove.
g) Display the total number of products manufactured by each manufacturer.

B. Write the output(s) produced by executing the following queries on the basis of the information given above in the table Product:

h) SELECT PName, Average (UPrice) FROM Product GROUP BY Pname;
i) SELECT DISTINCT Manufacturer FROM Product;
j) SELECT COUNT (DISTINCT PName) FROM Product;
k) SELECT PName, MAX(UPrice), MIN(UPrice) FROM Product GROUP BY PName;

Module 2	Applications of Biometric Data

Module Overview

The primary purpose of a biometric system is to use automated recognition technology to accurately validate the identity of an individual. A biometric system allows the recognition of a certain characteristic of an individual using mathematical algorithms and biometric data. Biometric data of an individual is a unique way of identification. The advantage of using the biometric data is that they are all universal, measurable, unique, and permanent. There are several applications of biometric systems. The most common types of biometric identifiers are face, fingerprints and iris. India is one of the leading nations in providing services relating to biometrics. The biometric identification system used by the Government of India, known as the Aadhaar system, is the largest biometric platform in the world. A biometric attendance system is another application of biometric systems and is being used in most of the private and government organisations. Biometric time and attendance tracking system that identifies and tracks employees' attendance by using their physical characteristics such as fingerprints, face or iris scans. The Indian passport includes biometric data such as a photograph, iris, palm, fingerprints and thumb impression of the passport holder to make it more secure. Indian driving licence is issued in the form of smart card. It uses biometric data such as a photo of an individual, figure and thumb impressions being recorded at the time of registration. These biometric data are stored in the chip of the smart card. So there are several other applications where biometric data is being used to store the identity of the person. In this unit you will be able to understand how these applications are being implemented for capturing, storing and retrieving the biometric data for report generation.

Learning Outcomes

After completing this module, you will be able to:

- Understand the functionality and benefits of biometric attendance systems for tracking employee presence and enhancing accountability.
- Learn how Aadhaar-based biometric systems operate and their role in streamlining attendance tracking while ensuring data security.
- Acquire knowledge of the steps and requirements for preparing and applying for an Aadhaar card, ensuring compliance with regulations.
- Understand the process and documentation required for preparing and applying for a passport, including application forms and verification procedures.

Module Structure

Session 1. Report Generation in Biometric Attendance System

Session 2. Aadhaar Based Biometric Attendance System

Session 3. Preparation of Aadhaar Card

Session 4. Preparation of Passport

Session 1. Report Generation in Biometric Attendance System

In Class XI, we have seen how to set up, install and configure the biometric attendance system (BAS). Now when the system is ready for use. The daily attendance can be recorded by using the BAS system. In this chapter session will understand how this attendance or punching is used for the generation of various reports. Note that for this report generation we have taken the prototype example of the WYSE BAS system.

BIOMETRIC PUNCH REPORTS

Employees can punch in biometric devices by using their finger or thumb impression. Their punching data can be observed by the administrator of the organisation. Following steps are required to observe daily punch reports.

Daily Punch Report

Step 1. Login into the software by using administrator login and password as shown in Figure 1.1.

Fig 1.1 Administrator login

Step 2. Select **Administration > Daily Punches** to see the daily punches of the current date as shown in the Figure 1.2.

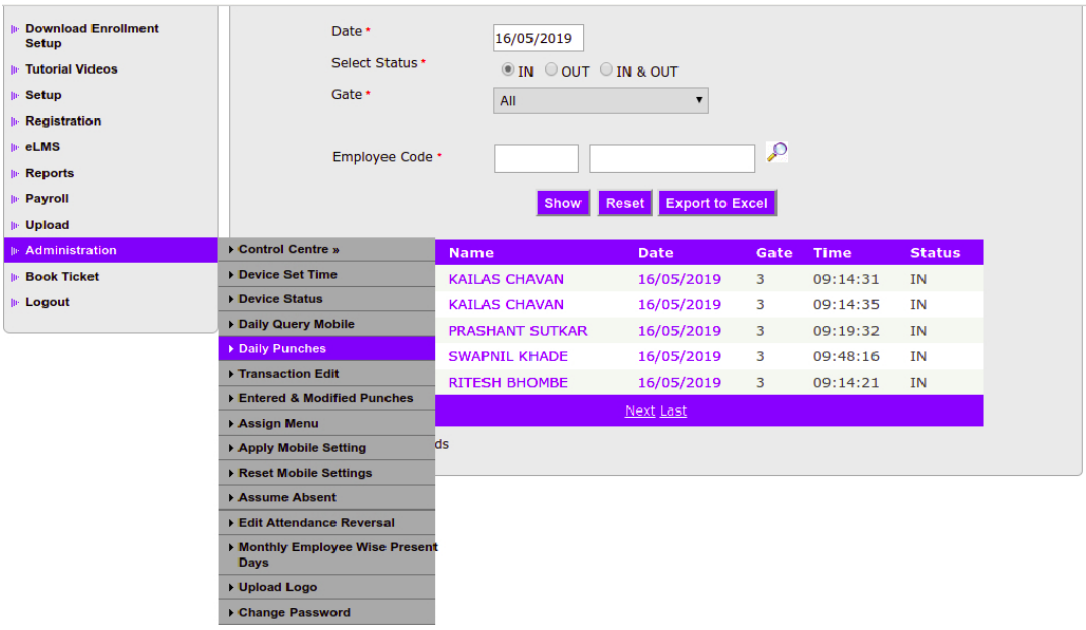


Fig. 1.2 Daily Punch Report

Step 3. The administrator can also see punch report of previous dates by selecting the required data in the given menu.

A particular device can also be selected by selecting the appropriate entry gate in Gate option from the user interface.

Step 1. It is also possible to export and download the daily punch report in Excel format by the appropriate option.

The punch data for **In** or **Out** or for both can be selected by clicking on the appropriate radio button. The punches of particular employees can also be observed by entering Employee Code in the appropriate textbox.

Summary Report for selected period

The punch report of employees can be generated for any specified period between two dates. i.e. a weekly report or monthly report or even a bimonthly report can also be generated as follows.

Step 1. Login into the software by using administrator login and password as done above.

Step 2. Select **Report > Attendance Reports > Summary Report** as shown in Figure 1.3.

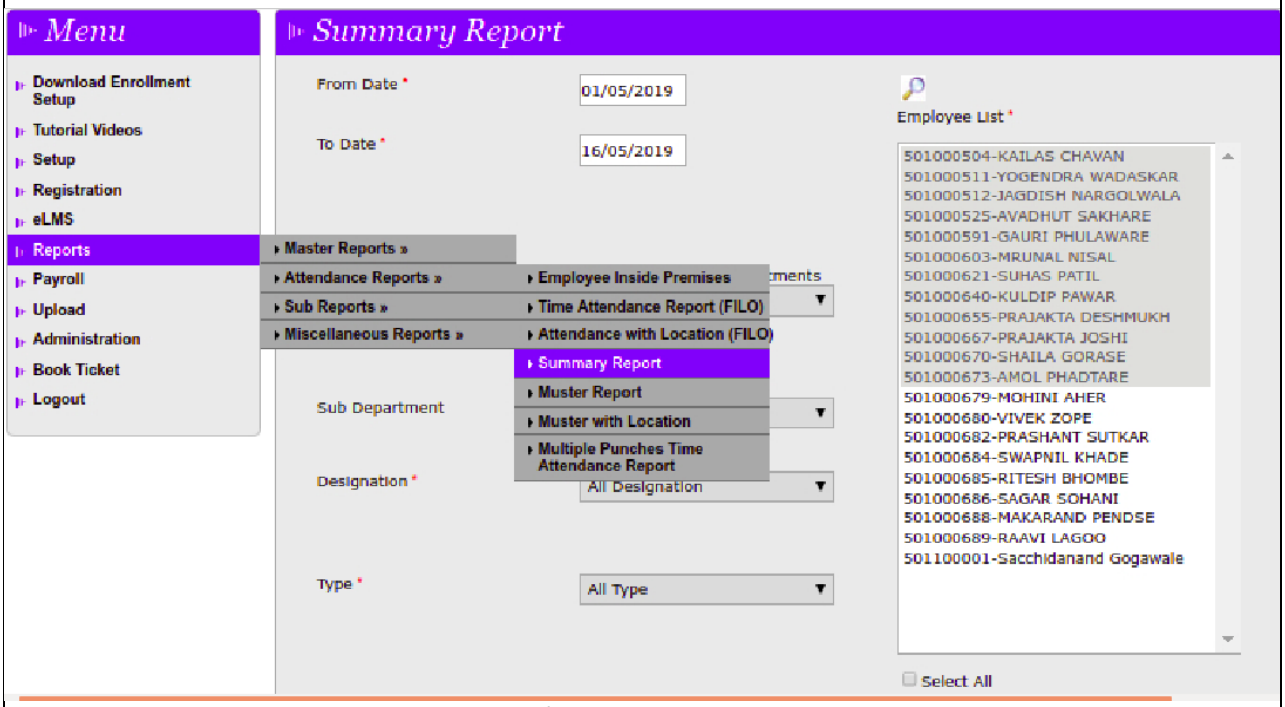


Fig. 1.3 Select Summary Report Type

Enter the starting date in the **"From Date"** and ending date in the **"End Date"** in the given textbox.

Enter the **Department, Sub Department, Designation** and **Type** in the respective list box.

Select the **Mode** PDF or MS Excel in which you want the report.

Then Click on the Submit button to get the Summary Report. A typical pdf report generated is shown in Figure 1.4.

Department: R&D HARDWARE

ID:	501000673					Name:				AMOL PHADTARE					AlphaNumeric ID:	501W000673
Date	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
Day	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu
In		09:41	14:03			13:50	09:11	09:09	13:26	09:14	09:17		09:12		10:43	09:14
Out		19:04	18:14			18:24	18:42	13:39	18:09	18:40	18:16		18:27		18:27	?
Total	00:00	09:23	04:10			04:34	09:30	04:29	04:43	09:26	08:58		09:14		07:43	?
Status	HO	P	P*	W	W	P*	P	P*	P*	P	P	W	P	A	P*	A

FILO Total: 72:10 **Present:** 7.5 **Absent:** 4.5 **Holidays:** 1 **WeeklyOff:** 3 **Leaves:** 0 **LWP:** 0 **Tours:** 0 **HalfDays:**

Designation: **MEMBER-PRODUCT**

ID:	501000655					Name:				PRAJAKTA DESHMUKH					AlphaNumeric ID:	501W000655
Date	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
Day	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu
In		09:20	?			09:17	09:18	09:21	09:17	09:36	09:17		09:19	09:18	09:39	
Out		18:55	18:25			18:27	18:34	18:49	18:13	18:55	18:28		18:21	18:19	18:30	
Total	00:00	09:35	?			09:09	09:16	09:28	08:56	09:18	09:10		09:01	09:00	08:50	
Status	HO	P	A	W	W	P	P	P	P	P	P	W	P	P	P	A

FILO Total: 91:43 **Present:** 10 **Absent:** 2 **Holidays:** 1 **WeeklyOff:** 3 **Leaves:** 0 **LWP:** 0 **Tours:** 0 **HalfDays:**

Fig. 1.4 Exported Summary Report

The above generated report gives a quick summary count of attendance of employees.

The report shows time for **"In"** and "**Out"** for all the dates employee-wise for selected employees. It also shows the total working hours for a day and for a selected period as well for each employee. Total number of present, absent, weekly off leaves, and holidays are shown in the report. This summary report can be given as input to calculate the pay of an employee.

Muster Report

The Mustor Report of employees can be generated for any specified period between two dates. i.e. a weekly report or monthly report or even a bimonthly report can also be generated as follows.

Step 1. Login into the software by using administrator login and password as done above.

Step 2. Select **Report > Attendance Reports > Muster Report** as shown in Figure 1.5.

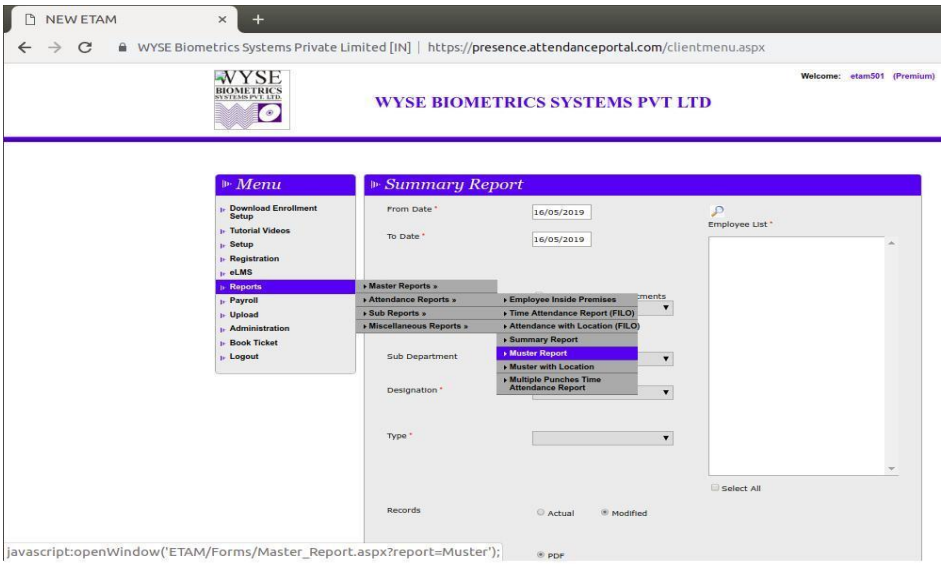


Fig. 1.5 Selecting Muster Report

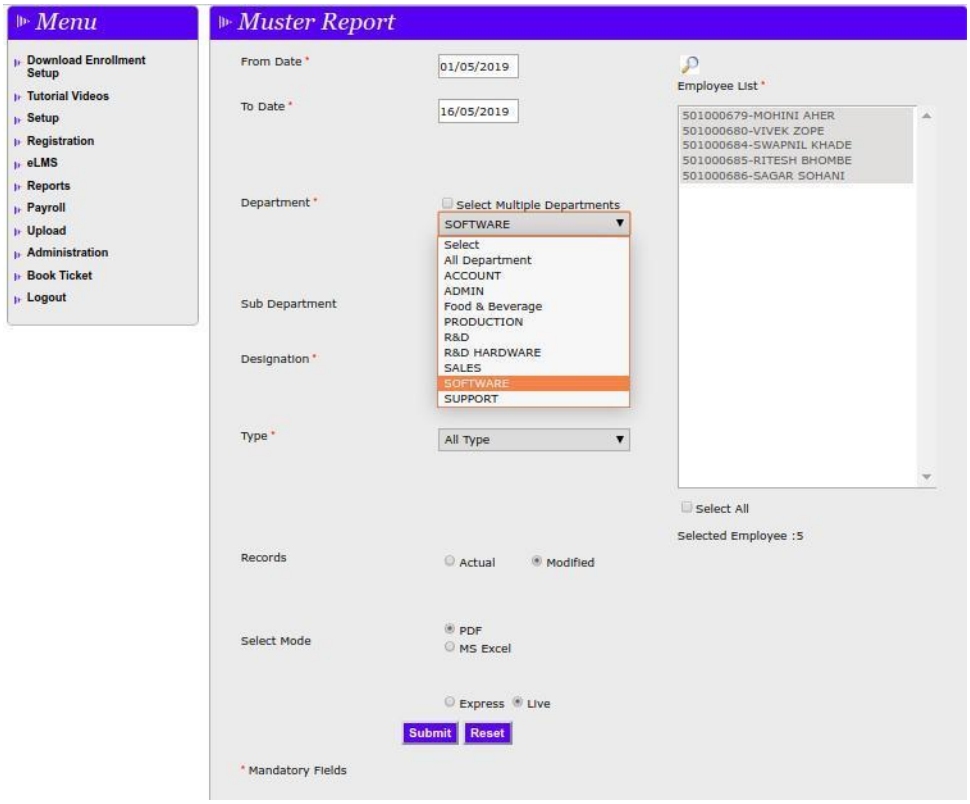
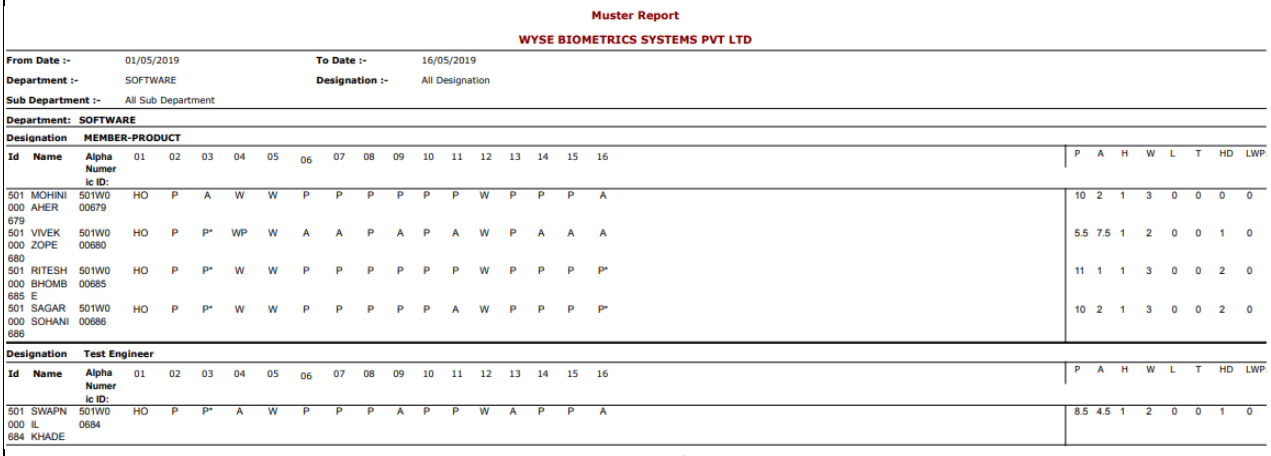


Fig. 1.6 Selecting Fields for Muster Report

To generate the Mustor Report supply the data such as department, designation, time and mode of the file in the respective fields as done above in Summary Report.

Lastly Click on the Submit button to get the Muster Report. A typical Muster Report generated in PDF form is shown in Figure 1.7.



Muster Report

WYSE BIOMETRICS SYSTEMS PVT LTD

From Date :- 01/05/2019 **To Date :-** 16/05/2019

Department :- SOFTWARE **Designation :-** All Designation

Sub Department :- All Sub Department

Department: SOFTWARE

Designation MEMBER-PRODUCT

Id	Name	Alpha Numeric ID:	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	P	A	H	W	L	T	HD	LWP
501000679	MOHINI AHER	501W000679	HO	P	A	W	W	P	P	P	P	P	P	W	P	P	P	A	10	2	1	3	0	0	0	0
501000680	VIVEK ZOPE	501W000680	HO	P	P*	WP	W	A	A	P	A	P	A	W	P	A	A	A	5.5	7.5	1	2	0	0	1	0
501000685	RITESH BHOMBE	501W000685	HO	P	P*	W	W	P	P	P	P	P	P	W	P	P	P	P*	11	1	1	3	0	0	2	0
501000686	SAGAR SOHANI	501W000686	HO	P	P*	W	W	P	P	P	P	P	A	W	P	P	P	P*	10	2	1	3	0	0	2	0

Designation Test Engineer

Id	Name	Alpha Numeric ID:	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	P	A	H	W	L	T	HD	LWP
501000684	SWAPNIL KHADE	501W000684	HO	P	P*	A	W	P	P	P	A	P	P	W	A	P	P	A	8.5	4.5	1	2	0	0	1	0

Fig. 1.7 Exported Muster Report

Observe that the Muster Report contains daily attendance status of employees. It also shows the total number of days present, absent, weekly off, leaves, tour of an employee. This report is also useful to generate the payroll report.

Time Attendance Report FILO (First in Last Out)

The FILO Report of employees can be generated for any specified period between two dates. i.e. a weekly report or monthly report or even a bimonthly report can also be generated as follows.

Step 1. Login into the software by using administrator login and password as done above.

Step 2. Select **Report > Attendance Reports > FILO Report** as shown in Figure 1.8.

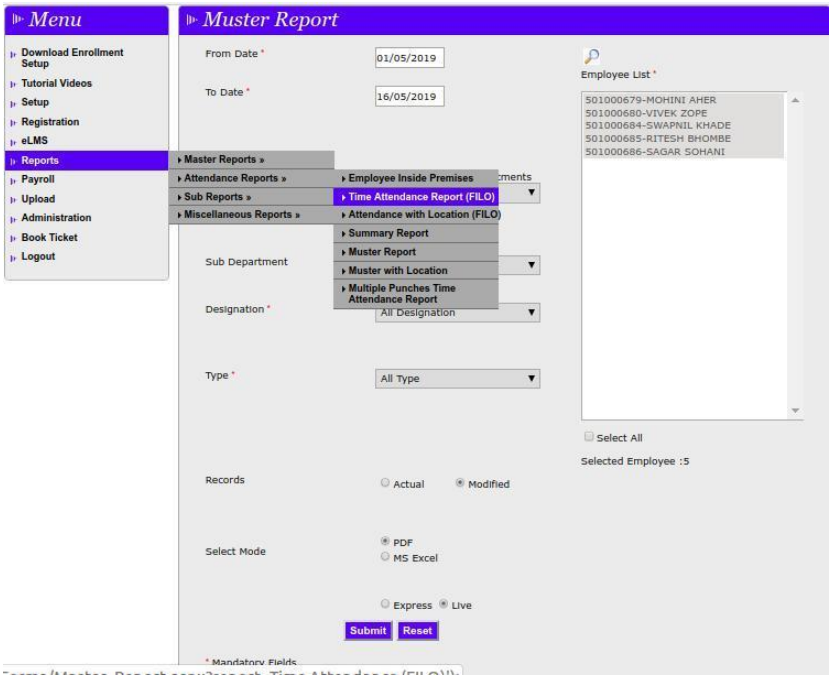
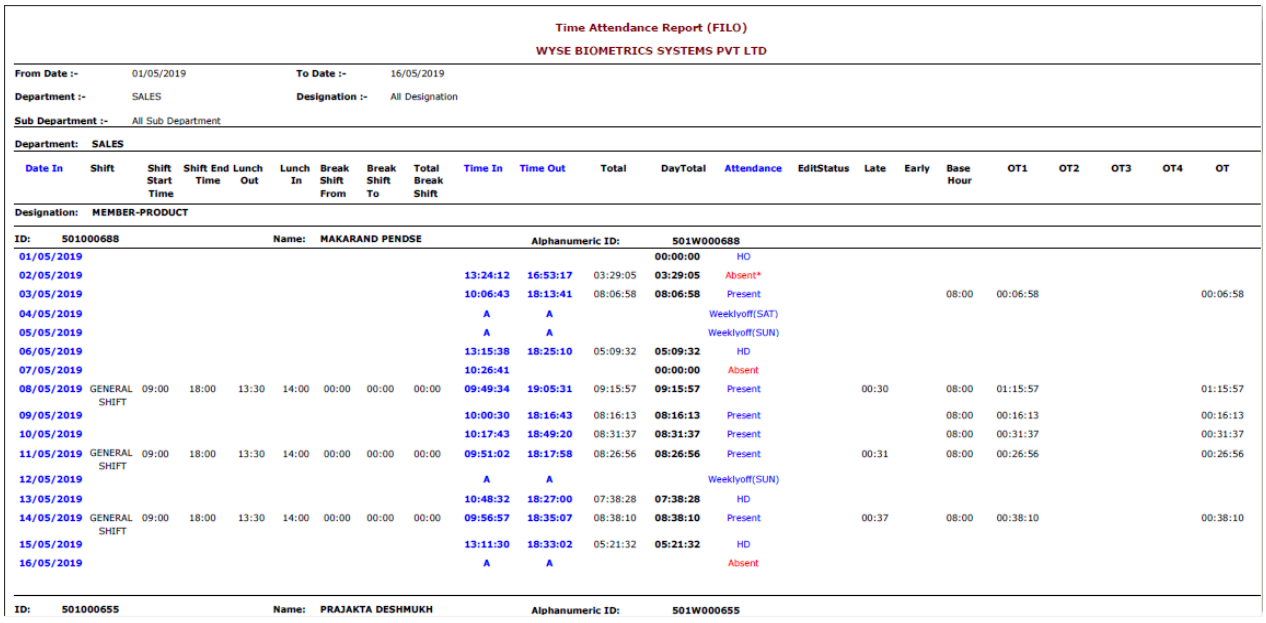


Fig. 1.8 Selecting Time Attendance (FILO) Report

To generate the **Time Attendance Report FILO** supplies the data in the respective fields such as department, sub-department, designation, time and file type in the respective fields as done above.

Lastly Click on the Submit button to get the **Time Attendance Report FILO**. A typical pdf of **Time Attendance Report FILO** generated is shown in Figure 1.9.



Time Attendance Report (FILO)

WYSE BIOMETRICS SYSTEMS PVT LTD

From Date :- 01/05/2019 To Date :- 16/05/2019

Department :- SALES Designation :- All Designation

Sub Department :- All Sub Department

Department: SALES

Date In	Shift	Shift Start Time	Shift End Time	Lunch Out	Lunch In	Break Shift From	Break Shift To	Total Break Shift	Time In	Time Out	Total	DayTotal	Attendance	EditStatus	Late	Early	Base Hour	OT1	OT2	OT3	OT4	OT
Designation: MEMBER-PRODUCT																						
ID: 501000688 Name: MAKARAND PENDSE Alphanumeric ID: 501W000688																						
01/05/2019												00:00:00	HO									
02/05/2019									13:24:12	16:53:17	03:29:05	03:29:05	Absent*									
03/05/2019									10:06:43	18:13:41	08:06:58	08:06:58	Present				08:00	00:06:58				00:06:58
04/05/2019									A	A			Weeklyoff(SAT)									
05/05/2019									A	A			Weeklyoff(SUN)									
06/05/2019									13:15:38	18:25:10	05:09:32	05:09:32	HD									
07/05/2019									10:26:41			00:00:00	Absent									
08/05/2019	GENERAL SHIFT	09:00	18:00	13:30	14:00	00:00	00:00	00:00	09:49:34	19:05:31	09:15:57	09:15:57	Present		00:30		08:00	01:15:57				01:15:57
09/05/2019									10:00:30	18:16:43	08:16:13	08:16:13	Present				08:00	00:16:13				00:16:13
10/05/2019									10:17:43	18:49:20	08:31:37	08:31:37	Present				08:00	00:31:37				00:31:37
11/05/2019	GENERAL SHIFT	09:00	18:00	13:30	14:00	00:00	00:00	00:00	09:51:02	18:17:58	08:26:56	08:26:56	Present		00:31		08:00	00:26:56				00:26:56
12/05/2019									A	A			Weeklyoff(SUN)									
13/05/2019									10:48:32	18:27:00	07:38:28	07:38:28	HD									
14/05/2019	GENERAL SHIFT	09:00	18:00	13:30	14:00	00:00	00:00	00:00	09:56:57	18:35:07	08:38:10	08:38:10	Present		00:37		08:00	00:38:10				00:38:10
15/05/2019									13:11:30	18:33:02	05:21:32	05:21:32	HD									
16/05/2019									A	A			Absent									
ID: 501000655 Name: PRAJAKTA DESHMUKH Alphanumeric ID: 501W000655																						

Fig. 1.9 Exported Time Attendance Report FILO

Observe that this is a much-detailed punch report of an employee. It consists of First In and Last Out (FILO) of a day of an employee. It also indicated late marks, overtime, shift start time, shift end time, lunch in-out time, early go time of an employee. This report is very useful to monitor attendance performance of an employee.

Other Attendance and Sub reports

There are various other reports that can be generated by using the Biometric Attendance Software as mentioned below.

1. Multiple punches Report
2. Absent Report
3. Late Report
4. Early Go Report
5. Overtime Report
6. Tour Report
7. Single Punch Report
8. Employee Leave Report
9. ShiftWise Report

Practical Assignment

Generate the Reports for Absent Report, Late Report, Early Go Report, Tour Report by filling up the appropriate data and selecting the appropriate options in the biometric attendance software. Use appropriate software for biometric attendance systems such as ETAM of Wyse Biometric Systems.

Assignment of Weekly off, Holidays in the software by the Administrator

The weekly off and gazetted holidays of the organisation has to be assigned by the administrator in the software in the Master database.

Assignment of Variable Weekly off

In some organisations every employee has been assigned a variable weekly off. i.e. the weekly off day of that employee will not be the same every week. For example, in the first week one may have Monday as a weekly off and in second week one may have Tuesday as a weekly off. In such a case the weekly off for each employee can be assigned by the administrator as follows.

Step 1. Login into the software by using administrator login and password as done above.

Step 2. Select **Registration > Variable Weekly Off** as shown in Figure 1.10.

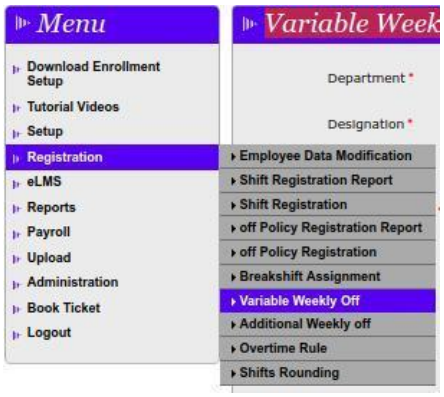


Fig. 1.10 Selecting Variable Weekly Off

Step 3. Select the Department, Designation and Employe Id. The alphanumeric id will appear in the next textbox. Enter the desired Year and Month. After that the month calendar will be displayed. Assign the weekly off in each week for the selected employee by putting the mark in the checkbox of the day as shown in Figure 1.11. Then save the variable weekly off. This will save the weekly off for the selected employee.

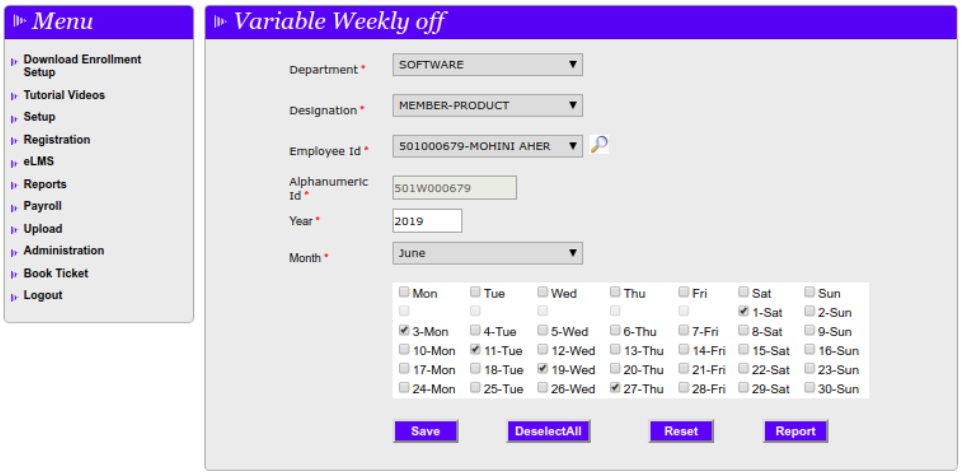


Fig. 1.11 Assignment of Variable Weekly Off

If the employee id is known then click on Search button next to the Employee id. After entering Employee id, automatically all the data of that employee appears in the remaining fields of the form, so that you need not to enter.

Assignment of off Policy Registration

Some organisations have a fixed weekly off policy. For example, for many organisations Saturday and Sunday are weekly off for all employees. Such fixed weekly off can be assigned as shown below.

Step 1. Login into the software by using administrator login and password as done above.

Step 2. Select **Registration > off Policy Registration.**

Step 3. Enter From Date, To Date, Department, Sub Department, Designation and Type. Select appropriate off policy, such as Sunday, second and fourth saturday, Saturday etc, as shown in the Figure 1.12. Select all employees by clicking on **"Select All"**. Even a particular employee can also be selected from the department. Then finally click on the Save button to save the policy. The corresponding successful message will be displayed in the text box.

The fixed off policy can also be deleted by using the Delete option provided in the menu.

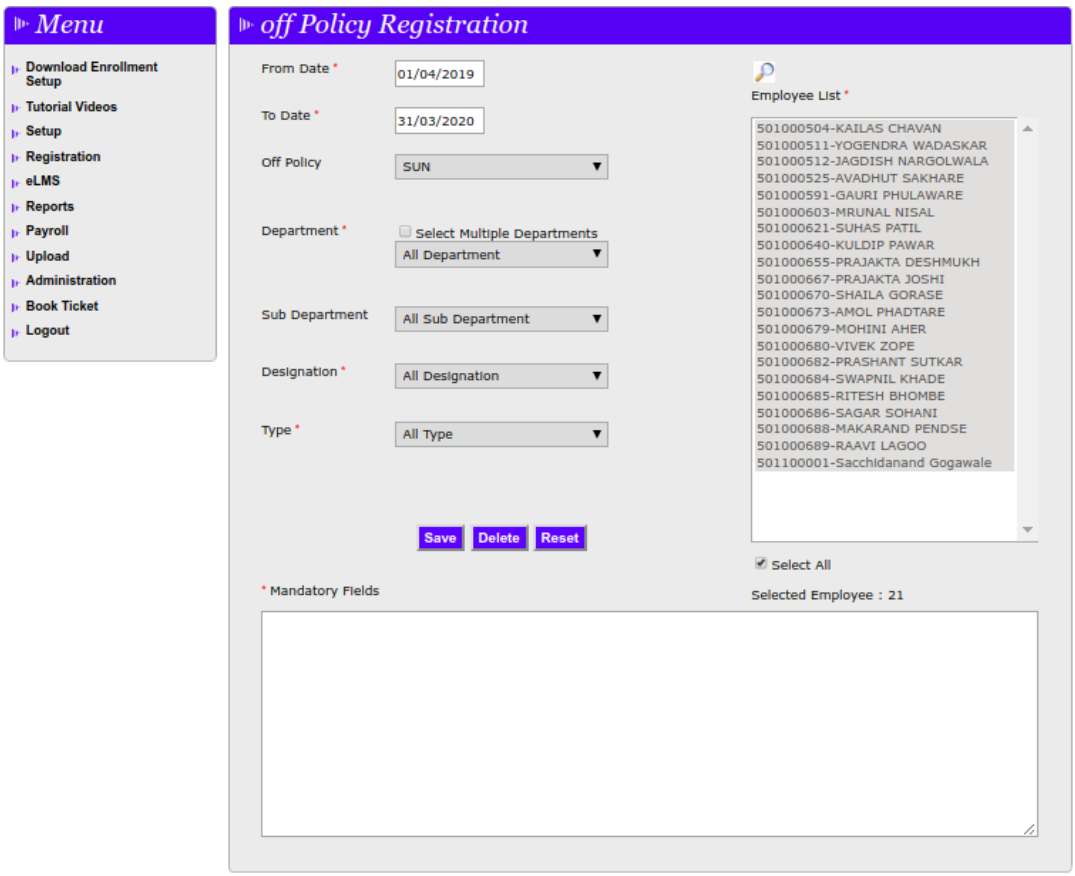


Fig. 1.12 Assign off Policy Registration

Registration

Assignment of Holidays

Every organisation has certain fixed holidays in a year. For example, there can be national holidays and local holidays. Such fixed holidays can be assigned in the form as shown in Figure 1.13. These holidays are applicable to all the employees of the organisation.

Step 1. Login into the software by using administrator login and password as done above.

Step 2. Select **Setup > Holiday Master.** The input form will open as shown in Figure 1.13. On the right side, already assigned holidays will be displayed.

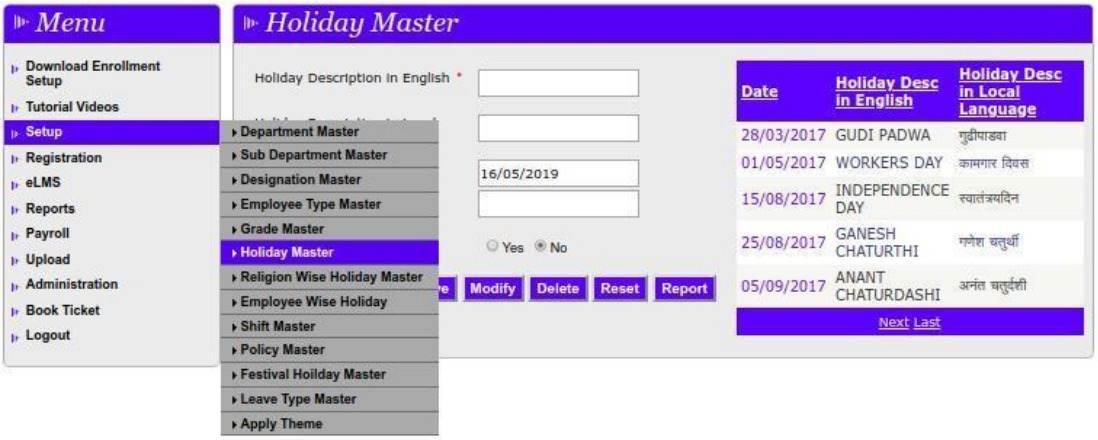


Fig 1.13 Selecting Setup Holiday Master

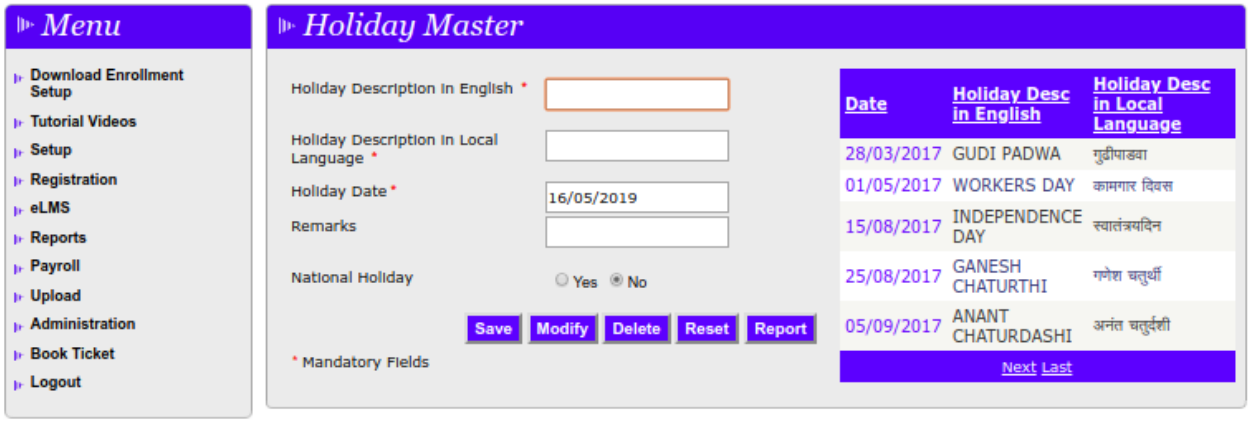


Fig. 1.14 Holiday Master

It is also possible to assign holidays religion-wise and employee-wise. Almost every biometric attendance software has a provision to assign such holidays.

Practical Assignment

Prepare religion wise holidays and employee wise holidays in the biometric attendance software. Use appropriate software for biometric attendance systems such as ETAM of Wyse Biometric Systems.

MAINTENANCE OF BIOMETRIC SYSTEMS

Maintenance of biometric systems involves the maintenance of hardware components of biometric machines as well as maintenance of biometric and related software.

(1) Hardware related

Like any other electronic equipment, in biometric devices there are no moving parts. And therefore, there is no mechanical maintenance for smooth running as well as upkeep. Note the following points in relation with the hardware maintenance.

1. No need for oiling and greasing.
2. No mechanical fine tuning required.
3. There are certain things to be taken care of such as.
4. Fingerprint sensor is exposed to a lot of wear and tear on the glass surface.
5. At the time of acquisition of fingerprint LEDs prone to get weaker over a period of time and continuous use.
6. The equipment is subjected to a lot of power supply fluctuations and variation which affects electrical interfaces and power supply equipment.

A typical biometric device maintenance requires the following steps which are a combination of mechanical, electrical and software activity.

Activity of fingerprint sensor

The fingerprint sensor is subjected to manufacturer's calibration and testing software tools, which diagnoses the possible faults and gives the compliance data. Such parameters are image resolution in dots per inch (dpi), image size, image quality and image skew.

After understanding the usage of such software tools one can identify and predict the possible failures in the fingerprint sensor.

Failures in the fingerprint sensor

Possible system errors are FAR and FRR. It is shown in Figure 1.15.

False Acceptance Ratio (FAR) **–** The number of instances detected over a sample data where a wrong person is authenticated.

False Rejection Ratio (FRR) **–** The number of instances detected over a sample data where a right person is not authenticated.

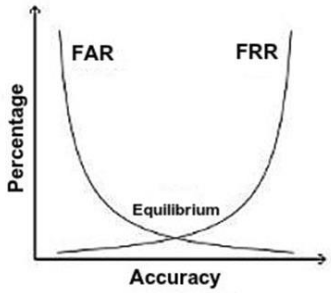


Fig. 1.15 Graph of FAR and FRR

FAR and FRR are the parameters by which we can measure the reliability of the biometric attendance system (BAS). FAR can be computed by using a formula as below.

FAR = (NFA/NEIA) * 100 [%]

Where,

FAR = False Acceptance Rate

NFA= Number of False Acceptance

NEIA = Number of Enrollee Identification Attempt

For any good biometric system the FAR should be very low in the range of 0.01 percent.

FRR can be computed by using a formula as given below.

FRR = (NFR/NEIA) * 100 [%]

Where,

FRR = False Rejection Rate

NFR= Number of False Rejection

NEIA = Number of Enrollee Identification Attempts

For any biometric attendance system FRR is low then the system is more convenient to the user.

Equeal Error Rate – The intersection of the FAR curve with the FRR curve is called the equal error rate. If you try to reduce FAR to the lowest possible level then FRR will rise sharply. If you make your system more secure then it will be less convenient to the user as the users are falsely rejected by the system. FAR and FRR must be appropriately set to get the appropriate equal error rate.

FTA

Many times it is found that the biometric impression such as the thumb impression of the humans is not accepted by the biometric machine. That is the machine is unable to capture the biometric data because of poor quality of image. Sometimes the wear and tear of the surface area of the biometric machine also causes such problems. In many cases the damaged part of the thumb or damaged part of the machine can contribute to such failure. When the machine is unable to acquire the biometric data then it is called as FTA (Failed to Acquire). The percentage of FTA must be very low for any good

biometric system. But it is normally found that when the machine is used over a long period of time then the percentage of FTA goes on increasing.

Maintenance log

Maintenance log is a register that keeps track of all maintenance jobs carried out with a resolution provided. This register contains minimum heads as follows.

1. "Date and time" on which call is received,
2. "Issue reported by" of customer, and company
3. "Problem reported"
4. "Problem observed"
5. "Solution provided"
6. "Material consumed"
7. "Whether new problem or repetitive"
8. "Completion date and time"

A typical maintenance log register is as shown in table 1.1.

Table 1.1 : Maintenance log Register

Issue description	**Remarks**
Date and time	12/01/20 13:25
Isssue reported by	Raj from ABS Company
Problem reported	Frequent rejection on registered members
Solution provided	End of life of the sensor. Need to be replaced
Material consumed	New Sensor need to install
Whether new problem or repetitive	New problem
Completion date and time	14/01/20 10:20

Common problems

The most frequently observed problems are Environment or infrastructural problems such as Power supply failure or network related problems.

Customer related problems

Customer related problems are due to incorrect operation or usage. Some of the common customer related problems are improper use of the BAS machine. It occurs due to selection of wrong menu items and wrong options.

Design problems

Design problems means that the machine is not designed for all the desired situations or conditions. The sensor of the machine is weak to handle large numbers of fingerprints in less time. Software is not equipped to handle certain situations, scenarios and cases.

Technological problems

It means the lacuna of a deployed technology. For example the capacitive thumb sensor is advisable to be used on mobile phones, but it will be inappropriate for heavy applications such as time attendance applications.

Training related problems

These types of problems occur if the user is not properly trained.

Software related problems

These problems arise due to bugs or limitations in software. Wrongly generated report on account of unexpected values, unexpected placement of values etc. Interoperability, portability, compatibility with the desired environment or data.

Environmental problems

Operating system related and browser related problems.

Crowd management

Throughput of biometric machines should be high. It means it should be able to take input from several people in less time.

Priority Service Request can be of two types

Priority based on time – If the two different employees punched at the same time on a biometric machine the priority is given to the employee who first punched.

Priority based on designation – If the two different employees punched at the same time on a biometric machine the priority is given to the employee of the higher designated employee.

Company documentation

As per the labour law or for security the records are maintained by HR for 7 years. Tools are being provided to them for record keeping.

Check Your Progress

A. Multiple Choice Questions

1. Employee can punch in biometric devices by using their (a) finger impression (b) thumb impression (c) finger or thumb impression (d) palm impression
2. The punch report of employees can be generated for any specified period between two dates. i.e. (a) weekly report (b) monthly report (c) bimonthly report (d) all of the above
3. Apart from total number of days present, absent, the Muster Report shows the (a) weekly off (b) leave period (c) tour period (d) all of the above
4. Maintenance of biometric system involves the maintenance of (a) hardware components of biometric machine (b) biometric and related software (c) Both (a) & (b) (d) Biometric data

B. State whether True or False

1. Any employee of the organisation can observe the report of biometric punching data of the organisation.
2. The administrator can also see the punch report of previous dates.
3. Muster Report contains daily attendance status of employees.
4. Time Attendance Report is useful to monitor attendance performance of an employee.
5. Time Attendance Report does not consists of details of the shift attendance.
6. The weekly off and gazetted holidays of the organisation has to be assigned by the administrator in the software in the Master database.
7. The fixed off policy cannot be deleted.
8. The fixed holidays assigned are applicable to all the employees of the organisation

9. Hardware maintenance of biometric attendance system consists of mechanical maintenance
10. In biometric attendance devices the general hardware failure occurs in Fingerprint sensor.
11. Capacitive thumb sensor is advisable to be used on the mobile phones

C. Fill in the blanks

1. It is also possible to export and download the daily punch report in _____and _____ format.
2. Muster report is useful to generate the _____ report
3. The biometric attendance software has a provision to assign the holidays _____ and _____.
4. Biometric device maintenance requires the combination of _____ , _____ and software activity.
5. The reliability of the biometric attendance system can be measured by the _____**and** _____

D. Match the following items of column A with column B

Column A	**Column B**
a) FILO	1. False Rejection Ratio
b) FAR	2. Number of False Rejection
c) NFA	3. Number of False Acceptance
d) NEIA	4. False Rejection Rate
e) FRR	5. First In and Last Out
f) NFR	6. Failed to Acquire
g) FTA	7. False Acceptance Rate
	8. Number of Enrollee Identification Attempt

E. Short answer questions

1. What is a Muster Report?
2. Time Attendance Report? What does it contain?
3. List the common problems observed in biometric attendance machines.
4. What are the two types of Priority Service Request?
5. What are the customer related problems in biometric attendance machines?
6. What are the design problems in biometric attendance machines?
7. What are the technological problems in biometric attendance machines?
8. What are the training related problems in biometric attendance machines?
9. What are the software related problems in biometric attendance machines?
10. What are the environmental problems in biometric attendance machines?
11. What is Crowd management?

Session 2: Aadhaar Based Biometric Attendance System

In Class XI, we have seen how to set up, install and configure the Aadhar Based Biometric Attendance System (ABBAS). Now when the system is ready for use, the daily attendance can be recorded by using the ABBAS system. In this chapter we will understand how this attendance or punching is used for the generation of various reports. Note that for this report generation we have taken the prototype example of PSSCIVE ABBAS.

Reports

Various reports such as s Attendance Register, Advance Report, Date wise Attendance and Weakly/Monthly report can be generated for the organization.

1. ATTENDANCE REGISTER

One can get the Attendance Register Report between the date ranges by selecting the office location and division/unit. For attendance register one needs to enter the office location, division/ unit within the organisation and the data range as shown in Figure 2.1.

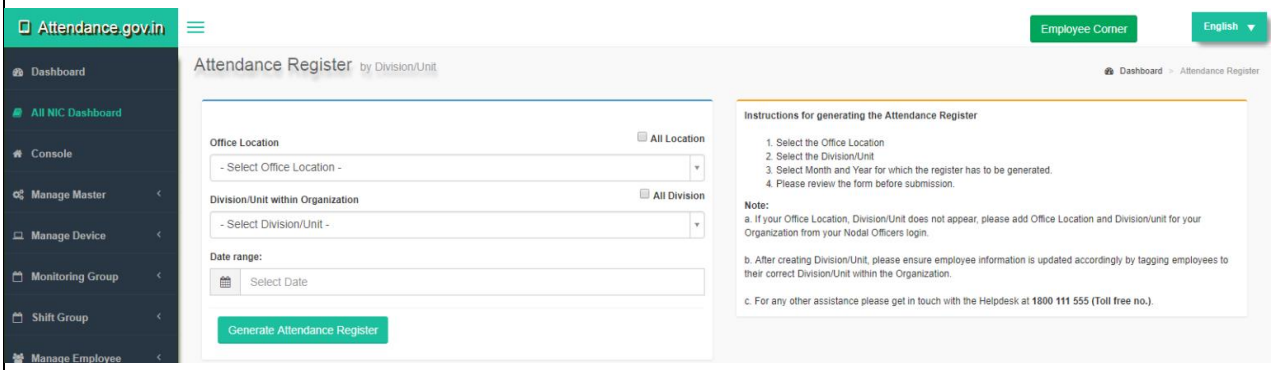


Fig. 2.1 Attendance Register generation

2. ADVANCE REPORTS

Attendance reports can be generated based on parameters such as daily, weekly, bimonthly and monthly and the data can be exported in Excel.

While generating the daily reports one needs to enter the appropriate data along with office location and department. Weekly reports can be generated by entering the start day and weekend day. Similarly the monthly report can be generated by selecting the appropriate month. For all these cases you need to select the start date and end date. Figure 2.2 shows the selection of the start date and end data in a month and Figure 2.3 shows the report generated between these two dates.

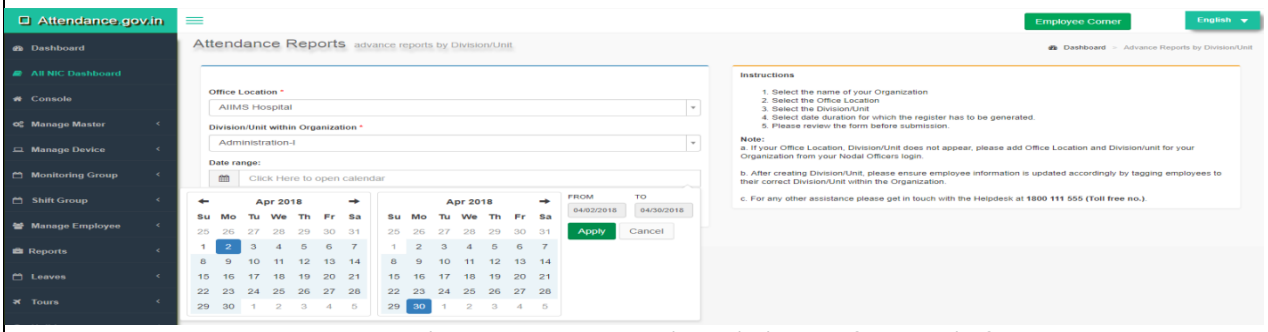


Fig. 2.2 Selecting start and end date of month for

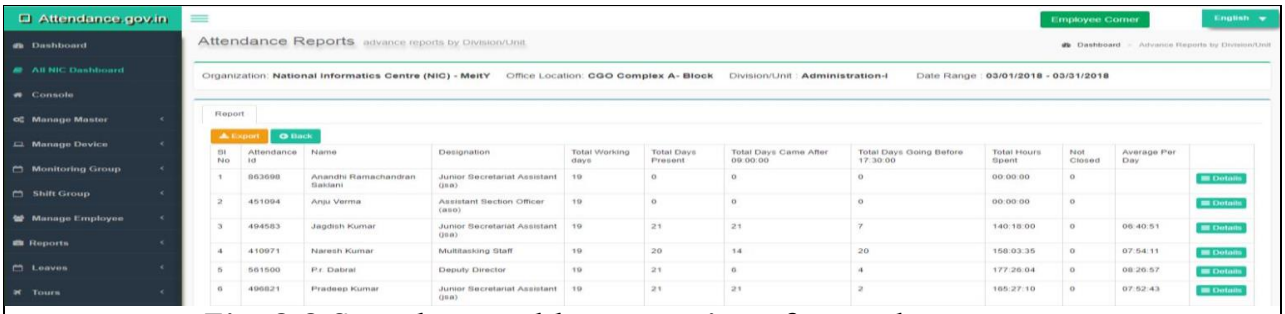


Fig. 2.3 Sample monthly generation of attendance report

Observe that in this report along with Name and designation of employee, total number of present days in a month, late entry and before exit of scheduled time is also given. The total number of working hours of the days are also displayed. This data is useful for calculation of paysheets.

3. DATE WISE ATTENDANCE REGISTER

Many times organisations require Date wise attendance reports. These reports are useful for calculation of pay of daily workers. Such reports can be generated by the Nodal Officer by selecting the date for which the report is sought. The report can be exported in Excel file as shown in Figure 2.4.

Fig. 2.4 Datewise attendance report

4. CUSTOMIZED ATTENDANCE REPORTS

Customized attendance reports can be generated based on the designation, employee code and name of the employee. In such reports the data such as leaves, holidays, working days and working hours are displayed. One such customized attendance report is shown in Figure 2.2.

Fig. 2.5 Customized attendance report

2. WEKLY/MONTHLY REPORT

In many organisations weekly payments are made for the employees. In such a case weekly attendance reports are generated. It is possible to generate attendance reports for any given time frame. For such reports we need to enter the start and end date appropriately. Month Wise reports can also be selecting the appropriate month. A sample monthly report is shown in the Figure 2.6.

Fig. 2.6 Monthly attendance report

6. BAS REPORTS

State Wise Attendance Reports for government employees can also be generated by using ABBAS. For example it is possible to generate the attendance report for all Maharashtra government employees by using such a system. For such reports it is necessary to select the proper URL and need to enter appropriate login and password. A typical report includes date wise report, employeewise report, monthly report, working days report, leave report, and number of working hours report.

7. B.A.S GRAPHICAL REPORTS

Many times the reports are in textual format. But it is easier to understand when the reports are displayed in graphical form. By using ABBS we can generate graphical reports such as *Stay Duration Report, Name Wise Attendance Report, Employee Performance, Device wise Attendance Report, Employee Incoming and Outgoing Report.* One such incoming and outgoing report is shown in Figure 2.7.

Fig. 2.7 Incoming and Outgoing Report

LEAVE MANAGEMENT

By using ABBS it is possible to manage the leaves of the employees. Sanction of the leave and addition of the leave can be managed by the corresponding head of the department/institute.

1. Add Leave Record

The concern authority has the option for the addition of the leave record of an employee. Such a leave application can either be accepted or can be rejected. The concerned employee will get the intimation about the status of the leave application through message on ABAS system and mail or mobile. Figure 2.8 shows the typical addition of leave in the leave record of an employee.

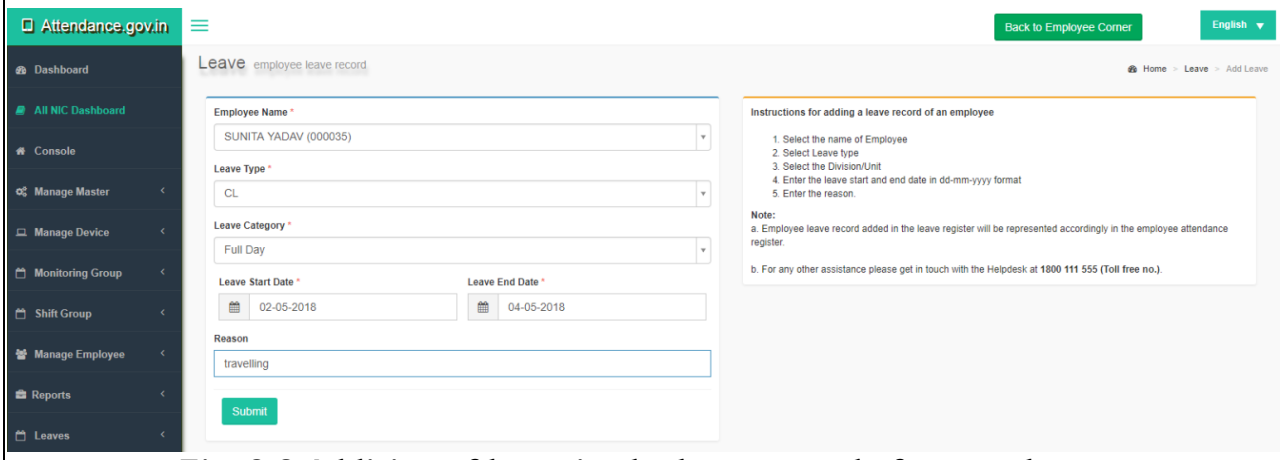


Fig. 2.8 Addition of leave in the leave record of an employee

2. Approved leaves

Every leave application that is submitted by the employee needs approval of the concerned authority. Most of the time the head of the concerned department/ institution will approve the leave application. It is necessary to mention the proper reason for the leave request. If such a reason is not suitable or there is any other important work to be carried out in the institution then the leave application can be rejected. The option to approve or reject leave is shown in Figure 2.9. If an employee has an unused quota of leaves available then the concerned leave application is mostly approved. Such approved leaves can be viewed by the user as shown in Figure 2.10.

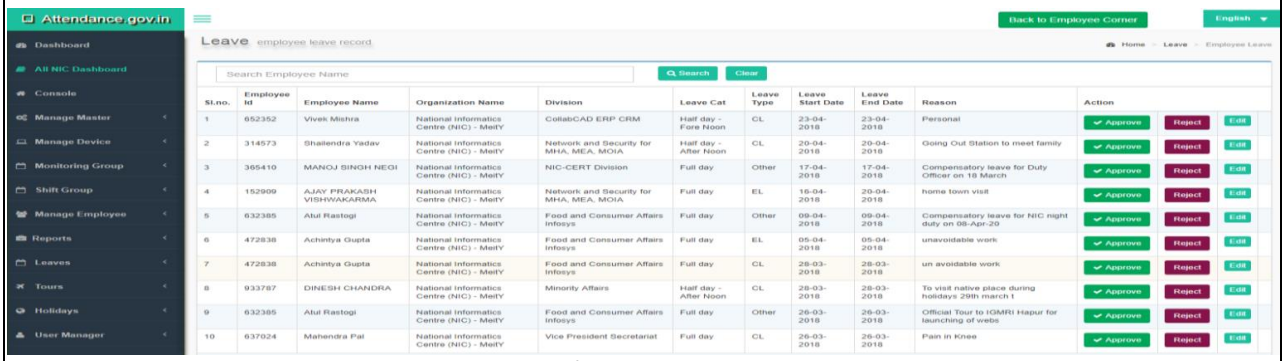


Fig. 2.9 Option to approve or reject leave

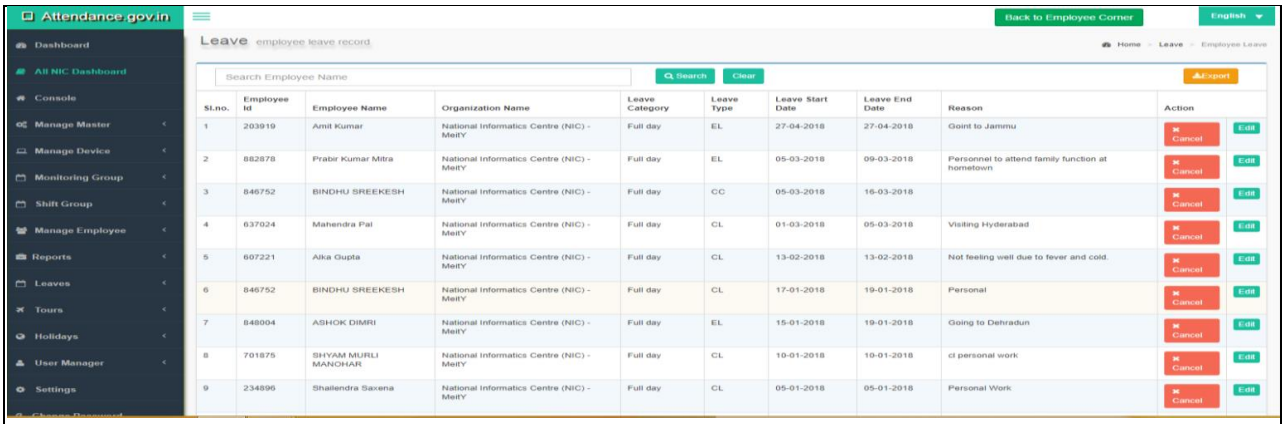


Fig. 2.10 Approved leaves

TOUR MANAGEMENT

In many organisations employees are assigned outstation duties. In such a case the employee needs to apply for an official tour. For these official tour days the employee is considered on duty and s/he is not considered as absent.

1. Add Tours

The official tour can be added by an employee by using the add tour option as shown in Figure 2.11.

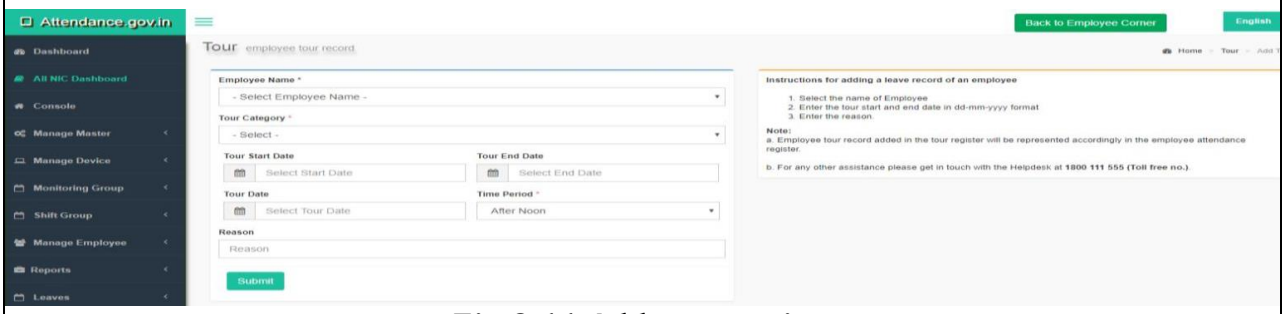


Fig 2.11 Add tour option

2. Approved Tours

Once such an application is submitted by an employee, then it needs approval by the concerned authority. The tour details received to the approving authority is shown in Figure 2.12. The head of the department can approve or reject the tour.

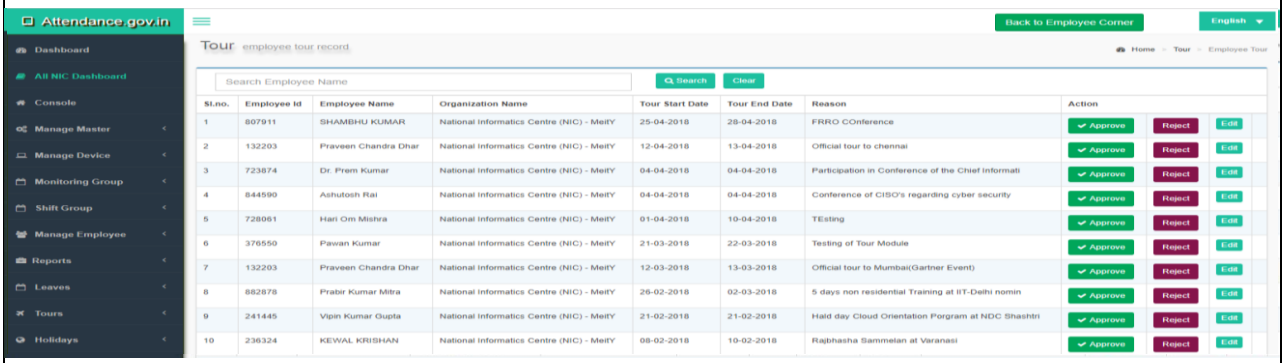


Fig. 2.12 Option to approve or reject tour

The head of the department will approve the tour details entered by the employees. After approval of authority, the details of approval are as shown in Figure 2.13.

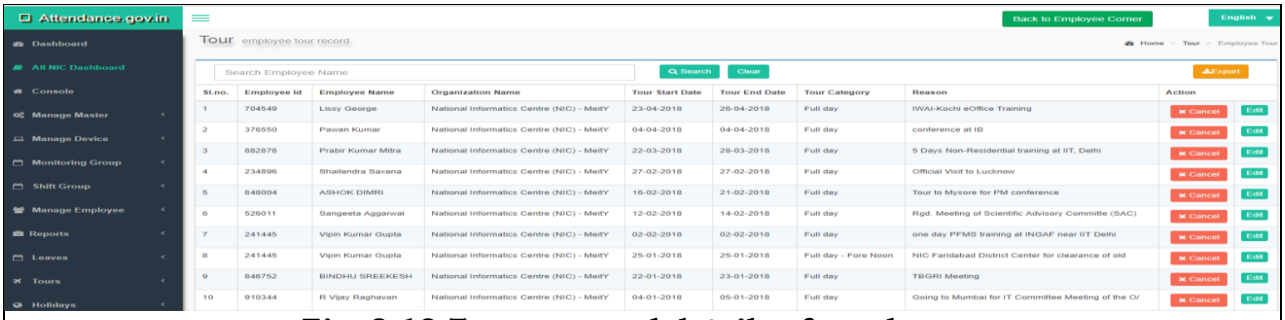


Fig. 2.13 Tour approval details of employees

HOLIDAY MANAGEMENT

The concerned authority of the organisation is able to add holidays in the records of ABBAS. The management of the holidays is explained below.

1. Add holidays

If the holidays are not present in the system then they can be added by using the Add holidays option as shown in Figure 2.14.

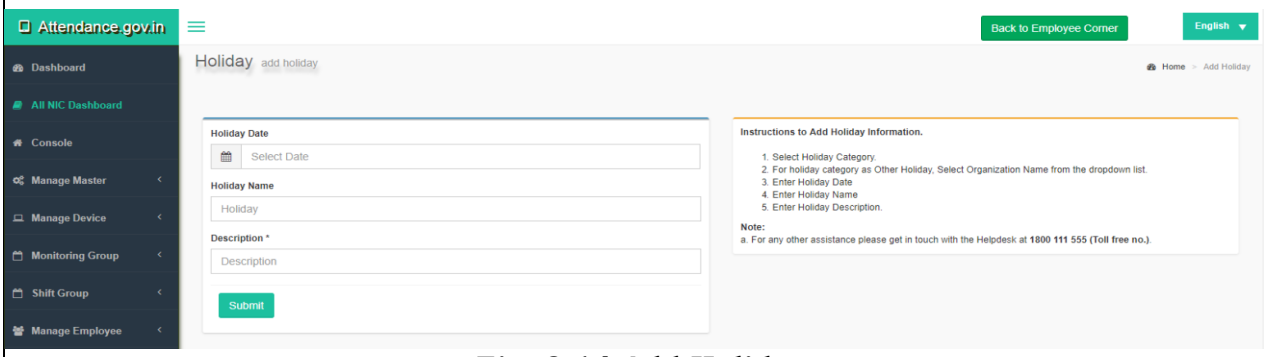
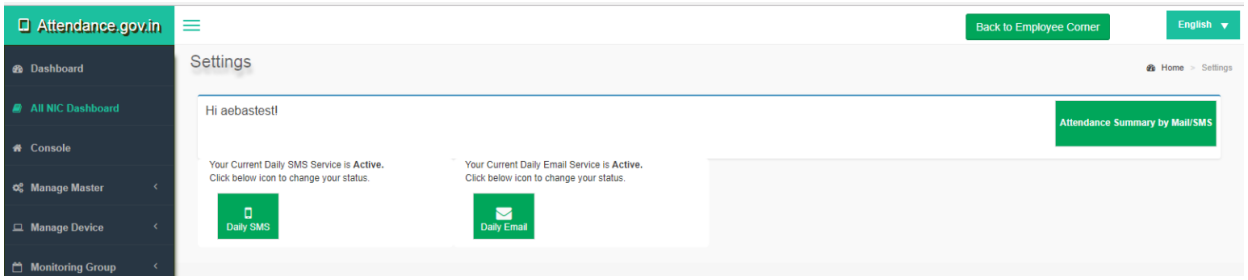


Fig. 2.14 Add Holiday



CHECK YOUR PROGRESS

Practical Exercise

1. Attendance reports can be generated based on parameters such as daily, weekly, bimonthly and monthly and the data can be exported in Excel.
2. Weekly reports can be generated by entering the start day and weekend day. Similarly, the monthly report can be generated by selecting the appropriate month.
3. Customized attendance reports can be generated based on the designation, employee code and name of the employee. In such reports the data such as leaves, holidays, working days and working hours are displayed.
4. By using ABBS we can generate graphical reports such as *Stay Duration Report, Name Wise Attendance Report, Employee Performance, Device wise Attendance Report, Employee Incoming and Outgoing Report.*
5. ABAS is used for (A) Leave Management (b) Tour Management (c) Holiday Management (d) All of the above

Session 3: Preparation of Aadhaar Card

The Unique Identification Authority of India (UIDAI) is a statutory authority established under the provisions of the Aadhaar (Targeted Delivery of Financial and Other Subsidies, Benefits and Services) Act, 2016 ("Aadhaar Act 2016") on 12 July 2016 by the Government of India, under the Ministry of Electronics and Information Technology (MeitY).

The enrollment of resident's (to whose card is to be generated) biometric data is done at Aadhaar Seva Kendra to generate the aadhaar card number. The Aadhaar Seva Kendra is setup with laptop/ desktop with aadhaar client installed and tested, attached with all devices like STQC certified biometric capture devices, GPS device and printer cum scanner.

Aadhaar Enrolment Kit

Aadhaar enrolment kit consists of a set of hardware devices required to carry out successful Aadhaar enrolment & update. Aadhaar Enrolment Kit consisting of specific make/model of device shall be UIDAI certified for its working with latest UIDAI's enrolment client (ECMP). All these devices shall be as per UIDAI's specifications. Biometric devices (Slap/Iris Scanner) shall be STQC certified. This set of devices comprises the following devices.

The hardware and software requirement for Aadhaar Seva Kendra is as follows.

1. Laptop/Desktop – Laptop/Desktop with USB hub for connecting biometric and other devices; (Check with techsupport@uidai.gov.in for latest requirements).

For ECMP version 2.0 at least 2 Ghz, Dual core CPU or later, 3GB RAM or higher, 160GB HDD, Dedicated USB 2.0 Port (minimum 5 ports required)

Note: (Windows Vista/any 64 bit Operating System is not supported)

2. UIDAI software installed, tested, configured and registered with CIDR as per installation and configuration manual. A new version must be installed latest within one month of release on all registered laptops. VDM installed and services for the devices are running.

Aadhaar client software (ECMP/UCL)

3. Iris capturing device

4. Fingerprint capturing device

5. Digital Camera

3. White background screen, non reflecting, opaque, ~3ft wide, and with stand for taking photographs

7. Extra monitor for residents to verify their data (15-16" with a resolution above 1024x768

8. Printer (A4 laser printer; must print photo with good quality receipt

9. Scanner for scanning documents during enrolment

10. Printer Paper (Inventory for 5 stations for 10 days ~ 20 rims

11. Antivirus / Anti Spyware

12. Data Card /Internet connectivity for Enrolment Client.

13. Sponge for wetting and hand-cleaning cloth available

14. GPS Receiver as per UIDAI specs

The operator of the Aadhaar Seva Kendra must follow the following steps before s/he actually starts the enrollment process of the residents (to whose card is to be generated).

- Operators must capture the GPS coordinates at the start of enrolments every day.
- Operators must Login with their own Operator ID in Aadhaar client, for undertaking enrolments, and log off the application when going away from the seat so that no one else can use the login window for enrolments.
- Brief the enrolment/update process to residents before and during the process to put the resident at ease and facilitate data capture.

- Make sure that the resident has never enrolled for Aadhaar before doing a fresh enrolment using the "Find Aadhaar Facility" provided in the client.
- Make sure that all the Original Documents are available, which are required for the type of Enrolment/Update requested by the resident and belong to the same resident whose enrolment/update is to be done.
- Make sure that all the Original Documents are available, which are required for the type of Enrolment/Update requested by the resident and belong to the same resident whose enrollment/update is to be done.
- Make sure that the resident has entered their Mobile Number for future communication with the resident and other uses like OTP based Authentication and online Aadhaar Update facility.
- Check that the resident's Aadhaar Enrolment/Update form is verified and carries Verifier's signature/thumb print and stamp/initials. The form must also carry Resident"s (Applicant"s) signature/thumbprint.

Aadhaar Enrolment/Update Process

The Aadhaar enrolment process includes visiting Enrolment Centre, filling the Aadhaar Enrolment/Correction form, getting demographic and biometric data captured, submitting Proof of Identity (PoI) and Proof of Address (PoA), Proof of Relationship (PoR), Proof of Date of Birth documents before collecting acknowledgement slip containing EID (Enrolment ID).

There are other modes of enrolment for the resident who do not have any Proof of Identity and Proof of Address documents i.e. through Introducer based enrolment or Head of the Family based enrolment.

Types of Enrolment

There are four types of enrolment

Type of enrollment	**Documents required**	
Document-based Enrolment	• Proof of Identity (PoI) -Mandatory • Proof of Address (PoA) – Mandatory • Date of Birth (DoB) – Optional	
Introducer-based Enrolment	• Introducers include: • Registrars own employees • Elected local body members • Members of local administrative bodies • Postman • Influencers such as teachers • Health workers • Doctors • Anganwadis / Asha workers • Representatives of local NGOs • Information Captured during Introducer-based Enrolment: • Introducer's name • Introducer's Aadhaar number	

	• One modality of biometric information of the Introducer	
Head of Family based Enrolment	• Name of Head of the Family • Proof of Relationship (PoR) of resident and HoF • Head of Family's Aadhaar number • Biometric confirmation of the Head of Family at time of enrolment	
Child Enrolment (below five years of age)	• Proof of Date of Birth • Proof of Relationship (parent and child) • Enrolment ID or Aadhaar number of any one parent, preferably that of the mother in the event both parents are alive, or guardian • Biometric confirmation of the any one parents at time of enrolment • The address of child will be the same as that of the linked parent / guardian	

Information captured during Enrolment

Biometric information required for enrolment from all individuals except for children below 5 years of age are Facial image, All ten fingerprints, Scans of both Irises. Biometric information

Facial image

All ten fingerprints

Scans of both Irises

namely - all ten fingers and Iris is not required for enrolment of children below 5 years of age. Facial photograph is captured for the children below 5 years in age

The demographic information shall not include race, religion, caste, tribe, ethnicity, language, record of entitlement, income or medical history of the resident.

Enrolment of residents with biometric exceptions like missing finger/missing eye, following needs to be captured: -

- Complete Demographic Information
- One iris, if not possible to capture both the irises
- Fingerprints of remaining fingers in case of missing finger
- Exception photograph

Aadhaar enrollment process

Enter the name of the resident and other details correctly as shown in Figure 3.1.

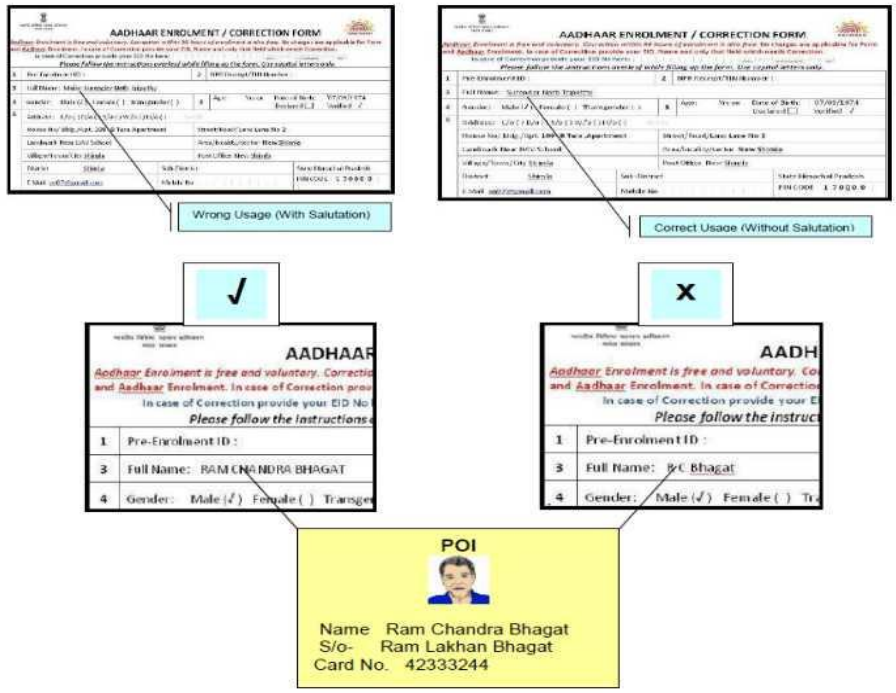


Fig. 3.1 Aadhaar enrollment process

Enter date of birth, residential address as per the documents provided by the user.

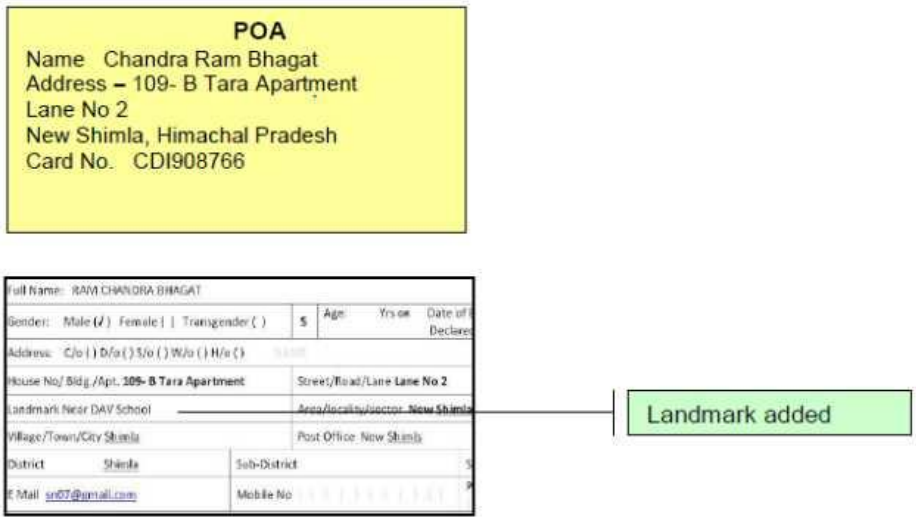


Fig. 3.2 Enter data in Aadhaar form

2. Enter relationship details, head of family details, mobile number and email address as per the details provided by the user.

3. Now capture the demographic and biometric data of the resident in aadhaar client software in the sequence of data capture as per the scenes provided on the software client.

Enrollment of residents with biometric exceptions like missing finger, missing eye etc., following needs to be captured.

a) Complete demographic information.

b) One iris if not possible to capture both iris.

c) Fingerprint of remaining fingers in case of missing fingers.

d) Exception photographs.

4. Once the enrollment data is collected the operator must store the data at the client computer. Such data needs to be uploaded at CIDR where it can be further processed. For such uploading appropriate url or destination IP must be used by the operator.

5. The authority at CIDR will verify the quality of data. If the quality of data is poor, then they may reject the enrollment request.

3. In the automated analysis the new enrolled biometric data will be compared with the existing enrolled biometric database. This is performed to avoid duplicacy and it is called de-deduplication service. This is a large and lengthy process of analysis.

7. Only after deduplication and other quality checks the authority generates aadhaar number. The false acceptance rate (FAR) and false rejection rate (FRR) are also considered for acceptance of the biometric data.

8. Aadhaar number is a 12 digit number called a unique identification number (UID). Mathematically, aadhar number generation uses the Verhoff algorithm. This algorithm basically is a checksum formula for error detection. The first UID number was issued in 2010 and so far about 125 crores aadhar numbers are generated.

9. Rejected biometric data will not be carried forward to the main biometric database where the fine data will be moved to the main biometric database and only that is eligible for issuance of aadhar number.

10. Demographic data is also checked with the deduplication process. Doubtful cases are manually observed and accordingly action is taken. Once the physical documents are received they will be compared with the digital demographic data and then the further validation process takes place. Once all validations are completed then the new unique aadhar number is allocated against that record and printed copy will be sent to the individual via post.

Aadhaar Generation/Updation Steps

Step 1. Enrolment/Update

The enrolling agencies shall upload the enrolment/update packet to the CIDR using the software provided by the Authority.

Step 2. Aadhaar Processing at CIDR

The Authority shall process the enrolment/update data received from the Enrolment Agency.

Step 3. Rejection

The Authority may reject an enrolment/update request due duplicate enrolment, quality or any other technical reason.

Step 4. De-duplication/Checks

After de-duplication and other quality checks as specified by the Authority, the Authority generates/updates the Aadhaar number.

Step 5. Delivery of Aadhaar Number

- The Aadhaar is communicated to residents in physical form (Aadhaar letter)
- In Electronic form (e-Aadhaar) available for download from https://resident.uidai.gov.in/ (registered mobile number is required)
- Downloaded in the form of m-Aadhaar Android Application (registered mobile number is required)

Step 3. Rectification or Update

1. In case there is some error in the information mentioned in Aadhaar Letter or e-Aadhaar, resident may contact the Authority by calling 1947 or writing to help@uidai.gov.in
2. Residents can also submit a Update Request by following the Aadhaar Update Process specified by the Authority.

Aadhaar Update Process

Aadhaar number holder may seek alteration of his demographic information or biometric information in cases mentioned below through the Aadhaar Update Process specified by the Authority.

1. In case any demographic information of an Aadhaar number holder is incorrect or changes subsequently, the Aadhaar number holder shall request the Authority to alter such demographic information in his record in the CIDR
2. In case any biometric information of Aadhaar number holder is lost or changes subsequently for any reason, the Aadhaar number holder shall request the Authority to make necessary alteration in his record in CIDR
3. Mandatory Update: The biometric information of children has to be mandatorily updated upon attaining five years of age and fifteen years of age
4. In case of deactivation, an Aadhaar number holder or resident is required to update his or her identity information partly or fully

CAPTURING DEMOGRAPHIC AND BIOMETRIC DETAILS OF RESIDENT AND USE OF ENROLMENT/UPDATE CLIENTS

Guidelines for Recording Demographic

a. Enter the Demographic details of the resident from the verified Enrolment/Update Form.

b. In case of Aadhaar Update, only the fields which need to be updated should be marked and filled.

c. Ensure that the resident has provided his/her mobile number in the form. In addition to this, encourage residents to email ID in the form, for UIDAI to get in touch with the resident using these details, if required, like in case of returned letters.

d. Pay attention to Data Aesthetics during demographic data capture. Avoid improper use of spaces, punctuation marks, capital and small letters during data capture.

e. Avoid use of unparliamentary language and transliteration errors.

f. Leave those non-mandatory fields blank where no data is provided by the resident. Do not enter N/A, NA etc. in fields where the Resident has not provided any data.

g. Filling a Father / Mother / Husband / Wife / Guardian field is not mandatory for residents above the age of 5 years in case the adult is not in a position or does not want to disclose. Then select the checkbox “Not Given” in “Relationship to Resident”.

h. In case of children below the age of 5 years, one of the parents‟ or guardian‟s name and Aadhaar Number shall be mandatorily recorded.

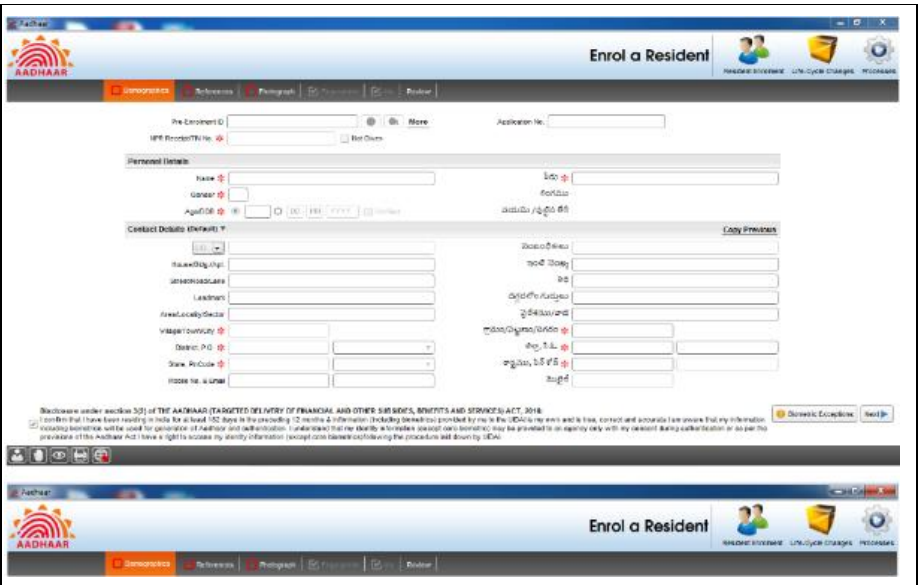
i. It is not compulsory for only father‟s name to be recorded against the „parent‟s name.‟ Mother‟s name can alone be recorded for the „parent‟s/ guardian‟s‟ name if so desired by the parent.

j. Enrolment of the parent is mandatory prior to the child. If the child‟s father /mother / guardian has not enrolled or does not possess an Aadhaar Number at the time of enrolment, the enrolment of that child cannot be done.

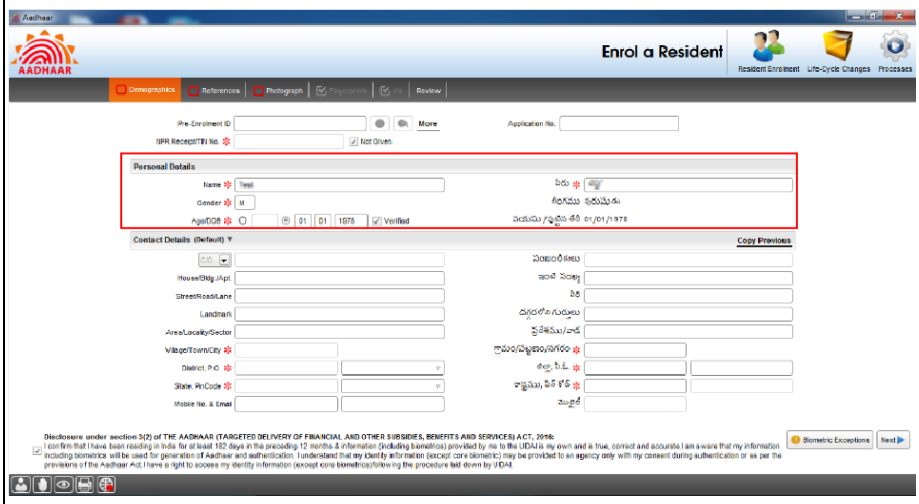
k. For Head of Family (HoF) based verification Name, Aadhaar Number of HoF and Relationship Details of the family member to HoF are mandatory details to be entered.

Steps to Enrol a resident using ECMP client

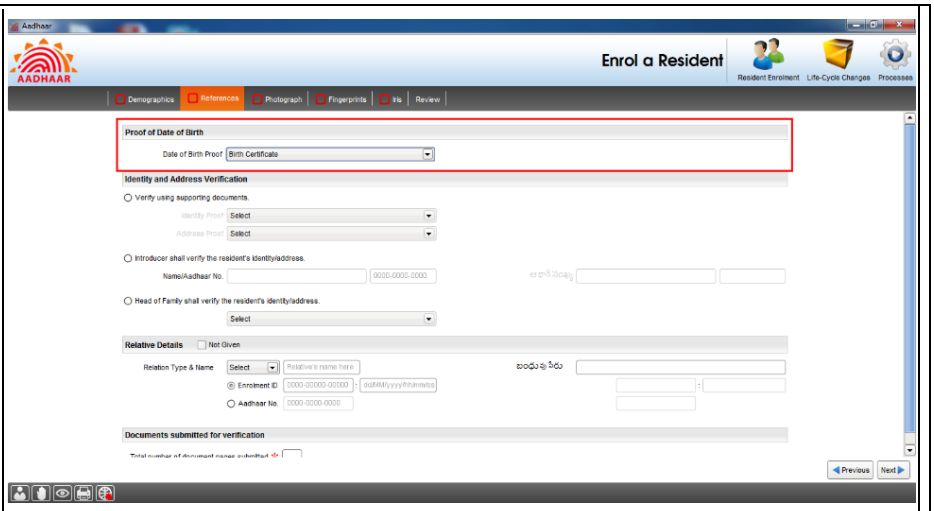
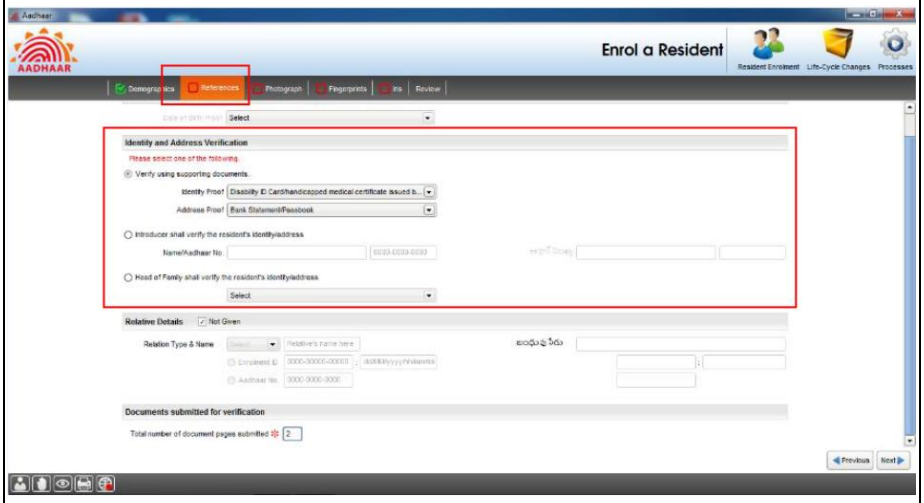
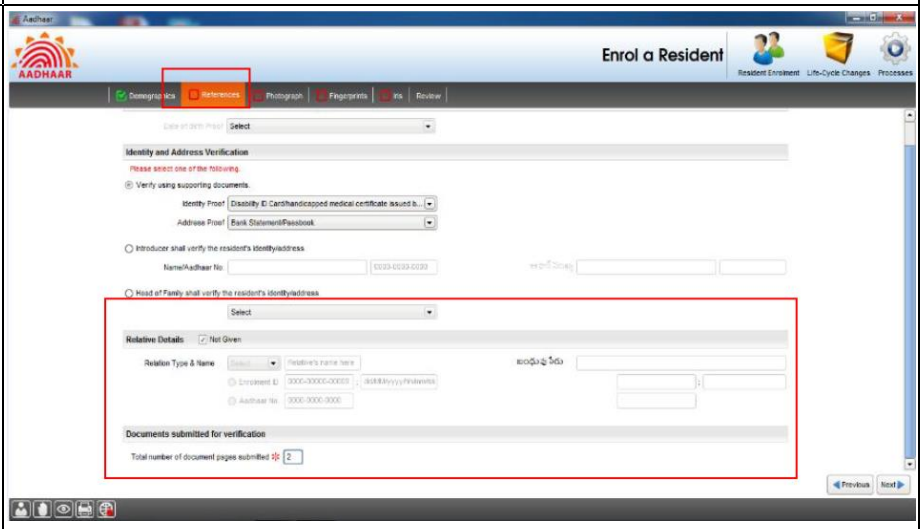
Step 1. Login to latest ECMP client using your login credentials

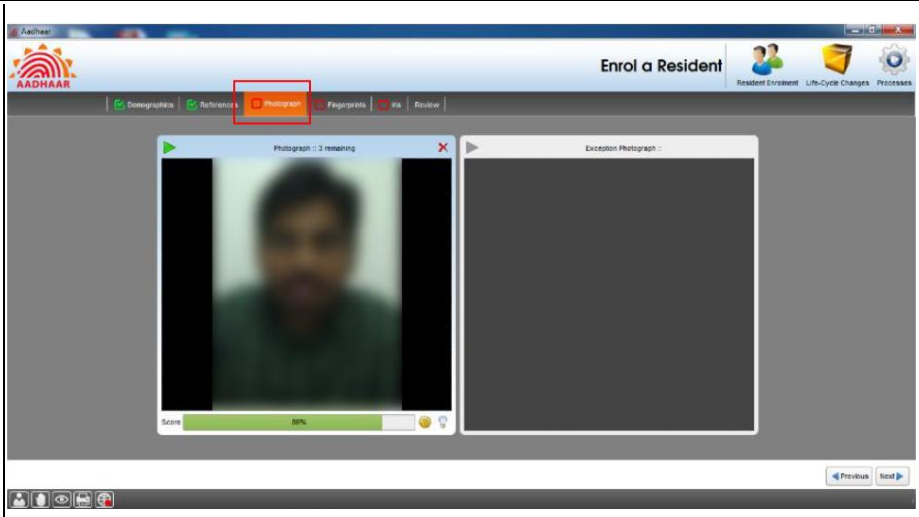
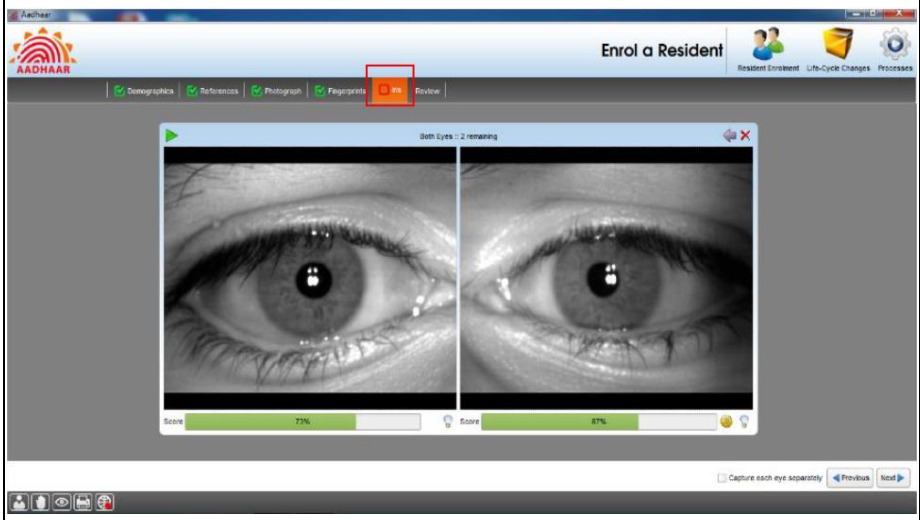


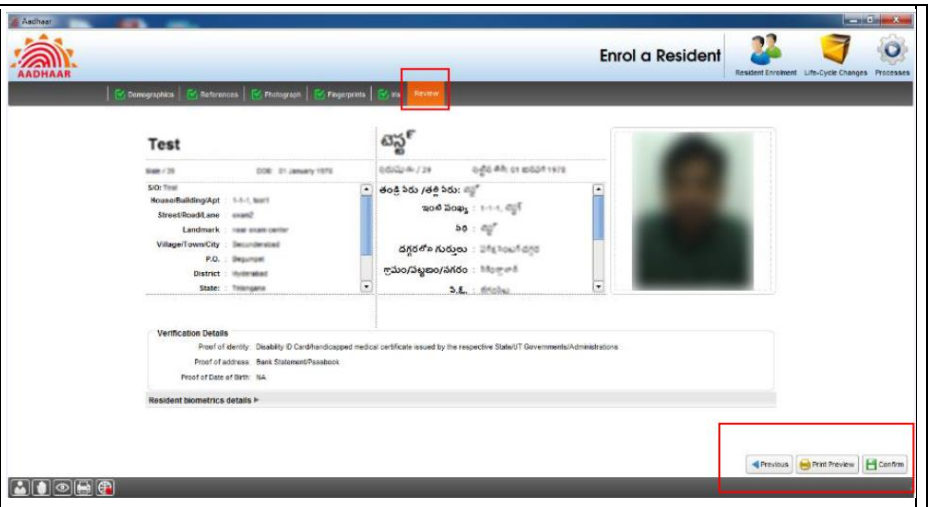
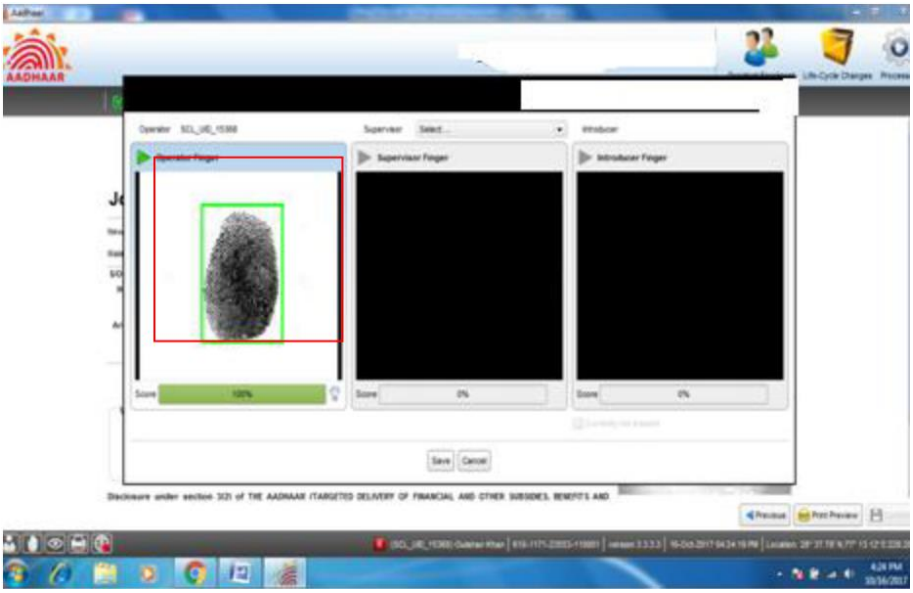
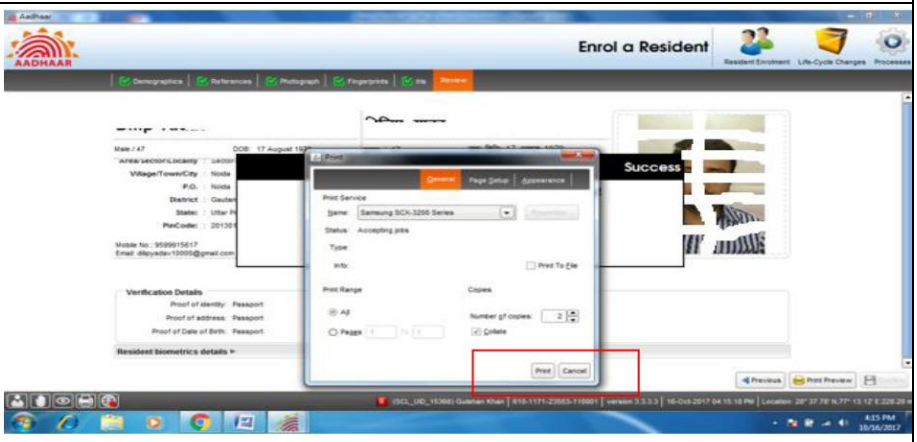
Step 2. Type the required details in the **Personal Details** section. In case of Child Enrolment STEP 6 & 7 are not applicable

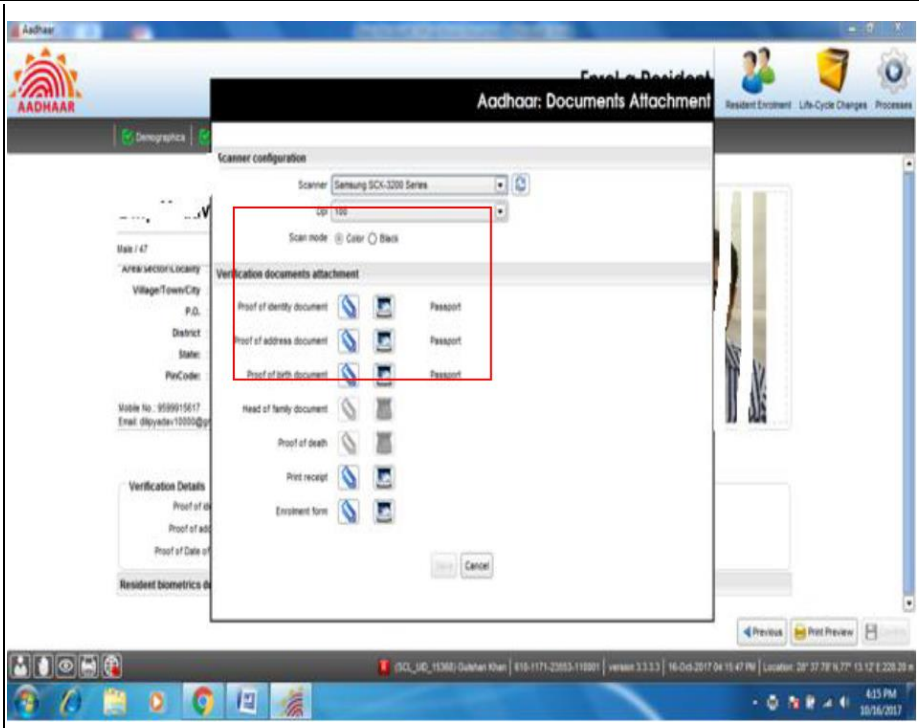


Step 3. Fill all the Demographic Details and **Contact Details including Mobile Number and email**

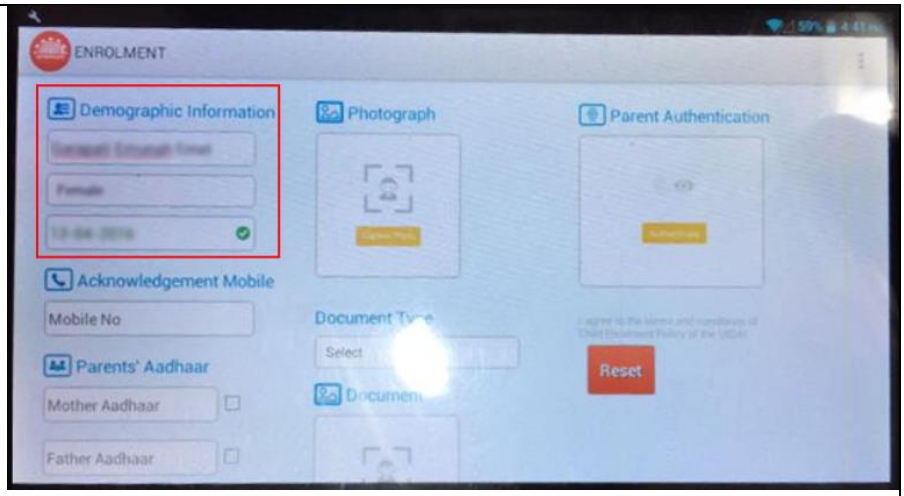
Step 4. Click **References** tab and select a document from **Date of Birth proof (PoB)** dropdown menu	
Step 5. Now, select the documents submitted by the resident as Proof of address (PoA) and Proof of Identity (PoI) and choose the documents from the dropdown menus	
Step 3. Note- Fill the Head of the Family Details (for HuF enrolment only) Enter the No. Of Supporting Documents based on the type of Enrolment	

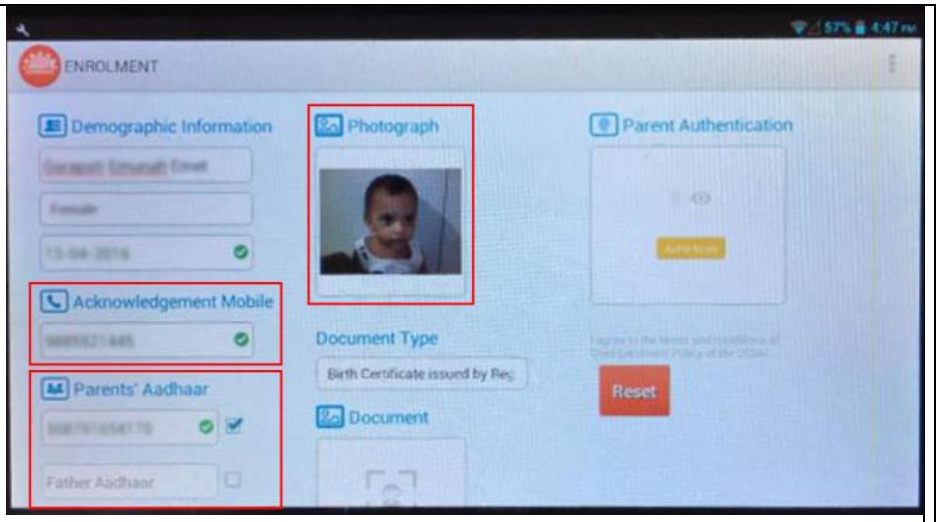
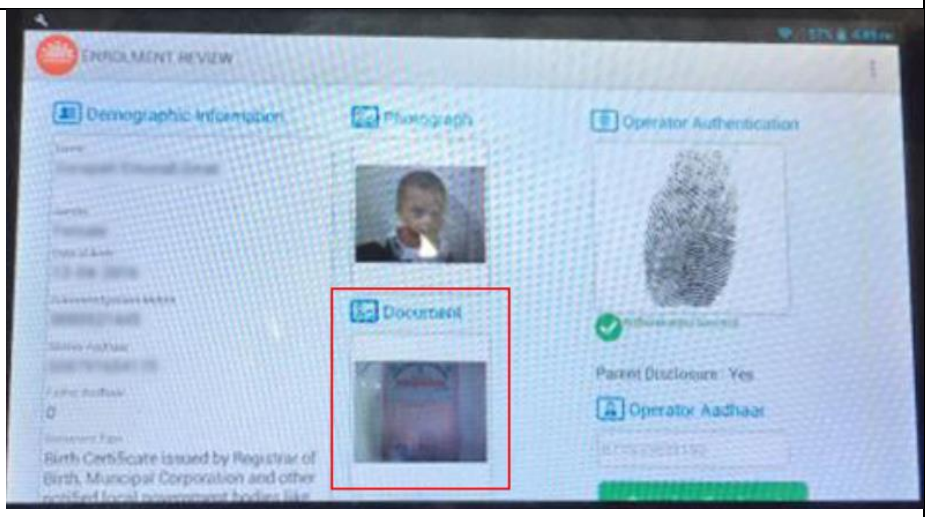
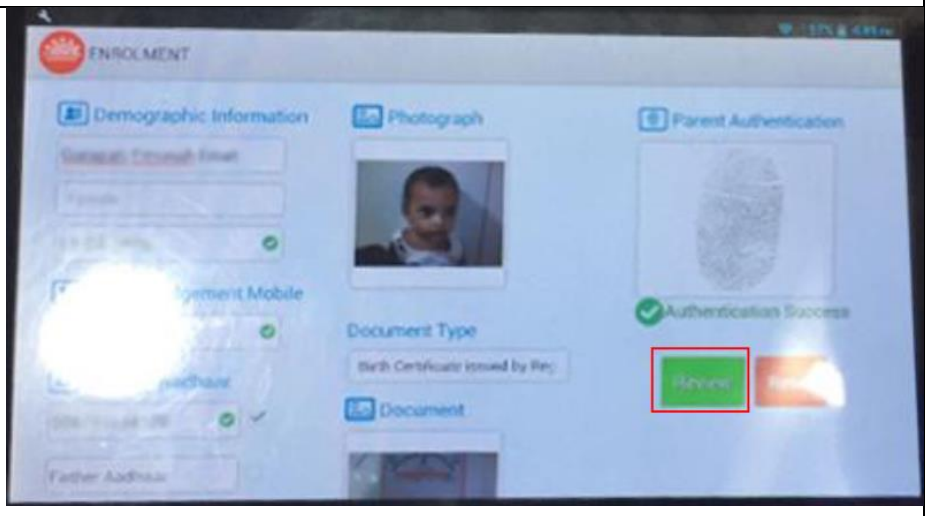
Step 7. Click the Photograph tab and click the photograph of the resident.	
Step 8. Go to the Fingerprints tab. Capture the left hand figure impression then right hand fingers impression followed by both Thumbs impressions using the biometric device.	
Step 9. Click the Iris tab. Capture both Iris impressions using the Iris scanner.	

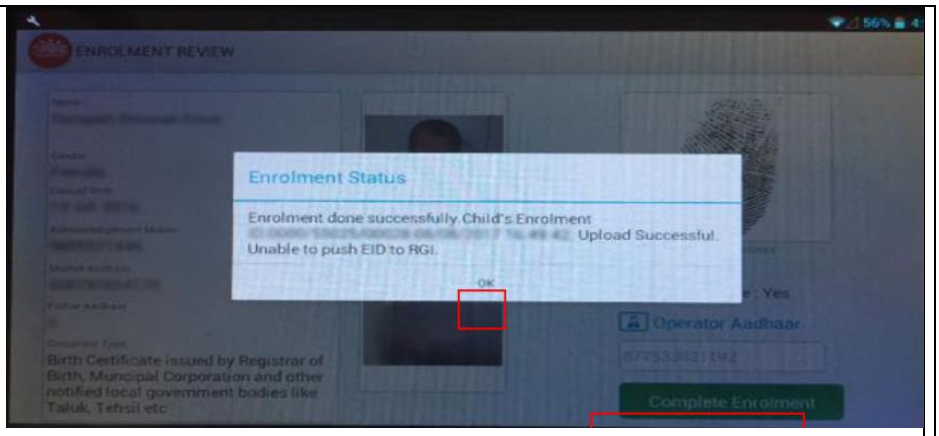
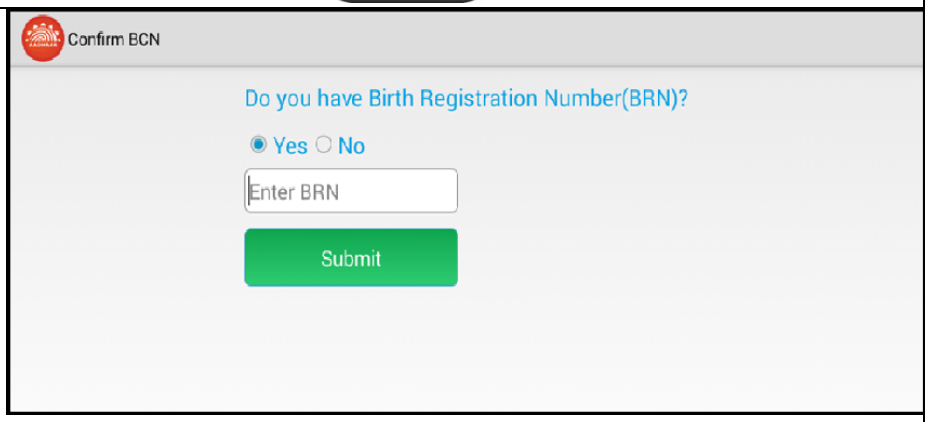
Step 10. Finally, click the Review tab and confirm the details with the resident. In case of any errors, go back to the relevant tab and correct the same. Click **Confirm.**	
Step 11. The operator should give his/her thumb impression in the biometric and click **Save**.	
Step 12. Printing of Acknowledgement Slip and getting it signed by the resident	

Step 13. Mandatory Scanning of Supporting Documents, Acknowledgement Slip and Aadhaar Enrolment Form	

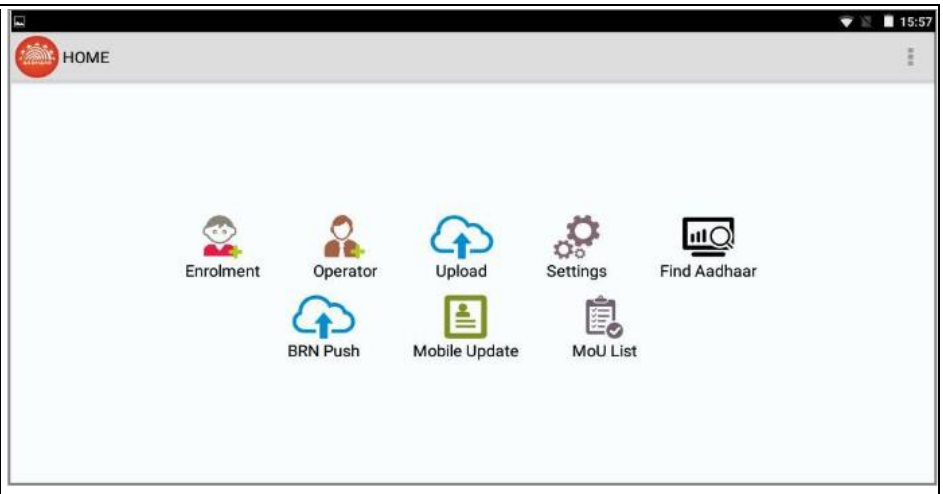
Steps to enrol a child using CELC client:

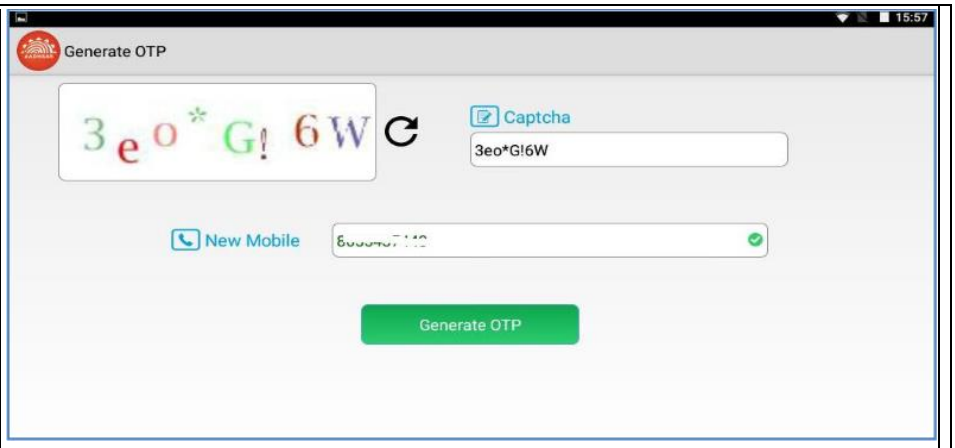
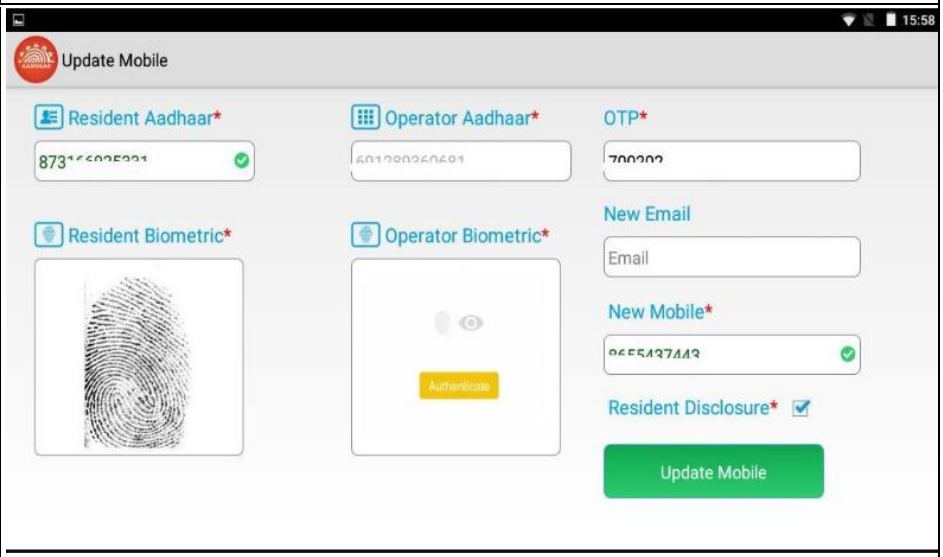
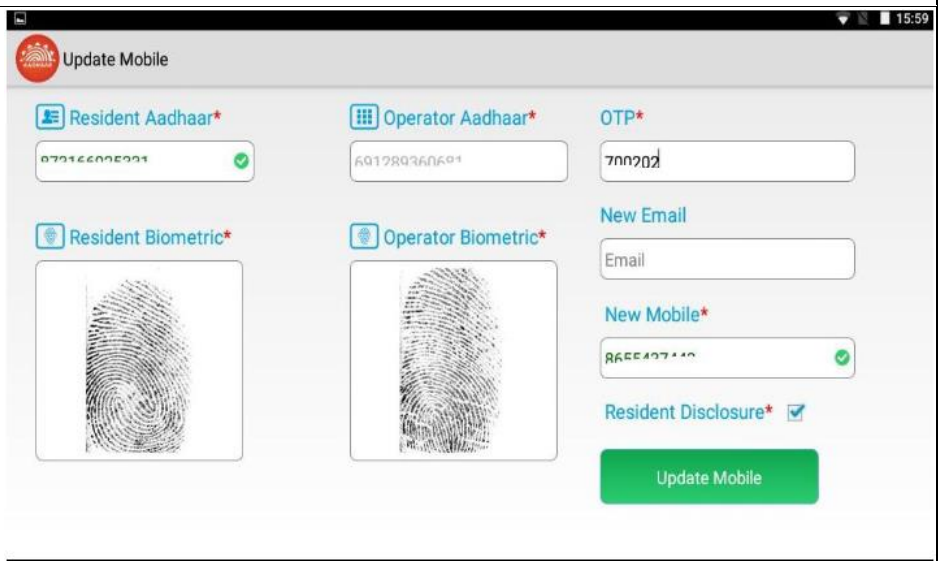
Step 1. Open CELC client using your login credentials. Enter the Demographic information.	

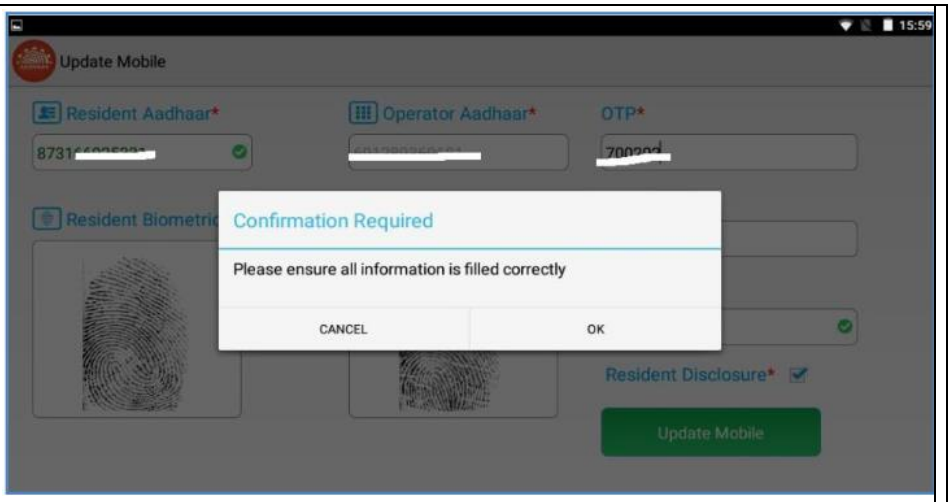
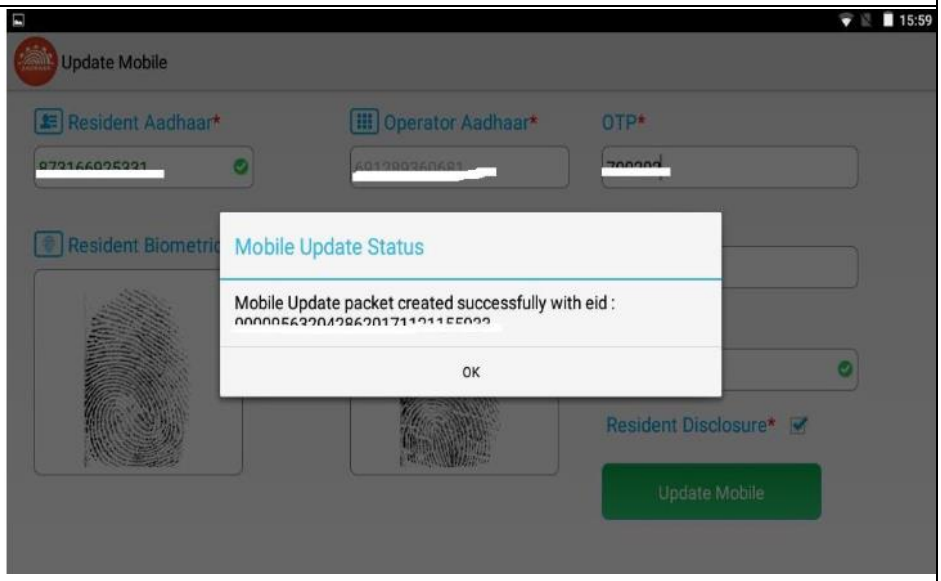
Step 2. Enter parent's mobile number and Aadhaar number. Then, take a photograph of the child.	
Step 3. Select the document submitted and capture the photo of the document. Next, capture the finger impression of the parent whose Aadhaar number is mentioned.	
Step 4. Click **Review** to validate the biometric impressions given.	

Step 5. Finally, click **Complete Enrolment** and click **OK** in the **Enrolment Status window.**	
Step 3. Once the enrolment is completed, the enrolled child"s parents will receive an SMS with the enrolment number.	
Step 7. In case the Birth Registration Number is available, please select YES and enter the BRN/BAN No. The client will return the Name, DOB and Gender of the Child	

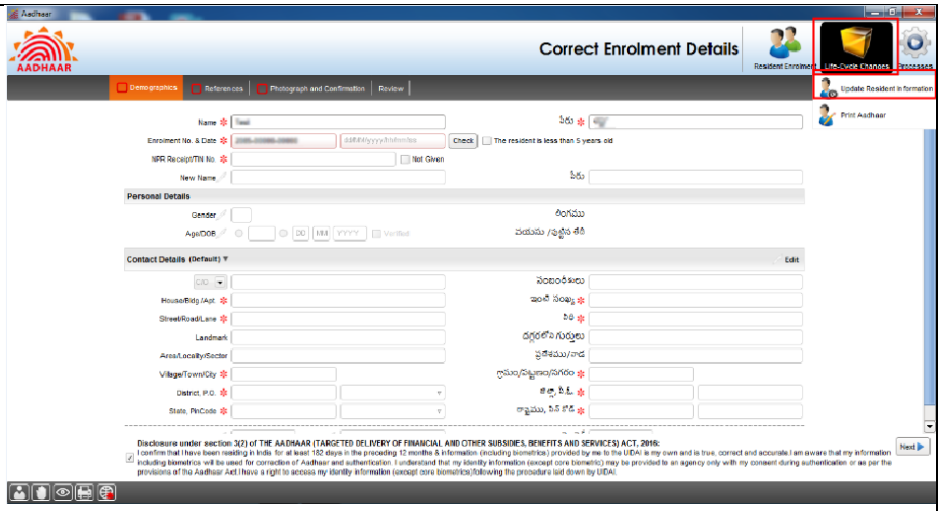
Steps to update Mobile Number using CELC client:

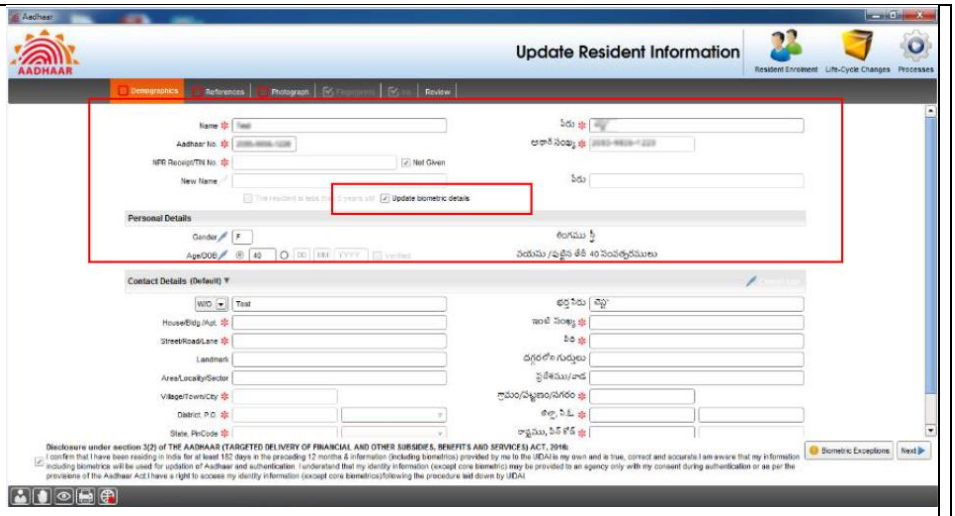
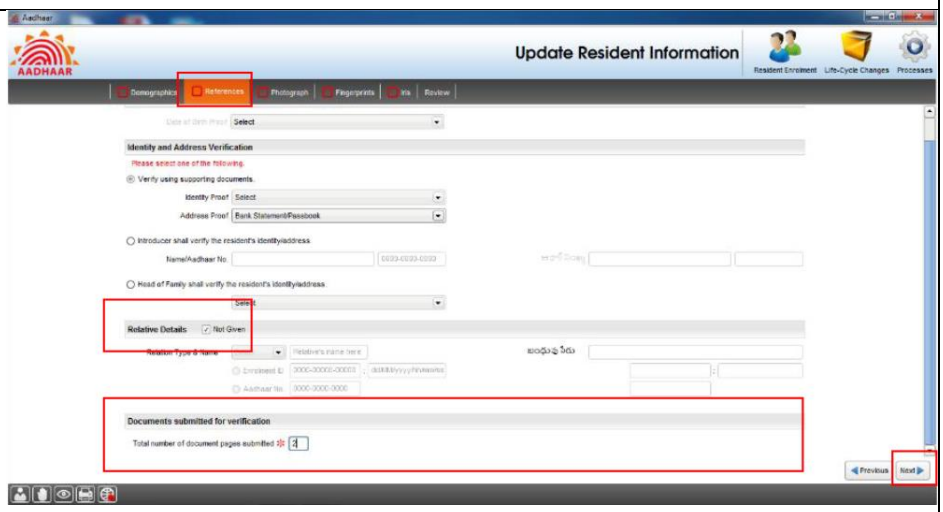
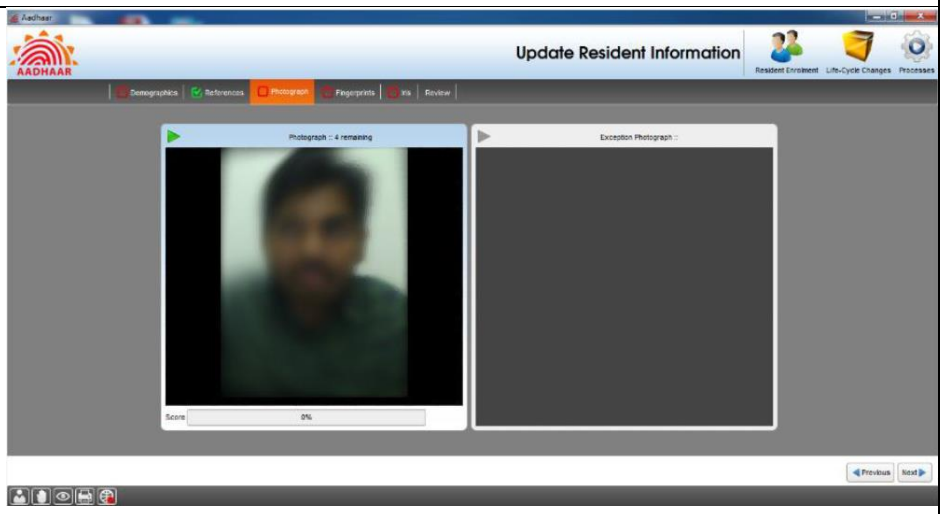
Step 1. CELC Tablet can be used to update resident's mobile number Login using Operator credentials and select "MOBILE UPDATE"	

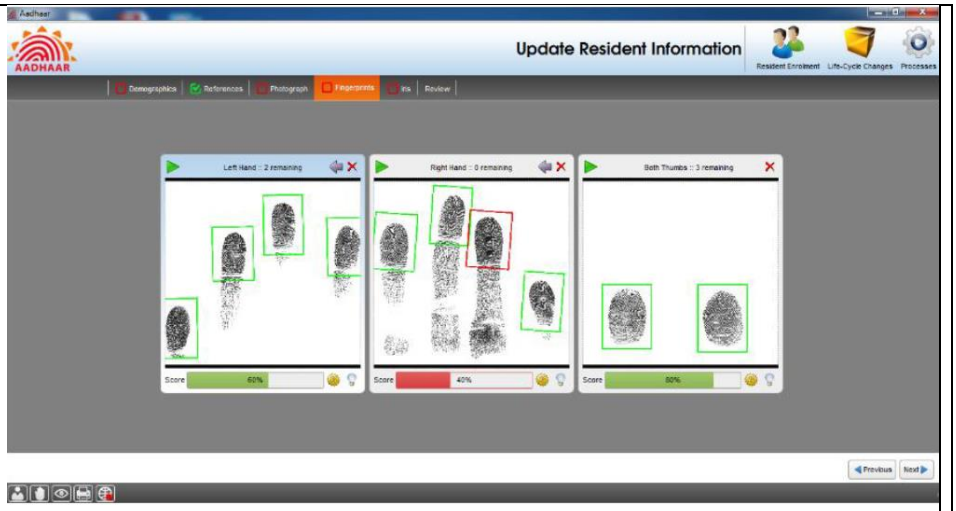
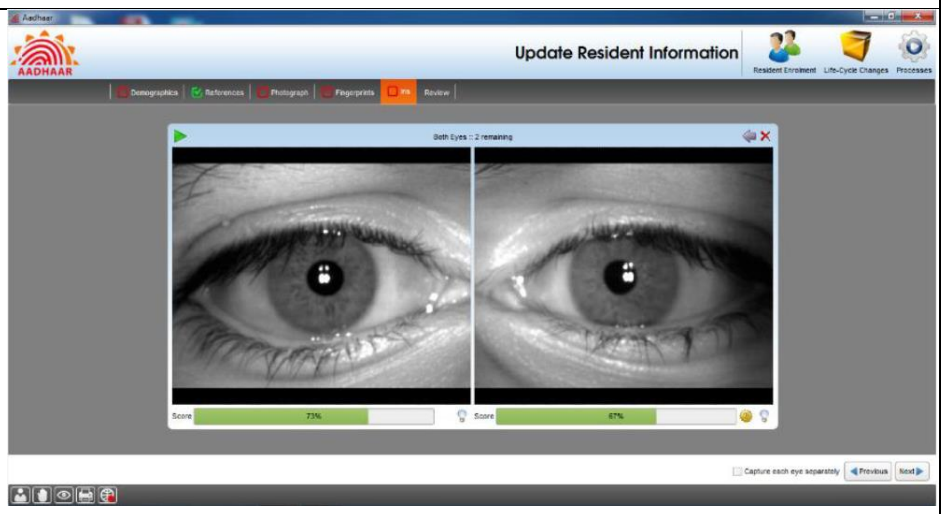
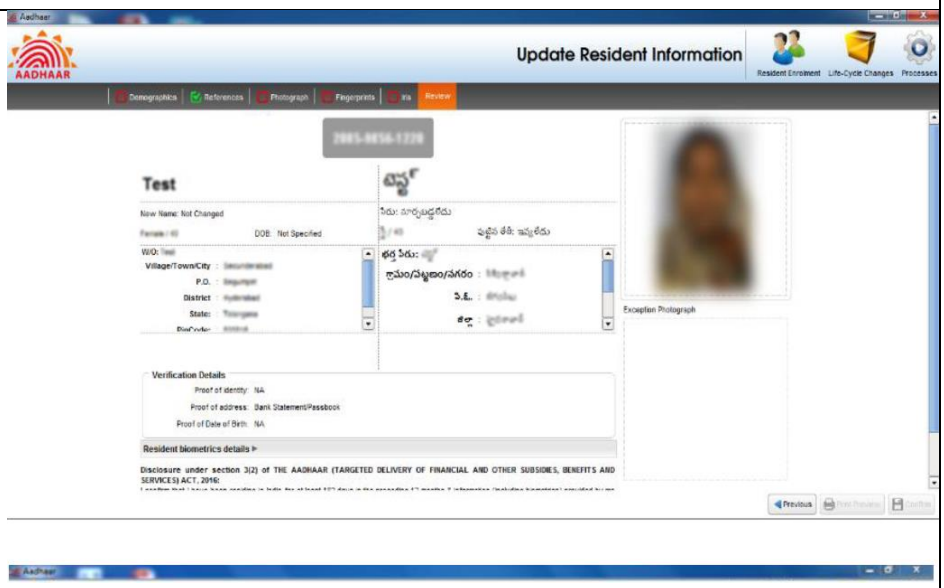
Step 2. Operator has to generate OTP to login into the Tablet	
Step 3. Operator has to enter Resident"s Aadhaar Number, his/her Own Aadhaar Number, New Mobile Number and OTP received on the Mobile and resident"s Authentication for confirmation Resident Disclosure needs to be "checked"	
Step 4. Operator has to give his/her confirmation by giving his/her Biometric Confirmation	

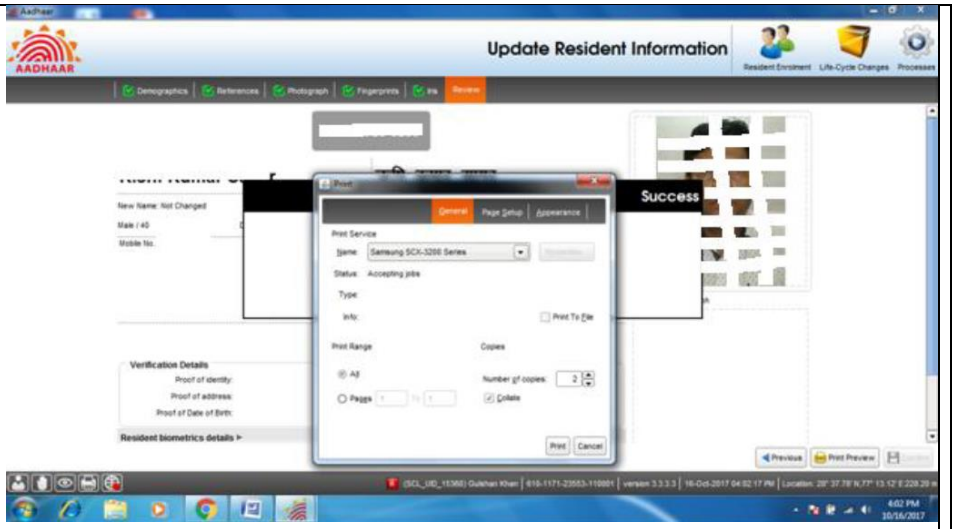
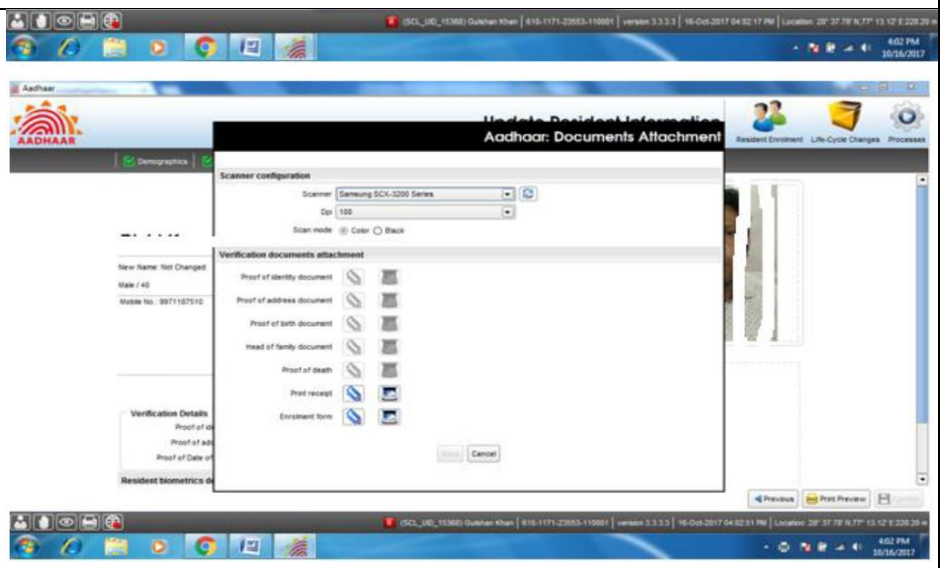
Step 5. After all the steps are successfully saved, Operator has to click “OK” for final confirmation	
Step 3. EID for the Mobile Update is generated and resident can track the status using the Update EID	

Steps to update biometric details in ECMP

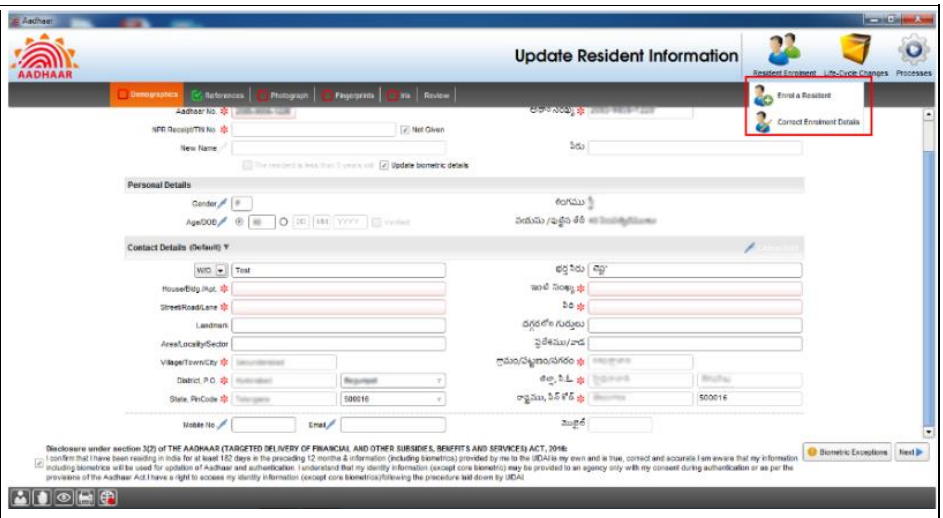
Step 1. Select the Life **Cycle Changes** menu. Click **Update Resident information** details.	

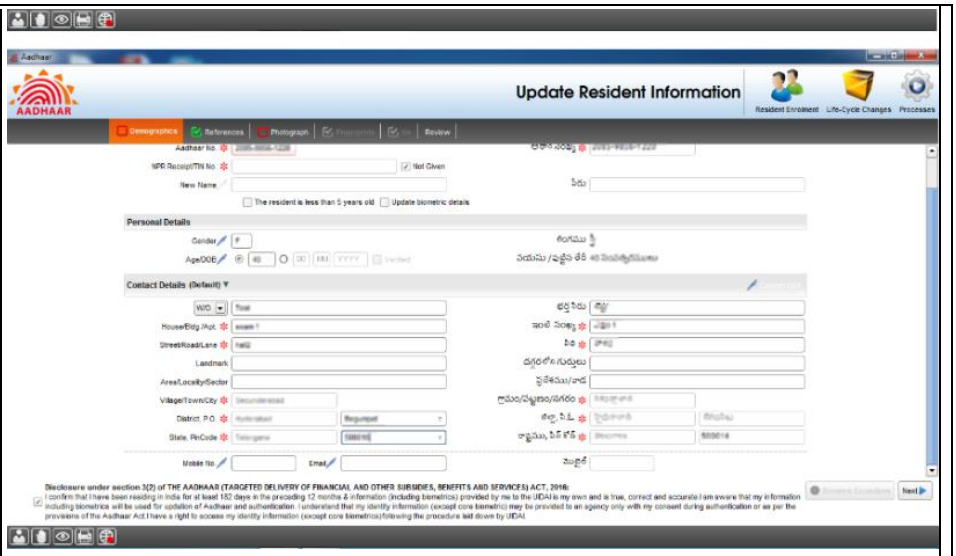
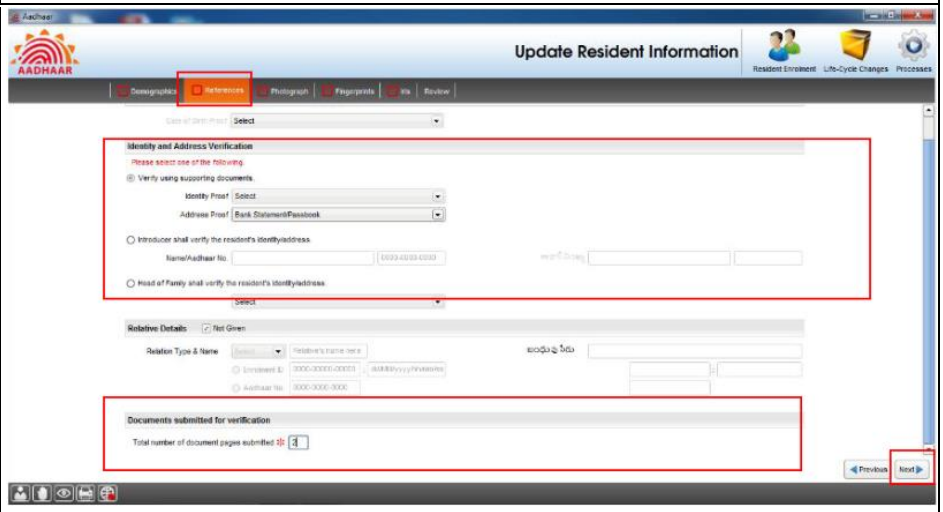
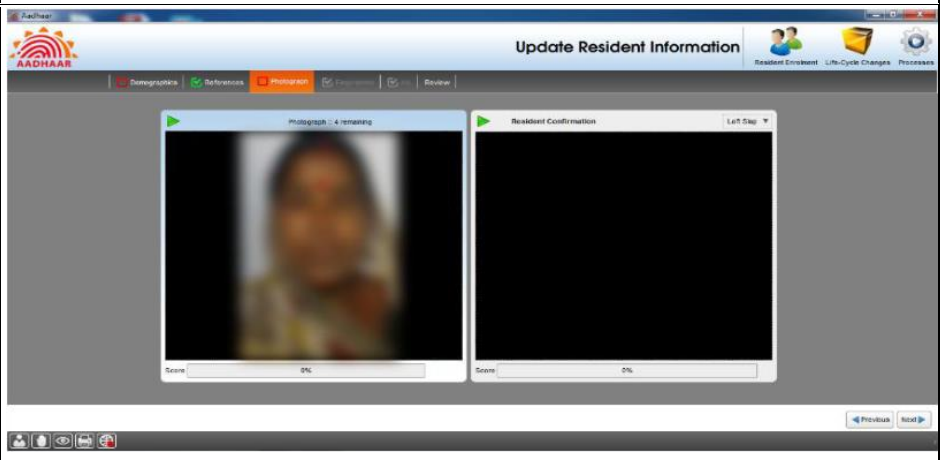
Step 2. Enter Aadhaar Number, Date of Birth and Gender of the resident **Note- Select "BIOMETRIC UPDATE CHECK BOX"**	
Step 3. Go to the References tab. Please select the **"CHECK BOX-NOT GIVEN"** Enter the number of Documents as "2" i.e. Update Form and Acknowledgement Slip	
Step 4. Take the photograph of the resident and click **Next.**	

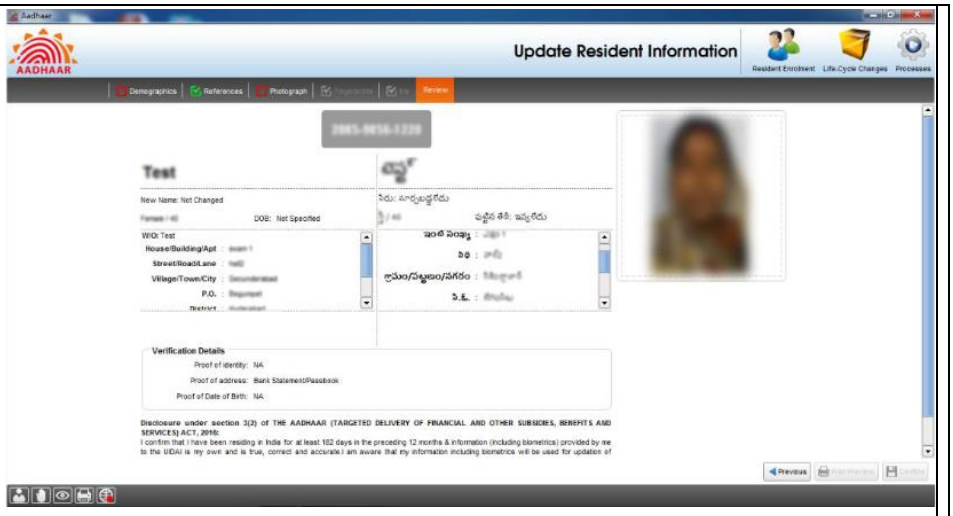
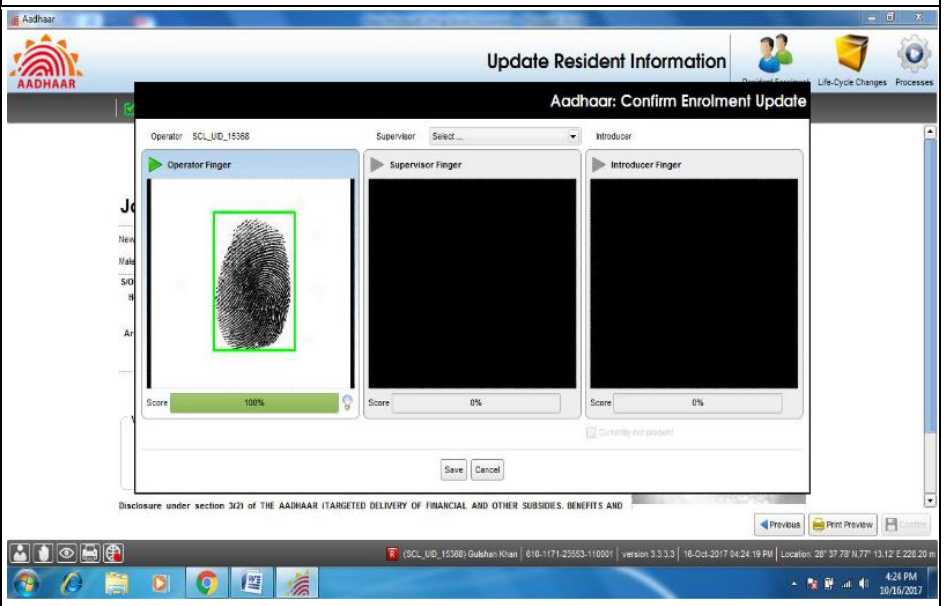
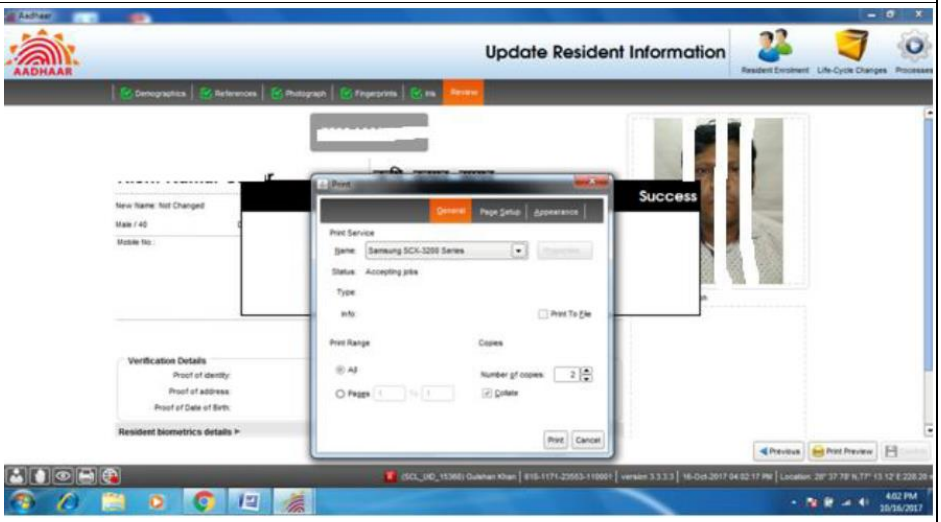
Step 5. Capture all fingerprints and both Thumb impressions of the resident and click **Next.**	
Step 3. Capture both Iris impressions of the resident and click **Next.**	
Step 7. Review the details and get confirmation from the resident. Click **Confirm**	

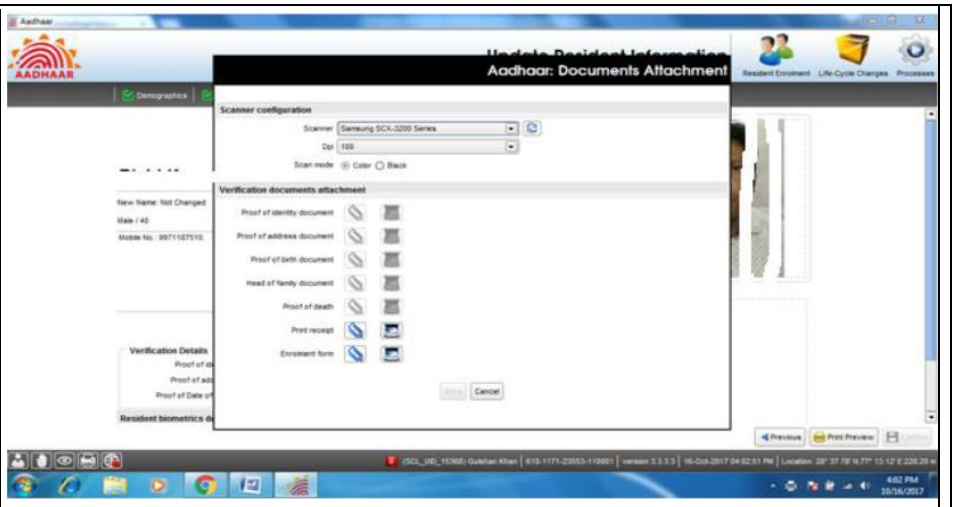
Step 8. Print the Acknowledgment Slip and get it signed by the resident.	
Step 9. Mandatory Scanning of Signed Acknowledgement Slip and Update Form	

Steps to update demographic details in ECMP

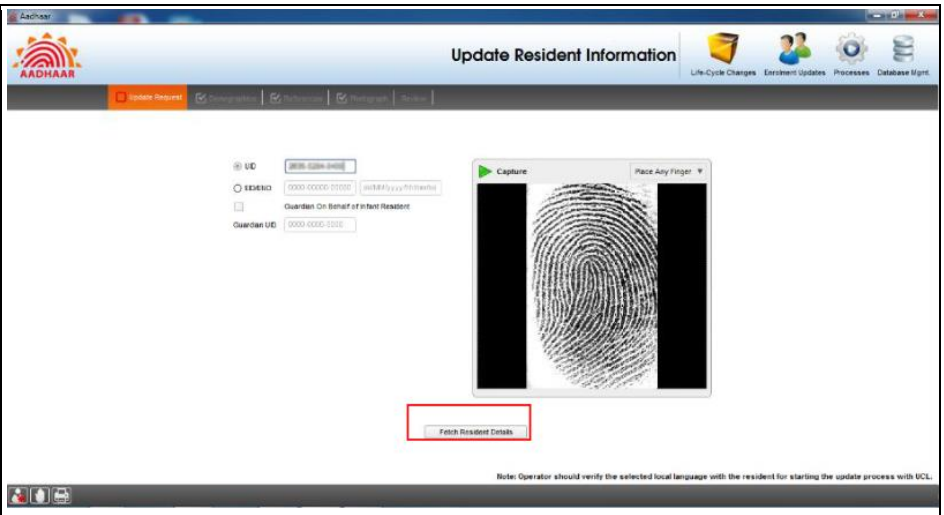
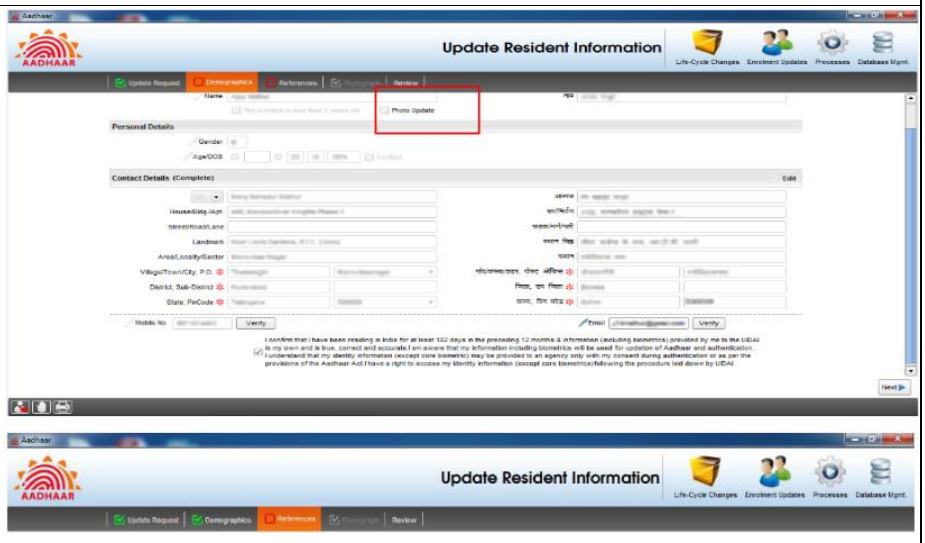
Step 1. Under the Resident **Enrolment** menu, select **Correct Enrolment Details.**	

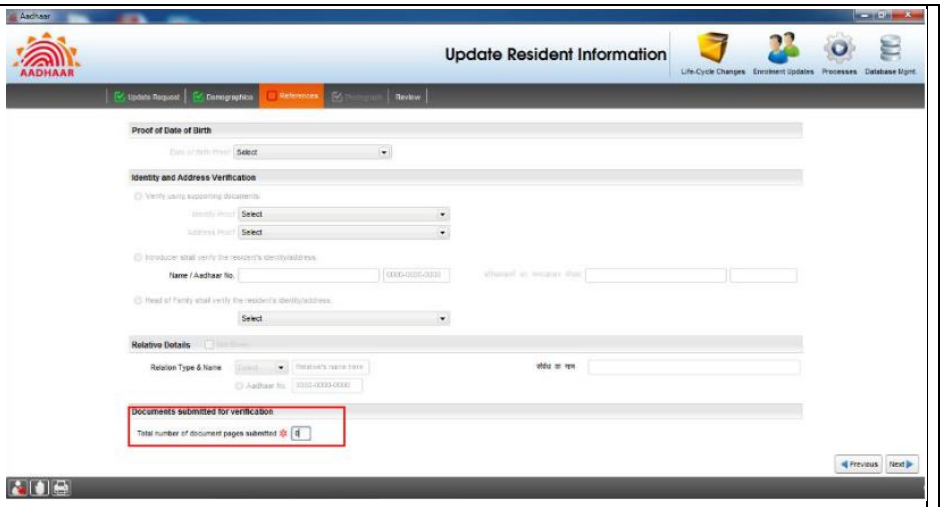
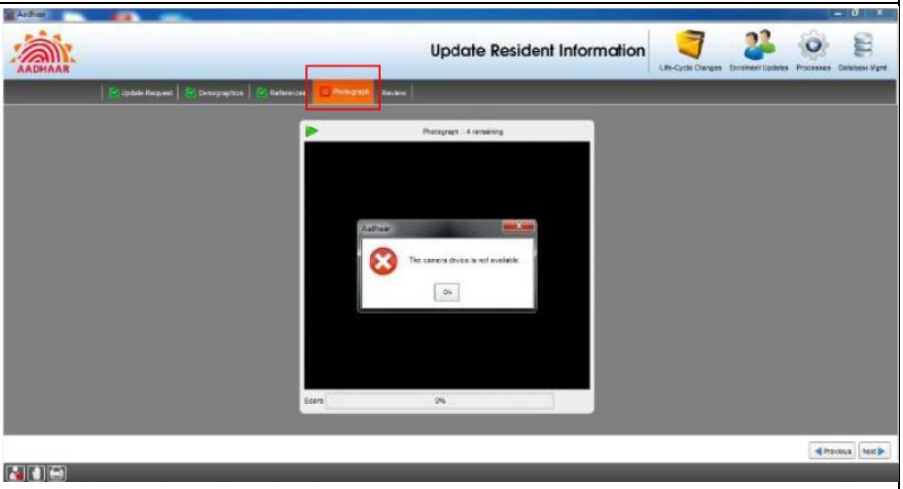
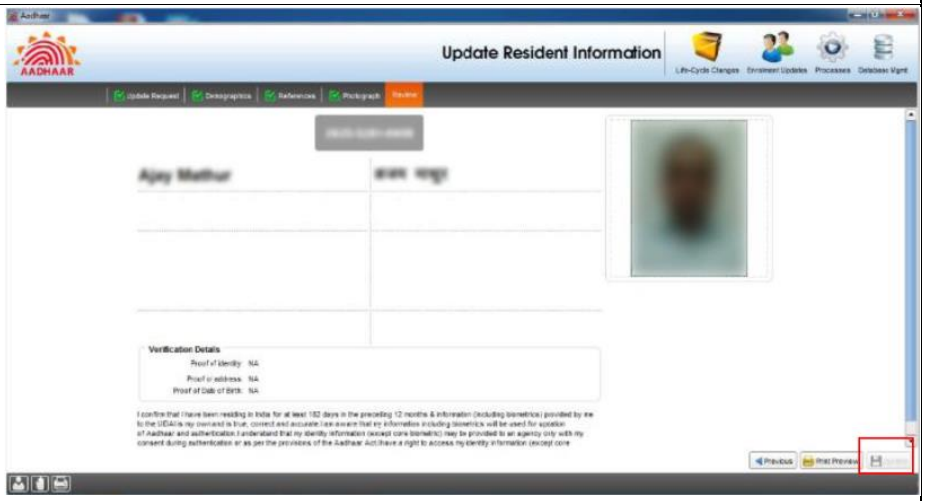
Step 2. Fill in the Resident Name, Aadhaar number, and fields Marked by the resident for Updation (as per the Update Form) Click **Next**.	
Step 3. Go to the References tab. Please select the supporting documents based on the update request Enter the number of Documents based on the update request and click **Next**	
Step 4. Take resident's picture and any one Biometric Attribute and click **Next**	

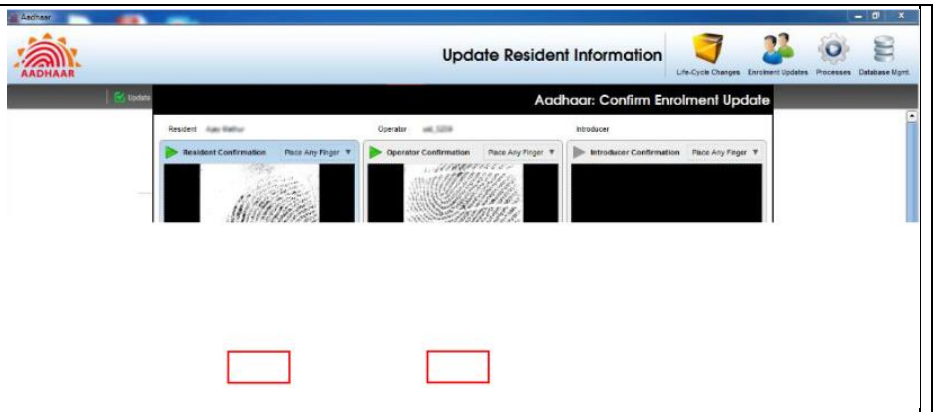
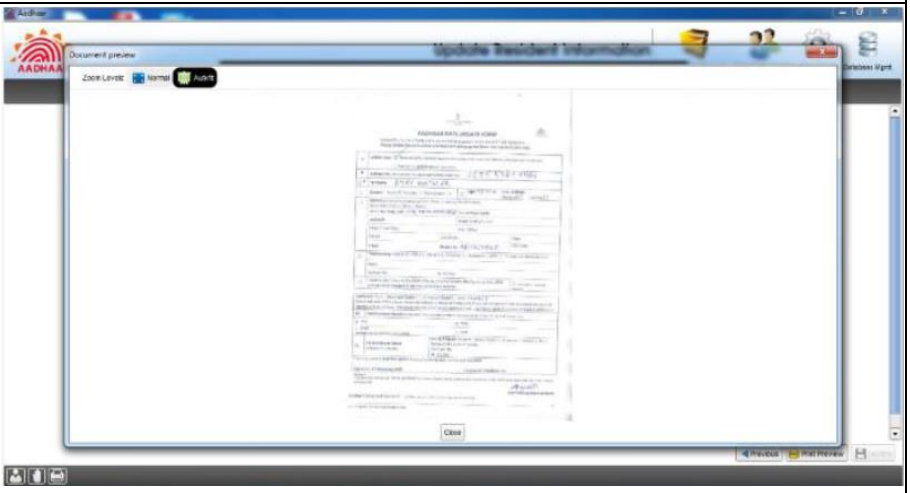
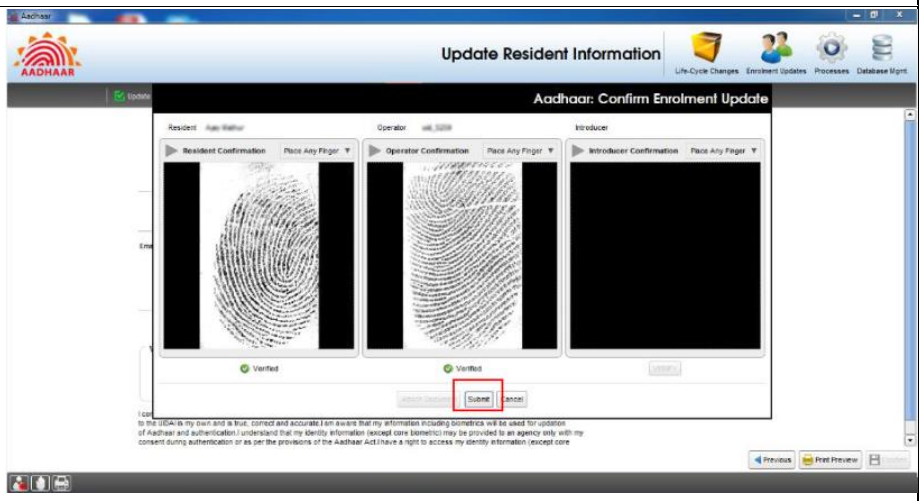
Step 5. Review the details entered and get the confirmation from the resident. Click **Save.**	
Step 3. The operator should give his/her thumb impression and click **Save.**	
Step 7. Print **Acknowledgement Slip** and get it signed by the resident.	

Step 8. Mandatory scanning of Supporting Documents, Acknowledgment Slip and Update Form	

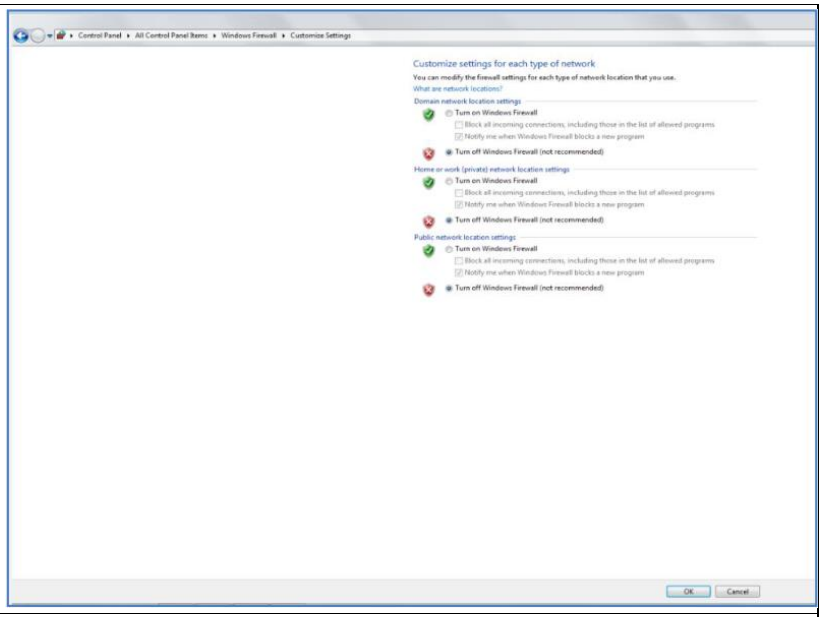
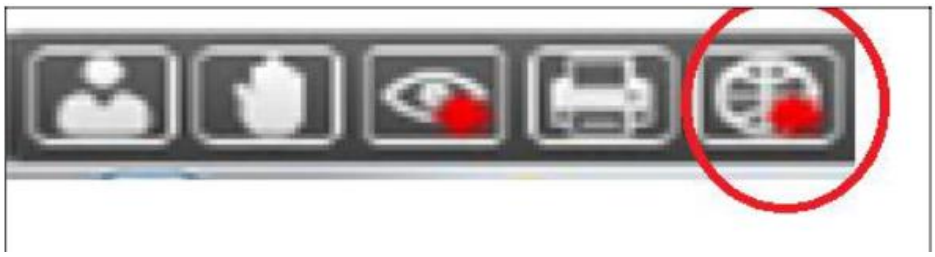
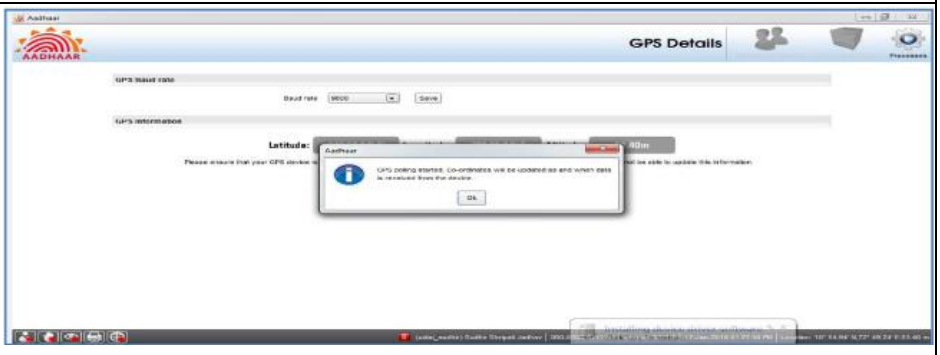
Steps to update Photo in UCL client

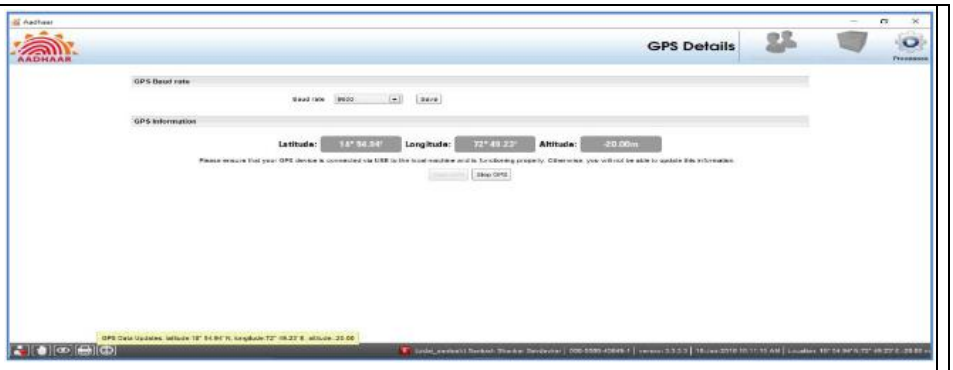
Step 1. Enter the **resident's Aadhaar Number** and take his/her **biometrics** and click **Fetch Resident Details.**	
Step 2. In the "Demographics" page, select **"Photo Update"** Checkbox and click next	

Step 3. Enter Number of supporting Documents as **"1" i.e. Update Form**	
Step 4. Now, go to the Photograph tab and click the **Resident's photo.**	
Step 5. Click the Review **tab** and check the updated details in confirmation with the resident. Finally, click **Save**.	

Step 3. Capture Biometric confirmation of Operator and Resident. Click **Verify**	
Step 7. Scan and upload the Update form filled by the resident	
Step 8. Click **Submit** to complete the updating of the demographic details.	
Step 9. Click **Print Receipt** to print the Acknowledgement Slip	

Steps for GPS Sync at start of Enrolment/Update Process (ECMP Client)

Step 1. • Open Start Menu. • Click on Control Panel • Click on Windows Firewall • Turn Off Windows Firewall • Window as attached in Right will Open • Click all three radio buttons to turn off firewall • Click Ok Button • Restart Your system • Start GPS	
Step 2. • Check all the connected device • This bar is seen in every page (left bottom) of the enrolment client, which indicating which devices are connected to the machine	
Step 3. • Click " GPS Device" icon" • Click on Start GPS Button	
Step 4. Check status" GPS Device started"	

Step 5. Check Status- Red status is removed and updated coordinates are shown	
Step 3. Please select "Band Rate as 9600" Once the GPS Synch Page is completed, Operator Synch Page Pops Up	

Guidelines for Collecting Biometric Data

For Aadhar Enrolment it is required to use Biometric Devices certified by STQC for capturing Biometric data namely, Fingerprint and Iris capture devices. The list of certified biometric devices is available at STQC website http://www.stqc.nic.in.

Fingerprint Capture

The fingerprints need to be captured in order of all four fingers of Left Hand followed by all four fingers of Right Hand and then the two thumbs.

- The fingers have to be positioned correctly on the Biometric Device to enable capture.
- There should be no direct light shining on the Biometric Device. Use the Indicators on fingerprint devices for positioning of fingers.
- The fingers should be placed in the right direction on the Biometric Device.
- Use a lint free cloth periodically to clean the platen of the Biometric Device.
- Check devices periodically for scratches, out of focus images or if partial images are getting captured.

- Fingerprints cut off, wet/smudged fingerprints, very light prints due to insufficient pressure will result in poor quality.
- The resident"s hands should be clean (no mud, oil etc). Ask residents to wash hands with water and soap, if necessary.
- The fingers should not be excessively dry or wet.
- The Resident should be requested to place all four fingers of the left hand/right hand/two thumbs on the fingerprint scanner for the four-finger capture to ensure good contact and maximise the area of the captured fingerprints.
- Ensure that the fingers are placed flat and till the top joint of the finger is placed well on the fingerprint scanner.
- If automatic capture does not happen, the operator should force the capture 4 times till all the lights on the device turn green.
- The operator should check the actionable feedback when capture fails. Some actionable feedbacks provided by software are:
- Number of fingers present does not match with expected number of fingers
- Finger not positioned correctly
- Too much pressure (duty cycle)
- Too little pressure
- Central region missing
- Excessive moisture (wetness)
- Excessive dryness
- Fingerprints are best captured in standing position
- In case of additional fingers, ignore the additional finger and capture the main five fingers
- Ensure correct placement of fingers during fingerprint capture
- In case of missing finger select the missing finger and follow the Biometric Exception Handling Mechanism

Iris Capture

- Ensure correct alignment of left and right eyes and allows for more accurate estimation of roll angle.
- The Resident will be required to sit in a fixed position, like taking a portrait photograph
- The software is able to measure the iris image quality. An initial image quality assessment would be done to provide feedback to the operator during the capture procedure. The software alerts the operator with actionable feedback, if the captured iris image is of insufficient quality. Some actionable feedbacks provided by software are:
- Occlusion (significant part of iris is not visible)

- Iris not in focus
- Gaze incorrect (resident looking away)
- Pupil dilation
- The iris capture procedure is sensitive to ambient light. No direct or artificial light should directly reflect off the Resident's eyes.
- The device should be held steady. In case device requires to be held by resident, the enrolment operator/supervisor may help the resident to hold the device steady.
- Table light used for facial image capture should be switched off during iris capture .
- Direct sunlight or any other bright light shining on a resident"s eye will create reflections and result in poor quality images.
- Operator must instruct the resident to look straight into the camera, eyes wide open, do not blink and to be stationary during iris capture.
- If a resident is having trouble during Iris scan and recapture is required, then the operator may navigate to the next screen to capture other details and then return to Iris capture. This will relax the resident from constant pressure to keep eyes wide open during iris capture.
- The Operator needs to be patient during capture and wait for the device response instead of scrolling, navigating back and forth on screen
- In case the Iris is not captured as required, Operator must try capturing the iris 4 times

Facial Image Capture

Position – For capturing facial image, it is advisable for the operator to adjust the camera instead of the resident to position herself/himself at the right distance or in the right posture. Frontal pose needs to be captured i.e. no head rotation or tilt

Focus – The capture device should use auto focus and auto-capture functions. The output image should not suffer from motion blur, over or under exposure, unnatural coloured lighting, and radial distortion

Expression – Expression strongly affects the performance of automatic face recognition and also affects accurate visual inspection by humans. It is strongly recommended that the face should be captured with neutral (non-smiling) expression, lips closed and both eyes open

Illumination – Poor illumination has a high impact on the performance of face recognition. It is difficult for human operators to analyse and recognise face images with poor illumination. Proper and equally distributed lighting mechanisms should be used such that there are no shadows over the face, no shadows in the eyes and no hot spots. No light exactly above the enrollee should be used since it can cause shadows. Light should be diffused and placed in front of the enrollee so that there are no shadows under the eye.

Eye Glasses – If the person normally wears glasses, it is recommended that the photograph be taken without glasses.

Accessories – Use of accessories that cover any region of the face is not permitted. Further, accessories like turban are also allowed as religious, traditional practices

Operators need to be trained to obtain the best possible face images that satisfy requirements of the software

For children, it is acceptable that the child sits on parent"s lap, but it needs to be ensured that parent's face is not captured along with child's face

Actionable feedback needs to be checked for captures that fail. Some of the actionable feedbacks in software are:

– No face found

– Resident too far (eye distance in input image is less than 90)

– Resident too close (eye distance in input image is greater than one third of image width)
– Pose (Look Straight)
– Insufficient lighting
– Very low face confidence (faceness, object not identified as human face)
– Pose (yaw angle in output image is greater than 11.5 degrees)
– Non-uniform lighting (of face in output image)
– Incorrect background (in output image)
– Insufficient lighting (bad gray values in face area of output image)

Aadhaar based Authentication Process

Many financial transactions such as opening of bank accounts, filing of income tax return can be authenticated by using aadhaar card number. In such a case, the user needs to enter the 12 digit aadhaar card number. The aadhaar server will retrieve the data and send it back to the concerned agency.

All authentication transaction packets/ requests are being sent over the air via a well secured channel. As well as with individual critical personal identity data (PID). It is further encrypted by using a complex cryptographic algorithm.

Authentication system systems can be performed using Authentication requesting agencies such as AUA (Authentication User Agency) and ASA (Authentication Service Agency) only over virtual private networks with CIDR (centralised identity data repository).

eKYC

eKYC means electronically knowing your customer process. It is a verification process performed by using aadhaar number. If the aadhar number is entered then the demographic data such as name, email, mobile number, photo can be generated. eKYC is frequently required while opening a new mutual fund account with mutual fund companies. According to the government policy some data of the user is shared with the organisation. The typical illustration of this authentication transaction flow is given in Figure 3.4.

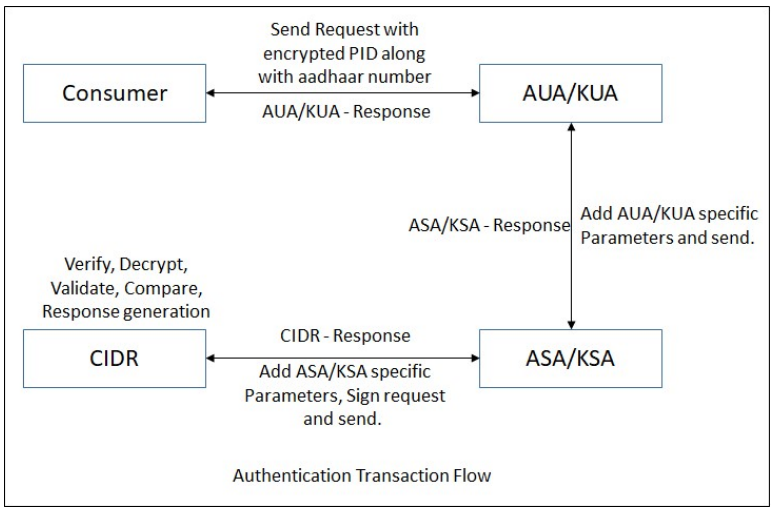


Fig. 3.4 Authentication transaction flow

AUA/KUA (KYC User Agency) received request which contains PID which is encrypted using UIDAI public key, from end-user application, and this request further forwarded to ASA/KSA (KYC Service Agency) by adding some AUA/ASA specific parameters.

ASA/KSA further adds its own parameters and prepares a final authentication request by signing it via its private key of digital Document Signer Certificate (DSC) and sending it to CIDR.

CIDR, first verify the signature of request using ASA/KSA public key. Encrypted data will be decrypted using UIDAI private key and further validation and comparison will take place.

Based on the result of comparison, response generated and delivered to a respected channel.

CHECK YOUR PROGRESS

A. Multiple choice questions

1. Which of the following biometric information is not required for the enrolment of children below 5 years (a) all ten fingers (b) Iris (c) Both a & b (d) Facial photograph
2. Aadhar card is not available in which of the following form (a) Aadhaar certificate (b) e-Aadhaar (c) m-Aadhaar (d) PVC Aadhaar
3. Aadhaar Enrolment Kit should be (a) UIDAI certified (b) Microsoft certified (c) STQC certified (d) ISI certified
4. The biometric devices (Slap/Iris Scanner) used for Aadhaar card preparation should be (a) UIDAI certified (b) Microsoft certified (c) STQC certified (d) ISI certified
5. Which of the following Aadhaar client software is used of enrolment of child below 5 years (a) ECMP (b) UCL (c) CELC (d) ECIL

B. Fill in The Blank

1. Mathematically aadhar number generation uses _____ algorithm.
2. Electronic form of aadhaar card is called as _____.
3. Aadhaar card downloaded for Android application is called as _____
4. In the _____ analysis the new enrolled biometric data is compared with exising enrolled biometric.
5. Enrolment of the _____ is mandatory prior to the child.

C. State whether True or False

1. Income or medical history of the resident are not included in the demographic information.
2. The Aadhaar number of every individual is unique.
3. Aadhaar number is a 10 digit number called a unique identification number (UID).
4. Rejected biometric data will not be carried forward to the main biometric database.
5. Demographic data is also checked with the deduplication process.
6. The m-Aadhaar can be viewed on any Android mobile phone.
7. Acknowledgement Slip should be signed by the resident.
8. Date of Birth (DoB) certificate is mandatory for Document-based Enrolment.
9. The biometric information of children has to be mandatorily updated upon attaining six years of age and sixteen years of age.
10. Head of Family's Aadhaar number is mandatory for Head of Family based Enrolment.

D. Write the long form of following acronyms

1. ASA
2. AUA
3. KSA
4. KUA
5. STQC
6. MeitY
7. GPS
8. UIDAI
9. USB
10. ECMP

11. CIDR
12. UCL
13. VDM
14. OTP
15. PoA
16. PoI
17. PoR

E. Answer the following questions in short

1. What is the demographic information required for enrolment of an Aadhaar card?
2. What biometric data is required for enrolment of an Aadhaar card from an individual?
3. Which information is not included in the demographic information?
4. Which shall not include race, religion, caste, tribe, ethnicity, language, record of entitlement, income or medical history of the resident.
5. What is a Mandatory Update?
6. What is eKYC? How is it performed?
7. What is an Aadhaar based Authentication Process?
8. What are the factors to be considered for capturing facial image?
9. What are the factors to be considered for capturing Fingerprint?
10. What are the factors to be considered for capturing Iris?

Session 4. Preparation of Passport

A passport is an official document issued by the government that certifies the holders identity and citizenship. By using this document one can travel to foreign countries and his travel is protected by the concerned government. A passport is a travel document which is required to travel to different countries other than your home country. If an Indian citizen wishes to travel to foreign countries such as the USA or Singapore for any purpose such as tourism then without a passport it is not possible to travel.

Types of passports

There are Three main types of passports that are issued to individuals by the Ministry of External Affairs, Government of India. They are: *Ordinary Passport, Diplomatic Passport, Official Passport.*

The passports issued by the government of India are shown in Figure 4.1.

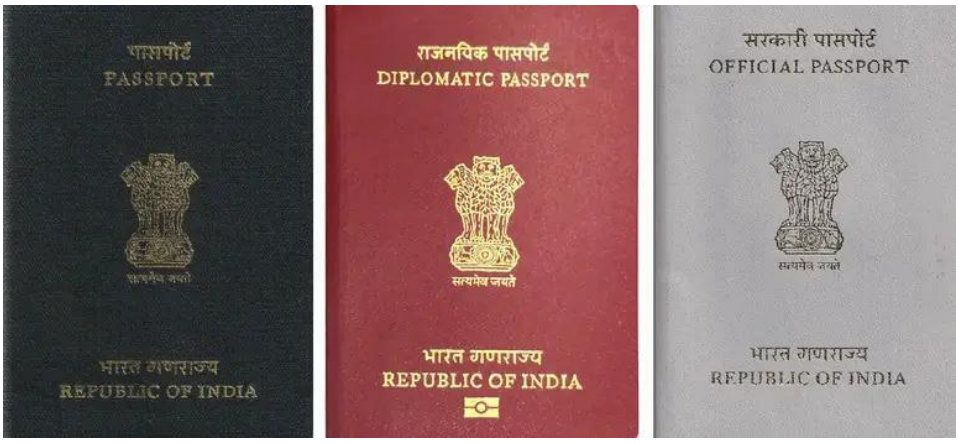


Fig. 4.1 Types of passport issued in India

Ordinary Passport – Ordinary passports are issued to ordinary individuals. These passports are for a general purpose which enables the holders to travel to foreign countries on business or holidays.

Diplomatic Passport – Members of the Indian Government who are authorised to go abroad on official business are given diplomatic passports.

Official Passport – Official passports are issued to designated Government officials or any other individual deputed overseas on official assignment which has been officially authorised by the Government.

Eligibility Criteria for Availing Different Types of Passports

The following are the eligibility criteria for availing different types of passports:

- The general public are eligible for blue passports.
- White passports are eligible for government officials.
- Indian diplomats and senior government officials are eligible for diplomatic passports.
- Individuals not studied beyond class 10 are eligible to avail themselves of orange passports.

Biometric data in preparation of passport

Almost all countries in the world have started to issue biometric passports. Such a passport contains biometric information such as name, place, date of birth, photograph, signature, fingerprint and iris images. The data items that are normally covered in the passport are shown in Figure 4.2.

Fig 4.2 Biometric data elements used in the passport (images of biometric data)

Procedure of preparation of passport

In India a passport is issued under the passport act 1964. Passport is a very valuable document and it is an offence punishable if any false information is provided by the user. Indian citizens can apply for their passport online at the Passport Seva website. All the passport applications are processed online by the Ministry of External Affairs.

The first step while applying for passport renewal online requires the applicant to have a passport account on the official website of Passport Seva at https://passportindia.gov.in.

Register on the Passport Seva Website?

An individual can create a passport account by following the steps mentioned below:

Step 1. First register for passport on the Passport Seva website, at https://passportindia.gov.in The initial screen of the website looks as shown in Figure 4.3.

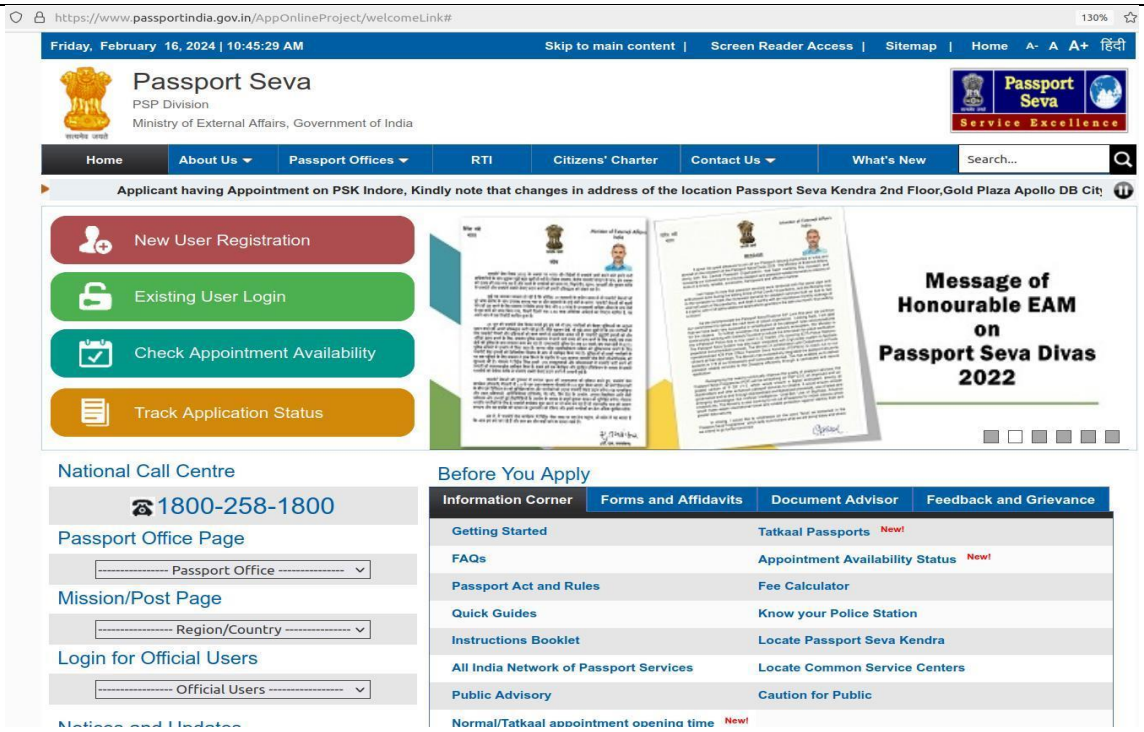


Fig. 4.3 Homepage of passportindia.gov.in

Step 2. The user already registered can login the portal by clicking on the **Existing User Login** tab. It is mandatory to register for the new user. Create an account by clicking on '**New User Register**'. You will then be redirected to an online form of User Registration as shown in Figure 4.4. Make sure that the radio button highlights **'Passport Office'**.

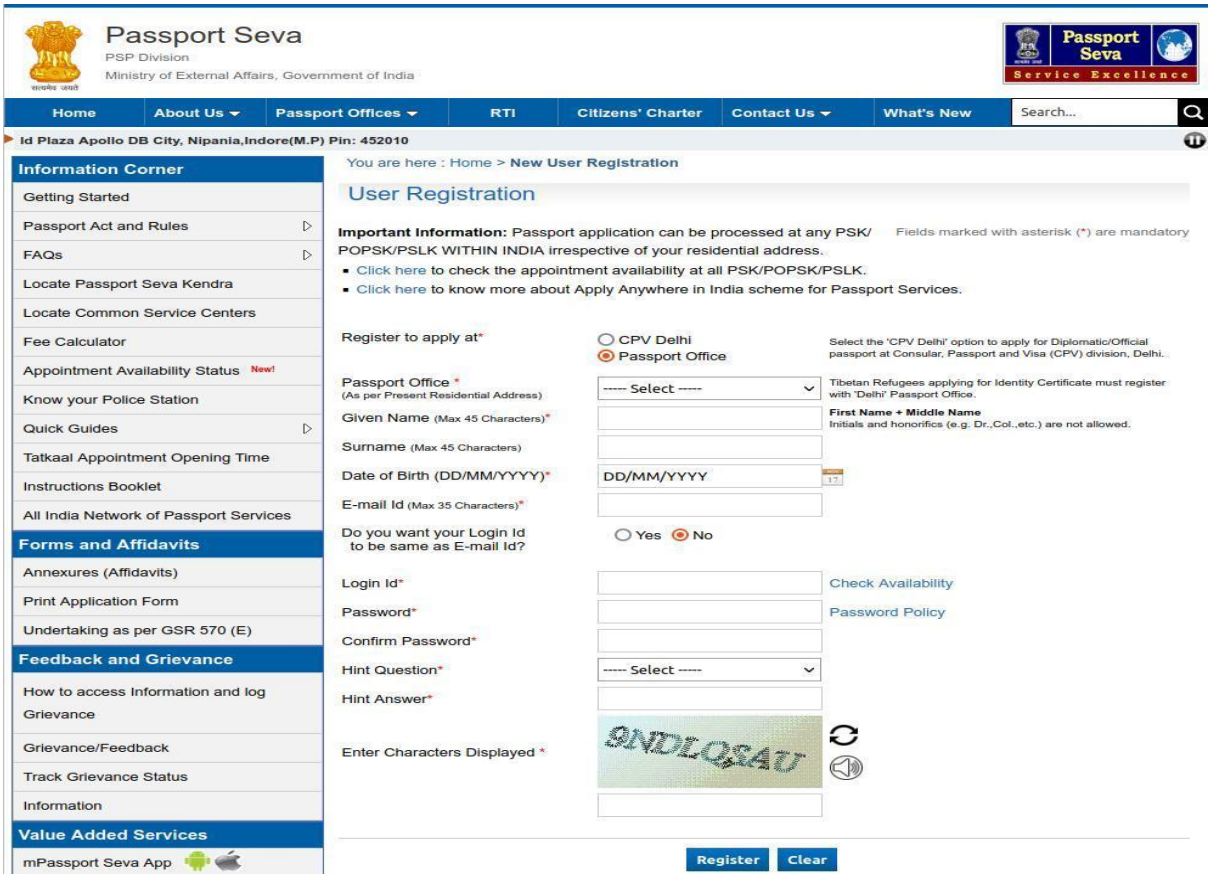


Fig. 4.4 User registration

Step 3. Select the nearest passport office located in your city from the option available at the dropdown menu. For example, if you reside in Bhopal, then under the **'Passport Office'** option choose, Bhopal.

Step 4. Next, proceed to provide other details such as Given Name, Surname, Date of Birth, Email Id, Login Id, Password. Email Id is mandatory, registration confirmation mail will be sent to your email Id.

Step 5. Ensure that the login ID and password are set according to the terms and conditions mentioned on the portal. Now, re-enter the password for confirmation. Choose a hint question and enter your answer which will help you retrieve your details if you forget your login ID and password. Enter the characters displayed and click on **'Register'**.

Step 6. You will receive an email with an activation link. Activate the account using the link in the email. Your account has now been created and you will be able to login using your credentials.

Apply for a Passport Online

Step 4. Visit the official website of Passport Seva at https://passportindia.gov.in. Enter the login ID & password. Enter the captcha code and click on the Login button as shown in Figure 4.5.

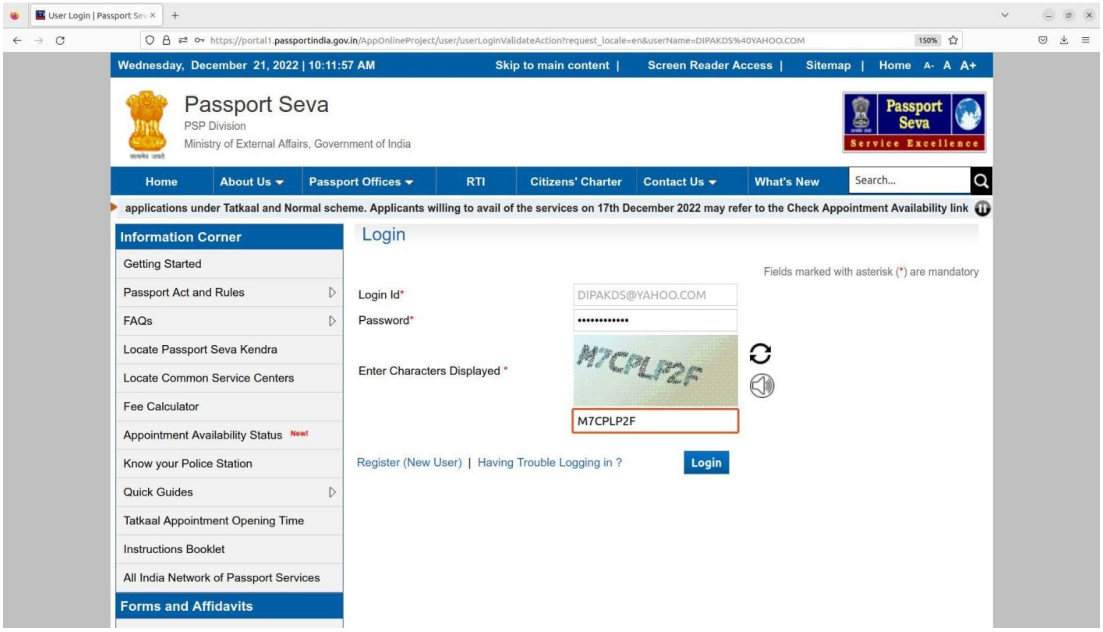


Fig. 4.5 Passport seva Login window

Step 8. After logging in, choose the service, Apply for Fresh Passport/Re-issue of Passport.

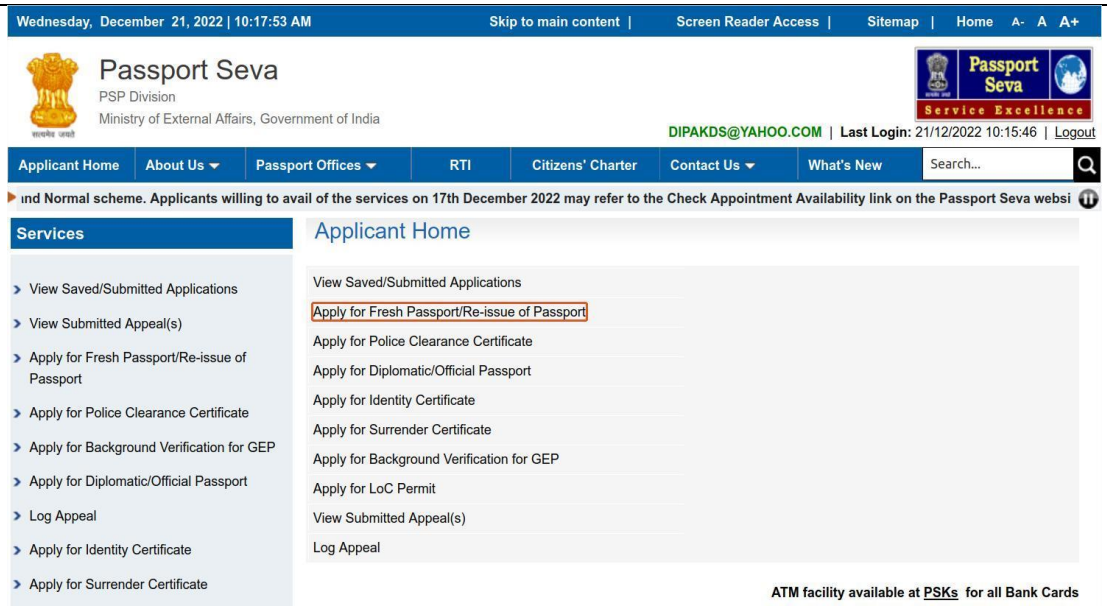


Fig. 4.6 Apply for Fresh passport Reissue of Passport

Step 9. You can apply for a passport/ reissue passport through two methods as shown in Figure 4.7. Choose any one of these as per your desire.

Alternate 1: Filling application form online

Alternate 2: Downloading e-Form and uploading later

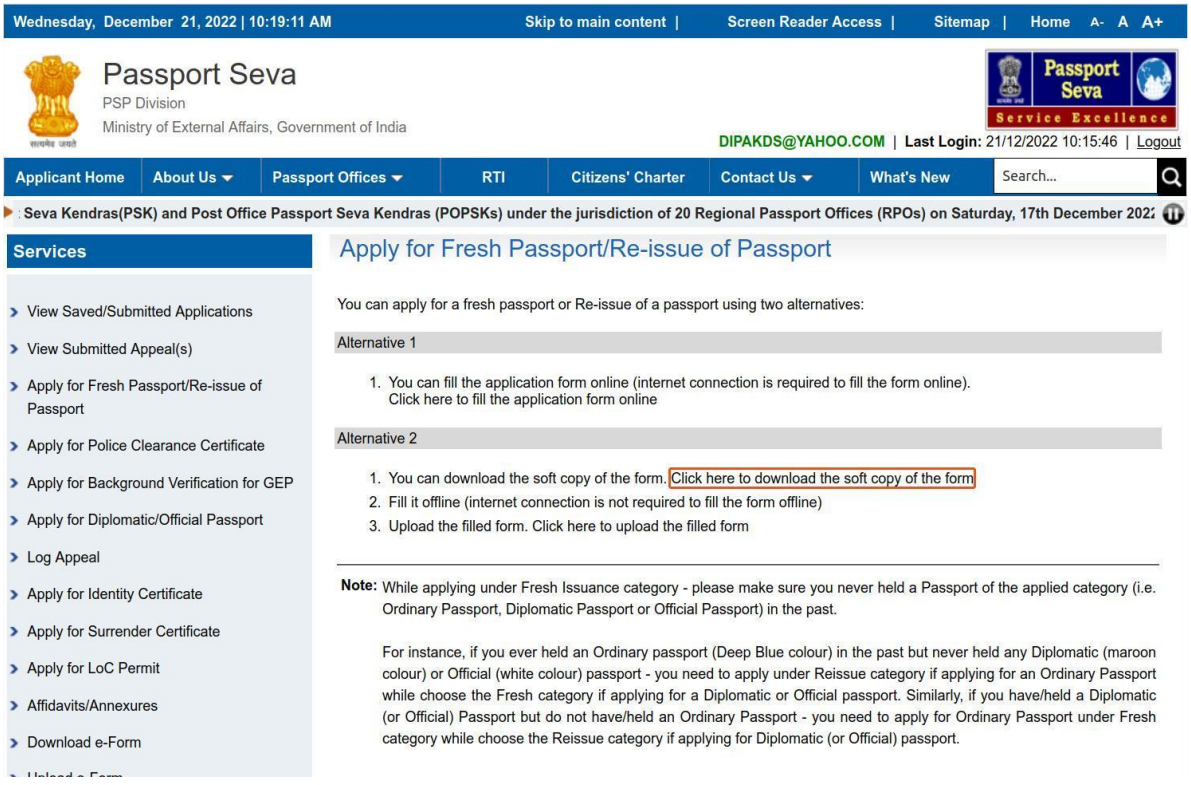


Fig. 4.7 Selecting the application form

Step 10. The downloaded e-Form can be uploaded after filling, while you have to fill the online form on the portal itself. Fill in the application e-form and upload the filled-in application form and click on the **Upload the e-form** link.

A typical application form looks as shown in Figure 4.8.

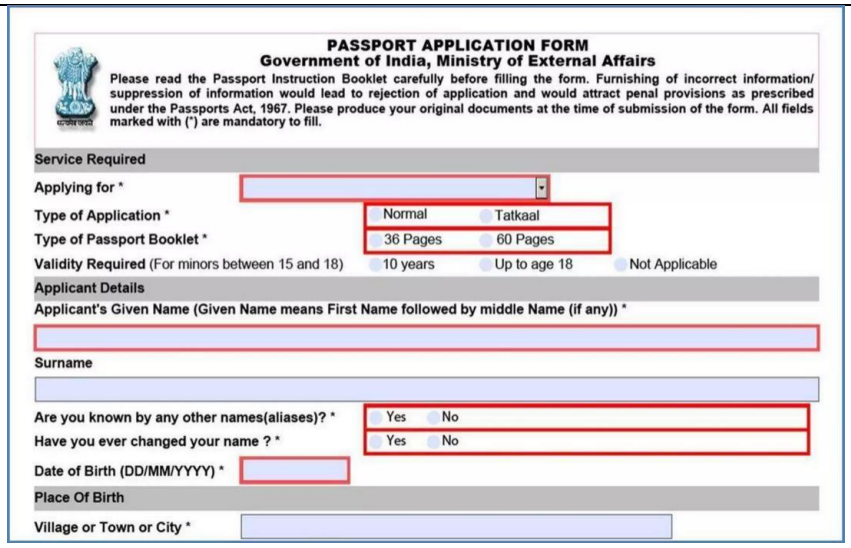


Fig. 4.8 Passport application form

Step 11. To fill the application form online click on the link **Click here to fill the application form online**. Fill the application form online as shown in Figure 4.9 and submit. The process can also be started in part and finished at a later time.

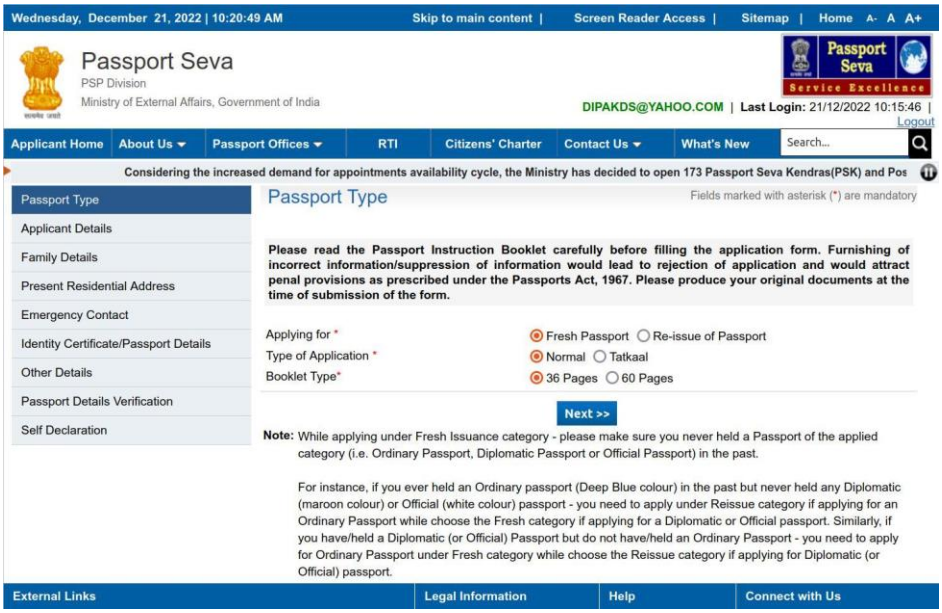


Fig. 4.9 Filling online application form

It is advised to double-check the form before sending it from the Passport details verification page as shown in Figure 4.10.

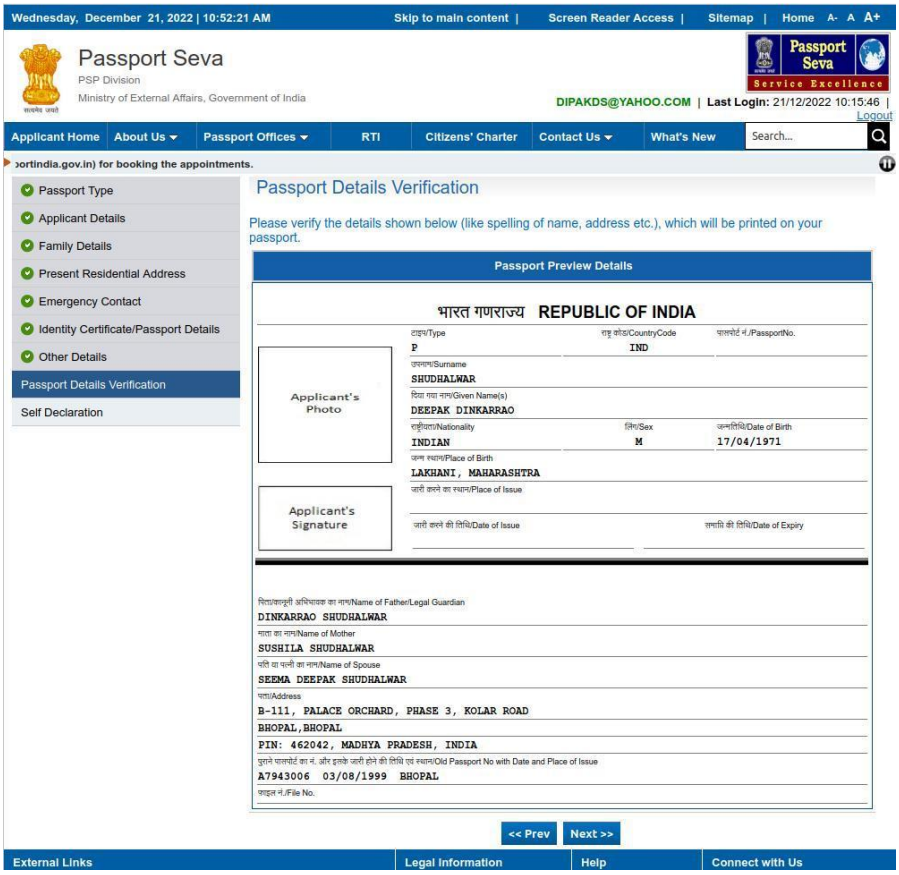


Fig. 4.10 Passport details verification

Every application must be supported by the documents such as proof of date of birth, identity proof with photograph, proof of residence and proof of nationality. After successful completion of submission of online form and relevant documents, one needs to pay an appropriate fee required for issuance of passport.

Step 11. Schedule, Pay & Book the appointment

After completing the form, you will be required to pay a charge. You can pay the money online or in person at the closest Passport Seva office, where you must also submit your application and any other paperwork. Take an online appointment to visit the nearest Passport seva kendra (PSK). Online appointments are alloted according to the handling capacity of the PSK. This is an electronic queue management system. After obtaining the online appointment one needs to visit the passport seva kendra along with original documents for further processing of the application. It is shown in Figure 4.11, 4.12, 4.13, 4.14 and 4.15.

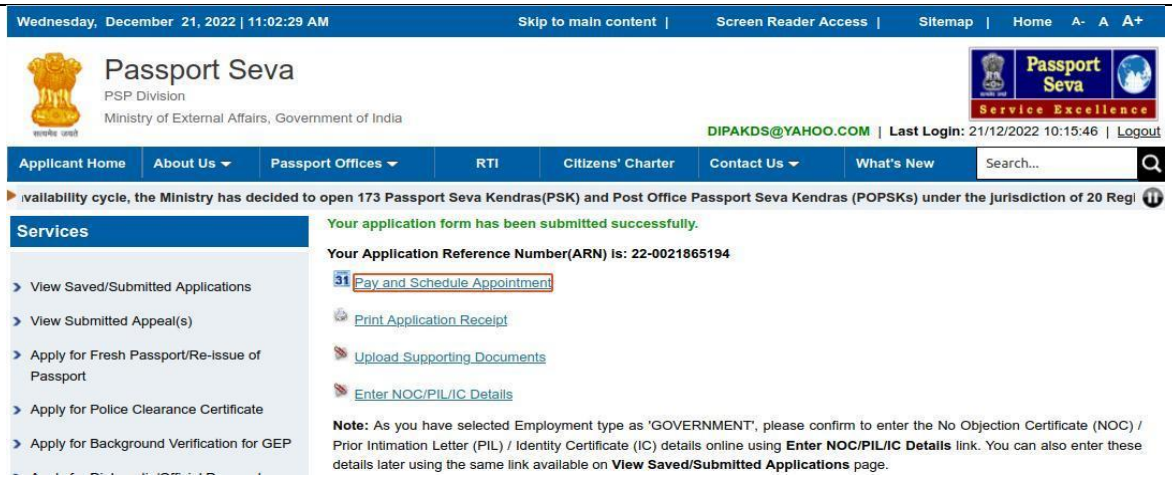


Fig. 4.11 Pay and Schedule Appointment

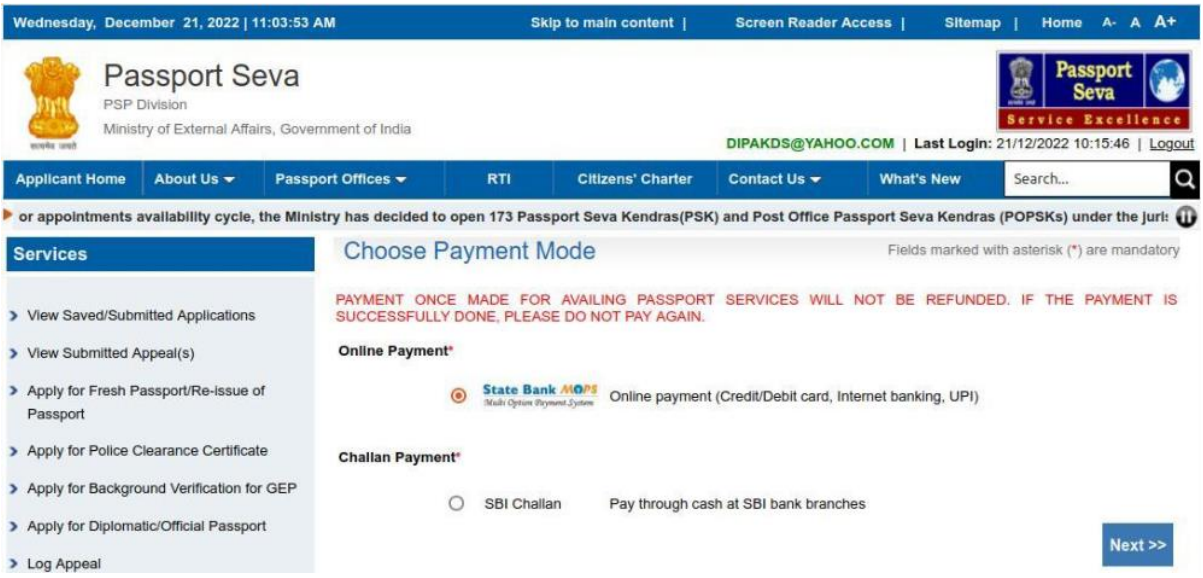


Fig. 4.12 Pay and Book Appointment

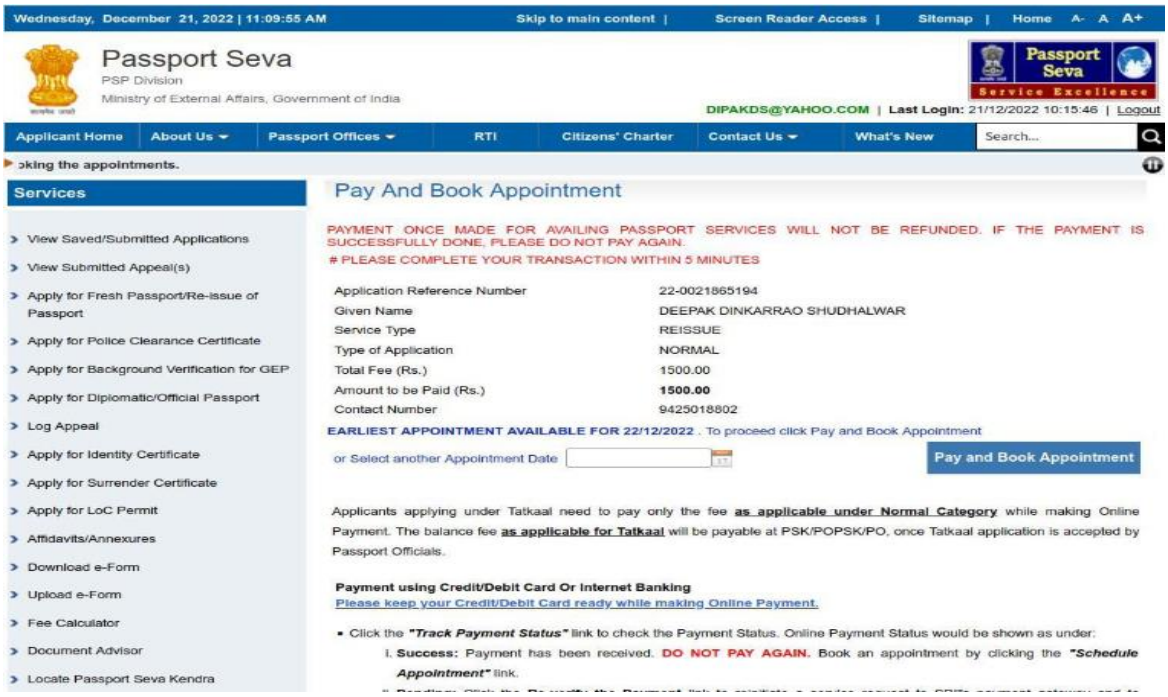


Fig. 4.13 Choose Payment Mode

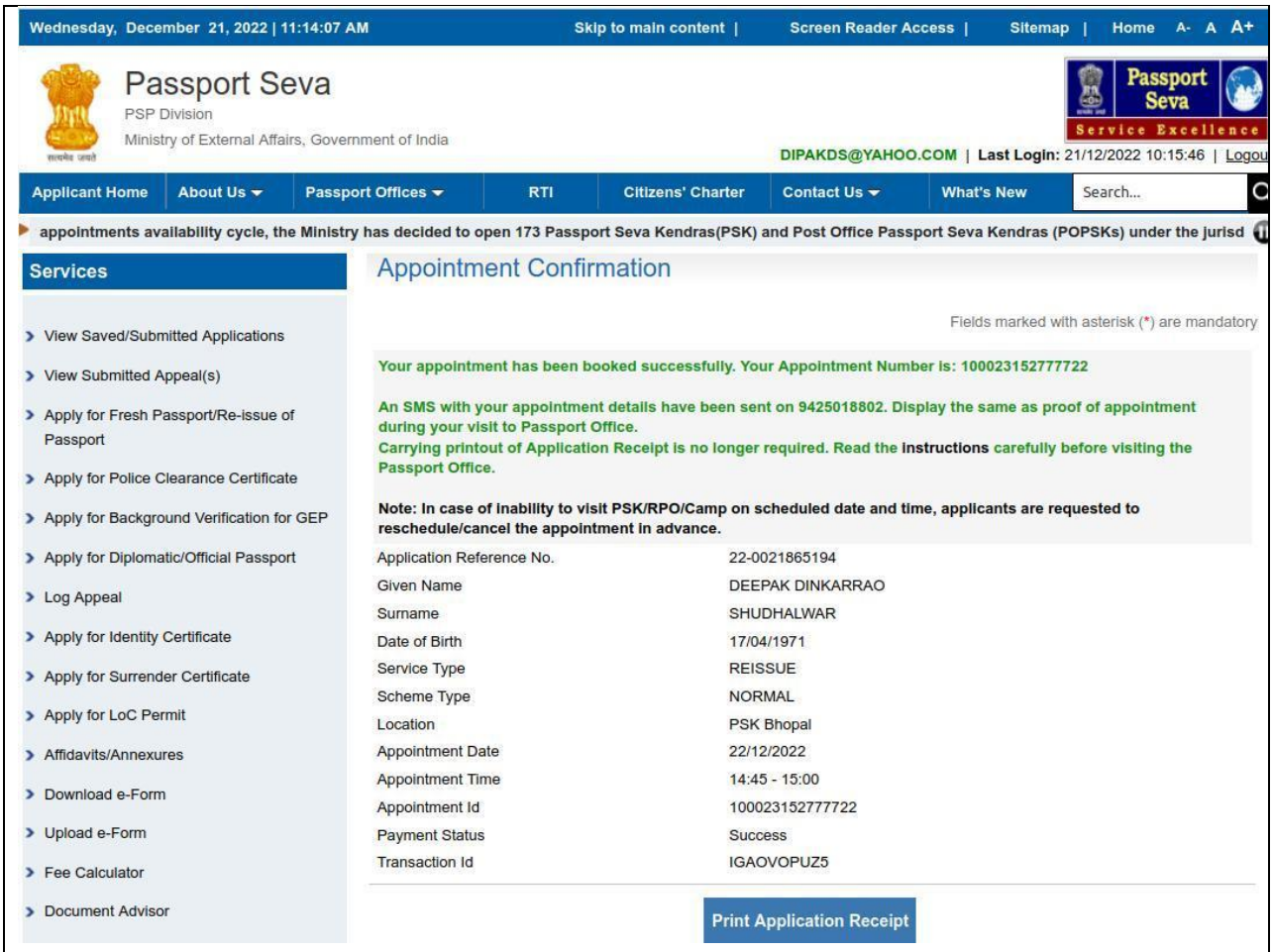


Fig. 4.14 Appointment Confirmation

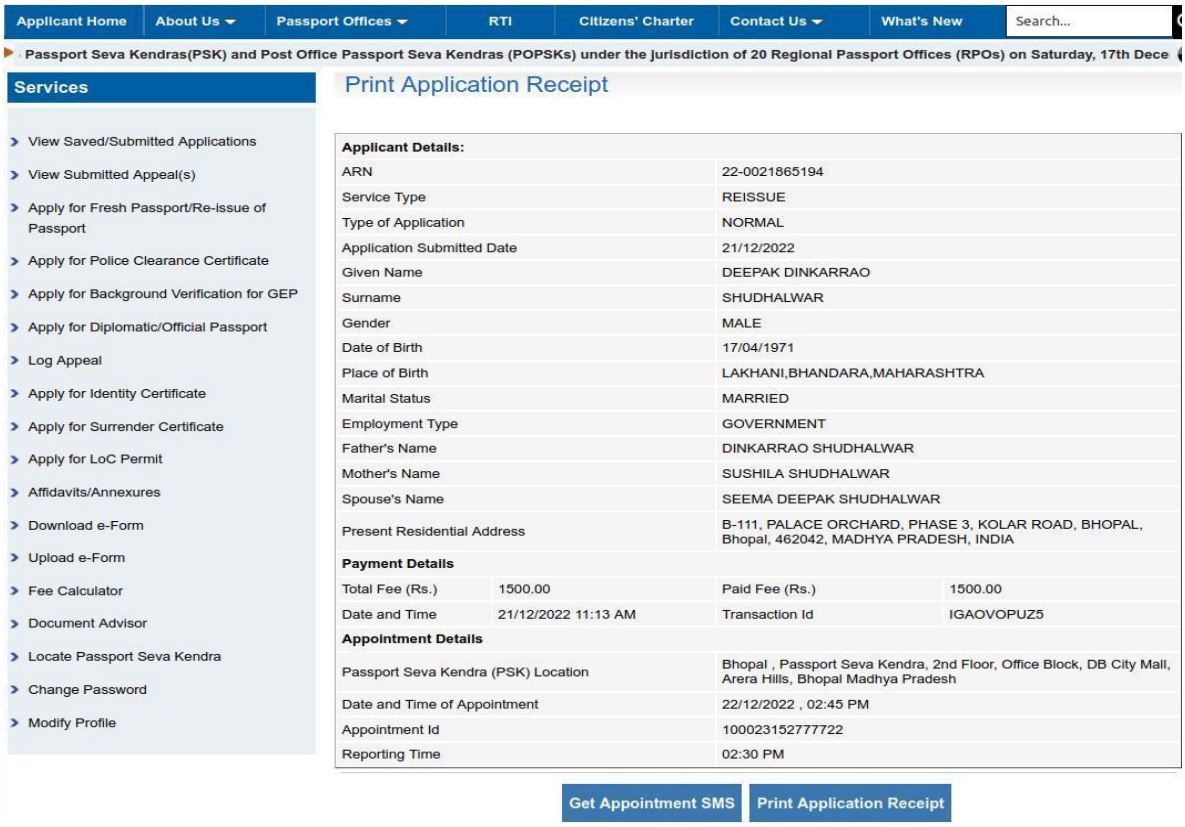


Fig. 4.15 Print Application Receipt

Setup required in preparation of passport

Passport seva kendra provides a world class ambiance. Amenities in the passport seva kendra includes helpful executives, self service kiosks, photocopying machines, food and beverage facilities, public poll booth, baby care, news paper, journals and television in a comfortable air conditioning meeting hall. The electronic queue management system ensures the first in first out principle in application processing. A typical ambiance of PSK is shown in Figure 4.16.

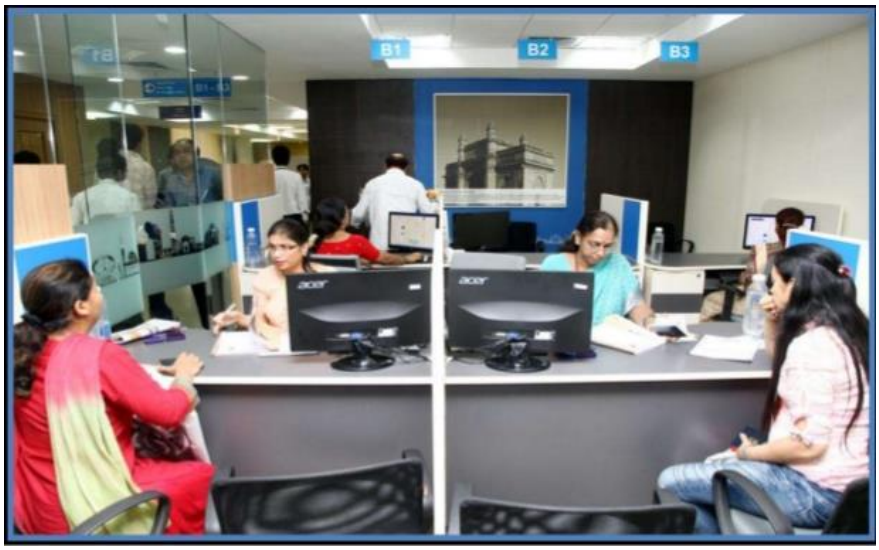


Fig. 4.16 PSK look

Every PSK is equipped with devices that are required to obtain the biometric data. The devices such a fingerprint scanner, digital camera, iris scanner are required to obtain the biometric data. The typical images of such devices are shown in Figure 4.17.

Fig. 4.17 Biometric devices required for passport (fingerprint scanner, camera, iris scanner)

Preparation of passport

Once the visitor visits the passport seva kendra, he will be issued a token. Following steps are carried in the passport seva kendra.

1. In PSK you will be called in batches and you will be passed through security checks. After the security check you will be issued a token number and you will have to wait till your turn will come in the waiting area.
2. Applicants are called in the sequential order based on the token number.
3. Initially the data verification is performed.
4. On the white background your photo is captured by using a high-quality digital camera.
5. Further your other biometric data such as fingerprint and iris is also obtained by using high quality digital devices.
6. All original documents are scanned and uploaded to the passport website.
7. Your original documents are verified then. The data or information entered in the application is matched with that of original documents.
8. Once everything is performed correctly then the passport will be further processed for police enquiry clearance.
9. The whole process may take around one hour or more at PSK. Figure 4.18 shows the typical flow of work at PSK.

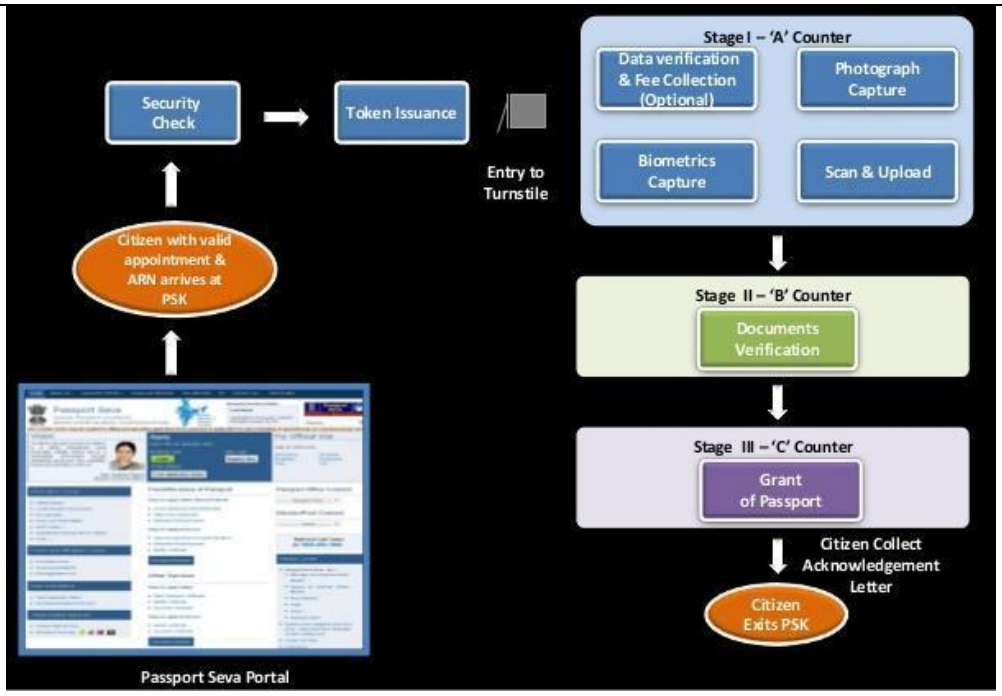


Fig. 4.18 Typical flow of work at PSK

10. Now the user will be intimated to report to the nearest police station through SMS for police clearance. Users can also check the status of the passport application by logging in the passport website.
11. When the user reports to the police station, the concerned police officer will check all the details of the user online by using an appropriate smart tab. The complete history information of the user and his biometric data such as face image is again collected and verified. After this the clearance will be issued to the user.
12. Once the user gets police clearance then his passport will be sent for printing. Once the passport is printed, it will be sent to his official address through a speed post.

Maintenance of the system in preparation of passport

Passport Seva Kendra (PSK) needs to be maintained well to offer good quality of service. It is mandatory to maintain cleanliness in the work environment. The surrounding working temperature must be at a pleasant level by using an air conditioning facility. It is necessary to update the computer software. Regular backup of the data needs to be obtained and it must be kept securely. Over a period of time the computer systems get old and perform slowly. Hence the regular updation in the computer hardware is mandatory. It is necessary to use high level antivirus and firewalls within the systems.

Practical Assignment

1. List the the data items required in the preparation of passport
2. Demonstrate the procedure of preparation of passport
3. Draw the setup diagram of various devices in preparation of passport
4. Demonstrate the maintenance procedure of the biometric system for preparation of passports.

CHECK YOUR PROGRESS

A. Multiple choice questions

1. Which of the following is not the type of passport (a) Ordinary Passport (b) Diplomatic Passport (c) Tatkal Passport (d) Official Passport
2. PSK stands for (a) Passport Service Kendra (b) Passport Seva Kendra (c) Passport Suraksha Kendra (d) Passport Shiksha Kendra
3. Which of the following biometric data is not required for preparation of passport? (a) Face (b) Iris (c) Fingerprint (d) handwriting

B. Fill in the blanks

1. There are _____ main types of passports that are issued to individuals by the Ministry of External Affairs, Government of India.

C. State whether the following statement is True or False

1. Only Indian citizens can apply for their passport in India.
2. All the passport applications are processed online by the Ministry of External Affairs.
3. For online renewal of passport the applicant must have a passport account on the official website of Passport.
4. The requisite fees for processing for the preparation of the passport is paid in online mode only.
5. Only online appointment should be taken to visit the nearest Passport seva kendra (PSK) for preparation of passport.

D. Answer the following questions in short

1. What are the types of documents required to apply for the passport?
2. What are the different biometric data required for preparation of passport?
3. What is a ePassport?

Module 3 Advanced Technologies

Module Overview

We, as human beings, recognise people by their faces. We remember their face pattern in our memory and will immediately recall all the data or information related with that person, when we personally meet them. Machines also can recognise human beings by using advanced biometric technologies. Biometrics technology is used for the recognition of face, plam, finger, iris and character. By using advanced biometric technology, it is now possible to recognise the face of human beings with almost 100% accuracy. Over a period of time these technologies are proved to be reliable and secure.

In this unit we are going to discuss various biometric technologies that are used in face recognition, palm recognition, iris and character recognition. Also, we will discuss the concept of cloud computing that is needed in the implementation of this biometric technology.

Learning Outcomes

After completing this module, you will be able to:

- Understand the fundamental concepts of cloud computing, including its models, benefits, and applications in modern technology.
- Learn the principles and technologies behind face and palm recognition systems, including their applications and accuracy factors.
- Explore the techniques used in thumb, finger, and character recognition, focusing on their implementation in biometric systems.
- Develop skills to identify and resolve common issues encountered in biometric data entry processes to ensure accuracy and efficiency.
- Understand the procedures for effective biometric data entry and the management of incidents related to biometric systems to enhance security.

Module Structure

Session 1: Cloud Computing

Yesterday we went to my friend's marriage ceremony. It was a very colorful event. We all attended the function as Arjun was a popular figure in our degree batch. Everyone demanded Arjun to share all photos and videos of the function. Arjun was able to share all the photos easily. He simply uploaded the photos in google drive and shared the link. He used the power of cloud computing. Can you imagine how much money and effort Arjun would have spent if he copied the photos into a pen drive or dvd disk and sent them to all friends. Most of you would have used Google Search, Mail services and some type of social networking applications. Apart from this we can do a lot of things like send mails, order food, apply for a new course in the university and apply for a passport. Have you ever thought of how these actually work? The PC that you are using has only a small role in the process. The actual work is taken care of by hundreds of networked computers in the background. Without even knowing, you are actually making use of cloud services. Now cloud computing is very effective in almost all fields of life including education, training, research, government and commerce. Figure 1.1 shows how a person can be connected to different services such as Bank, college, electricity board by using the Internet.

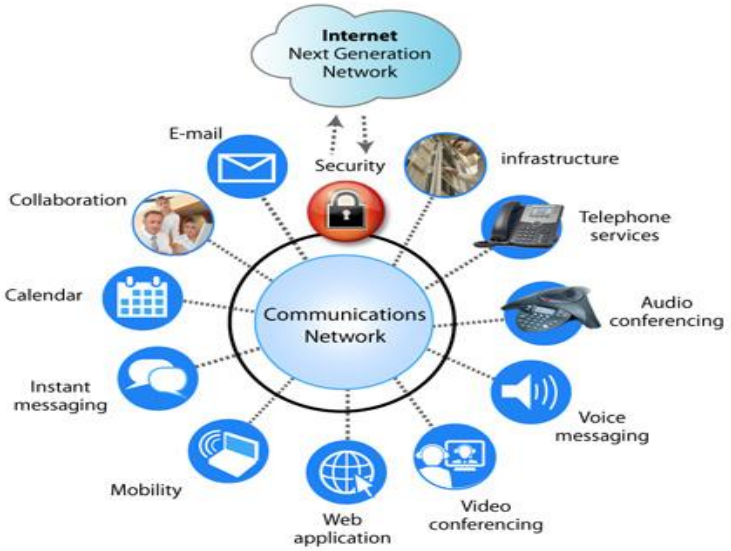


Fig. 1.1 Connection to different services through internet

In this chapter we will understand the basics of cloud computing and its importance in the growing IT oriented world. The term cloud and the concept behind cloud computing is discussed in detail. The basic architecture of cloud computers including user interface systems, internet, backend servers and how these components actually combine together to form a cloud system is also discussed. Familiarising cloud oriented biometric systems will also be covered. We will also explore some of the major cloud service providers like NIC, Google and Apple. Here we also investigate some of the latest networking techniques used in cloud computing. Cloud services always deal with analysis and processing of large volumes of data, technologies like data warehousing and data mart are used widely in cloud computing for managing large volumes of data from different sources.

1.1 CLOUD COMPUTING

Cloud Computing is the computing infrastructure such as hardware, software and network devices available remotely that can be accessed through the internet for use. The services comprise of all kinds of hardware, network devices and operating systems and software. There are various service providers such as Amazon, Google, Microsoft to offer these services through the internet. Some of them are freely available. For example Google provides us the services of Gmail, Google Drive, Google meet and many others which are freely accessible. In case we require a virtual machine and to use any proprietary software we need to take these services on cost basis from cloud service providers such as Google, Microsoft, Amazon and many others.

To give an example of cloud services, suppose you want to use an email service, you will require the hardware of an email server to send, receive and store your mails and software such as an email client to access the data and operations in your email server. Instead of purchasing this hardware and software, if you use a cloud based mail service like Gmail, Yahoo or Outlook, you need only a device, with an app or a browser, connected to the internet. So when we send an email or post an image in social media, the email will be initially forwarded and stored in the email service provider's server located in a remote place. After that, when the recipient switches on the computer it will be forwarded to his computer using the internet. Here the email service provider will have the cloud server located somewhere which can offer the services required for

storing and retrieving emails sent by different persons. We use cloud services while storing our pictures and videos on social media like Facebook, Tweeter and Instagram.

It is possible to run a big application or process a large amount of data through cloud services without having the required storage or processing power on their personal computer as long as they are connected to the Internet. Besides other numerous features, cloud computing offers cost-effective, on-demand resources. A user can avail need-based resources from the cloud at a very reasonable cost.

With the advances in technology, there is a high demand for efficient storage technologies and computational power since millions of users are accessing, sharing and processing data around the world. Cloud computing enables the user to store and process more data than the capacity of a normal PC. Figure 1.2 shows the cloud computing environment.

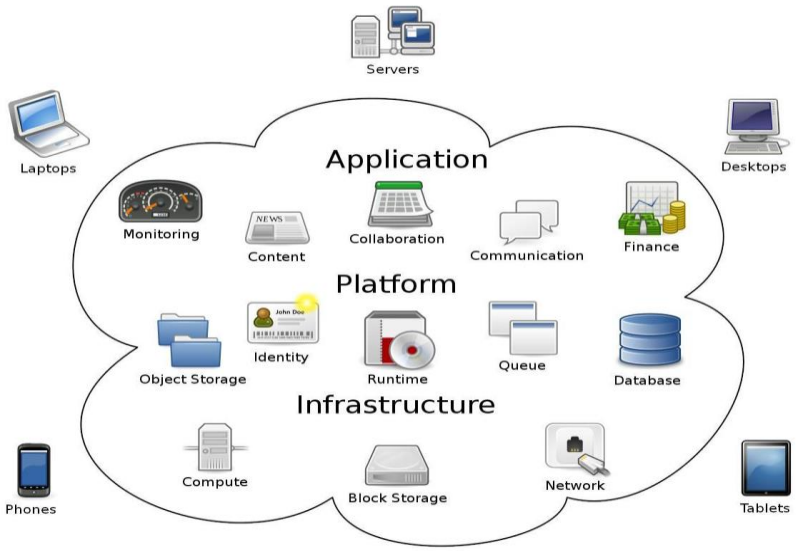


Fig. 1.2 Cloud computing environment

Advantages of cloud computing

Cloud computing is an essential part of modern computing. There are several advantages of cloud computing as mentioned below.

Cost saving – It is expensive to establish and maintain computing infrastructure. Cloud computing saves a lot of cost by availing the computing infrastructure at minimal cost. Some services are offered free of cost also.

Automatic Software Updates – Software and security are regularly updated by software vendors on behalf of the users.

Mobility – In cloud computing employees of the orgnisation can access the computing infrastructure and services in real-time from any location or device.

Scalability – Cloud computing can scale up or down the IT features based on the requirements.

Disaster Recovery – In cloud computing there is no permanent data loss in case of a disaster.

Data Security *– Cloud computing offers many advanced data security features to guarantee data safety and security.*

Time saving – Cloud computing offers competitive advantage to save time on installations.

High speed – Cloud computing services are deployed quickly and all the resources made available immediately.

Backup and restore data – The time consuming process of data backup and restoring can be easily done with cloud services.

Software and hardware integration – In cloud services, software and hardware are integrated with each other.

Reliability – Cloud services are highly reliable services.

Unlimited storage – Almost unlimited storage is offered for all types of data under cloud services with a very nominal fee.

Disadvantages

Technical issues, downtime, security threat, internet connectivity and lower bandwidth are certain disadvantages of cloud services.

Examples of Cloud Computing Uses in Everyday Life

Cloud apps and platforms have a lot of uses in everyday life. There are many examples of cloud computing uses that make work efficient. You might be using any of the following.

Cloud Computing in Chatbots – Chatbots are virtual assistants to know your preferences. Currently there are many applications using chatbots for improving the use of applications. It requires gathering the user's personal information and that requires a platform to store the large amount of data. To store huge amounts of people's information, these chatbots use cloud computing. For example, Facebook's data warehouse alone stores 300 petabytes of data. When you ask your Siri or Amazon Alexa to play a song, they will take note of it. You might get surprised when your apps start to suggest other songs of the same genre.	
Cloud Computing in Communication – Uses of cloud computing in messaging apps are also common. In normal SMS, the messages are stored only on your device. But with messaging apps such as WhatsApp, Facebook Messenger and email apps that use the cloud, you could access your information on any device. This is one of the examples of cloud computing uses. With normal SMS, data could be destroyed once your device is destroyed. But with messaging apps that use the cloud, your data is safe even when your device breaks. The flexibility of cloud computing is able to handle this huge amount of information.	

Cloud Computing in Productivity – Google Docs is well-known productivity software that uses cloud computing that makes your document secure. Suppose you have to submit or present some important document and as a matter of confidentiality you don't provide the access to others for editing or modifying a document. If you forgot to carry your laptop and if you had created that document in Google Docs then you can use any computer connected to the internet to share that document or print that document. In the same way it is possible to use compilers and interpreters to execute your program, databases and any kind of software.	
Cloud Computing in File Recovery – Loss and destruction of data are just some of the major concerns in modern life. Physical storage devices are prone to destruction. For example, destruction of a hard drive or flash drive also means the destruction of its contents. Malware is another factor in the destruction of data. So, it is important to have your information backed up. Dropbox and Google Drive are examples of cloud computing platforms for storing the backup.	
Cloud Computing in Social Media – The social media platforms are considered cloud platforms. Facebook, Twitter, LinkedIn, and MySpace also use cloud computing. Just imagine how many words or photos are posted on these platforms every day. About 500 million tweets are posted on Twitter every day. Cloud computing helps this platform to store huge amounts of data. The traffic within these sites is incredibly heavy. But, cloud computing helps them handle this traffic.	

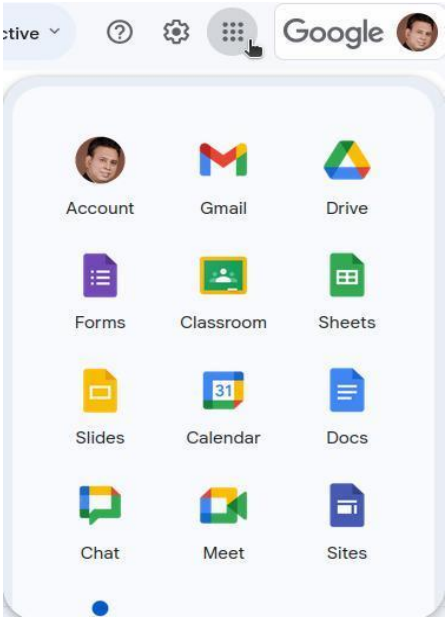
Practical Activity 1.1. Explore the cloud services offered by Google for Education.

Materials Required.

Computer with internet connection

Procedure

Step 1. Open your Gmail account and click on the Google app icon to view the various Google apps as shown below.



Step 2. Explore the Google apps useful for Education. Identify and name the Google Workspace for Education.

Step 3. Write the use of these cloud services in Education offered by Google.

Cloud Service Models

Cloud solutions come in three primary service models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). It is shown in Figure 1.3.

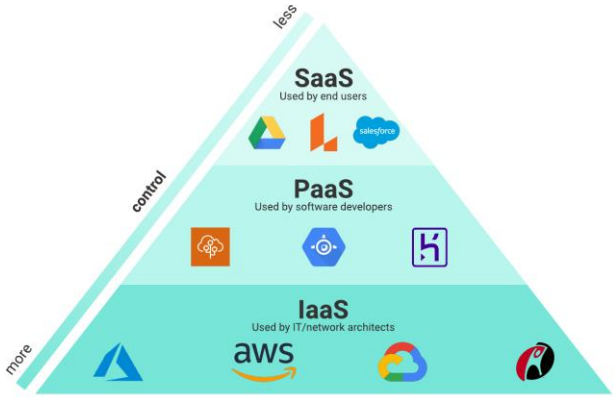


Fig. 1.3 Cloud Service Models

(a) Infrastructure as a Service (IaaS)

IaaS provides access to computing infrastructure, such as servers, virtual machines (VM), storage and backup facility, network components, and operating systems. Using IaaS from the cloud, a user can use the hardware infrastructure located at a remote

location to configure, deploy and execute any software application on that cloud infrastructure. Thus, the cost of purchasing and setting up, maintenance and security of the required hardware and software can be saved. Some popular examples of Iaas platforms are Amazon Web Services (AWS), Microsoft Azure, Google Compute Engine (GCE), Google Cloud Platform (GCP)

(b) Platform as a Service (PaaS) – The PaaS provides a platform or environment to develop, test, and deliver software applications. Suppose we have developed a web application using MySQL and Python. To run this application online, you can avail a pre-configured Apache server from cloud having MySQL and Python pre-installed. In PaaS, the user has complete control over the deployed application and its configuration. It provides a deployment environment for developers at a much reduced cost without buying and managing the underlying hardware and software. Google App Engine, Microsoft Azure, Openshift and Oracle cloud are examples of Paas.

(c) Software as a Service (SaaS) – SaaS provides on-demand access to application software, usually requiring a licensing or subscription by the user. SaaS from cloud can be used while using Google doc, Microsoft Office 365, Drop Box to edit a document online. Like PaaS, a user is provided access to the required configuration settings of the application software that they are using at present. In all of the above standard service models, a user can use on-demand infrastructure or platform or software on a charged basis. Microsoft office 360, Google G-Suite, Zoho, and Salesforce are common examples of Saas. The Government of India has embarked upon an ambitious initiative — 'GI Cloud' which has been named as 'MeghRaj' (https://cloud.gov.in).

Cloud Deployment Models

There are multiple cloud deployment models through which they can make their services. Following types of cloud models are available for the consumers.

(a) Public cloud – It is the most common and popular deployment model available for use by the general public. It is entirely owned, deployed, monitored, and managed by the cloud service provider. Public clouds provide the same services to all its users from individual users to enterprises, using the same shared infrastructure.

Example: DropBox provides storage space to the general public. Google provides Gmail and other cloud servers to the general public

(b) Private cloud – It is available only to users within a single organization. The private clouds are also called corporate, enterprise or internal clouds. It provides an additional layer of security through an enterprise firewall. This makes it more secure.

Example: Any organisation for confidentiality reasons doesn't want to use the public cloud service, they can build their own servers and make it available to their employees through the internet.

(c) Hybrid cloud – A hybrid cloud is a combination of public and private cloud models. In hybrid clouds, the different clouds are bound together at a network level but remain individual entities. This model takes advantage of secured applications and data hosting on a private cloud, still enjoying rapid elasticity by keeping shared data and applications on the public cloud. It is a popular cloud solution because it allows organizations greater flexibility to meet their IT needs.

Example: If any organisation wishes to conduct a large-scale study involving complex data, and also to maintain confidentiality, they would have to rapidly scale up for the big project and then reduce capacity after it finishes. In such a case, instead of investing

in hardware to accommodate the short-term need, they can send the extra workload to a public cloud and use its computing power to facilitate data analysis. The private cloud will continue to support regular operations.

CLOUD SERVICES IN RELATION WITH BIOMETRIC DATA SERVICES

All of us are using Aadhar cards as a unique identification card for various purposes. Apart from our demographic data such as Name, Age, Sex, Address, Date of Birth, Aadhaar card holds our biometric data such as fingerprint, palm, iris and facial image. Can you imagine the volume of data if all 140 crore people in India register for Aadhaar. Is it possible to store that much data in a computer and retrive it on demand? According to the Unique Identification Authority of India (UIDAI), the UID application is using cloud services to store this large amount of data. The e-Governance cloud platform called MeghRaj Cloud is used to store Aadhaar related data. When we use Aadhar for identification, our data will be pulled out from the cloud server and verified.

Biometric-as-a-Service

Biometrics-as-a-service (BaaS) models as shown in Figure 1.4 perform as per the SaaS model (Software-as-a-Service). It performs biometric matching operations in the cloud platform and provides it as a service.

The growing use of biometrics technology in different domains, utilizes an individual's biological traits like fingerprint, face, IRIS, and palm-vein images to verify the identity of a person accurately. Another technology of cloud computing is being used for securely storing and sharing data over the internet. It is marking a new wave of digitization by building an on-demand environment and network-centric infrastructure. This led to the emergence of unique & novel technology known as Biometrics-as-a-Service.

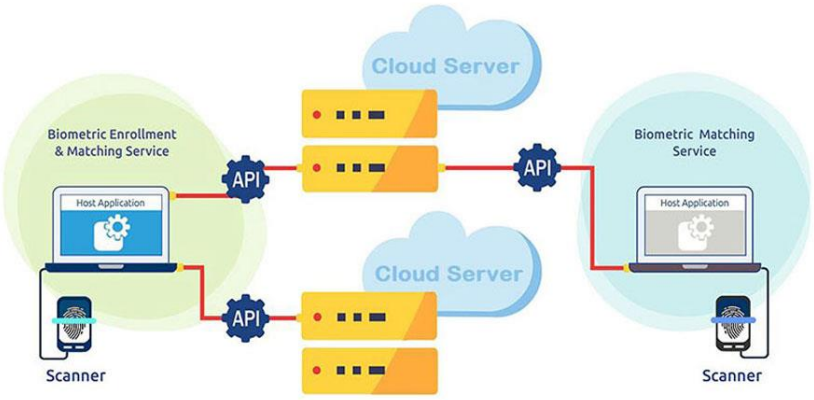


Fig. 1.4 Biometrics-as-a-service (BaaS) model

Taking biometrics to the cloud platform no longer requires building any additional software infrastructure and databases to add, store, update, or share biometric templates or information of a person. Additionally, being on the cloud, biometric services will be accessible from anywhere at any time (Biometrics-on-demand) and will be more secure than before.

BaaS infrastructure is built acutely upon the cloud platform consisting of networking, biometrics template databases, storage components, and any other kind of automation or processing components needed to identify an individual. Enabling biometrics recognition over the cloud will eliminate multiple hardware & software requirements as the only hardware it requires is biometric scanner devices like IRIS sensor, fingerprint scanner, facial and palm-vein recognition devices.

Need for Biometrics-as-a-Service

The traditional biometric authentication processes focus mainly only on acquiring biometric traits rather than data security. It captures an individual's biometric data (fingerprint, palm-vein, IRIS, or facial images) and converts it into templates for storage. The biometric details transmitted over public networks can be easily copied or extracted.

Cloud-based biometric identification & authentication (BaaS) can be an appropriate solution for private and government organizations as it offers complete security and processes the biometric authentication to run rapidly & securely through cloud services as shown in Figure 1.5.

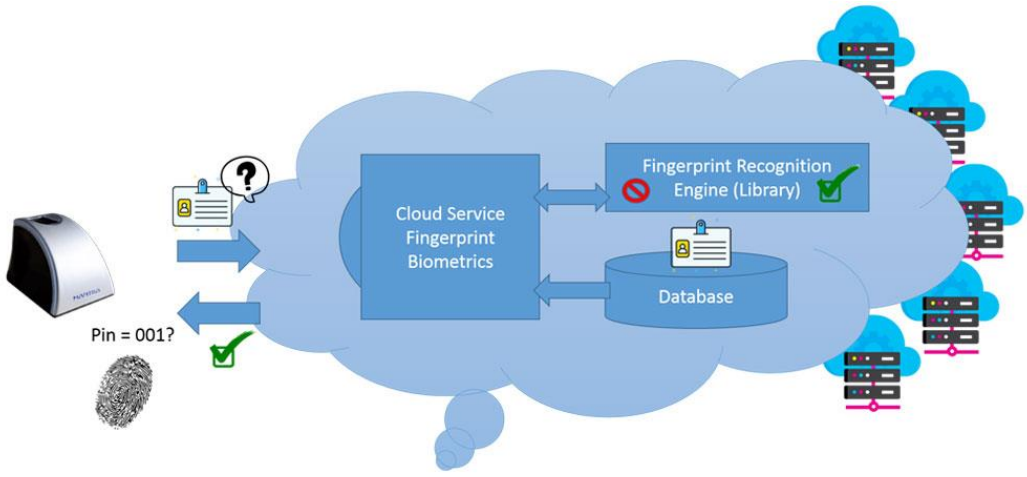


Fig. 1.5 Cloud-based biometric identification & authentication (BaaS)

By replacing conventional password or PIN-based authentication systems with BaaS, the service providers can streamline customer services without the need for any time-consuming & expensive resource-intensive software processing.

At present the Aadhaar service center uses the biometric devices connected to the local computer, but the data is being stored in the cloud. Modern biometric systems like Aadhaar Enabled Biometric Attendance System (ABAS) can share data with a remote centralized server over the internet. Employees of any office can mark their attendance in any geographic region using biometric data if that office is connected with the central cloud system.

With cloud computing, individual organizations need not to invest in the hardware, applications, and infrastructure. The cloud offers the services to run attendance recording, access control, desktop fingerprint reader, or any other specialized software on dedicated servers located all around the world. An authenticator can efficiently access biometric cloud infrastructure by simply connecting the biometric identification device with the cloud application.

The Practical Activity 1.2 illustrates the process flow of Aadhaar Enabled Biometric Attendance System.

Practical Activity 1.2. Draw the Process Flow of Aadhaar Enabled Biometric Attendance System

Materials Required

Computer, Drawing tools, Paper

Procedure

Step 1. Search on the internet about the Process Flow of Aadhaar Enabled Biometric Attendance System just like in Figure 1.6.

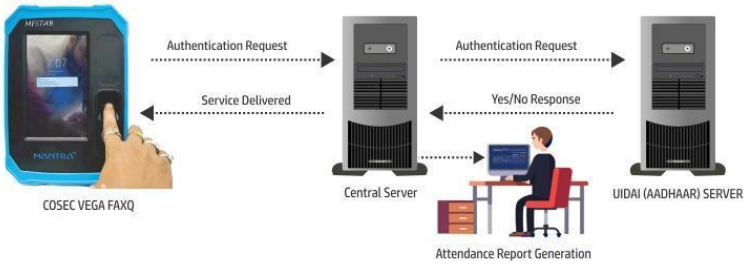


Fig. 1.6 Aadhaar Enabled Biometric Attendance System Process Flow

Step 2. Observe the Process Flow and identify the cloud service used in this process.

Step 3. Draw this diagram on paper and label the devices and path of authentication.

Connecting a USB biometric device to the cloud

In order to start communication, the biometric identification device should be connected to the cloud services through software application or app. There are various apps designed for this purpose. We will consider one such app known with the name ***FlexiHub***.

We will use this as an example for connecting USD biometric devices to the cloud.

Practical Activity 1.3 illustrates connecting USB biometric devices to the cloud using the app ***FlexiHub***.

https://www.flexihub.com/biometric-device-to-the-cloud/

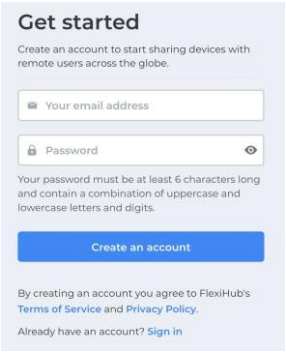
Practical Activity 1.3. Demonstrate to connect a biometric device to the cloud using the app *FlexiHub*.

Materials Required

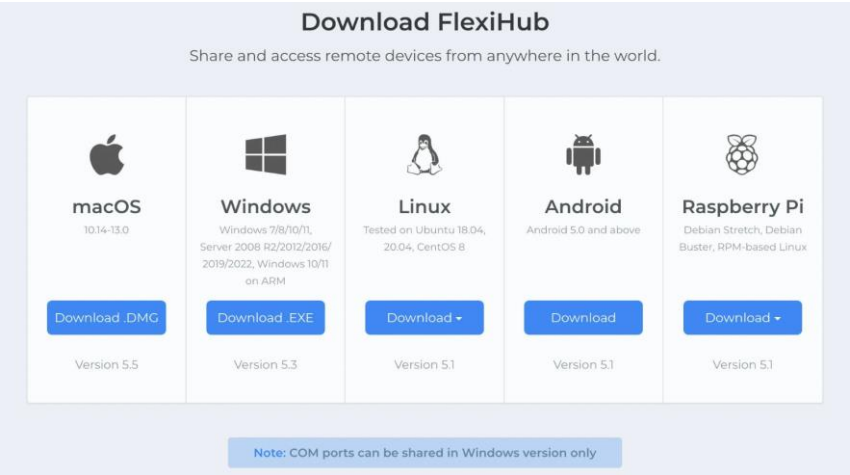
Computer with internet connection.

Procedure

Step 1. First register your account on the FlexiHub website https://www.flexihub.com.



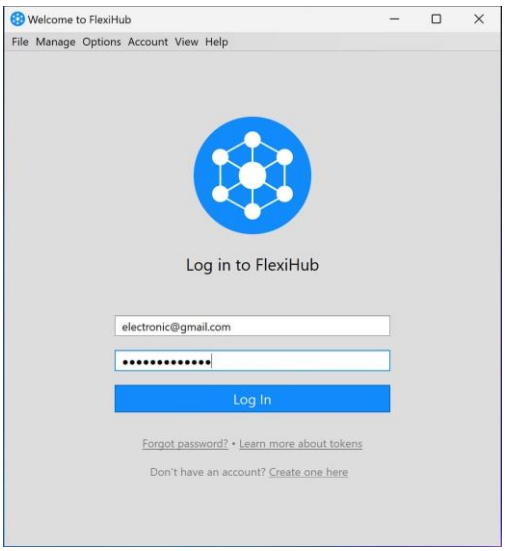
Step 2. Connect the fingerprint scanner that you want to use in the cloud to your computer's USB port. Download the app on this PC (or Mac).



Step 3. Start FlexiHub and log in to your account.

You will see the list of devices that are physically connected to your machine. Once you access your account, all of them become available for connection from a remote computer (real or virtual).

Note: For security reasons, some of the devices may need to be unlocked before they can be accessed from another PC.



Step 4. Install FlexiHub on the cloud desktop. Start the app.

Step 5. Log in to your account. The shared devices will be shown in the software interface. All you should do is find the USB fingerprint scanner and click the "Connect" button next to its name.

The device can now communicate with any dedicated app running in the cloud as though it were plugged directly into the virtual machine.

Whether you are using a Civil PIV Sensor, a U.are.U® 4500 Fingerprint Reader, a Futronic Fingerprint Scanner 2.0, a Goodix FingerPrint, or any other popular biometric device, FlexiHub will come in handy.

CHECK YOUR PROGRESS

A. Multiple Choice Questions

1. In cloud computing the user's data is stored in the (a) User's computer (b) Remote server (c) local server (d) Pen drive
2. Which of the following is is not cloud based system? (a) Gmail (b) Facebook (c) Notepad (d) Google Drive
3. Which is not an advantage of Cloud computing? (a) Improved performance (b) Low maintenance cost (c) High storage capacity (d) No need of internet
4. Which of the following cloud server is used for Aadhar System (a) Google (b) MeghRaj (c) Apple (d) Facebook
5. Which of the following is not a cloud service providers (a) School (b) NIC (c) Google (d) Apple
6. Which of the following services are offered under cloud computing (a) Software (b) Hardware (c) Network (d) All of the above
7. The user can use the cloud services through (a) LAN (b) Internet (c) Satellite (d) Personal computer
8. Which of the following social media is using the cloud services for storing pictures and videos (a) Facebook (b) Tweeter (c) Instagram (d) All of the above

B. Fill in the blanks

1. The private cloud provides an additional layer of security through _____ .
2. The biometric details transmitted over public networks can be easily _____ or _____ Public cloud is owned, deployed, monitored, and managed by _____
3. The biometric services will be accessible from anywhere at any time is called as _____
4. In cloud computing the computing infrastructure and services can be accessed in real-time from any location or device is called as _____

C. State whether the following statements are True or False

1. Cloud services cannot be availed without internet
2. The data is not secure under cloud storage
3. For Aadhar identification, our data is pulled out from the cloud server and verified.
4. A hybrid cloud is a combination of public and private cloud models.
5. Public clouds provide additional services to enterprises than the individual users.
6. Google Drive is an example of a public cloud.
7. Private cloud is more secure than public cloud.
8. The private clouds are owned by private organisation
9. Cloud services are not reliable.
10. In cloud based messaging apps data is not safe and secure.

D. State the long form of the following acronyms.

1. AWS –

2. BaaS –
3. GI Cloud –
4. GCE –
5. GCP –
6. IaaS –
7. PaaS –
8. SaaS –
9. SDN –
10. VM –
11. UID –
12. UIDAI –

E. Answer the following questions in short

1. Name any three occasions that make use of cloud computing in real life.
2. What is the meaning of the term cloud in information technology?
3. What is data warehousing ?
4. List basic elements of general cloud architecture.
5. Explain Software Defined Network (SDN) .
6. Briefly explain basic architecture of a cloud computing system..
7. Explain any three cloud services available ?
8. What is the use of cloud computing in biometric data processing?
9. State the advantage of cloud-based biometric systems over traditional biometric system?
10. Give the examples of Infrastructure as a Service.
11. Give the examples of Platform as a Service.
12. Give the examples of Software as a Service.

Session 2: Face Recognition and Palm Recognition

Rahul, a young industrious entrepreneur, has started a firm in the banking domain. Last year he had a strength of 50 employees in his office. Since his firm deals with highly confidential data from different banks he cannot take risk of entering outsiders into his office premise, for this Rahul needs a system to authenticate his employees and manage their attendance automatically. (Figure 2.1) Also, he is looking for a system which is comfortable, fast, less error prone and hygienic. He definitely doesn't want the punching device that records fingerprints in old fashion as it is time taking and less hygienic. In his research Rahul understood that now face recognition systems are available which are fast and advanced. It can authenticate the employees with ease too in a hygienic way.

Fig. 2.1 Face recognition attendance system

Worldwide the adoption rate for biometric data has increased tremendously in recent years. With advanced technologies and new algorithms, face recognition systems are working close to 100% accuracy. All major companies including Apple, Google, Facebook and Amazon already have very good face recognition systems. Many industries including mobile phones, airports, healthcare, security, corporate, and government are choosing biometric data as the preferred method to identify individuals.

In this chapter, we will study the advanced biometric technologies of Face recognition and palm recognition, which are widely used for identification and authentication purposes. Face recognition and palm recognition has emerged as one of the important ways to identify and authenticate a person. Here we will discuss the advantages, new technologies and algorithms used and limitations of face recognition systems and palm recognition systems in the field of biometric.

Biometric Recognition Process

Recognition based on biometrics is the process for recognition of individuals based on the behavioral and physiological characteristics. Biometrics Recognition Systems is easy to use but hard to implement and maintain. It is very costly. All biometrics recognition systems are using three major processes – *Enrollment, Storage* and *Comparison,* as shown in Figure 2.2.

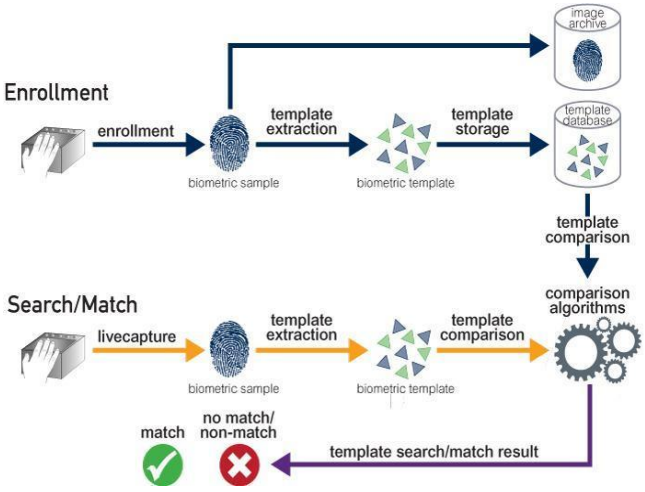


Fig. 2.2 Biometric Recognition Process

Enrollment **–** It is a user-onboarding process under which a system collects user's biometrics data along with personal information such as name, gender, age and then unique identification number allocated to it.

Storage **–** Collected user's biometrics data along with personal information will be stored in some storage. Storage can be either database, file-system, smart-card or any other type of safe storage.

Comparison **–** This is the phase when users re-visit the system periodically. In this process, real-time biometric data will be captured and will be compared to stored data to authentication users

In addition of comparison methodology, there are two mechanisms such as — 1:1 and 1: N

1:1 Comparison

This method can be called as authentication where the user's biometric data will be compared with its own biometrics data stored in the database against its unique id. This is the most accurate, faster and reliable method as comparison happens between single users' captures and stored data.

1: G or 1: N Comparison

This method can be called as identification where a user's biometric data will be compared against a group of user's or whole user's biometric data stored in the whole biometrics database to find out the user's unique id for which real-time biometrics are captured. This methodology is less accurate, time-consuming and less reliable due to FAR consideration because it might be possible that one user's biometrics can match little with another user's biometrics.

Biometric Standards

Most popular biometrics modalities such as Fingerprint, Iris and Face have their own standards defined by ISO (International Organization for Standardization) having website address www.iso.org.

ISO standard is declared for interoperability of biometrics data which is collected by various types of scanner with various types of methodology. ISO standard brings all biometrics vendors on a common platform for global acceptance of biometrics recognition systems.

ISO standardization specification series ISO/IEC 19794 is applicable to standardize biometrics. IEC is *"The International Electro-Technical Commission"* headquartered in Geneva, Switzerland, is the organization that prepares and publishes international standards for all electrical, electronic and related technologies.

Apart from ISO, for some modality such as fingerprint, ANSI-378 standards are also available. There are also some proprietary formats of biometric data being used by vendors, as given below.

ISO/IEC 19794

As discussed earlier, it is applicable to biometrics with various versions such as –

Fingerprint (Finger Minutiae Record) (Finger Image Record)	ISO/IEC 19794-2:2005 and ISO/IEC 19794-2:2011 ISO/IEC 19794-4:2005 and ISO/IEC 19794-4:2011
Face (Face Image	ISO/IEC 19794-5:2005 and ISO/IEC 19794-5:2011

Data)	
Iris (Iris Image Record)	ISO/IEC 19794-6:2005 and ISO/IEC 19794-6:2011

Other Formats

Biometrics are being used in some other formats also as specified below. Apart from this, there are certain proprietary formats.

Fingerprint	ANSI-378 (ANSI Template) WSQ (Wavelet Scalar Quantization) JPEG2000 (Joint Photographic Experts Group)
Face	JPEG2000 (Joint Photographic Experts Group)
Iris	JPEG2000 (Joint Photographic Experts Group) K3 for cropped image and K7 for cropped and masked image standards.

FACE RECOGNITION

Imagine you are meeting a childhood friend after a long time. But you can identify him immediately by face although you may not remember his name. Have you ever thought about how this is possible?. It is the magic of our brain. Our brain is a super computer. Whenever we see someone, without our knowledge, certain features of our face are stored in our memory. When we meet them again, this knowledge is used to recognise them. Biometric systems using face recognition technologies have the same basic concept. You may have seen mobile phones that can be unlocked by showing your face. Facial recognition is gaining attention everywhere from smartphones to ATMs to airport security checkpoints.

Face is an important part of the body that includes major objects such as eyes, nose, mouth, chin, jaw, forehead and philtrum. These major objects can be called as characteristics of the face. A typical face image with these characteristics is shown in Figure 2.3.

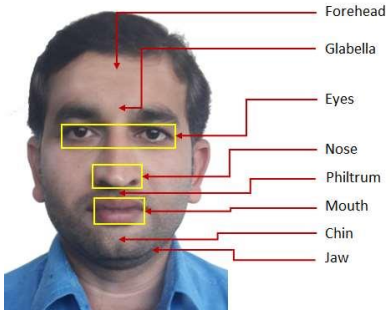


Fig. 2.3 Characteristics of face

Face Recognition Process

Facial recognition technology applies the science of biometrics to facial features. In the face recognition process, the features of the face are extracted. Extraction means calculation and measurement of characteristics of face objects. Extraction process is performed by using algorithms. Further they are converted into a specific format called as a template. Facial recognition algorithms create a biometric template by detecting and measuring various characteristics or feature points, including location of the eyes, eyebrows, nose, mouth, chin and ears. Two templates are compared to match scores. This indicates that the two images belong to the same person.

Image processing techniques such as background removal, projection, histogram, diffusion, transform applied on the face and finally the usable part will be extracted and that will be used for recognition.

In face extraction the size of each part, region, distance between the two parts, angle of the parts, starting and ending of the parts, relative positions of the part is measured. A typical figure for such measurements is shown in Figure 2.4.

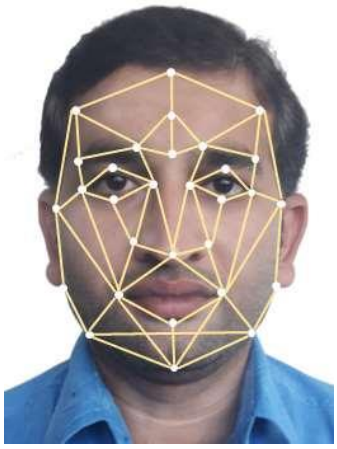


Fig. 2.4 Face extraction measurements

Working of Face Recognition Technology

A facial recognition system is a technology used for identifying or verifying a person from a digital image or a video frame called a faceprint. Faceprint is a digitally recorded representation of a face that can be used for security purposes. There are some parts of our face that makes it unique. Faceprint are just like fingerprints that are used to uniquely identify a person. Faceprint is prepared by mathematically calculating facial features.

In face recognition technology, the commonly used facial features are width, position, size and shape of eyes, nose, cheekbones, jaw, unique lines, patterns, and spots in a person's skin.

Face recognition system will capture these facial features or landmarks using different image processing techniques and store them in the database as faceprint along with persons name and identification number.

In general, all face recognition techniques work by comparing features from a given image with features stored within a database. Any face recognition system will have a database containing the faceprints of all people who can get access, that is a database of known faces. Figure 2.4 shows the general functioning of a face recognition system.

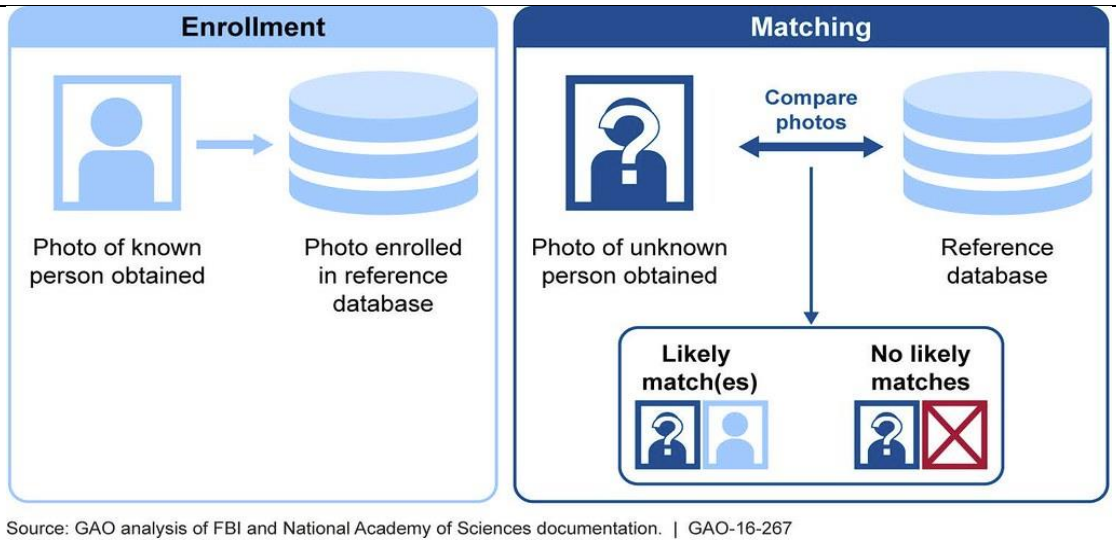


Fig. 2.4 General functioning of face recognition system

Step 1. The important features of faces of persons we want to remember are stored in the system database.

Step 2. Whenever the person tries to access the system, a photo would be taken.

Step 3. The stored data is compared with the data available from the photo.

Step 4. If both matches, access is given.

Facial recognition software

Facial recognition software verifies users by comparing the live image of a person against a database of face images. The process involves the capture, extraction, comparison and matching as shown in the Figure 2.5

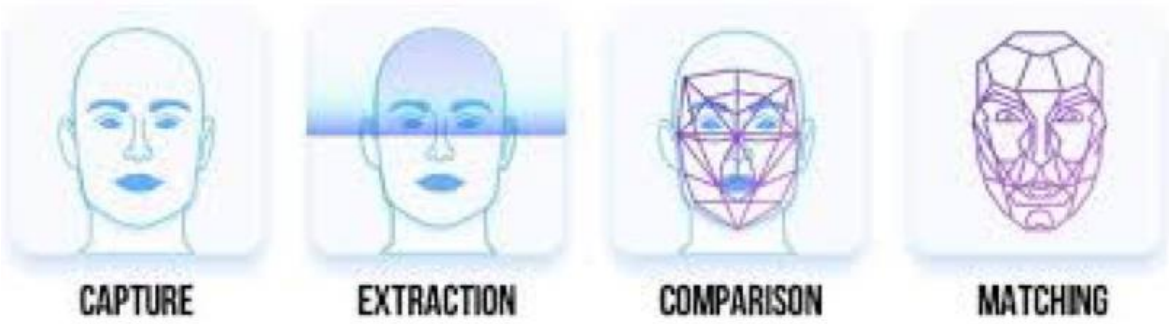


Fig. 2.5 Face recognition process

The general steps for the face recognition process are given below.

Step 1. Capture : Capture a live face image.

Step 2. Extraction : Extract the image to a template (a unique digital “faceprint”).

Step 3. Comparison : Compare the faceprint with the existing templates in the database.

Step 4. Matching : Determine whether the images match.

Major components of this system are – Capturer, Extractor and Matcher.

Capturer **–** is responsible for capturing biometrics samples from the body using specific methods and mechanisms.

Extractor **–** is complex-algorithm to convert original captured data in specific template format that can be further used for comparison.

Matcher **–** is responsible for comparing two biometrics samples and generating confidence-scores. Matcher is the programmatic complex algorithm designed using some graphical comparison methodologies to compare template data.

Accuracy and reliability of the recognition system somehow depends upon quality and accuracy of Capturer, Extractor and Matcher.

Applications of Face Recognition

In the Covid-19 era, facial recognition has become the most popular touch-free authentication technology. As a result, the general public regarded facial recognition as a safe, accurate, and hygienic authentication method. Several governments are using face recognition for surveillance, immigration, and financial services. India's Aadhaar identifying authority, UIDAI is ready to launch the world's most comprehensive facial authentication system soon. This might be used to leverage facial recognition in smart cities, private organizations, financial services, and so on.

Application of Face Recognition in Attendance System

The face recognition attendance system is now a popular attendance tracking method. Facial recognition systems read the unchanging, unique features of a face to identify the person, while an attendance management system tracks, manages, and analyzes the attendance of a person. The face recognition attendance system automates

attendance tracking by visually recognizing the person and registering the attendance. The employees or students need to show their faces to the camera of the attendance management system.

Advancing from Fingerprint to Facial Authentication in Aadhaar

UIDAI – an Aadhaar issuing-body, intends to step towards face recognition for seamless authentication of Indian citizenry utilizing Aadhaar. In the upcoming years, the facial biometrics will be combined efficiently with the pre-existing biometric fingerprint/IRIS verification, acting as an advanced security factor.

The utilization of facial recognition will assist in the Aadhaar verification rate by accurately authenticating those individuals who are unable to verify themselves using fingerprints including elderly persons, children below 5 years, or manual labor workers.

Aadhaar face authentication system working

Facial biometrics is a powerful biometric technology that offers enhanced security. Aadhaar-based face biometrics is easy to use. The following steps show how face-based Aadhaar authentication will work. The process is depicted in Figure Visual adopted from Aadhaar Overview, UIDAI.

Step 1. Individuals reckoning face-based Aadhaar verification/authentication shall stand before registered face recognition machines for a live facial image capture, on-the-spot.

Step 2. Now, besides an individual's Aadhaar No. and fingerprint/IRIS image data, the captured facial biometric data will then be sent to AUAs for gaining access to the Aadhaar authentication facility.

Step 3. Further, it will be transferred to the Authentication Service Agency (ASA) to connect to the CIDR and transmit authentication requests from AUAs to CIDR.

Step 4. Finally, UIDAI's CIDR will check if the face biometric pattern of an exerciser matches with the database.

Step 5. Confirming his/her authenticity, a YES/NO response will be sent back instantly to the system. It is shown in Figure 2.6.

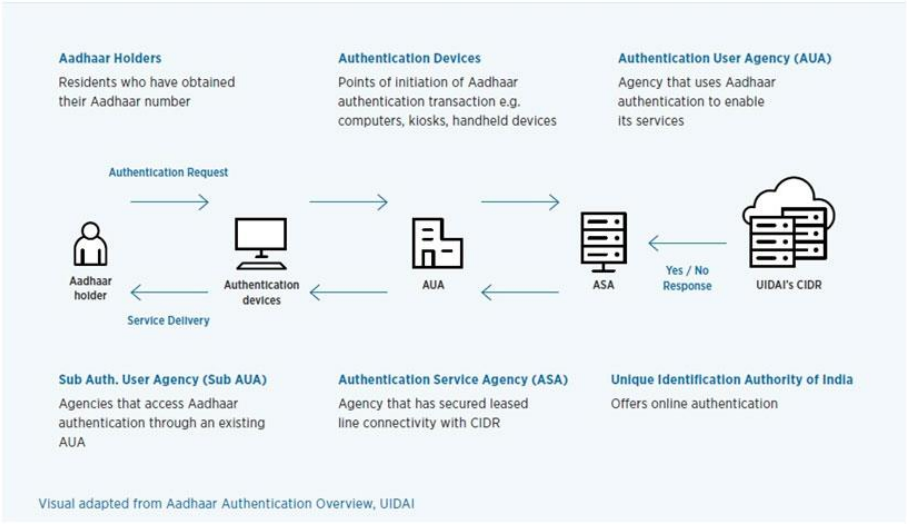


Fig. 2.6 Visual adopted from Aadhaar Overview, UIDAI

There are several benefits of using facial recognition attendance systems such as Accurate & secure, Geofencing, Automated, Contactless and Easy Integration.

Due to various advantages the Face recognition attendance system is useful for tracking the attendance of the employees in various sectors such as Healthcare, Manufacturing, Education, Aviation, Public, Private & Government Sector.

Aviation Sector – A facial recognition attendance management system marks staff attendance whenever they enter their work section. Airport management uses face recognition to expedite the attendance monitoring process and easily segregate employees depending on their work and true identity. For example, the attendance of airport vehicle drivers is marked when they enter the parking area. Plus, it offers a 360° security solution.

Healthcare Sector – Facial recognition of medical staff is very important even while wearing masks and gloves while entering restricted places like ICUs, drug stores, mortuaries, procedure rooms. Facial recognition can authenticate regular patients or those who have registered for health IDs. Doctors can monitor patients from anywhere remotely. They can give consultations from anywhere through the hospital's online platform, where they can verify themself on the facial recognition system.

Education Sector – Attendance marking in the large class in morning and afternoon or in every period is a time-consuming task that wastes teaching hours. The facial recognition cameras installed at the entrance of each class can automatically register the attendance of both students and teachers.

Public, Private & Government Sector – Facial recognition attendance trackers can be implemented at the office doors or integrated into employees' phones or laptops via cloud service. The employees going for the on-field work in the private sector, need not to carry an access card, keys, or any special sensor device for this.

Future Applications of Face Recognition

Facial recognition in Law & enforcement **–** CCTV cameras are already using facial recognition to spot people with criminal histories. India's National Crime Records Bureau (NCRB) plans to establish a nationwide facial recognition system. The system would include a centralized web application that will connect surveillance CCTV cameras at the NCRB Data Center in Delhi. The technology will automatically identify persons from CCTV footage.

Emotion detection **–** AI assisted facial recognition can recognize human facial expressions such as joy, contempt, happiness, surprise, fear, or sadness. Emotion detection at restaurants and hotels is used to read customer satisfaction. It can be used at hospitals to read the patient's condition.

Face detection at smart cities **–** Face detection CCTV camera networks can guard smart cities. A CCTV network can detect threats, people who dump rubbish in public and provide access control for parking lots, parks, and other public spaces.

Facial detection at sports events **–** Facial recognition at major sports events such as Olympics and Football World Cup is evolving rapidly for security and ticket booking.

Banking **–** India's UIDAI is using face recognition for security and KYC purposes in banks. Face authentication can ease the security check for mobile banking. ATM networks can restrict certain threat people from using ATMs by detecting them.

Liveness detection – Liveness detection improves security and reliability by detecting the liveness of skin that is present before the face recognition camera. As a result, the

use of synthetic skins and cosmetics to impersonate others can be avoided at the security check at airports and for financial services.

Voters verification – Face recognition can be used to authenticate the identification of voters.

Practical Activity 2.1. Illustrate imagination of working of facial recognition system

Materials Required.

Pen, Paper

Procedure

Step 1. Identify a person not familiar with you.

Step 2. Close your eyes for a while and try to list out important features of his face.

Step 3. That is eyes, nose, cheek bones, forehead or chin.

Step 4. Draw a rough picture if possible

Step 5. Verify your picture with the person once again.

Step 6. Analyze the result.

Practical Activity 2.2. Identify and list out the applications of face recognition systems in your surroundings.

Materials Required.

Pen, Paper, Computer , Web cam, Smartphone

Procedure

Step 1. If you are using the smartphone then explore how you can unlock your smartphone using face recognition.

Step 2. Visit the various government or private organizations where the face recognition system is being used for marking the attendance of employees. Observe the procedure for marking the attendance through face recognition attendance system. List out the device used in this system.

Step 3. Visit the bank and observe how facial recognition biometric systems are being used for various purposes. List out the five applications of facial recognition systems in the banking and financial sector.

Step 4. Identify how the facial recognition system is used in home security.

Step 5. Identify how the facial recognition system is used in Airport.

Step 6. Identify how the facial recognition system is used in Access control.

Step 7. Identify how the facial recognition system is used in Supermarkets.

Practical Activity 2.3. Demonstrate the use of facial biometric attendance system in your school or other institution

Materials Required

Pen, Paper, Computer, Attendance management System

Procedure

Step 1. First we obtain a good quality image of the face from an appropriate angle.

Step 2. In the next step of preprocessing slightly enhance these images to get more accurate information of the face and store it in the system database.

Step 3. Observe that when marking attendance in front of the face recognition biometric attendance system, every time an employee image is compared with the stored images.

Step 5. If a match is found corresponding employees attendance is marked for the day with time of entry.

Step 6. Same procedure is applied when the employee leaves for home in the evening, and the time of exit is marked.

Step 7. Total time in the office is calculated based on the above data, a report is generated based on this.

Now we can check some algorithms and techniques commonly used in face recognition systems and processing facial images. Traditional approaches in face recognition, transition from two dimensional to three dimensional systems, and combining different techniques for better results. Also we can see some emerging trends in face recognition.

Traditional Approaches

In traditional systems, some algorithms involving face recognition work by identifying facial features by extracting features, or landmarks, from the image of the face. These features, or landmarks include shape and size of the eyes, the size of the nose, and its relative position with the eyes, cheekbones and jaw etc. These extracted features would then be used for searching other images that have matching features.

There are algorithms which normalize the face images and then compress the face data, which only saves the data in image that is useful for face recognition. Template matching techniques was one of the earliest successful systems that used a set of selected facial features, providing a sort of compressed face representation.

Recognition algorithms can be classified based on different aspects. One of the main divisions is geometric and photometric approach, while geometric approach looks at distinguishing features, the photometric approach, which is a statistical approach that converts an image into values and compares the values with templates to eliminate differences. Another classification of these algorithms into two broad categories: are holistic and feature-based models. The holistic model attempts to recognize the face in its entirety (full form) while the feature-based subdivide the face into components based on selected features and analyze each as well as its spatial location with respect to other features.

Traditional algorithms have proved to be highly inaccurate as well as inefficient. These algorithms have not given good results and they are not scalable because there are many people who have similar facial features.

Over the years, the industry has moved towards Deep Learning. Convolutional Neural Networks have been employed lately to improve the accuracy of face recognition algorithms. These algorithms take images as input and extract a highly complex set of features out of the image. These include features like width of face, height of face, width of nose, lips, eyes, ratio of widths, skin color tone and texture. Basically, a Convolutional Neural Network extracts out a large number of features from an image. These features are then matched with the ones stored in the database.

Eigen face algorithm, SIFT (Scale-Invariant Feature Transform), SURF (Speeded Up Robust Features) and LBPH (Local Binary Pattern Histogram) algorithms are some examples of face recognition algorithms. While lot of commercial players are competing in the market, there are some academic projects also making headlines in face recognition field. The **GaussianFace** algorithm developed in 2014 by researchers at Hong Kong University achieved facial identification scores of 98.52% compared with the 97.53% achieved by human, though GaussianFace have many other limitations. *DeepFace* form *Facebook*, *FaceNet* from Google and *Rekognition* from *Amazon* are some of the important players in the market.

The recognition of the face is performed by using two popular approaches called Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA). Note that both of these approaches are used in appearance based recognition systems. If a model based recognition system is used then a 2D model or 3D model of face recognition is used. Another approach for face recognition is to use neural networks. In neural networks, a support Vector Machine (SVM) is used for recognition of faces. Figure 2.7 below shows the various approaches for face recognition systems.

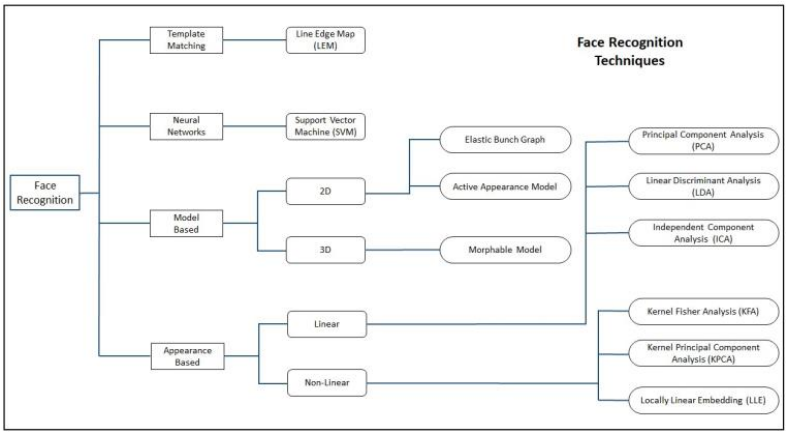


Fig. 2.7 Various approaches for face recognition system

Principal component analysis (PCA)

In PCA, given face images are converted into eigen faces as shown in Figure 2.8.

Fig. 2.8 Eigen faces

The eigenface approach is a low dimensional representation of the face image. They can be linearly combined to reconstruct the original image. In this approach a smaller set of

images is dimensionally reduced from which the original images can be easily constructed. Eigen faces are represented by eigenvectors as shown in Figure 2.9.

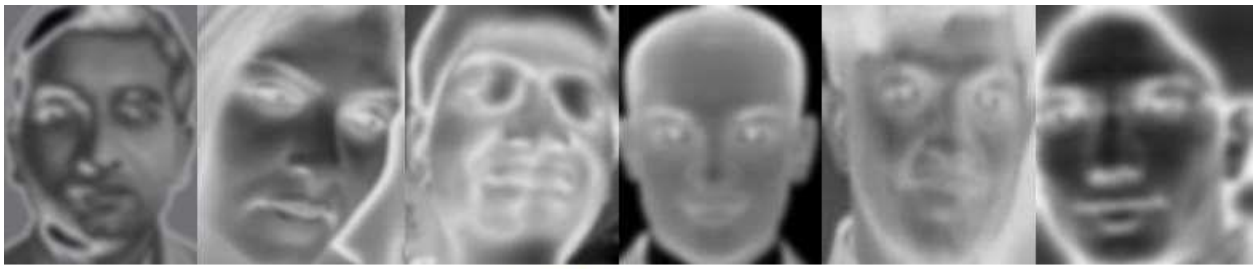


Fig. 2.9 Eigenvectors

Practical Activity 2.4. Illustrate to unlock a smartphone using face recognition technology

Materials Required.

Pen, Paper, Smart Phone

Procedure

Step 1. Go to your device's Settings menu.

Step 2. Locate and enter Security.

Step 3. Tap on Smart Lock under the Device security subheading.

Step 4. Enter your password, PIN, or pattern to confirm your ownership of the device.

Step 5. Select Trusted face.

Step 6. Hold your device level with your face and position yourself.

Step 7. Make sure your entire face is fully lit and inside of the on-screen circle**.**

Step 8. Keep your device for several seconds until your face has been fully recognized and saved.

Step 2. You can now unlock your Android device with facial recognition.

Step 10. Try locking and unlocking multiple times.

3-Dimensional recognition

Three-dimensional face recognition technique uses 3D sensors to capture information about the shape of a face. This information is then used to identify distinctive features on the surface of a face, such as the contour of the eye sockets, nose, and chin. An advantage of 3D face recognition is that it is not affected by changes in lighting and It can also identify a face from different viewing angles. Three-dimensional data points from a face vastly improve the precision of face recognition. Sophisticated sensors are developed now that do a better job of capturing 3D face imagery. The sensors work by projecting structured light onto the face. Up to a dozen or more of these image sensors can be placed on the same CMOS chip—each sensor captures a different part of the spectrum.

Even a perfect 3D matching technique could be sensitive to expression. A new method is to introduce a way to capture a 3D picture by using three tracking cameras that point at different angles; one camera will be pointing at the front of the subject, second one to the side, and third one at an angle. All these cameras will work together so it can track a subject's face in real time and be able to detect and recognize.

Skin texture analysis

Generally, skin texture is the surface texture pattern of any part of the human body with bare skin such as face, hand, and palm. In the context of biometrics, this term commonly refers to the technologies and methods of face recognition using highly detailed facial skin texture in *high-resolution images*

An emerging trend uses the visual details of the skin with facial recognition. This technique, called Skin Texture Analysis, turns the unique lines, patterns, and spots apparent in a person's skin into a mathematical formula. Surface Texture Analysis works much the same way facial recognition does. A picture is taken of a patch of skin, called a skinprint. That patch is then broken up into smaller blocks. The system will then distinguish any lines, pores and the actual skin texture. It can even identify the contrast between identical pairs or twins, which are not yet possible using facial recognition software alone

Face recognition using LDA

Face recognition using Linear Discriminant Analysis (LDA) with Fisherface is discussed below.

Basic class based classification can be assumed as shown in Figure 2.10.

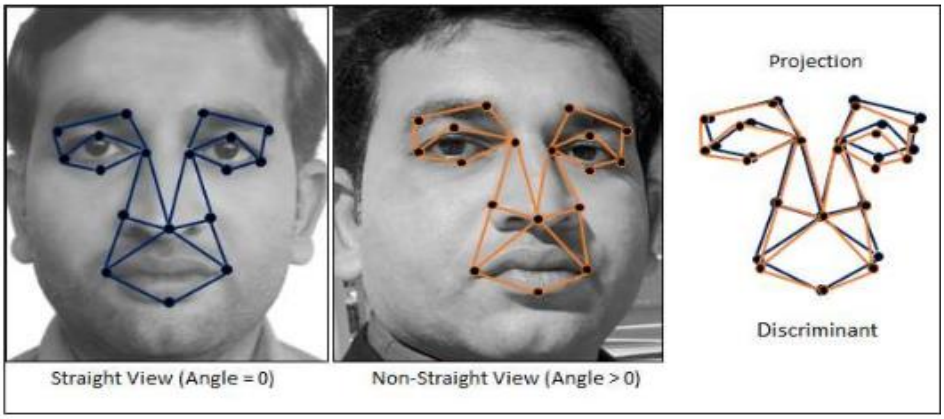


Fig. 2.10 Basic class based classification

Linear

Linear representation of fisherface features using LDA can be represented in Figure 2.11.

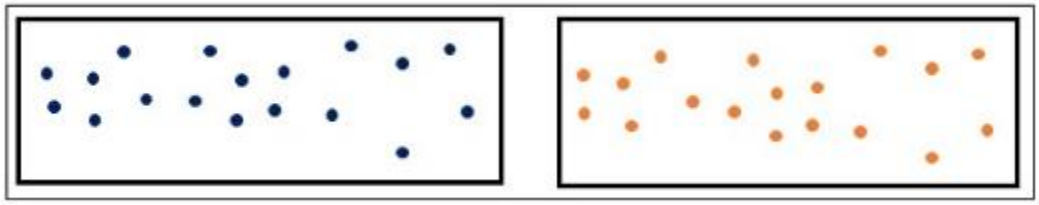


Fig. 2.11 Linear representation of fisherface features using LDA

Linear Discriminant Analysis (LDA) with Fisherface is performed.

Class base representation of Fisherface features using LDA, is shown in Figure 2.12.

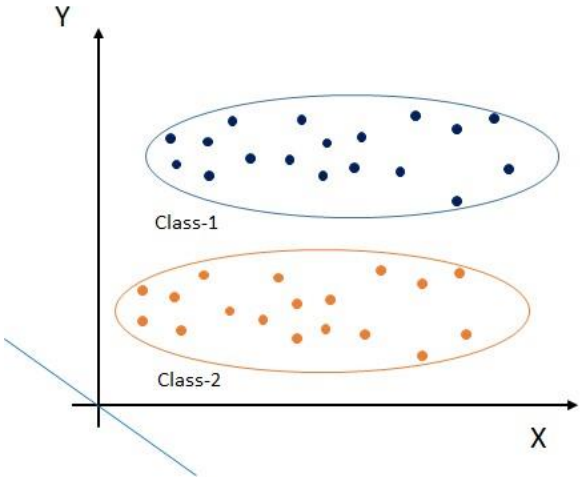


Fig. 2.12 Class base representation of Fisherface features

The idea of LDA is to find a linear transformation so that features are most separable after the transformation which can be achieved through scatter matrix analysis in both "Between" and "Within" classes.

Combination of Different Techniques

A combined form of traditional, 3D recognition and Skin Textual Analysis is used to create recognition systems that have higher rates of success. Combined techniques have an advantage over other systems. It is relatively insensitive to changes in expression, including blinking, frowning or smiling and has the ability to compensate for mustache or beard growth and the appearance of eyeglasses. The system is also uniform with respect to race and gender.

Advantages of Face Recognition System

Face recognition technology is widely used in many applications and situations. Some of the advantages of face recognition technology over other biometric systems are.

It does not require the cooperation of the person being identified to work. Hence it can be used in public places for identifying terrorists and criminals without their knowledge.

- It is convenient and comfortable for the users, as they just have to look at the camera.
- It is a more hygienic way of biometric data processing, as we are not touching the device.

Figure 2.13 shows face recognition at airports.

Fig. 2.13 Face recognition in airports

Challenges in Face Recognition

As compared to other biometric techniques, face recognition may not be most reliable and efficient. While taking a photograph, there are a lot of factors that affect the quality of the photo, such as light and the position of the camera. So when we are trying to identify someone from a photo, all these become a problem. Some of the challenges faced by face recognition systems are:

- A photo may contain details other than the face. So the face recognition system must find the position of the face in the photo before the features can be taken.
- The variations in light, shadows and angle may affect recognition accuracy of the system.
- Sometimes the person may not be facing the camera properly.
- Difficulties with data processing and storing.

Practical Activity 2.5. Identify the challenges in biometric face recognition systems.

Materials Required.

Pen, Paper, Computer, face recognition system

Procedure

Step 1. Install face recognition software on your computer with the help of your teacher.

Step 2. Store your image in the software.

Step 3. Identify the scenarios in which the system is failing to identify.

Step 4. List out the scenarios.

Step 5. List out the challenges if you do the same experiment out door.

PALM RECOGNITION

Have you seen fortune tellers studying palms and telling the future? Open your palms and look closely. What do you see? There are a lot of criss-crossing lines. Do you know that the pattern of lines in each person's palm is unique? There is nobody in this world having the same pattern of palm lines as you. This uniqueness of palm line patterns make palm prints an ideal choice for uniquely identifying a person. Palm recognition system is a biometric authentication method based on the unique patterns of various characteristics in the palms of people's hands. Palm print systems have merits of high accuracy, low cost, and user friendliness. Figure 2.15 shows a typical human palm.

Fig. 2.15 A human palm

Palmprint

A palmprint refers to an image acquired of the palm region of the hand. The palm consists of principal lines, wrinkles (secondary lines) and epidermal ridges. It also contains other information such as texture, spaces and marks which can be used when comparing one palm to another. A sample palm print is shown in Figure 2.16.

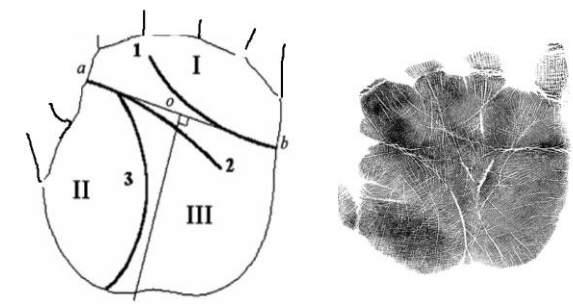


Fig. 2.16 Palmprint – Principle lines (1-heart lines, 2-head lines, 3-life lines)

Regions (I-finger root region, II-Inside region, III- Outside regions)

Datum points - a,b - end points, o-mid points)

A Palmprint consists of features.

Principal lines – the heart line, the life line and the head line.

Regions – finger-root (I), inside region (II) and outside region (III)

Datum points – end-points across the palm and their mid-point.

Other features:

Geometry features – width of the palm, length of the palm and the area of the palm.

Wrinkle features – these are lines other than the principal lines. They tend to be thinner and more irregular. They are classified as coarse wrinkles and fine wrinkles.

Delta point features – these are defined as the center of a delta-like region in the palm print.

Minutiae features – similar to fingerprint type of features.

Practical Activity 2.6. Identify and List the various parts of the palm. List some real life examples of biometric systems that use palm recognition.

Materials Required.

Pen, Paper, Computer

Procedure

Step 1. Draw the picture of the palm in a chart paper and identify Principal lines, Regions and Datum points.

Step 2. Visit the Aadhar Kendra and Passport Seva Kendra in your town and observe what kind of biometric system they are using. While observing various biometric data capturing processes that are being practiced there, Note the following three applications that use palm recognition for capturing biometric data.

1. Aadhar system
2. Passport system
3. Attendance management system

Technology Used in Palm Recognition

Palm recognition involves using the person's palm prints to identify who the person is or verify whether the person is *"whom he claims to be"*. As in the case of face recognition systems, here also we will have a database containing the palm prints of known persons. It is shown in Figure 2.17

Fig. 2.17 A palm recognition system with palm print scanner

There are different steps involved in recognizing a palm print. These are listed below.

1. The first requirement in palm recognition is to obtain an image of the palm. For this we use palm print scanners in the biometric system. The image can be low quality or high quality depending on the type of scanner used.
2. Next step is called preprocessing. Here the images that we got in step 1 are slightly enhanced, so that we can get more accurate information from them in step 3.
3. In this step, we collect the main features from the palm print using image processing techniques.
4. Now we can match the features we collected in step 3, with the palm prints of known persons stored in the database.
5. If the new palm print matches with one of the stored palm prints, the person is recognized.

Multispectral palmprint recognition, 3D palmprint recognition, Latent palmprint recognition are some of the palm recognition techniques used. With the advancement in technology Touch-less palm print recognition systems are also available now that can extract the palm print in real-time video stream.

Multispectral Palmprint Recognition (MPRS)

Recent progress in multispectral imaging makes it possible to develop effective palmprint recognition methods by utilizing features obtained with different spectral wavelengths, such as visible, near infrared, ultraviolet, and even single red, green, and blue channels. A multispectral image is one that captures image data within specific wavelength ranges across the electromagnetic spectrum. Multispectral systems were presented as a new technology in capturing images where normal cameras have limitations. The development of new cameras and new filters makes it possible to see beyond the visible spectrum, for example in infrared [700nm-1mm], ultraviolet [10nm-380nm], [0,01 nm-10 nm]. Spectral imaging can allow extraction of additional information the human eye fails to capture with its receptors for red, green and blue. The mechanism of multi-spectral palm images is based on the acquisition of a palm print image in different spectral bands (for eg infrared, ultraviolet). Each spectral

palmprint highlights different features of the palm. The higher wavelength spectrum is also able to capture internal information of the palm such as the palm vein.

3D Palmprint Recognition

The 3D palm-print method is used in palm-print identification. Although two-dimensional palm-print identification is accurate, the 2D palm-print images do not have much depth information about the image. Also 2D images can be easily forged, which will threaten the security of palmprint authentication systems. Furthermore, 2D images can be easily affected by noise, such as scrabbling and dirt in the palm. To overcome these shortcomings, a three dimensional (3D) palmprint identification system is being used in some recognition systems. The results of three-dimensional palm-print technique have high recognition performance. It can capture more depth information The three-dimensional palm-print recognition has the capability of avoiding replicas and it is more robust to variations by illumination. The 3D feature is binary and more efficiently computed.

The commonly used 3D imaging techniques are multi viewpoint reconstruction, laser scanning and structured light scanning. Structured light scanning is the most prominent form used in 3D imaging.

Latent palmprint recognition

Latent palmprint is a crucial crime scene mark for suspect and victim identification in forensic applications. Different from low resolution palmprint recognition, latent palmprint recognition is a latent-to-full matching. Similar to fingerprint recognition, minutiae features and matching are usually adopted in latent palmprint recognition.

Difference between 2D and 3D palmprint identification system

2D palmprint identification	3D palm print identification
1. a 2D system can capture less depth information about the object. 2. 2D systems can be easily forged. 3. 2D images can be easily affected by noise, such as scrabbling and dirty in the palm. 4. Not easy to avoid replica, affected by variations by illumination 5. 2D feature is binary and less efficient	1. a 3D system can capture more depth information about the object. 2. 3D systems cannot be easily forged. 3. 3D images cannot be easily affected by noise, such as scrabbling and dirt in the palm. 4. Can avoid replicas, and are robust to variations by illumination. 5. The 3D feature is binary and more efficiently computed.

Challenges in Palm Recognition

As in the case of face recognition systems, palm recognition also faces some challenges. Some of these challenges are listed below.

1. Palm recognition systems may not work properly if the palm lines are too faint or distorted.
2. Different regions of palmprints have varying quality and distinctiveness.
3. Computational complexity increases because of large amounts of data capture.
4. Proper recognition is not possible if the palm is wrinkled due to age or is covered with dirt,
5. Scanners used for palm recognition are large than that of used for fingerprint or iris.

CHECK YOUR PROGRESS

A. Multiple Choice Questions

1. Which of the following is unique for all humans? (a) Hair (b) Finger prints (c) Finger Nails (d) Ears
2. Which of the following is not the characteristic of face (a) eyes, nose, mouth, (b) hair and beard (c) chin, jaw, forehead (d) philtrum
3. An image processing techniques is applied on face to extract the usable part (a) projection, (b) histogram (c) diffusion (d) transform (e) all of the above
4. In face recognition systems, which of the following devices is used to capture the picture of face (a) Digital Camera (b) Scanner (c) Printer (d) Joystick
5. Which of the following is the correct sequence of face recognition process (a) Capture, Comparison, Matching, Extraction (b) Capture, Extraction, Comparison, Matching (c) Capture, Comparison, Extraction, Matching (d) Capture, Comparison, Extraction, Matching
6. Which of the following is not the components of facial recognition system (a) Capturer (b) Extractor (c) detector (d) Matcher
7. Which of the following is not a principal line of a palmprint (a) heart line, (b) life line (c) luck line (d) head line.
8. Which of the following is not an example of face recognition algorithm (a) SIFT (b) SURF (c) LBPH (d) PSA
9. Faceprint is used in which recognition system. (a) Finger print (b) Palm (c) Face (d) Hair
10. In which of the following applications, palm recognition is used? (a) Education (b) Forensics (c) Medicine (d) Gardening

B. Fill in the blanks

1. In the face recognition process, the features of face are extracted using _____
2. Faceprint is prepared by mathematically calculating the _____.
3. Matcher is the _____ complex algorithm
4. AI assisted facial recognition can recognize humans _____.
5. The higher wavelength spectrum is able to capture _____.
6. Minutiae features and matching are adopted in _____ recognition.
7. Eigen faces are represented by _____.
8. 1:G comparison method is called as _____.
9. 1:G comparison method is called as _____.
10. Extraction means _____ and _____ of characteristics of face objects.

C. State whether the following statements are True or False

1. Facial recognition algorithms create a biometric template.
2. When two templates are compared, the match score indicates that the two images belong to the same person.

3. Two templates are compared to match scores indicating that the two images belong to the same person.
4. Faceprint is a digitally recorded representation of a face.
5. Palmprint cannot be extracted without touching the palm on a palm recognition device.
6. Multispectral systems is the new technology for capturing face images.
7. 1:N is the most accurate, faster and reliable method as comparison.
8. In 1:G comparison one user's biometrics can match little with another user's biometrics.
9. Two images belong to the same person when the score of two templates are matched
10. 2D images can not be easily affected by noise.

D. Write the long form of following acronyms

1. ISO/IEC
2. JPEG
3. SIFT
4. SURF
5. LBPH
6. PCA
7. LDA
8. SVM
9. MPRS
10. WSQ

E. Answer the following questions in short

1. Name two areas where we can use face recognition.
2. List two advantages of face recognition systems.
3. Explain faceprint and palmprint?
4. Explain limitations of traditional approach in face recognition.
5. What are the challenges in face recognition systems?
6. Name any two facial features that can be used for face recognition.
7. Outline the steps in face recognition.
8. Explain different types of face recognition systems.
9. Write a short note on multi spectral palm recognition.
10. Differentiate different palm recognition methods with merits and demerits.
11. What are the challenges in palm recognition?
12. List the steps in palm recognition.

Session 3: Thumb, Finger and Character Recognition

In the last chapter we explored the biometric techniques of face recognition and palm recognition. There are many other unique traits in humans that can be used for recognition by biometric systems. In this chapter we will see three more of such technologies: Thumb or finger recognition, Iris recognition and Character or signature recognition.

3.1 THUMB / FINGER RECOGNITION

Have you seen illiterate people using thumb prints instead of signatures? Do you know why this method is followed? It is because, thumb / finger prints of a person are unique. There is no other person in this world who has the same fingerprint as yours, not even your twin. An image and impression of thumb is shown in Figure 3.1 (a) and 3.1 (b) respectively.

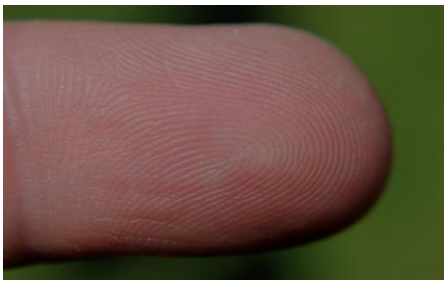


Fig. 3.1 (a) : Thumb image Fig. 3.1 (b) : Thumb impression

Practical Activity 3.1. Demonstrate an activity to examine the uniqueness thumb

Materials Required

Pen, paper, ink pad, magnifying glass

Procedure

Step 1. Press your thumb and index finger in an ink pad.

Step 2. Now press your fingers on a white sheet of paper.

Step 3. Ask your friend to do the same.

Step 4. Look closely at both sets of prints. Can you find any difference in patterns?

Step 5. Now look at the prints through a magnifying glass and find out the differences.

Nowadays the usage of thumb/finger prints for uniquely identifying a person is quite common. You may have heard of police using fingerprints from a crime scene to identify criminals. Many of you may have seen smart phones being unlocked using fingerprints. Also, most of the biometric attendance systems use fingerprints to recognise people. It is shown in Figure 3.2 and 3.3.

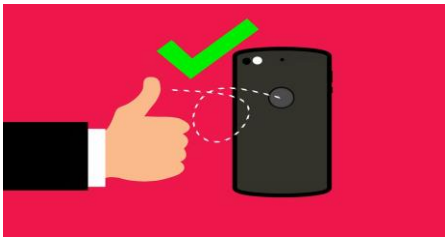


Fig. 3.2 Unlocking smartphone device using finger

Fig. 3.3 Fingerprint authentication

3.2 THUMB / FINGER PRINT

A fingerprint is the impression left by patterns in a person's finger. If you examine your thumb or fingers closely, you can see many lines in it. These lines are really slightly raised portions of skin and are called *ridges*. The ridges on the finger are shown in Figure 3.4.

Fig. 3.4: Ridges on a finger

It is the different patterns of ridges that form the finger print. The three basic patterns of fingerprint ridges are the arch, the loop, and the whorl are shown in Figure 3.5.

https://s.hswstatic.com/gif/why-fingerprints-1.jpg

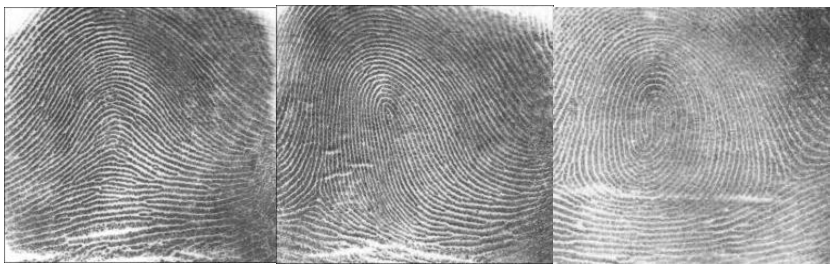


Fig. 3.5 : (a) Arch Pattern (b) Loop Pattern (c) Whorl Pattern

Other than the patterns, another important aspect of the finger print are *minutiae*. Minutiae are specific points in a fingerprint, for example the point where a line starts or ends, or the point where a line splits into two. These are small details in a fingerprint that are most important for fingerprint recognition.

Fingerprint

Fingerprints generally have two characteristics – *Ridge* and *Valley*. Ridge is the Black line and Valley is the White Space between two ridges. Valley is simple but Ridge further has three common patterns.

Fingerprint – Ridges

Ridges are divided into several types based on its placement on the finger as shown in Figure 3.6.

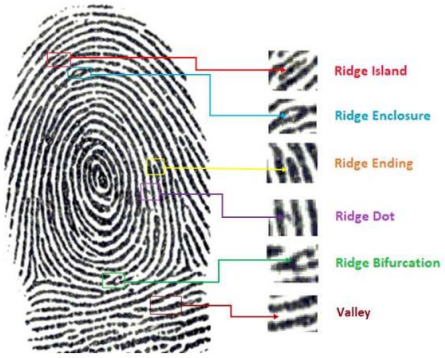


Fig. 3.6 Parts of fingerprint ridges

Fingerprint – Ridges

Bifurcation **–** A single ridge branches out into two or more ridges

Ending **–** Ridge end point

Enclosure **–** Look like a small area surrounded by a barrier.

Dot **–** Very small ridges look like a dot only

Island **–** Longer than dots which has occupied space in the middle between two ridges.

Bridge **–** Small ridge which is connecting two long running ridges.

Lakes **–** Running ridges having some white space similar to enclosure but not much big.

Crossover **–** Two ridges crossing each other.

Fingerprint – Minutiae

Minutiae refers to specific plot points on a fingerprint based on types of ridges. Generally, Ridges ending and bifurcation are mostly declared minutiae points. Other types of ridges are considered only along with ending and bifurcation of ridges. Minutiae of fingerprints are shown in Figure 3.7.

Fig. 3.7 Minutiae of fingerprint

Practical Activity 3.1 Identify the ridges and patterns of ridges on finger print.

Step 1. Look at your thumb through a magnifying glass.

Step 2. Can you see some raised lines? These are the ridges.

Step 3. Now try to find patterns of ridges looking like the above given fingers in your thumb and other fingers.

Technology Used in Thumb / Finger Detection

Fingerprint recognition is an automated method of identifying an individual based on the comparison of fingerprints. A biometric system using fingerprints must have the required hardware for inputting the finger prints and software for processing them. Also the system will have a database of known fingerprints. It will be matching any newly acquired fingerprint with this database to know if it is a known person.

Fingerprint Scanners

Fingerprint scanners are used to capture fingerprints. During Aadhar enrollment, you must have seen a device in which you were asked to press your fingers. That is a fingerprint scanner. (Figure 3.8) The portion in a mobile phone where you press your finger for unlocking, is also a scanner. (Figure 3.9) There are different types of scanners. Their purpose is to take an image of the finger pressed on it.

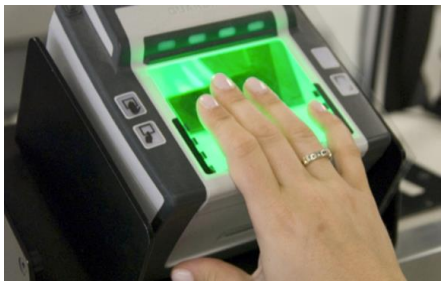


Fig. 3.8 Fingerprint machine

Fig. 3.9 Unlocking phone using fingerprint

Once the fingerprint has been scanned, the following steps are done:

1. **Image Enhancement –** A fingerprint image may contain some undesirable elements like dust particles in the finger. Also some parts of the image may not be clear. In order to get good results, the fingerprint is enhanced using image processing techniques.
2. **Feature Extraction –** Now from the enhanced image, we can find out the features such as patterns and minutiae, which can be used for matching with the known fingerprints in the database.
3. **Pattern Matching –** The features obtained in step 2 are matched with the known fingerprints stored in the Biometric System's database. If it matches with any of the stored fingerprints, the person is recognised.

Line Scan Algorithm (LSA) and Spaced Frequency Transformation Algorithm (SFTA) are two examples of fingerprint recognition algorithms.

Matching of fingerprints

Matching of biometrics is not just only normal value comparison but it is a very complex and lengthy algorithm that decides whether biometrics are matched or not. Matching of fingerprints generally happened based on minutiae.

While calculating matching score, number of matched minutiae, distance between minutiae, quality of minutiae, angle of minutiae, fingerprint rotation and many more are considered.

Based on the above consideration, the matching score is calculated between the range of 1 to 100. This score range is algorithm specific and so it may vary as per different algorithm used. Sometimes scores range from 1 to 1000 or even 1 to 10000 also. Some algorithms have this score in percentage (%) value instead of flat number.

Practical Activity

1. List the steps for recording your fingerprint in a mobile and then to unlock it using the fingerprint.
2. Observe the working of a fingerprint based Biometric Attendance System and note down your observations.

Advantages and Challenges of Thumb / Finger Recognition

Thumb / Finger recognition is one of the most well-known biometrics. It is the most used biometric solution for recognition. Some of the advantages and challenges faced by a fingerprint recognition system are given below.

Advantages

1. It is easy to scan and get a fingerprint.
2. Relatively low cost for hardware.
3. Small sized scanners can be used.
4. Widely accepted by the public.
5. Accurate and reliable results are obtained.

Challenges

1. Fingerprint image quality is very important for accurate recognition.
2. The scanned image will not be accurate if there are cuts or injuries in the finger.
3. Some skin conditions or diseases can make the fingerprint inaccurate.
4. The finger may not be placed correctly in the sensor, resulting in an incorrect image.
5. If the finger is wet due to water or sweat, the sensor will not give a correct image.

3.3 IRIS RECOGNITION

Iris is the most accurate and reliable biometrics among different types of biometrics modalities. Reasons behind it, first, it is touchless and second, it remains mostly unchanged throughout life; however very minor changes may happen. (Figure 3.10)

Iris capturing is associated with infrared. It is easy to capture at night also for recognition purposes where fingerprints and face are difficult to capture. It is a contactless capturing method making it hygienic to use. However, infrared may be harmful for long time usage. Twins are possible to identify uniquely through iris where faces may fail. Major parts of Iris which are considerable in authentication, are – *Eye-Lid, Pupil,* and *Iris-area.*

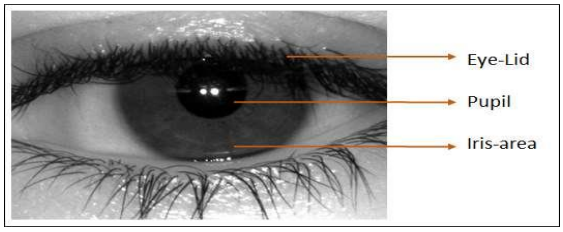


Fig. 3.10: Major parts of Iris

Iris-Pattern

In the iris recognition system, the Iris pattern is the most important factor. Generally, iris have a texture pattern that differs person-by-person which helps to find iris uniquely. Apart from texture, radius and distance are also useful in measurement of iris quality.

Iris texture has several types of characteristics based on waves such as – Smooth-Wave, Rough-Wave, Clear-Wave, Hard-Wave. Figure 3.11 shows different forms of iris texture.

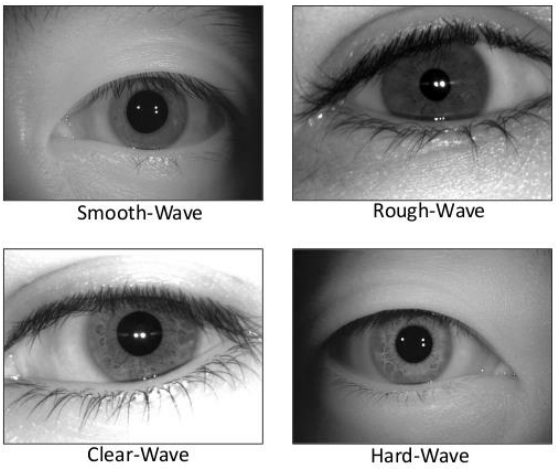
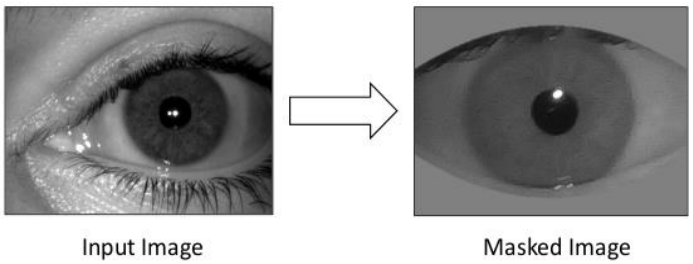


Fig. 3.11: Different forms of iris texture

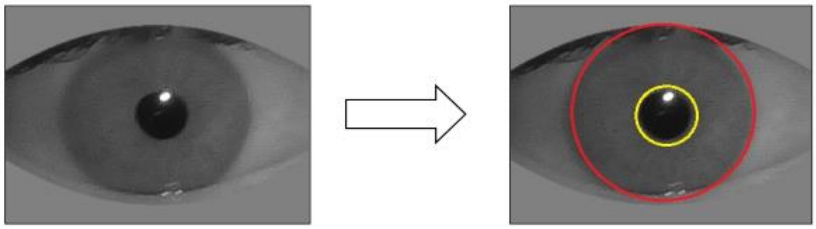
Iris-Extraction

Iris extraction is the mechanism to convert iris in the form which can be utilized while matching two irises. There are several steps for iris extraction as below.

Step 1. Masking – Masking is the process in which input will be masked as per interested region in which actual iris is present.

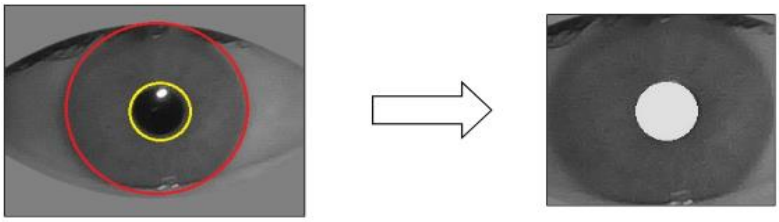


Step 2. Localization – In the process of localization, inner boundary and outer boundary will be measured and marked.



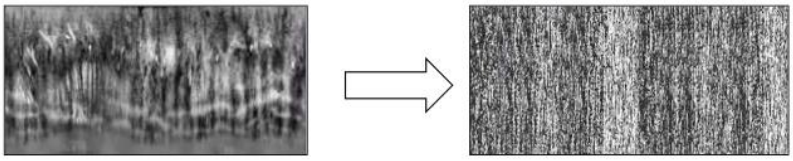
Masked Image Localized Image

Step 3. Cropping – Localized images will be cropped with a marked outer circle.



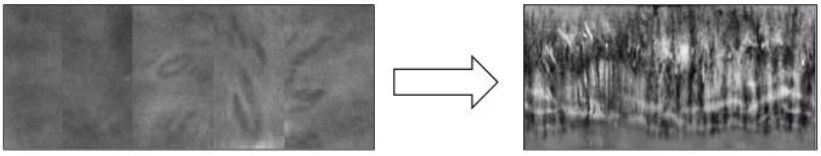
Localized Image Cropped Image

Step 4. Normalization – Circle images will be normalized in strip format.



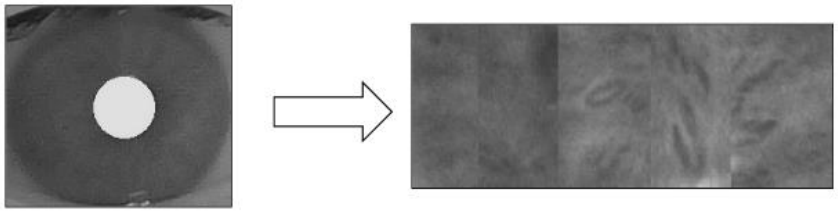
Enhanced Image Encoded Image

Step 5. Normalization-Enhancement – Enhancement of normalized image is the process in which contrast will be improved because it may be possible that original image may not have good contrast due to lighting source.



Normalized Image Enhanced Image

Step 6. Encoding – Encoding is the method based on mathematical functions called as Gabor Wavelets which is used to extract the unique texture of an iris.



Cropped Image Normalized Image

The unique texture of an iris is matched with an existing database to identify the person.

3.4 CHARACTER RECOGNITION

Let us take the notebooks of three of your friends. Compare their handwriting with your handwriting. Is it similar? No, it will not be. Each person will have his / her own style of writing. Each alphabet would be written in a different way by each person. But our

brain has the capability to recognise characters, whichever way it is written. Now, how can we make a computer understand printed or handwritten characters?

Practical Activity

Step 1. Write a sentence in English on a sheet of paper.

Step 2. Input this to a computer using a scanner.

Step 3. Open the scanned document and try to delete some characters from it.

Step 4. Now try to type some more alphabets into the document.

As you have seen from the activity, we cannot make changes to individual alphabets or numbers in a scanned document. This is because the computer considers this as a photo and not as an actual document. Hence it doesn't recognise individual characters and we can't type or delete in the scanned document. To solve this problem, we use character recognition.

Technology Behind Character Recognition

Character recognition is the conversion of images of handwritten or printed characters into text data that is normal alphabets and numbers. The commonly used technology for character recognition is Optical Character Recognition (OCR).

OCR systems are made up of a combination of hardware and software that is used to convert physical documents into text understandable by computers.

The main hardware part of an OCR system is a scanner. It is the scanner that converts the physical document into a scanned image. Figure 3.12 shows a typical scanner.

Fig. 3.12: Scanner

The scanned image will contain both characters and other information that need not be recognised. All those parts of the image that we don't need are called background.

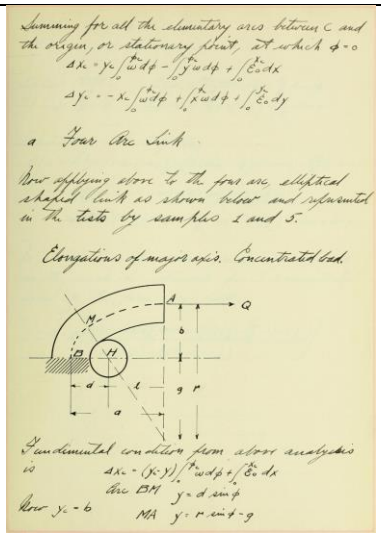
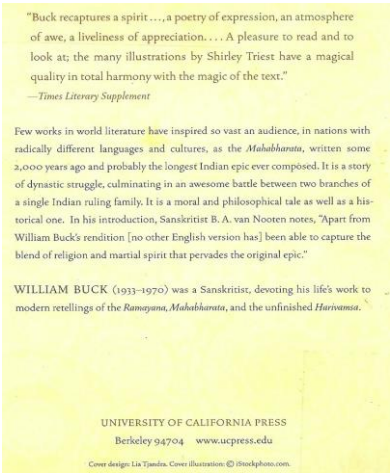


Fig. 3.13: A scanned handwritten document



"Buck recaptures a spirit . . . , a poetry of expression, an atmosphere of awe, a liveliness of appreciation. . . . A pleasure to read and to look at; the many illustrations by Shirley Triest have a magical quality in total harmony with the magic of the text."
—*Times Literary Supplement*

Few works in world literature have inspired so vast an audience, in nations with radically different languages and cultures, as the *Mahabharata*, written some 2,000 years ago and probably the longest Indian epic ever composed. It is a story of dynastic struggle, culminating in an awesome battle between two branches of a single Indian ruling family. It is a moral and philosophical tale as well as a historical one. In his introduction, Sanskritist B. A. van Nooten notes, "Apart from William Buck's rendition [no other English version has] been able to capture the blend of religion and martial spirit that pervades the original epic."

WILLIAM BUCK (1933–1970) was a Sanskritist, devoting his life's work to modern retellings of the *Ramayana*, *Mahabharata*, and the unfinished *Harivamsa*.

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Fig. 3.14: A scanned print document

The OCR software analyzes the scanned image for light and dark areas, where the dark areas are identified as characters that need to be recognized and light areas are identified as background. The dark areas are then processed further to find alphabets or digits.

OCR software uses different techniques to find characters.

- One technique is to compare parts of the current scanned image with the set of characters stored in a database. If it matches, we identify that part as the matched character.
- Another technique is to have a program which defines how each character should look like. This will analyze each dark part of the current document and determine which character it can be.

Once a character is identified, it is converted into a format that can be used by computer systems to handle further modifications.

Applications of Character Recognition

OCR can be used for a variety of applications, such as:

1. Converting printed documents into a form that can be edited with word processors, like Microsoft Word.

2. Changing documents into text that can be read aloud by a computer to visually-impaired or blind users.
3. Storing historic information, such as newspapers, magazines or important documents, in a form that allows search and edit operations.
4. Automatically identify vehicle numbers from number plates.

Signature Detection

As you know, the signature of each person is unique. This can be used by a biometric system for recognising people. Signature recognition is the process of determining to whom a particular signature belongs to. The basic technology used in signature recognition is the same as that of character recognition. Depending on how we are acquiring the signature, there are two types of signature detection systems.

Offline systems – Here, the users write their signature on paper and scan it through a scanner or a camera. The biometric system recognizes the signature by analyzing its shape.

Online systems – Here, the users write their signature in a digital device, such as a tablet or PDA using an electronic pen called a stylus. Figure 3.15 shows a digital pen for signing a document.

Fig. 3.15 : Digital pen for signing a document (include any one figure)

Challenges In Character / Signature Recognition

Character recognition usually gives accurate results for printed documents. The major challenge in character recognition is for handwritten documents. Most obvious problem when processing handwritten documents is poor quality or illegible handwriting. Joined / cursive handwritten text can also cause similar issues. Same issues can occur in case of signature recognition also.

Practical Activity

List some real-life situations where you can effectively use character / signature recognition.

Think of the possible challenges when a computer is trying to recognise your handwriting. Note down your answers.

3.5 DIGITAL SIGNATURE AND SCRIPTING TECHNOLOGY

Pranav received a letter from his friend Rajeev, asking if he can give Rs.1000/- as a loan. Pranav is ready to help, but how can he be sure that the letter was sent by Rajeev himself and not by some cheater? Surely, he can verify Rajeev's signature in the letter. If it is the same as the one he knows, he can be confident that the letter was sent by his friend himself. Figure 3.16 shows a signed letter.

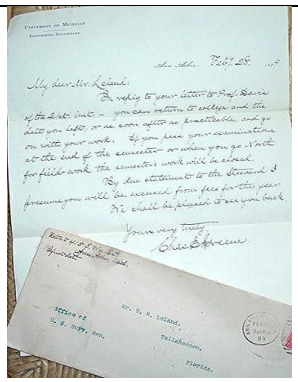


Fig. 3.16: Signed letter

Now, a lot of transactions and communications are taking place digitally, that is using computers and through the internet. So, how can we be sure that the messages or documents that we are getting are really from the persons whom we think it is from? Just like having a signature in a letter, it would be good if we can have something to verify in the electronic documents also.

Digital Signature

When we get an email from his bank, asking for his personal details and account details. How can it be sure that the email was from the Bank itself? In such situations, Digital Signatures can help us.

A digital signature is basically a way to ensure that an electronic document (e-mail, spreadsheet, text file, etc.) is trustable. Trustable means, you know who created the document / message and you can be sure that it has not been changed in any way since that person created it.

Technology Used in Digital Signature

We can create a digital signature using a signing software. You select the signature option, then select the document, and finally enter a password. Everything is accomplished electronically. You do not take a pen in hand and sign a paper. A digital signature may look like this:

```
------BEGIN SIGNATURE------
IQB1AwUBMVSiA5QYCuMfgNYjAQFAKgL/ZkBfbeNEsbthba4Blrcnjaqbc KgNv+
a5kr4537y8RCd+RHm75yYh5xxA1ojELwNhhb7cltrp2V7LlOnAelws4S87UX80c
LBtBcN6AACf11qymC2h+Rb2j5SU+rmXWru+=QFMx
------END SIGNATURE------
```

This signature will be added to the original message/ document and then sent to the recipient. The receiving person can verify the digital signature using his/her password. Figure 3.17 shows a form of digital signature.

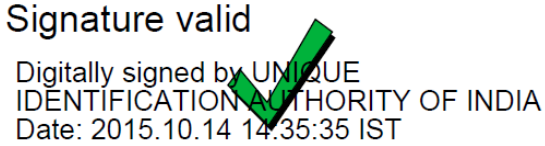


Fig. 3.17: A form of digital signature

Digital Signature Certificate

Digital Signature Certificates (DSC) is the digital equivalent of physical or paper certificates. Examples of physical certificates are driving licenses, passports or membership cards. A certificate serves as a proof of identity of an individual for a certain purpose; for example, a driver's license identifies someone who can legally drive in a particular country. Likewise, a digital certificate can be presented electronically to prove your identity, to access information or services on the Internet or to sign certain documents digitally.

Legally valid Digital Signature Certificates are issued only through a Controller of Certifying Authorities (CCA), Govt. of India and licensed Certifying Authorities (CA).

Digital Signature Dongles

For security reasons, the Digital Signature Certificate is stored on a hardware device, called a USB Token or Digital Signature Dongle. This can only hold your Digital Signature Certificate. This device must be connected to a computer to electronically sign a document. Figure 3.18 shows a digital signature dongle.

Fig. 3.18: Digital signature dongle

Practical Activity

1. Find out and list some real-life situations where digital signatures are used for authentication of digital documents.
2. List the steps for verifying digital signature in Aadhar downloaded online.

Scripting Technology

Scripting languages are used in web applications and to design web pages. JavaScript, ASP, JSP, PHP, Perl and Python are examples of scripting languages.

Advanced scripting technologies are used to create interactive webpages. Have you used the Aadhar website? It is an example of an interactive website using advanced scripting. Figure 3.19 shows aadhaar website

Fig. 3.19: Aadhaar website

Practical Activity

1. Visit the Aadhar website and observe the features. Note down your observations.
2. List the steps for downloading an Aadhar card from the Aadhar website.

CHECK YOUR PROGRESS

A. Multiple Choice Questions

1. Which of the following are used by police to identify criminals. (a) Photos (b) FInger prints (c) Books (d) Letters
2. The raised lines in fingers are called _____ (a) Ridges (b) Patterns (c) Loops (d) Points)
3. Which of the following device is used to take the image of finger (a) Digital camera (b) Flatbed scanner (c) Fingerprint scanner (4) Microphone
4. Which of the following is easy to capture in night for recognition (a) fingerprint (b) faceprint (c) palmprint (d) iris
5. Which of the following is the commonly used technology for character recognition (a) Optical Character Recognition (OCR) (b) Reading (c) Scanning (d) Printing
6. Which of the following device is used for online signature recognition (a) Pen (b) Pencil (c) Marker pen (d) Stylus
7. Which of the following is the mechanism to convert iris in the form required for matching of two irises (a) Iris extraction (b) Iris capture (d) Iris marching (d) Iris comparison

B. Fill in the Blanks

1. Fingerprints two characteristics are _____ and _____.)
2. Matching of fingerprints is based on _____.
3. Iris capturing is associated with _____.
4. In the iris recognition system, _____ is the most important factor.
5. A digital signature ensures an electronic document _____.
6. Digital Signature Certificate is stored on _____ .

C. State whether True or False

1. Many people can have the same fingerprint.
2. Character recognition techniques are used to identify vehicle numbers from number plates.
3. Iris capturing is contactless and hygienic to use.
4. Twins have the same iris.
5. Encoding is the method used to extract the unique texture of an iris.
6. Iris texture patterns are unique.
7. A scanned document can be edited in the same way as a normal word document.
8. The signature and handwriting of each person is unique.
9. The main hardware part of an OCR system is a scanner.
10. Character recognition is the conversion of handwritten characters into images.

D. Write the long form of following acronyms

1. CA
2. CCA
3. DSC

4. OCR
5. LSA
6. SFTA
7. USB

Short Answer Questions

1. List two applications of finger / thumb print recognition
2. Name the three basic types of patterns found in fingerprints.
3. List the challenges in a character / signature recognition system.
4. List the applications of character recognition.
5. Write the advantages of finger / thumb recognition.
6. List some of the challenges in finger / thumb recognition.
7. Write the steps involved in finger/thumb recognition
8. Which are the two types of signature recognition systems?
9. Briefly explain the working of OCR software.
10. Describe the characteristics of a fingerprint.

Session 4: Troubleshooting in Biometric Data Entry

Biometric data entry may experience some problems. It is essential to find out the ways to examine the common errors in data entry including transcription and transposition error. The nature of errors may be like volume spikes, slow turnaround, format issues. It is required to find out their root causes and determine principles of biometric system error rates including false accept, false reject, false match, false non match, equal error rate, detection error trade-off curve.

4.1 Common Biometric Data Entry Errors

Biometric technology such as facial recognition, voice recognition, fingerprint scanning, and iris scanning is becoming increasingly affordable, sophisticated and accurate. Biometric systems are improving in effectiveness as technology progresses, but they are not a perfect form of authentication or identification.

In the various biometric applications such as aadhaar card, passport, driving license the biometric data is to be stored in a centralized database. A database to securely store biometric data for comparison. But the biometric systems rely on capturing biometric data locally and then cryptographically hashing it to allow authentication or identification without direct access to the biometric data. The following are some of the drawbacks of biometric systems.

1. Inability to Enrol

This error occurs when a template for biometric data cannot be correctly constructed. There are various potential causes for this, including low-quality reference data due to sensors or bad ambient circumstances, such as lighting – at the time of registration or a person's physical or medical condition preventing them from participating in the system. Ensuring reasonable enrollment rates is critical to a biometric verification or authentication system's performance.

Cultural or religious reasons, technological challenges and physical or medical ailments may restrict a group's or individual's capacity to participate in or enroll in a biometric system.

2. False acceptance and rejection rates

There are two types of faults that biometric systems can make. When the system mistakenly matches an input to a non-matching template, it is called a *false positive,* whereas when the system fails to identify a match between an input and a matching template, it is called a *false negative*.

Such mistakes in a biometric system might happen for a variety of reasons. For example, individuals with comparable biometric traits. It may be difficult to differentiate identical twins based on face biometrics. In addition, other variables, such as aging, injuries, or medical problems, might cause changes in a person's biometric characteristics between the time of enrollment and at the time of enrollment.

A probability computation is used to match a person with a template stored in a biometric system. The ethnic or age features of the sample data used when the system was trained, as well as the lighting or posture of the subject at the moment of registration or subsequent identification, can all impact the margins of error. Therefore, work to limit the number of false positives and false negatives is a crucial aspect of any biometric system implementation.

3. Spoofing

Biometric identification has certain advantages for identity management, but it is not a foolproof solution to fraud or identity theft. Biometrics, like other security systems, have flaws and may be hacked. For example, fake artifacts such as a replica of a biometric trait can be manufactured and utilized to deceive a biometric sensor. Spoofing is a frequent term for this because it poses a threat to the security of biometric systems. Because computer vision differs from human eyesight, several spoofing techniques may initially seem counterintuitive.

Many biometric systems, such as liveness detection, have mechanisms to prevent the potential of spoofing. For example, the technique of liveness detection is used to assess whether the source of a biometric sample is a living person.

4. Compromised biometrics

Biometric features, unlike passwords or ID tokens, cannot be renewed or revoked, which is another disadvantage of biometric systems. If a person's fingerprint or other physiological biometric is compromised, changing that trait can be exceedingly difficult, if not impossible. This might be an issue if one wants to use that biometric feature for future authentication.

4.2 Manual Data Entry Errors

The manual data entries are caused due to the errors in their calibration. The manual data entry falls victim to human error. That could be a spelling, grammar or punctuation mistake, either through a rushed typo or just incorrect usage.

Then there are the occasions when people enter data incorrectly. An erroneous number, data unintentionally placed into the incorrect spreadsheet field, or an incorrect email entered into a CRM record are just a few examples. If not caught right away, the employee finds it frustrating to have to go back and amend the incorrect entry. The

records are messed up, but more significantly, if the problem is not fixed, it may result in embarrassing errors.

4.3 Biometric Data Breaching

Biometric data breaches are especially problematic because of the sensitive nature of the information. Unlike a username or password, Biometric data is unique to the individual and cannot be changed. Biometric data based logins are becoming more popular. Due to the centralizing nature of this method, consumers may become more exposed to identity theft and data breaches in the long run.

The preferred approach for defending individuals and organizations from hackers is gradually evolving to include biometric authentication. Unfortunately, hackers utilize this data to steal identities and perpetrate fraud. As a result, face recognition, iris scanning, and fingerprint scanners are increasingly widely used. Although there are many advantages to this technology in the fight against cybercrime, there are also some hazards. In order to safeguard themselves and their digital data, people and organizations need to be aware of two major issues:

1. Individuals should be alert that fingerprint or facial recognition can be hacked by cybercriminals attempting to steal or forge biometric data.

2. Organizations that store patient medical histories, blood samples, or DNA profiles, such as hospitals, must consider the security ramifications of a data breach and their possible liability.

4.4 Regulation of Biometric Data in India

At the moment, biometric data must be held, used, or handled in accordance with the same laws that must be abided by when managing sensitive personal data or information. However, because it may be accessed and processed through a computer resource and is considered personal data, biometric data is controlled by the IT Act.

Personal information is defined under the Privacy Rules as information about a natural person that may be used to identify that person, alone or in combination with other accessible information (Personal Data). Furthermore, for an individual, sensitive personal data or information is a type of Personal Data relating to the person's sensitive details that require a higher level of confidentiality, such as a password, some financial information relating to a bank account or cards, or biometric information, among other things (Sensitive Data). Privacy laws generally require more excellent protection and stricter standards when processing, dealing with or handling any data or information classed as Sensitive Data. As biometric data is classified as Sensitive Data, the same safeguards that apply to Sensitive Data must be applied to biometric data. It establishes, among other things, data collecting, retention, disclosure, and transfer standards.

Furthermore, an entity that handles biometric data must follow and implement appropriate security policies and procedures, the failure of which results in unlawful loss or gain to the entity or any individual, in which case the business is obliged to pay damages to the person affected. The IT Act is an exception to India’s general rule for damages, stating that if the wrongful gain is established, the violator entity must compensate the data subject without the data subject has to prove that he or she suffered a wrongful loss as a result of the entity’s failure to implement reasonable security practises and procedures in handling biometric data.

4.5 Biometric System Error Rates

The main system errors are usually measured in terms of FNMR (false no match rate) – mistaking two biometrics measurements from the same person to be from two different persons; FMR (false match rate) – mistaking biometric measurement from two different persons from the same person.

There are mainly two types of mistakes that biometric devices can make: the false accept, where the device mistakenly admits an unauthorized individual, and the false reject, where the device mistakenly rejects an authorized person.

False Rejection Rate (FRR) – It is the ratio of the number of false rejections divided by the total number of transactions. Probability that the system fails to detect a match between the input fingerprint template and a matching template in the database. It measures the percent of valid inputs which are incorrectly rejected. It is sometimes denoted as False Non-Match Rate (FNMR).

False Acceptance Rate (FAR) – The average number of false acceptances inside a biometric security system is measured using the false acceptance ratio (FAR), a unit of measurement. By calculating the rate at which unauthorized or illegal users are confirmed on a certain system, it gauges and assesses the effectiveness and accuracy of a biometric system.

Failed To Acquire (FTA) – Biometrics devices which are designed to capture biometric impression from human body and convert it into digital form, may failed to capture user's biometric due to certain reason such as poor quality, less surface area coverage, damaged part of body surface, damaged part of biometrics device etc. This case is considered as Failed To Acquire (FTA). If the Rate of FTA is high then it will also decrease the reliability of the biometrics recognition system.

False Match Rate (FMR) – It is the rate at which a biometric process mismatches biometric signals from two distinct individuals as coming from the same individual.

Equal Error Rate (EER) – EER stands for equal error rate. The threshold parameters for a biometric security system's false acceptance rate and false rejection rate are established using the equal error rate (EER) technique.

Detection Trade-off Curve (DET) – The false rejection rate vs. false acceptance rate of binary classification systems is plotted graphically in a detection error tradeoff (DET) graph.

FRR and FAR

FRR is the False Rejection Rate that is always considerable with biometric recognition systems. FRR can be calculated based on the below equation.

FRR = (NFR/NEIA) * 100 [%]

Where,

FRR = False Rejection Rate

NFR= Number of False Rejection

NEIA = Number of Enrollee Identification Attempts

Similarly, FAR is the False Acceptance Rate can be calculated based on the below equation.

FAR = (NFA/NEIA) * 100 [%]

Where,

FAR = False Acceptance Rate

NFA= Number of False Acceptance

NEIA = Number of Enrollee Identification Attempts

4.6 Security, Reliability, and privacy in biometrics

4.6.1 Security

It is extremely difficult to break the biometric system as it is characteristic of the body which is Non-Transferrable. If FRR and FAR are considered well in biometrics recognition systems, then it is very secure as each user has its own unique pattern.

Security of biometrics recognition systems also depends upon which modalities are being used in implementation such as finger, iris, face, voice and palm. Every modality has its own success rate that will decide the security of the system. Some of modalities can be hard but possible to fake also where security of the system can be a question which permits fake user to pass via biometric recognition system such as fingerprint, palm and face, where Iris and Retina (blood vessels) can be consider more secure than fingerprint, palm, voice and face.

4.6.2 Security of Biometric Storage System

On-device storage

Biometric templates are often stored on local devices, as with most fingerprint readers on mobile devices. This type of biometric storage is exceptionally secure because it does not store sensitive data on servers with large databases. As a result, only the device can be hacked, which, in the rare case that it is successful, will cause damage at a microscopic scale. If locally-stored biometric data does get hacked, the device's internal storage should be deleted as soon as possible.

Database server

At times, local device storage is not feasible. For example, large corporations using biometric authentication to grant special user access and permissions might prefer biometric database storage instead of local device access only. This allows companies to grant user-specific access in multiple locations and tracks behavior to help suspicious flag activity. Examples of suspicious activity might include users who access secured areas at odd hours of the day or those who interact with the information in unexpected patterns.

Biometric database servers are more cost-effective than other storage options but have a higher security risk. Because servers house thousands of templates, their susceptibility to hackers is also high. Many people and their irreplaceable biometric information will be at risk for malicious behavior. Though encryption significantly improves biometric security, determining who has access to the encrypted data and how they use it, is the real issue.

Portable token

Biometrics stored on portable tokens — security cards or USB drives, for example — work in the same way that on-device biometric storage does. Biometric information is stored on a single device, and that device must be presented during authentication for verification purposes. Biometric tokens tend to be a bit more costly to implement than the alternative because they require both the token and a separate biometric scanner, though the added step also adds another line of security to the mix.

Distributed data storage

Another method of double-backed biometric template storage is called distributed data storage. This method stores biometrics on a local device and a server, both of which

must be accessed concurrently for authentication. Because of the split nature of this biometric storage method, it utilizes distributed data storage and hence it is nearly impossible to hack and, therefore, highly secure.

Biometrics and blockchain data storage

For optimum security, personally identifiable information like biometric templates should be encrypted and stored off the blockchain instead of in off-chain storage systems. Encrypted biometric templates can further be protected by splitting the information into *"shares"* and storing each individual *"share"* in separate locations. For example, part or "share" of a person's biometric template can be stored on the individual's mobile device and the other on a server or blockchain.

A blockchain is a form of decentralized data storage. The publically stored blockchain data cannot be manipulated without altering other data sets along the "chain". For example, if the same data set is accessible throughout the entire digital sphere, alterations to the data should be easily traceable. This makes it extremely difficult for hackers to succeed in an attack, thus increasing data security through a decentralized approach.

Tokenized biometric data

Biometric data security is at the forefront of biometrics discussions and concerns. An individual must be careful with whom they share their biometric data. The real burden falls on biometrics companies entrusted with such valuable information. Before any company or organization acquires user biometric information, their biometric software should be tested for accuracy and security.

Many biometrics companies opt for tokenized biometric data rather than encrypted to remedy this concern. Unlike encryption, which uses a unique mathematical formula to alter data in a standardized manner, tokenized biometric data use *"tokens"* or randomized alphanumeric characters to hold the place of sensitive data. Because they are entirely random, tokens cannot be decrypted. Instead, the token is either encrypted or destroyed after a single-use.

In any case the biometric data is stored in encrypted form to protect user data. The encrypted data can be decrypted or returned to its original form. Furthermore, by its design, encrypted data can be reversed using the same algorithm used to alter it in the first place. In other words, no matter how advanced the mathematical formula is, encrypted data is only as secure as those with access to it.

4.6.3 Reliability

The reliability of biometrics devices depends upon many factors and areas where it is actually implemented in some circumstances to achieve the goal, such as it can be used in attendance systems, access systems, banking systems, industries, automobiles, and many more.

Purity – In case of biometric attendance, the use of fingerprint and palm as a biometrics modalities, can be reliable where part of fingerprint and palm was used with purity. But while using it for an access control system at industry level, it might increase risk in reliability due to impurities of fingerprint, palm or its part.

Weather – Movement of season will change weather that will affect to human's biometrics which are related to surface or touchables such as fingerprints and palm. In this case, the system may fail to recognize a person.

Diseases and Injuries – It is quite possible that a user may have an injury or suffer from a disease such as allergy, dryness, or wetness. Then in such a case the biometrics such as fingerprint, palm and face may be affected.

4.6.4 Privacy

Obviously, along with security and convenience, sharing of biometric data can be a user privacy concern. Biometric recognition system storing user's biometrics data in database that can be further used for many purpose such as –

- Misuse of biometrics data in critical system
- Misuse of biometrics data in fraud and criminal activity
- Misuse of biometrics data in proxy authentication
- Building of fake biometrics prints

But somehow, this might not present much of a problem on its own if the system only stores actual biometrics measurement rather than storing additional information. In this case, privacy concerns will be minimal.

CHECK YOUR PROGRESS

A. Multiple choice questions

1. Which of the following error occurs when a template for biometric data cannot be correctly constructed (a) Inability to Enrol (b) Spoofing (c) False acceptance (d) False rejection
2. The biometric data is controlled by the IT Act, because it is (a) sensitive data (b) information. (c) accessed and processed through a computer resource (d) unique data
3. The reliability of biometrics devices does not depends upon (a) Purity (b) Weather (c) Diseases and Injuries (d) Company
4. Which of the following biometric data is more secure than fingerprint (a) Palm (b) Retina (c) Face (d) Voice

B. Fill in the blanks

1. Biometric technology progresses is not a perfect form of _____ or _____.
2. When the system mistakenly matches an input to a non-matching template, it is called as _____, and when the system fails to identify a match between an input and a matching template, it is called as _____ .
3. Liveness detection has mechanisms to prevent the potential of _____ .
4. The technique of _____ is used to assess whether the source of a biometric sample is a living person.
5. Biometric data breaches are problematic because of the _____ nature of the information.
6. The tokenized biometric data use _____ or _____ alphanumeric characters to hold the place of sensitive data.
7. Tokens cannot be decrypted because they are _____

8. Biometric database servers are more _____ but have a _____.

C. State whether the following statement is True or False

1. In various applications biometric data is stored in a centralized database.
2. Biometric identification is a foolproof solution to fraud or identity theft.
3. Spoofing is the term used for the security of biometric systems.
4. For optimum security, biometric templates are encrypted and stored off the blockchain.)
5. The encrypted data can be reversed using the same algorithm used to alter it in the first place.
6. Tokens can be decrypted.
7. The biometric data is stored in encrypted form to protect user data.
8. Biometric data is not highly secure, because of the split nature of biometric storage methods.
9. A method of double-backed biometric template storage is called distributed data storage.
10. A fingerprint or facial recognition cannot be hacked by cybercriminals. (F)

D. State the long form of following acronyms

1. FRR – False Rejection Rate
2. FAR – False Acceptance Rate
3. FTA – Failed To Acquire
4. FMR – False Match Rate
5. FNMR – False Non-Match Rate
6. EER – Equal Error Rate
7. DET – Detection Trade-off Curve

E. Short Answer Questions

1. What is the technology used for verifying electronic documents or messages?
2. What is the privacy of biometric data?
3. What is the hardware device used to store Digital Signature Certificates?
4. Name two scripting languages.
5. Name one interactive website that you have visited.
6. What is the use of a digital signature?
7. What is a digital signature certificate?
8. What is the use of connecting a device to the internet?
9. What are three types of IoT devices?
10. What are the factors affecting the reliability of biometric data?

Session 5: Biometric Data Entry and Incident Management

Data is an important concern for an organization. Biometric data is used to authenticate users. This data can also be used in forensics investigations to help identify suspects or victims of crimes. So accuracy is the most important aspect of biometric data. It is essential to maintain the confidentiality of biometric data. Biometrics take cyber security authentication to a whole new level. Because biometric identifiers are so unique—no two fingerprints or voice patterns are exactly alike. The possibility of unauthorized access is drastically reduced.

In this chapter you will be able explore various data entry software. It also illustrates the proper ways of maintaining the confidentiality of storing security and backup files for future use, demonstrate the application of various solutions for different types of incidents/service requests and you will be able to examine typical response times and service times for problems through the incident management tool.

5.1 Data Entry

Data entry includes entering and updating data into an electronic service or database. The data entry operator enters data into a company database by using data entry tools and software. There are various data entry tools such as keyboard, mouse, scanner, speaker and a variety of software. There are several methods to enhance data entry skills, with the assistance of a computer system or through structured training on keyboarding skills as well by using online typing tools. There are a variety of online typing tutors available including free and open source tools.

Fig. 5.1 Computerised Data Entry

5.1.1 Data Entry Software

Data entry software provides the automation and replacement of costly and inefficient paper and manual data input operations with robust programmes that may be utilized on computers, cellphones, and tablets. Data entry software may either create electronic forms to replace paper forms or entirely automated categorization and data extraction from incoming documents, depending on the user's needs. By using data entry software typing and grammatical errors can be reduced, it saves time and expenses and resources, reduces paperwork, increases accuracy, enhances clarity and efficiency.

5.1.2 Examples of Data Entry Software

There are a variety of software used for data entry in computer systems. It is suggested to use an open source data entry software to customize data as per the need. Some of

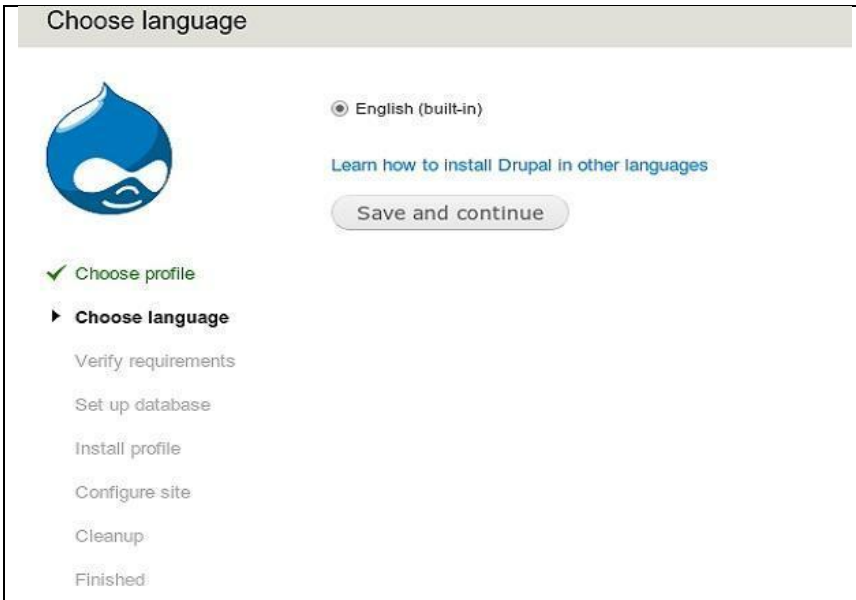
the free and open source software are explained herewith. There are many others which can be explored.

FormTools (free and open source)

FormTools is the free online data entry software that provides powerful and flexible solutions to its users. This open source web-based data entry system efficiently manages the forms and data. The users don't require any specific programming knowledge to create new forms. The software has a data visualization module that offers an easy and simple way to export the data, which can be used in other applications as per the requirement. You can use Form Tools to house the data from your own forms, create private forms for use by specific users only, or create forms right on your website – all with no programming knowledge needed. Form Tools offers a range of extra functionality through optional modules, letting you tailor your installation for your own project requirements. You can visit the website of FormTools for installation of this software on https://formtools.org/

DKAN (free and open source)

DKAN is the open source data entry software that offers the freedom to publish and consume structured information. This free data entry tool is flexible and agile for the users. It is easy-to-adopt and simple-to-use. The software is community-driven that can share, collect, and utilize data in the real world. This full-featured application serves as a 'ready-to-use' tool.



(Source: DKAN)

5.2 Data Extraction

Data extraction is gathering or obtaining various data types from several sources, many of which are unstructured or poorly organized. Data extraction allows data to be consolidated, processed and refined before being stored in a centralized location and changed. These locations may be on-site, cloud-based, or a hybrid of the two.

Data extraction is the first step in ETL (extract, transform, load) and ELT (extract, load, transform) processes. ETL/ELT are themselves part of a complete data integration strategy. The ETL procedure is divided into three steps.

1. Extraction – Data is extracted from various sources or systems. The extraction process locates and identifies important data before processing or transformation. Many different data types may be integrated and processed for business insight via extraction.

2. Transformation – The data may now be refined after being adequately extracted. Data is sorted, structured, and sanitized during the transformation stage. Duplicate entries will be eliminated, missing information will be removed or supplemented, and audits will be conducted to provide trustworthy, consistent, and usable data.

3. Loading – For storage and analysis, the converted, high-quality data is supplied to a single, unified destination location.

5.2.1 Types of Data Extraction

Data extraction is a flexible and powerful procedure that may help to collect various business-related data. For data extraction, it is essential to identify the type of data required. Types of data that are commonly extracted include:

Customer Data – This is the essential data for the organizations to understand their customers. Customer data includes personal information such as name, phone number, email address, unique identifying number, purchase history, social media activity and like that.

Financial Data – Financial data includes sales numbers, purchasing costs, operating margins, and competitor's prices. Companies may use this type of data to track performance, enhance efficiency, and plan strategically.

Use, Task, or Process Performance Data – This category of data includes information related to specific tasks or operations. For example, A retailer would want to know about its shipping operations, while a hospital might want to track post-surgical results or patient comments.

5.2.2 Importance of Data Extraction

The following are some of the advantages of employing a data extraction tool:

More Control – Companies can use data extraction to import data from other sources into their systems. Consequently, businesses can keep their data from being segregated by out-of-date programmes or software licensing. It is their information, and extraction offers the ability to do anything visitors want with it.

Increased Speed – Companies typically work with multiple sorts of data in different systems as they develop. Data extraction helps to integrate multiple data sets by consolidating that information into a unified system.

Simplified Sharing – Data extraction may be a simple approach for companies to give beneficial but restricted data access to external partners that wish to share some but not all of their data. Extraction also makes it possible to exchange standardized and usable data.

Accuracy and precision – Manual data entry process or hand coding increases the possibility of errors taking more time to edit and re-enter large volumes of data. Data extraction automates processes to reduce errors and avoid time spent on resolving them.

5.3 Data Validation and Error Detection

5.3.1 Data Validation

Data validation is the process of validating the accuracy and quality of data. It is accomplished by including various checks into a system or report to guarantee that input and stored data are logically consistent. Data is input into automated systems with little or no human intervention. As a result, it is critical to make sure that the data that goes into the system is valid and fulfills the quality requirements that have been set. If the data is incorrectly recorded, it will be of little utility and may result in more serious downstream reporting issues. Even if unstructured data is submitted accurately, cleaning, converting, and storing it will entail expenses.

5.3.2 Types of Data Validation

Data validation can take numerous forms. Before saving data in a database, most data validation methods will execute one or more tests to confirm that the data is accurate. The following are examples of data validation checks.

1. Verify the data type

A data type check verifies that the entered information is the right type. A field, for example, could only take numeric input. If this is the case, the system should reject any data that contains additional characters such as letters or special symbols.

2. Code Verification

A code check verifies that a field is chosen from a legitimate set of options or that it adheres to specific formatting constraints. For example, checking a postal code against a list of valid codes makes it easy to verify if it is legitimate. Other elements, such as country codes and industry codes, can be treated in the same way.

3. Range Verification

A range check will see if the input data is inside a specific range. Latitude and longitude, for example, are frequently employed in geographic data. The latitude should be between – 90 and 90 degrees, and the longitude should be between – 180 and 180 degrees. Any values outside of this range are regarded as invalid.

4. Format Check

Many data types have a predetermined format. Date columns with a set format, such as "YYYY-MM-DD"' or "DD-MM-YYYY", are famous use cases. Data validation that ensures dates are formatted correctly helps to preserve consistency across data and throughout me.

5. Consistency Check

A consistency check is a logical check that ensures data is entered in a logically consistent manner. For example, checking whether the delivery date for an item is later than the shipping date.

6. Uniqueness Check

Some data like IDs or e-mail addresses are unique by nature. Therefore, these fields in a database should almost certainly contain unique entries. A uniqueness check guarantees that an item is not put into a database numerous times.

5.3.3 Steps for Data Validation

The steps are:

Step 1. Determine Data Sample

Select the data to be sampled. If the amount of data is large, one should usually validate a portion of it rather than the whole data. It is important to select how much data to sample and what kind of error rate is acceptable to ensure the project's success.

Step 2. Validate the Database

Before moving the data, make sure that all necessary information is available in the current database. Compare the source and target data fields to determine the number of records and unique Ids

Step 3. Validate the Data Format

Determine the data's overall health and the changes that will be necessary to bring the source data into compliance with the direct instruction. Then search for incongruent or incomplete counts, duplicate data, incorrect formats, and null field values.

5.4 Error Detection

When data is transmitted from one device to another device, the system does not guarantee that the data received by the device is identical to the data transmitted. An Error occurs when the message received at the receiver end is not identical to the message transmitted.

Error detection reduces the chance of sending wrong frames to the destination, referred to as undetected error probability.

5.4.1 Error Detecting Techniques

The most popular Error Detecting Techniques are: Single parity check, Two-dimensional parity check, Checksum, Cyclic redundancy check.

1. Single Parity Check

It is a simple and inexpensive mechanism to detect the errors. In this technique, a redundant bit is also known as a parity bit which is appended at the end of the data

unit so that the number of 1s becomes even. Therefore, the total number of transmitted bits would be 9 bits. If the number of 1s bits is odd, then parity bit 1 is appended and if the number of 1s bits is even, then parity bit 0 is appended at the end of the data unit. At the receiving end, the parity bit is calculated from the received data bits and compared with the received parity bit. This technique generates the total number of 1s even, so it is known as even-parity checking.

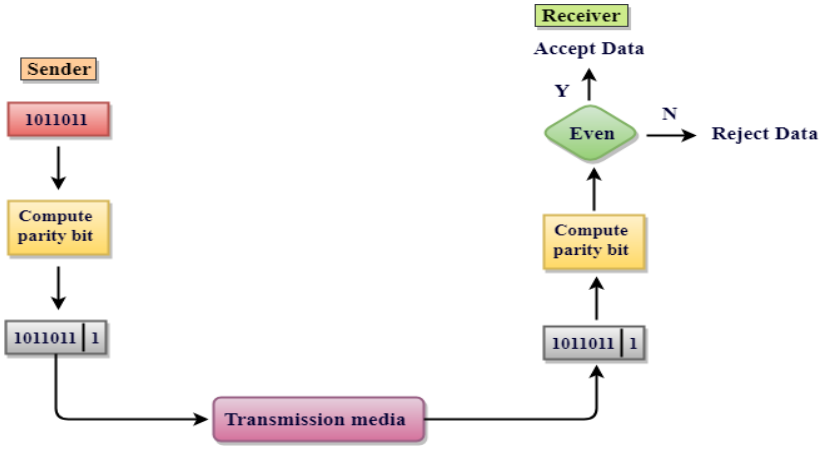


Fig. 5.2 : Single parity check

2. Two-Dimensional Parity Check

In Two-Dimensional Parity Check, performance can be improved. It organizes the data in the form of a table. Parity check bits are computed for each row, which is equivalent to the single-parity check. A block of bits is divided into rows, and the redundant row of bits is added to the whole block. At the receiving end, the parity bits are compared with the parity bits computed from the received data.

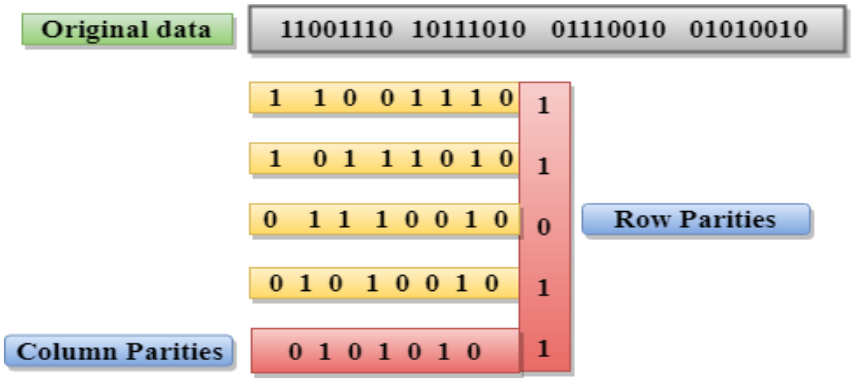


Fig. 5.3 : Two dimensional parity check

3. Checksum

It is an error detection technique based on the concept of redundancy. It is divided into two parts: *Checksum Generator* and *Checksum Checker.*

A Checksum is generated at the sending side. Checksum generator subdivides the data into equal segments of *n* bits each, and all these segments are added together by using one's complement arithmetic. The sum is complemented and appended to the original data, known as checksum field. The extended data is transmitted across the network.

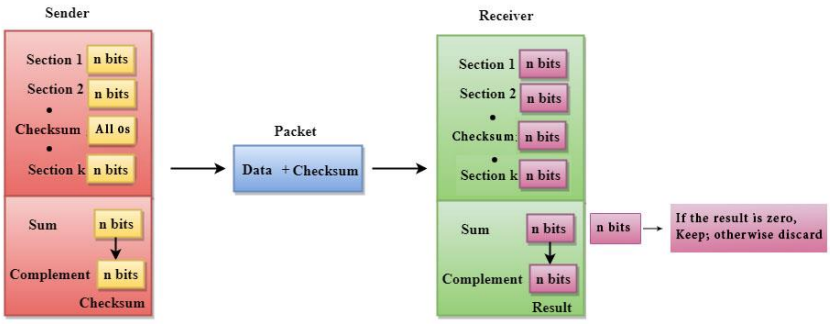


Fig. 5.4 : Checksum

A Checksum is verified at the receiving side. The receiver subdivides the incoming data into equal segments of n bits each, and all these segments are added together, and then this sum is complemented. If the complement of the sum is zero, then the data is accepted otherwise data is rejected.

4. Cyclic Redundancy Check (CRC)

CRC is a redundancy error technique used to determine the error. It is an alternative method for determining whether or not a received frame includes valid data. The binary division of the data bits being delivered is used in this approach. Polynomials are used to generate the divisor.

The sender divides the bits that are being transferred and calculates the remainder. The sender inserts the remainder at the end of the original bits before sending the actual bits. A codeword is made up of the actual data bits plus the remainder. The transmitter sends data bits in the form of codewords.

The receiver, on the other hand, divides the codewords using the same CRC divisor. If the remainder consists entirely of zeros, the data bits are validated; otherwise, it is assumed that some data corrupted happened during transmission. (Figure 5.5)

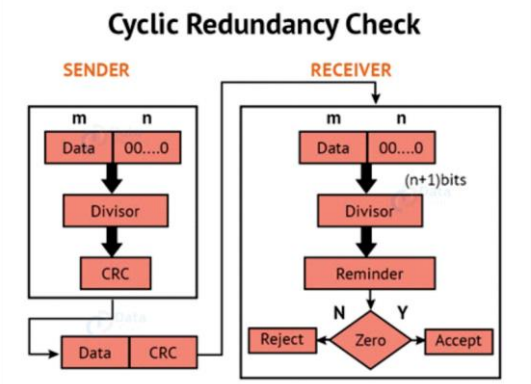


Fig. 5.5 : Cyclic redundancy check

5.5 Incident Management In Biometric Processes

5.5.1 Incident

Incident is any disruption to an organization's operations. An incident has to be handled promptly, otherwise it may turn into an emergency, crisis, or tragedy. An incident can impact corporate operations, services, security, and other critical business processes if it is not managed effectively.

5.5.2 Type of Incidents

Mainly there are three types of incidents: *Major incidents, Repetitive incidents* and *Complex incidents.*

1. Major Incidents – These are large-scale incidents that occur suddenly. Every organization need to be prepared to deal with them quickly and efficiently.

For example, an overnight server restart that causes app login issues for hundreds of users might significantly impact the business. Employees cannot complete their work the next day because they wait for the help desk crew to reset login credentials and distribute updates to users. At the same time, the help desk employees arrive to discover a slew of related support tickets waiting for them, putting them in a position where they must deal with a mountain of paperwork to get started fixing issues.

In this circumstance, the organization needs an incident management system to handle many support tickets while also recognizing and consolidating similar requests. It can also allow support staff to automatically deliver messages to end-users and exchange resolutions across the support team to speed up answers. Large-scale difficulties can result in long-term productivity losses; thus, using incident management to deal with these significant issues swiftly and effectively is crucial. It is critical to respond swiftly to these occurrences.

2. Repetitive Incidents – In many situations, these occurrences indicate underlying issues with the IT setup. If one is not in a position where problem management will help the organization, they have to rely on incident management to resolve these difficulties. Without incident management, the support team would be stuck dealing with these events every time they arise, hoping to remember what they did the last time so they can swiftly resolve the issue.

A knowledge management system may be integrated with an incident management platform to identify repeated events and provide users with the information they need to address them rapidly. The organization may also write scripts to automatically fix primary, repeatable occurrences, ensuring that the help desk staff is not spending me on frequently occurring issues.

3. Complex Incidents – Most events that come into the support desk are simple that can be resolved by level 1, while the complex issues are forwarded to level 2 engineers. It may take a long time to address. A dedicated incident management platform has the feature of workflow optimization, aletering, and incident tracking tools one needs to handle complicated situations without getting into difficulty.

5.5.3 Incident Management

An incident management process is a collection of processes and activities used to respond to and address important occurrences, including identifying and reporting incidents, who is accountable, what tools are utilized, and how the problem is resolved.

Many sectors employ incident management processes, and incidents can range from IT system failure to situations needing the attention of healthcare experts to vital infrastructure maintenance.

It covers every aspect of an incident across its life cycle. It facilitates ticket resolution and makes ticket administration more open. Ticket administration might be complex without incident management. Some of the most common issues that may arise are:

1. End users have little visibility into ticket progress or predicted timescales.
2. There is no reliable documentation of previous events.

3. Unable to document solutions to difficulties that occur frequently.
4. Business outages are higher, mainly when large disasters occur.
5. Longer resolution times
6. Lack of ability to report.
7. Customer satisfaction has dropped.

5.5.4 Incident Response Framework

Incident response refers to the procedures and policies followed by a company in the event of a cyber-attack or data breach. The purpose of incident response is to reduce the impact of an attack, thereby reducing the time, effort, expenses, and reputational harm connected with a cyber cassaulty or data breach. Aside from minimizing many impacts of cyber cassaulty, the ***Incident Response*** process may assist businesses in preventing future attacks that compromise their information security.

Every organization should have a plan to assist in recognizing, controlling, and removing cyber attacks. IR strategies define what constitutes an attack and provide organizations with a clear roadmap for what to do in these incidents.

An incident response framework's objective is to assist organizations in developing standardized response strategies. Large businesses with extensive security knowledge and experience are frequently the developers of these frameworks.

There are three important aspects in the incident management framework: *Prepare, Respond* and *Review.*

Prepare (Pre-Incident Patterns)

1. Make incidents visible and part of daily work
2. Well defined incident roles
3. Well defined incident response triggers
4. Well defined on-collaboration & schedule
5. On-call onboarding and training
6. Incident command training & certification
7. Well defined communication plan
8. Well defined behavior protocols

Respond (Incident Response Patterns)

1. Periodic CAN reporting (Conditions, Actions, Needs)
2. Shared incident state document
3. Incident call recording
4. Incident swarming

Review (Post-Incident Response Patterns)

1. Localized incident reviews
2. Global incident reviews
3. Post review improvement items
4. Incident review template
5. Incident impact assessment

5.5.5 Incident Management Process

The methods and activities used to respond to and resolve incidents are called incident management processes. Who is accountable for reporting, how incidents are detected and informed to IT teams, and the technologies used are all covered.

When well-designed, incident management methods guarantee that all events are immediately addressed, maintaining a high-quality level. Processes may also aid teams in improving existing operations and avoiding future issues.

Any incident resolution procedure follows a set of five steps. These procedures help teams respond to incidents successfully by ensuring that no component of the issue is neglected.

1. Incident Identification, Logging, and Categorization – User reports, solution analysis, and manual identification are all used to identify incidents. The incident is recorded, and the inquiry and classification process may begin. It is critical to categorize occurrences to determine how they should be handled and prioritize response resources.

2. Incident Notification and Escalation – This stage includes event aletering. If the incident is minimal, facts may be recorded or alert conveyed without the need for an official notice. Escalation is determined by the incident's categorization. Escalation can happen unnoticed if events can be controlled automatically.

3. Diagnosis and investigation – Staff can begin examining the kind, cause, and potential remedies for an issue after assigned incident duties. One can select the relevant remedial procedures when an event has been diagnosed. It involves informing affected employees, customers, or authorities about the situation and any anticipated service disruptions.

4. Resolution and Recovery – Eliminating threats or fundamental causes of difficulties and returning systems to full functionality is part of resolution and recovery. Additional phases may be necessary depending on the kind and severity of the incident.

For example, when a virus infection occurs, one cannot simply erase the infected files and resume operations. Instead, to prevent the infection from spreading, make a clean duplicate of afflicted systems, isolate the harmful components, and completely replace the systems.

5. Incident Closure – Closing incidents usually entails completing paperwork and analyzing the response procedures. This assessment assists teams in identifying areas for improvement and proactive ways to help prevent future accidents.

Providing a report or retrospective to administrative staff, board members or consumers may also be part of incident closure. This information can help regain any lost trust and openness in business processes.

5.5.6 Cluster Analysis

Cluster analysis is a statistical technique used to classify items into groups according to how similar they are. It can also be referred to as clustering, taxonomy analysis, or segmentation analysis.

The aim of a cluster analysis is to group various objects or data points so that there is a higher degree of association between two items if they belong to the same group and a low degree of correlation if they belong to separate groups.

Because it is frequently used when researchers do not have an assumed concept or fact that they are utilizing as the foundation of their research, cluster analysis varies from many other statistical techniques.

Since this analytical method doesn't distinguish between dependent and independent variables like factor analysis does, it is often used in the exploratory stage of a study. Instead, cluster analysis is used primarily to identify data structures without offering a justification or meaning.

5.5.7 Data Event Analysis

Data Event Analysis is the evaluation of a business-related event that the company has to be aware of and that needs to be documented in the firm's memory, i.e., the company files. A data event may be created internally or externally, as a consequence of an action being conducted or just as the result of time passing. the occurrence of data events that are somehow documented. The information that must be captured so that the event may be remembered and responded to is determined by data event analysis. It must also establish how the firm learned about the occurrence; in other words, what made them aware of it?

5.5.8 Database Access Control

Database access control, often known as database access control, is a technique for limiting access to unauthorized individuals and granting access to user groups that are permitted to view important corporate data in order to avoid data breaches in database systems.

Authentication and authorisation are the two key parts of DBMS's Database Access Control.

In order to verify a user's identity when they access your database, authentication is used. It's crucial to bear in mind that user authentication alone cannot safeguard data. An extra layer of security is authorization, which determines if a user's degree of access or data access control is adequate. Data security is ultimately impossible without identification and authorisation.

5.6 Incident Management Tools

IT teams may categorize, organize, and resolve significant incidents that cause downtime or service outages using an incident management tool. When an incident is detected, it remains at the center of an IT organization's ecosystem, sending real-time warnings to the relevant teams' phones.

5.6.1 Benefits of Incident Management Tools

The benefits of using incident management tools in the workplace are:

Increased communication – Incident management systems like Slack and Zoom allow employees and management to communicate instantly, which would generally take longer or get unorganized if done by email, text, or in-person talks. It can help in reducing the time it takes to respond to employee queries or concerns and make it easier for employees and managers to handle situations.

Quicker response time – Incident management software may significantly minimize time spent recognizing and responding to workplace issues. An employee, for example, may report a technological issue at their workstation in minutes using an incident management application, with management receiving prompt notification of the occurrence and being able to respond just as swiftly.

Detailed records – Incident management software is also helpful for keeping detailed records of the many occurrences that occur in the workplace over time. For example, a virtual service desk solution may keep track of the many events and reports that employees submit, with management and IT having access to that reported history as needed.

Reduced workload – Incident management software can help create a more efficient workplace by minimizing the workload that would otherwise be spent keeping track of various issues. Employees, particularly those in human resources, might benefit from the reduced burden by focusing their energies on more vital responsibilities at work.

5.6.2 Criteria for Selecting Incident Management Tools

The following steps assists in selecting incident management tools that are compatible with the company's practices:

1. Evaluate the company's needs

The first step in determining which best incident management tool is to assess its objectives and needs. Next, make a report outlining some of the company's most frequent problems, and think about how alternative management tools may help relieve or handle those situations. Next, consider getting input from employees on what they feel are the most prevalent issues in the company and how they presently handle them. It may be accomplished by sending out a survey or questionnaire to employees to learn about the most critical matters in the company.

2. Evaluate the options

The next step is to undertake extensive research to get completely aware of the various incident management tools. Then, make a spreadsheet where one may take notes on different tools and categorize them depending on their purpose, features, price, and any other significant criteria that might influence the ultimate pick. It might help limit the selections and focus on products that will impact the company's incident management strategy.

3. Consider compatible tools

After narrowing down the list of viable event management systems, it is required to assess their software compatibility. To further improve the incident management process, several management technologies may collaborate and extract information and resources from one another. Consider comparing the top tools to evaluate their cohesion and determine which is most consistent with the workplace's goal, duties, and occurrences before making a final decision.

5.6.3 Incident Management Tools

The most commonly used incident management tools are:

1. Resolver

Resolver is an incident management tool that investigates security issues that could disrupt an organization's operations. Employees may utilize Resolver to report problems, which management can address in minutes. Resolver simplifies incident management activities like record-keeping while also providing other benefits like effective data quality and the ability to quickly translate languages using artificial intelligence.

2. Splunk Enterprise

Splunk Enterprise is a tool that gives extensive data reports to managers and IT professionals so they can make key technical and business choices while dealing with problems. The package includes email and help desk assistance, in-person and live online training, anti-spam and virus protection, archiving, and interoperability with many common software programmes. Splunk, as an incident management tool, may help speed up problem resolution by altering IT teams to potential issues in real-time.

3. Fresh service

Fresh service, as an IT service management system, allows customers to submit tickets via a number of channels, including email, chat, and even its own support site, which serves as a service desk. Fresh service evaluates tickets using intelligence technology and provides related articles to the reporter that may assist them in fixing their reported trouble. This tool is most advantageous to a company's IT department since it allows them to send automatic answers to tickets, which may aid in the incident management process.

4. PagerDuty

PagerDuty is a tool that allows businesses to notice problems and respond to them in real-time. It allows customers to report and handle issues, while managers may reply right away with a swipe on their mobile app. Pager Duty also integrates with other incident management applications, such as Slack, and allows management to schedule on-calls from their mobile device, potentially increasing scheduling efficiency.

5. Manage Engine Service Desk Plus

Manage Engine Service Desk Plus is an incident management tool that works in a service desk structure, allowing employees to create tickets, make purchases, manage contracts, and track assets. Manage Engine provides an Integrated Package that combines the software with additional management solutions to improve productivity and optimize the issue management process. In comparison to other prominent incident management products on the market, this management tool has a comparatively modest pricing point.

6. Ops Genie

OpsGenie is an incident management tool which provides a fresh approach to dealing with unexpected technical and operational issues at work. When an employee reports an event or another concern emerges, the programme focuses on giving workers immediate notifications and alerts. It is connected with more than 200 IT service management solutions, allowing customers to make use of the most valuable resources available across several programmes to handle their specific corporate issues.

7. JIRA Service Management

JIRA Service Management is among the most widely used incident management tools, providing staff with a variety of choices for reporting, monitoring, and responding to unexpected events. It employs a collaborative platform to expedite incident management procedures, such as its self-service site, where employees may discover answers to problems without the intervention of management or supervisors. In addition, the JIRA application focuses on improving communication across many departments within a company, such as IT, development, and business operations.

8. iAuditor

iAuditor software is a common incident management tool that inspects and monitors numerous systems for possible dangers to a company's security, quality control, and general business operations.

The programme provides users with in-person and online training, as well as extra educational tools such as webinars and videos. It also employs collaboration technologies to make it easier for staff to work together on audits, financial report investigations, and other safety and quality assurance inspections.

9. xMatters

As an incident management tool, xMatters provides businesses with a simplified platform for preventing, monitoring, and resolving technical catastrophes like software problems or internet outages. The xMatters program's major purpose is to prevent and resolve technical issues before they disrupt company operations. Therefore it takes a proactive approach to incident management. Furthermore, the application links its own systems with standard management tools like JIRA, Splunk, and Slack, making it a viable alternative for managers looking for solutions that are compatible with other incident management programmes.

10. Slack

Slack is a collaborative work hub that allows employees to connect in real-time across several channels. Users can contribute images and documents, share links, and vote in surveys to assist management in making organizational choices. Slack simplifies employee communication by allowing managers to build channels for individual departments, projects, and subjects. Employees may also promptly report issues on Slack and share them with colleagues who can take fast action

CHECK YOUR PROGRESS

A. Multiple choice questions

1. Which of the following is not true when using data entry software (a) typing not required (b) saves time and expenses and resources, (c) reduces paperwork, increases accuracy, (d) enhances clarity and efficiency
2. Which of the following service management tool is the most widely used (a) PagerDuty (b) Slack (c) JIRA (d) iAuditor
3. Which of the following tool is an incident management tool that investigates security issues (a) Slack (b) xMatters (c) JIRA (d) Resolver
4. Which of the following tool provides a fresh approach to deal with unexpected technical and operational issues (a) OpsGenie (b) Fresh service (c) Splunk (d) JIRA
5. Which of the following tool that works in a service desk (a) Manage Engine Service Desk Plus (b) Slack (c) JIRA (d) iAuditor

B. Fill in the blanks

1. The incident management framework consists of Prepare, _____, and Review.
2. The three major incidents are: Major, Repetitive, and _____.
3. ETL stands for _____.
4. ELT stands for _____.

5. CRC stands for _____.

C. State whether True or False

1. Resolver is an incident management tool that investigates security issues.
2. Splunk Enterprise is a tool that gives extensive data reports to managers.
3. FormTools is the free online web-based data entry software.
4. DKAN is the paid data entry software.
5. A Checksum is generated at the receiving side.

E. Answer the following questions in short

1. Name any three commonly used incident management tools.
2. Explain the incident management process.
3. List the benefits of Incident Management Tools.
4. What is Data Event Analysis?
5. List the criteria for Selecting Incident Management Tools.

Module 4 Occupational Health, Safety and Security

Module Overview

The work culture in IT industry is different from routine office work, where working hours are also not fixed. Continuously working in front of the computer creates health problems especially in your eyes. Adopting the safe work practice in the work place, the productivity can be increased.

This Unit deals with the concept of working environment in IT industry. It focuses on safe working practices at work place. It explains about health related problem caused by the wrong practices and it's solution. It also gives the knowledge about resources required in workplace for smooth working. Further it explains how to deal with computer component and problem related to electrical hazards. It also explains workplace safety guidelines, workplace hazard and its control. The medical emergency situations and its solution is illustrated.

Learning Outcomes

After completing this module, you will be able to:

- Understand essential health, safety, and security protocols to maintain a safe workplace environment and protect employee well-being.
- Learn to identify and implement quality measures that enhance productivity, efficiency, and service standards within the workplace.
- Develop strategies and practices for preventing workplace accidents and emergencies, ensuring a proactive approach to safety management.

Module Structure

Session 1: Health, Safety and Security at Workplace

One evening we were traveling on the busy road of Mumbai. We were looking at the big and tall buildings. My friend was telling me that all these buildings hold different IT companies. Suddenly we found that there was a lot of smoke coming out of the one building. People working in that building were running away from the building and shouting about the fire. Soon we found that the fire alarm was ringing and fire brigade vehicles along with water tanks were approaching the building. People were saying that there are lot of casualties and the overall damage to the building was worth several lakhs. This event reminds us of the importance of health and safety at the workplace.

Fig. 1.1 Illustration of fire catches in the office building

1.1 Introduction to health, safety and security at workplace

Every workplace accident, illness or dispute is a cost to organization, as well as a cost to injured individuals and their families. It is our responsibility to create a safe workplace. This will improve the work environment and productivity. Employees have to take responsibility for their own health and safety rather than relying solely on the *"safety officer"* or management.

Health

Health of an employee is the state of the physical, mental and social well being. Every organisation must provide a healthy and safe working environment for their employees at the workplace. Health of an employee must be in a good condition so that the employees of the organisation will not suffer from any diseases. Cleanliness at the workplace is mandatory. The workplaces must be cleaned in the morning before the people start working. If it is neat and clean then the people will feel happy to work in that environment. A proper air conditioning is mandatory to provide clean and cool air at the workplace. A properly filtered water facility must be available for the employees of the company. A fresh food cafeteria must provide good quality food for the employees. This will help to maintain the health of the employee. The organisation should maintain a clean wash-room facility in good condition to be used by the employees.

Safety

The work environment of the organisation must be safe. It must be free from hazards and risk. A hazard is something that can cause harm to the people. A risk is a probability of causing harm to the people. A proper safety guidelines must be prepared by the company and it should be strictly followed. At regular intervals of time, the safety procedures must be practiced by the employees.

Security

Every employee working in an organisation must feel that they are secured in the company campus. Security is a kind of freedom from any potential harm. Security ensures the safety of the people working in the organisation. Every organisation must have a separate security department. This department should be responsible for various security such as personal safety, computer system safety, electrical safety, transport safety and other equipment safety. The proper security procedures will reduce liabilities, insurance and compensation for an organisation. This will increase the business revenue and will reduce the operational charges of the company.

1.2 Policies and procedures for health, safety and security

The Department of Information Technology (DoIT) has prepared the policy to provide employees with a healthy and safe work environment.

Definition

A health, safety and security policy is a written statement by an employer stating the company's commitment for the protection of the health, safety and security of employees and to the public. It is an endorsed commitment by management to employees regarding their health, safety and security.

A health, safety and security program/policy contains the health, safety and security elements of an organization and objectives which make it possible for the company to achieve its goal in the protection of its workers at the workplace.

The government has a specific section mentioned in their company laws, which states the minimum requirements to be followed for health, safety and security programs. Each employer or company should follow these requirements. Apart from that the company should also have their own health, safety and security committee to determine the hazards present at the workplace. Once these hazards are identified then their control measures should be specified in the health, safety and security program.

Reasons for Health, Safety and Security Programs or Policies in Workplace

There are several reasons that can be specified for safety policy as given below.

- It clearly indicates the company's commitment for their employee's health and safety;
- It shows the performance of the business and the safety performance are compatible with each other;
- It clearly states that the company is not only doing the business for profits but it is taking care of all its stakeholders.
- The accountability of everyone working for the company is outlined for the workplace health, safety and security;
- Company can comply national policy on Occupational Health and Safety (OH&S) of Government of India;
- Injuries and illness of the employees is prevented through such policy

A typical policy of an IT company may contain the following OH&S clauses.

- Provide adequate resources to ensure continual improvement in its OH&S performance.
- Comply with relevant OH&S legal and other requirements applicable to the organisation and drive for 'beyond compliance' leadership.
- Set appropriate OH&S objectives & targets and conduct periodic performance reviews against these targets.
- Adopt measures and processes that focus on the prevention of occupation related accidents, injuries, illnesses, and near-misses and strive to continuously improve such processes.
- Ensure OH&S awareness and build competency associated at all levels to handle individual OH&S responsibilities.

1 Breaches in Health, Safety and Security and Accident Report

In today's highly connected world, a reputation is its most valuable asset. A single health and safety breach brings down the reputation of an organisation. Health and safety breaches can lead to costly legal battles, fines, and compensation claims. The negative impact can lead to a loss of trust, brand loyalty, and market share. So it is important to take care of health, safety and security breaches.

Safety breaches in the designated premises are "Incidents" that need to be reported and duly responded to. Reporting a safety breach is done by providing an Incident Report. Some important points in the operations related to reporting and response related to safety breach must be included Incident Report are:

- The person/s involved (details of the offender/s)
- What exactly happened
- Number of casualties
- Where it happened (location of the incident)
- When did it happen (Exact time, when the incident took place)
- Why it happened (factors that caused the incident; the holes and gaps in the existing security system)
- Description, features, peculiar features and condition of the affected people, vehicles, properties, and goods

The common format of the Incident Report is given below:

INCIDENT REPORT

Day/ Night: _____ **Date :** _____ **Time:** _____

Report Writer Name: _____

Co No. _____ **Section :** _____

Telephone No. _____ **Extension :** _____

INCIDENT (Summary – Who, What, Where, When, Why, How etc.)

_____

_____

_____

_____

ACTION TAKEN BY SECURITY

_____

_____

_____

_____

RECOMMENDATIONS/ COMMENTS/ REFERENCES:

_____

_____

_____

_____

Copy to Client: _____ **Date:** _____

Creating reports with comprehensive information is a must for every organization. The main idea behind this is to let the management body of the company know the hazards at the workplace. With the help of such reports, the company can examine, pinpoint the risks, and carry on the essential improvements within the organization. Because of such reports, companies can recognize long-term risks and short-term risks and achieve remedial actions for those risks. In case of security-related issues or health-related issues, it is always a better choice to inform your supervisor or seniors.

A company can function in a systematic, smooth and successful way if it looks after the satisfaction of its employees. OH & S is one of the safety platforms where every corporation has to meet the safety guidelines.

Government Agencies for Safety at Workplace

As per Indian constitution there are the specific articles to ensure occupational safety and health for workers are: 42, 39 (e, f), and 24. Some government agencies that look into the safety and security of individuals at the workplace are follows:

- Labour Departments (for both UT and State)
- Ministry of Labour
- Government of India
- NSCI (National Safety Council of India)
- National APELL (Awareness and Preparedness for Emergencies at Local Level)

1.3 Workplace Safety Hazards

The most common definition of hazard is *'a danger or risk'* that is associated with something. Something can even be considered a hazard if it would be a trigger for causing another hazard to become present, which could hurt someone or something in the area. Workplace hazards pose potential harm to people at work, and that can cause damage to the work environment and everything else in it. Hazards could cause adverse health effects and losses of property and equipment for organizations.

There is a common way to classify hazards, and not all these are present in all workplaces. In some industries like manufacturing and pharmaceuticals, there are biological and chemical risks that pose risks to the workers. Physical dangers are present as well in many industries where there is exposure to electricity, radiation, extreme pressures, noises and magnetic fields. On the other hand, ergonomic hazards are present in facilities where there are repetitive movements and where workstations are set up haphazardly. But it can be generalized that in all these classifications, there are always safety hazards that come up along with the highlighted workplace dangers.

Physical hazards – It is the risks arising from the physical work environment – floors, facilities, walls, and ceilings. Physical hazards could also mean working with machinery and electricity-operated machines. Work processes or specific assignments could also qualify as areas where physical hazards are present. There is a vast list of physical hazards across all industries, but when we look at one specific sector, these dangers are also particular to the work setting.

Falling off heights, slipping and tripping – The reasons for falling are attributed to faulty scaffolding and ladders, as a result of contact with electricity, and slipping or crashing into anything that throws the worker off balance. On the other hand, trips and slips happen right on lower levels, particularly the floor, on ramps and any uneven surface in the workplace. Various injuries result from simply tripping over things at work, while many more accidents take place when employees slip on the floor, from motorized vehicles or from scaffolding or ladders.

To avoid falls and slips, all things must be arranged properly. Any spilt liquid, food or other items such as paints must be immediately cleaned to avoid any accidents. Make sure there is proper lighting and all damaged equipment, stairways and light fixtures are repaired immediately.

Fig. 1.2 Falling off heights, slipping and tripping

Electrical hazards – There are many reasons why workers get electrocuted or suffer from electric shock at work. For the most part, it's due to coming in direct contact with live wires, or having indirect contact through a conductor. While not all electrical accidents lead to death, there are many life-threatening, severe and often permanent injuries that could result from it. At work, the common causes of electrical accidents are exposed, worn-out wiring, overloading of electrical outlets, ungrounded or faulty equipment, and unsafe use of electrical equipment. Employees must be provided basic knowledge of using electrical equipment and common problems. Employees must also be provided instructions about electrical safety such as keeping water and food items away from electrical equipment. Electrical staff and engineers should carry out routine inspections of all wiring to make sure there are no damaged or broken wires.

Fire hazards – Each establishment must comply with housekeeping standards to ensure fire safety. Everyone does not follow such requirements, and this leads to accidents resulting in fire. Such events not only damage vital workplace equipment, stock and other items, and the building; it could also lead to injuries among its employees. To avoid fire, it is very important that safety precautions are in place. The whole organization must also have first response and emergency mitigation systems in place. Employees should be aware of all emergency exits, including fire escape routes, of the office building and also the locations of fire extinguishers and alarms.

Health hazards – Health refers to the physical well-being of the workers, and this includes the condition of their skin, eyes, ears and all other body parts. But it also includes the health situation of what we cannot see upfront – their respiratory and cardiovascular system, and the nervous system. Hazards are present in most workplaces that could impact any part of the human body. For example, a noisy machine or factory environment could damage the sense of hearing of the workers. In the same manner, exposure to bright lights and toxic fumes and vapour could damage the eyes and nose. There are also more serious and long-term health issues arising from hazardous workplaces, such as damage to the lungs because of the exposure to harmful chemicals.

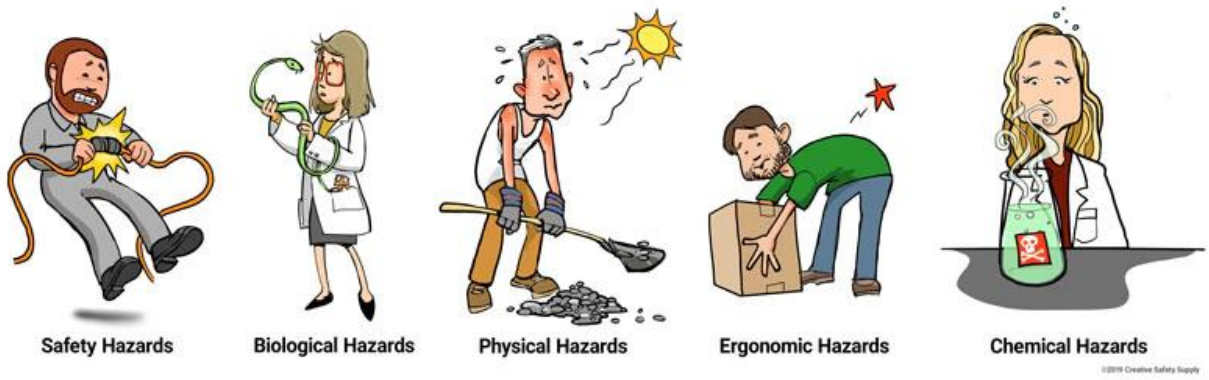


Fig. 1.3 Health hazards

Potential Sources of Hazards in an Organization

Bright light sources behind the display screen can create contrast problems, making it difficult to clearly see your work. Apply the following possible solutions to avoid this.

- Use blinds or drapes on windows to eliminate bright light. Blinds and furniture placement should be adjusted to allow light into the room, but not directly into your field of view.
- Use indirect or shielded lighting where possible and avoid intense or uneven lighting in your field of vision. Ensure that lamps have glare shields or shades to direct light away from your line of sight.
- Reorient the workstation so bright lights from open windows are at right angles with the computer screen.
- High contrast between light and dark areas of the computer screen, horizontal work surface, and surrounding areas can cause eye fatigue and headaches. So, use well-distributed diffuse light.

Hazards using computers – Hazards while using computers include poor sitting postures or excessive duration of sitting in one position. These hazards may result in pain and strain. Making the same movement repetitively can also cause muscle fatigue. In addition, glare from the computer screen can be harmful to the eyes. Stretching at regular intervals or doing some simple yoga in your seat can mitigate such hazards.

Handling office equipment – Improper handling of office equipment can result in injuries. For example, sharp-edged equipment, if not handled properly, can cause cuts. Staff members should be trained to handle equipment properly. A relevant manual should be made available by the administration on handling equipment.

Handling objects – Lifting or moving heavy items without proper procedure or techniques can be a source of potential hazard. Always follow approved procedures and proper posture for lifting or moving objects.

Stress at work – In today's organisations, you may encounter various stress-causing hazards. Long working hours can be stressful and so can aggressive conflicts or arguments with colleagues. Always look for ways for conflict resolution with colleagues. Have some relaxing hobbies for stress against long working hours.

Working environment – Potential hazards may include poor ventilation, chairs and tables of inappropriate height, hard furniture, poor lighting, staff unaware of emergency procedures, or poor housekeeping. Hazards may also include physical or emotional intimidation, such as bullying or ganging up against someone. The staff should be made aware of the organisation's policies to fight against all the given hazards related to a working environment.

Hazard Control

Hazards that have been identified and assessed as priorities are required to implement adequate control measures. Control measures should follow the hierarchy with a strong emphasis on eliminating hazards at the source, whenever possible.

- Take all feasible measures to eliminate the hazard, for example, by substituting or modifying the process.
- If elimination is impractical or remains incomplete, take all feasible measures to isolate the hazard, for example, instituting engineering controls such as insulating noise.
- If it is totally impossible to eliminate or isolate the hazard, its likelihood to cause injury should be minimized. Ensure that effective control measures are being applied, such as installing proper exhaust ventilation and providing personal protective clothing and equipment that is properly used and maintained.

Safety Guidelines Checklist

1. Store all cleaning chemicals in tightly closed containers in separate cupboards.
2. Throw rubbish daily.
3. Make sure all areas have proper lighting.
4. Do not wear loose clothing or jewellery when working with machines.
5. Never distract the attention of people who are working near a fire or with some machinery, tools or equipment.
6. Shut down all machines before leaving for the day.
7. Do not play with electrical controls or switches.
8. Do not operate machines or equipment until you have been properly trained and allowed to do so by your supervisor.
9. Repair torn wires or broken plugs before using any electrical equipment.
10. Do not use equipment if it smokes, sparks or looks unsafe.
11. Cover all food with a lid, plastic wrap or aluminium foil.
12. Do not smoke in 'No Smoking' areas.
13. Report any unsafe condition or acts to your supervisor.

Summary

- Safety breaches in the designated premises are "Incidents" that need to be reported and duly responded to.
- The full form of EHS is Environmental Health and Safety.
- The first rescuers will make the victim sit reach under their armpits and grab their wrist.
- Information based on organizational meetings with the Area Health and Safety Committee.
- One must rationally and critically think and assess the severity of the emergency and determine what requires to be done on an immediate basis.
- First Aid is an emergency care or treatment given to an ill or injured person before regular medical aid can be acquired.

Check Your Progress

A. Multiple Choice Questions

1. Workplace safety is essential in organisation (a) to avoid the accident and injury (b) to increase the productivity (b) to improve the work environment (d) All of the above
2. Which of the following is not mandatory to keep the good health of an employee (a) cleanliness (b) food court (c) clean and fresh air (b) clean washroom
3. The security department is not responsible for (a) personal safety (b) computer system and equipment safety (c) electrical safety (d) personal belongings
4. The proper security procedures will increase (a) liabilities, (b) insurance (c) business revenue (d) operational charges of the company.
5. Which kind of hazards can occur in IT industry (a) biological (b) chemical (c) physical (d) ergonomic
6. Which of the following can cause hazards while using computers (a) poor sitting postures or excessive duration of sitting in one position (b) lifting heavy object (c) mishandling of tools and equipment (d) improper handling of office equipment
7. Which of the following statements is likely to result in an injury to the operator? (a) Selecting the right tool for the job (b) Wearing safety goggles or glasses (c) Using a tool with loose handles (d) Keeping cutting tools sharp

8. What are the potential cause of hazards at workplace (a) poor ventilation (b) poor lighting (c) poor housekeeping (d) all of above

B. Fill in the blanks

1. Health of an employee is the state of the physical, _____ and _____ well being.
2. The workplaces must be cleaned in _____ before the people start working.
3. A proper _____ provides clean and cool air at the workplace.
4. A fresh food cafeteria helps to maintain the _____ of the employee.
5. The work environment of the organisation must be_____ and free from _____ and _____.
6. The proper security procedures will increase the _____ and will reduce the _____ of the company.
7. Injuries and illness of the employees is prevented through national policy on _____ .
8. Physical hazards occur due to _____.
9. Electrical hazards mostly caused due to coming in direct contact with _____, or indirect contact through a _____ .
10. Hazards while using computers occur due to _____ or excessive duration of sitting in _____.

C. State whether True or False

1. The employer and employees are responsible for workplace safety.
2. Any injury at work should be reported to the supervisor immediately.
3. No matter how big or small the injury; the injured person should receive medical attention.
4. While working with machines and equipment, employees must follow the safety guidelines set by the company.
5. Bright light sources behind the display screen can create contrast problems
6. Exposure to bright lights and toxic fumes and vapour could damage the mouth and ears.
7. The use of personal protective clothing and equipment can control the hazards at the workplace.
8. Do not throw rubbish daily.
9. Proper handling of office equipment can result in injuries.
10. Stress at the workplace can cause hazards in today's organisation.

D. Short Answer Questions

1. Briefly explain the concept of health, safety and security at the workplace.
2. State the most important reasons for health, safety and security programs in workplace
3. List out the various workplace safety hazards.
4. List out the potential sources of hazards in an organization.
5. List some of the IT workplace hazards.
6. What are the examples of potential hazards?
7. Describe information technology workplace hazards?
8. What are the workplace safety rules?
9. List out different safety guidelines?
10. Describe the type of emergency with an example?

Session 2: Workplace Quality Measures

In any organisation it is necessary to maintain a good air quality to improve the working capabilities of employees. Pollution free air is an essential requirement for any organisation. Also most of the IT companies make use of a centralised air conditioning system to keep the temperature of the working place at a pleasant level. Water pollution is another problem faced by many organisations. Most of the human activities make water polluted. The polluted water may cause the disease. So an organisation must ensure to prevent air pollution or water pollution.

Fig. 2.1 Air pollution and water pollution

2.1 Air and water quality monitoring process

Air and water pollution can be analysed by using several methods. There are three common forms of analysis – physical, chemical and biological. For such analysis samples can be collected in the surrounding region of the organisation. The water and air samples can be analysed by performing some physical, chemical and biological tests.

The temperature and content of the sample can be easily measured. For example, the various gases or percentage of various gases such as oxygen, nitrogen, carbon dioxide present in the air can be measured. The PH value of the water can be measured through chemical analysis. The effect of air and water on these plants and animals is studied. The microbial indicators are used to monitor the health of the ecosystem.

Guidelines for clean air and clean water.

A proper guidelines may be followed by organisations to keep the surrounding air and water clean. Some of the points of such guidelines can be.

1. Air pollution is mostly caused by production of the dust, a mixture of solid particles and gases in the surrounding air. So avoid dust production, generation of solid particles and gases in the air.
2. Extensive use of automobile vehicles in the campus can lead to air pollution. So organisations must use a limited number of vehicles to avoid air pollution. Practice a no vehicle day every week.
3. Ozone produced in the air can pollute the air. Many times it is called smog. The generation of ozone gas must be kept at low level by the organisation.
4. Most of the human activities make the surrounding water polluted. The sewage or the wastewater can also cause water pollution. Take care that their waste is not mixed with the surrounding water.
5. Extensive use of fertilizers and pesticide must be avoided as it can make the ground water polluted.

2.2 Importance of cleanliness at workplace

It is always safe to keep your workplace clean to avoid hazardous work. The poor handling and storage practices result in damages. A clean work station makes your job easier and more pleasant. Common areas should be cleaned up by all personnel, when necessary.

- All areas must be kept neat and clean. Each employee is responsible for the cleanliness of their work area and all tools and equipment used.
- Spills and breakage are to be cleaned up immediately.
- Spaces around machines and equipment should be kept clear and clean at all times to permit free movement.
- Floors should be kept clean and clear to prevent slipping and collision.

- Lighting fixtures are to be checked regularly to permit clear vision. Faulty lights should be reported to administration, so that building maintenance/ facilities can be contacted to rectify the situation.

2.3 OFFICE ERGONOMICS

Ergonomics is the science concerned with designing and arranging things so that people can use them easily and safely. Applying ergonomics can reduce the potential for accidents, injury to improve performance and productivity. In an office setting, the repetition of a seemingly innocuous task over a period of time can cause an injury. The resulting injuries can be physically painful and rehabilitation can be difficult and time consuming. The following office ergonomics emphasize the identification of early warning signs.

Early Warning Signs	Potential Cause	Try This
Sore lower back	No lumbar support	Use backrest of chair, put small pillow or lumbar support on backrest of chair
Burning in the upper back	No upper back support from chair	Put document holder or prop up so you can see without leaning forward
Stiff neck	Working with head turned to side tilting head forward holding telephone between the ear and shoulder	Move or raise monitor to centre of desk check if headset is available
Sore shoulders	Reaching forward for long periods or reaching forward frequently	Move closer to the keyboard, Bring mouse down to level of keyboard or 1" higher
Arching wrists	Working with wrists extended too much repetition	Add a wrist rest to the front of keyboard and mouse pad rest thumbs on front edge of keyboard so wrists can't drop.
Dry eyes	Forget to blink	Rest eyes periodically and do simple eye exercises
Eye strain and sore eyes	Glares from overhead lights or windows eye glasses not correct need vision check	Re-orient your desk and computer so light is not directly behind or in front of you.

Computer Health & Safety Tips

With the increased use of computers, several health and safety issues related to vision, musculoskeletal issues, body aches and pains may occur. Many of these issues are preventable and if incurred are temporary. They can be resolved by adopting simple corrective action.

Musculoskeletal Problems

This problem includes different areas of your body such as neck, back, chests, arms, shoulders and feet. It occurs because of your wrong posture, uncomfortable chair for sitting that is not ergonomically correct while working on the computer.

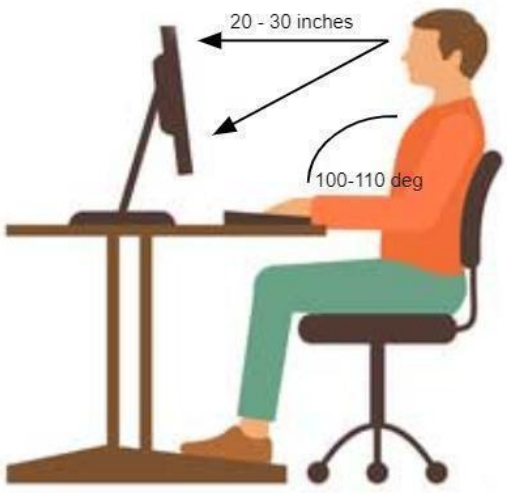


Fig 2.2 Ideal Neck and Monitor position

To avoid this problem,

- Position your computer such that the end of the monitor should be at your eye level.
- Keep the neck neutral with a monitor directly ahead to prevent turning your neck.
- Keep your monitor at least arm length distance, or 20 to 30 inches away from you.
- Maximize contact of your back against the backrest of the chair.
- Adjust height of armrests so that your elbows are at a 100-110 degrees open angle.
- Place the keyboard at a slight negative tilt if you are sitting upright.
- While typing, keep your hands slightly lower than elbows, with fingers pointing downwards at the floor.
- Minimize any twisting of your wrists from side to side or up and down.
- Use a keyboard palm rest as needed only when you are not typing. Do not rest your wrists when typing. It leads to wrist strain.
- Always take small breaks while working on the computer to stretch your muscles, keep your blood flowing, and to rest your eyes.

Occupational Overuse Syndrome

Occupational overuse syndrome, also known as repetitive strain injury (RSI), is a collective term for a range of conditions, characterised by discomfort or persistent pain in muscles, tendons and other soft tissues, with or without physical manifestations. It is usually caused or aggravated by work, and is associated with repetitive movement, sustained or constrained postures and/or forceful movements. Psycho-social factors, including stress in the working environment, may be important in the development of occupational overuse syndrome.

Repetitive use of muscle may feel pain in your neck, shoulder, wrist or fingers. One of the most common conditions related to repetitive use of muscles when using the computer is *carpal tunnel syndrome*. It causes pain, numbness, and tingling in the hand and arm as shown in Figure 2.3.

Fig 2.3 Symptoms of carpal tunnel syndrome

Ensure that you use appropriate posture when typing. For example, your fingers should be above the *'home position' (asdf and jkl; keys)* on the keyboard, when your elbows are by your sides. Users should avoid gripping the mouse too tightly. The keyboard and mouse should be kept at the same level. In addition, use of ergonomic keyboard and mouse help to reduce the risk of wrist related conditions.

Strain in Legs and Feet

Sitting to work for a long time may cause strain in the legs. Position your desk chair to sit comfortably with your feet flat on the floor and your lower legs vertical. Use a footrest for more support. Make sure that there's enough space to change position and stretch your legs out every now and then, too.

Eye Strain

Computer's bright light, glare and flickering images can cause eye strain and visual fatigue. When you constantly focus on the screen, you forget about blinking your eyes that can cause drying eyes. Computer Vision Syndrome is caused by poor lighting and glare on the computer screen. Both of these factors place strain on the user's eyes, causing blurry vision, burning and/or watering eyes, headaches and in some instances shoulder and neck pain. It is important to look after your eye health. Specifically, wear anti-glare glasses to work on the computer.

To reduce the risks of visual problems:

- Adjust the brightness of the computer screen to save your eyes from strain.
- Reposition the screen to avoid glare from lights or windows.
- Keep a proper vision distance from the computer screen and blink your eyes in an interval.
- Wear anti-glare glasses while working on the computer.
- Keep the screen clean and use a desk lamp to make it easier to see.
- Ensure the screen colours so that the characters look sharp and legible.
- Give eyes periodic breaks to eyes from the screen and perform frequent blinking.
- Look away from the screen into the distance for a few moments to relax your eyes.
- Focus on something 30 metres away for 30 seconds every 30 minutes.
- Keep your monitor between 18 to 24 inches away from your face.
- Lastly, position monitors to avoid glare from sunlight and keep them clean.

Headaches

Headache may occur due to muscle tension or pain in the neck. Strain on the eyes or vision problems can also cause headaches. Attend regular eye exams to work toward correcting any vision problems. Try your best to keep your neck straight in front of the computer and take breaks.

Obesity

Spending long hours on computers may lead to a lack of physical activity and exercise. In children prolonged use of computers or electronics in general, is a major contributing factor to obesity. You should take a break and try to squeeze in some exercise until you go back to work.

Stress Disorders

Technology impacts our behaviors and emotions. Prolonged use of computers may be accompanied by poor health and increased pressure on you in your workplace, which may lead to stress. The longer the stress is untreated, the greater the chances of contracting more serious health problems. Stress can lead to decreased attention span, lack of concentration, dizziness and becoming easily burned out. To tackle this problem, promote your own health and prevent future health conditions or by seeking treatment options for any stress that you may encounter.

Try things from yoga, to natural remedies, to medications as prescribed by a medical provider to combat your stress.

Injuries from Laptop Use

The growing use of laptops causes more pain and strain. Laptops are designed for short periods of use. In the present day individuals choose to use laptops over desktops more frequently, due to convenience. In a laptop the screen and keyboard are very close together and there is really no right way to use a laptop because if you position the screen at the right height for your back and neck, it will cause you to have to lift your arms and shoulders too high to use it and vice versa. It will probably cause a problem. To overcome this problem, you may use a desktop that is set up ergonomically-correct, while working for long hours.

Sleeping Problems

Artificial lighting from computer screens can trick your brain and suppress its release of melatonin substance that assists your sleeping patterns. To tackle this, refrain from using a computer right before going to bed.

Health and safety requirements for Computer workplace

The minimum health and safety requirements for computers including Desktop computers, Laptops, Tablets, Smart phones, Television screens and Video monitors are as follows:

Display Screen (Monitor) – Use the modern LED monitors of legible size and with adequate spacing between the characters and lines. The image on the screen should be stable, with no flickering or other forms of instability. The screen must be free of reflective glare and reflections liable to cause discomfort to the user.

Keyboard – The keyboard should tilt and separate from the screen to find a comfortable working position and avoid fatigue in the arms or hands. The space in front of the keyboard must be sufficient to provide support for the hands and arms of the user. The keyboard should have a matt surface to avoid reflective glare. The symbols on the keys must be adequately contrasted and legible from the design working position.

Work Surface – The work desk should be sufficiently large, low-reflectance surface and allow a flexible arrangement of the screen, keyboard, documents and related equipment. The document holder shall be stable and adjustable so as to minimise the need for uncomfortable head and eye movements.

Work Chair – The work chair must be stable and allow the user to move easily and find a comfortable position. It should be adjustable in height. The user's feet must be placed flat on the floor or a footrest should be used.

Space Requirements – The workstation should be designed to provide sufficient space for the user to change position and vary movements. The user should have enough desk space for the equipment they use.

Lighting – There must be satisfactory lighting conditions with appropriate contrast between the screen and background environment. Possible disturbing glare and reflections on the screen or other equipment should be prevented.

Reflections and Glare – Workstations should be designed so that sources of light, such as windows and other openings, transparent or translucent walls, and brightly coloured fixtures or walls cause no direct glare and no distracting reflections on the screen. Windows shall be fitted with a suitable system of adjustable covering to attenuate the daylight that falls on the workstation.

Noise and Heat – Noise emitted by equipment should not distract the attention. Noise cancelling earphones may provide a solution if some noise is unavoidable. The equipment may not produce excess heat which could cause discomfort to users.

Cautions while working on the computer

It is important to work safely on the computer. The static electricity generated just by walking on the carpet can damage computer components. So use a surge protector when you plug in the system. A battery backup system is the best way to protect against a power outage, as it provides the system with constant voltage.

Remove rings, watches and necklaces while working on the computer. These ornaments are made of conductive metals which can damage computer components by striking them with static electricity.

Unplug all power sources and cables from the computer. If you are working with a plugged in computer then it might damage your hardware. Modern processors will overheat within 7 sec if the heat sink is not attached.

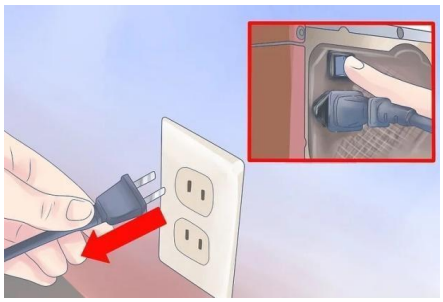


Fig 2.4 Unplug power source from computer

Watch out for cords and wires

Loose cords and wires can cause hazards and even electrical hazards as shown in Figure 2.5.

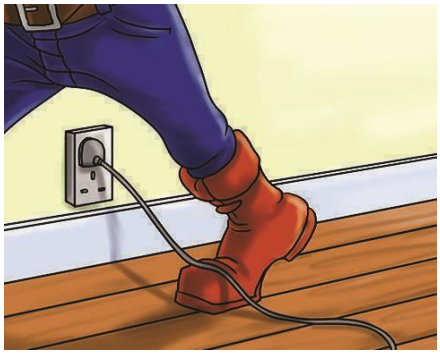


Fig 2.5 Loose cord that can be hazardous

If a cord or wire will cross a pathway safety it should be marked with hazard tape as shown in Figure 2.6.

Fig. 2.6 Hazard tape

Avoid water at all times when working with electricity. Never touch or try repairing any electrical equipment or circuits with wet hands. It increases the electrical conductivity of the body for the flow of electric current.

Fig 2.7 Avoid water while working with electricity

Check Your Progress

A. Multiple Choice Questions

1. To provide healthy and safety working environment, every organisation must have (a) Cleanliness (b) Filtered water (c) Clean wash-room (d) All of the above
2. Air pollution is mostly caused by production of the _____ in the surrounding air (a) dust (b) mixture of solid particles (c) gases (d) All of above .
3. Repetitive use of muscle may feel pain in your (a) neck (b) shoulder (c) wrist or fingers (d) All of the above .
4. The security department organisation is not responsible for (a) other safety (b) computer system safety (c) electrical safety (d) transport safety
5. For an organisation, the proper security procedures will reduce (a) liabilities (b) insurance (c) business revenue (d) operational charges of the company
6. Do not wear _____ when working with machines. (a) jewellery (b) safety glasses, (c) masks (d) gloves
7. Sore lower back cause due to (a) reaching forward frequently (b) no lumbar support (c) no upper back support from chair (d) reaching forward for long periods
8. Sore lower back cause due to (a) reaching forward for long periods or reaching forward frequently (b) working with wrists extended too much repetition reaching forward frequently (c) no lumbar support (d) no upper back support from chair
9. What should you do with the problem of dry eyes (a) forget to blink (b) rest eyes periodically and do simple eye exercises (c) do exercise (d) blink the eyes.
10. If light is coming directly behind or in front of you then you may suffer from (a) Eye strain (b) sore eyes (c) dry eyes (d) eye strain and sore eyes

B. Fill in the Blanks

1. Air and water pollution can be analysed by using – physical, _____ and _____ analysis.
2. The PH value of the water can be measured through _____ analysis.
3. The _____ indicators are used to monitor the health of the ecosystem.
4. Ergonomics is the science concerned with _____ and arranging things.
5. Working with wrists extended too much repetition can cause _____
6. The repetition of a seemingly _____ task over a period of time can cause an injury.
7. If a cord or wire will cross a pathway safely it should be marked with _____.
8. Loose cords and wires can cause _____ .
9. Glare and _____ on the screen should be prevented.
10. The keyboard should have a matt surface to avoid _____ glare.

C. State whether True or False

1. The work environment of the organisation must be free from hazards and risk.
2. Practice a no vehicle day every week to avoid air pollution.
3. Applying ergonomics can improve performance and productivity.
4. Wear rings, watches and necklaces while working on the computer.
5. Never touch or try repairing any electrical equipment or circuits with wet hands.
6. Unplug all power sources and cables from the computer while working on the computer.
7. Occupational overuse syndrome, also known as repetitive strain injury.
8. The work chair must be stable and allow the user to move easily.
9. Artificial lighting from computer screens can cause sleeping problems.
10. The keyboard and mouse should not be kept at the same level.

Q. 4. Short answer type questions

1. What causes the water pollution?
2. What is occupational overuse syndrome?
3. What are musculoskeletal problems?
4. What cautions to be taken while working on the computer?
5. Why is there no right way to use a laptop?
6. What causes eye strain and how to avoid it?
7. What type of display screen is suitable to work on a computer?
8. What type of keyboard is suitable to work on a computer?

Session 3: Prevent Accidents and Emergencies

In an organisation, any small accident or unforeseen situation may turn into emergencies if not given due attention. The emergencies can be natural such as *floods, hurricanes, earthquakes* or man-made emergencies may include *fire, toxic gas releases, chemical spills, illness, explosions, and civil disturbances*. Such situations may disrupt or shut down your operations, or may cause physical or environmental damage. While no one expects such emergencies and disasters that can strike anyone, anytime, anywhere. The best way to protect yourself, workers, and organisation is to develop a well thought-out emergency action plan to guide the employees in the event of an emergency. This chapter explains the general workplace hazards, its prevention, care and how to keep the workplace safe.

3.1 Accidents and emergencies

An accident is an unplanned, uncontrolled, or unforeseen event resulting in injury or harm to people and damages to goods. For example, a person falling down and getting injured or a glassware item that broke upon being knocked over. Emergency is a serious or crisis situation that needs immediate attention and action. For example, a customer having a heart attack or sudden outbreak of fire in your organization needs immediate attention.

Each organization has procedures and practices to handle and report accidents and to take care of emergencies. Although most of these procedures and practices are common across the industry, some procedures might be modified to fit a particular type of business within the industry. For example, procedures to handle accidents caused by slipping or falling will be similar across the industry. You need to be aware of the general procedures and practices as well as specific to your organization.

The following are some of the guidelines for identifying and reporting an accident or emergency:

Notice and correctly identify accidents and emergencies – You need to be aware of what constitutes an emergency and what constitutes an accident in an organization. The

organization's policies and guidelines will be the best guide in this matter. You should be able to identify such incidents in your organization, and be aware of the procedures to tackle each form of accident and emergency.

Get help promptly and in the most suitable way – Follow the procedure for handling a particular type of accident and emergency. Promptly act as per the guidelines. Ensure that you provide the required help and support as laid down in the policies. Do not act outside the guidelines and policies laid down even if your actions are motivated by the best intention. Only properly trained and certified professionals may be authorized to take decisions beyond the organization's policies and guidelines, if the situation requires.

Follow company policies and procedures for preventing further injury while waiting for help to arrive – If someone is injured, do not act as per your impulse or gut feeling. Go as per the procedures laid down by your organization's policy for tackling injuries. You need to stay calm and follow the prescribed procedures.

Act within the limits of your responsibility and authority when accidents and emergencies arise – Provide help and support within your authorized limit. Provide medical help to the injured only if you are certified to provide the necessary aid. Otherwise, wait for the professionals to arrive and give necessary help.

Promptly follow instructions given by senior staff and the emergency services – Provide necessary services as described by the organization's policy. Also, follow the instructions of senior staff who are trained to handle particular situations. Work under their supervision when handling accidents and emergencies.

Types of Accidents

The following are some of commonly occurring accidents in organizations:

Trip and fall – Customers or employees can trip on carelessly left loose material and fall down, such as tripping on loose wires, goods left on aisles, elevated threshold. This type of accident may result in simple bruises to serious fractures.

Slip and fall – Slips are mainly due to wet floors, spilling of liquids or throwing of other slip-causing material on floors. Slip and fall is generally caused by negligence. It can also be due to broken or uneven walking surfaces, such as broken or loose floor tile. People should be properly cautioned against tripping and slipping. For example, a *"wet floor"* sign will warn people to walk carefully on freshly mopped floors. Similarly, *"watch your steps"* signs can prevent accidents on a staircase with a sharp bent or warn against a loose floor tile.

Injuries caused due to escalators or elevators (or lifts) – Although such injuries are uncommon, they mainly happen to children, ladies, and elderly. Injuries can be caused by falling on escalators and getting hurt. People may be injured in elevators by falling down due to sudden, jerking movement of elevators or by tripping on elevators' threshold. They may also get stuck in elevators resulting in panic and trauma. Escalators and elevators should be checked regularly for proper and safe functioning by the right person or department. If you notice any sign of malfunctioning of escalators or elevators, immediately inform the right people. If an organization's procedures are not being followed properly for checking and maintaining these, escalate to appropriate authorities in the organization.

Accidents due to falling of goods – Goods can fall on people from shelves or wall hangings and injure them. This typically happens if pieces of goods have been piled improperly or kept in an inappropriate manner. Always check that pieces of goods are placed properly and securely.

Accidents due to moving objects – Moving objects, such as trolleys, can also injure people in the organization. In addition, improperly kept props and lighting fixtures can result in accidents. For example, nails coming out dangerously from props can cause cuts. Loosely plugged in lighting fixtures can result in electric shocks.

3.4 Handling Accidents

Try to avoid accidents in your organization by finding out all potential hazards and eliminating them. In case of an injury to a colleague due to an accident, do the following.

- Attend to the injured person immediately depending on the level and seriousness of the injury, see that the injured person receives first aid or medical help at the earliest.
- Inform your supervisor about the accident giving details about the probable cause of the accident and a description of the injury.
- Assist your supervisor in investigating and finding out the actual cause of the accident. Help your supervisor to take appropriate actions to prevent occurrences of similar accidents in future.

3.5 Types of Emergencies

It is important to have policies and procedures to tackle the given categories of emergencies. You should be aware of at least the basic procedures to handle emergencies. Here are some general emergency handling procedures to follow:

First Aid – First-aid kits should be quickly accessible to the employees. It should contain all the important items for first aid required to deal with common problems such as cuts, burns, headaches and muscle cramps.

Electrical Safety – Employees must be provided instructions about electrical safety such as keeping water and food items away from electrical equipment. Electrical staff and engineers should carry out routine inspections of all wiring to make sure there are no damaged or broken wires.

Keep a list of numbers to call during an emergency, such as those of police, fire brigade, security, and ambulance.

Regularly check that all emergency handling equipment such as the fire extinguisher and fire alarm system are in working condition.

Ensure that emergency exits are not obstructed and keys to such exits are easily accessible. Never place any objects near the emergency doors or windows.

Emergency Procedure and Reporting Accident

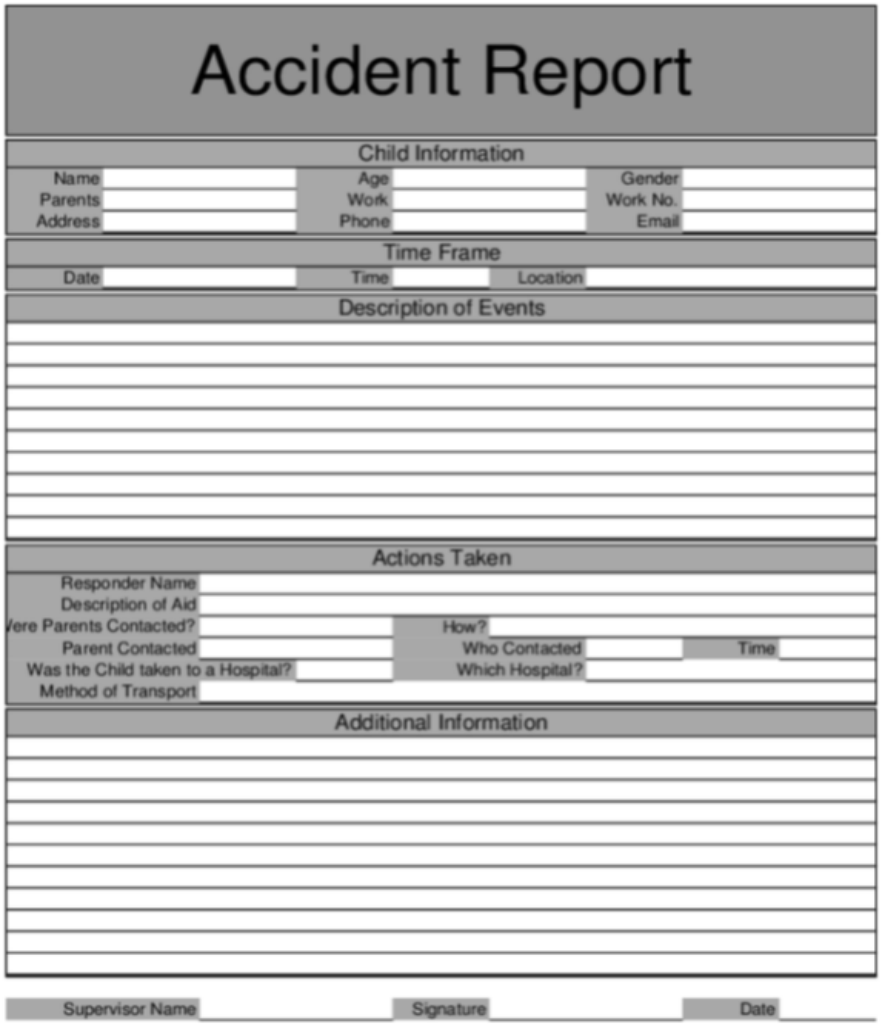
Follow the organization's emergency procedures quickly, efficiently and calmly

Evaluating the Emergency

- One must rationally and critically think and assess the severity of the emergency and determine what requires to be done on an immediate basis.
- One must remain calm and composed during an emergency situation since stress during an emergency complicates things and may confuse a person.
- The emergency dispatcher aims at providing instant and appropriate help based on the nature and degree of emergency.
- One must look for additional help by calling up the emergency toll-free number, which would help the caller reach an official or 'dispatcher'.
- One must help the dispatcher by answering his/her questions and providing the dispatcher with the precise location and nature of the emergency.
- It is suggested that one should call from a GPS equipped phone so that the dispatcher is able to track the location, even if the caller is unable to speak.
- One must be aware of the nature of the emergency, i.e. whether it is a medical, mental health or behavioral emergency.
- One must evaluate the immediate threats, for example, in case a person is severely injured from a running machine, the machine must be turned off instantly to prevent others from getting hurt as well.

Handling the Emergency

- Extremely high casualties must be informed to the Occupational Health and Safety Committee (OHSC).
- One must move from the emergency spot and help others follow the same.
- Secondary Hazards must be removed or mitigated, at least. For example, a car accident comprises the risk of a violent explosion and fire outbreak resulting from spilled fuel.
- One must not feel guilty if nothing can be done to help the others.
- In case nothing can be done to lessen the severity of the situation, one must provide support to others by uplifting them mentally, inquiring about their medical history, noting events as they occur. This information may prove vital for the emergency response team.
- One must help the other victims and take suitable measures to assist the specially abled ones.
- One must refrain from moving a severely injured victim and provide only the basic first aid
- Once the emergency team arrives, assist them with all required and relevant information.
- A First Aid kit must be used if required.
- One must try reviving a seemingly unconscious victim by rubbing the chest, pinching the earlobes, providing Cardiopulmonary Resuscitation (combination of chest compression and artificial respiration).



Accident Report

Child Information

Name		Age		Gender	
Parents		Work		Work No.	
Address		Phone		Email	

Time Frame

Date		Time		Location	

Description of Events

Actions Taken

Responder Name					
Description of Aid					
Were Parents Contacted?		How?			
Parent Contacted		Who Contacted		Time	
Was the Child taken to a Hospital?		Which Hospital?			
Method of Transport					

Additional Information

Supervisor Name		Signature		Date	

Sample form of Reporting Accidents

1. Work safely complying with health and safety legislation, regulations and guidelines

- Ensure that all emergency route maps are displayed in the accessible places on all floors of the building.
- Ensure that appropriate Fire Extinguishers are present on all the floors of the workplace.
- Learn and abide by company policy and procedures for dealing with security risks in the establishment.
- Ask your supervisor how you may retrieve PPE and its maintenance and storage.
- Stay aware that confined spaces must bear suitable signs, to restrict claustrophobic people from accessing them.

2. Ensure that health and safety instructions applicable to the workplace are being followed

- Lighting should be satisfactory in all areas and additional bulbs should be kept handy.
- While using cutting tools, the direction of cutting should always be away from your body.
- Arrange for frequent Safety Drills and Trainings to employees for safety awareness.
- Ensure that all manual cutting tools must be honed in advance because blunt tools may slip and lead to deep cuts.
- Have a clear idea of how much authority and accountability you have to deal with security risks, including your legal rights and duties.
- Learn and abide by company policies and procedures for maintaining security.

3. Check the worksite for any possible health and safety hazards

- Employ a Safety Supervisor in the workshop.
- Have your employer develop a daily checklist for all areas delegated to suitable employees.
- This Safety Supervisor will stay accountable for checking the worksite for potential health and safety hazards.

4. Follow manufacturer's instructions and job specifications relating to safe use of materials specifically chemicals and power equipment

- Ensure that all Chemical Solutions used on display shelves or for Housekeeping purposes must be used only after mentioning to the relevant MSDS (Material Safety Data Sheets) or Instruction Manuals.
- Loosely fitted clothes must be totally avoided because the loose ends may get caught in powered machinery and tools and may be lethal.
- Ensure that you read the Instruction Manual thoroughly before using powered tools and equipment.

5. Follow electrical safety measures while working with electrically powered tools & equipment

- Powered tools and equipment must be reviewed for any damage, before and after every use.
- Damaged switches must be reported to the supervisor and repaired with immediate effect.
- Plugs must be checked for missing or faulty prongs / pins.
- The power cord must be assessed carefully for any fraying, faults, cracks or loss of insulation.

6. Ensure safe handling and disposal of waste and debris

- All walkways should be free of clutter and debris, to avoid trips and falls.
- Any spill should be cleared off instantly and *'Wet Floor'* or *'Work in Progress'* signs should be used in suitable places.
- Store equipment, Tools and Chemicals should be stored correctly, abiding by all instructions provided in the Instruction Manual and *'Directions for Use'*.

7. Ensure electrical safety compliances and EMI/EMC hygiene requirements are met as per the guidelines

The risks associated with the use of electrical equipment are extended to both the user and the workplace. Few of such risks are mentioned below:

- Lethal Electrocution accidents.
- Non-fatal electric shocks leading to serious burn injuries.
- Non-fatal severe shocks leading to damages caused to the internal tissues and vital organs like the brain and the heart.
- Non-fatal yet painful static electric shocks.
- Falls from cranes, ladders, and scaffolding and resulting mechanical injuries due to electric shocks.
- Explosions and fire outbreaks caused by the sudden ignition of flammable materials.
- Health issues like nausea, muscle spasms, unconsciousness, and palpitations.

Evacuation

Environmental Health and Safety (EHS) studies and deploys the practical aspects of environmental protection and safety at work. Simply, it is what organizations and workshops must do to ensure that their actions do not cause harm to anyone. The EHS commands that there must be specific escape routes or safety evacuation points. This includes thorough plans or blueprint of the building which is understandable to anyone. Each floor of the workshop or building must have the Safety Evacuation Map. These are mainly applicable for cases of Fire outbreaks or natural calamities like Earthquake and Flood. It is critical for employees to know who is the coordinator or authority to make decisions during emergencies. The coordinator should be responsible for handling the evacuation process.

The sequence of an Evacuation situation is given below:

1. Detection
2. Decision
3. Alarm
4. Reaction
5. The movement to an area of refuge or an Assembly sta on
6. Transportation

General Evacuation Procedures

Each organization has its own evacuation procedures as listed in its policies. You should be aware of these procedures and follow them properly during an emergency evacuation. In addition to organization's policies, here are some general evacuation steps useful in such situations,

- Leave the premises immediately and start moving towards the nearest emergency exit.
- Guide your customers to the emergency exits.
- If possible, assist the person with disability to move towards the emergency exit.
- You may carry your hand-held belongings, as you move towards the emergency exit. Do not come back to pick up your belongings unless the area is declared safe.

- Do not use the escalators or elevators (lifts) to avoid overcrowding and getting trapped, in case there is a power failure. Use the stairs instead.
- Go to the emergency assembly area. Check if any of your colleagues are missing and immediately inform the person concerned.

Safety Signs

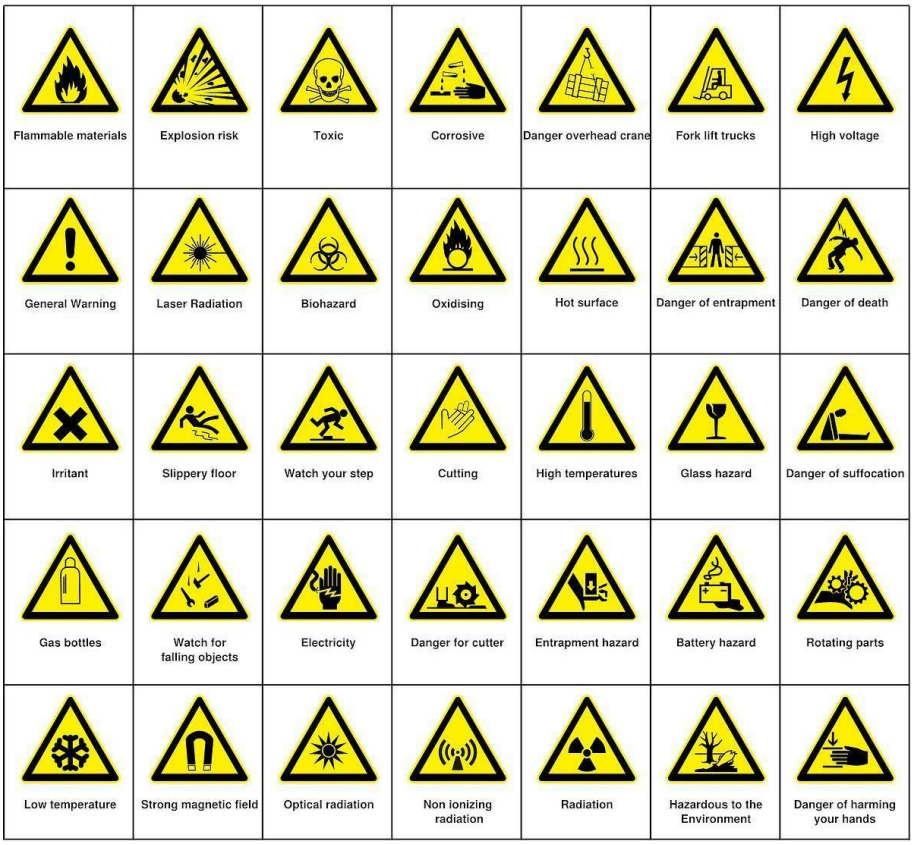


Fig. 3.1 (a) Safety signs

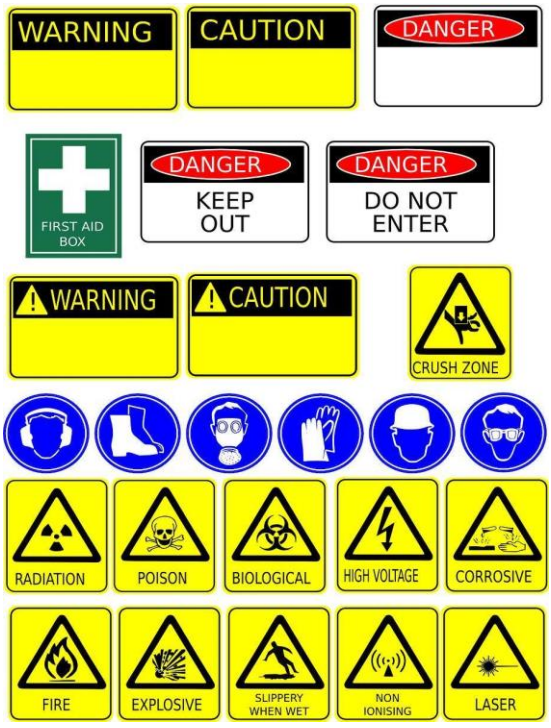


Fig. 3.1 (b) Safety signs

Fire Hazards in the Workplace

The first step to fire safety is assessing the existence of fire hazards in the workplace. In most facilities, there are three main types of hazards to evaluate – electrical hazards, combustible materials, and flammable materials.

Electrical issues, such as damaged extension cords, blocked electrical panels and heaters, and overloaded circuits often lead to fires. Fires are also commonly caused by electrical events such as arc flash. Maintenance of power cords and other electrical equipment should be conducted on a regular basis.

Workplace fires are also commonly caused by improper storage of flammable material or combustible dust. Both are dangerous and should be properly handled and stored. Dust explosions can be another cause of fire hazard.

Fire Safety

There are basically three methods with the help of which people can be rescued from a building engulfed in fire. To ensure on-site reception, here are two of the important steps that must be taken into consideration. These come under the best safe carrying and lifting practices.

1. Conventional Technique

This is a good method if there is an open area nearby. The first rescuers will make the victim sit, reach under their armpits and grab their wrist. The other rescuer will cross the ankle (victim) and pull up that person's legs on his shoulder. Finally, on the count of 3, both will lift the person up and move out.

2. Bomb Threat

During the Bomb Threat, don't panic and try to keep calm. Open the emergency exit gate so as to propagate the evacuation process. Think ahead and consider places where a bomb can be planted.

Don't assemble in the common assembly area because terrorists want to kill as many people as possible. The common assembly area is the place where the evacuees assemble and therefore the possibility of killing a maximum number of people is in the common assembly area. Always assemble at a place which is not premeditated.

Inform the local police immediately. Evacuate immediately after receiving a bomb threat and don't wait until something is found after investigation. Document everything and submit the documentation to the concerned authority. If anything suspicious comes into sight, barricade it with red ribbon maintaining a diameter of 100 meters. Ensure that no one comes within the boundary. Bring sandbags and put them around the barricade to minimize the effect of the blast. Don't try to touch any suspicious object and wait for the police to arrive at the spot to diffuse it.

Fig 3.2 Proper Evacuation Procedures During Bomb Threat

For Fire Outbreak

The emergency and evacuation procedures are given below:

- A clear passageway must be present to all escape routes.

- Signage like escape routes should be clearly marked.
- Don't use the Elevator during a fire.
- All people at the workplace must be given brief instructions about the positions of the escape routes.
- Enough exits and routes must be there for all people to escape.
- Emergency lighting (Infrared lights for night and blurred vision) must be present.
- Emergency doors, that open easily, must be present.
- Brief instructions must also be given regarding the availability and use of fire extinguishers.
- The workplace must have a safe meeting point or assembly area for the staff.

Correctly demonstrate rescue techniques applied during fire hazard:

1. Responding to Fire

- The Fire Alarm System must be initiated and an alert must be raised.
- The appropriate class of Fire Extinguisher must be chosen.
- A safe evacuation path must be identified before dealing with the fire.
- Immediate evacuation must be initiated if the extinguisher is exhausted and the fire still exists.
- Call the workplace security or the local emergency services.
- Summon the fire-fighting services at the earliest.
- Look out for the nearest emergency exit routes and call out for people, who you can take along with you.
- Always use a staircase and not the elevator.
- While opening a door, first touch the door with the back side of your palm.
- The P.A.S.S technique must be adopted for extinguishing the fire.
- Always move downstairs and avoid returning to the burning premises, till the fire-fighters arrive.
- As you move out of the building, gather people, whoever you come across.
- Stay as far as possible from smoke, because smoke may comprise toxic gases.
- Cover your mouth and nose with a damp cloth to protect yourself. If possible, help your colleagues (those who are with you) to repeat the same.
- Keep doors open, after you open them.
- Start moving out of the building and ask your colleagues to do so.
- Do not rush.

2. Initiate Evacuation

- Stop your work and move out safely and without spreading panic.
- Carry only the most important items like cell phones.
- Await instructions from the Safety Committee.
- Leave the workplace from the nearest door bearing an "Exit" sign.
- Report to the designated Assembly Area.

- Incorporate first aid treatment to anyone in need.

Fire Prevention

- All employees must know where the fire extinguishers are located, and how to properly use them.
- Fire extinguishers and First Aid Stations should be clearly marked with signs.
- Never block access to Exits, fire extinguishers, electric switches and panels.
- Do not block or stack material against doors, which would prevent them from operating properly in the event of a fire.
- Do not use flammable material near electrical panels, switches, lift trucks or any electrical equipment.
- Make sure all equipment is properly grounded where needed.
- Fire extinguishers must be inspected regularly.
- Report to your supervisor any defect in electrical, fire prevention or material handling equipment.
- No flammable materials are to be placed around an exit doorway.

Identification of Materials and Ignition Sources

Materials are classified by risk, and are sorted according to these fire classifications:

Class A Materials – materials such as wood, cloth, and paper, which won't ignite on their own but will continue to burn once exposed to a heat source.

Class B Materials – all liquid, grease, and gas materials that burn when exposed to ignition sources.

Class C Materials – electrical materials and equipment. These materials cause fires very quickly and present a serious risk of arc flash.

Class D Materials – any materials that are volatile and able to quickly ignite, such as magnesium, potassium, and sodium.

Examples of ignition sources include:

Open flames such as gas ovens, lighters in smoking areas, and welding torches.

Sparks from wood or metal saws and other types of equipment.

Heat sources such as combustion engines, space heaters, ovens, and machines that produce heat during operation.

Chemical ignition from chemicals that combust under normal working temperatures.

Select the suitable type of fire extinguisher

	Water CO_2	**Dry chemical powder**	**Carbon dioxide**	**Mechanical foam**	**ABC dry powder**
Class A	Suitable	Not suitable	Not suitable	Suitable	Suitable
Class B	Not suitable	Suitable	Suitable	Suitable	Suitable
Class C	Not suitable	Suitable	Suitable	Not suitable	Suitable
Class D	Not suitable	Suitable	Not suitable	Not suitable	Suitable

Fire Extinguisher

A fire extinguisher is a protection device used to extinguish fires. It is a cylindrical pressure vessel containing an agent which can be discharged to extinguish a fire. The Figure 3.2 shows the different parts of the fire extinguisher.

Fig 3.3 Fire extinguisher with its parts labeled

The method of using a fire extinguisher is to follow the method: P.A.S.S.

To use an extinguisher in a proper way follow the PASS method. PASS is the acronym for:

Pin (P) – The first step is to pull the handle's pin

Aim (A) - The next step is to aim the extinguisher's nozzle. The direction should be toward the fire's base. This is because the sprayed foam at the top will diminish or extinguish only the fire at the top. This will not serve the purpose for which the extinguisher is used and the burned down flame may spring up to life if it gets enough oxygen or any combustible material.

Squeeze (S) – Then in an extremely controlled manner, squeeze the trigger to release the agent.

Sweep (S) – Sweep the extinguisher's nozzle from left to right. Continue with this process until you put out the fire as you need to act fast as most extinguishers' discharge time is nearly 10-20 seconds.

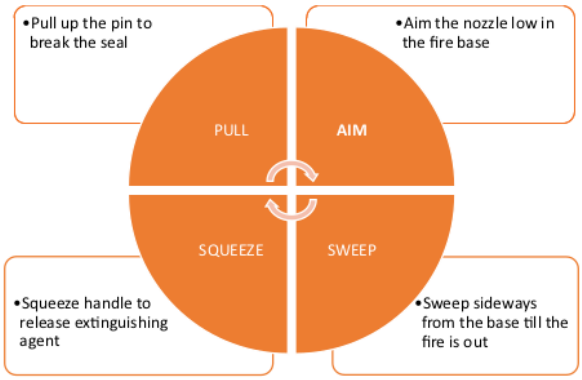


Fig 10.3.1 P.A.S.S Technique for Fire Fighting

The following activity will demonstrate the operation of a fire extinguisher.

Practical Activity – Demonstrate the operation of a fire extinguisher.

Procedure

Step 1: Identify the safety pin of the fire extinguisher, present in its handle.

Step 2: Break the seal and pull the safety pin from the handle.

Step 3: Use the fire extinguisher by squeezing the lever.

Step 4: Sweep it from side to side.

Fig 3.4 Steps to open the seal and safety pin

For Natural Calamities / Disasters:

2. Flood and Storms

The emergency and evacuation procedures are:

- Move to the high grounds and help others move before the flood strikes
- Stay alert, avoid panicking and monitor the surroundings with eyes and ears open
- Accumulate disaster supplies like:
    - Canned, dry, ready-to-eat and packaged food, which do not require refrigeration or cooking
    - Liquid cash
    - Drinking water in clean containers
    - First Aid Kit
    - Adequate batteries
    - Flashlights
    - Essential clothing
- Instruct people around you not to drive.
- Shut off the Mains Supply (electricity) at the circuit breakers.
- Do not walk or swim through the flooded water.
- Stay alert for evacuation calls and help people identify alternate routes of getting there.

3. Earthquake

The emergency and evacuation procedures are given below:

- Inform others in the area by raising an alarm if they have not heard it while you are evacuating yourself.
- Quickly shutdown any hazardous operations or processes.
- Exit the room.
- Take jackets or other relevant clothing material needed for protection from the weather.
- If possible, close windows and doors as you leave, but avoid locking the doors and emergency exit routes.
- Exit the building and walk to the nearest safe exit route.
- Do not run.
- Do not use elevators.

4. For Accidents

The emergency and evacuation procedures are:

- Summon emergency medical help by ringing the Safety Committee officials or the toll-free number.
- One must inform the immediate supervisor about an injury or illness.
- Check and examine the site, to gather as much information as possible, so that the same can be provided to the emergency team, once it arrives.
- One must extend help and assistance to others.
- If possible, workers may treat themselves to first aid or ask colleagues to do so.

5. The general steps involved in carrying out an evacuation are

- Stop your work and move out without spreading panic.
- Gather and carry only the most important items like cell phones.
- Report to the designated Assembly Area.
- Leave the workplace through the nearest door bearing an "Exit" sign.
- Await instructions from the Safety Committee.
- Incorporate first aid treatment to anyone in need.

6. Evacuation and emergency procedures for the specially abled

With Impaired Hearing, Turn lights on/off to gain the person's a en on, or specify directions with gestures, or write a note with evacuation directions. The Visually Impaired, Announce the type of emergency, Offer your arm for help.

People with Prosthetic Limbs, Crutches, Canes, Walkers, Evacuate these individuals along a route specially designated as injured persons. Accompany and assist the evacuation site if possible. Notify emergency crew of their location. Use a sturdy chair, or a wheeled one, to move the person to an enclosed stairwell.

DEALING WITH EMERGENCIES

1. Emergencies at Workplace

An Emergency can be defined as a serious, unexpected, and dangerous situation requiring immediate action. Every organisation has an evacuation procedure. Every organisation also has an assembly point, within the organization compound or outside it, where all employees are expected to gather in case of an emergency evacuation. The team leader guides the team and takes them to a safe place. It is very important to assemble at the safe area immediately during an emergency evacuation.

If a team member does not reach the safe area on time, the team leader is responsible for his or her team member's safety.

- An unforeseen situation is one that:
- threatens the employees, customers or the public;
- disrupts or shuts down the operations;
- Causes physical or environmental damage.

Emergencies that require evacuation include:

- Explosion;
- Floods;
- Earthquake;
- Hurricane;
- Tornado;
- Toxic material release;
- Civil disturbance;
- Workplace violence.

2. Equipped for Emergency

Every company has:

- An evacuation policy. All the TIs are responsible for informing their employees about it.
- When the U is informing you about these details, pay attention. Negligence at this time could cost lives.
- A designated assembly point for emergencies. Ensure you know where it is.
- A 'buddy system' for individuals with special needs or disabilities. This system ensures that the differently abled are assisted and guided out of the premises or the impacted area properly. If you are a buddy to someone, ensure that your buddy is safely at the assembly point with you.
- Floor plans with evacuation routes in work areas. Ensure that you understand these so you can use it in time of need.
- Assembly areas. These are the areas where you are required to assemble after evacuation.
- Periodic evacuation drills. Ensure that you pay attention during these drills. You need to save your life and you can be helpful in saving someone else's life too.

Respond to Emergency Situation

Responding to an Emergency situation while working at the site involves the given steps:

1. Undertake first aid activities in case of any accident, if required and asked to do so.

First Aid is an emergency care or treatment given to an ill or injured person before regular medical aid can be acquired.

Before administering First Aid to a victim, one must check the category and degree of emergency and then apply the techniques accordingly.

***2.* Report hazards that you are not competent enough to deal with to the relevant person in line with the organizational procedures and alarm others who may get affected.**

As an important part of the emergency management procedure, any workplace must designate a Safety Committee, which comprises liable and senior people from all departments and teams. This committee would act as the legislative body, the authority and the first point of contact for reporting any hazard, potential risks / threats and emergency situations in the workplace. This committee would also be liable to conduct training sessions, safety audits, and drills, to help all employees prepare themselves for emergency and unprecedented situations. The list of the committee members, their designations and job titles, as well as contact numbers, must be listed and circulated among the employees as well as displayed at popular parts of the workplace, in the form of an Emergency

Furthermore, this list must be mandatorily included in every First Aid kit in the workplace premises, so that a person treating a victim with first aid techniques may call for additional help and report the accident.

Practice no Loss for Company Due to Safety Negligence

Safety negligence at the workplace or even at home can prove to be lethal to the individual. So to ensure that there no chances of safety carelessness, companies should follow these aspects:

- The companies should ensure that the wiring in the workplace is insulated.
- No malfunctioned machinery should be kept with the new or spare ones.
- No sharp objects or equipment are kept on the walkway.
- First aid kits should be kept either at the reception or in a separate medical supply area.
- There are no open or damaged sockets.

Practice regular safety drills for being prepared in the event of a fire or natural calamity

- The first step in this process is to raise the alarm as all companies and workshops do have push-glass fire alarm systems. Breaking the glass and pushing the alarm button should be the first step to let the people know that the building is on fire.
- On hearing the emergency evacuation alarm, the foremost thing that a person must do is cease and wind up all activities and look for an exit path.
- The next should be to find out the place where the fire started.
- It should be followed by tackling the fire with an appropriate fire extinguisher.
- Meanwhile, a person from that workshop or building should call for emergency help services like ambulance and fire brigade officers.
- People should take the stairs to get out of the office building instead of using the lift.
- Every company should keep folding wheelchairs so that company employees or even visitors can transport individuals with severe mobility impairments or health.
- It is important that all individuals emptying the building should be calm and composed.

Participate in Emergency Procedures

Raising Alarm – Fire Alarms may either have a "Break Glass" or a "Pull / Push" mechanism. In case of the break glass system, the glass sheet must be forcefully hit with a clenched fist. One must continue repeating the process until the glass breaks. In case of the "Pull / Push" systems, one must break the glass first and then either pull down or push up the lever to raise the alarm.

Correct Assembly Point – Proper instructions must be given to the workers about the site of and the directions to the correct assembly point in the workplace. Information about this must be given during mock evacuation drills and training sessions as well.

Safe and efficient evacuation – Suitable evacuation procedures must be adopted for the common public and for specially abled persons. Specially-abled persons must be helped to evacuate the place by giving them access to Wheelchairs and other aids.

Roll call – Once everybody has evacuated the building / workshop and arrived at the Assembly Point, Roll call or Head Count must be done to ensure that nobody is left behind in the affected area. This must be done mandatorily to ensure that everybody on the premises is safe.

Correct return to work – Evacuation must be conducted in a very streamlined, organized, and noiseless manner. Likewise, everybody, who had evacuated the workplace, must return to their respective locations/positions/seats, following normal or emergency routes, depending on whether the situation has been re-established to normal or not. Once everybody is back in place, another Roll call is taken.

Electrical Emergencies

Electrical accidents cause countless injuries. Electrocution is injury or death caused due to electric shock. Injury could be minimised and many lives can be saved if proper rescue techniques and treatment are used. Electrical accidents may occur at any time or place. Timely response and treatment of victims is a major concern. When an electrical accident occurs, due to the effect of muscle cramping, a victim is often incapable of moving or releasing the electrical conductor. There should always be an emergency response plan for scheduled electrical maintenance or work.

Fig. 3.5 An unconscious state because of an electrical shock

Electrical Rescue Techniques

Step 1. Approaching the accident

- The first step is to approach the accident spot cautiously.
- Call for help from a colleague, who is trained in treating electrocution victims.
- Inspect the accident scene to ensure if the source of electrocution is still active.
- Inspect if the victim is still in contact with the source of shock.
- Call 108 as soon as possible.

Fig 3.6 Approach the Victim and Inspect the Accident from a Safe Distance

Step 2. Examining the scene

- Visually examine victims to determine if they are in contact with energised conductors.
- Metal surfaces, objects near the victim itself may be energised.
- Do not touch the victim or conductive surfaces while they are energised.
- Touch the victim only if all power sources have been deactivated.
- Switch off the electrical circuits if possible.
- Detach the main power supply of the area.
- Dodge any electrical conductors in the surroundings.

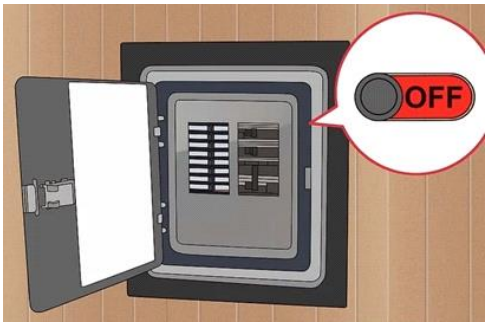


Fig 3.7 Disconnect the Source of Power

Hazards and solutions

- Be alert for hazards, such as heated surfaces and fire etc.
- In case it is impossible to deactivate the power supply, the victim must be removed from the location of the live power source.
- Wear appropriate insulating gloves and shoes to protect yourself from electric shocks.
- Ensure that your hands and feet are dry.
- Use non-conductive material to remove a victim from the conductor.

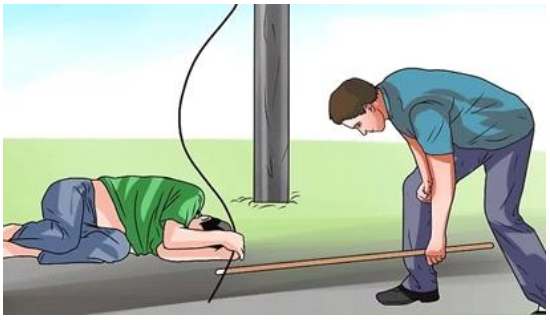


Fig 3.8 Use Insulators to Approach the Victim of Electrocution

- The victim must not be removed in case of neck or spine injury.
- The area must not be crowded so as to allow sufficient breathing air.
- The victim's pulses and breathing rate must be checked.
- CPR may be provided if required.

Fig 3.9 Perform CPR if Required

Medical emergency

A medical emergency is an accidental injury or a medical crisis that is severe. It includes the situations where:

- The person is not breathing;
- Stroke or heart attack;
- Severe bleeding;
- Shock;
- Poisoning;
- Burns.

A medical emergency requires your immediate attention. Sometimes, even before you call emergency services for help. It is crucial to know the Emergency Medical Service (EMS) number for your safety and the safety of others.

Call EMS if:

A seizure happens to someone who is not known to have epilepsy or seizure disorder. It could be a sign of serious illness.

- A seizure lasts for more than five minutes.
- The person is slow to recover, has a second seizure or has difficulty breathing afterwards.
- Has another medical condition.
- The lady is pregnant.
- There are any signs of injury or illnesses.

Do not:

- Give the person anything to eat or drink.
- Restrain the person.
- Put anything between the person's teeth during the seizure.
- Splash or pour any liquid on the person's face.
- Move the person to another place (unless it is the only way to protect the person from injury).

1. Bleeding

Procedure to assist someone who is bleeding:

- Wherever necessary, apply additional pressure to help reduce bleeding.
- Apply direct pressure to the wound with a direct pressure bandage.
- Elevate the wound to slow the bleeding

2. Shock

Shock is made worse by fear and pain.

Procedure to assist someone who is in shock:

- Keep the person lying down, if possible.
- Elevate the person's leg unless you suspect a back injury or broken bones.
- Cover the person to maintain body temperature.
- Provide the person with plenty of fresh air and space.
- If the person begins to vomit, place him/her on his/her left side.
- Loosen restrictive clothing.
- If the person's condition seems to worsen, call EMS.

3. Fainting

Fainting is a brief loss of consciousness that is caused by a temporary reduction of blood flow to the brain. A person suffers from shock when the circulatory system fails and insufficient amount of oxygen reaches the tissues. If it is not treated quickly, vital organs can fail that ultimately cause death.

Procedure to assist someone who has fainted:

- Position the person by lying on their back and elevate legs.
- Check the person's airway to ensure it is clear.
- Check for signs of breathing, coughing or movement.
- Loosen clothing (neck ties, collars, belts etc.)
- If consciousness is not regained within one minute, call the EMS.

4. Muscle Cramps

Procedure to assist the person suffering from muscle cramps:

- Slowly stretch the affected muscle to counteract the cramp.
- Massage the cramped muscle firmly but slowly.
- Apply moist heat to the area.

- Get medical help if the cramp persists.

5. Strains and Sprains (R.I.C.E)

The steps to follow when assisting someone suffering from strain or sprain:

- Rest- Avoid movements and activities that cause pain.
- Ice- Ice helps reduce pain and swelling.
- Compression- Light pressure can be applied from using an elastic wrap or bandage. It helps reduce swelling.
- Elevation- Raising the affected limb reduces pain and swelling.

6. Fractures

A fracture is a break or crack in the continuity of the bone.

Symptoms:

- Pain at or near fractured site;
- Tenderness at or near the affected area;
- Swelling over the fracture site;
- Deformity e.g. irregularity of bone, angulation or rotation of limb, depression of bone etc.;
- Temporary loss of movement;
- Signs and symptoms of shock.

7. Dislocation

A dislocation is the displacement of one or more bones at a joint. It usually occurs in the shoulders, elbow, thumb, fingers and the lower jaw.

Symptoms:

- Pain at the site of injury;
- Limited movement at the joint;
- Deformity;
- Swelling;

8. Dislocation and Fractures

Steps to take when assisting someone suffering from a fracture or dislocation:

I – Immobilize the area. Stop any movement by supporting the injured area. Use pillows, jackets, blankets etc.

A – Activate Emergency Medical Services (EMS). Call your office medical helpline.

C – Care for the person if he or she seems in shock.

T – Treat any additional secondary injuries.

9. Early Warning Signs of an Asthma Attack

The early signs of an asthma attack:

- Coughing with no cold;
- Wheezing (however light) especially upon exhaling;
- Fast/irregular breathing;
- Anxiousness;
- Cyanosis (bluish skin colour);
- Nostrils flaring with each breath.

Procedure to assist someone suffering from an asthma attack:

- Keep the person in a comfortable upright position leaning slightly forward. This is known as the 'tripod' position. Generally, the person will dictate what position is most tolerable

to them. Usually, sitting up makes it easier to breathe. Check with the person first about the most comfortable position for him or her.

- Try to calm and reassure the person.
- Administer warm fluids if possible.
- Ask the person about any asthma medication he or she may be using. Usually, the person will have an inhaler nearby.
- If the person does not respond to his or her medication, cannot speak or cannot breathe, seek medical attention immediately.

10. Animal Bites

Procedure to assist someone who has been bitten by an animal:

- Wash the bite area with mild soap and warm water for five minutes to remove saliva and any other foreign matter.
- Use direct pressure or pressure point bleeding control to stop any bleeding.
- If the wound is swollen, apply ice wrapped in a towel for 10 minutes.
- Cover the wound with a clean dressing or bandage.
- Seek medical assistance if the person showcases any severe symptom.

11. Nose Bleeds

Precautions to take while assisting someone with a nose bleed:

- It often occurs when a person has been breathing dry air.
- Seek professional help if they occur often.
- Do not tilt the person's head back. This could cause them to choke as the blood runs down their throat.

12. Object in the Eye

Procedure to assist someone who has a foreign object in their eye:

- Do not rub the eye.
- Wash your hands, clean the person's eye using water.

Check Your Progress

A. Multiple Choice Questions

1. What are the steps necessary for operating a fire extinguisher? (a) Identify the safety pin of the fire extinguisher which is generally present in its handle (b) Break the seal and pull the safety pin from the handle (c) Use the fire extinguisher by squeezing the lever (d) All of the above
2. Which of the following is an examples of ignition sources of open flames (a) gas ovens (b) lighters in smoking areas (c) welding torches (d) All of the above
3. In fire classification, all liquid, grease, and gas materials comes under (a) Class A materials (b) Class B materials (c) Class C materials (d) Class A materials
4. In fire classification, materials magnesium, potassium, and sodium comes under (a) Class A materials (b) Class B materials (c) Class C materials (d) Class D materials
5. In fire classification, materials wood, cloth, and paper comes under (a) Class A materials (b) Class B materials (c) Class C materials (d) Class D materials
6. In fire classification, electrical material and equipment comes under (a) Class A materials (b) Class B materials (c) Class C materials (d) Class D materials

7. When do we use a fire extinguisher? (a) In case of flood (b) In case of electric shock (c) In case of fire (d) In case of burn injury
8. What is the primary fire emergency telephone number? (a) 011 (b) 101 (c) 108 (d) 111
9. Which of the following contains everything you need to know about evacuating your facility safely (a) Evacuation Diagram (b) Emergency Action Plan (c) Employee Directory (d) Both a and b
10. The best course of action to take during a medical emergency is to (a) Begin first aid immediately (b) Activate the emergency plan for reporting injuries (c) Notify the person's family about the situation (d) Both a and b

B. Fill in the blanks

1. Emergency is a serious or crisis situation that needs_____attention and _____.
2. A _____ sign will warn people to walk carefully on freshly mopped floors.
3. _____ signs can prevent accidents on a staircase with a sharp bent or warn against a loose floor tile.
4. The _____ should be responsible to handle the evacuation process.
5. Workplace fires are commonly caused by improper storage of _____ material or _____ dust.
6. There should always be an _____ plan for scheduled electrical maintenance or work.
7. If the victim is breathing and has a heartbeat, give _____ for injuries and treat for shock.
8. Fire extinguisher is a _____ containing an agent which can be discharged to extinguish fire.

C. State True or False

1. The organization’s policies and guidelines are the best guide to handle emergencies.
2. If someone is injured, act as per your impulse or gut feeling.
3. Keep water and food items away from electrical equipment.
4. Always switch off the electrical circuits.
5. Always wear protective equipment, such as gloves and shoes.
6. A fire extinguisher is a protection device used to extinguish fires.
7. Flammable materials can be placed around a door exit.
8. You can determine possible evacuation routes from floor plan diagrams posted in your facility.

C. Short Answer Questions

1. What is a workplace emergency?
2. How do you protect yourself, your employees, and your business?
3. What is an emergency action plan?
4. What should your emergency action plan include?
5. How do you develop an evacuation policy and procedures?
6. How do you establish evacuation routes and exits?
7. What are the various types of fire extinguisher and their extinguishing material?
8. What are the steps for operating a fire extinguisher in case of a fire emergency.
9. Compare the different types of fire extinguishers.
10. List the different classes of fire.
11. List out electrical rescue techniques?
12. What is the first aid for electrical emergencies?

Vocabulary Words

Mock Drill/Fire Drill – Practice how to respond/react in case of an emergency, such as a fire
Fire Extinguisher – A small container usually filled with special chemicals for putting out a fire.
Exit – The way to go out of a building or room
First Aid Kit – A container, which has medicines and ointments
Fire Escape Route – The way out in case of a fire
Emergency – A sudden, urgent and unexpected event
Spilt Liquid – Soft drink/water/coffee/tea etc. that has fallen on the floor
Routine inspections – Regular checking
Damaged equipment – Torn wires or broken plugs
Stairways – Staircase/ stairs to go to the next floor
Light fixtures – Bulbs, tube lights etc.
Injury – Getting hurt/bleeding
Kitchen equipment – Vessels used in the kitchen, such as wok, knives, cutting board etc.
Cleaning Supplies – Liquid soap, dish washing liquid etc.

ANSWER KEY

Module 1. Fundamentals of RDBMS

Session 1. RDBMS Concepts

A. Multiple choice questions

1. (c) 2. (c) 3. (a) 4. (b) 5. (b) 6. (b) 7. (c) 8. (a) 9. (a) 10. (b) 11. (b) 12. (d)

B. Fill in the blanks

1. Relation, Tuple 2. DBMS 3. tables 4. show database 5. structure 6. foreign key 7. Composite Key 8. Primary Key 9. Primary Key 10. null, duplicate

C. State whether True or False

1. (T) 2. (T) 3. (T) 4. (T) 5. (T) 6. (F) 7. (F) 8. (T) 9. (F) 10. (F)

Session 2. Structured Query Language (SQL)

A. Multiple choice questions

1. (b) 2. (c) 3. (d) 4. (c) 5. (c) 6. (d) 7. (d) 8. (d) 9. (c) 10. (b) 11. (c) 12. (c) 13. (b) 14. (b) 15. (c) 16. (c)

B. Fill in the blanks

1. Five 2. Desc 3. Delete 4. alter 5. truncate 6. Drop 7. virtual 8. one 9. DCL 10. TCL 11. ORDER BY DESC 12. DISTINCT

C. State whether True or False

1. (F) 2. (T) 3. (T) 4. (F) 5. (F) 6. (T) 7. (T) 8. (F) 9. (T) 10. (F)

Session 3. Functions In SQL

A. Multiple choice questions

1. (d) 2. (c) 3. (a) 4. (d) 5. (a) 6. (b) 7. (d) 8. (d) 9. (c) 10. (a)

B. Fill in the blanks

1. value 2. (c) set of records 3. numeric 4. numeric 5. ascending 6. first occurrence 7. (d) 8. leading 9. leading, trailing 10. Intersect

C. State True or False

1. (F) 2. (F) 3. (T) 4. (T) 5. (F) 6. (F) 7. (T) 8. (T) 9. (T) 10. (T)

Module 2. Applications of Biometric Data

Session 1. Biometric Attendance System

A. Multiple choice questions

1. (c) 2. (d) 3. (d) 4. (c)

B. Fill in the blanks

1. (Excel, PDF) 2. (payroll) 3. (religion-wise, employee-wise) 4. (mechanical, electrical) 5. (FAR, FRR)

C. State whether the following statement is True or False

1. (F) 2. (T) 3. (T) 4. (T) 5. (F) 6. (T) 7. (F) 8. (T) 9. (F) 10. (T) 11. (T)

Session 3. Preparation of Aadhaar Card

A. Multiple choice questions

1. (c) 2. (a) 3. (a) 4. (c) 5. (c)

B. Fill in the blanks

1. (Verhoff) 2. (e-Aadhaar) 3. (m-Aadhaar) 4. (automated) 5. (parent)

C. State whether the following statement is True or False

1. (T) 2. (T) 3. (F) 4. (T) 5. (T) 6. (F) 7. (T) 8. (F) 9. (F) 10. (T)

Session 4. Preparation of Passport

A. Multiple choice questions

1. (c) 2. (b) 3. (d)

B. Fill in the blanks

1. (Three)

C. State whether the following statement is True or False

1. (T) 2. (T) 3. (F) 4. (F) 5. (T)

Module 3. Advanced Technologies

Session 1. Cloud Computing

A. Multiple Choice Questions

1. (b) 2. (c) 3. (d) 4. (b) 5. (a) 6. (d) 7. (b) 8. (d)

B. Fill in the blanks

1. enterprise firewall 2. copied, extracted 3. cloud service provider 4. Biometrics-on-demand 5. Mobility

C. State whether the following statements are True or False

1. (T) 2. (F) 3. (T) 4. (T) 5. (F) 6. (T) 7. (T) 8. (F) 9. (F) 10. (F)

Session 2. Face Recognition and Palm Recognition

A. Multiple Choice Questions

1. (b) 2. (b) 3. (e) 4. (a) 5. (b) 6. (c) 7. (c) 8. (d) 9. (c) 10. (b)

B. Fill in the blanks

1. (algorithms) 2. (facial features) 3. (programmatic) 4. (facial expressions) 5. (palm vein) 6. (latent palmprint) 7. (eigen vectors) 8. (identification) 9. (authentication) 10. (calculation, measurement)

C. State whether the following statements are True or False

1. (T) 2. (T) 3. (T) 4. (T) 5. (F) 6. (F) 7. (F) 8. (T) 9. (T) 10. (T)

Session 3. Thumb, Finger and Character Recognition

A. Multiple Choice Questions

1. (b) 2. (a) 3. (c) 4. (d) 5. (a) 6. (d) 7. (a)

B. Fill in the Blanks

1. (Ridge, Valley) 2. (minutiae) 3. (infrared) 4. (iris pattern) 5. (trustable) 6. (Digital Signature Dongle)

C. State whether True or False

1. (F) 2. (F) 3. (T) 4. (F) 5. (T) 6. (T) 7. (F) 8. (T) 9. (T) 10. (F)

Session 4. Troubleshooting in Biometric Data Entry

A. Multiple choice questions

1. (a) 2. (c) 3. (d) 4. (b)

B. Fill in the blanks

1. (authentication or identification) 2. (false positive false negative) 3. (spoofing) 4. (liveness detection) 5. (sensitive) 6. (tokens, randomized) 7. (entirely random) 8. (higher security risk, cost-effective)

C. State whether the following statement is True or False

1. (T) 2. (F) 3. (T) 4. (T) 5. (T) 6. (F) 7. (T) 8. (F) 9. (T)

D. State the long form of following acronyms

1. False Rejection Rate 2. False Acceptance Rate 3. Failed To Acquire 4. False Match Rate 5. False Non-Match Rate 6. Equal Error Rate 7. Detection Trade-off Curve

Session 5. Biometric Data Entry and Incident Management

A. Multiple choice questions

1. (a) 2. (c) 3. (d) 4. (a) 5. (a)

B. Fill in the blanks

1. (Respond) 2. (Complex) 3. (extract, transform, load) 4. (extract, load, transform) 5. (Cyclic Redundancy Check)

C. State whether True or False

1. (T) 2. (T) 3. (T) 4. (F) 5. (F)

Module 4. Occupational Health, Safety and Security

Session 1. Health, Safety and Security at Workplace

A. Multiple Choice Questions

1. (d) 2. (b) 3. (d) 4. (c) 5. (d) 6. (a) 7. (c) 8. (d)

B. Fill in the blanks

1. (mental, social) 2. (morning) 3. (air conditioning) 4. (health) 5. (safe, hazards, risk) 6. (business revenue, operational charges) 7. (Occupational Health and Safety) 8. (physical work environment) 9. (live wires, conductor) 10. (poor sitting posture, one position).

C. State whether True or False

1. (T) 2. (T) 3. (T) 4. (T) 5. (T) 6. (F) 7. (T) 8. (T) 9. (F) 10. (T)

Session 1. Workplace Quality Measures

A. Multiple Choice Questions

1. (d) 2. (d) 3. (d) 4. (a) 5. (c) 6. (a) 7. (b) 8. (a) 9. (b) 10. (d)

B. Fill in the blanks

1. (chemical, biological) 2. (chemical) 3. (microbial) 4. (designing) 5. (arching wrists) 6. (innocuous) 7. (hazard tape) 8. (electrical hazards) 9. (reflections) 10. (reflective)

C. State whether True or False

1. (T) 2. (T) 3. (T) 4. (F) 5. (T) 6. (F) 7. (T) 8. (T) 9. (T) 10. (F)

Session 13. Prevent Accidents and Emergencies

A. Multiple Choice Questions

1. (d) 2. (d) 3. (b) 4. (d) 5. (a) 6. (c) 7. (c) 8. (b) 9. (d) 10. (d)

B. Fill in the blanks

1. (immediate, action) 2. (wet floor) 3. (watch your steps) 4. (coordinator) 5. (flammable, combustible) 6. (emergency response) 7. (first aid) 8. (cylindrical pressure vessel)

C. State whether True or False

1. (T) 2. (F) 3. (T) 4. (F) 5. (F) 6. (T) 7. (F) 8. (T)