

QR Enabled Attendance Monitoring System

A PROJECT REPORT

Submitted By

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**Under the Supervision of
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CERTIFICATE

Certified that **Aditi Srivastava (Enrolment No-200029014005694), Ritesh Kumar Bharti (Enrolment No-200029014005788)** have carried out the project work having “**Title of Report QR Enabled Attendance Monitoring System**” for Master of Computer Applications from Dr. A.P.J. Abdul Kalam Technical University (AKTU) (formerly UPTU), Technical University, Lucknow under my supervision. The project report embodies original work, and studies are carried out by the student himself /herself and the contents of the project report do not form the basis for the award of any other degree to the candidate or to anybody else from this or any other University/Institution.

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ABSTRACT

The aims to develop a digital attendance taking system using the QR Code technology. The main goal of this project is to eliminate the manual process of attendance taking mainly in colleges and universities. This system will help provide an efficient automated alternative to the expensive and complex attendance systems being developed and implemented.

Smartphones are becoming more preferred companions to users than desktops or notebooks.

Knowing that smartphones are most popular with users, using smartphones to speed up the process of taking attendance by university instructors would save lecturing time and hence enhance the educational process. This project proposes a system that is based on a QR code, which is being displayed for students during or at the beginning of each lecture. The students will need to scan the code in order to confirm their attendance. The paper explains the high level implementation details of the proposed system.

ACKNOWLEDGEMENTS

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Finally, my sincere thanks go to my family members and all those who have directly and indirectly provided me moral support and other kind of help. Without their support, completion of this work would not have been possible in time. They keep my life filled with enjoyment and happiness.

Aditi Srivastava

Ritesh Kumar Bharti

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1. Introduction

The manual process of taking attendance is a time consuming and inefficient way. The project aims to automate the process and give a user-friendly and more efficient way.

The idea is to digitize the way attendance is taken in colleges and gives a more comfortable and easier experience while taking attendance. Tracking of attendance is entirely web-based so the data can be entered from anywhere you can access the internet.

This idea is viable and is a requirement amongst the teachers at colleges and universities. After interviewing faculties and their views on the current attendance system, a need for a more robust and time-efficient method of attendance was identified. The market for is all the colleges and universities who look forward to entering into digitization and also make the task of taking attendance easier and efficient.

It aims at creating 2 platforms:

1. A web application for the teachers to generate the QR code and maintain the attendance record.
2. A mobile application for students to scan the QR code displayed on the screen and mark their attendance.

The vision is to create attendance tracking software that is so simple and effortless to use that the faculties with any size of classes or organizers of any groups or events can spend more time with their students and participants.

1.1 Project description

Instructors manually take attendance in every class each day. They spend time to do that during class time. The QR-based Attendance Monitoring System will help them do this process in an easy way. The main scope of this project is to make attendance process more organized in every class. This project will help instructors take the attendance automatically without spending some time during the class. It will provide the instructor who is/isn't present an early-warning of high levels of non-attendance through the Canvas page. There are also many benefits for students: they can check their attendance, absences. They will also know the current grade in their reports. It makes it easier to have a clear picture of every student's attendance throughout the academic year. Attendance - an unavoidable part of any class or lecture! Marking attendance is quite important for a number of reasons. As significant as attendance is, it consumes a lot of class time and doesn't contribute toward student progress. The crucial class-time can be saved with a student attendance system, which is an automated solution to not only mark attendance but also to find out meaningful patterns in order to monitor student performance around key metrics. Attendance taking process leveraging QR code technology will save time, reduce teacher workload and streamline the process of attendance management. The purpose of this to make the traditional tedious attendance taking process seamless. The existing process consumes a lot of time and energy to take the attendance manually. It cuts the time required to take the attendance in less than half.

1.2 Project Scope

The scope of the system is to have a high-tech environment. That means by using the QR-based attendance monitoring system, the community will transfer to the technical environment that they already have the Canvas system to help them manage the courses they have in the whole semester. This system will add some features in the attendance system to Canvas by using QR-based attendance monitoring system

That will help the community use the technology in effective ways:

1. Make the attendee process easier and effective.
2. Help faculty in the attendance process every time.
3. Manage and organize the attendance page through Canvas.

1.3 Project Definition

Definitions:

Student:

- i. Student is supposed to login using its ID and Password. Each account will be associated with their library id. This will allow only a single user to login from a particular mobile device.
- ii. A QR code will be displayed on the screen with the help of a projector. The students will use the application from their respective mobile phones to scan that QR code.
- iii. ON successful scanning of the QR code, the students will be automatically marked present at the backend and they will get a notification.
- iv. Students can check their attendance in all the subjects to date. The subject whose attendance criteria is not met will turn red to warn the student.

Faculty:

- i. The Faculty will log in by entering the Username and Password.
- ii. Then, faculty has to select the course, division, set a time limit for the QR Code and the other details to be displayed on the screen.
- iii. Faculty will be able to see the roll numbers of students who have scanned the QR code in green and others in red.

The Registration Office: This is for the system management, and it will be presented by the employees.

1.4 Hardware and software use in project

Hardware Specification

Processor	MT6762 (Helio P22) Processor or above
Storage	Between 50MB and 100 MB
Ram	Minimum 40 MB
Screen resolution	Automatic adjustable as per the device
GPS	For locating user

Software Specification

Operating System	Windows and above , IOS 5 and above
IDE	Android 5.1.1, Visual Studio Code
Database	Firebase
Frontend	ReactJs, React native

1.5 Project Features

- i. Proposes a system that is based on a QR code, which is being displayed for students during or at the beginning of each lecture. The students will need to scan the code in order to confirm their attendance. It requires a high-level implementation of the proposed system and discussion of student identity to eliminate false registrations.
- ii. Deals with the process of attendance management and evaluation of attendance. It emphasizes on the provision of QR code to the students to mark the attendance. The purpose of the paper is to computerize the traditional way of recording attendance and a smart way of tracking attendance in the institutions.
- iii. Discusses the elimination of the current problems, while also promoting a paperless environment at the same time. The aim was to develop an attendance system that will require minimal hardware cost, setup and maintenance. i.e. by having the application to run on the instructor's existing Android mobile device.
- iv. Discusses how the system speeds up the process of taking attendance would save valuable teaching time. It helps students avoid consequences that may result from poor attendance which will eventually penalize them from sitting their final examinations as required by the administrators.

2. Feasibility Study

A feasibility analysis is used to determine the viability of an idea, such as ensuring a project is legally and technically feasible as well as economically justifiable. It tells us whether a project is worth the investment—in some cases, a project may not be doable. There can be many reasons for this, including requiring too many resources, which not only prevents those resources from performing other tasks but also may cost more than an organization would earn back by taking on a project that isn't profitable.

A well-designed study should offer a historical background of the business or project, such as a description of the product or service, accounting statements, details of operations and management, marketing research and policies, financial data, legal requirements, and tax obligations. Generally, such studies precede technical development and project implementation.

2.1 Technical feasibility

This assessment focuses on the technical resources available to the organization. It helps organizations determine whether the technical resources meet capacity and whether the technical team is capable of converting the ideas into working systems. Technical feasibility also involves the evaluation of the hardware, software, and other technical requirements of the proposed system. As an exaggerated example, an organization wouldn't want to try to put Star Trek's transporters in their building—currently, this project is not technically feasible.

2.2 Operational Feasibility

This assessment involves undertaking a study to analyse and determine whether—and how well—the organization's needs can be met by completing the project. Operational feasibility studies also examine how a project plan satisfies the requirements identified in the requirements analysis phase of system development.

2.3 Economical Feasibility

In Economic Feasibility study cost and benefit of the project is analyzed. Means under this feasibility study a detail analysis is carried out what will be cost of the project for development which includes all required cost for final development like hardware and software resource required, design and development cost and operational cost and so on. After that it is analyzed whether project will be beneficial in terms of finance for organization or not.

2.4 Behavioral Feasibility

It evaluates and estimates the user attitude or behaviour towards the development of new system. It helps in determining if the system requires special effort to educate, retrain, transfer, and changes in employee's job status on new ways of conducting business.

3. Database Design

A properly designed database provides you with access to up-to-date, accurate information. Because a correct design is essential to achieving your goals in working with a database, investing the time required to learn the principles of good design makes sense. In the end, you are much more likely to end up with a database that meets your needs and can easily accommodate change.

This article provides guidelines for planning a desktop database. You will learn how to decide what information you need, how to divide that information into the appropriate tables and columns, and how those tables relate to each other. You should read this article before you create your first desktop database.

Database design can be generally defined as a collection of tasks or processes that enhance the designing, development, implementation, and maintenance of enterprise data management system. Designing a proper database reduces the maintenance cost thereby improving data consistency and the cost-effective measures are greatly influenced in terms of disk storage space. Therefore, there has to be a brilliant concept of designing a database. The designer should follow the constraints and decide how the elements correlate and what kind of data must be stored.

The main objectives behind database designing are to produce physical and logical design models of the proposed database system. To elaborate this, the logical model is primarily concentrated on the requirements of data and the considerations must be made in terms of monolithic considerations and hence the stored physical data must be stored independent of the physical conditions. On the other hand, the physical database design model includes a translation of the logical design model of the database by keep control of physical media using hardware resources and software systems such as Database Management System (DBMS).

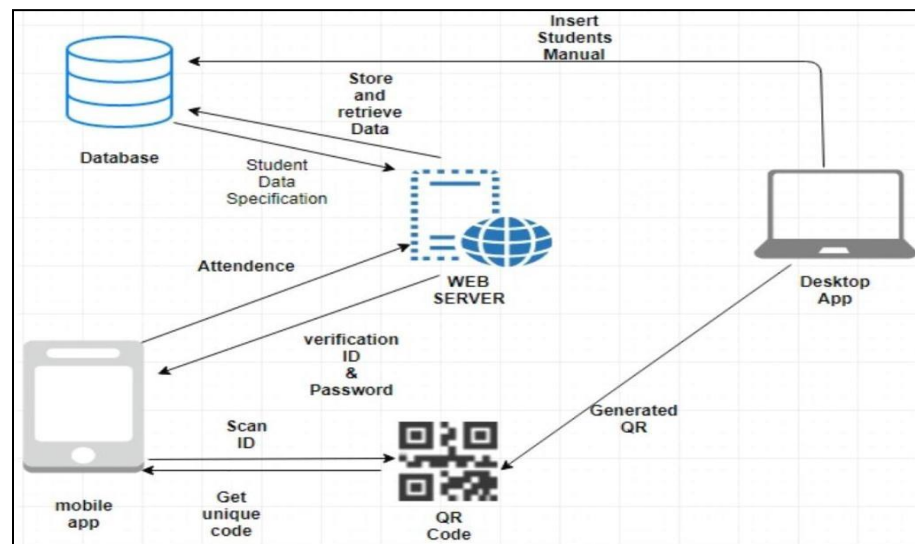











Fig 3.1.: System Design

1. Flow Chart

A flowchart is a diagram that depicts a process, system or computer algorithm. They are widely used in multiple fields to document, study, plan, improve and communicate often complex processes in clear, easy-to-understand diagrams. Flowcharts, sometimes spelled as flow charts, use rectangles, ovals, diamonds and potentially numerous other shapes to define the type of step, along with connecting arrows to define flow and sequence. They can range from simple, hand-drawn charts to comprehensive computer-drawn diagrams depicting multiple steps and routes. If we consider all the various forms of flowcharts, they are one of the most common diagrams on the planet, used by both technical and non-technical people in numerous fields. Flowcharts are sometimes called by more specialized names such as , Process Map, Functional Flowchart, Business Process Mapping, Business Process Modeling and Notation (BPMN), or Process Flow Diagram (PFD). They are related to other popular diagrams, such as Data Flow Diagrams (DFDs) and Unified Modeling Language (UML) Activity Diagrams.

	Flowline (Arrowhead)
	Terminal
	Process
	Decision
	Input/Output
	Annotation (Comment)
	Predefined Process
	On-page Connector
	Off-page Connector

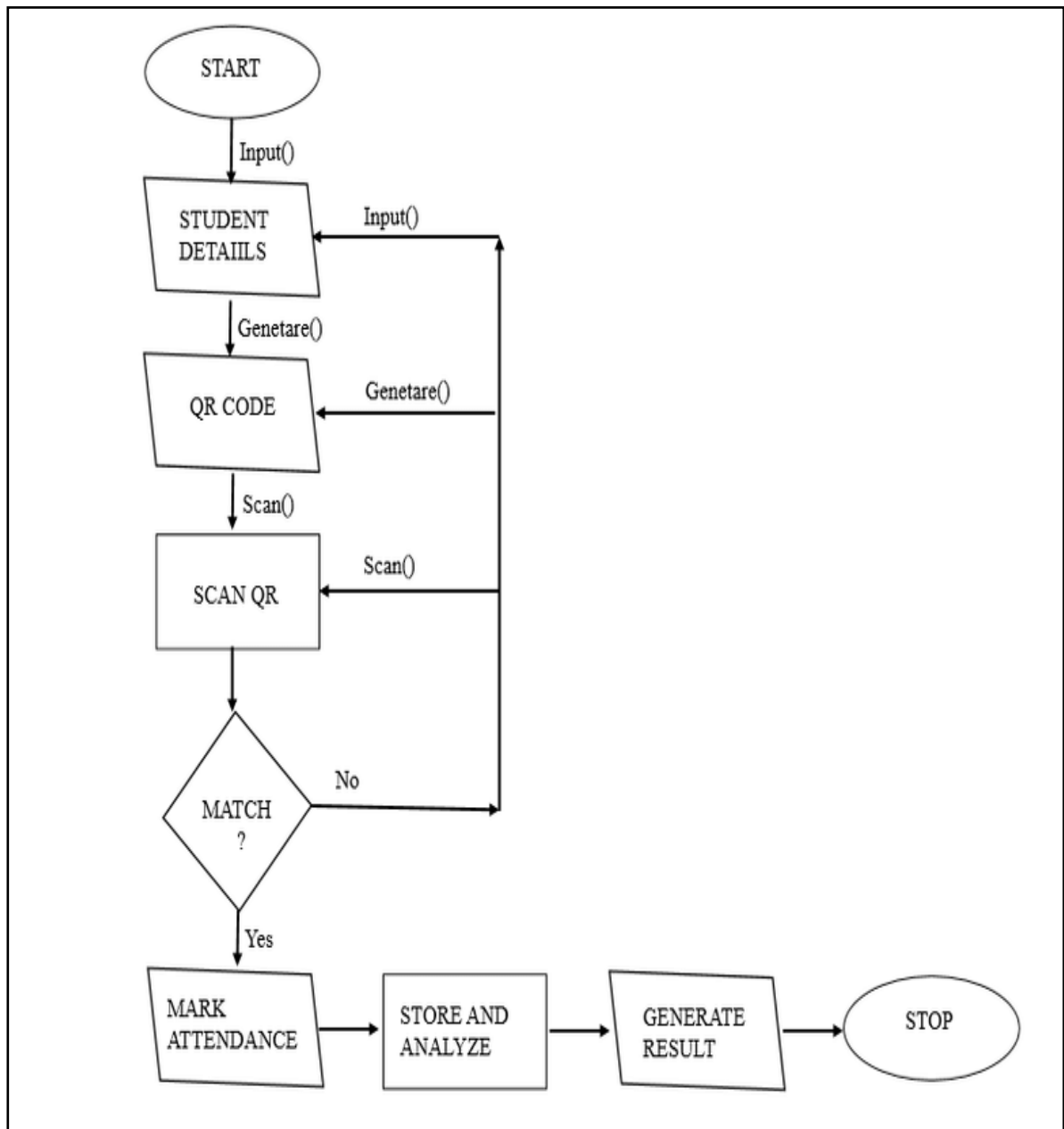


Fig 3.1.1. : Flow Chart

3.2 Use Case Diagram

A use case diagram is a graphical depiction of a user's possible interactions with a system. A use case diagram shows various use cases and different types of users the system has and will often be accompanied by other types of diagrams as well. The use cases are represented by either circles or ellipses. The actors are often shown as stick figures.

The purpose of use case diagram is to capture the dynamic aspect of a system. However, this definition is too generic to describe the purpose, as other four diagrams (activity, sequence, collaboration, and State chart) also have the same purpose. We will look into some specific purpose, which will distinguish it from other four diagrams.

Use case diagrams are used to gather the requirements of a system including internal and external influences. These requirements are mostly design requirements. Hence, when a system is analyzed to gather its functionalities, use cases are prepared and actors are identified.

When the initial task is complete, use case diagrams are modelled to present the outside view.

In brief, the purposes of use case diagrams can be said to be as follows –

- i. Used to gather the requirements of a system.
- ii. Used to get an outside view of a system.
- iii. Identify the external and internal factors influencing the system.
- iv. Show the interaction among the requirements are actors.

How to draw a Use Case diagram?

It is essential to analyze the whole system before starting with drawing a use case diagram, and then the system's functionalities are found. And once every single functionality is identified, they are then transformed into the use cases to be used in the use case diagram. After that, we will enlist the actors that will interact with the system. The actors are the person or a thing that invokes the functionality of a system. It may be a system or a private entity, such that it requires an entity to be pertinent to the functionalities of the system to which it is going to interact. Once both the actors and use cases are enlisted, the relation between the actor and use case/ system is inspected. It identifies the no of times an actor communicates with the system. Basically, an actor can interact multiple times with a use case or system at a particular instance of time. Following are some rules that must be followed while drawing a use case diagram:

- i. A pertinent and meaningful name should be assigned to the actor or a use case of a system.
- ii. The communication of an actor with a use case must be defined in an understandable way.
- iii. Specified notations to be used as and when required.
- iv. The most significant interactions should be represented among the multiple no of interactions between the use case and actors.

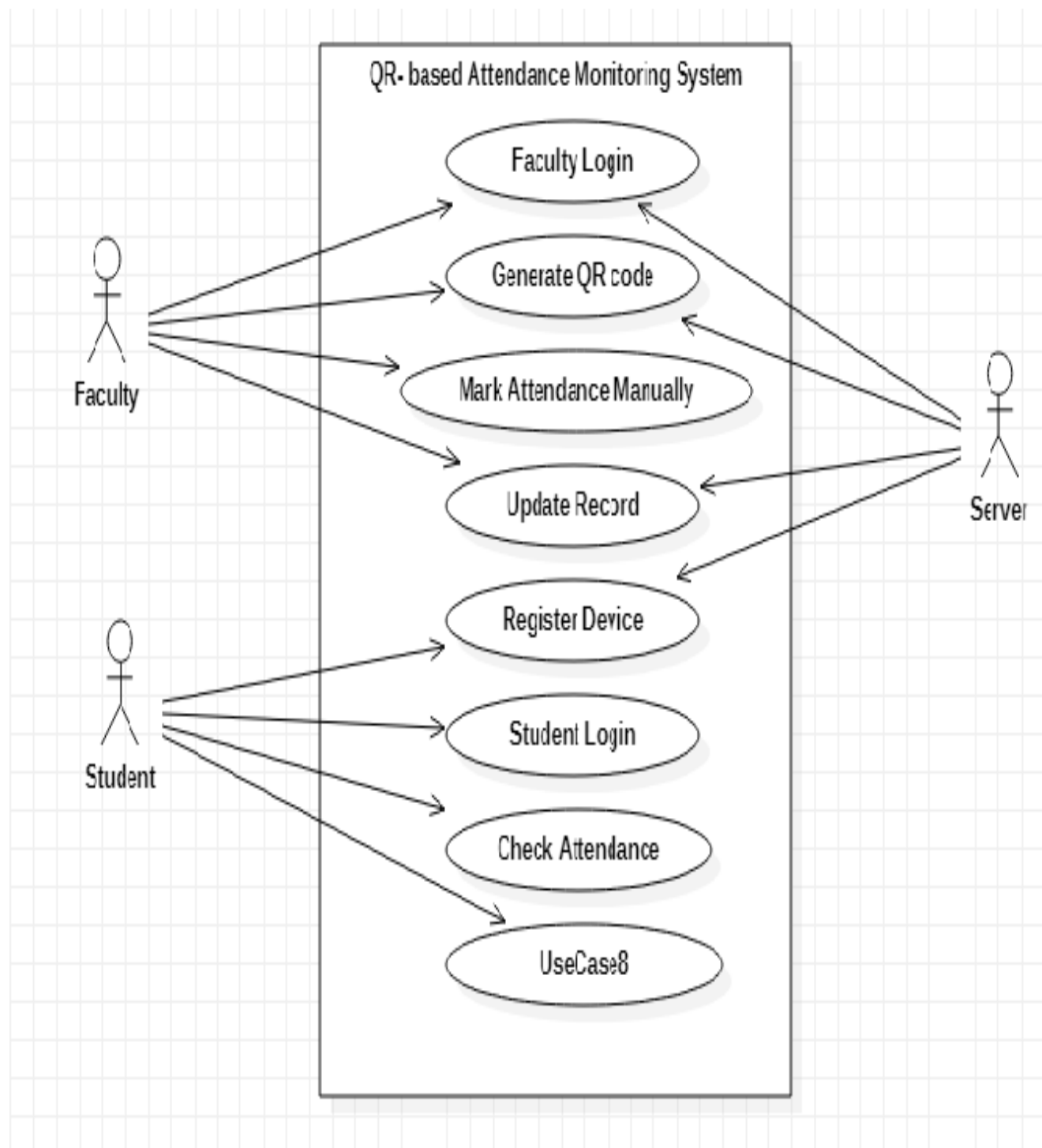


Fig 3.2.1.: Use Case Diagram

3.3 Sequence Diagram

A **sequence diagram** or system sequence diagram (SSD) shows object interactions arranged in time sequence in the field of software_engineering. It depicts the objects involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of scenario. Sequence diagrams are typically associated with use case realizations in the logical_view of the system under development. Sequence diagrams are sometimes called event diagrams or event scenarios.

For a particular scenario of a use case, the diagrams show the events that external actors generate, their order, and possible inter-system events. All systems are treated as a black box; the diagram places emphasis on events that cross the system boundary from actors to systems. A system sequence diagram should be done for the main success scenario of the use case, and frequent or complex alternative scenarios.

- i. To model high-level interaction among active objects within a system.
- ii. To model interaction among objects inside a collaboration realizing a use case.
- iii. It either models generic interactions or some certain instances of interaction.

Sequence Diagram Notations –

- i. **Actors** – An actor in a UML diagram represents a type of role where it interacts with the system and its objects. It is important to note here that an actor is always outside the scope of the system we aim to model using the UML diagram
- ii. **Lifelines** – A lifeline is a named element which depicts an individual participant in a sequence diagram. So basically each instance in a sequence diagram is represented by a lifeline. Lifeline elements are located at the top in a sequence diagram.
- iii. **Messages** – Communication between objects is depicted using messages. The messages appear in a sequential order on the lifeline. We represent messages using arrows. Lifelines and messages form the core of a sequence diagram.
- iv. **Guards** – To model conditions we use guards in UML. They are used when we need to restrict the flow of messages on the pretext of a condition being met. Guards play an important role in letting software developers know the constraints attached to a system or a particular process.

Uses of sequence diagrams –

- i. Used to model and visualise the logic behind a sophisticated function, operation or procedure.
- ii. They are also used to show details of UML use case diagrams.
- iii. Used to understand the detailed functionality of current or future systems.
- iv. Visualise how messages and tasks move between objects or components in a system.

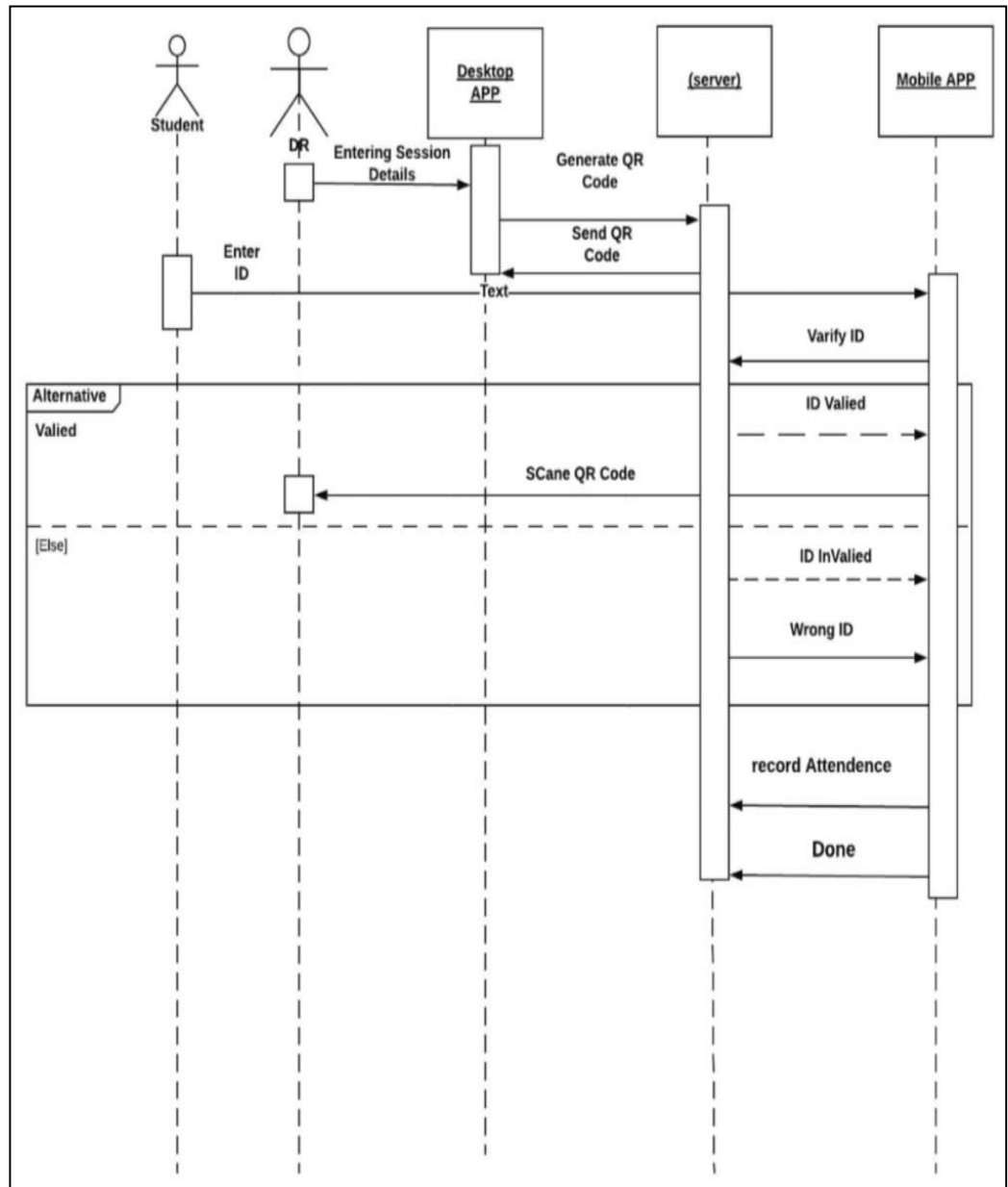


Fig 3.3.1. : Sequence Diagram

3.4 Activity Diagram

The activity diagram is used to demonstrate the flow of control within the system rather than the implementation. It models the concurrent and sequential activities.

The activity diagram helps in envisioning the workflow from one activity to another. It put emphasis on the condition of flow and the order in which it occurs. The flow can be sequential, branched, or concurrent, and to deal with such kinds of flows, the activity diagram has come up with a fork, join, etc.

It is also termed as an object-oriented flowchart. It encompasses activities composed of a set of actions or operations that are applied to model the behavioral diagram

Why use Activity Diagram?

An event is created as an activity diagram encompassing a group of nodes associated with edges. To model the behavior of activities, they can be attached to any modeling element. It can model use cases, classes, interfaces, components, and collaborations.

It mainly models processes and workflows. It envisions the dynamic behavior of the system as well as constructs a runnable system that incorporates forward and reverse engineering. It does not include the message part, which means message flow is not represented in an activity diagram.

It is the same as that of a flowchart but not exactly a flowchart itself. It is used to depict the flow between several activities.

How to draw an Activity Diagram?

An activity diagram is a flowchart of activities, as it represents the workflow among various activities. They are identical to the flowcharts, but they themselves are not exactly the flowchart. In other words, it can be said that an activity diagram is an enhancement of the flowchart, which encompasses several unique skills.

Since it incorporates swim lanes, branching, parallel flows, join nodes, control nodes, and forks, it supports exception handling. A system must be explored as a whole before drawing an activity diagram to provide a clearer view of the user. All of the activities are explored after they are properly analyzed for finding out the constraints applied to the activities. Each and every activity, condition, and association must be recognized.

After gathering all the essential information, an abstract or a prototype is built, which is then transformed into the actual diagram.

Following are the rules that are to be followed for drawing an activity diagram:

- i. A meaningful name should be given to each and every activity.
- ii. Identify all of the constraints.
- iii. Acknowledge the activity associations

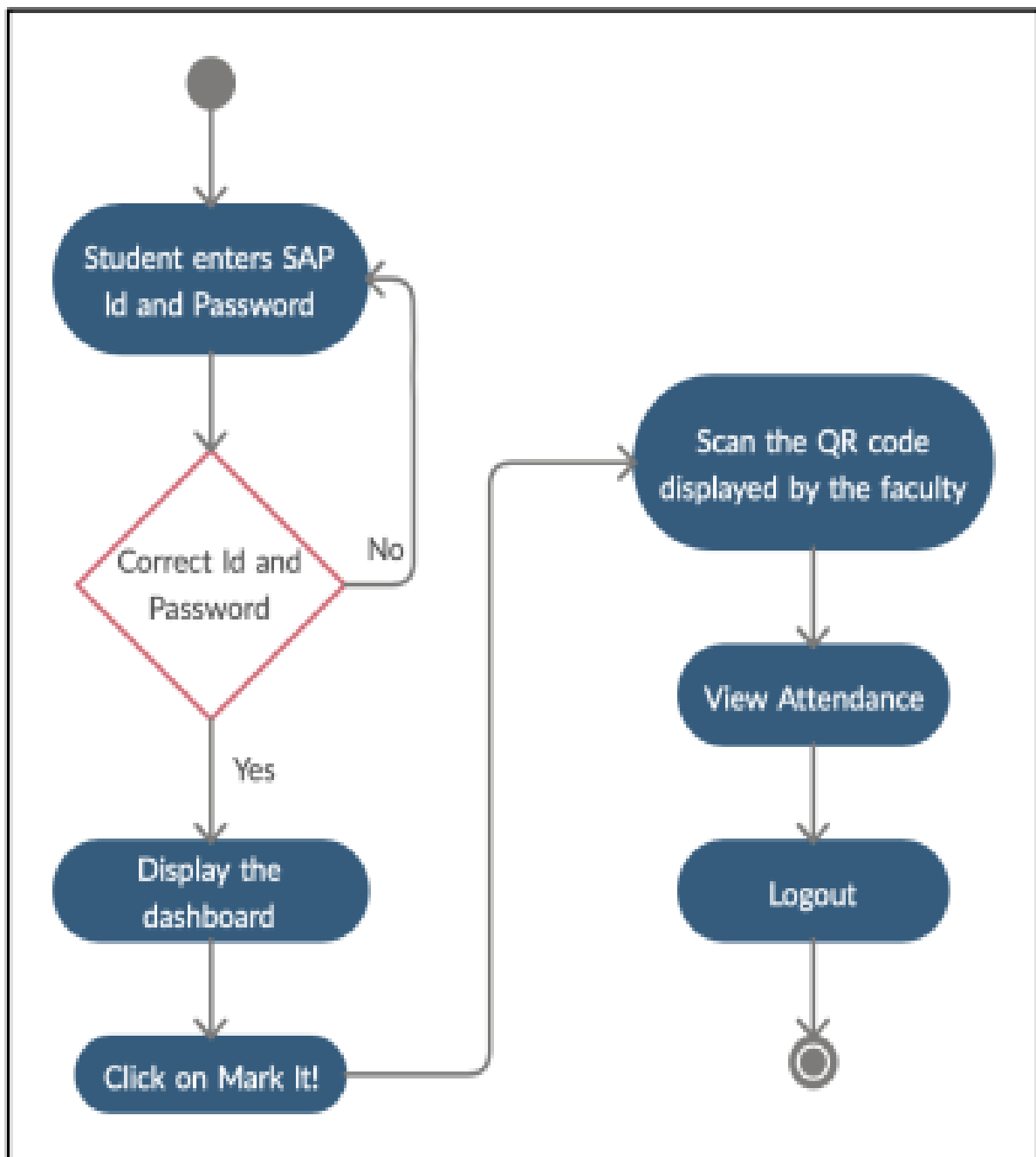


Fig 3.4.1. : Student Activity Diagram

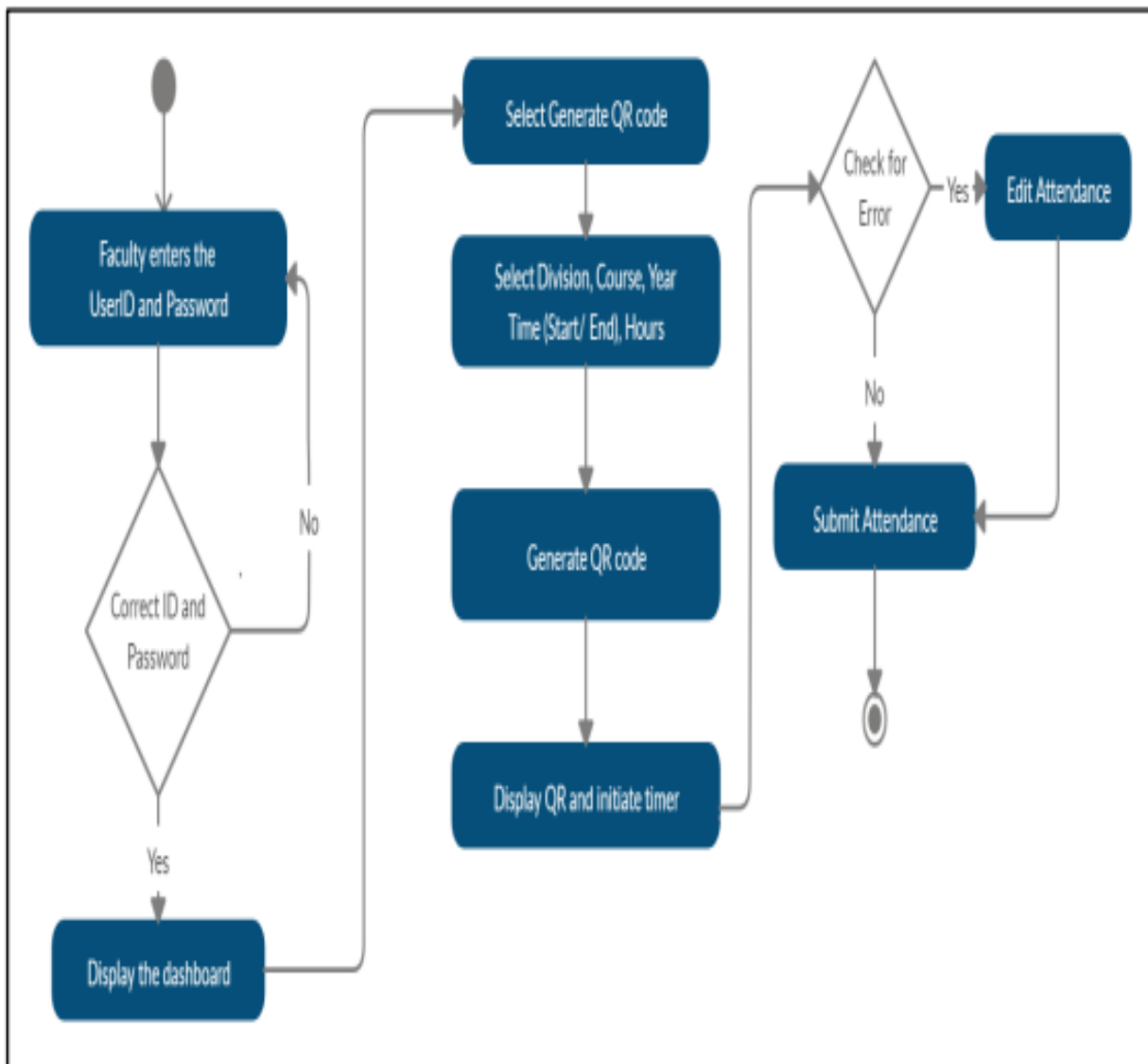


Fig 3.4.2. : Faculty Activity Diagram

3.5 Class Diagram

The class diagram depicts a static view of an application. It represents the types of objects residing in the system and the relationships between them. A class consists of its

objects, and also it may inherit from other classes. A class diagram is used to visualize, describe, document various different aspects of the system, and also construct executable software code.

It shows the attributes, classes, functions, and relationships to give an overview of the software system. It constitutes class names, attributes, and functions in a separate compartment that helps in software development. Since it is a collection of classes, interfaces, associations, collaborations, and constraints, it is termed as a structural diagram.

Purpose of Class Diagrams

The main purpose of class diagrams is to build a static view of an application. It is the only diagram that is widely used for construction, and it can be mapped with object-oriented languages. It is one of the most popular UML diagrams. Following are the purpose of class diagrams given below:

- i. It analyses and designs a static view of an application.
- ii. It describes the major responsibilities of a system.
- iii. It is a base for component and deployment diagrams.
- iv. It incorporates forward and reverse engineering

How to draw a Class Diagram?

The class diagram is used most widely to construct software applications. It not only represents a static view of the system but also all the major aspects of an application. A collection of class diagrams as a whole represents a system.

Some key points that are needed to keep in mind while drawing a class diagram are given below:

1. To describe a complete aspect of the system, it is suggested to give a meaningful name to the class diagram.
2. The objects and their relationships should be acknowledged in advance.
3. The attributes and methods (responsibilities) of each class must be known.
4. A minimum number of desired properties should be specified as more number of the unwanted property will lead to a complex diagram.
5. Notes can be used as and when required by the developer to describe the aspects of a diagram.
6. The diagrams should be redrawn and reworked as many times to make it correct before producing its final version.

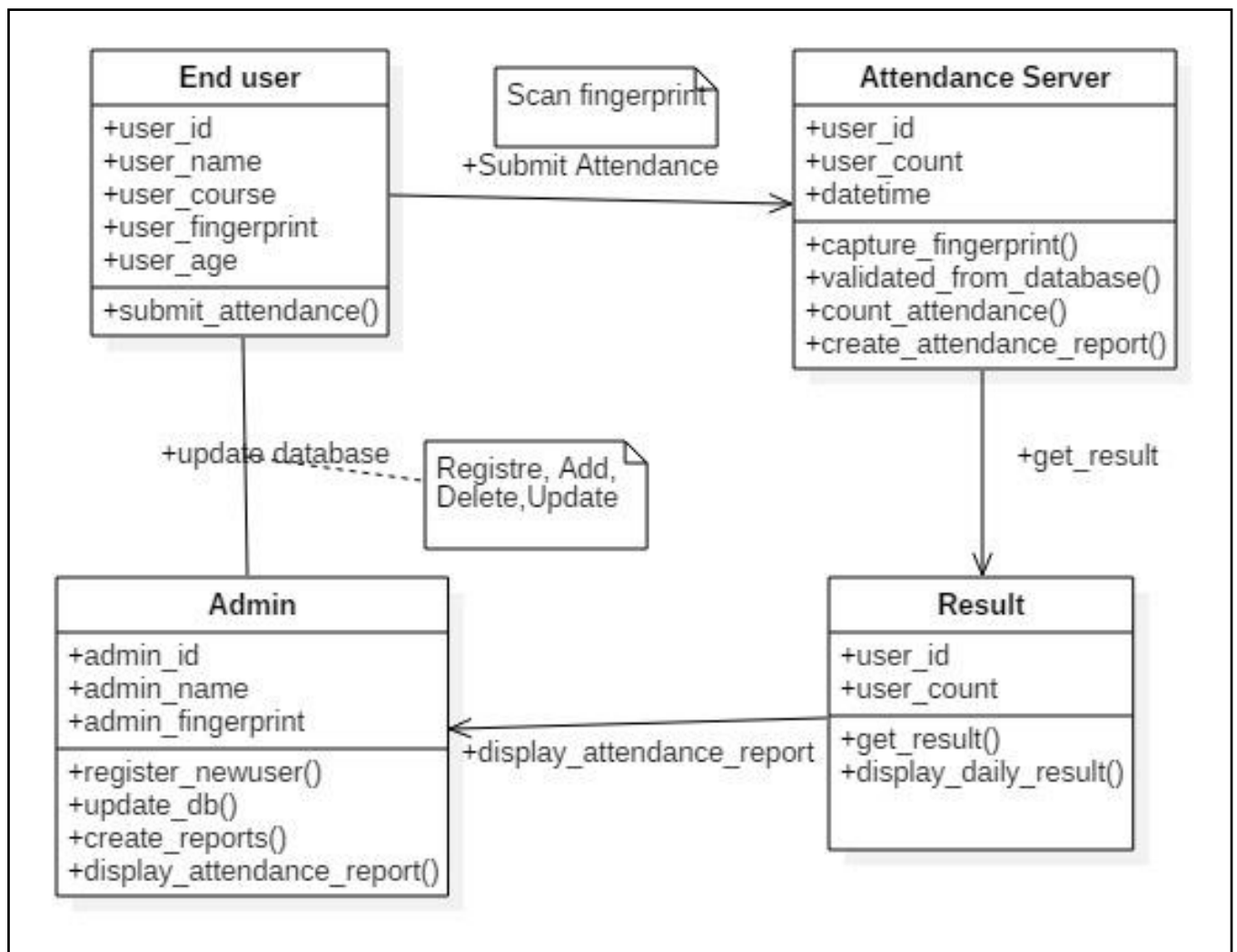













Fig 3.5.1. : Class Diagram

3.6 E-R Diagram

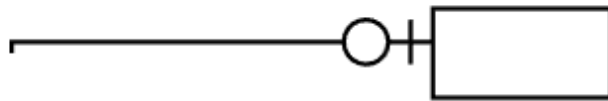
An Entity Relationship (ER) Diagram is a type of flowchart that illustrates how “entities” such as people, objects or concepts relate to each other within a system. ER Diagrams are most often used to design or debug relational databases in the fields of software engineering, business information systems, education and research. Also known

as ERDs or ER Models, they use a defined set of symbols such as rectangles, diamonds, ovals and connecting lines to depict the interconnectedness of entities, relationships and their attributes. They mirror grammatical structure, with entities as nouns and relationships as verbs. ER diagrams are related to data structure diagrams (DSDs), which focus on the relationships of elements within entities instead of relationships between entities themselves. ER diagrams also are often used in conjunction with data flow diagrams (DFDs), which map out the flow of information for processes or systems.

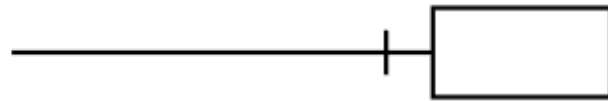
Components of ER Diagram

	Represents Entity
	Represents Attribute
	Represents Relationship
	Links Attribute(s) to entity set(s) or Entity set(s) to Relationship set(s)
	Represents Multivalued Attributes
	Represents Derived Attributes
	Represents Total Participation of Entity
	Represents Weak Entity
	Represents Weak Relationships
	Represents Composite Attributes
	Represents Key Attributes / Single Valued Attributes

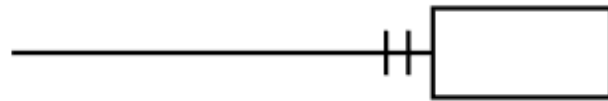
Cardinality



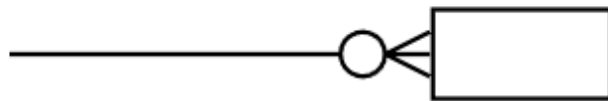
Zero or One
an optional relationship



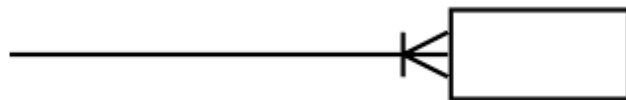
One



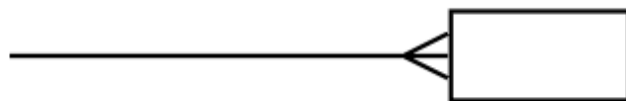
One and Only One



Zero or Many
an optional relationship



One or Many



Many

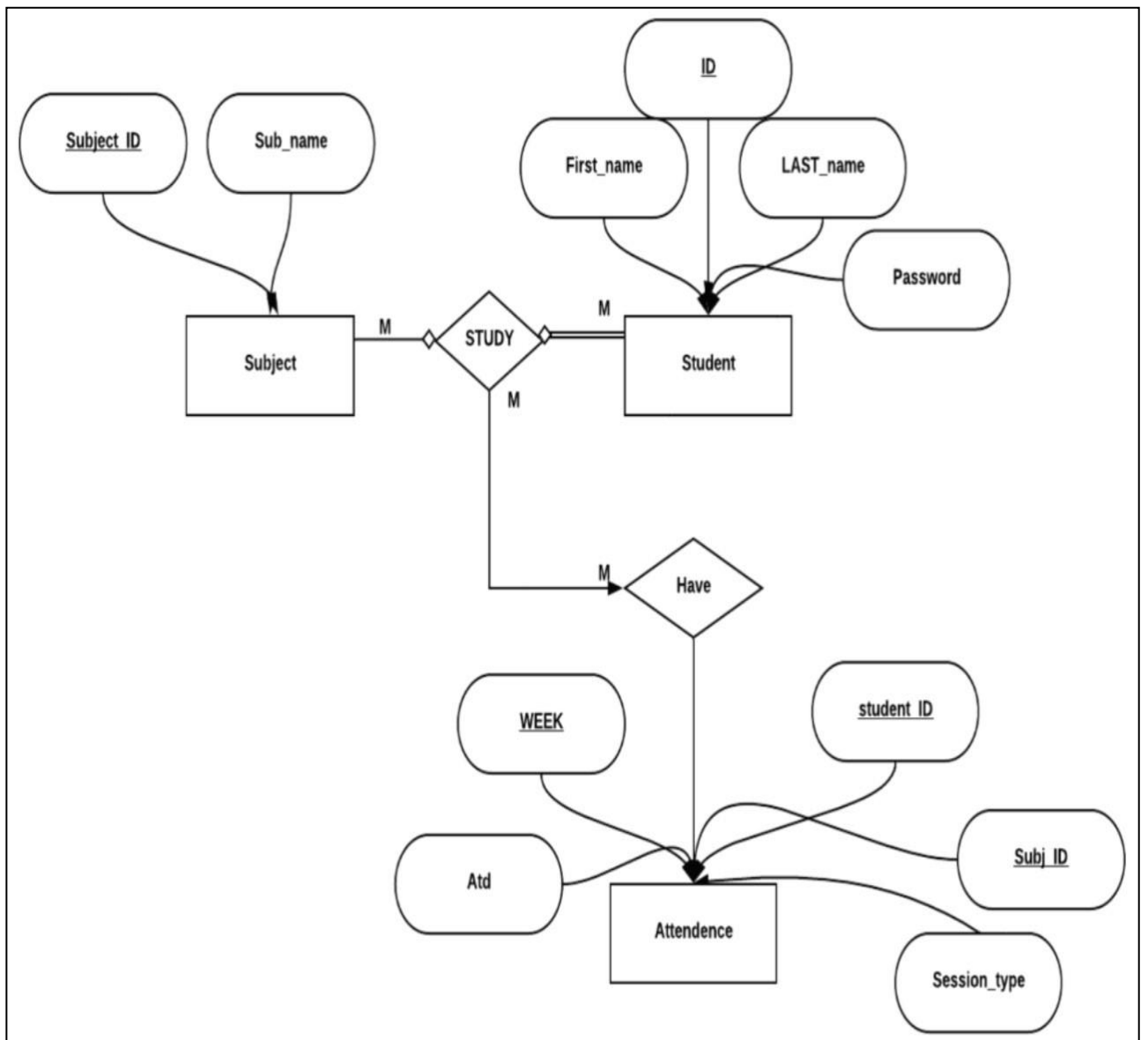


Fig 3.6.1: E-R Diagram

3.7 Data Model Design

This system contains many processes to be completed. One of the processes is the database design. It needs to present data that is the data understandable not only for the human being but also for computers. This step would organize the needed data on every side of this project to make the database relationship. In this project.

The system has four entities, each with its own attributes: People, Class list, Courses and scanner. The People entity has the student library id, first name, last name. The class list entity has class list ID, class ID class data and class time. The course entity has course ID, course name, credits, room number, and class time. Also, the course entity has an index for the date and time. Finally, the QR entity has the class list ID, class ID, student library id, class date, and attendance information.

The relationship in this entity relationship diagram has many ways to define the following:

- i. Every student has zero to many classes (not all take classes this semester)
- ii. Every faculty teaches zero to many classes (not all teach any class this semester, such as doing research)
- iii. Every class has zero to many students
- iv. Every class has only one faculty

The result of this relationship is connected with the others with the QR entity. The QR entity is the final result of this relationship. It has the student information, and the course information in one format. In the other words, it has the one to many relationships with each entity and its shows the result of the relationship.

- i. All entities related to the QR entity
- ii. Classes have one to many relationships

The process starts with the class list entity. It must have at least one student in each class. Every faculty and student has a unique library ID. Faculty can be signed for one mandatory class to many classes, and each class has only one faculty member, Students has zero to many optional classes. So, each class has many students with only one faculty. In the QR page, all results of the one to many relationships would end up on this page to give the outcome.

The whole process would be in this relationship as one part of the work, and it has everything we need to get the project started as planned. Entity relationship diagrams help this project to be more clear and understandable. This will continue working on the same steps that we use in this diagram. The overall benefit of this structure is to facilitate easy communication between humans and computers. Better communication will expedite the desired results.

4. System Features

4.1 Functional Requirements

1. Adding a New student:

- i. Function: Sign up a new student to the system.
- ii. Priority: Top (Required for first release)
- iii. Requirements: To add a new user to the system, all of them should have registered in the admission office before they can register in their classes. On the orientation day, all students must scan their thumbs in the input device for only one time to save the fingerprint data in the registration office to sign up.

2 Use the system to attend to classes

- i. Function: Attend to classes
- ii. Priority: Top (Required for every class attended)
- iii. Requirements: When students have a class, which is being displayed for students during or at the beginning of each lecture. The students will need to scan the code in order to confirm their attendance. It requires a high level implementation of the proposed system and discussion of student identity to eliminate false registrations.

3. Report students

- i. Function: The user will look at their reports for the current status.
- ii. Priority: Top (Required for first release)
- iii. Requirements: When the students have enrolled in the class, they are now able to check on their current attendance situation through the QR page. In the system, they will be shown a page that gives them the whole attendance status in the semester.

4. Faculty receive a report

- i. Function: Faculty receives a current report every class.
- ii. Priority: Top
- iii. Requirements: The system will send a message to the faculty. Faculty will have the all students' attendance reports in the particular class. Faculty can modify some of the attendance grades if he/she needs.

5. Students missed classes

- i. Function: Students receive a message for missing class and have to submit a form.
- ii. Priority: High (Required for second release)
- iii. Requirements: When a student misses a class, he/she will receive a message via email and Canvas page. Students must log in to the application page and go to the attendance page to write the reason for missing the class. Students have to submit the form to wait for the response of the faculty's decision.

6. Students missed two classes and more

- i. Function: Students receive a warning message for missing class for the second time.
- ii. Priority: High (Required for second release)
- iii. Requirements: When students miss more than one class, students will receive a warning message for missing two classes or more. The warning message should be for the missed classes for the whole semester and their status in a danger level.

7. Faculty check the report and the attendance control panel page

- i. **Function:** Users can provide feedback about search terms.
- ii. **Priority:** Medium (Second release if possible, mandatory for third release)
- iii. **Requirements:** Faculty has to check on the report and give the final submission. Faculty has full control of modifying any grades and looking at students who have excuses to modify their grades. Faculty receive messages from the system about students who missed classes. For students who submit the note for the missed class, faculty members could look at the note and give a decision on the student's grades.

4.2 External Interface Requirements

User Interfaces

i. **Login Display:**

This is the login page for Student & Faculty. This interface designed to be in the device view in every class. "Scan QR" is the login to the class and the system.

ii. **Welcome View page:**

This view will be also in the device screen. This page means the device accepts the data and identify the person. So, in the screen, it will show the student information (name, and his picture). Also, it has the data for the particular class at the time.

iii. **Error message view:**

If the student data is not identified with the device, the student has to check with the registration office to fix that. This means, this student does not have a record in the system. Or, the student is in the wrong class or wrong class time.

iv. **Add a New student:**

This page appears in the registration office when they add a new student. Students have to scan QR in the device. And then, their fingerprint record will be added by the employer to make sure the student has his record with his information; not anyone else's. The employer submits the information to the system and the system will give a message that this student with his fingerprint information has added to the system.

v. **Student Report:**

This page will appear in a separate page in the system. It is a web page gives the students current report during the semester. It has the weekly report, the check in each class, and grade. It gives the student how many times he has been in the class and how many he missed. Also, it provides all grades that student makes during the semester.

vi. **Missed class form:**

If a student missed any class, the system automatically will send to him this form. Students should write their note and submit it to the system. The system will send it to the faculty member to have the final decision.

4.3 Other Non-functional Requirements

Security Requirements

The Current System Security

The current system, which is website, has its policy on its site page. The current system builds upon a user name and password access. Students and faculty can access to his/her account through their page, and they can control it.

The system now has its own policy and security; however, the new feature we will add to the system will need some security requirements to the system. The new feature in the system will add some values to the current policy to maintain the security in the right way. It also provides proof of compliance.

The new policy in the system will deal with the security in many cases. The security will have more components on the system in a high control panel. The plan is to secure the outsider and insider community of misused the system (e.g. identification theft). Strong security is part of the policy's purpose.

User Access

Inside the community, there are students, faculty, and registration office staff who are going to use the system. The main actor of the users in the entity is students. Students will use the entity everyday by scanning QR code in each class. Faculty will only use the system through website, and they can access to student information. The faculty member will use the entity to control the attendance page. Faculty's job is to add, edit, update and delete any record. Furthermore, registration office staff will check on every student's identification for security purposes. They check on students for identification in person before they add, edit, update and delete any information from their fingerprint records in the system. The staff will ask students for ID for identification.

Threats to the system security

This system may face many threats. Sometimes, it comes from a community insider. This could be someone who discloses the data from the database where it is located, in the registration office. Another type of deception is false identification, such as a fake ID, when students present in the registration office. The system will reduce this kind of misuse because the fingerprint identification is more secure than others. However, staff in the registration office should check on the identification carefully before initiating any processes in the system. These records will be the official record for all students, since they begin school and until they graduate.

Levels of security:

The operating system: the security in this case will be in the same level of the website & application security.

The network: it is part of the current system security.

The data management system:

- i. Students can access to their classes to the system check by QR code
- ii. Faculty access to website would be the same as we have now, and they will control the attendance page/report.
- iii. The purpose of the registration office is to make sure every student has the right fingerprint record and right information in the system on a consistent basis.

Level of access

Subject:

People level:

- 1) Users (students).
- 2) Faculty (Control).
- 3) Registration office (control the system).

Reference Monitor

The authorization and the access control present in the security matrix below:

Faculty can create, read, update and delete the “Report student,” “Report faculty,” and only read “process student check.”

Registration office can create, read, update and delete the “add a new record,” “Process student’s check,” and they can only read the “Check-in.”

Students are able to create and read the “Check-in,” and they can only read the “Receive student check” and “report student”.

4.4 System Architecture

A system architecture is the ideational model that defines the structure, behavior, technology and other views of any system. In the QR based system, we have the whole structure to build the system. In this architecture, we will describe the formal definition and the representation of the system. This description is a high level that can show the relationship between the components induces software, hardware and the communication between them.

The first level of this architecture is the hardware component. The hardware here is the fingerprint reader which will be connected to the system and other components. Then, it will check with security level. The security level here has database for the security purposes. Next, the architecture level will go to the process task, which has four components in the software. They are check in for every class when student scan his/her fingerprint, check on fingerprint, this is kind of the security and to check into every class. Then check into the class, which is the class check list to make sure the student in the right class. Finally, notify step, this step is to report everyone involves in the system to receive a notification.

The last two level of this architecture are the access data and the databases. There are three databases for this step which are for the classes, students, and fingerprint records. This architecture is the whole structure for the Automatic Attendance System. So, all process here will complete the communication between all the components.

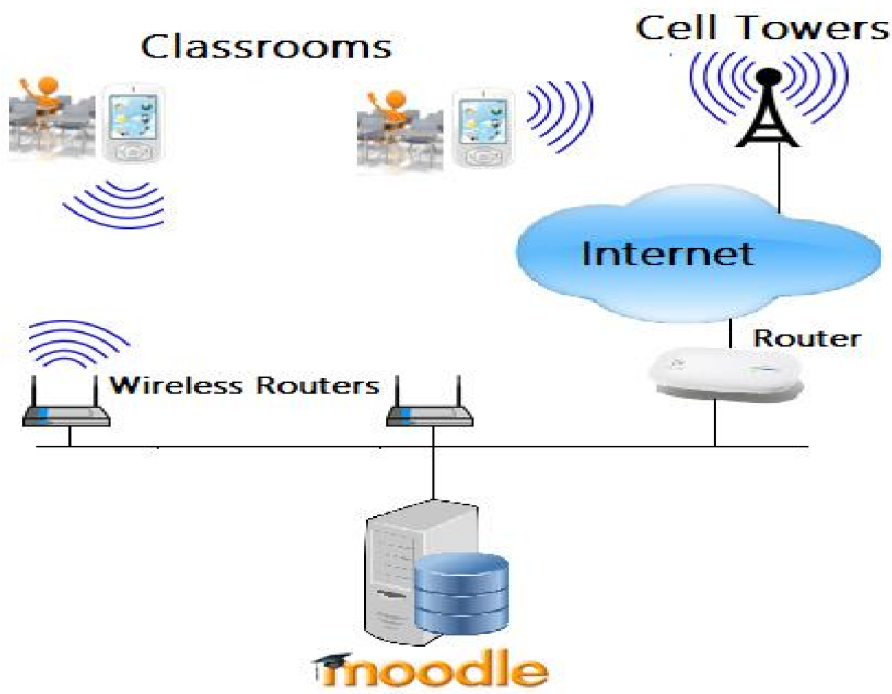


Fig 4.4.1: System Architecture

5 Technologies Used

5.1 FRONT-END

5.1.1 ReactJs:

ReactJS tutorial provides basic and advanced concepts of ReactJS. Currently, ReactJS is one of the most popular JavaScript front-end libraries which has a strong foundation and a large community.

ReactJS is a **declarative, efficient**, and flexible **JavaScript library** for building reusable UI components. It is an open-source, component-based front end library which is responsible only for the view layer of the application. It was initially developed and maintained by Facebook and later used in its products like WhatsApp & Instagram.

Our ReactJS tutorial includes all the topics which help to learn ReactJS. These are ReactJS Introduction, ReactJS Features, ReactJS Installation, Pros and Cons of ReactJS, ReactJS JSX, ReactJS Components, ReactJS State, ReactJS Props, ReactJS Forms, ReactJS Events, ReactJS Animation and many more.

React Features

- i. **JSX** – JSX is JavaScript syntax extension. It isn't necessary to use JSX in React development, but it is recommended.
- ii. **Components** – React is all about components. You need to think of everything as a component. This will help you maintain the code when working on larger scale projects.
- iii. **Unidirectional data flow and Flux** – React implements one-way data flow which makes it easy to reason about your app. Flux is a pattern that helps keeping your data unidirectional.
- iv. **License** – React is licensed under the Facebook Inc. Documentation is licensed under CC BY 4.0

React.js Features

- i. React.js is declarative
- ii. React.js is simple
- iii. React.js is component based
- iv. React.js supports server side
- v. React.js is extensive
- vi. React.js is fast
- vii. React.js is easy to learn

5.1.2 React Native

React Native is a JavaScript framework for writing real, natively rendering mobile applications for iOS and Android. It's based on React, Facebook's JavaScript library for building user interfaces, but instead of targeting the browser, it targets mobile platforms. In other words: web developers can now write mobile applications that look and feel truly “native,” all from the comfort of a JavaScript library that we already know and love. Plus, because most of the code you write can be shared between platforms, React Native makes it easy to simultaneously develop for both Android and iOS.

Similar to React for the Web, React Native applications are written using a mixture of JavaScript and XML-esque markup, known as JSX. Then, under the hood, the React Native “bridge” invokes the native rendering APIs in Objective-C (for iOS) or Java (for Android). Thus, your application will render using real mobile UI components, *not* webviews, and will look and feel like any other mobile application. React Native also exposes JavaScript interfaces for platform APIs, so your React Native apps can access platform features like the phone camera, or the user's location.

React Native currently supports both iOS and Android, and has the potential to expand to future platforms as well. In this book, we'll cover both iOS and Android. The vast majority of the code we write will be cross-platform. And yes: you can really use React Native to build production-ready mobile applications! Some anecdota: Facebook, Palantir, and Task Rabbit are already using it in production for user-facing applications

React Native Features

Following are the features of React Native –

- i. **React** – This is a Framework for building web and mobile apps using JavaScript.
- ii. **Native** – You can use native components controlled by JavaScript.
- iii. **Platforms** – React Native supports IOS and Android platform

5.1.3 JSX

JSX stands for JavaScript XML. It is simply a syntax extension of JavaScript. It allows us to directly write HTML in React (within JavaScript code). It is easy to create a template using JSX in React, but it is not a simple template language instead it comes with the full power of JavaScript. It is faster than normal JavaScript as it performs optimizations while translating to regular JavaScript. Instead of separating the mark up and logic in separated files, React uses components for this purpose. We will learn about components in detail in further articles.

React embraces the fact that rendering logic is inherently coupled with other UI logic: how events are handled, how the state changes over time, and how the data is prepared for display.

Instead of artificially separating technologies by putting markup and logic in separate files, React separates concerns with loosely coupled units called “components” that contain both. We will come back to components in a further section, but if you’re not yet comfortable putting markup in JS, this talk might convince you otherwise.

React doesn’t require using JSX, but most people find it helpful as a visual aid when working with UI inside the JavaScript code. It also allows React to show more useful error and warning messages

Characteristics of JSX:

- i. JSX is not mandatory to use there are other ways to achieve the same thing but using JSX makes it easier to develop react application.
- ii. JSX allows writing expression in { }. The expression can be any JS expression or React variable.
- iii. To insert a large block of HTML we have to write it in a parenthesis i.e, ().
- iv. JSX produces react elements.
- v. JSX follows XML rule.
- vi. After compilation, JSX expressions become regular JavaScript function calls.
- vii. JSX uses camel case notation for naming HTML attributes. For example, tab index in HTML is used as tab Index in JSX.

5.2 BACK-END

5.2.1 Firebase:

The Firebase Real time Database is a cloud-hosted database in which data is stored as JSON. The data is synchronized in real-time to every connected client. All of our clients share one Realtime Database instances and automatically receive updates with the newest data, when we build cross-platform applications with our iOS, and JavaScript SDKs.

The Firebase Realtime Database is a NoSQL database from which we can store and sync the data between our users in real-time. It is a big JSON object which the developers can manage in real-time. By using a single API, the Firebase database provides the application with the current value of the data and updates to that data. Real-time syncing makes it easy for our users to access their data from any device, be it web or mobile.

The Realtime database helps our users collaborate with one another. It ships with mobile and web SDKs, which allow us to build our app without the need for servers. When our users go offline, the Real-time Database SDKs use local cache on the device for serving and storing changes. The local data is automatically synchronized, when the device comes online.

Key capabilities

1. A Real-time database is capable of providing all offline and online services. These capabilities include accessibility from the client device, scaling across multiple databases, and many more.
2. Real-time: The Firebase Real-time database uses data synchronization instead of using HTTP requests. Any connected device receives the updates within milliseconds. It doesn't think about network code and provides collaborative and immersive experiences.
3. Offline: The Firebase Database SDK persists our data to disk, and for this reason, Firebase apps remain responsive even when offline. The client device receives the missed changes, once connectivity is re-established.
4. Accessible from client devices: There is no need for an application server to access the Firebase Real-time database. We can access it directly from a mobile device or web browser. Data validation and security are available through the Firebase Real-time Database Security Rules, expression-based rules executed when data is read or written.
5. Scaling across multiple databases: With the Firebase Real-time Database on Blaze Pricing Plan, we can support the data needs of our app by splitting our data across multiple database instances in a single Firebase project. Streamline authentication with Firebase authentication on our project and authenticate users in our database instances. Controls access to data in each database with custom Firebase real-time database rules available for each database instance.

6 **Testing**

6.1 **Unit Testing**

Unit testing involves the testing of each unit or an individual component of the software application. It is the first level of functional testing. The aim behind unit testing is to validate unit components with its performance.

A unit is a single testable part of a software system and tested during the development phase of the application software.

The purpose of unit testing is to test the correctness of isolated code. A unit component is an individual function or code of the application. White box testing approach used for unit testing and usually done by the developers.

Whenever the application is ready and given to the Test engineer, he/she will start checking every component of the module or module of the application independently or one by one, and this process is known as **Unit testing** or **components testing**.

Objective of Unit Testing:

The objective of Unit Testing is:

1. To isolate a section of code.
2. To verify the correctness of code.
3. To test every function and procedure.
4. To fix bug early in development cycle and to save costs.
5. To help the developers to understand the code base and enable them to make changes quickly.
6. To help for code reuse.

6.2 Integration Testing

Integration testing is done to test the modules/components when integrated to verify that they work as expected i.e. to test the modules which are working fine individually does not have issues when integrated.

When talking in terms of testing large application using black box testing technique, involves the combination of many modules which are tightly coupled with each other. We can apply the Integration testing technique concepts for testing these types of scenarios

Integration testing is the second level of the software testing process comes after unit testing. In this testing, units or individual components of the software are tested in a group. The focus of the integration testing level is to expose defects at the time of interaction between integrated components or units.

Unit testing uses modules for testing purpose, and these modules are combined and tested in integration testing. The Software is developed with a number of software modules that are coded by different coders or programmers. The goal of integration testing is to check the correctness of communication among all the modules.

Integration Strategies:

1. Big-Bang Integration
2. Top Down Integration
3. Bottom Up Integration
4. Hybrid Integration

6.3 White Box Testing

The box testing approach of software testing consists of black box testing and white box testing. We are discussing here white box testing which also known as glass box is testing, structural testing, clear box testing, open box testing and transparent box testing. It tests internal coding and infrastructure of a software focus on checking of predefined inputs against expected and desired outputs. It is based on inner workings of an application and revolves around internal structure testing. In this type of testing programming skills are required to design test cases. The primary goal of white box testing is to focus on the flow of inputs and outputs through the software and strengthening the security of the software.

The term 'white box' is used because of the internal perspective of the system. The clear box or white box or transparent box name denote the ability to see through the software's outer shell into its inner workings.

Developers do white box testing. In this, the developer will test every line of the code of the program. The developers perform the White-box testing and then send the application or the software to the testing team, where they will perform the black box testing and verify the application along with the requirements and identify the bugs and sends it to the developer.

The developer fixes the bugs and does one round of white box testing and sends it to the testing team. Here, fixing the bugs implies that the bug is deleted, and the particular feature is working fine on the application

The white box testing contains various tests, which are as follows:

1. Path testing
2. Loop testing
3. Condition testing
4. Testing based on the memory perspective
5. Test performance of the program

6.4 Black Box Testing

Black box testing is a technique of software testing which examines the functionality of software without peering into its internal structure or coding. The primary source of black box testing is a specification of requirements that is stated by the customer.

In this method, tester selects a function and gives input value to examine its functionality, and checks whether the function is giving expected output or not. If the function produces correct output, then it is passed in testing, otherwise failed. The test team reports the result to the development team and then tests the next function. After completing testing of all functions if there are severe problems, then it is given back to the development team for correction.

Generic steps of black box testing

1. The black box test is based on the specification of requirements, so it is examined in the beginning.
2. In the second step, the tester creates a positive test scenario and an adverse test scenario by selecting valid and invalid input values to check that the software is processing them correctly or incorrectly.
3. In the third step, the tester develops various test cases such as decision table, all pairs test, equivalent division, error estimation, cause-effect graph, etc.
4. The fourth phase includes the execution of all test cases.
5. In the fifth step, the tester compares the expected output against the actual output.
6. In the sixth and final step, if there is any flaw in the software, then it is cured and tested again.

6.5 System Testing

System Testing includes testing of a fully integrated software system. Generally, a computer system is made with the integration of software (any software is only a single element of a computer system). The software is developed in units and then interfaced with other software and hardware to create a complete computer system. In other words, a computer system consists of a group of software to perform the various tasks, but only software cannot perform the task; for that software must be interfaced with compatible hardware. System testing is a series of different type of tests with the purpose to exercise and examine the full working of an integrated software computer system against requirements

System testing falls under Black box testing as it includes testing of the external working of the software. Testing follows user's perspective to identify minor defects.

System Testing includes the following steps.

1. Verification of input functions of the application to test whether it is producing the expected output or not.
2. Testing of integrated software by including external peripherals to check the interaction of various components with each other.
3. Testing of the whole system for End to End testing.
4. Behavior testing of the application via a user's experience

7. Form Design

7.1 Input / Output Form (Screenshot)

7.1.1 Student

7.1.2 Faculty

The Faculty will log in by entering the Username and Password which they were already provided by the institutes.

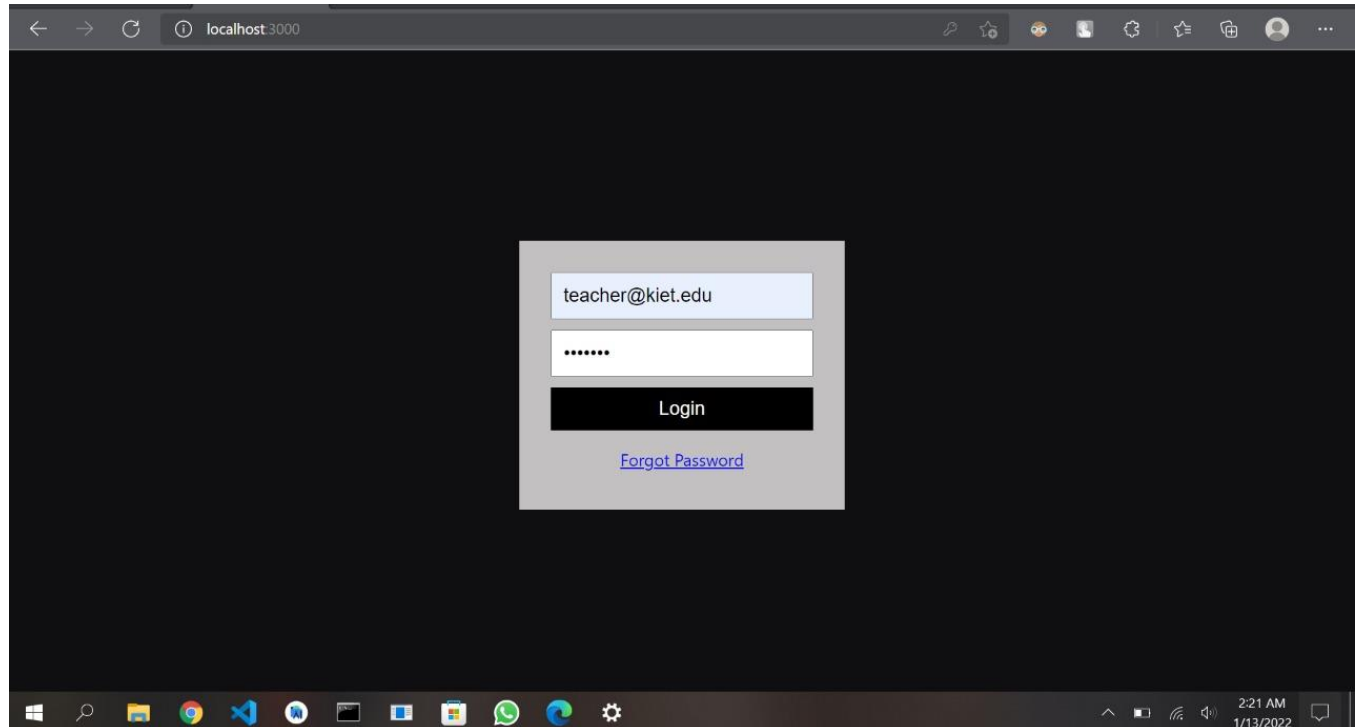
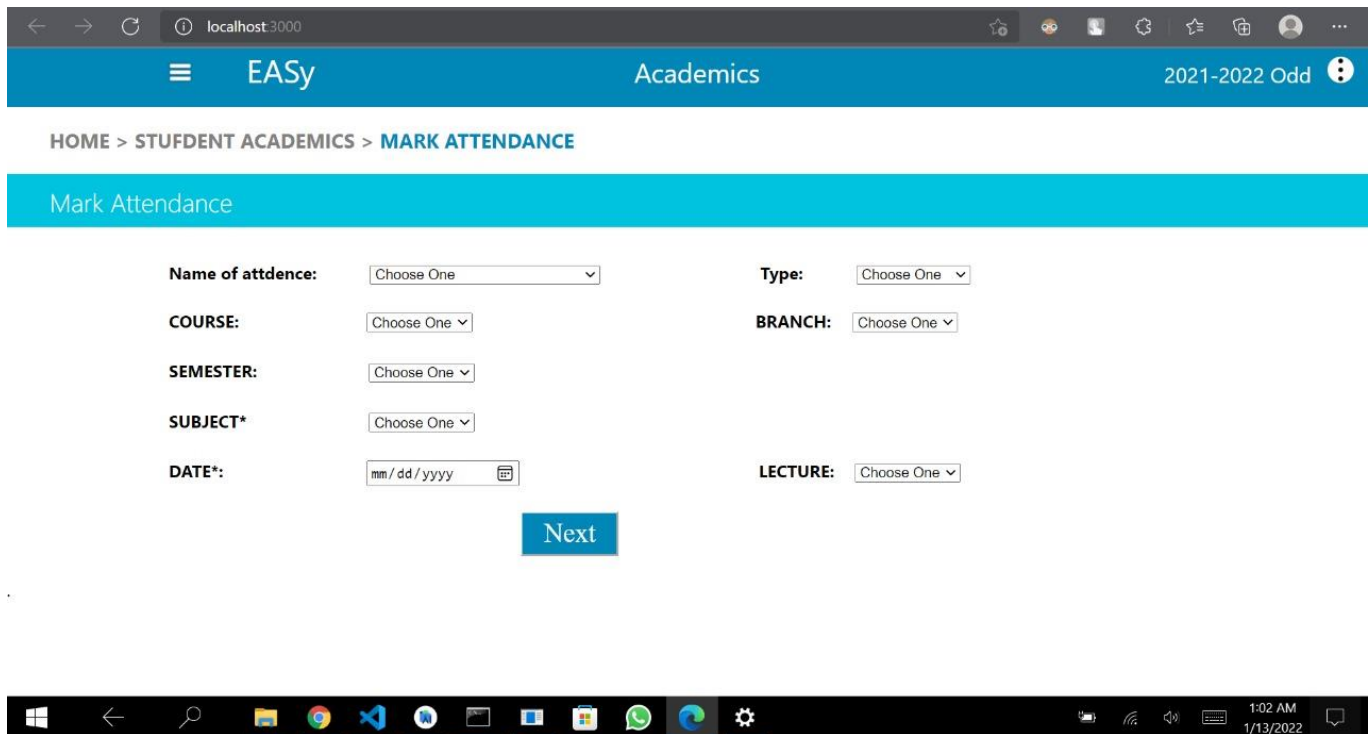


Fig 7.1.2.1. Faculty Login

After login, faculty can access the dashboard to generate QR code.



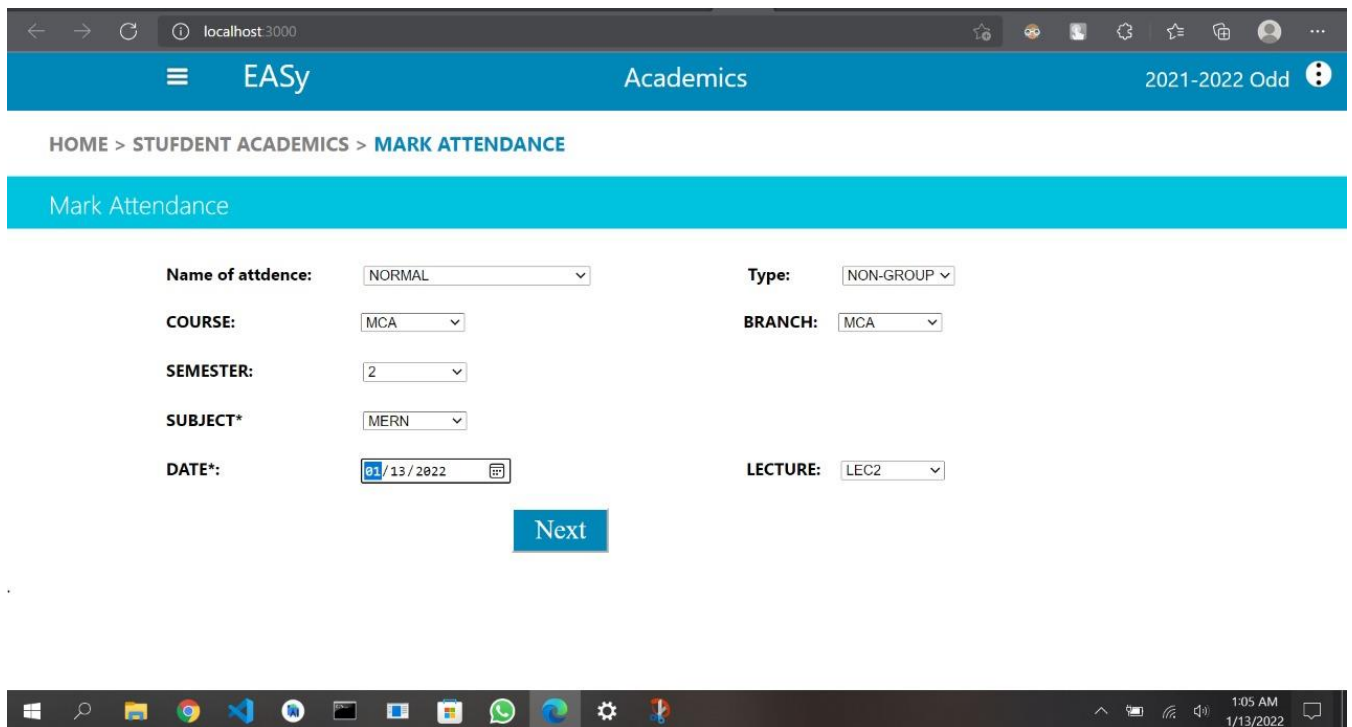
The screenshot shows a web browser at localhost:3000 displaying the EASy Academics dashboard. The top navigation bar is blue with the EASy logo, 'Academics' text, and '2021-2022 Odd' with a user profile icon. Below the navigation bar is a breadcrumb trail: 'HOME > STUFDENT ACADEMICS > MARK ATTENDANCE'. The main content area has a light blue header 'Mark Attendance'. The form contains the following fields:

- Name of attndence:** Choose One
- Type:** Choose One
- COURSE:** Choose One
- BRANCH:** Choose One
- SEMESTER:** Choose One
- SUBJECT*:** Choose One
- DATE*:** mm/dd/yyyy
- LECTURE:** Choose One

A blue 'Next' button is located below the form fields.

Fig 7.1.2.2: Dashboard

Then, faculty has to select the course, and all other details for the QR Code to be displayed on the screen.



This screenshot shows the same 'Mark Attendance' form as the previous one, but with specific values selected in the dropdown menus:

- Name of attndence:** NORMAL
- Type:** NON-GROUP
- COURSE:** MCA
- BRANCH:** MCA
- SEMESTER:** 2
- SUBJECT*:** MERN
- DATE*:** 01/13/2022
- LECTURE:** LEC2

The blue 'Next' button remains at the bottom of the form.

Fig 7.1.2.3: Dashboard

After entering all the details to generate QR code, QR code will be generated for the students to mark their attendance by scanning it.

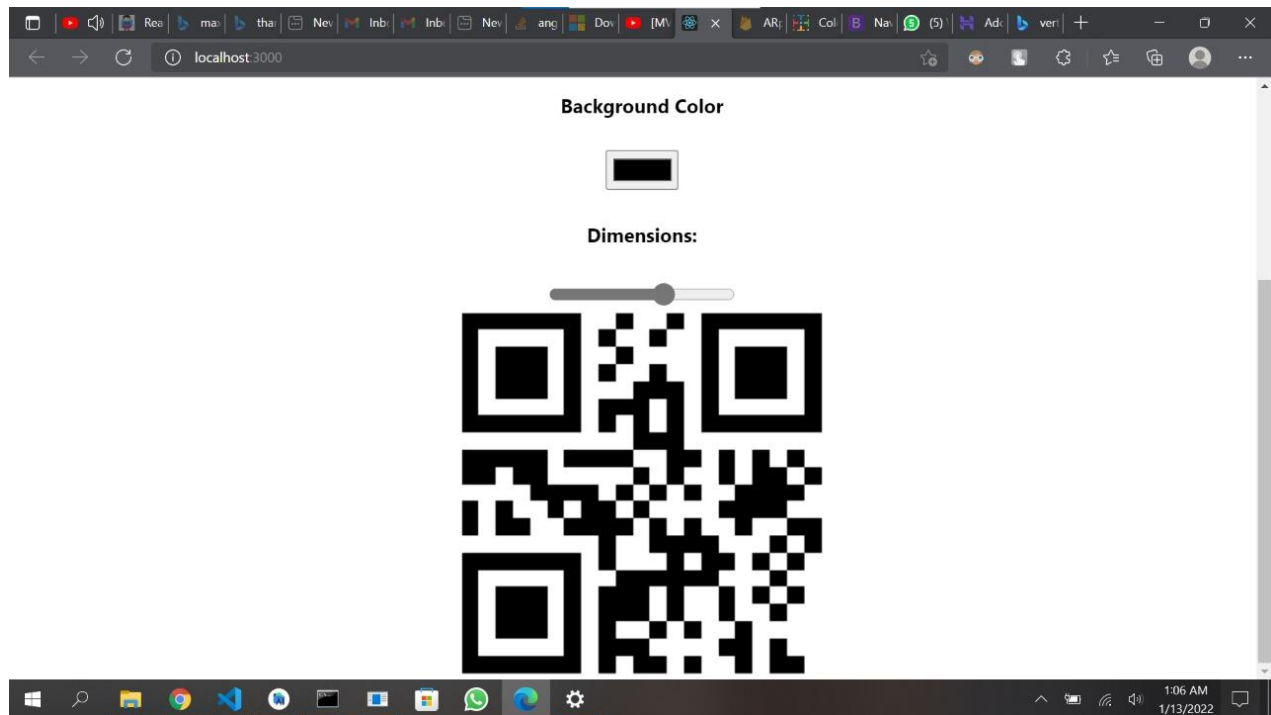


Fig 7.1.2.4. Generated QR code

Faculty can also access the database, to know about whether students get marked or not.

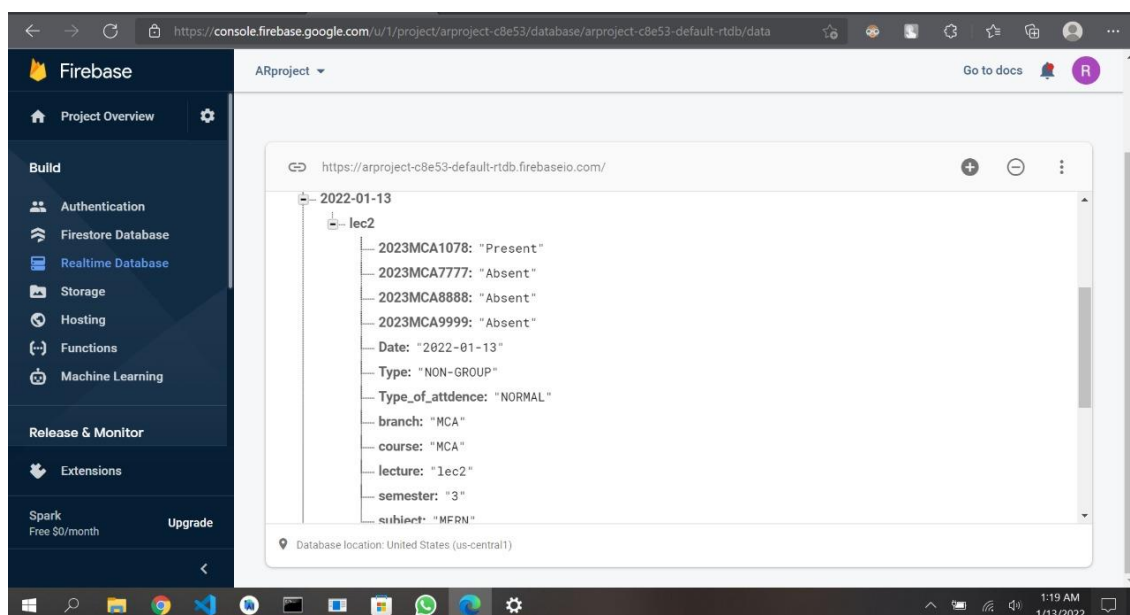


Fig 7.1.2.5: RealTime Database

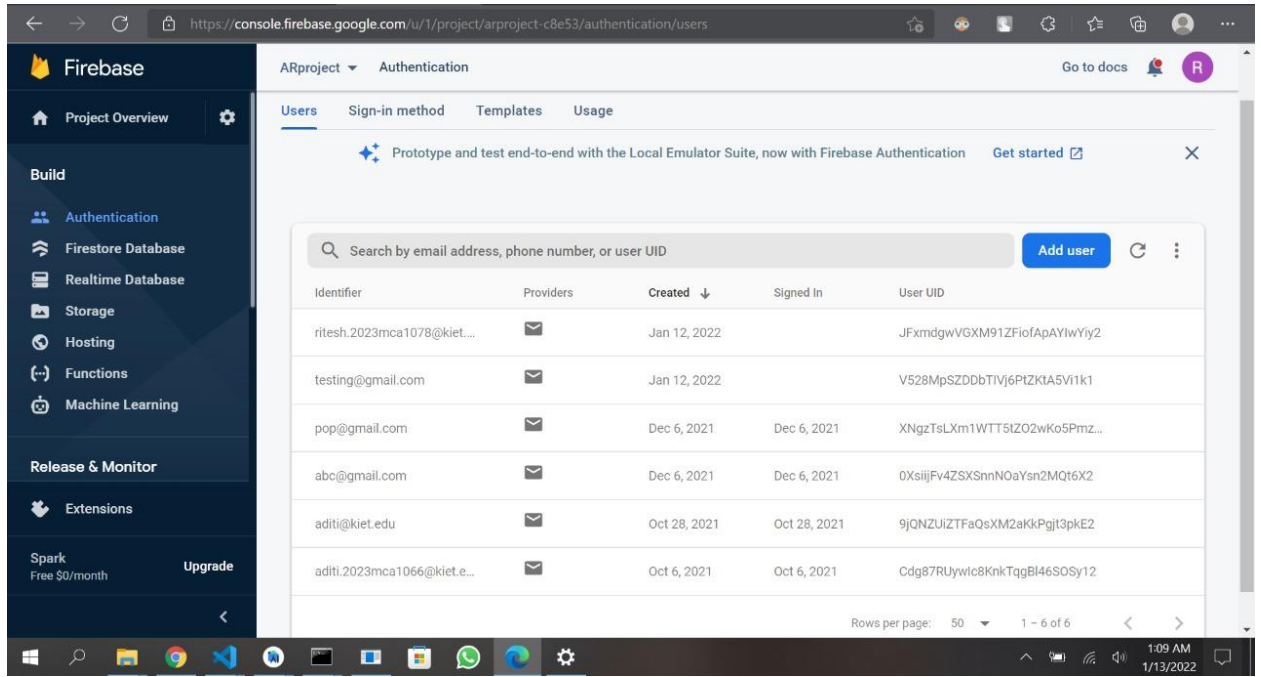


Fig 7.1.2.6: Authentication Database

8. Test cases

Test Case Id	Component	Priority	Test cases	Description/Test Summary	Pre-requisites	Test Steps	Expected Result	Actual Result	Status	Test E
TC01	Registration	p10	TC01.1	To verify that when a user enters an unregistered email address and presses enter, an OTP must be sent to that email and a page should open that will ask the user to enter the OTP(One Time Password).	ELP website must be open.	1. Click on the register option. 2. Once the registration page is launched, enter a valid and unregistered email address. 3. Press enter	An OTP should be sent to the entered email address and next page should be launched where the user needs to enter the	An OTP sent to the entered email address and next page launched where the user needs to enter the OTP.	Pass	
			TC01.2	To verify that when a user enters an already registered email address then an error message should pop up saying "Account already exists, login instead".	A registered email address and ELP website must be open.	1. Click on the register option. 2. Once the registration page is launched, enter an already registered email address. 3. Press enter	An error message should pop up saying "Account already exists, login instead".	An error message pops up saying "Account already exists, login instead".	Pass	
			TC01.3	To verify that when a user enters an invalid email address then an error message should pop up saying "Enter a valid email address".	ELP website must be open.	1. Click on the register option. 2. Once the registration page is launched, enter an invalid email address. 3. Press enter	An error message should pop up saying "Enter a valid email address".	An error message pops up saying "Enter a valid email address".	Pass	
			TC02.1	To verify that when a user enters a registered email address and presses enter, next page should be launched where the user	ELP website must be open.	1. Click on the Login option. 2. Once the Login page is launched, enter a registered email address. 3. Press enter	Next page should be launched where the user needs to enter the	Next page launched to enter the password.	Pass	

02	Login	p10	TC02.1	To verify that when a user enters a registered email address and presses enter, next page should be launched where the user needs to enter the password.	ELP website must be open.	1. Click on the Login option. 2. Once the Login page is launched, enter a registered email address. 3. Press enter	Next page should be launched where the user needs to enter the password.	Next page launched to enter the password.	Pass	
			TC02.2	To verify that when a user enters an unregistered email address and presses enter, an error message must pop up saying "No such account found, SignUp instead".	ELP website must be open.	1. Click on the Login option. 2. Once the Login page is launched, enter an unregistered email. 3. Press enter	An error message should pop up saying "No such account found, Login instead."	An error message pops up saying "No such account found, Login instead."	Pass	
			TC02.3	To verify that when a user enters an invalid email address and presses enter, an error message must pop up saying "Enter a valid email address".	ELP website must be open.	1. Click on the Login option. 2. Once the Login page is launched, enter an invalid email. 3. Press enter	An error message should pop up saying "Enter a valid email address."	An error message pops up saying "Enter a valid email address."	Pass	
03	Search_Bar_Module	P5	TC03.1	To verify that when a user writes a search term and presses enter, search results should be displayed.	ELP website must be open.	1. Write the write the name of the course or subject in the search bar. 2. Press enter	Search results related to the searched term should be displayed	Search results with 'searched term' keywords are displayed.	Pass	

9. Bibliography

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2. www.javatpoint.com
3. www.tutorialporint.com
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5. [file:///C:/Users/Aditi%20Srivastava/Downloads/Paper_10-A_Students_Attendance_System_Using_QR_Code%20\(1\).pdf](file:///C:/Users/Aditi%20Srivastava/Downloads/Paper_10-A_Students_Attendance_System_Using_QR_Code%20(1).pdf)