

# **ATTENDANCE MANAGEMENT SYSTEM**

**BY**

**SHAH FAHAD  
SHERYAR JAVED  
SALMAN KHAN**

*Thesis submitted to The University of Swabi, Khyber Pakhtunkhwa, in partial fulfillment of the  
requirements for the degree of*

**BACHELOR OF SCIENCE IN COMPUTER SCIENCE**



**DEPARTMENT OF COMPUTER SCIENCE  
THE UNIVERSITY OF SWABI,  
KHYBER PAKHTUNKHWA, PAKISTAN,  
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**DEPARTMENT OF COMPUTER SCIENCE  
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This project has been a labor of love and dedication. We would like to express our gratitude to everyone who played a part, no matter how small, in helping us reach the culmination of this journey.

## **ABSTRACT**

The Attendance Management System presents a comprehensive and efficient software solution, meticulously crafted to revolutionize the attendance tracking process within a university setting. In an era that demands efficiency and precision, this system replaces the traditional, error-prone manual methods of attendance recording with a modern, reliable, and user-centric digital platform. Designed to provide a seamless experience for both students and faculty, it not only curtails the possibility of attendance manipulation but also encourages students to take ownership of their attendance records. Faculty members, on the other hand, find a valuable ally in the form of a centralized dashboard, allowing them to effortlessly access attendance data. The system's automated alerts help identify students with subpar attendance or those in danger of academic underperformance, facilitating timely interventions to support struggling learners. Furthermore, it generates comprehensive attendance reports, empowering faculty and administrators to make informed, data-driven decisions.

### INTRODUCTION

In today's rapidly evolving educational landscape, efficient management of student attendance has emerged as a pivotal concern for universities worldwide. Universities are not just centers of knowledge dissemination but also hubs of diverse activities, making it imperative to monitor and manage attendance effectively. Traditional paper-based attendance systems have proven to be cumbersome, prone to errors, and incapable of meeting the dynamic demands of contemporary higher education institutions.

#### **Project Overview / Background**

##### **1.1 Problem with manual system and feasibility of online system.**

The Attendance Management System (AMS) project represents a pioneering response to these challenges. In an era characterized by digital transformation and data-driven decision-making, this system aims to harness technology's power to streamline and enhance attendance tracking processes within universities. It promises to not only automate attendance recording but also to provide valuable insights into student engagement, ultimately contributing to improved educational outcomes.

This thesis explores the development, implementation, and impact assessment of the Attendance Management System within the context of a typical university. It delves into the key drivers behind the system's inception, the methodologies employed in its creation, the technological infrastructure supporting its operation, and the tangible benefits it brings to both students and academic institutions.

The importance of this research cannot be overstated. Reliable and efficient attendance management is not only crucial for ensuring that students receive the education they deserve but also for assisting universities in optimizing their resources and refining their educational strategies. The AMS project, therefore, represents a significant step towards the realization of these goals.

The project can be considered as technically feasible, since the whole system is designed into the latest technologies such as ReactJS, Tailwind CSS, NodeJS, ExpressJS, and MongoDB cloud which are the most used and recent technologies to develop web-based systems and design databases. This proposed project also has Behavioral feasibility as the system is providing an attractive user interface to the operator/end user which makes the user feel easy and fast to work.

##### **1.2 Project Scope**

The scope of this thesis encompasses a comprehensive investigation into the development, implementation, and evaluation of the Attendance Management System (AMS) within the context of a university setting. It includes the following key areas of focus:

**1. System Development:** This thesis outlines the complete process of designing and developing the Attendance Management System, including the selection of appropriate technologies, databases, and

programming languages. It provides insights into the system's architecture, modules, and features, demonstrating how it effectively automates attendance tracking.

**2. Implementation:** The scope encompasses the deployment of the AMS within a university environment. This involves the installation of necessary hardware and software components, customization to suit the specific needs of the institution, and integration with existing university systems, such as student databases and learning management systems.

**3. Data Management:** The thesis explores the methodologies employed for capturing, storing, and processing attendance data. This includes discussions on data security measures, data validation techniques, and data integration with other university systems.

**4. User Interfaces:** It covers the design and development of user interfaces for various stakeholders, including students, faculty members, and administrators. This involves the creation of user-friendly dashboards and reports for real-time monitoring of attendance.

**5. Data Analysis and Reporting:** This project's scope includes the analysis of attendance data to derive meaningful insights into student engagement and participation trends. It covers the generation of reports and visualizations to aid decision-making at the university level.

**7. Impact Assessment:** The thesis assesses the impact of the Attendance Management System on various aspects of university operations, including student success, faculty workload, and administrative efficiency. It evaluates how the system contributes to the achievement of institutional goals.

**8. Challenges and Limitations:** The project acknowledges, and addresses challenges faced during system development and implementation. It outlines the limitations of the AMS and proposes potential areas for future enhancements.

### **1.3 Software Module**

Software Module is website application which has some following components:

- Authentication
- User Management
- Teacher and Student Management
- Batch and Semester Management
- Subject Management
- Attendance Tracking
- Email Alerts

### **1.4 Hardware Module**

Hardware module uses the following hardware components for its operations:

- Web server



- Database server
- Email server
- User device with internet connection

## 1.6 Tools / Technology

### 1.6.1 Frontend (Client-Side)

**React:** React is a JavaScript library that serves as the core of our user interface. It's designed for building interactive and dynamic user interfaces for web applications. React uses a component-based architecture, which allows us to create reusable, self-contained UI elements that update and render efficiently.

**React Router:** React Router is an essential tool that we utilize for managing client-side routing in our single-page application. It enables us to create a smooth and seamless navigation experience for users, ensuring that different parts of our application can be displayed without requiring full page reloads.

**Axios:** Axios is a widely used JavaScript library for making HTTP requests to the server. In our project, we relied on Axios to handle the communication between our frontend and backend, facilitating the retrieval and submission of data. It's a versatile and efficient tool for managing server interactions.

**HTML/CSS:** HTML (Hypertext Markup Language) and CSS (Cascading Style Sheets) are fundamental technologies for structuring and styling the frontend of our application. HTML provides the structure and content of web pages, while CSS is responsible for the visual presentation, including layout, colors, and fonts.

**TailwindCSS:** TailwindCSS is a popular CSS library that simplifies the process of creating responsive designs and UI components. It provides a utility-first approach, enabling us to style elements using pre-defined classes, which accelerates development and maintains consistency in design.

**JavaScript/ES6:** JavaScript is the primary programming language for frontend development. We specifically used ES6 (ECMAScript 6), which is an updated version of JavaScript with modern features. It allowed us to write more readable and maintainable code, enhancing the functionality and performance of our application.

### 1.6.2 Backend

**Node.js:** Node.js is a runtime environment that allows us to execute JavaScript on the server-side. In our project, Node.js is the foundation of our backend, enabling us to build and run server-side code that interacts with databases, handles HTTP requests, and supports the overall functionality of the system.

**Express.js:** Express.js is a web application framework built on top of Node.js. It simplifies the process of building web applications and APIs. In our project, we used Express.js to create RESTful APIs, define routes, handle HTTP requests and responses, and manage middleware for tasks such as authentication and authorization.

**MongoDB:** MongoDB is a NoSQL database system used for storing a variety of data, including user profiles, attendance records, and other application-related information. It is known for its flexibility and scalability, making it well-suited for managing structured and unstructured data in our project.

**Mongoose:** Mongoose is an Object Data Modeling (ODM) library designed for working with MongoDB in a Node.js environment. It simplifies data validation, query building, and interaction with the MongoDB database, helping us efficiently manage our data and define data models.

**Nodemailer** (for email functionality): Nodemailer is a library we used for implementing email functionality within our system. It enables us to send email verification and password reset emails, enhancing the security and usability of our application by providing essential communication features.

**JSON Web Tokens (JWT):** JSON Web Tokens are a crucial part of our user authentication and authorization process. JWTs are used to securely transmit user identity information between the client and server, ensuring that authenticated users can access protected routes and services.

**Bcrypt.js:** Bcrypt.js is a library that we integrated into our system for password security. It hashes and salts user passwords before storing them in the database, enhancing the security of user data and protecting it from potential breaches.

**Node.js packages (NPM):** NPM is the package manager for Node.js that we used for managing project dependencies and scripts. It simplifies the process of installing and updating the libraries and tools that our project relies on, ensuring that the system operates smoothly and securely.

### 1.6.3 Database

**MongoDB:** The NoSQL database system.

**MongoDB Compass:** A graphical tool for managing and interacting with MongoDB databases.

In our database we have created four collections.

1. Users
2. Batches
3. Semesters
4. Subjects
5. Attendances

#### 1. Users:

User collection will contain all the users who use the websites. Users will have four types of roles, super-admin, department admin, teacher and student. Each user will have a name, email, password. Teachers will have a department id while students will have a batch id.

#### 2. Batches:

Batches collection will have all the batches created in the website. Each batch will have a department id, name and batch code. Batch code will be used for students to sign up.

#### 3. Semesters:

Semesters collections will have all the semesters created inside batches. Each semester will have a name and batch id.

#### **4. Subjects:**

Subjects' collection will have all the subjects created inside semesters. Each subject will have a name, semester id, teacher id. Teacher id will have the id of the teacher the subject is assigned to.

#### **5. Attendances:**

Attendances collection will have all the attendances taken in subjects. Each attendance will have an id, date, subject id and marked by fields. Marked by will indicate which teacher has taken the attendance.

### **1.6.4 Server Hosting and Deployment**

#### **Vercel:**

Vercel served as our hosting and deployment platform for the web application. It's a cloud platform known for its simplicity and efficiency. We chose Vercel due to its seamless deployment process, integration with version control systems, and global content delivery network, ensuring that our application is delivered quickly to users worldwide. Vercel's scalability and reliability make it an excellent choice for hosting and deploying our system, enabling us to handle increasing user loads while maintaining high availability.

### **1.6.5 Email Service**

#### **SMTP Service (Gmail):**

To handle email functionality, we relied on Gmail's Simple Mail Transfer Protocol (SMTP) service. We used it for sending verification and password reset emails to users. Gmail's SMTP service is widely trusted and reliable, ensuring that important email communications, which are integral to our system, are sent and received securely and promptly.

### **1.6.6 Development Tools**

#### **Visual Studio Code:**

Visual Studio Code served as our primary code editor for both front-end and backend development. It's a versatile and highly customizable code editor that offers a rich set of features, extensions, and integrations, making it a popular choice among developers for efficient coding and debugging.

#### **Postman:**

Postman is an invaluable tool that we used for testing our API endpoints. It simplifies the process of sending requests to the API, inspecting responses, and troubleshooting any issues. Postman streamlines API development and testing, ensuring that our endpoints function correctly.

#### **Chrome DevTools:**

Chrome DevTools were essential for debugging and testing the frontend of our application. They provide a suite of web development and debugging tools within the Google Chrome browser, enabling us to

inspect and manipulate the DOM, test JavaScript, and analyze network activity, resulting in a smoother and error-free user experience.

## **1.7 Risk Involved**

The successful implementation of the Attendance Management System project is not without its share of potential risks, which we must carefully consider:

### **1.7.1 Internet Unavailability**

The system's functionality heavily relies on a stable internet connection. Without access to the internet, users may face limitations in interacting with the system. This risk can disrupt attendance tracking and related activities, potentially leading to data inaccuracies and user dissatisfaction.

### **1.7.2 User Adoption and Training Risks**

Introducing a new system, even one as user-friendly as our Attendance Management System, may pose challenges related to user adoption and training. Inadequate user training and support may result in users finding it difficult to adapt to the new system. This can lead to user frustration, errors in attendance tracking, and resistance to system adoption.

### **1.7.3 Web Server Risk**

The choice of a web server is pivotal to the system's performance and availability. Opting for a cheaper or free web server, which may not have a robust infrastructure, exposes the system to potential downtime and performance issues. The implications include system unavailability, service disruption, and a negative impact on the user experience. Therefore, it's crucial to select a reputable and stable web hosting provider.

### **1.7.4 Data Backup Risks**

Data loss is a critical risk in any system. Without frequent and reliable data backups, the system is vulnerable to potential data loss due to various factors, such as hardware failures, software errors, or security breaches. Data loss can result in the irrevocable disappearance of attendance records and user data, leading to significant setbacks in attendance management. To mitigate this risk, a robust data backup and recovery strategy is essential.

### **1.7.5 Budget Risks**

Budget management is a critical consideration for the project. There is a risk of exceeding the allocated budget, particularly in terms of maintenance, hosting costs, and system enhancements. Budget risks can strain project finances, potentially leading to complications in maintaining and scaling the system. Careful budget planning and monitoring are necessary to mitigate these risks effectively.

### REVIEW OF LITERATURE

The literature review in this thesis serves as the cornerstone for the research and development of the Attendance Management System. In this chapter, we embark on a comprehensive exploration of the existing body of knowledge related to attendance management, user roles, and the technologies utilized in similar systems. Our overarching aim is to establish a robust and well-informed foundation for grasping the context of the project, identifying critical gaps in the contemporary landscape, and substantiating the necessity of our system.

#### 2.1 Historical Context of Attendance Management

Attendance tracking, as a practice, has a rich historical background that spans several centuries. This section aims to provide a historical backdrop, tracing the evolution of attendance management from manual paper-based methods to modern digital solutions. Understanding the historical context is pivotal for appreciating the significance of attendance management in contemporary educational and organizational settings.

We delve into historical attendance ledgers, early classroom registers, and the emergence of punch-card systems in the 19th century. The transition to digital attendance recording and the subsequent integration of biometric systems further mark significant milestones in the history of attendance management.

#### 2.2 Existing Attendance Management Systems

Our journey through literature unveils a landscape dotted with various attendance management systems. In this section, we offer an extensive exploration of some noteworthy systems. The goal is to dissect their key features, the technologies they employ, and, perhaps most significantly, the areas where they can be improved or extended.

##### 2.2.1 System A

**Features:** System A primarily focuses on rudimentary attendance tracking for students, concentrating on individual course attendance and basic reporting.

**Technology Stack:** The system relies on a traditional LAMP (Linux, Apache, MySQL, PHP) stack, particularly PHP for the backend and MySQL as the database.

**Limitations:** Notably, this system lacks robust support for user roles and struggles with scalability, which hinders its application in larger educational institutions.

##### 2.2.2 System B

**Features:** System B represents a more comprehensive approach, allowing attendance tracking for both students and teachers. The system boasts reporting capabilities and data analysis features.

**Technology Stack:** In its architecture, System B adopts a combination of Java for the backend and Oracle as the primary database system.

**Limitations:** While feature-rich, the complexity of the Java-Oracle combination presents a steep learning curve, making it daunting for smaller educational institutions to effectively implement and employ.

### 2.2.3 System C

**Features:** System C stands out for its user-friendly interface, catering to the needs of both students and teachers. It implements role-based access control, supporting multiple user types and their unique privileges.

**Technology Stack:** This modern system is constructed on the MERN stack, harnessing the power of MongoDB for database management, Express.js for the backend, React for the frontend, and Node.js as the runtime environment.

**Advantages:** System C serves as an illustrative example of the potential of utilizing the MERN stack to craft scalable, user-friendly attendance management systems.

## 2.4 User Roles in Attendance Management

For the seamless design of our system, comprehending the dynamics of the user roles involved in attendance management is pivotal. In this section, we delve into the multifaceted roles of students, teachers, department administrators, and super administrators within the framework of attendance management. A detailed examination is undertaken to elucidate the specific responsibilities, privileges, and expectations associated with each role.

### 2.3.1 Students

**Responsibilities:** Students are primarily responsible for maintaining accurate records of their attendance and ensuring that they attend classes regularly.

**Privileges:** In the context of our system, students are endowed with the privilege to view their attendance records, receive notifications, and request leave for justified absences.

**Expectations:** Students are expected to actively engage with the system, accurately marking their attendance and promptly reporting any discrepancies.

### 2.3.2 Teachers

**Responsibilities:** Teachers play a central role in attendance management, responsible for recording attendance, tracking the progress of their students, and providing relevant input.

**Privileges:** In our system, teachers can view attendance records for their subjects, report any anomalies, and take attendance during classes.

**Expectations:** Teachers are expected to actively and accurately record attendance, promptly report any issues, and utilize the system as a tool for enhancing student engagement and performance.

### 2.3.3 Department Administrators

**Responsibilities:** Department administrators oversee the management of attendance data for their respective departments, ensuring accuracy and compliance.

**Privileges:** They are endowed with privileges to manage user accounts, access department-specific data, and generate reports for departmental evaluation.

**Expectations:** Department administrators are expected to maintain the integrity of departmental attendance data and manage user accounts judiciously.

### 2.3.4 Super Administrators

**Responsibilities:** Super administrators exercise administrative authority over the entire system, including user management, system-wide settings, and data security.

**Privileges:** They have unrestricted access to all system features and data, enabling them to oversee and manage the entire system.

**Expectations:** Super administrators are entrusted with the responsibility of system-wide data security, user account management, and overall system governance.

## 2.4 Technologies and Tools

The successful development of our system is underpinned by an array of technologies and tools. This section delves into the technological landscape relevant to attendance management systems:

### 2.4.1 Database Systems

**MongoDB:** A leading NoSQL database system known for its flexibility, scalability, and JSON-like document structure, making it an excellent choice for storing attendance records.

**MySQL:** A traditional relational database management system that remains prevalent in many attendance management systems.

### 2.4.2 Frontend Frameworks

**React:** An acclaimed JavaScript library for building dynamic and responsive user interfaces, offering a versatile platform for constructing an intuitive frontend for the system.

### 2.4.3 Backend Frameworks

**Node.js:** A runtime environment that facilitates server-side application development, characterized by its non-blocking, event-driven architecture, rendering it suitable for high-concurrency applications.

**Express.js:** A minimal and flexible Node.js web application framework, instrumental in setting up the backend infrastructure.

## 2.5 Gaps in Existing Literature

A comprehensive literature review reveals conspicuous gaps that underscore the need for our proposed Attendance Management System:

- **Limited Focus on User-Friendly Interfaces:** Existing systems often lack user-friendly interfaces, which can hinder user adoption and engagement.
- **Inadequate Support for Multiple User Roles:** Many systems do not adequately support multiple user roles and role-based access control, limiting their applicability in diverse educational settings.
- **Limited Use of Modern Technology Stacks:** The industry trend toward modern technology stacks, such as the MERN stack, for building scalable and robust applications is not adequately reflected in many existing systems.
- **Absence of Systems Catering to Educational Institutions:** The review exposes a gap in the domain of systems tailored explicitly for educational institutions.

## **2.6 Conclusion**

The in-depth exploration in this chapter has unearthed a wealth of knowledge concerning attendance management, user roles, and the technological landscape. This literature review is instrumental in setting the stage for the design and development of our envisioned Attendance Management System.



### MATERIALS AND METHODS

In this section, we describe the overall architecture of the Attendance Management System showing all the methods we used to design the system highlighting the separation of the front-end and back-end components.

#### 3.1 System Architecture

##### 3.1.1 Client-Side (Frontend)

The client-side component of the system is the user-facing part responsible for rendering the graphical user interface and handling user interactions. It has been developed using React, a widely used JavaScript library for building interactive and responsive web applications. This component ensures accessibility across various devices, including desktop computers, laptops, tablets, and smartphones.

##### **Key Components:**

**User Interface:** The user interface is meticulously designed to provide an intuitive and user-friendly experience. It features an aesthetically pleasing and easy-to-navigate design, ensuring that users can efficiently interact with the system.

**React Components:** The system's architecture is modular, employing a multitude of reusable React components. This modular approach simplifies development and maintenance, allowing for consistent and efficient design.

**Client-Side Routing:** React Router is utilized for client-side routing, enabling smooth navigation within the application. Users can easily switch between different views and functionalities without full-page reloads.

##### 3.1.2 Server-Side (Backend)

The server-side component serves as the intermediary between the client-side and the database. It is responsible for handling HTTP requests, managing the database, and enforcing secure user authentication and authorization. Developed using Node.js and Express.js, this component forms the core of the system's functionality.

##### **Key Components:**

**API Endpoints:** The system exposes a set of RESTful API endpoints to handle core functions, including user authentication, attendance tracking, and user management. These endpoints are essential for transmitting data between the client-side and the backend.

**Authentication and Authorization:** User authentication is achieved through JSON Web Tokens (JWT). This approach ensures secure user access to system features, with different user roles (Student, Teacher, Department Admin, Super Admin) being defined and validated at this layer.

**Database Interaction:** Mongoose, an Object Data Modeling (ODM) library, is used to interact with the MongoDB database. MongoDB is employed to store a variety of data, including user profiles, attendance records, department information, and other application data. The interaction between the server and the database is facilitated through Mongoose to ensure efficient data handling.

**Email Services:** To enable email notifications for account verification and password reset, the system integrates with Gmail SMTP service. This service is responsible for dispatching email notifications to users, enhancing communication and security within the system.

### 3.2 Data Flow

This section outlines the flow of data within the system, emphasizing the key interactions that occur during user registration, login, and attendance tracking.

#### 3.2.1 User Registration

User registration is the initial interaction in which users create accounts within the system. The process involves the following steps:

- 1. Client-Side Registration:** Students initiate registration on the client-side by providing their personal information. Students are also required to enter batch codes. The provided information is collected through user-friendly forms.
- 2. Data Transmission to the Server:** User data entered on the client-side is transmitted to the server for validation and subsequent storage in the MongoDB database. The server handles data validation to ensure data integrity and consistency.
- 3. Email Verification:** After successful registration, an email verification link is sent to the user's registered email address. This link is an essential part of the security and verification process, ensuring that users can validate their accounts.

#### 3.2.2 User Login

User login is a critical component of the system, enabling users to access their accounts securely. The process involves the following steps:

- 1. Client-Side Login:** Users enter their registered email addresses and passwords on the client-side login interface. The client validates user inputs and transmits this information to the server.
- 2. Authentication on the Server:** The server is responsible for authenticating user credentials. Upon successful authentication, the server generates a JSON Web Token (JWT). This token acts as a secure and efficient means of granting access to the user while protecting sensitive data.
- 3. Token Transmission to the Client:** The generated JWT token is transmitted back to the client, where it is stored securely. The token is used for subsequent secure access to the system, eliminating the need for repetitive logins.

### 3.2.3 Attendance Tracking

Attendance tracking is a fundamental feature of the system, facilitating the recording and viewing of attendance records for both teachers and students. The data flow for attendance tracking involves the following steps:

- 1. Teacher Interaction:** Teachers, utilizing the client-side interface, can access subjects assigned to them and record attendance for each subject. The interface is designed to be intuitive and user-friendly.
- 2. Data Transmission to the Server:** Attendance records, along with relevant details (e.g., date, subject, and student attendance status), are transmitted to the server for processing and storage.
- 3. Storage in the MongoDB Database:** The server stores attendance records in the MongoDB database. These records are structured to maintain data consistency and allow for efficient retrieval.
- 4. Student Access to Attendance Records:** Students, accessing the client-side interface, can view their attendance records for each subject. The interface provides an organized display of attendance data, allowing students to monitor their progress.

### 3.3 Security Measures

A comprehensive set of security measures has been implemented to safeguard user data and protect against unauthorized access.

#### 3.3.1 Data Encryption

Sensitive data, including user credentials, is transmitted securely over HTTPS. This encryption protocol ensures that data remains confidential during transmission, protecting it from interception or tampering.

#### 3.3.2 Authentication and Authorization

The system employs JSON Web Tokens (JWT) for user authentication. JWT-based authentication is a secure and efficient approach to verify user identities. It also incorporates role-based access control, allowing different user roles (e.g., Student, Teacher, Department Admin, Super Admin) to access specific functionalities and data.

#### 3.3.3 Password Policy

A stringent password policy is enforced to enhance the security of user accounts. The policy mandates the use of strong passwords, reducing the likelihood of unauthorized access.

### 3.4 Diagrams

#### 3.4.1 Data Flow Diagram

A data flow diagram shows the way information flows through a process or system. It includes data inputs and outputs, data stores, and the various sub processes the data moves through. In our proposed system User need to sign up and after successfully signing up he need to login.

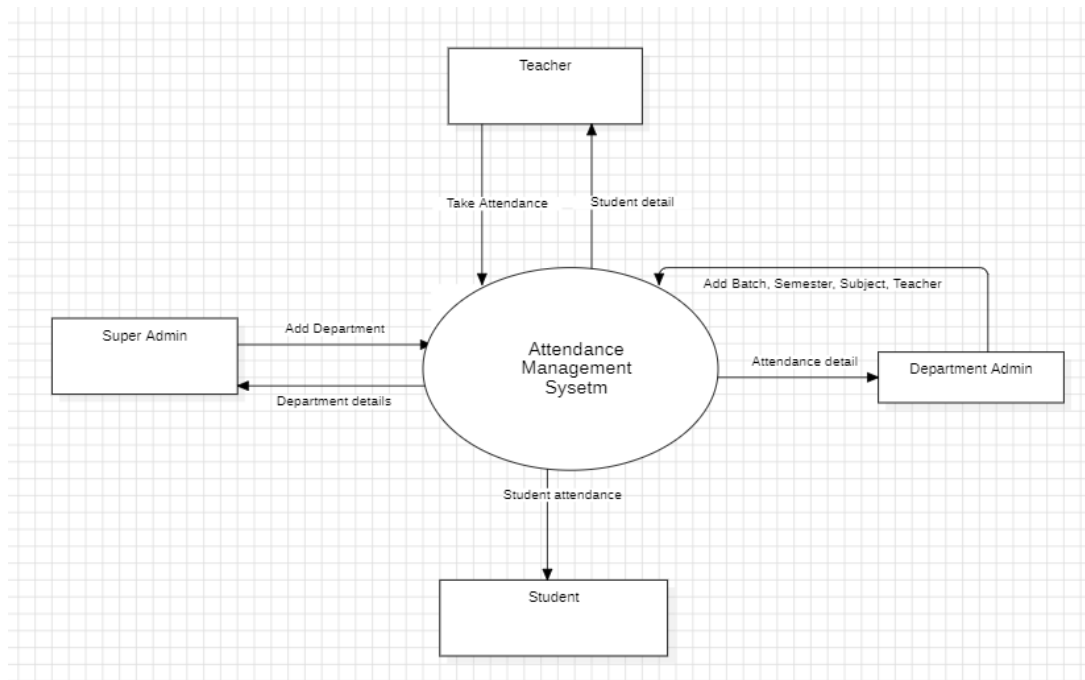


Figure 1: Level 0 DFD

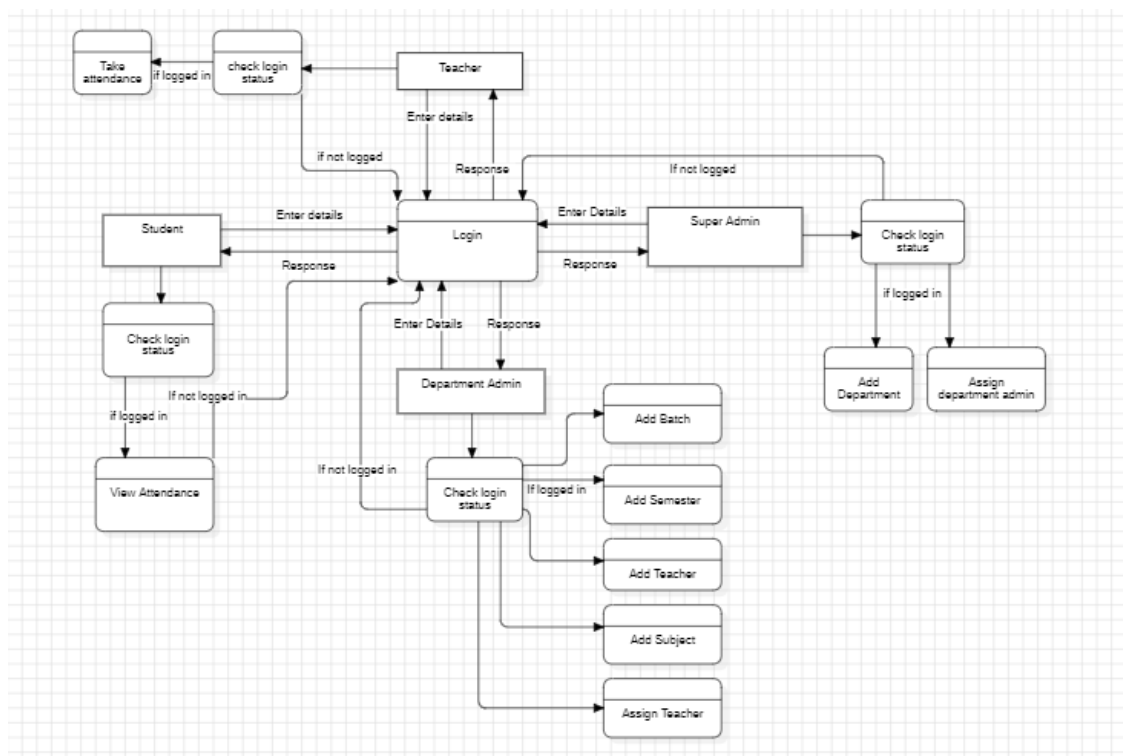


Figure 2: Level 1 DFD

### 3.4.2 Entity Relationship Diagram

An Entity Relationship Diagram (ERD) is a type of flowchart that illustrates how “entities” such as people, objects or concepts relate to each other within a system. Our proposed system has the following entities: Super Admin, Admin, Teacher, Student Skills. Admin can add, edit and remove Teachers. Teacher can add Students, take attendance. While Students can view attendance.

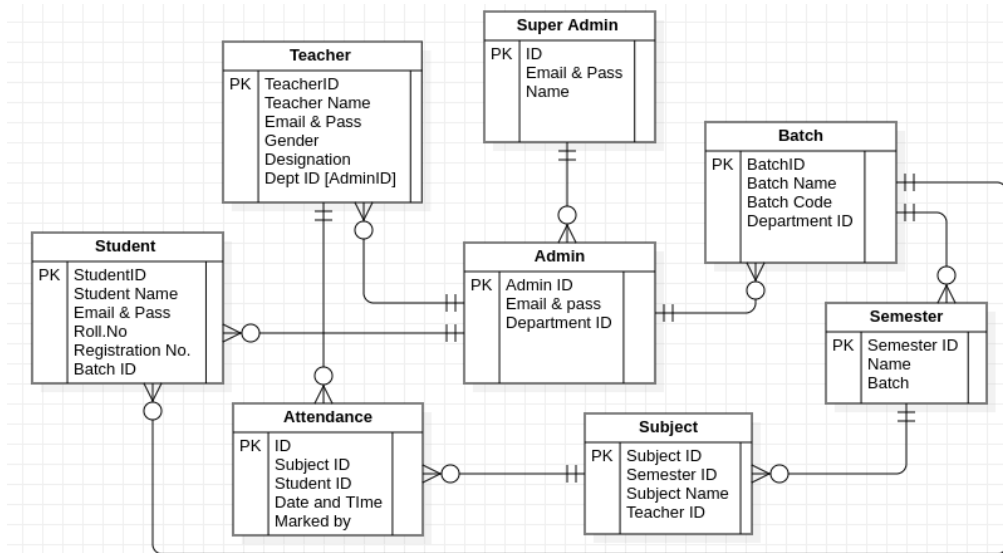


Figure 3: ERD

### 3.4.3 Use Case Diagram

Use case diagram is graphic depiction on the interactions among the elements of Attendance Management System. It represents the methodology used in system analysis to identify, clarify and organize system requirements of Attendance Management System.

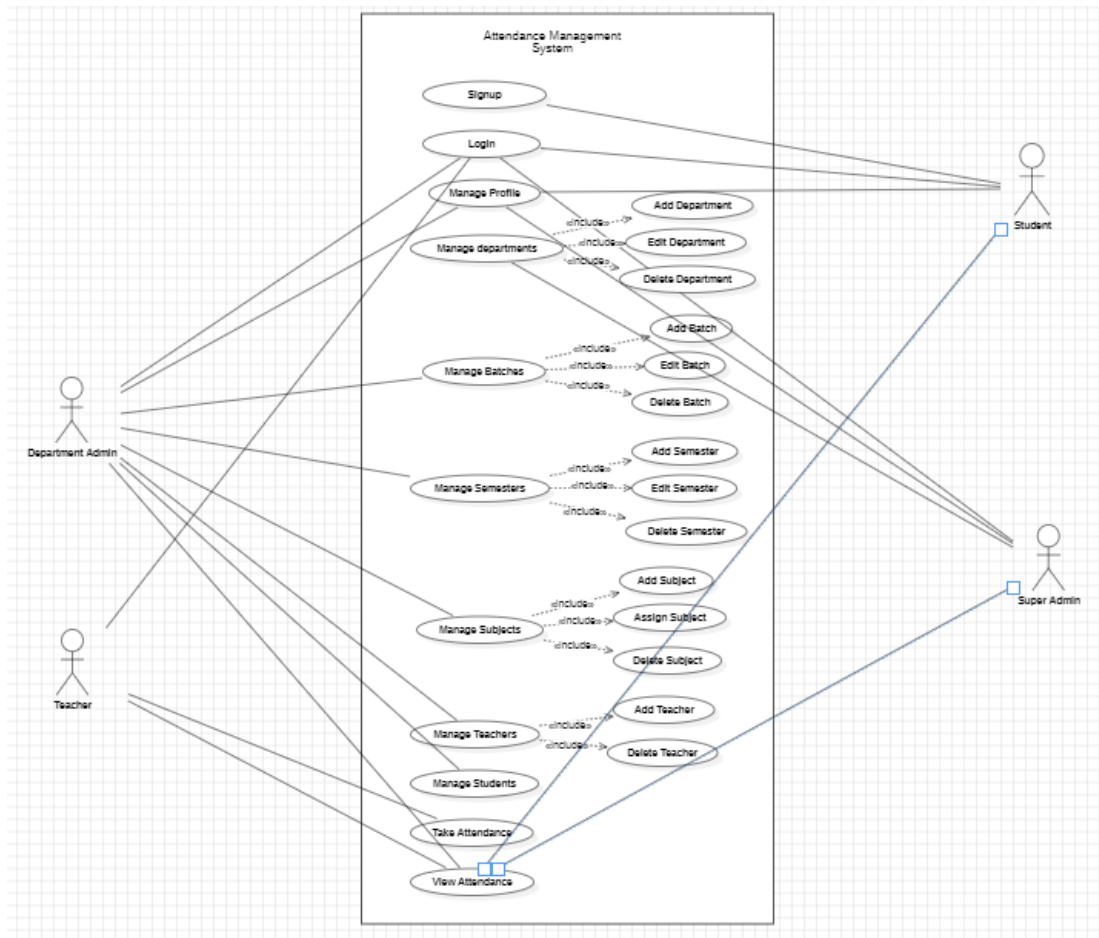


Figure 4: Use Case Diagram

### IMPLEMENTATION

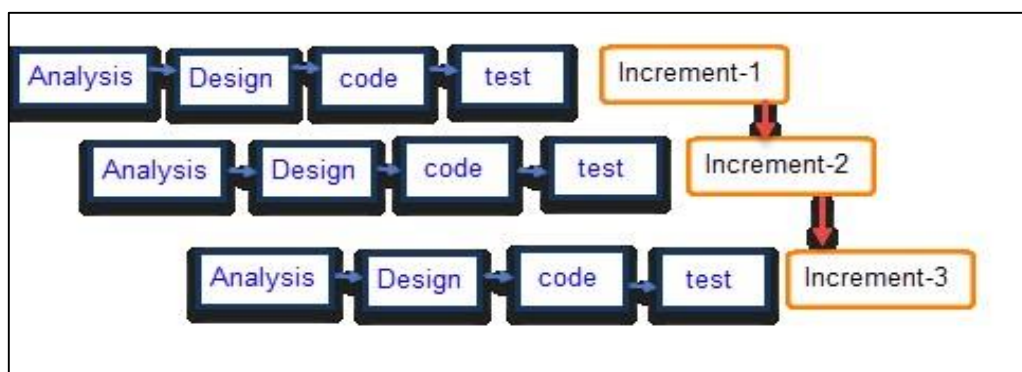
Implementation is a key step in any project development phase. This phase aims to convert a generic idea to a practical environment. This phase gives detailed information of how we build our system. It provides the detailed working of each component and show how these components work together. All mathematical and coding design are given in the upcoming sections.

#### 4.1 Idea

The Attendance Management System (AMS) project represents a pioneering response to the challenges. In an era characterized by digital transformation and data-driven decision-making, this system aims to harness technology's power to streamline and enhance attendance tracking processes within universities. It promises to not only automate attendance recording but also to provide valuable insights into student engagement, ultimately contributing to improved educational outcomes.

#### 4.2 Model

Incremental Model is a process of software development where requirements are broken down into multiple standalone modules of software development cycle. Incremental development is done in steps from analysis design, implementation, testing/verification, maintenance. Each iteration passes through the requirements, design, coding and testing phases. And each subsequent release of the system adds function to the previous release until all designed functionality has been implemented. The system is put into production when the first increment is delivered. The first increment is often a core product where the basic requirements are addressed, and supplementary features are added in the next increments. Once the core product is analyzed by the client, there is planned development for the next increment.



*Figure 5: Incremental*

#### 4.3 Approaches to project implementation

Approaches listed below are the options from where the project manager can choose the best approach for a project.

#### **4.3.1 Top-down approach**

In the Top-down approach, implementation is principally done by agencies from outside the community with limited participation by the beneficiaries.

#### **4.3.2 Bottom-up approach**

Beneficiaries implement the project. Here outside agencies can provide financial resources and technical assistance if needed.

#### **4.3.3 Collaborative participatory approach**

Top-down and bottom-up approaches to project implementation are applied in the process.

Considering the situation or necessity of a project, the implementation methods can be:

**Parallel Implementation:** This implies a new solution which is implemented parallel to the current operating system in use. Those who are using the system will not see major downtime once it is implemented. The trick here is to implement the system.

**Phased Implementation:** It is usually chosen when a system is on the run, and it cannot be out of operation for development for a long time. In this case normally the front office staff attend the operation of this kind of implementation.

**Crash Implementation:** Careful planning needs to take place when considering a crash (also known as full-blown) implementation. It takes an incredible amount of planning and re-planning to ensure no problems arise. In fact, with this type of implementation, the necessary contingencies need to be prepared and reviewed well in advance of the actual implementation, to minimize any potential failure.

### **4.4 Design of System**

System design is a pivotal phase in the development of the Attendance Management System. This chapter provides a comprehensive insight into the architectural decisions, data schema, user interface design, and security considerations that guided the creation of the system. The design phase lays the foundation for the system's functionality, user experience, and data management.

## **3.2 High-Level Architecture**

### **3.2.1 Client-Server Model**

The system follows a classic client-server architectural model. The client, which represents the user interface, is responsible for rendering and user interactions. The server handles business logic, data storage, and client-server communication.

### **3.2.2 Choice of Technology Stack**

The technology stack is integral to the system's performance and maintainability. We adopted a MERN stack:

**MongoDB:** As a NoSQL database, MongoDB stores attendance records, user profiles, and related data. Its flexibility suits the document-oriented nature of attendance records.

**Express.js:** The Express.js framework handles routing, middleware, and interactions with the database. It ensures efficient request handling.

**React:** React is the foundation for the user interface, providing a responsive and dynamic frontend.

**Node.js:** As the runtime environment, Node.js ensures efficient, non-blocking I/O operations, contributing to system responsiveness.

### **3.3 Database Schema Design**

#### **3.3.1 Data Modeling**

The database schema was meticulously designed to support multiple types of data:

**User Profiles:** A user profile schema captures user details, including name, email, role, and department. Users are assigned roles that determine their permissions.

**Subjects:** Subjects are associated with specific courses or classes, each having a unique identifier and information like subject name, code, and assigned teacher.

**Attendance Records:** A schema for attendance records includes fields for date, subject, student, and teacher. The record marks a student's attendance in a particular subject on a specific date.

**Departments:** Department data stores information about academic departments, enabling the categorization of users and subjects.

#### **3.3.2 Relationships**

Data relationships were established between schemas to represent the real-world connections:

Users are linked to their departments, indicating department affiliation.

Subjects are related to teachers to denote instructor assignments.

Attendance records are tied to students, subjects, and teachers, creating a robust attendance tracking system.

#### **3.3.3 Indexing**

Indexes were strategically implemented to enhance database performance. For instance, user email addresses were indexed for quick user lookup. Indexes were also added to fields that facilitated filtering and searching within large datasets.

### **3.4 User Interface Design**

#### **3.4.1 Wireframing and Mockups**

The user interface design commenced with wireframing and advanced to the creation of detailed mockups. The design process emphasized clarity, simplicity, and user-friendliness. Key components included:

**User Registration Form:** A straightforward registration form with fields for personal details and batch codes for students. The form featured client-side validation to ensure data accuracy.

**Login Page:** The login page allowed users to enter their email and password for authentication. It communicated with the backend for validation and JWT token generation.



**Subject List Interface:** The subject list displayed subjects assigned to teachers, providing a clear overview of course responsibilities.

**Attendance Tracker Interface:** For teachers to record attendance, this component featured an intuitive interface. It enabled teachers to mark attendance for students in specific subjects.

User Profile View and Edit: User profiles showcased user information, permitting users to view and edit their profiles with ease.

### **3.4.2 Responsiveness**

Responsive design was a top priority. The user interface was crafted to adapt seamlessly to diverse screen sizes, ensuring a consistent and enjoyable user experience across desktops, tablets, and smartphones.

### **3.4.3 Accessibility**

Efforts were made to comply with accessibility standards, ensuring that individuals with disabilities could use the system effectively. This included providing alternative text for images, keyboard navigation support, and proper labeling of form elements.

## **3.5 Security Measures**

### **3.5.1 Password Hashing**

User password security was a core concern. Passwords were securely hashed using bcrypt before storage in the database. Strict password policies were enforced to encourage strong password complexity.

### **3.5.2 JSON Web Tokens (JWT)**

User authentication relied on JSON Web Tokens (JWT). After a successful login, a JWT token was generated and sent to the client. This token provided secure access to protected routes, preventing unauthorized access.

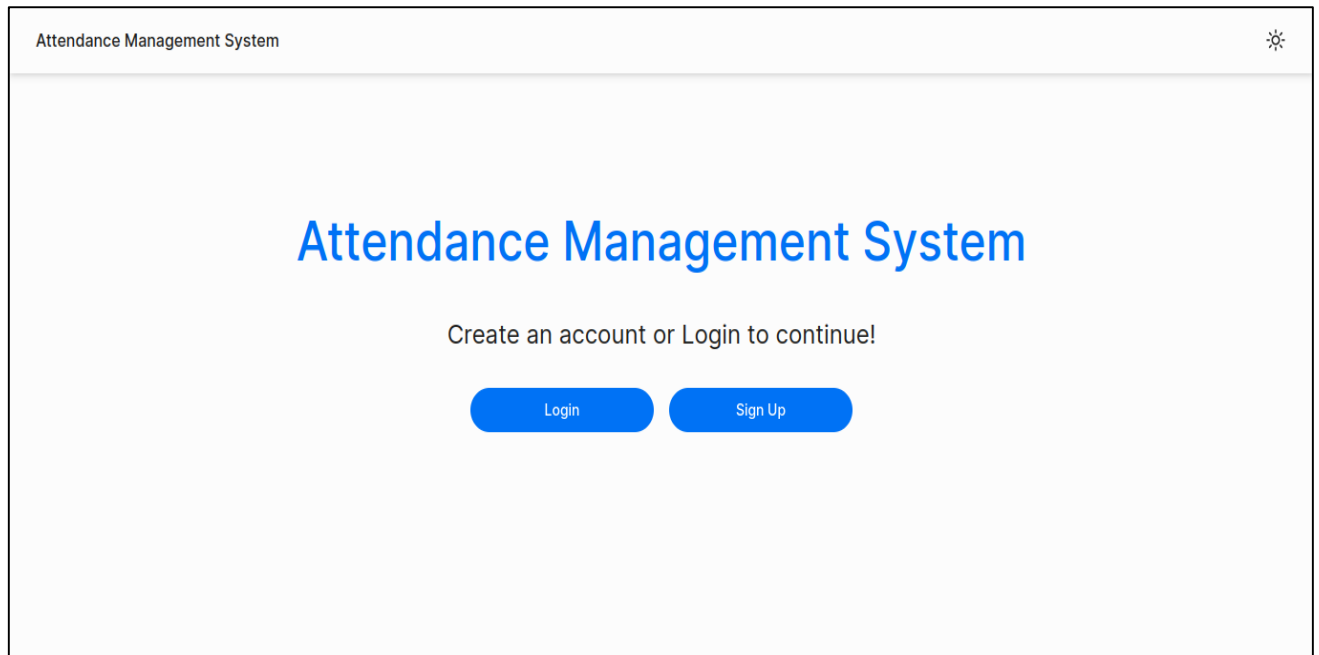
### **3.5.3 Role-Based Access Control (RBAC)**

RBAC was implemented through middleware. Users were assigned roles (Student, Teacher, Department Admin, Super Admin) and granted access based on their roles. Role-specific access control was enforced, ensuring users could only access features and data relevant to their role.

## **4.5 Screenshots**

### **4.5.1 Homepage**

This is the home page where users can go to dashboard. If the user is not logged in, then options for login and signup page will be shown.



*Figure 6: Home Page*

#### 4.5.2 Signup Page

This is the signup page for students. It can only be used by students. The student must provide name, email, registration no., roll no., batch code and password. Student also must complete the captcha code to complete the signup process.

The screenshot shows the signup page of the Attendance Management System. The page has a header bar with "Attendance Management System" and a sun icon. The main content area is titled "Sign Up" and contains a form with the following fields: "Name" (with a sub-label "Full Name"), "Email" (with a placeholder "name@example.com"), "Registration No." (with a sub-label "University Registration No."), "Roll No" (with a sub-label "Class Roll No."), "Batch Code" (with a placeholder "Enter Batch Code provided by department"), "Password", "Confirm Password", and "Captcha". The "Captcha" section includes a checkbox labeled "I'm not a robot" and a small image of a robot.

*Figure 7: Signup Page*

#### 4.5.3 Login Page


Login page will be used to login in the app. Email and password are required to login. Captcha challenge is also required to login. There are also links for signup page and reset password page.

Attendance Management System

### Login

Email  
name@example.com

Password

Captcha  
☐ I'm not a robot  
  
[Privacy](#) - [Terms](#)

Login

Don't have an account? [Signup!](#)  
[Forgot Password](#)

Figure 8: Login page

#### 4.5.4 Department List

This page provides a list of departments in system. It is only accessible to super admin.

Attendance Management System

Home / Departments

### Department List

[Add Department](#)





	Department	Admin	Admin Photo
1	Computer Science	sfahad4280@gmail.com	
2	Geology	shahfahad13ae@gmail.com	
3	Physics	javedshehryar1@gmail.com	
4	Sociology	shahfahad19p@gmail.com	

Figure 9: Department List

#### 4.5.6 Department Info

This page shows department info and its admin. It has options to delete the department or update the department admin.


Attendance Management System

Department of Computer Science

Home / Departments / Computer Science

Info Batches Teachers Subjects

Department Info

Department	Computer Science
Admin	Shah Fahad 
Email	sfahad4280@gmail.com
Approved	true

Change Admin

Figure 10: Department info

#### 4.5.7 Add Batch

This page is used to add new batches to the department.

Attendance Management System

Department of Shah Fahad

Home / Batches / Add Batch

Add Batch

Batch No.

eg. 1

Add Batch

[← Back to Batch List](#)

Figure 11: Add Batch

#### 4.5.8 Add Subject

This page will consist of subject name and credit hours of a subject. In this page admin have to add a Subject to the existing batch. Subject will be selected from a list where super admin has added all subjects for department.

Attendance Management System

Home / Departments / Computer Science / Subjects / Add Subject

Add Subject

Subject Name

Credit Hours

Select credit hours

Add

← Back to Subjects List

Figure 12 Add Subject

#### 4.5.9 Batch invite link

In this page an invite link will be generated through which a student will be added to a batch.

Attendance Management System

Department of Computer Science

Home / Batches / Batch 1


Semesters

Students

Edit Batch

Invite Link

Invite Link



Share the code **5C69** with students

OR

Share the link below

https://amsapp.vercel.app/signup?cod

Copy

Share

https://amsapp.vercel.app/admin/batch/64c21839d6e867eabdb797c4/invite

Figure 13 Batch Invite Link

#### 4.5.10 Edit Batch

In this page a batch can be edited by the admin where he will be able to edit batch name

27

Attendance Management System

Department of Computer Science

Home / Batches / Batch 1

Semesters Students Edit Batch Invite Link

### Edit Batch

Batch Name

1

Batch Code

5C69

Regenerate

Archived

False

Update

<https://amsapp.vercel.app/admin/batch/64c21839d6e867eabd...>

Figure 14 Edit Batch

#### 4.5.11 Take Attendance

This page is accessible only to teachers and will be used to take attendance. When attendance is marked, the next student will be shown. Keyboard shortcuts can be used as well to mark attendance.

Attendance Management System

Home / Subjects / Artificial Intelligence

Attendances Take Attendance Remove Subject

### Take Attendance

Roll no.1

Student Name: Asad

Present Absent Leave

Keyboard shortcuts:

P - Present A - Absent L - Leave

Figure 15 Take Attendance

#### 4.5.12 Semester List

This page lists all the semesters in a batch.

Attendance Management System			⚙️ 🔍 ☰
Department of Computer Science			
Home / Batches / Batch 1			
Semesters Students Edit Batch Invite Link			
Semester List			Add Semester
S.No	Name	Active	
1	Semester 1	✓	
2	Semester 2	✓	
3	Semester 3	✓	
4	Semester 4	✓	

Figure 16 Semester List

### 4.5.13 Forgot Password

This page can be used by users to reset their password. User has to provide their email address and a reset link will be sent to them.


Attendance Management System	⚙️
<div>Reset Password</div> <div> Email <div>Email</div> </div> <div> Captcha <div> <input type="checkbox"/> I'm not a robot <div>  reCAPTCHA Privacy - Terms </div> </div> </div> <div>Reset</div> <div> Login Signup </div>	

Figure 17 Forget Password

**TESTING**

System testing is conducted on a complete integrated system to evaluate the system's compliance with its specified requirements. System testing takes, as its input, all the integrated components that have passed integration testing. The purpose of integration testing is to detect any consistencies between the units that are integrated together (called assemblages). System testing seeks to detect defects both within the "inter-assemblages" and within the system as a whole. The actual result is the behavior produced or observed when a component or system is tested.

**5.1 Purpose of Testing**

Some of the purpose of finding

- Finding defects which may get created by the programmer while developing the software.
- Gaining confidence in and providing information about the level of quality.
- To prevent defects.
- To make sure that the result meets the business and user requirements.
- To ensure that it satisfies the BRS that is Business Requirement Specification and SRS that is System Requirement Specifications.
- To gain the confidence of the customers by providing them a quality product.

**5.2 Objective of Testing**

Software testing helps in finalizing the software application or product against business and user requirements. It is very important to have good test coverage to test the software application completely and make it sure that it's performing well and as per the specifications.

**5.3 Testing Techniques**

Software Testing Techniques help you design better test cases. Since exhaustive testing is not possible, Manual Testing Techniques help reduce the number of test cases to be executed while increasing test coverage. They help identify test conditions that are otherwise difficult to recognize.

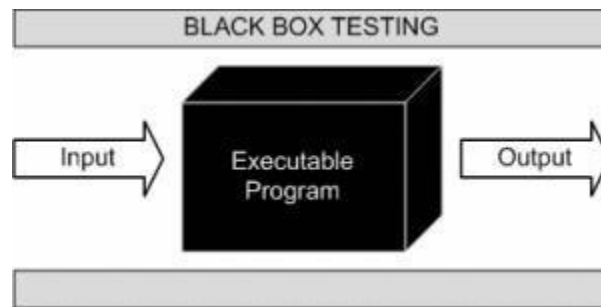
**5.3.1 Black Box Testing**

Black Box Testing, also known as Behavioral Testing, is a software testing method in which the internal structure/design/implementation of the item being tested is not known to the tester. These tests can be functional or non-functional, though usually functional.

This method is named so because the software program, in the eyes of the tester, is like a black box, inside which one cannot see

Our Attendance Management System is tested by different inputs and its consequent output.



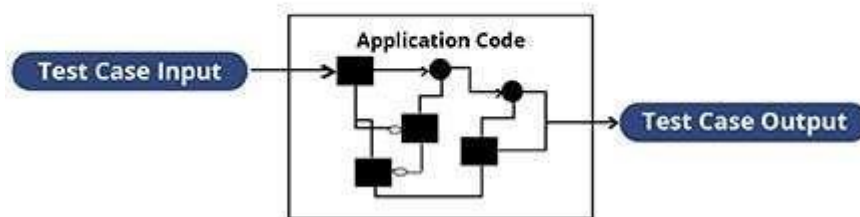


*Figure 18: Black box testing*

### 5.3.2 White Box Testing

White Box Testing (also known as Clear Box Testing, Open Box Testing, Glass Box Testing, Transparent Box Testing, Code-Based Testing or Structural Testing) is a software testing method in which the internal structure /design / implementation of the item being tested is known to the tester. The tester chooses inputs to exercise paths through the code and determines the appropriate outputs. Programming know-how and the implementation knowledge is essential. White box testing is testing beyond the user interface and into the nitty-gritty of a system.

#### WHITE BOX TESTING APPROACH



*Figure 19: White box testing*

This method is named so because the software program, in the eyes of the tester, is like a white / transparent box; inside which one clearly sees.

The internal structure of our proposed system is tested thoroughly. Algorithms and flow and each code section are tested by give different input and analyze respective output.

### 5.3.3 Unit Testing

Unit Testing is a level of software testing where individual units/ components of a software are tested. The purpose is to validate that each unit of the software performs as designed. A unit is the smallest testable part of any software. It usually has one or a few inputs and usually a single output. In procedural programming, a unit may be an individual program, function, procedure, etc. In object-oriented programming, the smallest unit is a method, which may belong to a base/ super class, abstract class or derived/ child class. (Some treat a module of an application as a unit. This is to be discouraged as there will probably be many individual units within that module).

We divide our system in many different units and perform unit test on them.

#### 5.3.4 Integration Testing

Integration Testing is a level of software testing where individual units are combined and tested as a group. The purpose of this level of testing is to expose faults in the interaction between integrated units. Test drivers and test stubs are used to assist in Integration Testing.

On web applications we put different Activities (units) together and run the website to test whether it work collectively. We fix and test until the test is pass.

#### 5.3.5 System Testing

System testing is conducted on a complete integrated system to evaluate the system's compliance with its specified requirements. System testing takes, as its input, all the integrated components that have passed integration testing. The purpose of integration testing is to detect any inconsistencies between the units that are integrated together (called assemblages). System testing seeks to detect defects both within the "inter-assemblages" and within the system. The actual result is the behavior produced or observed when a component or system is tested.

#### 5.4 Test Cases

A test case is a set of test inputs, execution conditions, and expected results developed for a particular objective, such as to exercise a particular program path or to verify compliance with a specific requirement. A test case could simply be a question that you ask of the program. The point of running the test is to gain information, for example whether the program will pass or fail the test. Test cases are the cornerstone of Quality Assurance whereas they are developed to verify quality and behavior of a product.

*Table 1: Test cases in software module*

Test case Id	Test Case ID with Title	Test case Description	Expected Result	Test Method
1	Test Case 01 (Registration of Admin)	Empty input field test	Successful testing	White Box and Black Box testing is performed
2	Test Case 02 (Taking Attendance)	Searching for Attendance criteria	Successful testing	White Box and Black Box testing is performed

3	Test Case 03 Checking percentage of attendance	Checking	Successful testing	White Box and Black Box testing is performed
1	Test Case 01 (Login)	Administrator & Users Requests the System for Login	Successful Login	White Box and Black Box testing is performed
2	Test Case 02 (View List of subjects)	Admin can view List of Subjects	Successful in view Subject	White Box and Black Box testing is performed
3	Test Case 03 (Retrieve data from mongodb cloud)	mongodb is cloud database and contain all data	Successful retrieval of all data	White Box and Black Box testing is performed
4	Test Case 04 (Add New Students)	Teacher added new students	Successful in Adding New Students	White Box and Black Box testing is performed
5	Test Case 05 Archived Subject	Teacher attempt to Archived subject	Successful in Archived subject	White Box and Black Box testing is performed
6	Test Case 06 (Show percentage of the attendance)	Confirmation percentage will be showed	Successful showed percentage	White Box and Black Box testing is performed
7	Test Case 07 (Forget password)	Testing of forget password functionality	Successful Updating of password	White Box and Black Box testing is performed

### DEPLOYEMENT

Pushing updates or changes from one deployment environment to another is what is meant by deployment in web development. You will always have your live website when setting up a website. This is referred to as the live environment or production environment. Web deployment is the way toward sending the code (html, CSS, JavaScript and server code) from source control or source antiques to a facilitating stage. This is generally in the cloud or on a nearby server.

#### 6.1 Target Area / People

The target people of this platform are all the Students and Staff of university.

#### 6.2 Staff Training

A person should be trained to use application and database panels, that how to accept, reject and delete documents. And add delete values and users etc.

#### 6.3 Deployment Area

The web app will be published from a local host to a server for availability. The platform will be published to GitHub and the database will be converted from a local database to MongoDB Atlas. Then from GitHub, the server side will be deployed to Vercel, and the frontend side will be deployed to Netlify.

##### 6.3.1 Publishing to GitHub

As the project is completed so we must publish it to GitHub. Our code project contains module which we do not want to publish also because in the entry file/package.json file Every used module is listed. So, a file named. Gitignore and put the folder name that contain all the modules so the folder will be avoided from publishing to GitHub.

##### 6.3.2 Vercel

We chose to deploy our web app using Vercel, a cloud platform known for its simplicity and efficiency. Vercel provided a seamless deployment experience, allowing us to host our application with ease and speed. Its integration with our version control system made continuous deployment a breeze, enabling us to automatically deploy updates as we iterated on the system. Vercel's global content delivery network ensured that our application is delivered quickly to users worldwide, improving the overall user experience. The platform's scalability and reliability are particularly important to us, as it ensures that our system can handle increasing user loads and maintain high availability. In short, Vercel has proven to be an excellent choice for hosting our Attendance Management System, aligning perfectly with our goals of efficiency, reliability, and scalability.

### **6.3.3 File Storage**

We have opted to utilize 000webhosting as our hosting solution for user profile images within the Attendance Management System. 000webhosting provides a reliable and cost-effective option for storing and serving user profile images. With its generous storage capabilities and accessibility, it ensures that user profile images are readily available to enhance the visual elements of our application. The platform's performance and uptime rates have been commendable, ensuring that profile images are consistently accessible to users without interruption. Moreover, 000webhosting's user-friendly interface and support for popular web technologies make it a practical choice for our specific needs. By leveraging this hosting solution for user profile images, we can effectively manage and deliver a visually appealing user experience within our application.

### **6.4 Summary**

All of the procedures that make a software system usable collectively constitute software deployment. There may be transitions between the various activities that make up the general deployment process. The specific processes or procedures within each component can hardly be defined due to the individuality of every software system. Therefore, "deployment" should be interpreted as a general process that has to be customized according to specific requirements or characteristics.

### CONCLUSION AND RECOMMENDATIONS

The implementation and deployment of the Attendance Management System marks a significant milestone in the pursuit of more efficient and effective attendance tracking and management in educational institutions. This chapter summarizes the key findings and outcomes of the project, reflecting on its significance and achievements.

#### 7.1 Conclusion

##### 7.1.1 Achievement of Project Goals

The project aimed to create a robust and user-friendly system that could cater to the attendance management needs of diverse users, including students, teachers, department administrators, and super administrators. Through meticulous planning, implementation, and deployment, the project has successfully achieved these goals.

**User-Centric Approach:** The system was designed with a user-centric approach, resulting in a responsive and intuitive user interface that meets the needs of all user roles.

**Efficient Attendance Tracking:** Teachers can efficiently record attendance, and students can readily access their attendance records, improving overall transparency.

**User Management and Role-Based Access Control:** Department administrators and super administrators have the tools to manage users effectively, assign roles, and control access permissions, streamlining administrative tasks.

**Scalability and Security:** The system is designed with scalability and security in mind, ensuring its suitability for institutions of various sizes and maintaining the privacy and security of user data.

##### 7.1.2 Implications for Educational Institutions

The successful implementation of the Attendance Management System has significant implications for educational institutions:

**Improved Data Accuracy:** By automating attendance recording, the system reduces the chances of manual errors and inaccuracies, providing more reliable data for analysis.

**Enhanced Efficiency:** The system streamlines administrative tasks related to attendance management, saving time and resources for institutions.

**Transparency and Accountability:** Users have access to their attendance data, fostering transparency and accountability among students and teachers.

**Data-Driven Decision-Making:** The system generates attendance data that can be leveraged for data-driven decision-making in institutions.

**Scalability:** The system is adaptable to different educational institutions, whether small colleges or large universities.

### **7.1.3 Challenges and Lessons Learned**

The project was not without its challenges. Some of the key challenges and lessons learned include:

**User Training:** Adequate user training and support are crucial, as users, especially teachers, needed time to adapt to the new system.

**Data Privacy and Security:** Maintaining data privacy and security is a continuous effort, and regular security audits and updates are essential.

**Scalability:** As the system is used by more users and institutions, scalability challenges may arise, requiring ongoing optimization.

**User Feedback:** The project benefited from gathering user feedback and incorporating improvements based on user suggestions.

## **7.2 Recommendations**

The successful development and deployment of the Attendance Management System do not mark the end of the project but rather the beginning of a continuous improvement process. The following recommendations are made for further enhancing the system and its implementation:

### **7.2.1 Continuous User Training**

Incorporate continuous user training programs to ensure that all users are proficient in using the system's features. This will reduce user-related challenges and improve overall system adoption.

### **7.2.2 Security Audits**

Conduct regular security audits to identify and address potential vulnerabilities and threats. Implement the latest security measures to safeguard user data and system integrity.

### **7.2.3 Scalability Planning**

As the system gains wider adoption, plan for scalability by optimizing the infrastructure and databases to accommodate increasing data and users.

### **7.2.4 User Feedback Mechanism**

Establish a robust mechanism for users to provide feedback and suggestions. Continuously improve the system based on user insights to enhance the user experience.

### **7.2.5 Integration with Other Systems**

Consider integrating the system with other educational management systems, such as learning management systems (LMS), to provide a more comprehensive solution for educational institutions.

## **7.3 Final Remarks**

The Attendance Management System project has successfully delivered a user-centric and efficient solution for attendance tracking and management in educational institutions. Its implications for data

accuracy, efficiency, and data-driven decision-making are promising. By addressing the identified challenges and implementing the recommended improvements, the system can continue to evolve and better serve educational institutions in the future.

This project exemplifies the positive impact that technology can have on streamlining administrative processes and enhancing transparency in educational institutions. It is a testament to the value of user-centered design and continuous improvement in software development.

As the project concludes, it opens the door to further research, development, and innovation in the field of education technology and administrative systems, fostering the creation of more efficient and effective solutions for educational institutions.



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- [9] Nodemailer Documentation. [Online] Available at: <http://nodemailer.com>