
Research Paper**Improving Attendance Management in Educational Institutions: A Model View Controller Approach****Rudra Pratap Singh¹, Madhav Arora², Gurwinder Singh^{3*}**^{1,2,3}Dept. of AIT-CSE, Chandigarh University, Punjab, India*Corresponding Author: singh1001maths@gmail.com

Abstract: Efficient attendance management plays a crucial role in the success of educational institutions. This paper proposes a novel approach to enhance attendance management through the utilization of the Model-View-Controller (MVC) architecture. Traditional manual methods for attendance calculation are prone to errors and time-consuming. To address these challenges, an effective web application is designed to electronically monitor student activity in the classroom and store attendance records in a database. The application leverages the power of the Laravel Framework and incorporates JavaScript for improved usability. By implementing the MVC architecture, the system enables easy manipulation of attendance data through a user-friendly graphical user interface (GUI). Moreover, the system takes into account the distinction between theoretical and practical teaching hours, facilitating accurate calculation of student absences. The successful implementation and testing of the system demonstrate its readiness to manage student attendance in any department of a university. This paper provides valuable insights into leveraging MVC architecture for attendance management and offers a practical solution to enhance efficiency and accuracy in educational institutions.

Keywords: Attendance management, Model-View-Controller (MVC), Web application, Electronic monitoring, Attendance records, Laravel Framework.

1. Introduction

Due to the students' interest in classrooms, which is the largest union in the study environment of a university or institution, recording absences in a department with a large number of students in a class is a difficult and time-consuming task. In addition, this process takes a lot of time and departmental staff spend a lot of effort to supplement the attendance rate for each student. Thus, in many institutions and academic organizations, attendance is a very important criterion that is used for various purposes. These purposes include record keeping, student evaluation, and promoting optimal and consistent classroom attendance. As in many developing countries, a minimum percentage of attendance is required in most institutions and this policy has not been followed due to the various problems that the current attendance method presents. The process of recording attendance for students took place in the form of paper documents and the system was implemented manually. In addition to wasting time and effort in preparing sheets and documents, other disadvantages may be visible to the traditional manufacturer due to the loss or damage of sheets - the sheet could be stolen. He considers the developed system as an alternative to the traditional one, it is easy, fast and reliable than the traditional one, especially after the development of information technologies and their use by educational institutions. Therefore, the proposal of the

attendance system of students has a significant real meaning. The system is a web application developed for the daily attendance of students at departments within the university. Facilitates access to a specific student's attendance in a specific class. This system will also help in generating reports and evaluating student attendance. The system not only improves work efficiency, study and student development, but also can save human and material resources.

1.1 Objectives

The objectives of this paper are summarized as follows:

- To identify the challenges and limitations of traditional manual attendance management methods in educational institutions.
- To explore the benefits and potential of implementing the Model-View-Controller (MVC) architecture in attendance management systems.
- To implement the application using the Laravel Framework and incorporate JavaScript to enhance usability.
- To design a user-friendly graphical user interface (GUI) for easy data manipulation and management.
- To evaluate the effectiveness and functionality of the proposed attendance management system through testing and analysis.
- To contribute to the body of knowledge on attendance management in educational institutions and provide insights

into the implementation of MVC architecture for this purpose.

2. Literature Survey

This literature survey highlights various approaches for digitizing attendance management in educational institutions. These methods utilize technologies such as online systems, biometrics (fingerprint, face recognition), GPS, etc. described and categorized as follows: Digitizing the Legacy Method: The traditional method of recording attendance in educational institutions involves time-consuming processes, such as manually rounding up the names of students and marking their attendance on paper. [9] addressed this issue by developing an online system that reduced the completion time of the attendance audit. Their system eliminated the need for paper recording and allowed teachers to track student engagement more efficiently by accessing the necessary information from a database.

Fingerprint Recognition: Fingerprint recognition has proven to be an effective method for attendance management. [3] introduced a fingerprint device as part of a unique fingerprint access plan, allowing students to check their attendance by placing their fingers on the device's sensors. However, fingerprint recognition methods have limitations, as they require additional time for fingerprint scanning. [4] proposed a solution that utilized smartphone GPS and fingerprint devices to record attendance time.

GPS Based Time Tracking System: The Global Positioning System (GPS) enables real-time location tracking of individuals, offering a convenient method for attendance management. [12] proposed a real-time location and attendance tracking system implemented through an Android mobile application. By leveraging GPS technology, the system reduced the need for additional biometric scanning devices. GPS on the students' phones determined their location, which facilitated accurate time and attendance tracking.

Barcode/QR Code Based: Barcodes and QR codes provide machine-readable information and have been utilized in attendance management systems. [9] presented an automated student attendance system using unique identification numbers assigned to barcodes that can be scanned by mobile phones. [11] developed a smart opt-in system that utilized QR code technology to expedite the attendance process. Students could generate and scan QR codes using a mobile application, enabling efficient attendance management. [10] proposed a lesson attendance system that encoded class information into a QR code, which students could capture with their mobile phones for attendance management.

Face Recognition Based: Face recognition has emerged as a popular method for attendance management. [6] developed a collaborative classroom system that utilized face recognition to record attendance. The system employed face detection and recognition algorithms, such as the Local Binary Pattern Histogram (LBPH), to identify students' faces in live video

classes. [5] implemented a face recognition system using a camera in the classroom, which recorded student presence or absence. The system utilized the NVIDIA Jetson Nano for face recognition and analyzed the data using the LBPH algorithm. [7] proposed a "Student Auto Attendance Management of Face Mask" system that utilized cloud computing and facial recognition for attendance checking.

Android Based Authorization: Android-based systems offer convenient authorization methods for attendance management. [17] implemented an Android-based smart combiner that automatically created attendance records and provided an efficient solution for tracking student attendance online. [16] developed an attendance management system where both students and teachers had an APK installed on their Android devices. Students registered their attendance with a single click, and parents received monthly newsletters regarding their child's attendance status.

Android-Based RFID: RFID (Radio Frequency Identification) technology, often associated with NFC (Near Field Communication), has been utilized for attendance management. [15] explored frameworks for collaboration, suggesting the use of RFID components to record student participation and mobile applications to provide attendance information to families. The RFID component served as a backup for attendance tracking, particularly in situations with limited electricity or network connectivity.

Many authors have significant contributions for this, above mentioned domain, summarized in Table 1

Table 1: Summary of Literature Survey

ID	Authors	Title of Paper	Year
[1]	Patel UA, Swaminarayan Priya R.	Development of a student attendance management system using RFID and face recognition: a review	2014
[2]	Anitha V Pai, Krishna A, Kshama PM, Correa M.	Web service for student attendance management system	2016
[3]	Srinidhi M, Roy R.	A web enabled secured system for attendance monitoring and real-time location tracking using Biometric and Radio Frequency Identification (RFID) technology	2015
[4]	F. Alhaidari, A. Rahman, and R. Zagrouba	The Cloud of Things: Architecture, Applications and Challenges	2020
[5]	A. Rahman, S. Dash and A.K. Luhach	Dynamic MODCOD and power allocation in DVB-S2: a hybrid intelligent approach	2021
[6]	M.T. Naseem, I.M. Qureshi, A. Rahman, M.Z. Muzaffar	Robust and fragile watermarking for medical images using redundant residue number system and chaos	2020
[7]	M. Ahmad, M. A. Qadir, A. Rahman, et al.	Improved query processing over semantic caches for cloud-based relational databases	2020
[8]	D.A. Almubayedh, G. Alazman, M. Alkhalis et al.	Quantum bit commitment on IBM QX	2020
[9]	A. Rehman, A. Athar, M. A. Khan, S. Abbas, A. Rahman, A. Saeed	Modeling, Simulation, and Optimization of Diabetes Type II Prediction using Deep Extreme Learning Machine	2020

[10]	M. Mahmud, A. Rahman, M. Lee, J. Choi	Evolutionary-based image encryption using RNA codons true table	2020
[11]	G. Zaman, H. Mahdin, K. Hussain, A. Rahman, N. Ibrahim, N.Z.M. Safar	PDF Digital Library of Online Resources: An ETL Approach	2020
[13]	M. Mahmud, A. Rahman, M. Lee, J. Choi	Evolutionary-based image encryption using RNA codons truth table	2020
[14]	G. Zaman, H. Mahdin, K. Hussain, A. Rahman, N. Ibrahim, N.Z.M. Safar	Digital Library of Online PDF Sources: An ETL Approach	2020
[15]	F. Alhaidari, A. Rahman, & R. Zagrouba	Cloud of Things: architecture, applications and challenges	2020
[16]	A. Rahman, S. Dash, & A.K. Luhach	Dynamic MODCOD and power allocation in DVB-S2: a hybrid intelligent approach	2021
[17]	K. Zhang, L. Tan, Z. Li, Y. Qiao	Gender and smile classification using deep convolutional neural networks	2016
[18]	de Azevedo et al.	School attendance management system for students through facial recognition	2022
[19]	Najaf, Abdul Rezza Efrat et al.	Designing a Web-Based Elementary School Attendance System Using the Laravel Framework	2023
[20]	Vinay, Mallela David, Mandavyapuram Hemanth Kumar, Banoth Hemanth, and Deepak Singh Tomar	Smart Attendance System Using Biometric and GPS	2023

3. Proposed System

The proposed Smart Attendance Management System (SAMS) aims to revolutionize the traditional attendance-taking process in universities by introducing a smart, efficient, and reliable attendance system. SAMS leverages modern technology, including biometric authentication and smartphone integration, to ensure accurate attendance tracking and mitigate the challenges associated with manual methods.

Some key features as described as follows:

Biometric Authentication: SAMS utilizes Face ID and/or fingerprint recognition on students' smartphones to authenticate their identities securely and uniquely. This feature eliminates the need for paper-based sign-in sheets or phone calls, reducing time consumption and minimizing the potential for attendance manipulation.

Classroom Location Identification: Along with biometric authentication, SAMS captures the date, time, and classroom location ID during the attendance marking process. This information provides an additional layer of security and validation, ensuring that students are physically present in the designated classroom.

Seamless Communication: The SAMS application on students' smartphones facilitates smooth communication with the server unit. Students can connect to the server either through the university's local intranet or via the Internet,

enabling real-time attendance updates and data synchronization.

Automated Attendance Calculation: SAMS goes beyond just marking attendance by providing an automated system for calculating total attendance throughout the semester. This feature proves valuable for supervisors in identifying students with insufficient attendance (DN status) who may be ineligible to appear for exams.

Enhanced Security and Efficiency: By leveraging biometric authentication, SAMS offers a more secure and accurate method for individual student identification. This not only streamlines the attendance process but also enhances overall security access within the university premises.

4. Methodology

The Student Attendance Management System (SAMS) is a robust application designed with MVC architecture and implemented using the Laravel framework. JavaScript, jQuery, and AJAX libraries were employed to enhance usability and aesthetics. The system includes the following components:

DATABASE: MySQL is used as the primary database language, with migration techniques enabling compatibility with other databases like SQL Server and SQLite.

TABLES: Eight normalized tables—Object, Employees, Department, Course, Employee Course, Student, Record, and Absence—were implemented, with established relationships between them to avoid redundancy.

SYSTEM DIAGRAM: The system begins with a main gateway page, providing separate staff and student pages. Users must log in with their email and password to access personalized information. Students view their name, department, class, image, and course participation ratio. Staff members are directed to an entry console based on their role.

CORE OF THE SYSTEM: The system comprises a public and a private site. The public part allows anyone with credentials to log in and check their attendance details. The private part is for authorized personnel, categorized into Full Admin User, Head of Department User, Staff of Department User, Theoretical Lecturer User, and Practical Lecturer User.

SYSTEM FEATURES: The system offers numerous features, including statistics, search functionality, report generation, and credential logging. Staff members access a control panel tailored to their permissions. Statistical data provides up-to-date information, and the search function retrieves relevant information using Ajax. Customizable report generation options include specific class or course reports, and reports can be downloaded as PDF or spreadsheets. Attendance information is recorded, increasing system reliability. A complete history is maintained for each student, facilitating department monitoring of student attendance activities.

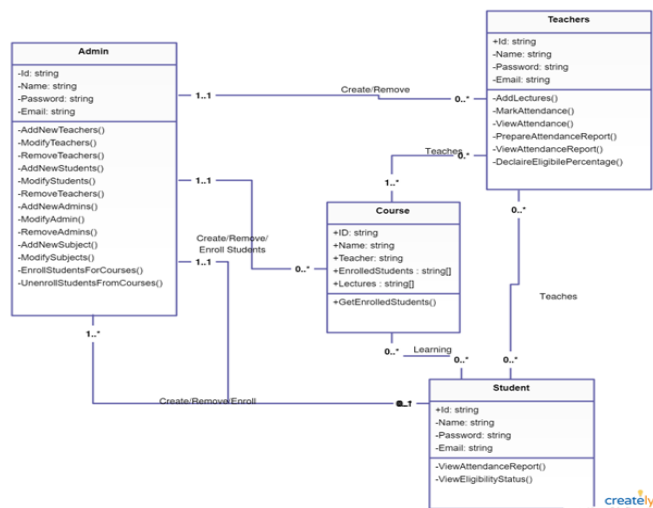


Figure 1: Design of Modules

5. Results and Discussion

The importance of attendance management in organizations, including educational institutions, cannot be overstated. By effectively monitoring individuals such as students, organizations can maximize their performance and ensure optimal outcomes. The proposed system offers a student attendance monitoring process that aims to assist teachers in classrooms and laboratories by enabling them to manage and record attendance electronically, eliminating the need for paper-based methods and saving valuable time and effort.

Smart attendance systems commonly employ biometric identification techniques, with this study focusing on face recognition for identification purposes. Advanced security camera-based facial biometrics are utilized to accurately identify students' faces, ensuring seamless continuation of the lesson. Images of students are captured as input and classified using a Convolutional Neural Network (CNN) algorithm, providing a robust layer of protection for attendance data. Furthermore, machine learning algorithms are employed to identify influential factors on students' Grade Point Average (GPA), enabling effective monitoring of their academic progress.

In addition to attendance management, this study explores the examination of graduates' academic performance by collecting and analyzing their data from previous years. By examining the consequences of both high and low results, valuable insights are obtained that can contribute to performance improvement strategies.

Real-time monitoring, as part of the proposed system, utilizes GPS and GEO beacons to locate and track employees. This enables organizations to monitor employee locations in real-time, gain insights into customer interactions, and enhance overall operational efficiency. Furthermore, the integration of GEO fencing automates personnel capture when they are within designated areas, further streamlining the attendance tracking process.

One of the primary obstacles to organizational profitability is low productivity. Hence, business success hinges on minimizing mistakes and maximizing efficiency. By adopting an electronic attendance management system, organizations can significantly reduce administrative tasks such as updating working hours and enjoy a simplified and efficient payment process.

Conflict of Interest

Authors declare that they do not have any conflict of interest.

Funding Source

None

Authors' Contributions

Rudra Pratap Singh: Played a key role in conceptualizing the approach for improving attendance management using the Model-View-Controller (MVC) architecture. Contributed to the design and development of the system's model components.

Madhav Arora: Contributed to the design and development of the system's view and controller components based on the MVC architecture. Worked on user interface design and user experience improvement.

Gurwinder Singh (Corresponding Author): Provided overall guidance and supervision for the project. Assisted in refining the MVC approach for attendance management and ensuring its alignment with educational institution requirements.

All authors reviewed and contributed to the editing of the manuscript and have given their approval for the final version of the manuscript.

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6. Conclusion

In conclusion, this paper explores the implementation of IoT-based smart classroom management in colleges and universities. Utilizing RFID technology and facial recognition within the Internet of Things framework, a classroom attendance management system was developed. The experiment demonstrated that the RFID-based system effectively detects absent students and facilitates class changes with its fast response time and cost-effectiveness. Additionally, the facial recognition-based system records and analyzes student activity, including late arrivals, early departures, and changes in attendance. The test results aligned with the expected standards with minimal errors. This research contributes to the advancement of IoT technology and enhances education management practices in higher education institutions. While the experimental outcomes were generally consistent, the facial recognition system's performance can be influenced by factors such as lighting conditions and variations in students' sitting positions and facial appearances. Both attendance management systems fulfill the requirements of colleges and universities, but

further refinement and development are necessary to address the limitations identified in the study.

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