

Web-Based Smart Attendance System Using Face Recognition and GPS Authentication

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ABSTRACT

Traditional attendance system and smart attendance system such as manual sign-in and QR-code scanning are widely used in institution, but it prone to fraud and inefficiency. However, this project presents the development of a web-based smart attendance system that used face recognition and Global Positioning System (GPS) authentication to improve the accuracy and security in recording student attendance. The proposed system ensures that only students physically present within the campus building and match with the face image are marked as attended. The system is develop using HyperText Markup Language (HTML), Hypertext Preprocessor (PHP), Structured Query Language (SQL) and JavaScript, and website development software that provides real-time interaction between students and lecturers. This system can reduce lecturer workload and enhance data reliability. The combination of face recognition and location tracking offers a practical, accurate and scalable solution for educational institutions.

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1. INTRODUCTION

A smart attendance system is an automated, technology-driven solution specifically designed to track, record, and manage the presence of individuals in real-time, such as in a lecture room. Compared to conventional methods like signing sheets, a smart system minimizes human intervention and manual data entry.

To overcome the persistent limitations of conventional attendance recording methods, especially time-consuming manual signing sheets and QR-scanning, this study introduces an innovative and automated smart attendance system. By leveraging facial recognition technology, it seamlessly scans and identifies students' unique facial features. This effectively eliminates the fraud, manipulation, and errors often seen in traditional or QR-based systems, where students can easily share barcodes or sign in for absent friends. Ultimately, this automation not only boosts data accuracy but also frees up

valuable time for lecturers, allowing them to focus entirely on teaching rather than administrative tasks [2].

To ensure complete reliability and prevent remote check-ins, the system pairs its facial recognition feature with GPS tracking. This dual-verification process confirms that students are physically present within the specific campus boundaries when they attempt to record their attendance [3]. The platform operates securely on the web, built with a robust combination of HTML, PHP, SQL, and JavaScript to allow real-time updates. This means lecturers and administrators can instantly monitor attendance records without any manual data entry.

The testing of the proposed smart attendance system is conducted at Universiti Tun Hussein Onn Malaysia (UTHM)

which aims to simplify the attendance process and reduce lecturer workload [4].

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2. LITERATURE REVIEW

2.1 Comparison of the Proposed with the Existing Systems

As shown in Table 1, there are several differences between the smart attendance system proposed in this study with the existing systems. Comparison according to several features are summarized in the table.

Table 1. Comparison Between Existing Attendance Systems and The Proposed Web-Based Attendance System

Feature	Attendance Application using QR Code, Face Recognition and Location Tracking [1]	Smart Attendance System Using QR-Code, Finger Print and Face Recognition [2]	Information System with Face Recognition and Geolocation at MA Al Bukhary [3]	Web-Based Smart Attendance System Using Face Recognition and GPS Authentication [4]
Main Objectives	An Android-based attendance system using QR-code, face recognition and location tracking to improve attendance accuracy and reduce manual work.	IoT-based smart attendance system using QR-code, face recognition and fingerprint authentication for students and employees to automate attendance management.	Attendance system using face recognition and geolocation.	Attendance recording using face recognition and GPS authentication within the campus building area.
Methodology	Android application integrating QR-code scanning, face recognition, GPS location tracking and cloud database for attendance recording.	Android and IoT-based system using QR-code generation, face recognition, fingerprint authentication, GPS verification and mobile database integration.	Web and mobile-based attendance system integrated with TensorFlow face recognition and smartphone geolocation.	Web-based attendance system integrating face-api.js face recognition and GPS geofencing validation.
Face Recognition Method	Haar Cascade for face detection and Siamese Neural Network for face recognition with model retraining.	Face recognition using registered facial images stored in the database for identify verification before attendance is accepted.	TensorFlow-based facial recognition model.	Face-api.js face recognition using facial landmarks and face descriptors.
Location Verification	GPS confirms that students are within the lecturer's predefined location radius.	GPS verifies that users are located within the approved workplace or campus before allowing attendance registration.	Smartphone geolocation to verify user location.	GPS authentication with predefined latitude and longitude coordinates of the campus building.
Programming Languages	Java, Python, NodeJS, NextJS and Kotlin	Java using android Studio for mobile application development.	Not stated.	HTML, PHP, SQL and JavaScript.
Database	Firebase and SQLite.	Mobile database integrated with a central server database.	Web and mobile database integration.	MySQL database managed through phpMyAdmin and XAMPP Control Panel.
Key Advantage	Combine QR-code, face recognition and GPS verification to improve attendance accuracy while reducing proxy and manual recording.	Supports multiple authentication methods, provides attendance reports and manages both educational and workplace attendance.	Detects spoofed locations and supports mobile integration.	Prevents proxy attendance, real-time attendance monitoring and physical presence on campus building.
Limitations	Face recognition struggles in poor light, GPS signal weak indoors and needs retraining for new users.	GPS fail in weak signal areas and fingerprint devices cause queues and hygiene issues.	Requires strong internet, high computational and Geolocation can be spoofed.	GPS geofencing limited to campus building.

The previous research explored different approaches to smart attendance system. From reference [1], it is focused on an Android-based solution combining the QR-code, face recognition and GPS tracking to reduce manual work. Reference [2] proposed an IoT-based system using QR-code,

face recognition, fingerprint authentication and GPS verification for students and employees. Meanwhile, reference [3] focuses on integrating the face recognition and geolocation through web and mobile platforms. The proposed system is developed as a fully web-based smart attendance system that

using face recognition and Global Positioning System (GPS) authentication. The proposed system not only verifies student identity and location but it also provides interfaces for administrator, lecturers and students. It is more efficient attendance management, reducing fraudulent and more accurate attendance system.

3. METHODOLOGY

3.1 System Architecture

The following Fig. 1 shows the architecture diagram that consists of 3-tier architecture which consist of Front-end Development, Server-side Processing, and Database. This 3-tier architecture is the core components of modern web architecture, working together to deliver a functional website or application.

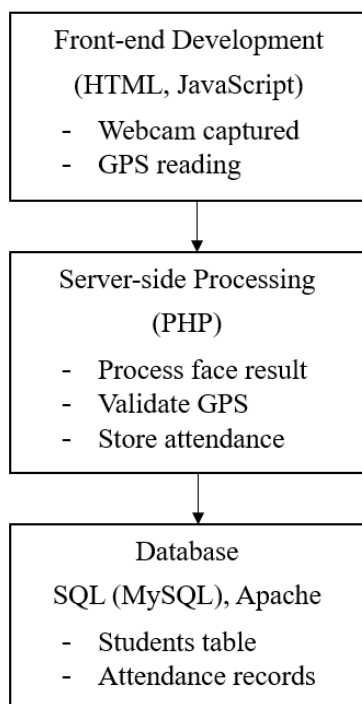


Fig. 1. System Architecture

Front-end development of the system consists of HTML and JavaScript languages. The method used to create the user interface and handle user interactions. JavaScript is used to access the webcam for image capture and obtain GPS readings. For server-side processing, PHP is used to receive data from the front-end development. It processes the face result, validates GPS location and stores attendance records in the database. Lastly, the database is managed using SQL and Apache functionality as the web server that connects the application to the database. The database contains structured tables such as user data and attendance records, which are used to store student information and track attendance data securely.

3.2 Flowchart of the System for Student

Fig. 2 shows the flowchart of the developed system for student. A literature assessment is carried out to gain a better understanding about the existing attendance systems, face recognition method and GPS authentication method, and other materials that match with this project.

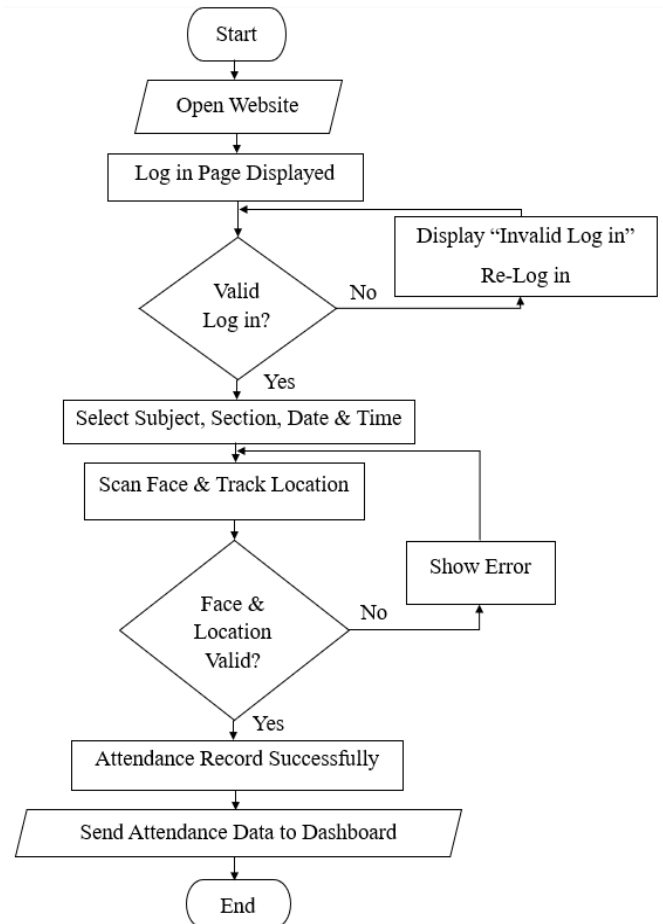


Fig. 2. Flowchart of the developed system for student

The workflow of the system started with opening the website log in and the user needs to enter their matriculation number and password to validate their identity. If the validation is successful, the attendance form will display and the user can proceed to select subject, date and time. However, if the validation fails, the system will display "Invalid Log in" and the user is required to re-log in. After that, the user is required to scan their face and track their location. If the validation is successful, the attendance is successfully recorded and the data is sent to the dashboard. If not, the system will show an error and the user needs to scan and track the location again until it is valid and attendance is successfully recorded.

3.3 Flowchart of the Developed System for Administrator and Lecturer

Fig. 3 presents the flowchart of the system for administrator and lecturer. It starts with opening the website and the log in page will display. The user can log in as an admin or a lecturer. If the staff number and password are invalid, the user needs to re-log in. If the user logged in as an admin, it shows the attendance system management where the admin can manage directly. On the other hand, if the user logged in as a lecturer, it displays the students' attendance records on the lecturer's interface.

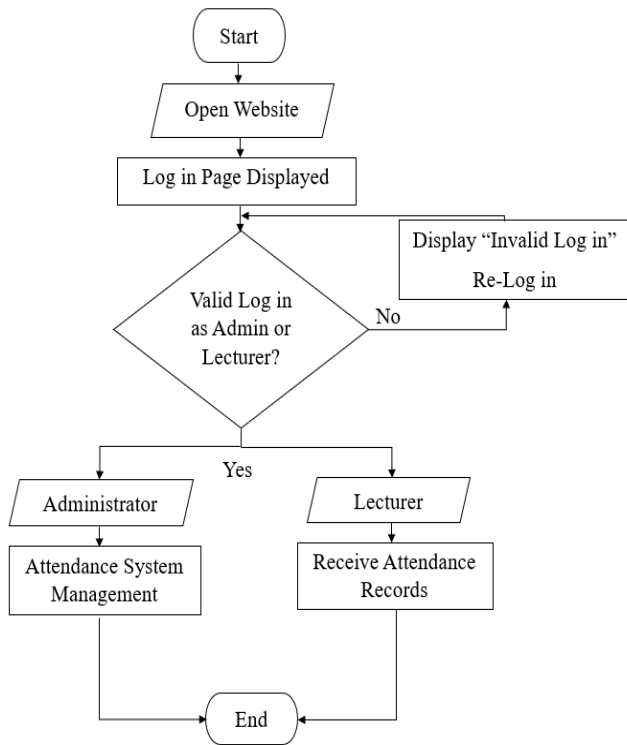


Fig. 3. Flowchart of the developed system for administrator and lecturer

3.4 The XAMPP Control Panel

According to Fig. 4, it shows XAMPP control panel. The XAMPP software functions as the local server environment that enables the development and execution of the web-based smart attendance system by integrate PHP, SQL, HTML, JavaScript into a single platform.



Fig. 4. XAMPP Control Panel

By using XAMPP, PHP processes backend operations such as handling log in requests, face recognition validation and verifying GPS coordinates before marking attendance. Next, SQL is to store data including user accounts, face recognition for identifying user's face, GPS logs and attendance records. SQL and Apache services also started to enable website hosting and database operations through this interface. XAMPP ensures smooth testing, secure data processing and smooth workflow throughout the entire system development process [5].

3.5 The phpMyAdmin Browser

The following Fig. 5 shows about phpMyAdmin browser. The phpMyAdmin browser provides a graphical environment that helps users interact with SQL (MySQL).

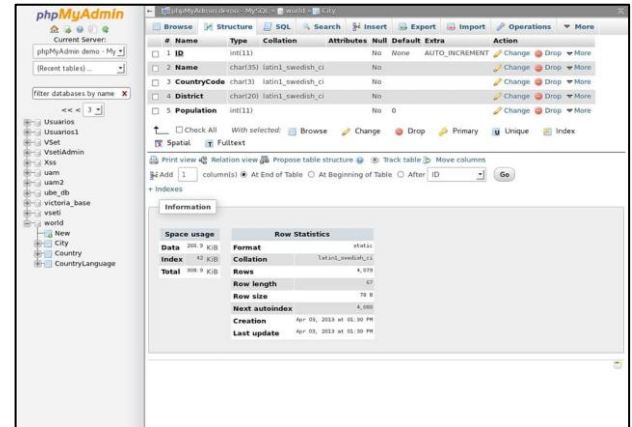


Fig. 5. phpMyAdmin Browser

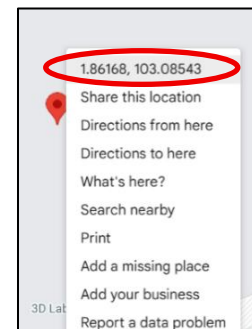
This browser is used to create database, define tables and manage structure. It also allows admin to visually browse, edit and delete database entries writing the SQL queries manually. In addition, it provides an intuitive interface for managing the database, doing maintenance and troubleshooting of backend data [6].

3.6 Face Recognition and GPS Authentication Method

This section presents the workflow of the face recognition process in the system and a geofencing method to determine whether the student is within the building area. Fig. 6 shows about attendance verification via face recognition and the Google Map.



(a)



(b)

Fig. 6. Attendance verification (a) Face recognition process, (b) The Google Map

In Fig. 6 (a), the system uses face-api.js to perform three main process. The *detectAllFaces(video)* code is used to detect the presence and location of faces captured from the video stream. Next, *withFaceLandmarks()* is used to identify key facial landmarks such as user's eyes, nose and mouth for structural mapping. Lastly, *withFaceDescriptors()* is used to generate a

numerical face descriptor representing unique facial characteristics for recognition.

Meanwhile, in Fig. 6 (b), the *Google Map* is used as a mapping service to set up the coordinates of the building and it is set as a center point. A specific range is then defined around the building location to form a virtual boundary [7]. The system will automatically capture the current GPS location and make comparison with the predefined geofence area when the student marks their attendance.

4. RESULT AND DISCUSSION

4.1 Log In Interface

The log in interface for the smart attendance system is developed using XAMPP and phpMyAdmin. XAMPP provides a local server environment to run PHP scripts, while the phpMyAdmin allows management of the database which include the storing and retrieving user credentials securely for log in process.

Fig. 7 presents the log in interface for the attendance system. It consists of two sections, which is “Sign In” and “Create Account”. This interface facilitates lecturers and students to create an account or log in to the system. Moreover, the admin can manage the attendance system through the same platform.

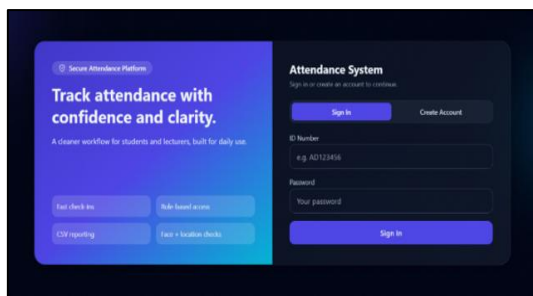
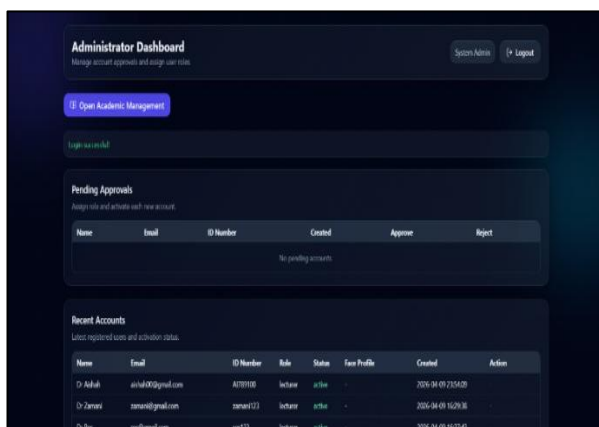


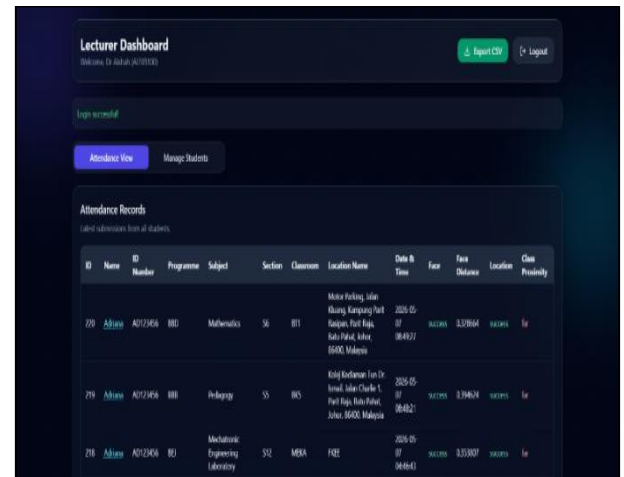
Fig. 7. Log in Interface

4.2 Administrator and Lecturer Interface

Fig. 8 shows administrator interface and lecturer interface for the attendance system.



(a)



(b)

Fig. 8. System Interface: (a) Administrator Interface, (b) Lecturer's Interface

Fig. 8 (a) shows the administrator dashboard which admin no longer needs to open phpMyAdmin to edit or manage the system. New account can be managed directly through the dashboard system. On the other hand, there is the academic management interface, which admin can add programmes, subjects, and classroom locations through the system. In addition, the admin can assign lecturers and students for each subject.

Fig. 8 (b) presents the lecturer interface that consists of two sections which is “Attendance View” and “Manage Student”. The first “Attendance View” section is used to provide real-time updates on students who have submitted their attendance. Thus, lecturers can easily download the Microsoft Excel file to tracking student attendance. The second “Manage Student” section is used to manage students who are unable to submit their attendance through the system, allowing lecturers manually record the students’ names to the system.

4.3 Attendance Forms

In this section, attendance forms have been developed, including subject selection, date and time, image capture and location detection features.

Fig. 9 shows the attendance form for the student interface. Before submitting attendance, students need to update their faces to confirm their identity. Students can easily select their enrolled subject by verifying the subject code, section, class or lecturer’s name, and the subject information will be displayed at the bottom of the dashboard.

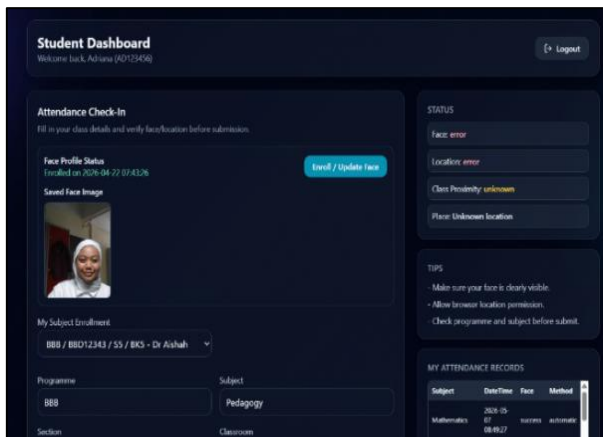
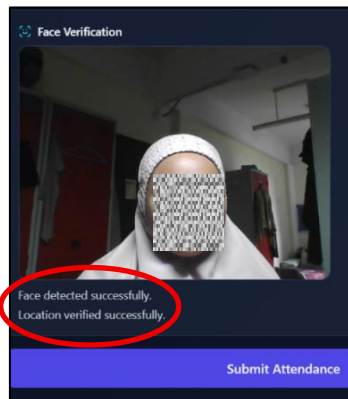


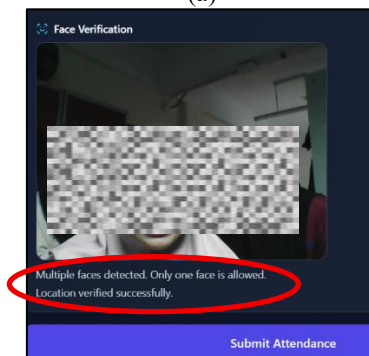
Fig. 9. Final implementation of the attendance form

4.4 Face Recognition and GPS Authentication

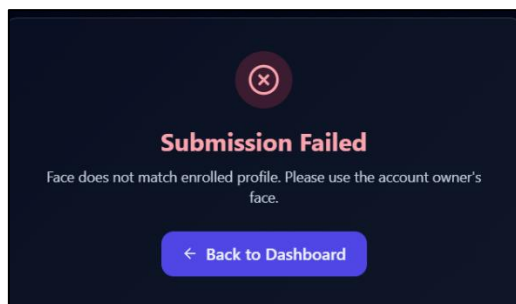
Fig. 10 shows the results of face scanning and location validation.



(a)



(b)



(c)



(d)

Fig. 10. Different detection (a) Valid face detection, (b) Multiple face detection, (c) Error detection, (d) Location validation

Fig. 10 (a) presents a valid face detection indicating that the actual user is scanning the attendance. The result in Fig. 10 (b) the system detects multiple faces in one account, it will detect an error and the user cannot submit the attendance. However, when a user attempts to use another person's face to submit attendance, the system automatically rejects and the user cannot submit their attendance as stated in Fig. 10 (c). As a result, it proved that the system can ensure the attendance been submitted with only their identical face that has been saved in the system.

As shown in Fig. 10 (d), the attendance record is successfully recorded and it present the class proximity to verify whether the student is at the correct location or not. The result displayed the class is 72.6m away from the exact coordinate of longitude and latitude. Even though the class proximity does not match the exact coordinate, the result is still accurate because the student is present within the campus building area.

5. CONCLUSION

The objectives of this project are to develop web-based smart attendance system that can record using face recognition for identifying student's face and track their location within the campus building area. In this project implementation, programming languages of HTML, SQL, PHP and JavaScript and several tools have been used. Based on the method used, the website has been developed to manage and maintain the attendance system effectively. The system can be used to facilitate the process of taking attendance in classes with accurate GPS information. In conclusion, after testing and troubleshooting, the system functions effectively and accurately. This means the objectives have been successfully achieved which the system can record attendance using face recognition and verify location within campus building area. Overall, the system can scan, track and record attendance data smoothly. All the attendance records are stored in the database safely. Lastly, the system's accuracy in detecting location at the area of campus building has successfully achieved.

After implementing this project, the system can function effectively according to the planned objectives. However, the system can be improved to achieve better accuracy. For future work of the system, the face recognition process can be scan automatically. Student do not need to click the submit button in the system like scanning QR-code. Furthermore, the system can

be enhanced to track the exact classroom latitude and longitude instead of only the area of campus building to differentiate each class location.

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