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MOBILE ATTENDANCE SYSTEM USING GPS AND FACIAL AUTHENTICATION

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ABSTRACT

Student attendance in any educational institutions is a critical content of the administration of school and the major task of the course lecturer who maintain attendance. The conventional method of monitoring students' attendance in the classroom typically involves requiring students to physically record their attendance. Initially, this process was carried out manually using pen and paper. However, as the student population grows, this approach becomes increasingly burdensome, time-consuming, and susceptible to mistakes. To avoid these challenges, this paper proposes a Mobile attendance system using GPS locator and facial authentication algorithm to monitor students' attendance using android mobile devices. The mobile attendance app is based on Client-Server Architecture where the server is hosted in the cloud and clients are with mobile devices with in-built GPS Locator. To secure the integrity of the attendance, the GPS locator helps in locating the precise geographical position of the students present, a mock detector is also integrated into the app to detect fake location of the students in the classroom meeting and the facial image used by the student at runtime support startup camera.

Keywords: Graphical User Interface, Attendance, Mobile Application, Biometric, Facial Recognition

1. INTRODUCTION

Regularly attending all lectures and lab sessions specified in the timetable is vital for students. This practice ensures effective learning throughout the semester, allowing students to cover the curriculum as intended. Some might argue that independent learning is the best way for students to learn and that student has the right to manage their own time, even if this means missing class (Jain, 2015), In some institutions, without a certain percentage of attendance, students are not allowed to sit for an examination, while other institutions, attendance is part of the continuous assessment. Research findings have consistently demonstrated a strong link between students' attendance and their academic performance. Student attendance administration is a critical content of the administration of school, college or university students (Zhang, 2013). In the traditional method of monitoring student attendance in the classroom, it is obligatory for students to physically indicate their presence on an attendance sheet that is circulated during the lecture by the course instructor. Today, attendance monitoring in many organizations have been revolutionized with information technological advancements especially Facial Biometric control with GPS Technologies. Facial biometrics is a significant application of

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image processing that finds utility in various domains. One such application is the use of face recognition for identifying individuals in an organization for attendance purposes. The maintenance and monitoring of attendance records are crucial for analyzing organizational performance. The development of an attendance management system aims to digitize the conventional method of taking attendance. By automating the process, an attendance management system reduces the need for extensive human involvement and efficiently handles the tasks of marking and analyzing attendance on a daily basis. The prevalent techniques and methodologies for detecting and recognizing face fail to overcome issues such as scaling, pose, illumination, variations, rotation, and occlusions (Chaitanya et al, 2017).

Mobile phones equipped with a GPS receiver are readily available on the market. Currently, the General Packet Radio Service (GPRS) stands out as an affordable and highly efficient mode of communication. The attendance system utilizes this type of mobile phone technology and is capable of carrying out all necessary operations. Upon launching the application on a user's mobile phone for the initial time, they will be prompted to complete the registration process. Thereafter, the user opens the software by entering their username and password. When the user enters their username and password, these are checked for authenticity. If not authenticated, the user is prompted with a message of wrong username and password and may re-enter their log in details (Geetha, 2016).

Biometric technology is the automated utilization of physiological or behavioral traits to establish or authenticate a person's identity. Additionally, the term "biometric" encompasses any human physiological or behavioral attribute that possesses the necessary properties for biometric analysis (Bolle et al., 2004). On the other hand, a GPS tracking unit is a device that employs the Global Positioning System to accurately ascertain the location of a vehicle, individual, or other object to which it is attached. It records the asset's position at regular intervals. The captured location data can be saved within the tracking device itself or sent to a central database or internet-connected computer via a cellular (GPRS), radio, or satellite modem integrated into the unit. This functionality enables the asset's location to be presented on a map background in real-time or during subsequent analysis of the tracking data. Customized software can be utilized for this purpose, as described in the study conducted by Amol et al. (2015).

The objective of this paper is to develop an attendance system that enables students to conveniently mark their attendance using their personal mobile devices. This system utilizes face recognition technology and a GPS locator. Notably, our proposed attendance system eliminates the need for additional peripheral devices, relying solely on students' smartphones. This approach reduces computational time and eliminates the expense associated with deploying physical devices in classrooms. One step toward sustainable development is using mobile phones to take

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attendance instead of the more conventional method. The same tasks can be completed on mobile devices, which not only conserves resources but also gives customers quick and interactive access to student attendance records. We attempted to create a tool that would allow instructors to take student attendance using their own mobile devices.

2. Precious research work on Attendance Monitoring System

Several approaches have been developed to efficiently monitor students' attendance. Shoewu et al. (2011) introduced a cost-effective computer-based embedded attendance management system that utilized electronic cards for attendance tracking. These cards, containing essential individual information, were inserted into a machine that recorded the time and other relevant details for a server The limitations of this study include its limited generalizability due to a small sample size, short duration, potential data accuracy issues, and a lack of exploration into student and faculty acceptance of the computer-based attendance management system. In a similar vein, Cheng et al. (2005) devised a system that employed user identification and passwords for authentication. However, a drawback of these electronic card or password-based systems is the potential for card or password sharing and dishonest use. This challenge can be overcome by employing a biometric recognition system, such as fingerprint or iris recognition. Basheer (2012) and Shoewu (2012) proposed and implemented a system using fingerprint scans to record attendance and generate reports periodically. Individuals simply needed to place their fingers on a fingerprint reader to have their attendance verified. To tackle the issue of misuse in electronic attendance systems, Kadry et al. (2013) proposed a wireless attendance management system that utilizes the uniqueness of an individual's iris for authentication. This system employs a scanner to capture the iris pattern, enabling automatic login. Compared to fingerprints, the iris is less susceptible to environmental factors. However, both fingerprint and iris recognition methods require additional devices and scanners typically connected to a server. Alternatively, radio frequency identification (RFID)-based approaches record attendance similarly to the fingerprint reader method, but with the use of RFID cards as the tools. These cards store encrypted user information and serve as a key to log arrival times.

Zhang et al. (2007), is with the assessment that attendance administration is overlooked by current instructive organization administration framework, concentrating just on record administration, training design, course administration, and so on thus they established attendance administration framework utilizing VisualStudio.NET and Oracle. Mohamed et al. (2012), outlined a unique finger impression gadget that is utilized as a part of unique finger impression attendance framework. Students verify their presence by placing their finger on the sensor of the device. However, this method is not always reliable as fingerprint scanners may fail to detect the fingerprints on the first attempt. In contrast, NFC-based applications streamline various daily human activities by simply touching an object embedded or integrated with

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an NFC tag. For example, Smart Touch is one of the early NFC ventures that spotlights on NFC innovation which was composed by VTT Technical Research Centre Finland; applications in different zones were produced under this venture, for example, mobile compensation and ticketing, savvy publication, attendance framework for schools, home utilize, family unit get to control and security, blood glucose meter, and so forth (Strommer et al., 2009). Soewito et al. (2015), proposed an attendance system using finger print and GPS technology through smartphone. Due to the utilization of fingerprint technology, the system is inefficient in terms of time consumption. Additionally, the system lacks the capability to generate .pdf or .xlsx files from the collected data. Noor et al. (2015) devised an attendance automation system for students that involves assigning a barcode-based ID to each student. The smartphone application reads this barcode to record attendance. However, an issue with this system is that one student can carry the ID of another student, potentially leading to misleading attendance records.

3. Methodology

The suggested system architecture adopts a client-server framework (Figure 1), with the client component being a lightweight Android application available for download as an Android Package Kit (APK) from the Google Play Store. This application features a user-friendly interface that allows users to register their device and personal information once. Additionally, it includes a functionality to enter a unique code provided by the lecturer whenever students wish to mark their attendance. The web server facilitates GSM connections to clients that have successfully logged into the system. To ensure proper mapping of user identity to their respective device (smartphone), a one-time registration process is required with the server. The server-side system is using 3-tier architecture. The initial layer grants system access to end-users (students, administrators, and course creators) through a smartphone application installed on the client's device. The design aims for a simple and user-friendly experience.

The middle layer encompasses crucial business functions, including registration, attendance marking, reporting, and sub-functions related to facial attendance analytics.

The final layer consists of the server's data tier, implemented using the MySQL Relational Database Management System and designed using MySQL Workbench. It comprises multiple relational tables carefully structured to facilitate scalability and flexibility. Users can create or sign into courses or events, while participants only need to register once to mark attendance for any event.

3.1 System Design Approach

The research utilizes two-factor authentication techniques Facial Biometric Technology and a Geographical Positioning System (GPS) Technology to record, track and manage students' class attendance data seamlessly. The proposed system allows students to record their attendance using their own mobile device. The proposed system is divided into three different

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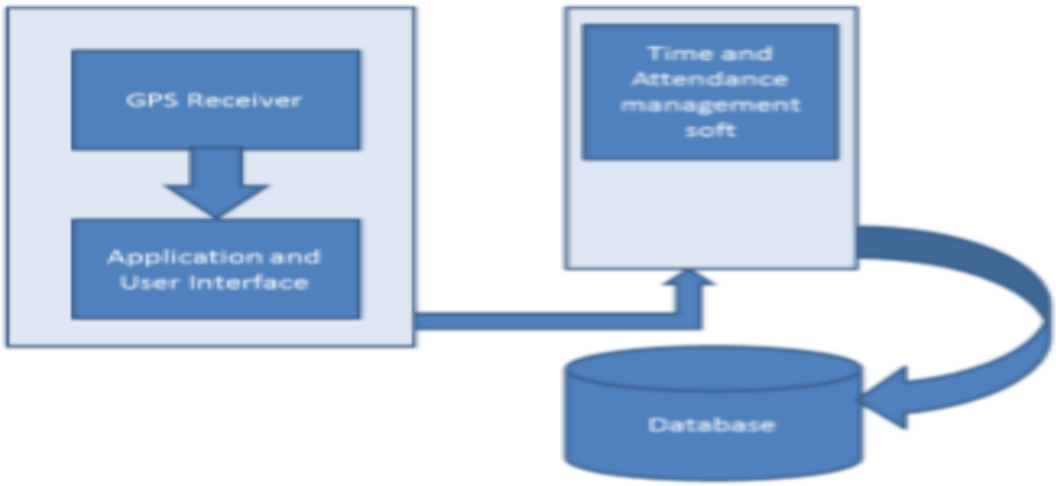

Figure 1. Schematic Diagram of the Mobile Attendance system

modules defined as follows: Lecturer attendance setup, process of attendance capturing and attendance report Figures 2 shows the process flow of Mobile Attendance System. The mobile application requires one-time registration of new user both Lecturer and student to map user identity with Matric No. or Staff No. and manage courses, creating new attendance session, marking attendance, taking photo to authenticate attendance and notification for successful sign in and sign out section in the lecturer module.

To utilize the facial attendance authentication system, students are required to download and access the corresponding mobile application. Upon initial use, students must complete a registration process to provide their relevant details. Once logged in, students can utilize the application to scan both a sign-in code and a sign-out code for recording their attendance. In Figure 3.2 of the system diagram, the lecturer's activity involves creating a session for a specific course and generating the corresponding sign-in and sign-out codes. This includes creating courses with their details by lecturer and reports, such as adding new course, creating session, editing or deleting the course itself. The lecturer has the ability to create multiple courses, each encompassing various sessions. These sessions can encompass lecture slots, test slots, or presentation slots, among others. Each session is assigned a specific date and duration, allowing for accurate scheduling within the course.

3.1.1 Attendance Code Generation

This phase is the most important phase in the all-whole process of the attendance system and it is performed by the lecturer assigned to a course, i.e., lecturer who wants to record student attendance. The attendance code is generated by the course lecturer by first logging-into the mobile application with their log-in credentials then generate a unique code for marking attendance and also signing-out after specifying which course they want to generate a code for (Figure).

3.1.2 Attendance Marking

This is phase is the actual purpose of developing this system, it is performed by the student who want to either mark attendance or

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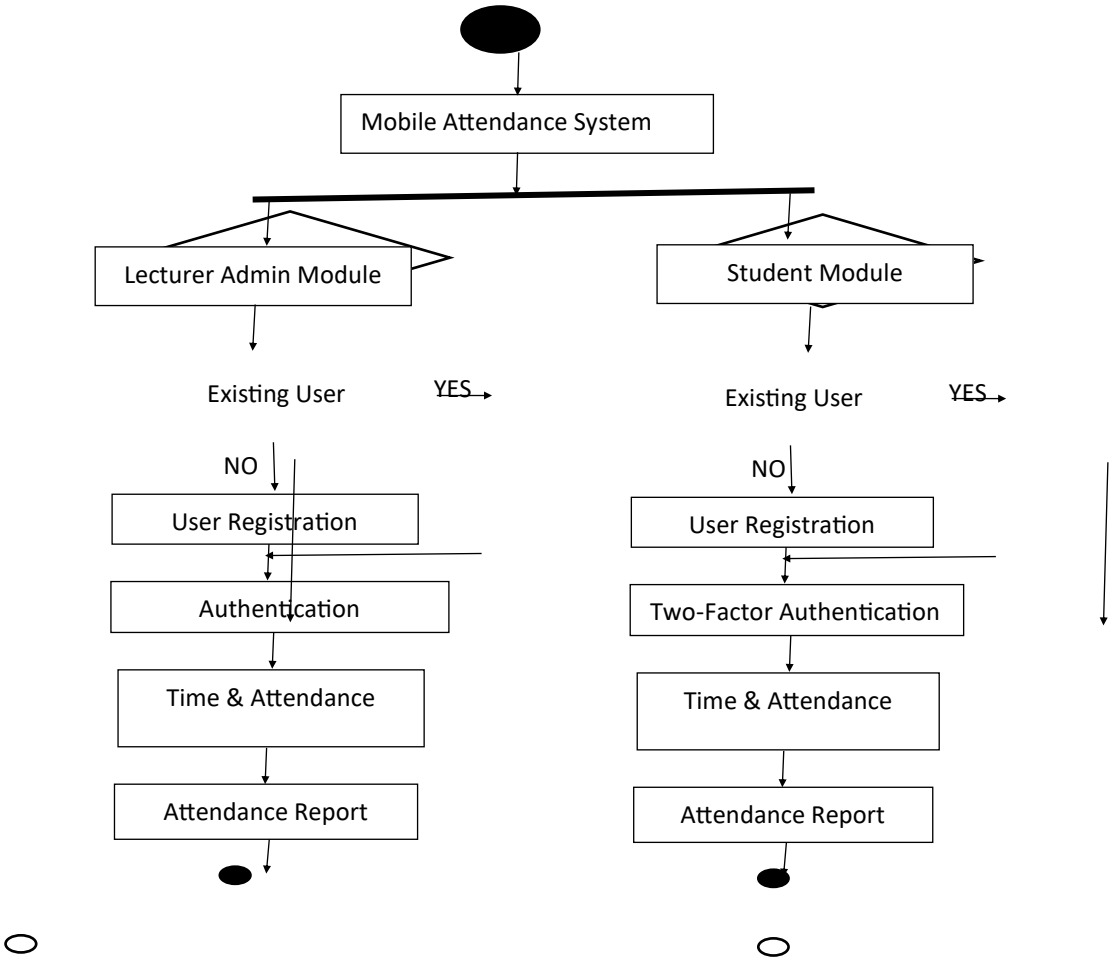

Figure 2: Activity Diagram – Schematic Design of Mobile Attendance System

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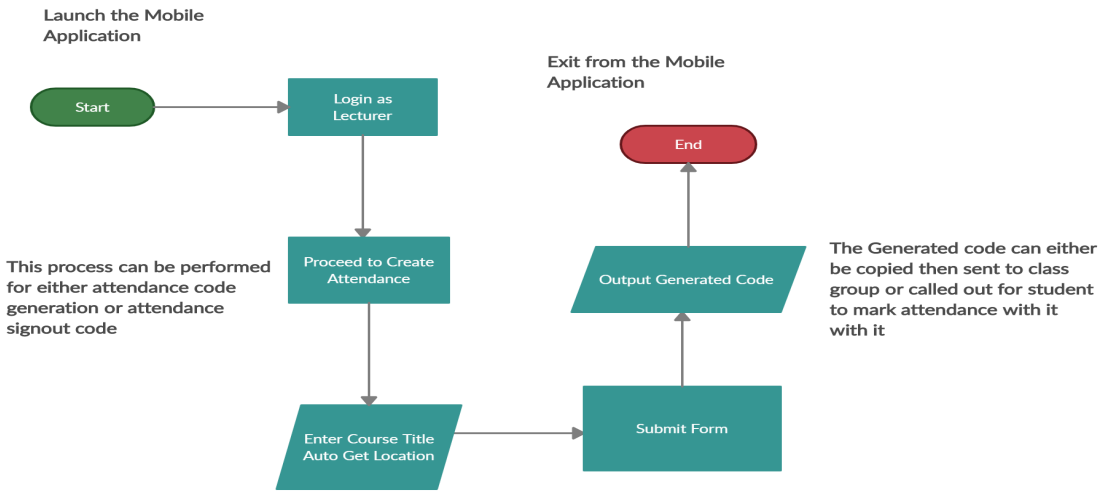

Figure 3. : Code Generation Process for Lecturer

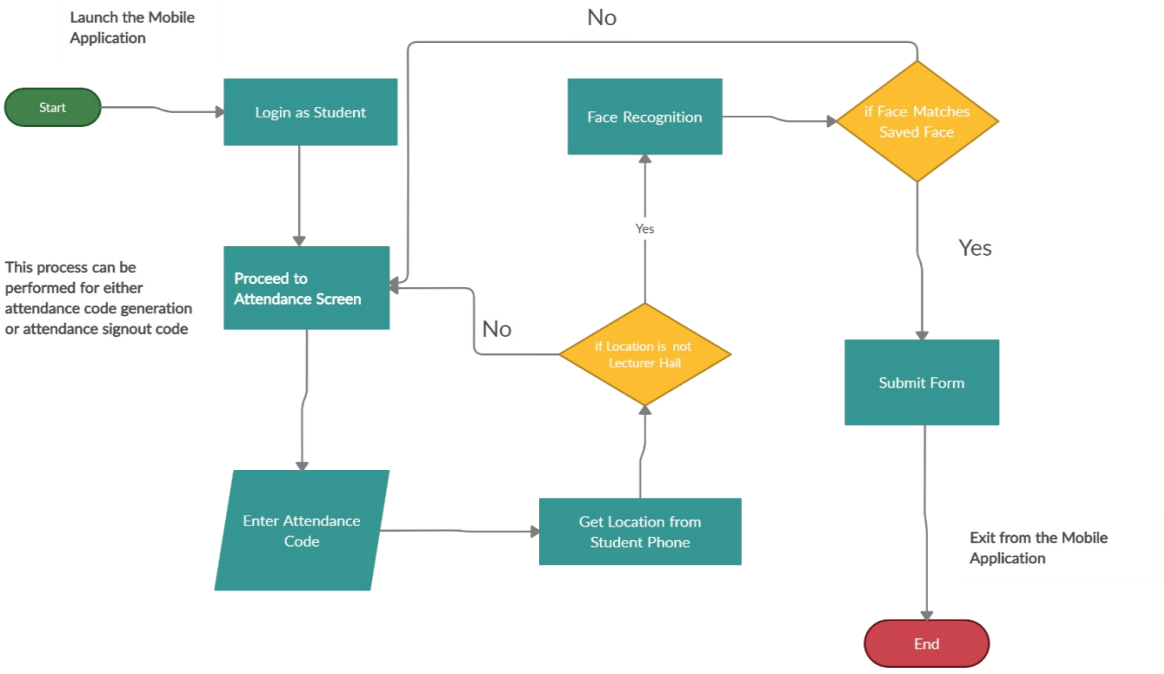

Figure 4 Attendance Marking Process for Student

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or sign-out. This process is done by each student logging into the application with their respective log-in credentials, then navigating to the attendance signing screen which prompt them to input the attendance code of which they want to sign-in for. The system then checks if the student's GPS location is in range with the lecturer's locations if not it prompts the student to move to the lecture area/ room. The next stage which is the final stage of this phase prompt the student to take his /her photograph with the application for facial recognition, if the application detects that the scanned face does not match the logged-in profile it rejects the attendance else it marks the student attendance for that class. This same process is performed for student signing-out.

After the application has confirmed the GPS location of the student is in a close range with the lecturer, it requests for a facial recognition of the student to confirm his/her identity which is solving the problem of impersonation. This is done by each student taking their facial photograph, save it and the mobile application confirms student identity. The application allows when student want to sign-out from a class after successfully marking attendance.

3.1.3 Attendance Report

The reporting feature of Mobile Attendance System provides documentation to the lecturers and the Yaba college of Technology. Users have the option to choose the courses they wish to view or download reports for. The term "output" refers to the information or results that are generated by a mobile or computer system and presented to the user for further action or consideration. The attendance report comes in two different forms, namely: Hardcopy (printed report on paper) and Softcopy (on the mobile/computer screens i.e., phone/monitor). The generated attendance report includes Sign out / sign in code generated by course lecturer, course lecturer assigned courses and student registered courses, lecturer attendance record report (week, month, semester), student attendance record report (week, month, semester) and screen notification.

3.2 System Implementation

The system's client-server architecture was implemented using simulation tools such as React Native and JavaScript framework developed by Facebook for mobile application development. The mobile attendance can run on any mobile application platform ranging from Android OS of Google LLC, OSX of Apple Inc. and Windows Mobile of Microsoft Corporation. The mobile attendance system is made up of the following pages:

Home Page: The home page of the mobile app links to the log in and sign up. The login interface allows lecturers and students to login their details and take both the students and lecturers to the dashboard respectively.

Registration Page: This is where both the lecturer and student enter their required details and it is stored in the database. Among these details, the image stored is required for facial recognition verification for the student to mark attendance. Login and Dashboard page allows users gain access to the application by entering

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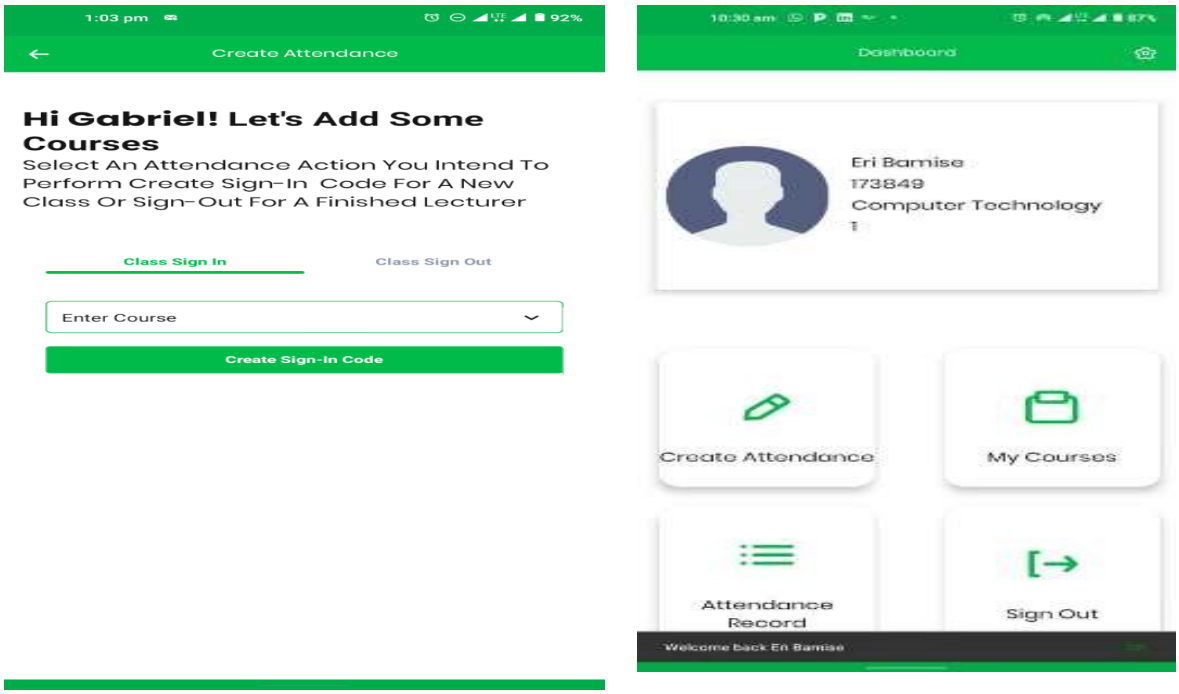

Figure 5: Login/sign up and Dashboard

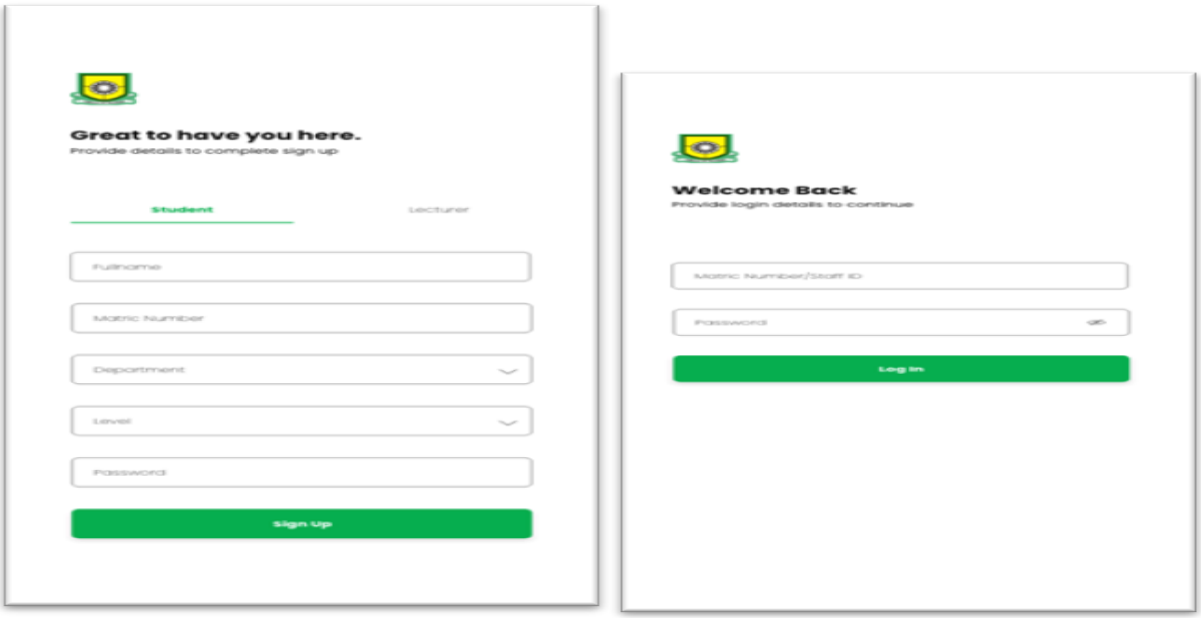

Figure 6: User Registration

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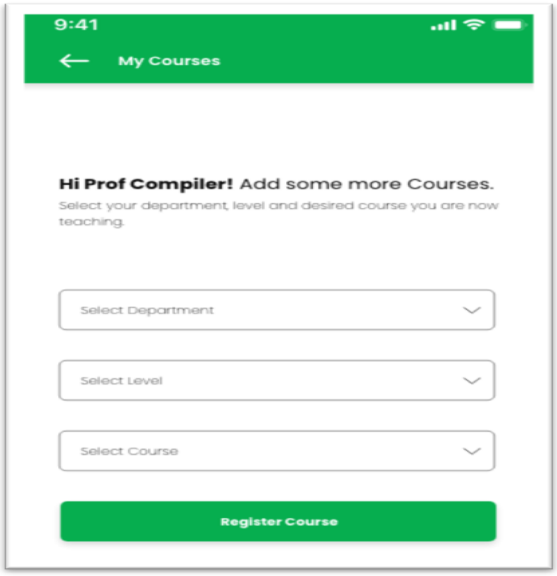
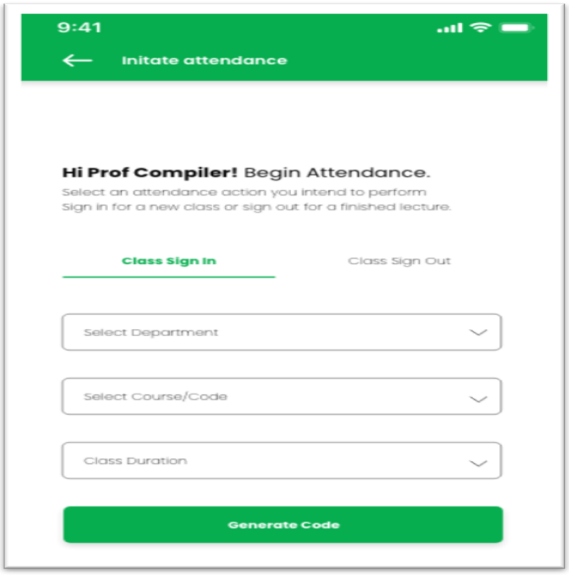
their correct username and password. The dashboard is the Main Interface that provides access to all other pages; the dashboard page can be accessed after the user has provided the appropriate login required information (Figure 6).

Attendance Process Page: Here, the lecturer setup the current course that's he/she wants to take, enabled GPS and setup attendance code that student will use to mark attendance lecturer. The student will input the code generated by the lecturer on the same course, then do the confirmation of the face authentication by scanning the face again, if it is successful, the student will click on submit attendance and a successful message pop up.

Attendance Report Page: The student has access to his/her record for every course at a particular time before or after end of the session or semesters, this enables the student to rate himself/ herself (figure 3.8). The lecturer will be able to view details information about the attendance he/she make for a particular course(s) he/she teaches. The lecturer will be able see time the student sign in/out, coordinates of the student at point of sign in/ out, the average attendance he/she made. The lecturer will also be able to get the excel format of the attendance.



(a)



(b)

Figure 7 (a & b): Lecturer: Setup Course and Generate Attendance Code

4. Results and Discussions

The mobile application class attendance system was able to register both student and lecturer in order for the student to mark attendance. The lecturer can activate the attendance system and specify range of time span for student to mark attendance. The mobile application can effectively recognize the face of a student that was saved in the database through the use of facial authentication. The GPS detector recognizes the exact geographical location of every student that login to the mobile application to mark course attendance. It allows students who are within the range of 10 metres from the lecture room to mark their attendance and denied access to those students outside the specified class proximity. To validate the findings of the cost-effective

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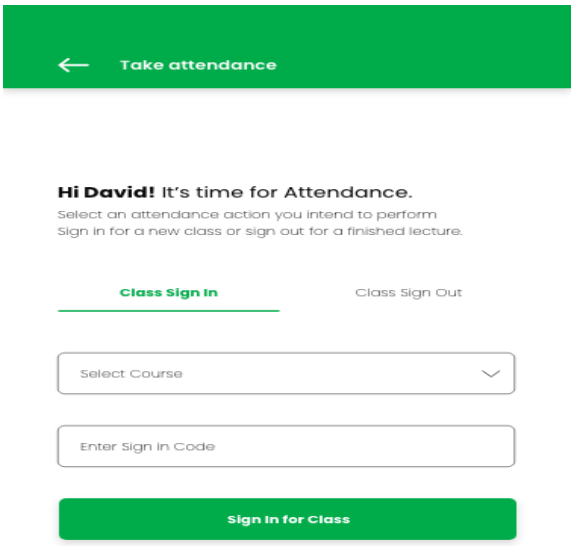
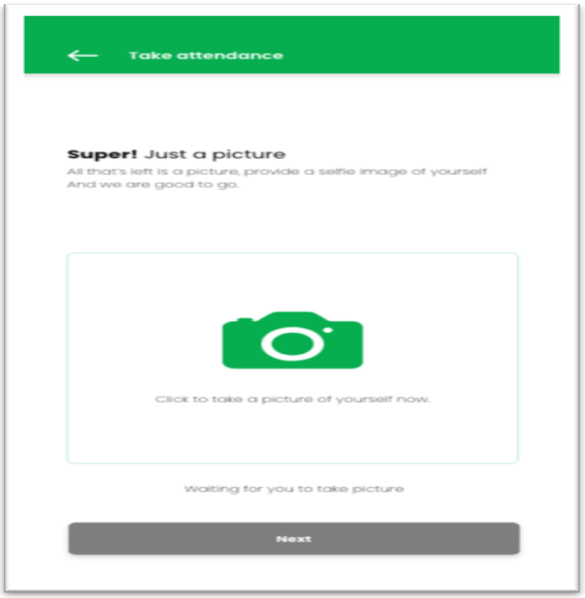
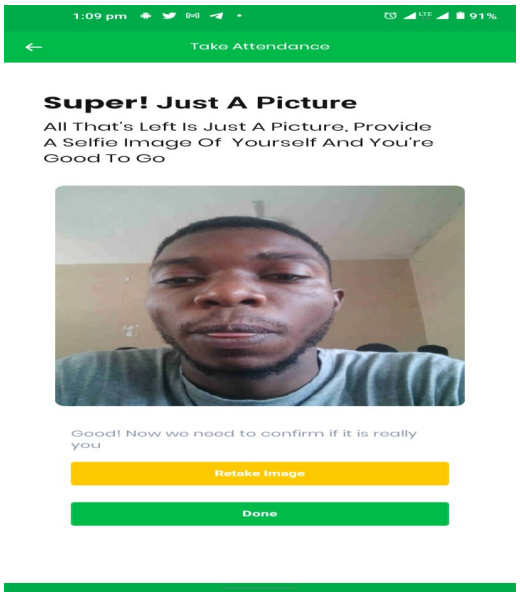


(a)



(b)



(c)

(d)

Figure 8 (a-d): Student: Mark Attendance

computer-based embedded attendance management system introduced by Shoewu et al. (2011), a comparison with the results of the mobile application class attendance system can be conducted, which utilizes facial authentication and GPS detection for attendance marking, potentially offering improved accuracy and convenience. The implementation result from the mobile attendance system is exported to Microsoft Excel Format and it contains detailed information such as student matric number, date, sign in time, sign in location, sign out time and sign out location as shown in Table 1. The different attendance reports summary can be generated based on lecturer usability criteria such as daily, monthly or semester. The report in Figure 10 is a student attendance record summary (week, month, semester).

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Table 1: Daily Students' Attendance Record Generated by the Lecturer in Excel Format.

B9 F/HD/18/3210023

	A	B	C	D	E	F	G
1	S/N	Matric No	Date	Sign In	Sign In Location	Sign Out	Sign Out Location
2	1	F/HD/18/3210049	Wed 28th Jul,2021	02:12 pm	{"lat":6.5178503,"lng":3.372534}	02:16 pm	{"lat":6.5178502,"lng":3.3725336}
3	1	1234	Wed 28th Jul,2021	06:29 pm	"{lat:13.466,lng:56.098765}"	06:34 pm	{"lat":13.466,"lng":56.098765}
4	2	F/HD/18/3210014	Fri 30th Jul,2021	07:48 am	{"lat":6.5450782,"lng":3.3954351}	07:52 am	{"lat":6.5450782,"lng":3.3954351}
5	2	1234	Fri 30th Jul,2021	08:11 am	{"lat":6.5450782,"lng":3.3954351}	08:13 am	{"lat":6.5450782,"lng":3.3954351}
6	3	F/HD/18/3210014	Fri 30th Jul,2021	07:53 am	{"lat":6.5450782,"lng":3.3954351}	07:54 am	{"lat":6.5450782,"lng":3.3954351}
7	3	1234	Fri 30th Jul,2021	08:07 am	{"lat":6.5450782,"lng":3.3954351}	08:14 am	{"lat":6.5450782,"lng":3.3954351}
8	4	F/HD/18/3210023	Fri 30th Jul,2021	02:16 pm	{"lat":6.5177652,"lng":3.372501}	02:21 pm	{"lat":6.5178465,"lng":3.3725238}
9	5	F/HD/18/3210023	Fri 30th Jul,2021	02:24 pm	{"lat":6.5177435,"lng":3.3725363}	02:29 pm	{"lat":6.5177437,"lng":3.3725365}
10	8	F/HD/18/3210000	Fri 30th Jul,2021	03:44 pm	{"lat":6.5177285,"lng":3.3725413}	03:50 pm	{"lat":6.5177179,"lng":3.3725649}
11	9	F/HD/18/3210014	Fri 30th Jul,2021	05:41 pm	{"lat":6.5178519,"lng":3.3725161}		

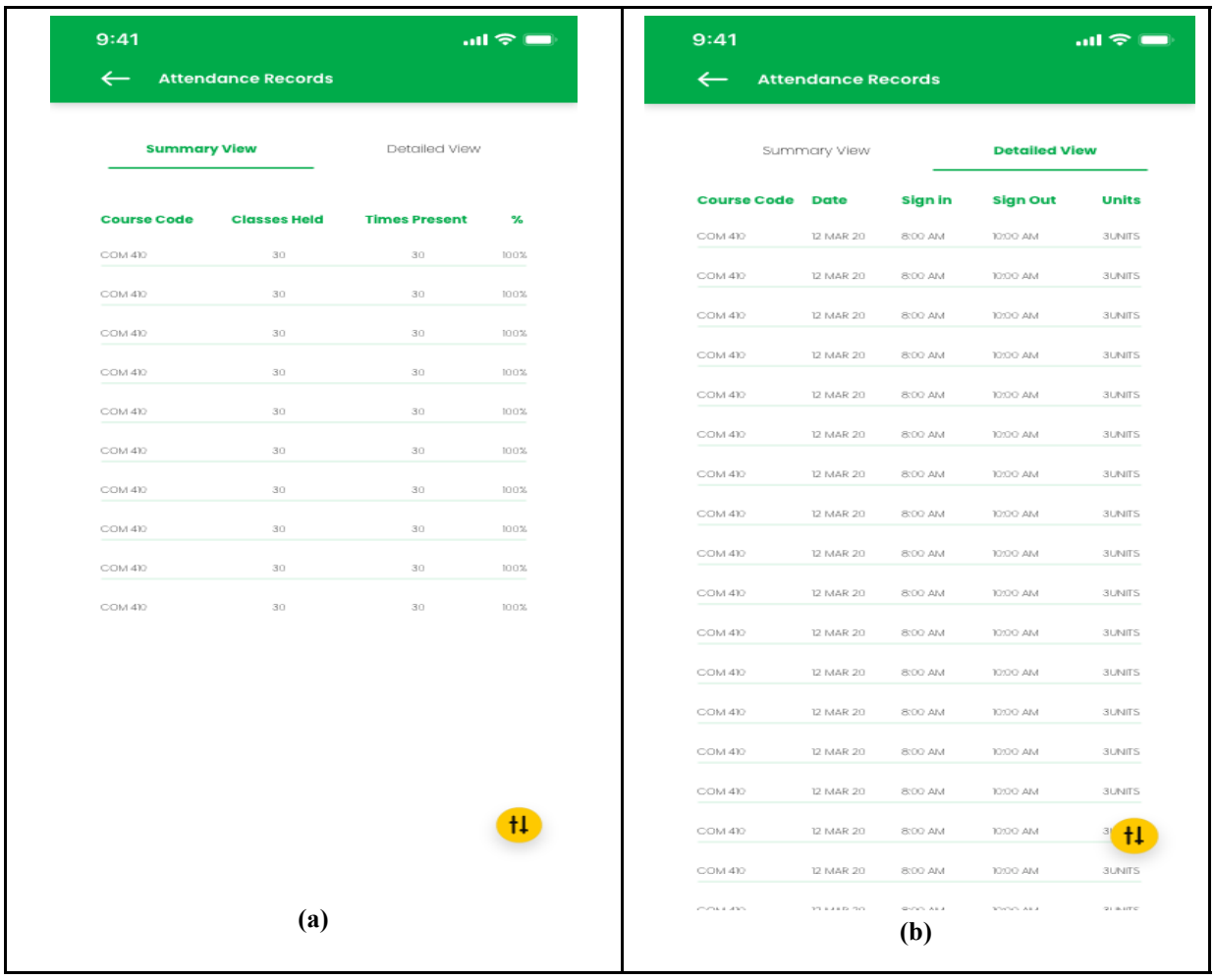

Figure 10: Student Attendance Record Summary (Week, Month, Semester)

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The implementation results presented above demonstrates the robustness of the proposed system in tracking students' attendance in Yaba College of Technology. The mobile attendance system eliminates the challenges of the existing manual system especially students' impersonation and proxy student' attendance capturing. The new system offers seamless attendance capturing without interfering with ongoing course lecture. The report generation is very fast and time-saving because students' attendance summary is produced with the click of a button. The system provides user-friendly interface for students to create and access their account from their mobile device. It allows the students to mark their attendance within the vicinity of the class in Yaba College of Technology with the right timing based on real-time facial recognition.

5. Conclusion

The study investigates the introduction of a mobile attendance system that effectively addresses the issue of impersonation during lectures by employing two-factor authentication methods. Geographical Positioning System (GPS) and Facial Authentication techniques were used for the investigation. The system provides seamless recording, tracking, and management of students' class attendance data, ensuring enhanced security, reliability, and time savings. Additionally, the system's capability to track the location of students during attendance marking makes it a valuable tool for various applications, including examination attendance tracking and other related fields.

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