Chapter in Book

AttenTriX - Student Attendance Application with Geofencing and Facial Recognition

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Abstract: *Most educators will spend a few minutes taking students' attendance in the classroom, particularly in universities and colleges. It is possible to carry out this procedure in several ways, such as calling out students' names or giving them a piece of paper to sign as confirmation of attendance. This procedure is time-consuming, susceptible to fraud, and disruptive during class. This project aims to improve the attendance system to offer a more dependable and secure way to track students' attendance. Using the Convolutional Neural Network (CNN) algorithm, we examined the student's facial shape, eyes, nose, mouth, and other facial traits. The algorithm is used to build a model that can classify each student based on their face image. Moreover, geofencing detects and measures the student's location to determine whether the student is inside the classroom area.*

Keywords: attendance management; convolutional neural network; geofencing; facial recognition; mobile application.

1. INTRODUCTION

An attendance management system is a method used to track attendance information. Taking and maintaining student attendance manually has always been a difficult task. Many businesses, colleges, and schools still use paper-based attendance systems, which can be risky and prone to error (Bharathy et al., 2021). This approach requires students to write their name or sign on paper and hand it to the educators at the end of the class. Most universities in Malaysia that apply and use this attendance system have proved to be easily manipulated. Some students can easily imitate their friends' signatures to help their friend absence from class (Zainal et al., 2014). The attendance system should not be taken for granted for various reasons. One reason is that the attendance system allowed the higher authority to view and monitor the staff members' dedication to their jobs (Zainal et al., 2014). In this case, the student's commitment to attend the class. Attendance is a criterion for passing a course in many educational institutions. In Universiti Teknologi MARA itself, according to the university academic regulations, students will receive a notification letter as the first warning whenever the absenteeism rate reaches 10%. When the absenteeism rate hits 20%, the last warning will be given, and the students may be barred from taking the final examination.

The rise of Artificial Intelligence, Machine Learning, and Deep Learning has revolutionised and opened many possibilities in various fields. "Computer Vision is a combination of image processing and pattern recognition where the output will be an image understanding" (Wiley & Lucas, 2018). The process of computer vision involves obtaining the raw input in the form of digital images to be

processed to obtain various information and features. This information will then be used for image, iris, facial, and face recognition. On the other hand, geofencing is a location-based service in which an app or other software uses GPS, RFID, and Wi-Fi to trigger some action, such as a notification when a mobile device enters or exits a virtual boundary built up around one geographical location (White, 2017). Geofencing is primarily being used to track the movement of some entities accurately at one location.

The idea of this attendance system is to combine all three elements above to develop a mobile application that can track attendance by using face recognition and geofencing. Digital attendance management systems can change how lecturers manage the classroom. Lecturers can say goodbye to paper-based attendance and shift to a more effective system. Calculating and recording absence takes less time and effort if an accurate attendance and time-tracking system is used.

2. METHOD & MATERIAL

The development model adopted in this project is the Waterfall model. Waterfall model is one of the earliest process models for software development. The main advantages of the waterfall approach are that it is very straightforward, simple to understand, and simple to use (Kramer, 2018). There are five phases involved, namely information and idea gathering, requirement analysis, design, development, and testing. There is no task overlap between the phases, and each step must be completed before moving on to the next. The outcome of the earlier phase serves as the basis for the subsequent phase.

a) Phase 1 (Information and Idea Gathering) - This phase focused on the application's requirements. Detailed project information was gathered.

b) Phase 2 (Requirement Analysis) - The project's requirements were analysed and documented. Every constraint and limitation that can impact the development process was considered.

c) Phase 3 (Design) - The application was designed in three stages. The use case diagram, flowcharts and mock user interface designs are the key elements of the design.

d) Phase 4 (Development) - The development phase is the technical phase, where the source code and algorithm were written, and the image dataset was collected. The application was coded in the Ionic Hybrid mobile app and Django environment.

e) Phase 5 (Testing) - Testing is critical to ensure that the application functions as intended and conforms to the requirements. Testing was carried out by providing test inputs, recording the outcomes, and confirming that the actual results match the predicted results.

3. FINDINGS

The findings are discussed in this section.

3.1 Graphical User Interface (GUI) of AttenTriX

Figure 1 shows the GUI of submitting the attendance after face recognition. The student must take a picture of themselves and upload it to the server. The server will retrieve the image and execute

the facial recognition using the Convolutional Neural Network (CNN) algorithm. A pop-up message will be displayed once the student's attendance is successfully taken. Figure 2 shows the GUI when the student is not within the designated area. The application will read the student's latitude and longitude. Then, the student can click on the take attendance button. A pop-up message will be displayed if the student is not in the designated area. Figure 3 shows the GUI of the attendance list. The list view displays the name and matric number of each student that has ticked their attendance. The map view shows the location of the student as the marker and the designated area as a rectangular box. The marker representing the student's location can be clicked to show their name.

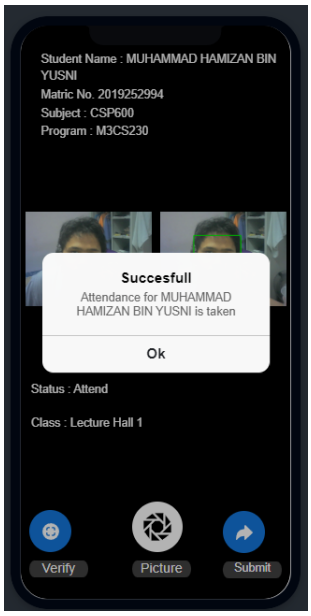

Figure 1

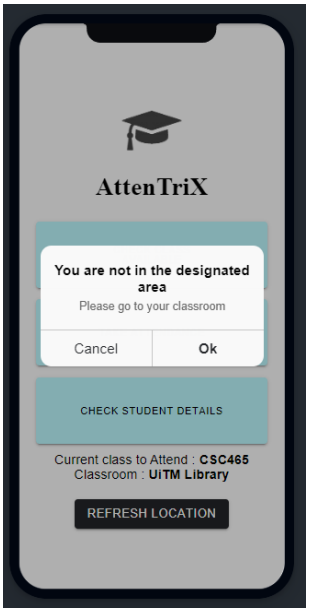

Figure 2

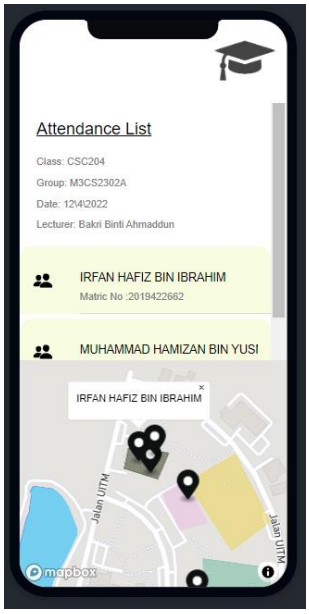

Figure 3

3.2 Functionality Testing

Functionality testing was conducted to ensure AttenTriX's main features work as intended and without error. The outcome demonstrates that AttenTriX is functioning as expected. The results of functionality testing are presented in Table 1.

Table 1. The summary of functional testing

Use Case Name	Use Case Description	Fail/Pass
View student detail	This use case allows students to view their details by inserting their student id.	Pass
Take attendance	This use case allows the student to take their image, verify it with Convolutional Neural Network algorithm and send their attendance to the database.	Pass
Check class availability	This use case is for the student to check and select the available class before taking attendance.	Pass
Read location	This use case allows the application to read the user's location and compare it with the location of the designated area.	Pass

4. DISCUSSION

This study introduced an attendance system by using face recognition and geofencing technology. We have designed and tested our proposed attendance system on smartphones. The results show that the application can recognise the face and detect the location of the students in the designated area. Nowadays, smartphones are more than simply communication tools. Smartphones present chances to enhance the educational process, such as daily attendance management. An attendance management system that is manually maintained has numerous drawbacks, including the waste of paper, difficulties in preserving data, and others. This mobile attendance system is software-based, not hardware-based. Hence, the classrooms do not need to be equipped with anything else. Modern technology breakthroughs like mobile devices make it possible for managing attendance more efficiently. Class attendance records can be viewed in real-time, allowing lecturers to determine whether a student is present.

5. CONCLUSION

We now live in a digital age where technology is constantly evolving. Education institutions will significantly benefit from this application. AttenTrix is an integrated and innovative platform that automates the process of taking attendance. There is no need for expensive additional devices such as a scanner to record attendance as students can use their smartphones. This application can effectively track the location of students and recognise the students accurately when taking attendance. This application also provides a friendly User Interface (UI) and available for both Android and IOS users. By digitising attendance, less time and effort are required to calculate and record the absence as it provides a more effective solution.

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