INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES
Vol 13, Issue 12, (2023) E-ISSN: 2222-6990

Assessing Functionality and Usability of Smart Attendance Apps for Student Monitoring System

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To Link this Article: http://dx.doi.org/10.6007/IJARBSS/v13-i12/19902 DOI:10.6007/IJARBSS/v13-i12/19902

Published Date: 10 December 2023

Abstract

Apart from monitoring, student attendance serves many other essential reasons. In certain universities, one of the prerequisites for a student to be eligible to take the final exam is to have completed the course. Pen and paper or a basic web-based system that requires time-consuming and challenging faculty monthly monitoring have been the methods of choice for documenting attendance in the majority of Malaysian Institutions of Higher Learning (IHL). Using Bluetooth Low Energy (BLE) technology, this project attempts to design a Smart Attendance for Faculty Monitoring System to help faculty properly record, manage, and monitor students' attendance and class schedules in order to overcome the highlighted drawbacks. Iteration an incremental approach is an agile process used in the development of the system for Android-based devices. Therefore, a survey was sent to 140 Universiti Poly-Tech Malaysia (UPTM) lecturers and students in order to assess the system's functioning and usability. Purposive sampling was used to choose the respondents. According to the descriptive analysis, 87.9% of the respondents strongly agreed that the system assists lecturers to keep track of students' attendance, manage class schedules, and support faculty in monitoring student absenteeism.

Keywords: Bluetooth Low Energy Technology, Beacon-Based Application, Smart Attendance System, Attendance Monitoring System, Students' Absenteeism.

Introduction

Effective attendance recording and management play an important role in today's world whether in industries or educational institutions. Attendance is one of the work ethics valued by employers and it is also one of the factors that influence the performance of students (Arif et. al., 2018). Students can gain valuable information from lecturers by attending classes, which can increase students' competencies. Studies have shown that the traditional methods are inefficient as it required more class time, difficult for faculties periodic monitoring and the possibility of misuse by students, especially in classes involving large group of students (Mijić et. al., 2019), and is time consuming and requires human interference, hence, it can be prone to human error and fraud (Limkar et. al., 2019). Therefore, there is a critical need to adopt an automated attendance management system to assist lecturers to record, manage and monitor students' absenteeism effectively. According to Credé et al (2010), attendance in class has a significant impact on students' traits and behaviours in addition to their grades. Interestingly, despite empirical evidence showing students with poor attendance records perform poorly academically, both students and some educational experts appear to be somewhat sceptical of the significance of class attendance (Newman-Ford et al., 2007). Similarly, Ahmad et al (2020) found that, on average, students who miss classes do poorly on their final exam, with their marks being reduced by 1.89 percent at these universities. Furthermore, according to Mijic et al (2019), class attendance might serve as a signal for implementing corrective and preventive actions aimed at enhancing student achievement. Consequently, keeping track of attendance is crucial for faculty.

In recent years, Internet of Things (IoT) technology has made a significant impact in the development of innovative systems that have been investigated by many researchers in various domains. Many attempts have been made by researchers to address the weaknesses of traditional systems by developing automated systems using this latest technology. Therefore, this research aims to propose an effective attendance taking process integrated with Bluetooth Low Energy (BLE) technology using IoT applications to assist faculty to monitor student absenteeism via web-based and mobile applications.

Literature Review

Most educational institutions and industries in developing countries still use paper-based attendance methods to maintain their attendance records (Walia & Jain, 2016; Jadhav et. al., 2018). In Malaysia, most universities still use the traditional attendance taking method to record physical class attendance (Azmi et. al., 2018). But, in recent years, some of them have use a simple web-based system for lecturers to manually record attendance data and store the data into a database. However, there are some difficulties faced by lecturers using traditional methods such as inefficient attendance taking process, tedious monitoring student absenteeism, high risk of data loss, and tendency to allow students to sign attendance on behalf of absent peers (Baharin et. al., 2020). Mijić et. al (2019) also agreed that the traditional methods are inefficient as it required more class time, difficult for faculties periodic monitoring and the possibility of misuse by students, especially in classes involving large group of students. Moreover, Limkar et. al (2019) stated that the traditional way of recording student attendance is time consuming and requires human interference, hence, it can be prone to human error and fraud. Therefore, there is a critical need to adopt an automated attendance management system to assist lecturers to record, manage and monitor students' absenteeism effectively.

The COVID-19 epidemic has had a severe impact on the education and industry sectors over the past three years. Businesses and academic institutions were compelled to close in order to stop the disease's spread. To meet the existing needs and help stop the disease from spreading, a contactless system for class attendance was suggested. For instance, in order to lower the risk of COVID-19 infection, Tamilselvan et al (2021) designed a contactless temperature measurement and web-based attendance monitoring system employing the Node MCU, MLX90614 Infrared Thermometer, RFID Reader, and Ultrasonic Sensor. With the speed at which new technologies are developing, there are many different kinds of automated attendance systems available to meet demands today. These include hardware- and software-based solutions utilising barcode, magnetic stripe, and RFID technology (Dedy et. al., 2018; Mijić et. al., 2019), Bluetooth Low Energy (BLE) Technology and biometric (fingerprint and face-recognition) solutions (Rani et. al., 2021; Sutabri et. al., 2019; Walia & Jain, 2016; Rajamanogaran et. al., 2020).

A number of automated systems for tracking and managing attendance have recently been created and made available. In these state-of-the-art systems, the most crucial steps are the data processing model and the data gathering technique (Arif et al., 2018). For this aim, a variety of well-known technologies have been used, such as barcode readers, Bluetooth, NFC, RFID, and biometric techniques like voice, fingerprint, face, and iris recognition. (Rajamanogaran et al., 2020; Rajani et al., 2021; Sutabri et al., 2019; Walia & Jain, 2016). The process of gathering attendance data is made easier, faster, and more precise by these technologies (Dedy Irawan et. al., 2018).

Based on the percentage of attendance permitted by the institution, Bakhri et al (2020) built a software-based system that monitored student absenteeism through the use of Short Message Service (SMS) notifications. Parents and students will receive automated SMS notifications from the system to help the Academic Affairs Division (ADD) handle the lecturer's warning letters. However, instructors still have to manually enter the information about the absent pupils into the system, which takes time and costs money for SMS services. Jadhav et al. (2018) created a low-cost, semi-automated Android system with a QR code that holds all attendance-related data, in contrast to existing software-based systems. Android is a smartphone operating system primarily meant for touchscreen devices.

Using QR codes, barcodes, and magnetic stripe charges for hardware-based solutions has certain drawbacks, according to (Rjeib et al., 2018). These include lengthy registration times, a high error rate, low accuracy, and artificial identification in addition to traditional manual management and staff statistics for attendance management records. The previously proposed solutions are also not environmentally friendly. In order to efficiently monitor students' attendance and class schedules, Rjeib et al (2018) presented an RFID-based Attendance Management System (AMS) and a web-based application. As an alternative. A Bluetooth Low Energy-based student placement system was presented by Puckdeevongs et al (2020) to automatically record student attendance in schools.

The technology used in this study is based on BLE technology and is combined with cloud and Internet of Things applications to run and track attendance in real time. Bluetooth, commonly referred to as "Bluetooth Smart," is a subset of the traditional lightweight Bluetooth class that was included in the core Bluetooth 4.0 specification. Bluetooth is a wireless technology standard used for short-range data transfer. According to Azmi et al. (2018), BLE seeks to offer much lower costs and power consumption while preserving a comparable communication range. BLE is a wire-less network technology that is safe, inexpensive, and compatible with many different operating systems. It also has a similar communication range. Therefore, the proposed system with the use of this technology assists faculty in recording, managing and monitoring students' attendance and class schedules effectively. However, the importance of BLE applications is not only employed in education, rather in occupancy detection, emergency management, health monitoring, asset tracking, access control and smart energy management show the huge potential and flexibility of BLE. Studies have been conducted to propose the BLE based systems for construction related applications such as occupancy patterns and profiles in office spaces (Tekler, et. al., 2020) emergency management system (Filippoupolitis, et. al., 2016), and occupancy-driven plug load management (Tekler, et. al., 2022). However, BLE based systems are now being applied on other areas such as asset tracking (Pešić, et. al., 2018), traffic monitoring (Lewandowski, et. al., 2018), access control (Heyn, et. al., 2019) and mobile electrocardiogram (ECG) monitoring system (Yu, et. al., 2012).

Additionally, the BLE technology solves challenges with interoperability, low power operation, secure data transfer, affordability, and electronic compatibility that previously prevented wireless technology from being widely used in medical applications (Yu, et al., 2012; Omre & Keeping, 2010). Bluetooth is based on standards maintained by the Bluetooth Special Interest Group (SIG), an association with around 14,000 members from commercial electronics businesses, for the development of medical applications. In particular, during the COVID-19 pandemic, self-isolating COVID-19 patients can be monitored remotely to obtain health information, and Bluetooth SIG has developed Health Device Profile (HDP) software to optimize traditional Bluetooth including BLE performance for health applications such as monitoring temperature, scale, glucose, pulse oximetry, heart rate, pedometer, speed, distance, accuracy, blood pressure, battery status, and simple remote-control devices (Omre & Keeping, 2010). (Priambodo & Kadarina, 2020). Furthermore, BLE technology integrated with a wireless ECG monitoring system has also been developed to transmit electrocardiogram data, process and display ECG waveforms on smartphones to assist patients and doctors in telemedicine (Yu, et. al., 2012). Therefore, the studies showed that BLE technology can reduce power consumption for long-term monitoring [Pešić, et. al., 2018; Lewandowski, et. al., 2018; Heyn, et. al., 2019) and it can be used to integrate with many IoT applications including medical applications for computer-monitored rehabilitation, emergency care, and continuous patient monitoring at home or to send analysis results to remote hospital central (Yu, et. al., 2012; Omre & Keeping, 2010; Priambodo & Kadarina, 2020).

Today, most smartphones, tablets and other communication devices are BLE compatible. Users can communicate seamlessly with devices such as Blue-tooth-enabled wireless headphones, digital signage, car stereos, fitness trackers, smart watches and beacons. Beacons are small BLE radio transmitters that have given mobile applications the ability to understand position sed on micro-local scales and provide proximity content to location-based receivers (Baharin et. al., 2020). Beacon devices are placed in fixed locations (e.g., classrooms, lecture hall, etc.) or can be brought by the lecturer. When-ever there is a class, students' smartphones can detect the beacon thus allowing at-tendance to be taken. The range of BLE devices can be adjusted, thus, the device can transmit, and it can be connected to an infinite number of devices or smartphones (Puckdeevongs et. al., 2020). This device will be placed in the classroom where students will check in to confirm their attendance via Bluetooth. Students will be able to verify their personal information via the mobile app and lecturers will be able to easily observe the number of attendees for their classes and the information of participating students anytime and anywhere. As such the system developed falls into the smart university taxonomy (Uskov et. al., 2016) to fit in a smart environment supported by smart technologies, utilizing smart tools and smart devices to adopt novel technologies such as cloud and grid computing. Next Generation Network (NGN) services, and portable devices with advanced applications in highly interactive frameworks (Sultan et. al., 2018).

The goal of this project is to create a faculty monitoring system that uses smart attendance based on Android and Bluetooth Low Energy (BLE) technologies to address the drawbacks found in conventional attendance taking procedures. The system helps faculty efficiently record, manage, and monitor student absences and class schedules through a combination of web-based and mobile applications. 140 instructors and students from Universiti Poly-Tech Malaysia (UPTM) participated in a survey to assess the system's ability to achieve the goal. The practical contribution of the study is the applicability of the system by the users. According to the lecturers, class attendance has improved, and the monitoring process is easier. The sequential mixed approach adds methodological contribution, making the study more robust and reliable. The study's final contribution is the theoretical contribution of TAM in the research to ensure functionality and usability of smart attendance apps for student monitoring system

Methodology and Development

This study applies a sequential mixed method approach that starts with designed-based research followed by a quantitative method using survey questionnaire (Jayatilleke, et. al., 2018). An Android-based smart attendance for faculty monitoring system using the Bluetooth Low Energy (BLE) technology was designed to address weaknesses identified in traditional attendance taking processes at UPTM. Upon completion of the system, a sample of students and lecturers are requested to assess the functionality of the system based on a questionnaire to measure the following tasks: managing class schedules; taking student attendance; managing student attendance; monitoring students' absenteeism; and sending students' absenteeism notifications.

The system development uses combination of various software and programming tools. The web-based platform is developed by utilizing Vue as the development software. Whereas the mobile platform uses React Native and UI Kitten mobile frameworks. The server back-end framework uses Apollo server which is spec-compliant with GraphQL server. The system uses MongoDB and Redis as the database while Redis is used as the database which cater the in-memory data structure store, cache, and message broker.

Figure 1 illustrates the backend and frontend structure of the development process. The backend development provides endpoint access for frontend to request data from database. Web and mobile frontend request data using endpoint applying the Application Programming Interfaces (API) concepts to get response from backend. This way will provide a great deal of flexibility and improved connectivity between data and systems.

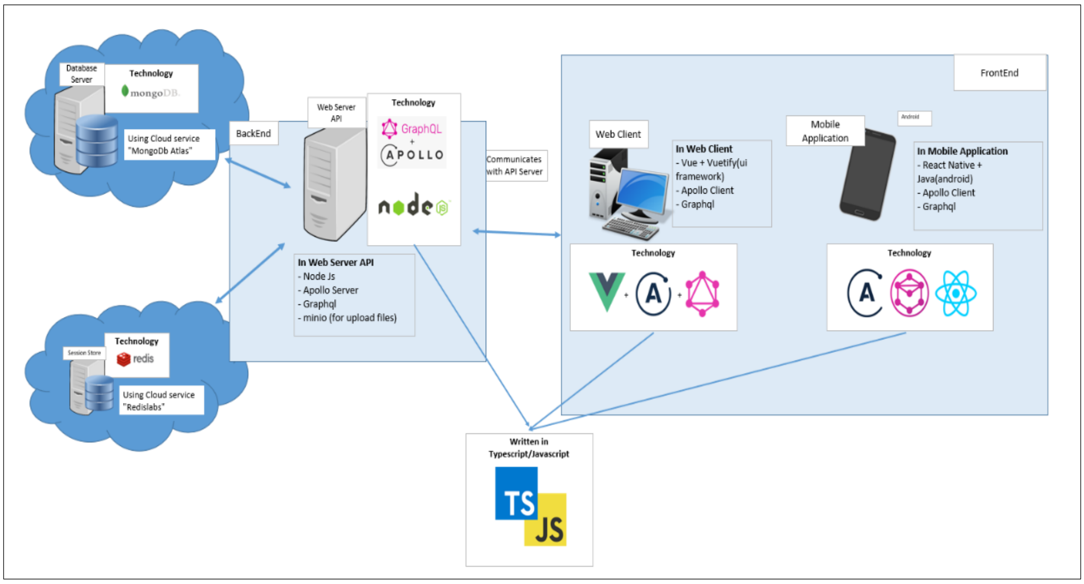


Figure 1: Development Specification

Agile methodology is used as a system development lifecycle for this research. The agile methodology uses an iterative and incremental approach in developing a software as shown in Figure 2. Agile approaches dissolve tasks into lesser versions, or segments. This method does not directly require long-term planning. Plans are clearly defined in advance regarding the number of iterations, the length, and the range of each iteration. This approach can save significant development time as users can see the product for the first time through the rework process. It is an excellent way for developers to validate their understanding of the specifications and ensure that the solutions proposed are consistent with organization expectations. In the agile development methodology, each iteration is seen as a brief "frame" phase that typically lasts one to four weeks. Reducing project uncertainty and the total amount of time needed to complete the project can be achieved by breaking the project up into smaller parts. Before a work product is presented to the client, a team goes through the entire software development life cycle throughout each iteration, which includes planning, requirement analysis, design, coding, and testing. The requirements collecting, design, construction, testing, quality assurance, deployment, and feedback phases make up the six stages of the agile model.

Requirement gathering is the first phase which involve the definition of the project scope and specifications. This phase is the most crucial phase to ensure the next development process is smooth and clear. Technical and economic feasibility are also deter-mined to clarify the time and effort needed for the development of the project plan. Next phase is designing the requirement. This phase involves specifications design such as designing use case diagram, user flow diagram and class diagram. These diagrams are useful to view the function of new features and demonstrate how it would relate to the current system. After completed design the requirements, construction or iterations process will begin to work towards delivering a working product on the project. The software will be enhanced in various stages. Therefore, it includes simple and minimal functionality. Testing or quality assurance phase checks the consistency of the material in this cycle and searches for the error. A few agile test methods will be used as the testing or quality assurance. The final phase is deployment and feedback. The product is published and de-ploy in real environment of the user during this process. The real environment normally will face a lot of problems and incompatibility issues. From here, feedback is gained through the experiment of user experiences on the system.

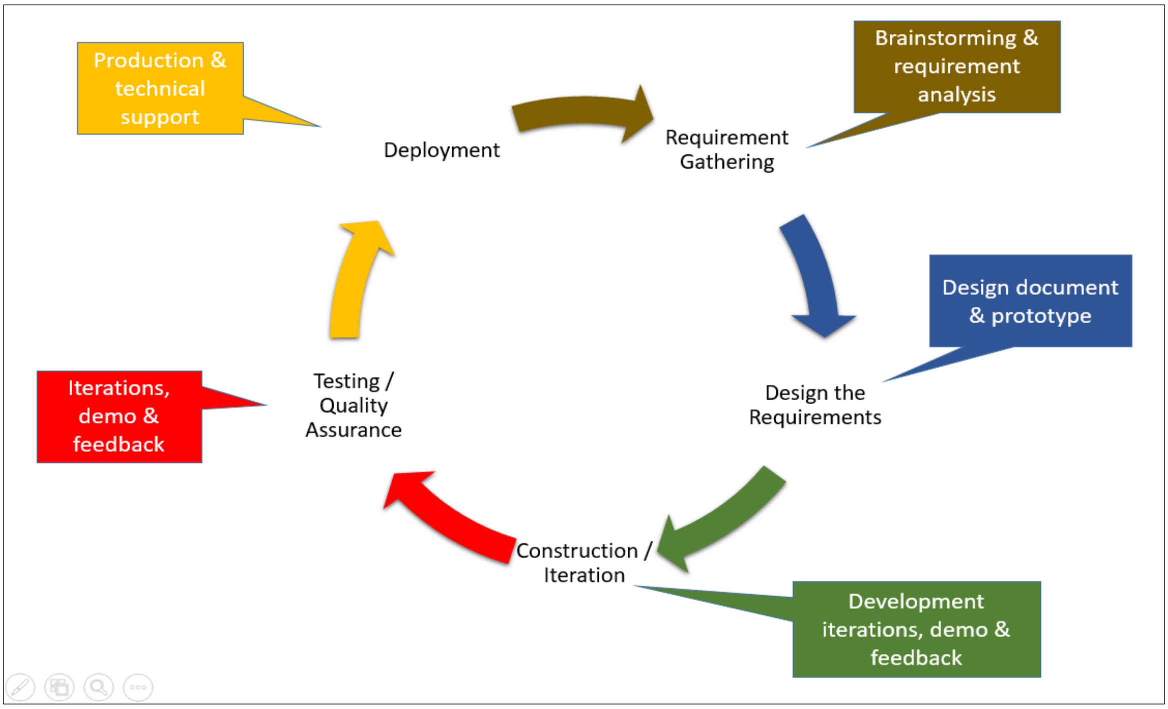


Figure 2: Agile Methodology Development Life Cycle

Interface Design

This section discusses the interface design of the research paper. The system aimed to provide an effective attendance-taking process and monitoring management. It uses BLE technology integrating with the Internet of Things (IoT) applications to assist lecturers in performing automated attendance monitoring and management system. The focus of this section is divided into five main tasks (modules) of the interface design including Task 1: Managing class schedules; Task 2: Taking student attendance; Task 3: Managing student attendance; Task 4: Monitoring students' absenteeism; and Task 5: Sending students' absenteeism notifications.

Task 1: Managing class schedules

Managing class schedules module focuses on organizing lecturers' and students' timetable within the application. The system allows lecturer to upload the class information file into the system as shown in Figure 3. The class information file should be in xls or xlsm format that contains course information, time, venue, and list of students. The system will generate the schedule for the user to view. If the user is a lecturer, the schedule can be viewed in both platforms, i.e., web-based and mobile. Whereas, for students, the schedule is viewed in mobile application platform only. Figure 4 and Figure 5 show the schedule page in web-based and mobile application platform respectively. Moreover, this module also allows the lecturer to add replacement class for replacement classes accordingly. The replacement classes slot can be viewed and edited in the schedule as shown in Figure 6 and Figure 7.

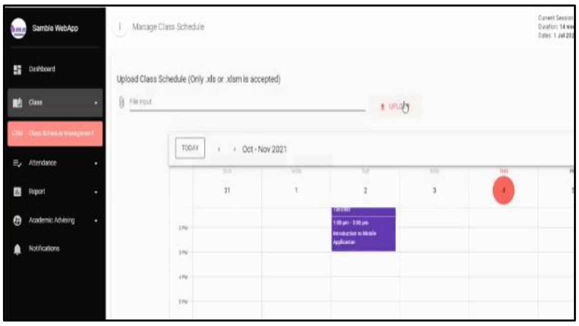


Figure 3: Lecturer can upload .xls or .xlsm file to generate schedule

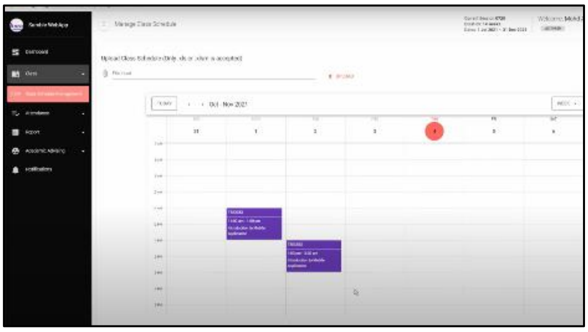


Figure 4: Class schedules in web-based platform

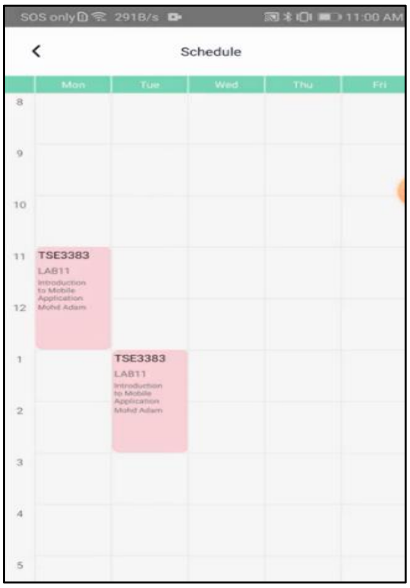


Figure 5: Schedule view in mobile application platform

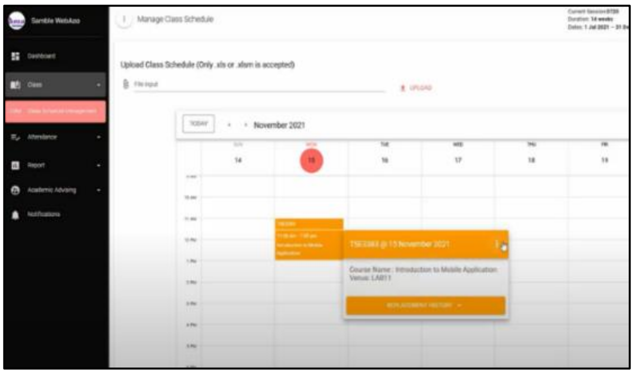


Figure 6: Lecturer can view replacement class history

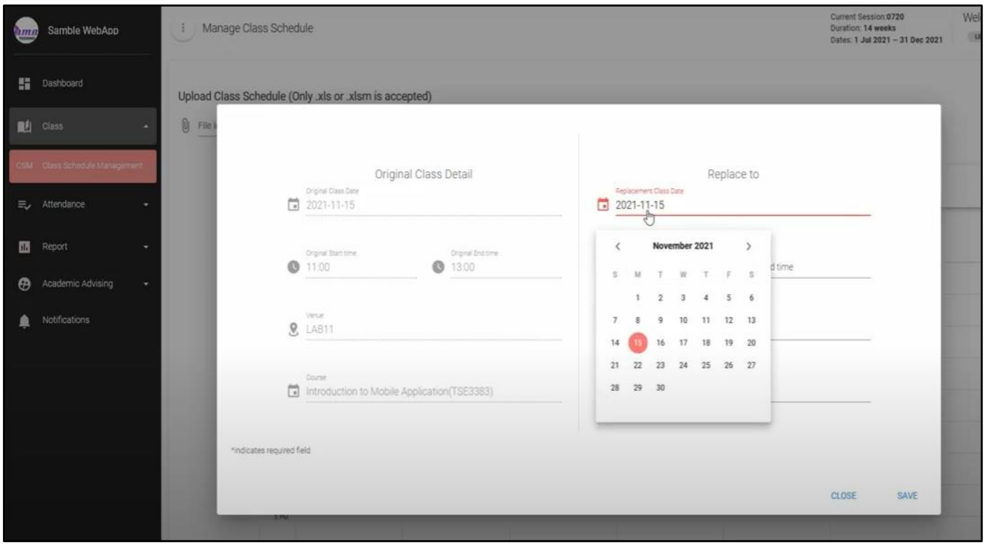
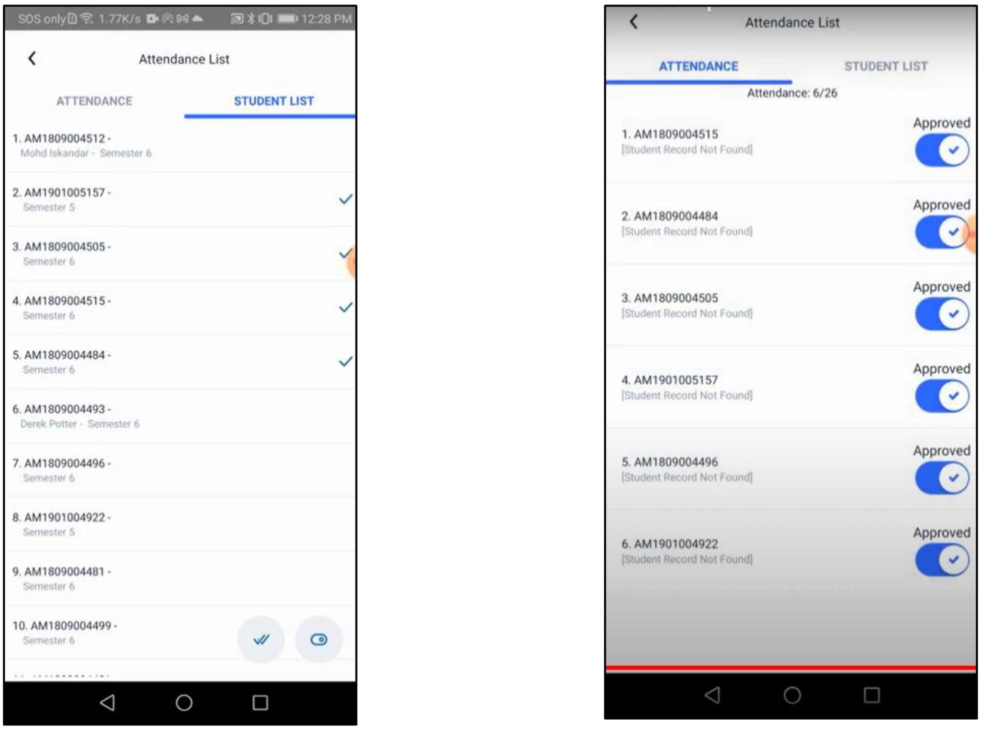


Figure 7: Lecturer can add and edit replacement class

Task 2: Taking student attendance

The system can record student attendance automatically using proximity detection by integrating with the BLE beacon. A lecturer can activate the system to take attendance automatically. After the student has logged into the apps, his/her attendance is automatically recorded upon activation of his/her smartphone's Bluetooth whilst in the classroom. The lecturer needs to validate the attendance after class session by activating the check button. If a student forgets to bring a smartphone or has a smartphone problem during class, the lecturer can help to record the attendance manually. Figure 8 shows the interface of students' attendance taking in the apps.



(a) (b)

Figure 8: Manage students' attendance in apps

Task 3: Managing student attendance

The lecturer also can update manually students' attendance in case of any technical issues that occur during attendance taken by the beacon. The lecturer can also view students' list for the taught courses and attendance can be updated manually. Finally, the lecturer can view the list of students for his/her class and can manage the class attendance easily as shown in Figure 9.

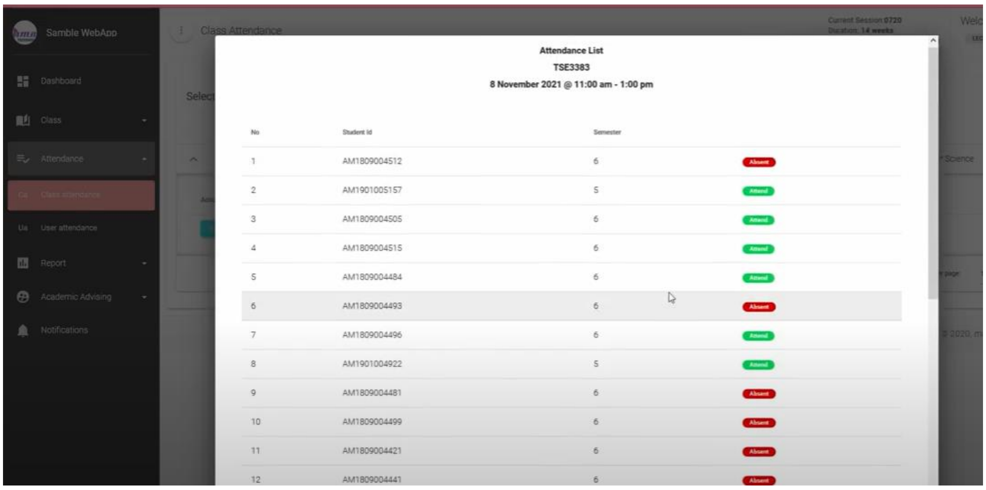


Figure 9: Lists of summary records of student attendance

Task 4: Monitoring students' absenteeism

The system provides many ways to monitor students' absenteeism record. Firstly, the lecturer can view the analytical graph reports of the attendees, absentees, and attendance rate in the dashboard page of the web-based platform as shown in Figure 10. Secondly, the lecturer can view and manage the students' attendance record for all courses that he or she taught for the semester. The system can list summary records of student absenteeism for monitoring purpose. Thirdly, the system will notify the lecturer to automatically send warning letters to students, other lecturers, parents, and mentors based on permissible percentage (7%, 14% and 21%).

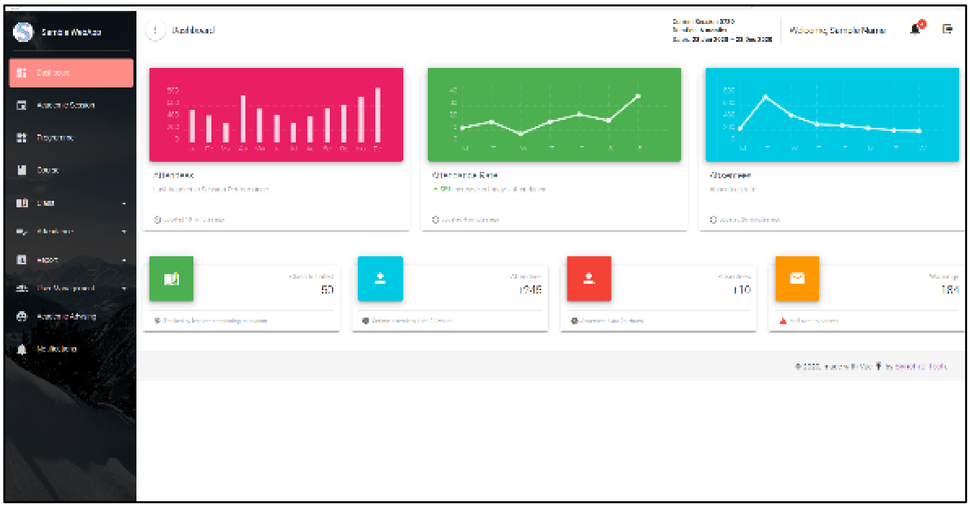


Figure 10: Dashboard page with analytical graphs for students' absenteeism reports

Task 5: Sending students' absenteeism notifications

The applications provide notification features which alert the lecturer on students who are absent from class based on permissible percentage discussed earlier. The notification is sent via in-apps alert and email. The system notifies the lecturer to inform that students' warning letters have been sent to his/her email. Moreover, the system can also notify mentor by email, if the respective mentee receives a first or second warning letter or a warning letter that bars the student from taking the examination. Finally, the system can also notify parents by email (refer Figure 11).

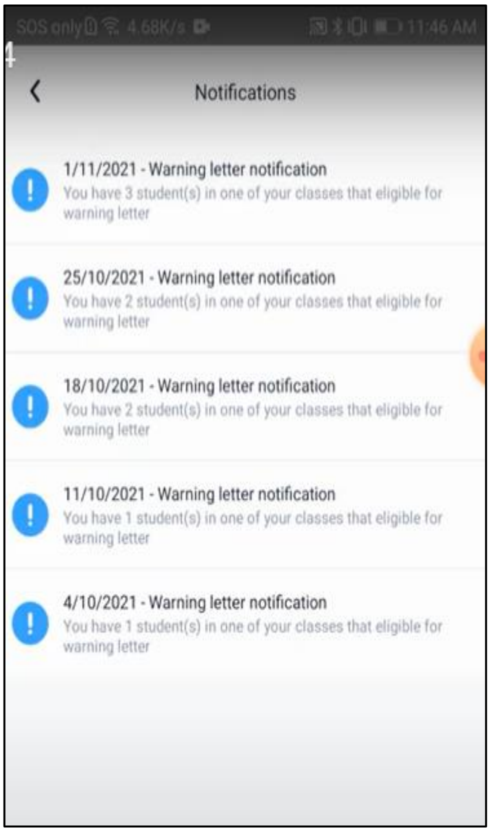


Figure 11: In-app or warning letter notification

Results and Discussions

In this exploratory study, a questionnaire was developed to gather responses from the lecturers and students. The questionnaire for lecturers consisted of 25 items that assessed five tasks namely managing class schedules, taking student attendance, managing student attendance, monitoring students' absenteeism, and sending students' absenteeism notifications. In addition, the questionnaire for students consists of an additional task which focuses on the perception of students on the system. Furthermore, the system was evaluated based on the functionality and usability tests of the five tasks identified earlier. Each item was assessed using a 10-point Likert scale with a range from (1) strongly disagree to (10) strongly agree as per the recommendation by (Courser and Lavrakas, 2012). The questionnaires were distributed to 32 lecturers and 108 students of Universiti Poly-Tech Malaysia (UPTM) using purposive sampling for subsequent analysis.

Table 1
Demographic characteristics

Item	Lecturer			Student	
	Frequency	**Percentage**		**Frequency**	**Percentage**
Faculty					
FBASS	6	18.8		39	36.1
FCOM	16	50.0		25	23.1
FEHA	10	31.3		44	40.7
Gender					
Male	4	12.5		33	30.6
Female	28	87.5		75	69.4
Position			**Programme Level**		
Lecturer	21	65.6	Diploma	7	6.5
Senior lecturer	11	34.4	Bachelor's Degree	91	84.3
			Professional	10	9.3
Year of Services			**Semester**		
5 years or below	6	18.8	1 – 2	11	10.2
6 - 10 years	9	28.1	3 – 4	63	58.4
11 - 15 years	12	37.5	5 – 6	22	20.3
16 - 20 years	2	6.3	7 – 8	12	11.1
More than 20 years	3	9.4			

Table 1 shows the demographic characteristics of the respondents which are divided into lecturers and students. Most lecturers who participated in the study were from the Faculty of Computing and Multimedia (FCOM) which contributed 50% of the data. While most students who participated in the survey were from the Faculty of Education, Humanities and Arts (40.7%). In addition, 87.5% were female lecturers and 69.4% were female students. By position, 65.6% were lecturers and 34.4% were senior lecturers. Among the respondents, there are lecturers who have served at UPTM for 11 to 15 years (37.5%), while only 6.3% have years of service between 16 to 20 years. The largest group of students came from semesters 3 and 4 which was 58.4% of the sample.

Table 2
Reliability Statistics

Tasks	Number of items	Cronbach's Alpha	Mean	Variance
Lecturers	25	0.972	9.15	1.24
Students	28	0.992	8.68	2.44

Table 2 shows the value of Cronbach's alpha, mean and variance of the overall instruments based on lecturers' and students' tasks. Cronbach's alpha values of 97.2% and 99.2% for the questionnaire items for the two groups indicate good statistical reliability. Any component with a Cronbach's alpha value of 0.7 or higher has a reliable measure of internal consistency (Singh et. al., 2020).

Table 3
Mean and standard deviation based on tasks

Tasks	Lecturer		Student	
	Mean	**Standard deviation**	**Mean**	**Standard deviation**
Tasks for students	Not applicable		8.601	1.449
Task 1: Managing class schedules	9.200	0.859	8.734	1.491
Task 2: Taking student attendance	9.083	0.917	8.701	1.431
Task 3: Managing student attendance	9.138	0.851	8.707	1.477
Task 4: Monitoring students' absenteeism	9.117	0.998	8.584	1.438
Task 5: Sending students' absenteeism notifications	9.200	1.050	8.676	1.446
Perception of students on the SAMBLE system				
Overall	**9.145**	**0.850**	**8.680**	**1.408**

Table 3 summarizes the mean and standard deviation for each task for both groups of respondents. From the lecturer's perception, manage class schedules (Task 1) and sending students' absenteeism notifications (Task 5) showed the highest mean compared to other tasks of 9.20 out of 10 with standard deviations of 0.86 and 1.05, respectively. This can be interpreted that the system can assist lecturers in managing class schedules as well as sending student absenteeism notifications. Task 2 indicated slightly lower mean values than the other tasks, but still within a highly agreed range (Mean = 9.08, SD = 0.92). For Task 3, managing student attendance, lecturers tended to strongly agree that this system could be used to manage student attendance (Mean = 9.14, SD = 0.85). Similar results are shown in Task 4, monitoring students' absenteeism showing a mean of 9.12 and a standard deviation of 0.99. The same results are also shown from the students' perception. Although the mean results showed slightly lower than the lecturer's mean, the values still almost strongly agreed with a mean of 8.68 and a standard deviation of 1.41. Therefore, it can be said that both instructors and students firmly agreed that the system can help instructors keep track of attendance, manage class schedules, and assist faculty effectively in monitoring student absenteeism by sending out emails and in-app notifications.

Conclusions and Recommendation

Findings of the survey showed positive feedback from the respondents. The system provides automatic attendance recording by interacting with the BLE beacons and it is agreed by the respondents in assisting lecturers and students in managing attendance. In addition, the system promotes a contactless attendance-taking process to prevent students from contracting infectious diseases, especially COVID-19. Furthermore, this research is significant for faculty monitoring system, where the notifications via application (in-app and forced notifications) and via email is sending automatically to the respective individuals such as parents, subject lecturers, and academic advisors when the percentage of student absenteeism reached the allowable percentage set by the educational institution. The application of the system has improved the overall quality of the attendance recording process as quality is not a static condition and must be evaluated and improved on a regular basis (Fesenko et. al., 2022).

The result indicates that this method can assist lecturers to keep track of student attendance, manage class schedules, and assist faculty in monitoring student absenteeism. Nevertheless, Table 4 highlights a few of the suggested system's limitations and recommendations.

Table 4
Limitations and Recommendations

Limitations	Recommendations
The mobile application can only support Android-based devices. For students who use a mobile phone such as an iPhone, lecturers are required to verify the students' attendance manually by clicking the Approved button provided by the application.	Use a cross-platform technology such as React Native to build native mobile application for Android and iOS using a shared codebase. However, to test the application, it requires a Mac to set up a simulator or set up a Mac agent and connect it to Visual Studio.
The system still lacks security features to authenticate students. Students can hand over their smartphones and ask their classmates to log in on their behalf. Then, the BLE beacon will automatically detect their presence.	Provide additional security features such as fingerprints to authenticate student's identity.
The system will notify the lecturer to automatically send the student's absence warning letter to the parents via email. However, if the parents do not have an email address, especially for parents who are not IT literate, the warning letter will not be successfully sent to them.	Identify an effective communication platform for sending student absence warning letters to parents.

Based on the limitations and recommendations described in Table 4, thus, the drawbacks can be improved in the future. In addition, a qualitative study involving interviews and observations of students and lecturers should be conducted using a modified version of TAM to assess their perceptions with regards to the system's usefulness, satisfaction and behavioural intention to use towards technology adoption and actual system use.

Acknowledgements
A special thank goes to Kolej Poly-Tech MARA Sdn Bhd which funded this research under the UPTM URG internal grant and managed by the Research Management Centre (RMC).

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