Global Scientific JOURNALS

GSJ: Volume 11, Issue 8, August 2023, Online: ISSN 2320-9186
www.globalscientificjournal.com

Attendance management system for blended learning in tertiary institutions: a proposal

Johnwendy Chinedu Nwaukwa

Department of Computer Science and Information Technology

Veritas University, Abuja

Clinton Oborindo

Computer Security and Reliability, Information Science

Petroleum Training Institute, Warri

Abstract Most educational administrators are concerned about students' irregular attendance, and staff's inappropriateness and unavailability in lecturing students. A variety of attendance systems have been adopted, including biometric-based attendance systems, RFID-based attendance systems, geofencing mobile-based attendance systems and web-based attendance systems. With the increasing relevance of blended learning, attendance collecting systems are no longer adequate to meet the needs of Institutions. In this research, we proposed a unified standardized relational database design, algorithms and architecture for the proposed attendance system for blended learning. The proposed system allows for the tracking of engagement and early identification of disengagement through the use of rich analytics, allowing for intervention as well as efficient and effective report evaluation for staff and students.

Keywords: Geofencing, Ibeacon, API, Biometric-based attendance, Mobile-based, RFID

1. Introduction

Blended learning is becoming more popular as a way to simplify lecture activities, particularly for remote students, as technology has advanced through time, particularly in the educational industry. Due to their incapacity to attend in-person sessions, students are increasingly asking for more flexible study options, such as the capacity to participate in online learning (Brown et al., 2018). Blended learning is described by the Joint Information Systems Committee (JISC) as a combination of in-person instruction and dynamic digital activities and content that promotes learning at any time or location (Freeman et al., 2014). Although some schools have incorporated blended learning technology, there still appear to be certain holes in the attendance system that track staff and student attendance on a regular basis.

The evaluation of students and staff is critically dependent on attendance (Abdelhafez et al., 2019). Regular attendance is essential for students to succeed and receive the greatest start in life, as well as for institutions to check staff adherence to lecture and work hours (Brown et al., 2018). Most tertiary institutions have adopted cutting-edge eLearning tools like Google Classroom, EdMoodle, and Moodle for blended learning, however these tools don't have all the features necessary to effectively monitor staff and students and provide better evaluation attendance statistics (Sempavalan and Sumathi, 2020).

Attendance standards are employed at numerous institutions for a variety of reasons. These goals include maintaining records, evaluating students, and encouraging regular attendance. The number of students who are eligible to take the tests is determined by attendance keeping, which takes a lot of time (Shoewu and Idowu, 2012).

Several automated attendance systems have been built ranging from web based attendance systems (AL-Mesbahi, 2021; More et al., 2021; Kurniali and Mayliana, 2014; Saputra and Tanaamah, 2021; Triyono and Metandi, 2021; Takahashi et al., 2020), the mobile based attendance systems (Abdelhafez et al., 2019; Utomo et al., 2020; Islam et al., 2017; Salac, 2018; Lio, 2016; Kiran et al., 2020; Anand et al., 2016; Taekyoung et al., 2016), web and mobile attendance systems (Banepali et al., 2019; Nguyen and Chew, 2017 ; Pawar et al., 2019), and the biometric based attendance sysytem (Dey et al., 2014; Malathy et al., 2020). These systems, according to studies, are only focused on face-to-face attendance systems and do not adequately, safely, or effectively capture students and staff for both face-to-face and online learning. The design algorithms for the blended learning attendance system are the main focus of this study. We consider a crucial approach that uses geofencing, bluetooth, and biometric technology to solve the research challenge. For the suggested system, we created a database scheme, and we also provided algorithms and an architecture plan as well as the proposed implementation.

2. Literature Reviews

Several methods for automating the attendance system are covered in this section. The methodologies are based on web-based, biometric, geofensing, RFID, and mobile-based methodologies.

For monitoring student attendance on a daily basis under any constitution, AL-Mesbahi (2021) developed a web-based attendance system with OTP implementation. The staff members in charge of the relevant disciplines are in charge of recording student attendance. Depending on the topic they manage, each member of staff will have a unique username and password. Based on the student attendance, a precise report is produced. Although this method will take attendance quickly, it won't instantly determine whether a student is present for class.

A system that can be utilized for distance learning was described by More et al. (2021). It is a webbased system that allows users to log their attendance using face recognition, and the system will automatically calculate all the statistics so that teachers may examine them in a frictionless yet effective way. The disadvantage of this technique is that it is slower for students to use face technology on a web-based platform than it is on a native mobile platform. Utilizing this approach is ineffective for face-to-face learning. If a class has a lot of students, it's possible that some won't show up and will still use their absence as proof of attendance.

Kurniali and Mayliana (2014) concentrated on creating an RFID-enabled web-based attendance system for a higher education facility in Indonesia. The fact that students' attendance records are

one of the key components that indicate their academic success served as motivation for the system's development. The system's innovation in designing it proved trustworthy in supporting related business processes and enabled the goal of maximizing the use of the RFID card. The system's flaw is the usage of an RFID card to check in and record attendance. The method allows for the possibility of taking attendance anywhere, and it also provides the opportunity for a student who skips class to do so.

To address the issue of a manual attendance system during the Covid-19 epidemic, Saputra and Tanaamah (2021) created a web-based attendance system. The attendance system was created using the QR code technology, however it has the flaw of not tracking the security code provided to each employee to ensure proper attendance.

Using the RFID system on the Raspberry Pi 3+ as a device and deployed in every class in the building, Triyono and Metandi (2021) created a web-based attendance system for staff and students. The system was able to eliminate the issue with the manual attendance method, but it cannot be used to take attendance remotely and cannot determine with accuracy whether a student is present in class.

By utilizing the NFC tag's capacity to launch the web browser and access the URL stored in the tag, Takahashi et al. (2020) demonstrated a web-based system for managing student attendance. Imagine if every seat in every school had an NFC tag sticker attached to it. Let the query section of the URL, which represents the classroom and seat IDS, be formed of the FQDN for the student's web application. A student's smartphone's default web browser accesses the URL printed in the NFC tag sticker affixed at his or her seat to inform the student's web application about the seat and classroom IDS.The web server stores those IDS in session variables, asks the user for their student ID and password, gets the time from the clock, and retrieves the lecture ID from the database. The student's web application logs the student's attendance in the database once all of the session variables have been filled out for the session. This system's flaw is that it lacks the functionality to handle a remote attendance system.

To reduce the amount of paperwork and guard against data loss, Abdelhafez et al. (2019) created a mobile attendance system utilizing Android Studio and a database. Each faculty member displays the QR code to the students so they can scan it and become self-present. The system applies the QR code to each subject. The faculty member may also take attendance by calling the names of the pupils in the room. The manual verification of students present in class means that this method is not totally automatic.

By automatically cross-checking user positions with numbers, Utomo et al. (2020) created a mobile application to improve the records attendance system with a smartphone. The application uses the polygon approach to locate the user inside the designated polygon area. This procedure, in which x is the latitude and y is the longitude, increases x and fixes y starting from a point p. The outcome of the experiment showed that, depending on the GPS sensor integrated into a mobile device, the proportion of successfully validating user coordinates inside edges of the polygon boundary is 87 percent.

To eliminate the laborious procedure of taking attendance, Islam et al. (2017) created a smartphone-based attendance system. The course professor would be able to take attendance conveniently using Smartphone and Android technology. The system's attendance security is a flaw. The system is unable to handle an accurate distance learning attendance system and is unable

to monitor and determine whether a student is present in the class in order to take his or her attendance.

In order to make attendance checking and monitoring quicker and easier, Salac (2018) developed an Android-based class attendance monitoring application that uses face recognition. The system also integrated SMS technology to alert parents and guardians whenever pupils attended a specific subject or class. This system's disadvantage when it comes to in-person instruction is that the student can take attendance anywhere. The presence of students in a classroom is not monitored.

A mobile device and a web application make up the framework Lio (2016) designed for the attendance management system. While the lecture is still going on, students who are in attendance can sign in on a mobile device with a selfie or their signature. Because this technique needs students to manually take attendance while the lecturer is teaching, it will generate unneeded noise. It doesn't safely verify if a student is in class or not.

In order to automate student attendance in classroom settings, Banepali et al. (2019) proposed a system that makes use of cutting-edge technologies like smart phones and Wireless Access Point (WAP). The system was set up in four stages, starting with the creation of a Wireless Local Area Network (WLAN) using a Raspberry Pi and mobile devices, followed by the determination of each setting's Received Signal Strength (RSS) threshold, the development of a database and web interface using an Apache server, MySQL, and PHP, and the updating of the attendance using the threshold RSS, Media Access Control (MAC) address, the association status of mobile devices, and the RSS value. The system was tested in a variety of classroom environments, including the lab, lecture hall, and tutorial room, and it consistently marked attendance with an accuracy of more than 94% in each environment. However, the system does not have the complete functionality to handle blended learning attendance system.

An automated attendance management system that may be used in professional gatherings of various types and scales (conferences, exhibits, training courses, etc.) was described by Nguyen and Chew (2017). (from small-to-medium seminars and workshops to large congresses and technical shows). The system is built using IT, RFID, and mobile communication technologies. It has the capacity to gather, record, and process information on attendees of a technical gathering and their participation in various sessions, visits to various exposition booths, etc. Additionally, the system is capable of producing real-time combined detail data on participant inflow and outflow throughout the event, as well as their most and least favored hobbies and activities. This can be done for a variety of sites and facilities over a long period of time. The system does not handle the complete feature of blended learning attendance system.

The system proposed by Pawar et al. (2019) comprises of a mobile RFID solution in a logical environment. The attendance management system offers general system capabilities, including live ID tag transactions display, ID registration, ID deletion, attendance recording, and other minor operations. The system lacks the necessary features to administer the blended learning attendance system.

Anand et al. (2016) developed a cutting-edge method for students to use their smartphones to record their attendance. The technology uses face recognition and the front camera of the smartphone to identify the student, and it also uses the campus Wi-Fi network to pinpoint the student's location. The suggested approach has sufficient guaranteed safeguards against false or

proxy attendance while not requiring expensive hardware or other specialist resources. Even in classroom settings, where signal interference is typically very severe, experimental investigations using the system demonstrate that fingerprinting, the method used to detect indoor location, can achieve very good positioning accuracy. According to Taekyoung et al. (2016), WIFI signal strengths may not be able to localize the student at the granularity of a classroom. Nevertheless, this system does not have the full feature to handle the blended learning attendance management system. The system is well designed in terms of taking indoor attendance.

In order to acknowledge the importance of a biometric-based attendance system for institution professors, Malathy et al. (2020) highlighted the issue that arises since there is no system in place that uses an alert or notification method, such as sending an SMS to faculty members' mobile phones, to remind them to record their attendance. The system's main objective is to automate attendance notifications based on biometric fingerprint authentication. The solution prevents attendance-related errors and costs associated with a central repository, but it is unable to handle all of the functions of a blended attendance management system.

A speech biometric-based attendance system was developed and implemented, according to Dey et al. (2014). Users call a select group of pre-determined cell phones to gain access to the system. A new user's enrollment and an existing user's verification processes are both guided by an interactive voice response (IVR) system. For user authentication, the system employs text independent speaker verification using MFCC features and i-vector based speech modeling. The effects caused by session/environment variables are normalized using linear discriminant analysis and within-class covariance normalization. The classifier employs a straightforward cosine distance scoring combined with score normalization, and the decision is reached using a defined threshold.

A unique facial recognition technique-based student attendance system was introduced by Kiran et al. (2020). The human face attendance system was created using the most recent advances in image recognition technology to identify students' faces in a classroom and record their attendance if their faces match those in the provided facial database. The HFR system will independently record each student's attendance in a classroom without interfering with the teacher, allowing the latter to better fulfill their job as a teacher in many ways. Utilizing the suggested system will save time. An open CV is used to create the concept. The idea is developed by using an open CV. The drawback of the system is that it is time wasting in terms of handling large class and does not have the complete feature to handle blended learning attendance system.

3. Proposed system

From previous literature, no system captured the requirements for the implementation of an attendance system for blended learning. This research demonstrated the growth of the blended learning attendance system in higher educations. The proposed application's architecture diagram and database schema give the user an understanding of the system. The suggested system's database is created using Microsoft SQL Server 2019. All system objects, such as tables, views, procedures, and functions, are properly written to meet the system's overall working process. The ASP.NET core is used to construct a secure RESTFul API. The solution is being developed in two phases: an ASP.NET Core Web interface and a Xamarin cross-platform native interface. The Human Resources Department manages the Web portal to obtain staff and students' attendance reports. Both staff and students can use the cross-platform mobile device. The system offers the

biometric API, the geofencing API, which uses polygons, latitude, and longitude, as well as the Bluetooth device, which uses the IBeacon API to detect when a student is in a class with the registered lecturer for the Course. These three APIs are all available for the blended learning process. The system will only provide biometric identification for online distance learners, as it will also automatically track their whereabouts during and after lectures using the geofencing algorithm. This means that users must first enable their location before the system will automatically activate their phone's camera to capture face verification and authentication for attendance. There are some constraints we took into account when designing an effective solution for the On Campus students. The location of the class is first, followed by its geolocation. The Administrator adds the latitude, longitude, and polygon measurement to the database for structures with just one major hall. Therefore, the system immediately alerts and triggers the lecturer to take his biometric and geolocation attendance when he or she enters the building to teach. If the lecturer has not automatically activated the class for that specific venue, the student cannot take attendance. We also take into account the area around a building with multiple classrooms. There is currently no geolocation capability that can record a class's dimensions, particularly the indoor measurements. The Bluetooth API was employed. Each class needs a physical Bluetooth device, after which the threshold for the range inside and outside the class is determined and recorded in the database. When a lecturer enters a room to provide a lesson, they are immediately alerted to use their smartphone to take their face biometric (Android or IOS phone). The system records the attendance of the lecturers in the database. Only enrolled students are permitted to take attendance in the same location as the lecturer. Due to the placement of the iBeacon inside and outside of the classroom, as well as the calculation and storage of the distance between the indoor and outdoor, the system does not permit students to take attendance outside of a classroom. The suggested system's architecture is shown in Figure 3.1, and the database design is shown in Figure 3.2.

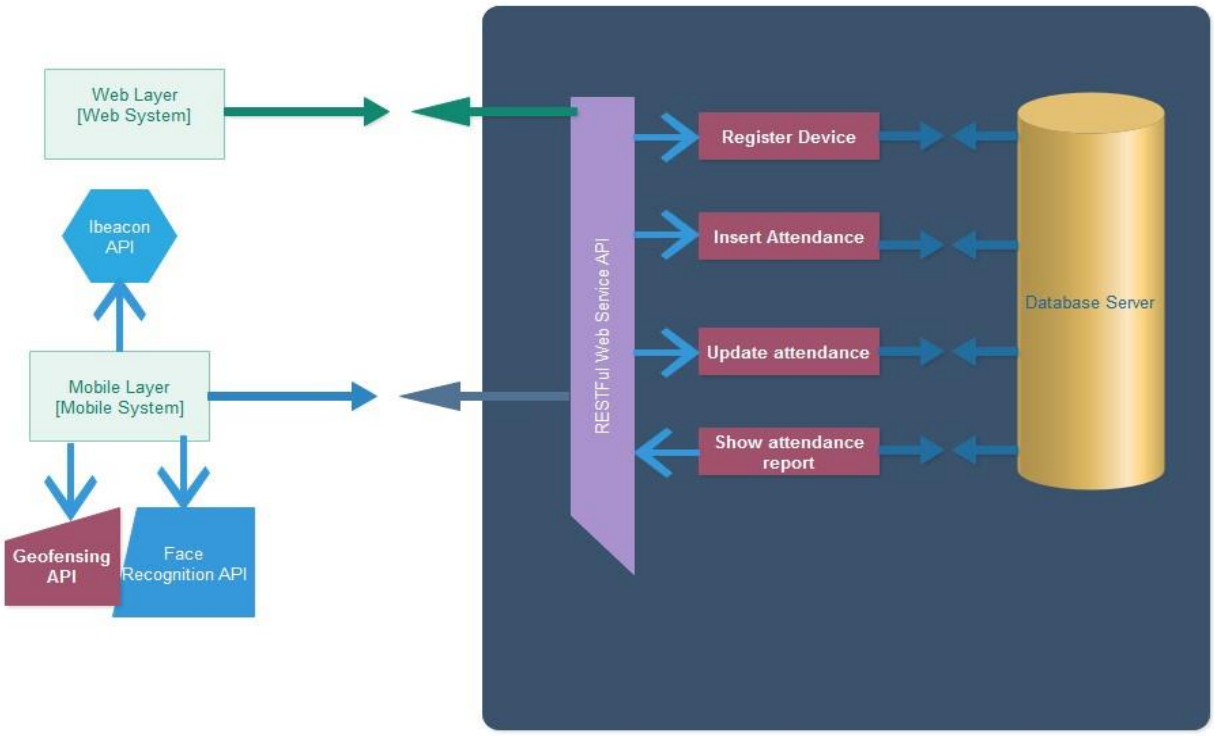

Figure 3.1.: System Architecture

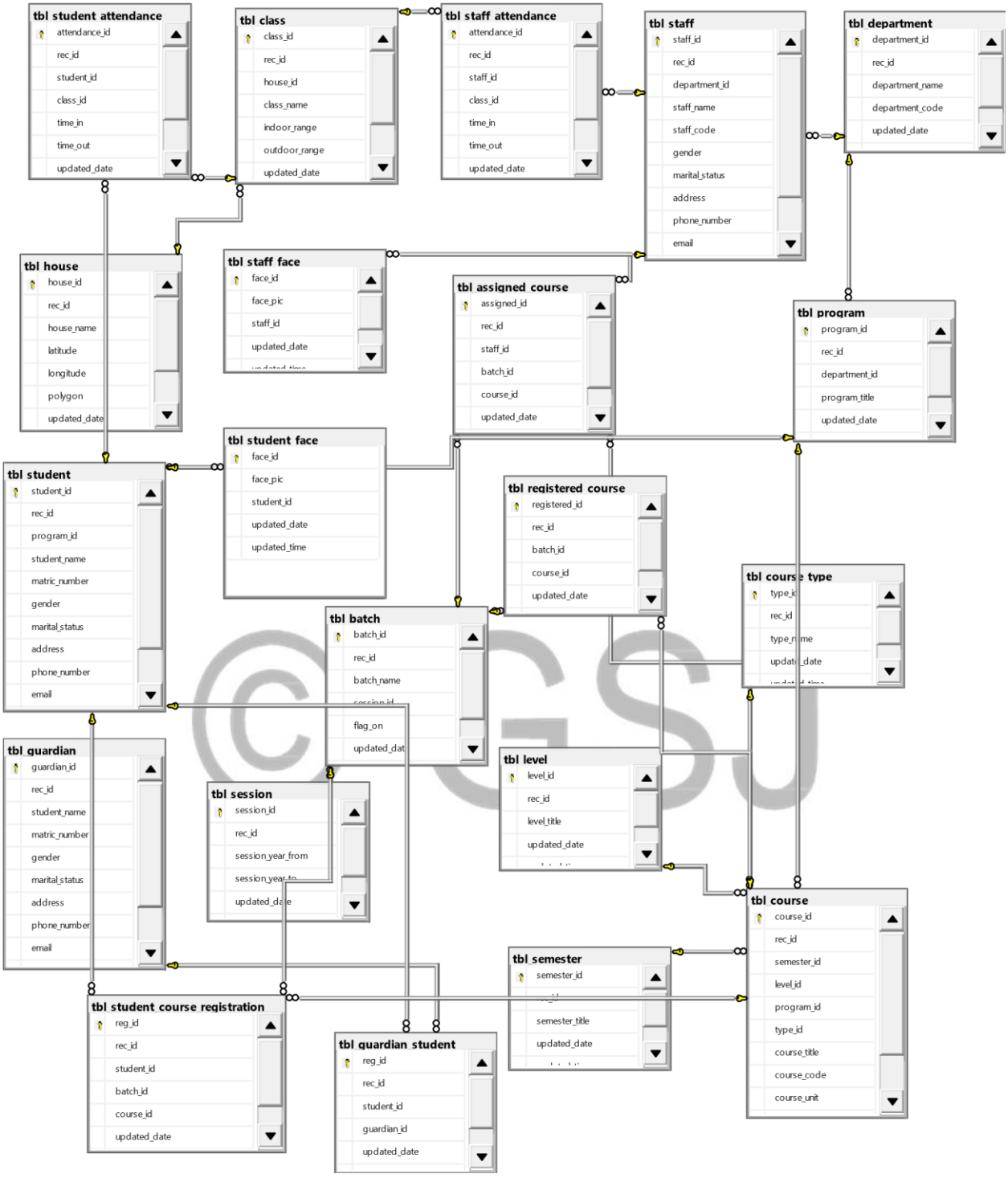

Figure 3.2.: Database Design

Algorithm for Lecturer attendance

1. Validate Course
2. Check assigned staff authentication

3. Input: p is the polygon of the registered building
4. Input: Take latitude and Longitude
5. Verify the building with registered geolocation from database server
6. If building has more than one class
7. Input: b is the Bluetooth range
8. Get width and length range within the class
9. Verify the static range from the database server within a registered class
10. If Lecturer attendance ==indoor range in class
11. Verify Face biometric
12. If face==verified
13. Authenticate and take attendance (time and class)
14. Else go to 11
15. If lecture attendance ! =indoor range in class
16. Go to 7
17. If building has one hall/Class
18. Call 3 and 4
19. Take Face biometric
20. Call 11, 12 and 13
21. end

Algorithm for Student attendance

1. Get attendance notification from Lecturer
2. If Lecturer attendance ==true
3. Identify the registered Class for attendance by Lecturer
4. Input: p is the polygon of the registered building
5. Input: Take latitude and Longitude
6. If student location not in registered class
7. Go to 3
8. If student location is in registered class
9. Verify the building with registered geolocation from database server
10. If building has more than one class
11. Input: b is the Bluetooth range
12. Get width and length range within the class
13. Verify the static range from the database server within a registered class
14. If student attendance ==indoor range in class
15. Verify Face biometric
16. If face==verified
17. Authenticate and take attendance
18. Else go to 15
19. If student attendance != indoor range in class
20. Go to 11
21. end

4. Conclusion

We proposed a mixed learning attendance scheme for tertiary institutions in this study. We created algorithms to manage the attendance system for both staff and students. The Native mobile

application that will be utilized by both staff and students was created using Xamarin and an ASP.NET Core Restful Web service API. For an accurate attendance system, the system makes use of the geolocation function, the biometric mobile feature, and the Ibeacon Bluetooth API. All tertiary institutions will benefit from the system's assistance in properly and effectively monitoring their staff and students in real time and producing more effective reports.

References

Abdelhafez, H., Alamri, M., Alomari, R., Alzoman, B., BinSheeha, R., Albawardi, A., and Alzahrani, R. (2019). *Mobile Based Attendance System using QR Code.*

AL-Mesbahi, L. (2021). *Web based attendance system with OTP implementation.*

Anand, S., Bijlani, K., Suresh, S., and Praphul, P. (2016). Attendance monitoring in Classroom using Smartphone and WIFI fingerprinting. *2016 IEEE 8th International Conference on Technology for Education (TAE),* (pp. 62-67).

Banepali, A., Kadel, R., Guruge, D., and Halder, S. (2019). Design and Implementation of WIFI based attendance system using Raspberry Pi., (pp. 1-6). 2019 29th International Telecommunication Networks and Applications Conference (ITNAC).

Brown, C., Davis, N., Sotardi, V., and Vidal, W. (2018). Towards understanding of student engagement in blended learning : A conceptualization of learning without borders. *Proceedings ASCILITE2018 Geelong,* (pp. 318-323).

Dey, S., Barman, S., Bhukya, R., Das, R., Haris, C., Prasanna, S., and Sinha, R. (2014). Speech Biometric based attendance system. *2014 20th National Conference on Communications (NCC),* (pp. 1-6).

Freeman, S., Eddy, S., McDonough, M., Smith, M., Okoroafor, N., Jordt, H., and Wenderoth, M. P. (2014). Active learning increases student performance in Science, engineering, and mathematics. *Proceedings of the National Academy of Sciences.* doi:doi.org/10.1073/pnas.1319030111

Islam, M., Hasan, M., Billah, M., and Uddin, M. (2017). Development of Smartphone-based student attendance system. *IEEE Region 10 Humanitarian Technology Conference (R1-HTC).*

Kiran, T., Reddy, N., Ninan, A., Krishnan, P., Aravindhar, D., and Geetha, A. (2020). PCA based Facial Recognition for attendance system. *2020 International Conference on Smart Electronics and Communication (ICOSEC),* (pp. 248-252).

Kurniali, S., and Mayliana. (2014). *The Development of a web-based attendance system with RFID for higher education Institution in Binus University.*

Lio, J. (2016). Attendance Management System using a Mobile Device and a Web application. *2016 19th International Conference on Network based Information system (NBiS),* (pp. 510-515).

Malathy, E., Sivamurugan, V., and Rajtilak, S. (2020). Performance Analysis and enhancement to Biometric based attendance system. *2020 4th International Conference on Computer, Communication and Signal Processing (ICCCSP),* (pp. 1-3).

More, S., Kadam, N., Savla, S., Shelar, S., Shah, A., and Mali, S. (2021). A WEB-based attendance system using face recognition. *2021 IEEE 6th International Forum on Research and Technology for Society and Industry(RTSI)*, (pp. 91-96).

Nguyen, H., and Chew, M. (2017). RFID-based attendance management system. *2017 2nd Workshop on recent trends in Telecommunications Research (RTTR)*, (pp. 1-6).

Pawar, S., Jaiswal, R., and Labhasetwar, S. (2019). Smart Attendance System. *International Journal of Advance Research and Innovative ideas in Education, 5*, 1574-1577.

Salac, D. (2018). *Andriod-based class attendance monitoring system using Face Recognition Technology*. ArXiv.

Saputra, D., and Tanaamah, A. (2021). *Optimizing the use of QR Codes in Web based attendance Information systems during the Covid-19 Pandemic.*

Sempavalan, V., and Sumathi, S. (2020). Learning Management Systems through Moodle and Google Classroom for Education. *Advances in Research, 21*(10), 32-37.

Shoewu, O., and Idowu, O. (2012). Development of Attendance Management System using Biometrics. *The Pacific Journal of Science and Technology*, 300-307.

Taekyoung, K., Myungchul, K., Junghwan, S., Selin, C., and Seokho, C. (2016). A Smartphonebased Tool for Checking Attendance of Students. *ASEE 123rd Annal Conference and Exposition*, (pp. 1-19).

Takahashi, K., Niibori, M., and Kamada, M. (2020). *A web-based attendance management system with NFC Seat identifiers.* NBiS.

Triyono, A., and Metandi, F. (2021). *Attendance System application for lecturers and students using RFID and web-based Raspberry Pi 3+*.

Utomo, B., Wibowo, A., Ridwan, M., Izzuddin, M., Gumelar, A., and Arifin, S. (2020). Enhanced of attendance records Technology used Geospatial based on Crossing number. *International Journal of interact. Mob. Technology*, 101-116.