3rd International Conference on Applied Engineering and Natural Sciences

https://www.icaens.com/

July 20-23, 2022, Konya, Turkey

A Literature Review on Smart Attendance Systems

Bawar Ali Abdalkarim Abdalkarim[1*] and Devrim Akgün[2]

[1] *Sakarya University, Institute of Natural Sciences, Computer and Information Engineering Department, Sakarya, Türkiye*
ORCID ID 0000-0001-7008-7613
[2] *Sakarya University, Faculty of Computer and Information Sciences, Software Engineering Department, Sakarya, Türkiye*
ORCID ID 0000-0002-0770-599X

[*] *(Bawar.Abdalkarim@ogr.sakarya.edu.tr)*

Abstract **–**Every institution that depends on people must account for its employees as a first step in the modern-day. As a result, creating and maintaining a suitable management system costs the different organizations a substantial sum of money. In many countries, government organizations and educational institutions keep track of attendance using paper-based methods. For example, to maintain track of each student's attendance, it takes time to call out their name at the beginning of the course. False signs, names missing from spreadsheets, manually inputting data into systems, and the possibility of proxy attendance are further problems. Such techniques have a few problems that have grown over time. To track attendance, it is crucial to swap out these outdated practices for modern ones. As a result, a lot of work and research has been done in this area using current technologies. Especially, automatic recognition of a particular individual based on distinguishing characteristics such as QR code, ID and password, face recognition, fingerprint recognition is of interest to researcher. This paper presents a literature overview of the recent works on automated and smart attendance tracking systems. Concerning technology, application domain, and key findings, our critical assessment has emphasized research in the body of literature.

Keywords – Attendance System, Automated, Biometric Recognition, Mobile, RFID, QR code, Face Recognition.

I. Introduction

Keeping track of employees or students in a class is one of the time-consuming activities in any school, institution, or educational place. Taking attendance, for example, takes up both the teacher's time and the lecture period. If the instructor skips this procedure, the school and community will be unaware of whether the students are participating in the classes. Various human and automated tracking approaches and techniques have been developed to ensure that users' and employees' attendance is checked and recorded regularly[1]. It is great to know those performed studies to address this problem; researchers tried to get benefits from various technologies available to date, including biometric-related systems, which are technology systems that use data about a person for identifying[2]. Biometric systems require precise information on distinctive biological features to function correctly. Passing data into algorithms for a particular output, typically connected to a user's or other person's identification, is what a biometric system is related to. Face, GPS, Barcode, QR Code, and fingerprint identification are just a few examples of the various biometric systems available, which are the best but also demanding options to make a system fully automated. The use of SMS technology commonly referred to as "Text Message" has been employed in attendance tracking in parallel with biometric techniques. For example, SMS technology sends messages to students or families informing them that their children are present for the specified topics or classes. Additionally, this approach guarantees students' safety after evaluating existing attendance programs. A brief sample regarding the significance of attendance management systems and incorporating current technology to tackle modern

challenges is included in the paper's conclusion, along with an overview of the wide varieties.

II. Related works

Utilizing an automated attendance system is a recent method of keeping track of attendance. Several attendance tracking systems that make use of biometric recognition have been presented, including Fingerprint Recognition (Mohamed and Raghu [3]; Soewito et al. [4]), Face Recognition (Varadharajan et al.[5], Smitha [6]; Ofualagba et al. [7]; Alburaiki et al. [8]), Barcodes (Noor et al. [9]), QR Codes (Sunaryono et al. [10], Sutar et al. [11]), GPS (Kumar and Kumar [12]), Jetson Nano (Chandramouli et al. [13]), Sensors (Prangchumpol [14]), RFID (Souza et al. [15]), Authorized Username and Password Mobile Device (Kumbhar et al. [16]; Hameed [17]) to obtain student ID for the attendance process. Many systems have been installed on Portable Devices (Chandramouli et al. [13], Varadharajan et al.[5], Mendonca et al. [18]) and Smartphones (Souza et al. [15], Prangchumpol [14], Kumar and Kumar [12], Somasundaram et al. [19]; Noor et al. [9]; Soewito et al. [4]; Kumbhar et al. [16]; Hameed [17]). In the coming section, some of those current approaches will be discussed and evaluated briefly along with their used technologies and their main findings.

III. Literature Review

A. *Digitalizing the Old Approach*

Traditional student attendance involves all the roll-calling issues and takes a lot of time for students and teachers to conduct departmental sessions. The procedure is lengthy and takes many instructors' and students' time. Mendonca et al. [20] reduced the length of the complete attendance verification by designing an online system. Substituting the conventional procedure, teachers had to call each student's name in class and note the attendance when the student answered. It offers a more straightforward and quicker approach to monitoring attendance. Instructors will no longer require a paper sheet to mark student attendance in their proposed system. They can construct attendance records by obtaining the necessary information from the database, making the entire procedure paperless.

Another Research used mobile devices in the attendance management system were developed and put into practice. A mobile-based attendance management program for Android systems was developed using VB.NET and SQL Server. This project allows for the maintenance of student attendance, calculating attendance grades, and creating a report. Five components make up the system: admin, registration, student, SMS, and an Android component. Students can use the android part to send messages to the system informing lecturers of their absence. Parents can also get SMS notifications on students' behavior [19].

B. *Fingerprint Recognition Based*

Most of the research has demonstrated that fingerprint or hand gesture recognition is a highly suitable method for an attendance management system. The method of digitally comparing one or more unknown fingerprints to a collection of known and unknown fingerprints in the database is known as automated fingerprint recognition. A particular finger assumption device that is used as a component of a special finger impression attendance framework was described by Mohamed and Raghu [3]. The students may check their essence by placing their fingertips on the device's sensor. But because fingerprint scanners can't always identify something the first time, this framework lacks viability.

Soewito et al. [4] presented an attendance system employing smartphone GPS and fingerprint technologies. The method takes a lot of time since it makes use of fingerprint recognition.

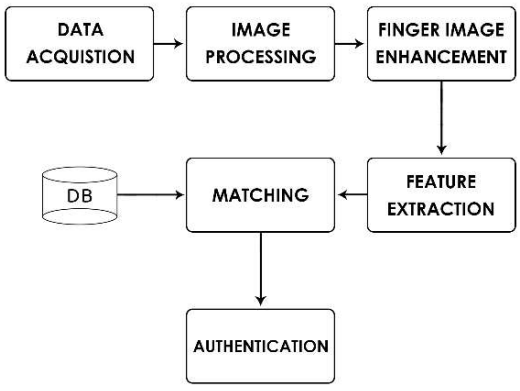

Fig. 1 General Architecture of Fingerprint Recognition

C. *GPS-based Attendance System*

Global Positioning System, or GPS, enables us to determine a person's location and direction at any time, any place on Earth. In terms of knowing where humans are and how to go to other areas, people still

need objects in the sky, but now satellites utilize them. In their work, Kumar and Kumar [12] presented a creative location-based time and attendance monitoring system that was deployed on an Android mobile app. The use of smartphones helps to reduce the need for additional biometric scanning equipment. Components of the organization include a specific location, which may be located using GPS. The GPS on mobile phones determines each student's place, and these locations are crucial for some time and attendance tracking.

D. Barcode / QR code Based

An associated barcode is a graphical way to represent data that machines regarding the item can read. A quick Response Code, sometimes known as a QR code, is comparable to a barcode. However, it holds data in both two perpendicular directions because of its two-dimensionality. As a result, a QR code may store several times more data than a barcode. Discussing a system for automating student attendance was introduced by Noor et al. [9]. Everyone in this system has a unique ID that is assigned a barcode that the mobile app can scan. Each user in this system has an individual ID with a barcode that the mobile app may scan. One of the drawbacks of this approach was that a single student may trick it by using the IDs of the other students in the arrangement.

Another approach depends on gathering attendance and updating data in one area. The suggested method, which was built utilizing QR code technology and is based on research by Sutar et al. [11], is a smart attendance system that would speed the attendance process by creating and scanning QR codes. The system runs as an application on mobile devices and is built on QR Technology.

Moreover, to assure student attendance in the course, Sunaryono et al. suggest "an Android-based course attendance system using face recognition." [10]. The course information is encoded into a QR code and presented from the front of the class. The student is just required to use their phone to take a photo of their face and display a QR code. The picture will subsequently be transmitted to the server to manage the attendance.

E. Face Recognition Based

The idea of finding human faces in referenced photographs or videos is known as face detection. A face recognition system is a type of tech that can compare face images from a video or photograph to a database of known and unknown faces. The Face, Recognition-based Attendance Management System, was developed by Smitha to develop an organized classroom attendance system using face recognition methods [6]. Through facial ID, the system can record involvement. Through a camera, it finds faces and then recognizes them. The system is split into two parts: facial recognition and detection. Using the Local Binary Pattern Histogram (LBPH), the system will identify faces of students in the live-streamed video from the class and, if the recognized face is found in the database, will mark their attendance.

Face recognition technology was also discussed by Varadharajan et al. in their paper. They placed a camera inside the class, using this technique to take pictures. The attendance is registered as a present after faces are found and identified in the database. Parents are informed of a student's disappearance if their attendance is noted as absent [5].

The research by Chandramouli et al. [13], wherein they utilized NVIDIA's Jetson Nano, is one of many that tries to modernize how attendance is managed in a certain method and even the parameters for time management. The device is set in the class, where the names and photos of the students are held. Open CV is used to obtain the photos. The processor board would be NVIDIA Jetson Nano's Developer kit. A Haar classifier is used to identify faces once the extraction has been processed. They subsequently identified with the aid of the LBPH Algorithm. An Excel spreadsheet is generated and refreshed hourly with data from the appropriate class teacher.

Ofualagba et al. [7] suggested a system named Automated Student Attendance Management System Using Face Recognition that highlights the use of Cloud Computing (CC) technological concepts to boost the performance of face identification methods. The FACECUBE system, which is suggested here, uses facial recognition to take attendance. The system provides students, instructors, and administrators with online features. However, putting this system together involves several steps, including purchasing new hardware and software.

Susanto et al. [21] were attempted to perform a slightly different type of research concerning the detection of face recognition of lecturers who are present in the application system via an Android device. They make a connection with face

recognition detection and, after that, save it to the database that was used as information about the presence of lecturers who are teaching. The local binary pattern histogram (LBPH) classifier approach, which may be used as a strategy in the attendance system of lecturers to be more efficient and productive, is used to evaluate the facial recognition system.

An open-source, generic application for assessing daily attendance using face recognition and making use of the Android system was proposed in the Hava et al. [22] study. Almost every institution may readily get it at no cost. With this suggested solution, Google Sheets are automatically created and available to the institution with no effort. The system involves facial identification and recognition algorithms to identify individual students and record their participation.

Prangchumpol mentions in his research, "Face Recognition for Attendance Management System Using Multiple Sensors,"[14] that his performance still falls short when it comes to accurately identify students' faces and that he is still unable to confirm or rectify the data when a mistake occurs in class. Therefore, he seeks to improve the efficiency of the face recognition-based attendant system and make the system's principles simple for students to understand. This sort of validation aims to discover how to detect faces utilizing the Android Face Recognition with Deep Learning approach. The database is linked to the web server using cloud storage.

Alburaiki et al. [8] developed a methodology that solved three key elements: First, using mobile phone cameras and automatically recognizing and analyzing faces. The second is a machine-learning-based facial recognition API. Lastly, maps API. The outcome demonstrates that face recognition has attained high accuracy in identifying students' faces even in unfavorable conditions. The system displayed practical examples of responses by marking the student's attendance after identifying the student's face and location, as well as the lecturer has the option to access a report of submitted attendance.

A portable attendance system that could be accessed from any location at any time inspired Salac's study [23]. Without carrying paper and PCs, the lecturer may simply verify attendance using an Android smartphone. The students' Android phones make it simple for them to check their attendance information. Additionally, SMS technology is employed to ensure the safety of the students and to notify families about their child's attendance. Face recognition is also used to establish a proper attendance record. A particular student's face is detected and recorded as present in the database using the Android device's camera. When necessary, attendance reports could also be formed.

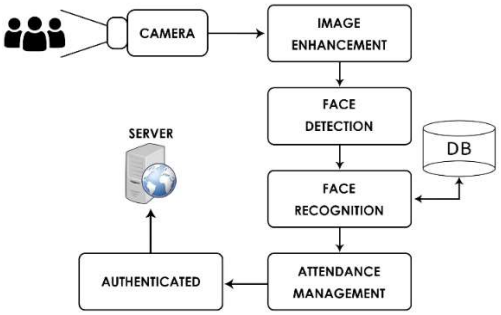

Fig. 2 Fundamentals of Face Recognition Process

F. *Android-Based Authorized ID and Password*

Android OS was developed mainly for touch mobile devices. It is based on a slightly different version of the Linux kernel and other open-source applications. You can be prompted to sign up or sign in each time you use an android-based smartphone and visit an application or website. Typically, a login/password creation request can be made for you. Now that this procedure is so popular, some users may register their accounts without giving attention to their password because it has practically become part of the routine. Unfortunately, if a user picks poor credentials, there is much risk. Hameed [17] developed and put into use an intelligent Android-based attendance system. The technology creates attendance data automatically and offers a quicker, more economical, and accessible solution for tracking online student attendance. The three characteristics of the attendance system are the admin account, which can log in and change the database; the instructor account, which can mark students as the present; and the reporter which can verify attendance records and report all duties.

The course instructor will be ready to obtain attendance with ease using phones with Android OS which has been developed to save attendance both on the device and servers, as well as to Verify statistics and print a paper version according to Islam et al. [24] paper. Their system can record attendance, mark invaders' admission, calculate attendance percentages, and send emails and Text

Messages to the parents to keep them informed about their child's enrolment at the Institution using the stored data. The proposed system allows internet access at any time and from any location, which might greatly help course instructors take care of their student's attendance.

An attendance management system was developed by Kumbhar et al. [16] to address issues with class attendance using Android devices. Both students and teachers must install APKs on their phones to access the system. They also received a unique ID and password. Students must fill out the application with their information and their parents. The student may register their attendance with only one click after the program is started by the lecturer and is ready for use during attendance checking. Both weekly and monthly attendance records are available for lecturers. Parents are informed about their student's attendance through SMS each month.

G. *Android-Based RFID*

Some researchers refer to RFID as a more straightforward form of the NFC (Near field communication) technology that many Android devices utilize for digital payments. Souza et al. [15] explores numerous frameworks put up for board involvement using different improvements. The board is advised to use another form of participation specifically for ordinary level institutions in consideration of this discussion. The proposed model includes components for mobile applications and RFID. The RFID component is suggested for documenting student engagement in the database at the back end. The application portion is intended to give their families attendance information. When there is no electricity or not many resources to send by the RFID component, the application part is used as a backup to track the attendance.

IV. DISCUSSION

Researchers have made several studies to establish biometric recognition based on smart attendance

Author & Year	Technology	Main Findings
Sutar et al. (2022)	Android, and QR code	Propose a system by generating a QR code for each lecture and scanning it for marking [11].
Chandramouli et al. (2021)	IoT, NVIDIA Jetson Nano, and Face Recognition	Faces are identified by the Haar classifier, then recognized by LBPH Algorithm, the histogram is checked against the dataset and marks attendance [13].
Kumar and Kumar (2021)	Android, GPS, and Server	Students' location is decided by GPS using phones. this is defined as a key to marking attendance [12].
Susanto et al. (2021)	Android, and Face Recognition	Developing an Android app through speed detection using OpenCV. The LBPH Histogram will be embedded in facial detection [21].
Sunaryono et al. (2021)	Android, Face Recognition, and QR code	Each student will ask to capture his/her face and QR code displayed in the class using a smartphone [10].
Alburaiki et al. (2021)	Android, GPS, and Face Recognition	Lecturers generate class attendance and students mark their selves by scanning their faces along with their location [8].
Smitha (2020)	IoT, Face Recognition, and Email Server	At each class, faces will be detected from a live video of the classroom and will mark attendance [6].
Prangchumpol (2019)	Android, IoT, Cloud, and Face Recognition	Recognize the face by using the use of Android Face Recognition with Deep Learning [14].
Hameed (2019)	Android, Authorized Username/Password, and Web Server	The three roles of the system are the admin can change the database, the instructor can mark students as present, and the reporter can verify attendance records and report all duties [17].
Souza et al. (2019)	Android, RFID, and Email Server	RFID is used for documenting student engagement at the back end. The application is intended to give families the attendance information [15].

Table 1. Summary of recent findings and developments of Smart Attendance System.

systems. They primarily engaged in developing technical products that satisfy obstacles in identifying, recognizing, recording, monitoring, positioning, and tracking students or staff as opposed to conventional systems that require more processes and daily resources and impose duplication of effort. Academic institutions were used to apply in earlier research recommending attendance management systems. Consequently, by emphasizing current research that was performed in this field, we will discover that the facial recognition-based method, whether with portable or mobile devices, has become significantly more widespread than any other accessible technique. And this technology has become the most popular and effective for researchers to work on.

V. CONCLUSION

One of the most challenging and time-consuming duties is managing the attendance of employees or students. Every study by researchers aims to simplify such a challenging process using various methods and technologies, including biometrics, IoT, and Portable Devices. Commonly, one of the algorithms will be applied before marking attendance on the system. Different algorithms may be utilized to identify a person and inform instructors or administrators of a place about their staff's engagement. It will be essential to pay attention to how quickly and effectively data can be stored and retrieved. This review's objective is to provide the most recent research and concerns in such an area and provide a brief overview of their significant contributions.

REFERENCES

[1] A. Abbasi and H. Bamakan, "Automation Attendance Systems Approaches: A Practical Review," *BOHR Int. J. Internet Things Res.*, vol. 1, no. 1, pp. 7–15, 2022.

[2] Techopedia, "What is a Biometric System?," *Techopedia*, 2012. https://www.techopedia.com/

[3] B. K. P. Mohamed and C. V. Raghu, "Fingerprint Attendance System for Classroom Needs," in *2012 Annual IEEE India Conference, INDICON 2012*, 2012, doi: 10.1109/INDCON.2012.6420657.

[4] B. Soewito, F. L. Gaol, E. Simanjuntak, and F. E. Gunawan, "Attendance System on Android Smartphone," in *ICCEREC 2015 - International Conference on Control, Electronics, Renewable Energy and Communications*, 2015, pp. 208–211. doi: 10.1109/ICCEREC.2015.7337046.

[5] E. Varadharajan, R. Dharani, S. Jeevitha, B. Kavinmathi, and S. Hemalatha, "Automatic Attendance Management System using Face Detection," in *2016 Online international conference on green engineering and technologies*, 2016.

[6] P. S. H. Smitha, "Face Recognition based Attendance Management System.," *Int. J. Eng. Res. & Technol.*, vol. 9, no. 05, 2020.

[7] O. Godswill, O. Osas, O. Anderson, I. Oseikhuemen, and O. Etse, "Automated Student Attendance Management System using Face Recognition," *Int. J. Educ. Res. Inf. Sci.*, vol. 5, no. 4, pp. 31–37, 2018.

[8] M. S. M. Alburaiki, G. M. Johar, R. A. A. Helmi, and M. H. Alkawaz, "Mobile Based Attendance System: Face Recognition and Location Detection using Machine Learning," in *2021 IEEE 12th Control and System Graduate Research Colloquium, ICSGRC 2021 - Proceedings*, 2021, pp. 177–182. doi: 10.1109/ICSGRC53186.2021.9515221.

[9] S. A. M. Noor, N. Zaini, M. F. A. Latip, and N. Hamzah, "Android-Based Attendance Management System," in *2015 IEEE Conference on Systems, Process and Control (ICSPC)*, 2015, pp. 118–122.

[10] D. Sunaryono, J. Siswantoro, and R. Anggoro, "An Android Based Course Attendance System using Face Recognition," *J. King Saud Univ. - Comput. Inf. Sci.*, vol. 33, no. 3, pp. 304–312, 2021, doi: 10.1016/j.jksuci.2019.01.006.

[11] H. Sutar, S. Chaudhari, P. Bhopi, and D. Sonavale, "Automated Attendance System," *Int. Res. J. Mod. Eng. Technol. Sci.*, vol. 04, no. 04, 2022.

[12] Y. N. S, A. Kumar, and N. R. Kumar, "Location Based Smart Attendance System Using GPS," *Ann. Rom. Soc. Cell Biol.*, vol. 25, no. 2, pp. 4510–4516, 2021, [Online]. Available: http://annalsofrscb.ro

[13] B. Chandramouli, S. A. Kumar, C. V. Lakshmi, G. B. Harish, and P. A. Khan, "Face Recognition Based Attendance System Using Jetson Nano," *Int. Res. J. Mod. Eng. Technol. Sci.*, vol. 3, no. 8, 2021.

[14] D. Prangchumpol, "Face Recognition for Attendance Management System Using Multiple Sensors," in *Journal of Physics: Conference Series*, 2019, vol. 1335, no. 1, doi: 10.1088/1742-6596/1335/1/012011.

[15] J. D. W. S. Souza, S. Jothi, and A. Chandrasekar, "Automated Attendance Marking and Management System by Facial Recognition Using Histogram," in *2019 5th International Conference on Advanced Computing and Communication Systems, ICACCS 2019*, 2019, doi: 10.1109/ICACCS.2019.8728399.

[16] A. A. Kumbhar, K. S. Wanjara, D. H. Trivedi, A. U. Khairatkar, and D. Sharma, "Automated Attendance Monitoring System using Android Platform," *Int. J. Curr. Eng. Technol.*, vol. 4, no. 2, pp. 1096–1099, 2014, [Online]. Available: International Journal of Current Engineering and Technology

[17] M. A. J. Hameed, "Android-based Smart Student Attendance System," *Int. Res. J. Eng. Technol.*, vol. 12, pp. 2356–2395, 2017.

[18] B. J. Mendonca, G. D'mello, R. D'souza, and J. More, "Automated Attendance using Android Devices," *Int. J. Appl. Inf. Syst.*, vol. 8, no. 6, pp. 21–26, 2015.

[19] V. Somasundaram, M. Kannan, and V. Sriram, "Mobile Based Attendance Management System," *Indian J. Sci. Technol.*, vol. 9, no. 35, pp. 1–4, 2016,

doi: 10.17485/ijst/2016/v9i35/101807.

[20] B. J. Mendonca, G. D'mello, R. D'souza, and J. More, "Automated attendance using android devices," *Int. J. Appl. Inf. Syst.*, vol. 8, no. 6, pp. 21–26, 2015.

[21] F. Susanto, F. Fauziah, and A. Andrianingsih, "Lecturer Attendance System using Face Recognition Application an Android-Based," *J. Comput. Networks, Archit. High Perform. Comput.*, vol. 3, no. 2, pp. 167–173, 2021, doi: 10.47709/cnahpc.v3i2.981.

[22] V. Hava, S. Kale, A. Bairagi, C. Prasad, S. Chatterjee, and A. Varghese, "Free & Generic Facial Attendance System using Android," *Int. Res. J. Eng. Technol.*, vol. 06, no. 09, p. 6, 2019.

[23] D. M. V. Salac, "PRESENT: An Android-Based Class Attendance Monitoring System Using Face Recognition Technology," *Int. J. Comput. Sci. Res.*, vol. 2, no. 3, pp. 102–115, 2018, doi: 10.25147/ijcsr.2017.001.1.28.

[24] M. M. Islam, M. K. Hasan, M. M. Billah, and M. M. Uddin, "Development of Smartphone-Based Student Attendance System," in *5th IEEE Region 10 Humanitarian Technology Conference 2017*, 2018, vol. 2018, doi: 10.1109/R10-HTC.2017.8288945.