

A Survey on Smart Attendance Collection Systems

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Abstract – Smart attendance collection systems are designed to record, store and manage attendance data efficiently in educational institutions and workplaces. These systems use sensors and software to accurately log student attendance. The implementation of biometric systems aids in uniquely identifying students based on facial recognition or fingerprints collected. Web-based systems provide students with distinctive credentials and allow for marking their attendance in a mobile app upon scanning a QR code and can also track attendance using Global Positioning Systems (GPS). Radio Frequency Identification (RFID) based attendance system assign each student with an RFID tag and use radio waves to read the tags when tapped on a reader to record attendance. This survey explores a few current methods of attendance collection used in various educational institutions. It deals with a few effective technologies to track student attendance.

Keywords – Biometric systems, RFID systems, QR code systems, GPS systems, Arduino UNO, ESP32, fingerprint sensor, MySQL, PHP Laravel, Chameleon code, DBMS.

I. INTRODUCTION

Attendance is one of the criteria that affects a student's academic performance. In most cases, attending classes regularly is linked with better grades. Poor attendance may indicate that the student is not developing the knowledge and skills needed for later success. Manual methods of marking attendance such as roll-call attendance and sign-in sheets are prone to human errors and have become susceptible to proxy attendance. This method compromises on the accuracy of a student's attendance record. To tackle these difficulties, smart attendance collection systems have been developed that use modern technology.

Studies have revealed that biometric attendance systems such as facial recognition systems and fingerprint matching enable faster and authenticated attendance verification. It uniquely

identifies students and there is very little or no possibility of proxy attendance as the biometric features are unique. Other methods such as RFID based attendance system contain electromagnetic fields that are used to identify students based on their RFID tag attached to their ID card. These tags have a unique ID which is initially stored in the database before assigning it to a student. Web based attendance system such as GPS combines geolocation technology with attendance tracking. It marks attendance based on a student's proximity (upto 50 meters) to predetermined classroom locations using real-time GPS data from their device. Web based system also provide for scanning QR code to mark the attendance. Recent works on QR code-based systems have implemented 'Chameleon code' methods that changes the colour of matrix elements within seconds to avoid sharing of these codes with the absentees.

Survey of a majority papers has included two stage operation of attendance marking:

- i. Enrollment stage – This stage captures and stores student fingerprints.
- ii. Authentication stage – At this stage, the scanned fingerprints are matched against a stored records of fingerprints to mark attendance.

The survey records that attendance data has accuracy rates exceeding 94%. It also ensures proxy-free attendance that is not easily susceptible to human errors and helps in marking attendance in less time as compared to traditional methods.

Smart Attendance Collection System Strategies

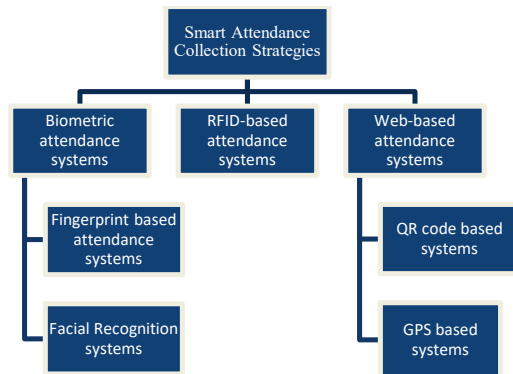


Figure 1: Smart attendance collection strategies

Figure 1 mentions a few smart strategies used in tracking student attendance. The survey focuses on biometric attendance systems based on fingerprint matching and facial recognition, RFID-based attendance systems and web-based attendance systems that include QR code systems and GPS tracking.

II. LITERATURE SURVEY

Biometric Attendance Systems

1. Fingerprint-based Systems

The paper [1] presents two applications of fingerprint biometric: Access Control System (ACS) to provide access to specific people inside the classroom and Classroom Attendance Management System (CAMS) that uses fingerprint as biometric feature for marking attendance. The system interfaces f19 fingerprint sensor device to Arduino Uno microcontroller. The standard analog Servo Motor is used for locking and unlocking the door. The entry time is automatically registered in a database and is updated on a website. The authors achieved an average success rate of 87% from the ACS and a success rate of 92% from CAMS application.

The authors [2] incorporated a GSM module with a SIM card and good network strength in their work on smart and secure fingerprint attendance system to send SMS alerts to parents of absentees. All the registered students are provided with unique code that is pre-programmed in the Arduino code along with phone number of each parent. Fingerprints of students are collected during enrollment stage and is used to match with the fingerprints taken while marking attendance. Teacher types the unique code of absentees in the serial monitor that will blink an LED with a delay of 2-3 seconds to indicate that it is ready to send a notification SMS to their parents.

Author [3] presented a portable biometric attendance system using ESP32 that adds portability, battery operation and local database storage. A DY50 fingerprint sensor and an OLED screen are used for enrolling users and then recognizing them to log attendance. The device is powered by a rechargeable battery and uses Wi-Fi to send attendance records to a database.

The study [4] on an optical fingerprint sensor is paired with an Arduino to automate attendance. The use of a 2D Gabor filter enhances accurate fingerprint-matching. It offers low-cost, portable, and user-friendly method for good management of

attendance.

A new approach presented in [5] offers a practical, low-cost fingerprint-based attendance. It combines the hardware-software contributions: Arduino Mega 2560, R305 fingerprint sensor, OLED display, and an Android application. The MATLAB used for enhancing fingerprint images helps improve the verification accuracy. One of the main enhancements of the present system is that the modified Adafruit library enables more than the default storage limit of the R305 sensor, making such a setup applicable for larger classrooms.

The paper [6] proposes a Fingerprint-Based Student Attendance System (BSAS) using an ATmega328P microcontroller, RS305 fingerprint module, LCD, and a Visual Basic.NET interface to handle issues such as fraudulent attendance, incorrect records, and time wastage. The circuit is first tested by simulation in Proteus 8 before assembling it on a PCB. The system functions in two major steps: enrollment includes saving a student's fingerprint and ID in the EEPROM, and verification works by comparing the scanned fingerprint against the stored data in the EEPROM to authenticate the particular subject; attendance data recorded in real time through an Arduino Data Logging Shield is then sent for more processing to a PC. The software automatically prepares the attendance report, showing each student's percentage of presence/absence.

A proposed paper [7] Smart Attendance System (SAS) integrates IoT with fingerprint. The hardware setup includes an ESP32 microcontroller, an R307 fingerprint sensor, and a 1.44-inch OLED display to capture and show attendance data. With built-in Wi-Fi and Bluetooth, the ESP32 sends data instantly to a XAMPP server for remote access. On the software side, PHP, MySQL, and the Twilio API handle the database, web interface, and SMS alerts to parents. The system manages enrollment, verification, and automatic logging. Tested on 20 students for seven days, it delivered 100% accuracy.

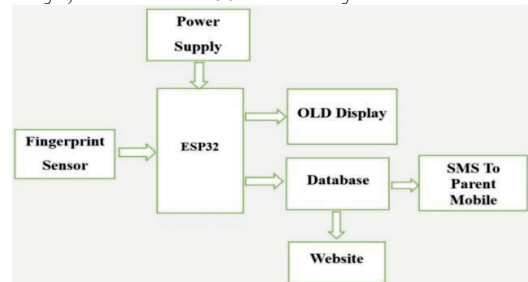


Figure 1(a): Proposed Smart Attendance System Block

An IoT-based fingerprint attendance and security system using an ESP32 Wi-Fi module, Arduino Mega, fingerprint sensor, and ultrasonic sensor for automated attendance and access control is proposed in [8]. The system handles both attendance and access control by first verifying the fingerprint and then confirming the person's entry using the ultrasonic sensor, and attendance data is securely transferred to a Laravel-based web server, while a touchscreen interface makes enrollment, operation easier for users and eliminating proxy attendance with improved efficiency.

An IoT-based biometric is presented in [9]. A Wi-Fi module ESP8266 is used for cloud connectivity, an Adafruit Fingerprint Sensor for biometric authentication, and an OLED display for the user feedback, all controlled through Arduino technology. On the software side, it uses HTTP protocols for communication. Adafruit Fingerprint library for real-time data

transfer and storage in a cloud database. The system provides safe, Automatic attendance recording with instantaneous feedback and real-Time Tracking.

In paper [10], the system uses a minutiae-based approach, especially crossing number technique that makes it easier to identify important points like ridge endings and bifurcations. The whole setup keeps user information and attendance data in an SQL database, and it automatically records when a person arrives and leaves. In testing, they found that fingerprint system works quicker and avoids problems false attendance.

In this paper [11], the authors describe a biometric attendance system operating on an Android smartphone with a fingerprint scanner. Students register only once by scanning their fingerprint and entering their basic details, which is then stored in a cloud database. Then, they are able to mark attendance by placing their finger on the scanner. The mobile application also sends the attendance report to faculty via email.

A few authors [12] describe how the ridges and furrows in a fingerprint contain important points called minutiae, such as ridge endings and bifurcations, which help in identifying a person correctly. The paper states that proper image enhancement is necessary for extracting clear minutiae, and thus a Gabor filter helps in the enhancement of fingerprint images.

The paper [13] proposes a fingerprint-based student attendance system integrated with GSM technology, which enable automatic recording and sending of SMS to the parents. The proposed system is built using Arduino, a GSM module, and a fingerprint sensor that detects minutiae points in order to verify an individual's identity. The verification can be done without any time lag, recognition is possible at 360°.

The authors [14] present a system that joins fingerprint recognition with GPS and GSM technology to manage attendance. Their design utilizes a microcontroller for capturing both the fingerprint data and the student's real-time location, making sure that the person is really present at the place needed. The GSM module then sends the information over the mobile network to a central database where the attendance can be Monitored easily. The system checks both identity and location of a student.

2. Facial Recognition Systems

The proposed [15] system uses Local Binary Patterns Histogram (LBPH) algorithm that extracts 128 key facial points of each captured face and converts it into numerical patterns. It then compares it against previously stored samples present in MySQL workbench to recognize the registered face. The recorded attendance data is made accessible in Excel sheets. Euclidean function is used to compute the distance between face in image and all faces in the dataset. If the current image is matched with the 60% threshold, then the attendance is marked. Parents get an automatic SMS if the student attendance < 75%.

In Paper [16] a machine learning-based face recognition system is proposed that captures the faces using a camera, processes them using OpenCV and the LBPH algorithm, and matches these with an pre-existing database for automatic marking of the attendance. The LBPH can yield up to 90% accuracy.

In the study [17], the authors use the Haar cascade method to detect faces because it works quickly and can identify a

person's face in a live camera stream without much delay. Once the face is detected, it uses dlib to generate "face embeddings," which are basically numerical values that represent the unique features of each person's face and allows the system to store and compare faces more accurately. To classify these features, researchers used an SVM model.

RFID-based Attendance Systems

Authors [18] have suggested using RFID tags and card readers along with web-based GUI to mark student attendance. The Card reader senses the RFID tag number and checks for that number in the database. A green LED glows to indicate that the student's login time is recorded by the system. The recorded attendance data can be accessed by the Administrator at any time from server to view various details of the students. The GUI also provides a facility for the admin to notify the parents of absentees.

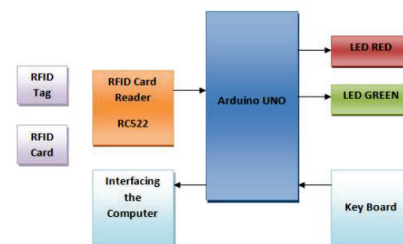


Figure 1(b): Block design of the system

The paper [19] presents a simple, efficient and low-cost solution for automating attendance using RFID technology. The system is a contactless process where each student is provided with an RFID card containing a unique identification number. When the card is brought near the RFID reader, data is transmitted wirelessly to an Arduino microcontroller, which verifies the ID, records attendance and stores the data along with the date and time using a Real-Time Clock (RTC) module.

Web-based Attendance Systems

1. QR code Systems

The author [20] presented a system that provides students with dual registration options: taking a selfie or providing a signature directly on a shared mobile device. The attendance information is uploaded to a web application (Roll Sheet) after the lecture. The author also introduced a one-time authentication known as a Chameleon code to provide feedback comment options. This code recognizes its position when displayed on the classroom smart screen. Each student will have their own mobile with web application installed that captures images in real-time and detects the code within the frame, confirming the student's attendance.

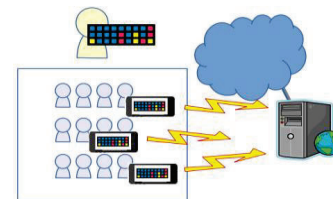


Figure 1(c): An overview of chameleon code-based attendance system

The paper [21] presents a very simple system of attendance where the students scan the QR code using their phones to mark their attendance. The system has a basic setup with a teacher's app, a student's app, a QR code creator and a place to store all attendance records. As the QR code changes for every class, there is less possibility of proxy attendance. However, the authors identified a few drawbacks, such as students getting a phone regularly, internet issues and long-life battery.

2. GPS based Systems

The proposed [22] system automatically records the student attendance when they are within 10 meters radius of the predetermined attendance zone. The current location of the student is calculated using Haversine Formula. If the distance is more than 10 meters from the designated area, the app will notify the students that they are outside the permissible range. Parents and Instructors get notifications about the students' attendance record as SMS and email via Python libraries.

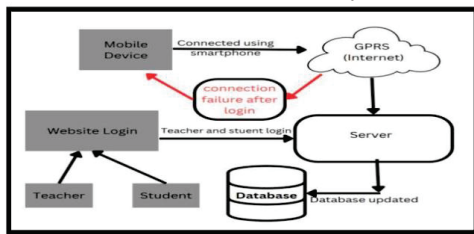


Figure 1(d): Suggested System Architecture

The paper [23] proposes an intelligent event attendance system for universities that integrates QR code scanning and GPS tracking attendance. Students log in using a mobile Android app via their matric number, scanning an encrypted event QR code provided by the organizer to send their identity, timestamp, and GPS location to the server to confirm physical presence at the event. The admin uses the web system to view all attendance records. The results of the system evaluation using 20 students showed that attendance tracking is faster.

III. SUGGESTED METHODOLOGY

From the survey we can infer that fingerprint based biometric attendance system provides accurate collection of attendance data, eliminates human errors and manipulation of attendance records as compared to RFID based and web-based attendance systems.

RFID-based attendance systems have reliability concerns such as lost tags and are liable to buddy punching. These systems require students to carry an individual tag or card, which can easily be shared or duplicated. It cannot identify if the student has got a proxy as their friend could have punched in absent students' card to mark the attendance.

Web-based attendance systems have connectivity issues such as disruption in data transmission, remote attendance and it lacks personal verification accuracy. As these systems depend on stable internet connectivity, any network interruption can halt data transmission or synchronization. It may also face privacy and security concerns, as data stored and transmitted online is vulnerable to unauthorized access and breaches.

Biometric attendance systems rely on unique features such as fingerprint or facial recognition. However, a drawback of using facial recognition systems is that it does not check for physical

presence of a student to give their attendance. A student's photo can be used to get them a proxy attendance. It only matches facial features without verifying real-time presence. This makes facial recognition systems less reliable compared to fingerprint biometric attendance systems.

On the other hand, fingerprint-based attendance systems capture fingerprints and extract the minutiae (microscopic ridges that form the backbone of fingerprint recognition systems) which is then used for fingerprint matching. These are highly distinctive features that make every fingerprint unique, even among identical twins. Thus, these systems help to achieve proxy-free attendance and provide accurate attendance records.

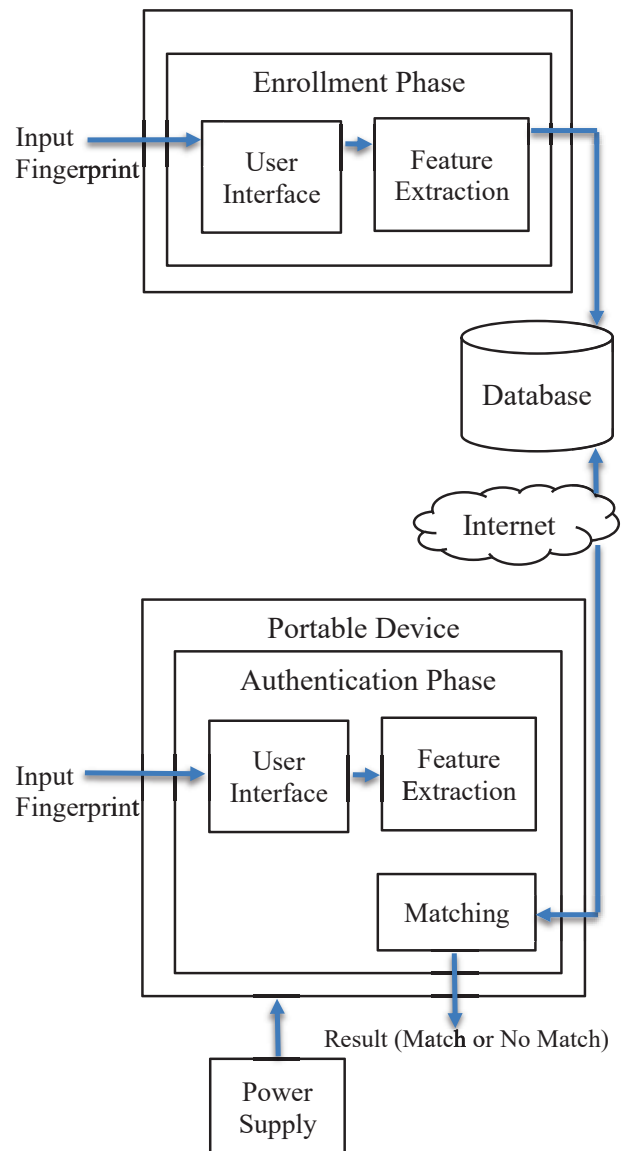


Fig 2: System Architecture

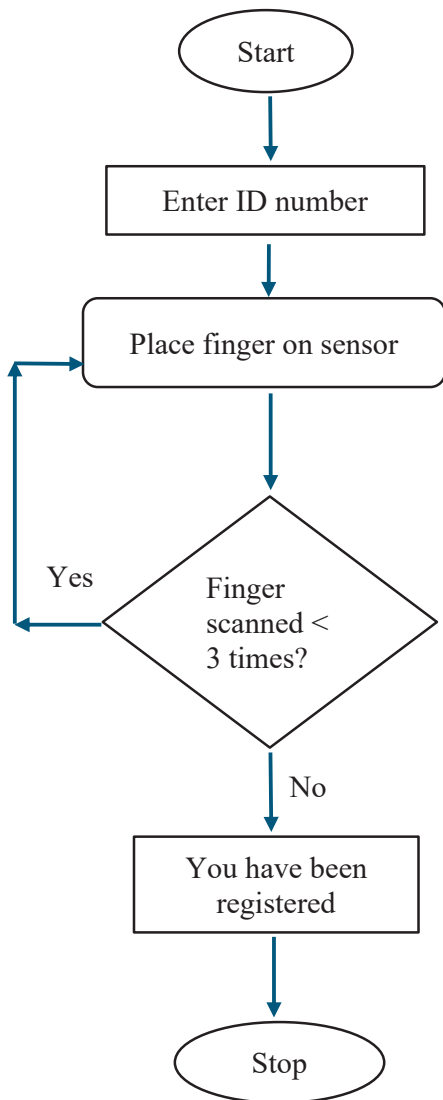


Figure 3: Flowchart of Enrollment Stage

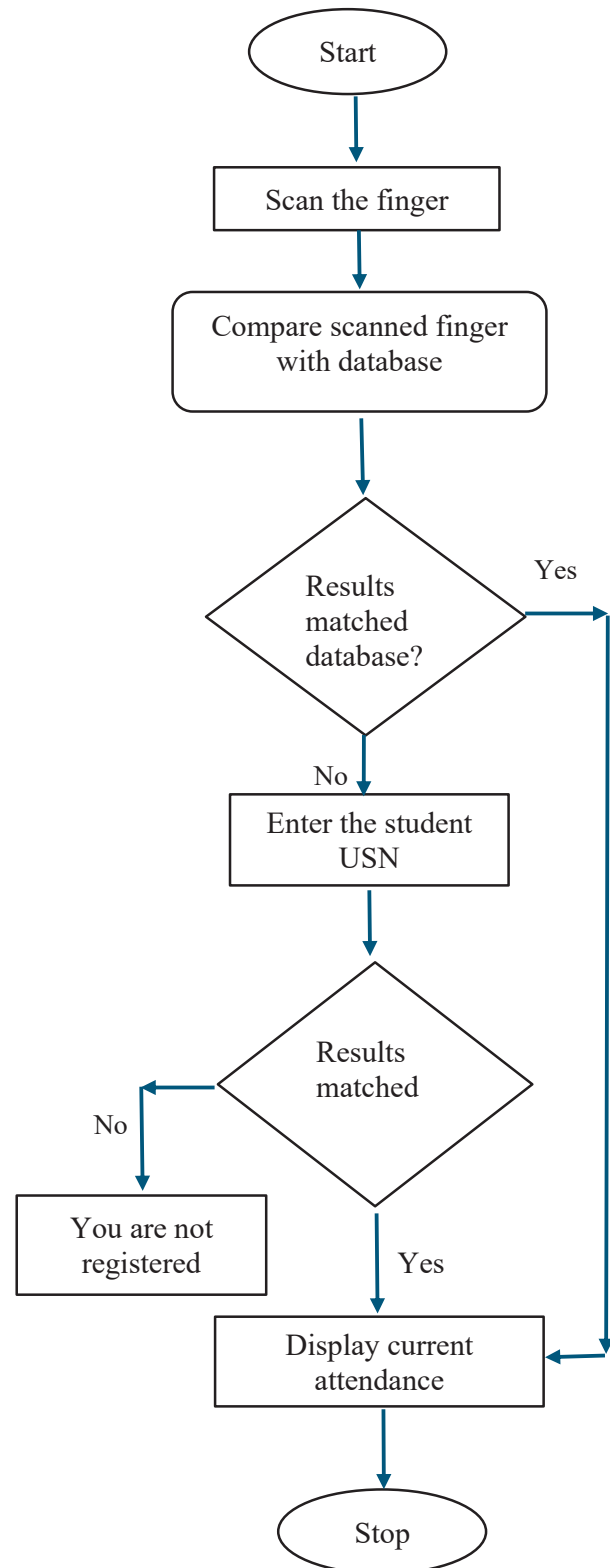


Figure 4: Flowchart of Authentication Stage

In our project we aim to build a portable and rechargeable Fingerprint-based Smart Attendance Collection System as shown in figure 2 by interfacing ESP32 microcontroller with R307s fingerprint sensor. The system will operate in two

phases:

- i. *Enrollment phase* – Fingerprint samples of students will be collected during this phase that will be used to extract the minutiae, and it will be stored in a database.
- ii. *Authentication phase* – At this phase, the fingerprints taken in class will be compared against the samples stored in the database. If a match is found, the student is marked present.

IV. CONCLUSION

In this survey paper we have surveyed 23 papers regarding Smart Attendance Systems and the summary of those papers are presented in the literature survey section. Literature survey consists of 17 survey papers on biometric attendance systems with 14 paper surveys on fingerprint based and three paper surveys on facial recognition systems. The section also consists of two papers surveyed on RFID based system and four papers surveyed on Web-based attendance systems where two papers are surveyed each on QR code based and GPS based attendance systems. A gist of important findings is listed in this survey paper. After a thorough survey of all papers is done, an alternative methodology is also suggested here.

REFERENCES

- [1] Yash Mittal, Aishwary Varshney, Prachi Aggarwal, Kapil Matani and V K Mittal, "Fingerprint Biometric based Access Control and Classroom Attendance Management System", *IEEE INDICON 2015 1570199167*, 2015
- [2] Ritam Dutta, Tenzing Tamang, Pranoy Paul, Nitesh Kumar, Chandan Chetri and Pradip Kumar Dutta, "Smart and Secure Fingerprint Attendance System using Arduino UNO with GSM Alert", *2020 3rd International Conference on Intelligent Sustainable Systems (ICISS)* | 978-1-7281-7089-3/20/\$31.00 ©2020 IEEE | DOI: 10.1109/ICISS49785.2020.9316127
- [3] Aadil S, "Portable Biometric Attendance Management System Using ESP32", *International Journal of Scientific Research and Engineering Development – Volume 8 Issue 3, May-Jun 2025*.
- [4] Karthik Krishnamurthi, S. Irudaya Mary, B. N. Sumalatha and Adler Pereira, "Fingerprint Based Attendance System", *International Journal of Advanced Research in Computer and Communication Engineering*, Vol. 4, Issue 3, March 2015. DOI 10.17148/IJARCCCE.2015.43149.
- [5] Biswaranjan Swain, Jayshree Halder, Siddharth Sahany, Praveen Priyaranjan Nayak and Satyanarayan Bhuyan "Automated Wireless Biometric Fingerprint Based Student Attendance System" *2021 1st Odisha International Conference on Electrical Power Engineering, Communication and Computing Technology (ODICON)* | 978-1-7281-7663-5/21/\$31.00 ©2021 IEEE | DOI: 10.1109/ODICON50556.2021.9428983.
- [6] Elebede Adedayo Wasiat, Olusanya Olamide Omolara, Sodipo Queen Busayo and Sam-Leeloo Tambari Ayotunde, "Design and Implementation of a Fingerprint-based Student Attendance System" *2024 IEEE 5th International Conference on Electro-Computing Technologies for Humanity (NIGERCON)* | 979-8-3315-4255-9/24/\$31.00 ©2024 IEEE | DOI: 10.1109/NIGERCON62786.2024.10927278.
- [7] Vishal V. Panchbhai, Om D. Waghmare, Prachi D. Tijare, Mahesh H. Bhojar and Vinay Patle, "Smart Attendance System: An Internet of Things (IoT)-Enabled Concept" *Cureus Journal of Computer Science* ©2024, DOI: <https://doi.org/10.7759/s44389-024-00164-z>.
- [8] Sayed Al Amin, Md. Ashikul Islam and Md. Saiful Islam, "A Fingerprint Based Smart Attendance and Security System Using IoT and Ultrasonic Sensor" *2021 International Conference on Automation, Control and Mechatronics for Industry 4.0 (ACMI)* | 978-1-6654-3843-8/21/\$31.00
- [9] M. P. Gaikar, S. Patil, Y. Bhoir, and K. Kapde, "Fingerprint Based Attendance System," *International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)*, vol. 5, no. 7, pp. 696–703, Mar. 2025, DOI: 10.48175/IJARSCT-24494.
- [10] Akinduyite, C.O., Adetunmbi, A.O., Olabode, O.O., and Ibadunmoye, E.O, "Fingerprint-Based Attendance Management System", *Journal of Computer Sciences and Applications*, 1(5), 100-105. DOI: 10.12691/jcsa-1-5-4.
- [11] Shakhivel Murugavel and Sabarinathan C. (2020). "Biometric Attendance System using Fingerprint for Smartphones." *Journal of Emerging Technologies and Innovative Research (JETIR)*, Volume 7, Issue 5, pp. 80–84. ISSN: 2349-5162.
- [12] R. Anitha and Dr. S. Sankaranarayanan (2022). "Fingerprint Based Biometric Attendance Monitoring System." *International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)*, Volume 9, Issue 5, pp. 45–50. ISSN: 2394-2320.
- [13] Z. Abbas, B. Ahmad, J. Abbas, A. Akbar, and R. Batool, "A Fingerprint Based Students Attendance System with SMS Alert to Parents," *Iraqi Journal of Information and Communications Technology (IJICT)*, vol. 6, issue 3, pp. 76–87, Dec. 2023. doi: 10.31987/ijict.6.2.271.
- [14] J. Chandramohan, R. Nagarajan, M. Ashok Kumar. "Attendance Monitoring System of Students Based on Biometric and GPS Tracking System," *International Journal of Advanced Engineering, Management and Science*, vol. 3, no. 3, pp. 241–246, Mar. 2017, doi: 10.24001/ijaems.3.3.16.
- [15] Darshana Band, Garima Agrawal, Harshada Deo, Vaishnavi Dhengekar, Rushikesh, Dadanje and Yugandhara Thakare, "Smart Attendance Management System (Sams): Attendance Tracking Process in Educational Institution", *International Research Journal of Engineering and Technology (IRJET)*, Volume: 11 Issue: 04 | Apr 2024
- [16] V. Gupta, M. Kashyap, V. Gupta, and P. Singh, "Smart Attendance System Using Face Recognition: A Machine Learning Approach," *International Journal of Research Publication and Reviews*, vol. 5, no. 3, pp. 932–939, Mar. 2024. doi: 10.55248/gengpi.5.0324.0634.
- [17] Sejal Shinde, Rutuja Shinde, Pramod Muchwad, Aniket Nagargoje & Nancy Kumari (2024). "Face Recognition Based Attendance System." *International Journal for Research in Applied Science & Engineering Technology (IJRASET)*, Vol. 12, Issue 4, DOI: 10.22214/ijraset.2024.60784.
- [18] Unnati Koppikar, Shobha Hiremath, Akshata Shiralkar, Akshata Rajoor and V. P. Baligar, "IoT based Smart Attendance Monitoring System using RFID", *2019 1st International Conference on Advances in Information Technology*, 978-1-7281-3241-9/19/\$31.00 © 2019 IEEE.
- [19] Ajay Joshi, Aman Ahmad, Arpit Saxena and Poonam Juneja, "RFID Based Attendance System", *International Journal for Modern Trends in Science and Technology*, 2021, DOI: <https://doi.org/10.46501/IJMTST0701009>
- [20] Jun Iio, "Attendance Management System using a Mobile Device and a Web Application", *2016 19th International Conference on Network-Based Information Systems*, IEEE DOI: 10.1109/NBiS.2016.44507
- [21] Samina Anjum, Shruti Jitendra Gondane, Manteshwari Lomeshwar Pipare and Yash purshottam Valhe, "Student Attendance System using QR Code", *International Journal of Current Science (IJSCPUB)* © 2023 IJSCPUB | Volume 13, Issue 2 April 2023 | ISSN: 2250-1770
- [22] Jeevarathinam A and Janani K, "Gps-Based Attendance Tracking System using Haversine Distance Algorithm", *International Research Journal of Modernization in Engineering Technology and Science*, Volume:07/Issue:03/March-2025.
- [23] Zakiah Ayop, Chan Yee Lin, Syarulnaziah Anawar, Erman Hamid and Muhammad Syahrul Azhar, "Location-aware Event Attendance System using QR Code and GPS Technology", *International Journal of Advanced Computer Science and Applications (IJACSA)*, Vol. 9, No. 9, 2018.