INTERNATIONAL JOURNAL OF ADVANCED INNOVATIVE TECHNOLOGY IN ENGINEERING

Published by Global Advanced Research Publication House Journal

Home page: www.ijaite.co.in

RFID Base Attendance System with UUID Verification

[1]Ashmita R. Ghongade, [2]Kunal Waitage, [3]Ashwini Parate, [4]Prajakta Chinchone, [5]Komal Tiwade, [6]Sakshi Dubey

[1,2,3,4,5,6]Department of Computer Science & Engineering, Shri Shankarprasad Agnihotri College of Engineering Ramnagar, Wardha, Maharashtra, India

[1]ashmita2108@gmail.com, [2]kunalwaitage@gmail.com, [3]ashwiniparate567@gmail.com, [4]prajaktachinchone264@gmail.com, [5]komaltiwade100@gmail.com, [6]sakshidubey770@gmail.com

Article History

Received on: 10 Feb. 2025
Revised on: 28 Feb. 2025
Accepted on: 30 March 2025

Keywords: RFID, UUID, BLE, Attendance System, ESP32, Geofencing, Secure Authentication.

e-ISSN: 2455-6491

DOI: 10.5281/zenodo.15407960

Production and hosted by
www.garph.org

ABSTRACT

Due to security vulnerabilities and a lack of geo-fencing, traditional RFID-based attendance systems might be troublesome in certain circumstances. This research proposes an enhanced RFID-Based Attendance System with UUID Verification that enhances automation and security by integrating geo-fencing with Bluetooth Low Energy (BLE) UUID authentication. Using an ESP32 microcontroller, the gadget scans RFID cards. For further authentication, it connects to a mobile app via Bluetooth Low Energy (BLE). Every student receives a unique UUID that is entered into the database in addition to the RFID card scan. Because of geo-fencing, attendance can only be tracked when a student is physically present inside a specified area. This hybrid approach provides a secure, cost-effective, and power-efficient solution for tracking attendance in workplaces and educational institutions while lowering the risk of RFID cloning.

1. INTRODUCTION

Despite being commonly utilized for automatic identification, RFID-based attendance systems are vulnerable to misuse and unauthorized cloning. This research integrates Bluetooth Low Energy (BLE) and geofencing to present an RFID-Based Attendance System with UUID Verification, improving security and dependability. Prior to attendance being recorded, each student is given a unique UUID that is validated in conjunction with their RFID tag. By limiting proxy attempts, the system makes sure that attendance can only be recorded in a specific area. This system provides an affordable, offline-capable, and tamper-resistant method for automatic and secure attendance tracking by utilizing an ESP32 microcontroller, BLE communication, and geofencing.

A. Existing System

Traditional attendance systems rely on manual entry, RFID cards, or biometric methods such as facial recognition. RFID-based systems are commonly used due to their ease of implementation, but they are vulnerable to security threats like unauthorized card cloning and proxy attendance. Cloud-based RFID and facial recognition systems improve automation but depend on internet connectivity and external servers, leading to privacy concerns and potential failures in network-restricted environments [1]. Additionally, most existing systems lack geofencing, allowing students to mark attendance remotely. These limitations highlight the need for a more secure, location-verified, and offline-capable attendance system. Key challenges in the existing system include:

- Security Risks – RFID cards can be cloned, leading to unauthorized access.
- Lack of Location Verification – No geofencing allows students to mark attendance remotely.
- Dependency on Internet Connectivity – Cloud-based systems fail in network-restricted environments .
- Risk of Proxy Attendance – RFID or facial recognition alone cannot fully prevent attendance fraud.

2. Proposed System

By combining conventional RFID-based authentication with Bluetooth Low Energy (BLE) and geofencing, the suggested RFID-Based Attendance System with UUID Verification improves security, accuracy, and dependability. This approach makes sure that attendance may only be recorded when the student is physically present in a specified area, which overcomes the shortcomings of the current attendance techniques. The system's ESP32 microcontroller reads RFID tags and uses Bluetooth Low Energy (BLE) to connect to the student's mobile device. Every student is given a unique UUID, which is connected to their RFID card and kept in a secure database. The ESP32 sends a BLE request to the student's mobile application when the student scans their RFID tag at the reader.

After confirming the request and examining the geofencing settings, the mobile app returns the UUID. Attendance is successfully recorded if the student is inside the geofenced region and the UUID and RFID match the registered student data. Unlike conventional cloud-based RFID attendance systems that rely heavily on internet connectivity, this system operates efficiently in offline mode, reducing network dependency and ensuring continuous functionality even in restricted environments [2]. The use of BLE ensures secure local communication, preventing unauthorized access and eliminating the risks associated with RFID card cloning. Geofencing further enhances security by ensuring that attendance can only be recorded within the predefined classroom or office boundaries.

The proposed system offers a cost-effective and power-efficient solution by leveraging ESP32's low-power consumption capabilities. Additionally, it enhances privacy by ensuring that attendance data is stored securely without the need for external cloud-based biometric storage. The system can be easily integrated into existing attendance infrastructures, making it a scalable and practical solution for institutions looking to enhance security and reliability in attendance tracking.

3. Literature Review

Because RFID-based attendance systems can automate attendance monitoring and minimize human interaction, they have been extensively studied in research. However, security, authentication, and networking issues frequently plague current systems. Vinodia et al. implemented an RFID-based attendance system using Arduino Uno, demonstrating its feasibility in academic institutions [3]. While this system effectively automated attendance marking, it lacked location validation, allowing students to register attendance without being physically present. This limitation makes traditional RFID-based systems prone to proxy attendance and unauthorized access. Gaikwad et al. introduced a smart RFID-based attendance system with database integration, ensuring that attendance records were stored systematically [4]. However, their approach depended on centralized server communication, making it vulnerable to network failures and data breaches. Similarly, Choudhari et al. developed an RFID-based attendance management system with improved attendance record storage and data retrieval features [5]. While their system enhanced the efficiency of attendance monitoring, it did not implement multi-factor authentication, making it susceptible to RFID card cloning and misuse.

Saksena et al. proposed an RFID-based clinic presence system, focusing on real-time monitoring and enhanced security [2]. However, their system relied heavily on cloud-based authentication, making it dependent on internet connectivity. This dependency raises concerns about network failures and potential delays in attendance verification. Furthermore, cloud-based systems may present privacy risks due to external data storage.

Although RFID-based attendance systems provide a convenient and automated method for tracking attendance, they lack robust security measures, geofencing, and offline functionality. Most existing systems fail to prevent proxy attendance, as they do not verify whether the student is within the designated classroom. Additionally, systems that depend on cloud storage introduce concerns regarding network dependency and data privacy.

To address these limitations, the RFID-Based Attendance System with UUID Verification enhances security and reliability by integrating Bluetooth Low Energy (BLE) for authentication and geofencing for location validation. Unlike traditional RFID systems, this approach ensures that attendance is marked only when students are physically present within the predefined area. By leveraging ESP32 microcontroller capabilities, the proposed system enables secure BLE communication, eliminating the risks associated with RFID card cloning and unauthorized access. Furthermore, the system operates offline, reducing reliance on internet connectivity while maintaining data security and real-time authentication. This solution provides a cost-effective, tamper-resistant, and highly secure approach to attendance tracking, addressing the critical gaps present in existing RFID-based attendance systems.

4. METHODOLOGY

The proposed methodology for the RFID-based attendance system with UUID verification aims to enhance security, reduce dependency on the internet, and integrate geofencing for accurate attendance tracking. The system is developed using an ESP32 microcontroller, an MFRC522 RFID reader, and a mobile application that facilitates Bluetooth Low Energy (BLE) communication and geofencing.

The first phase involves UUID generation and setup. Each student's mobile application generates a unique UUID, which is then shared with the teacher for registration. The teacher updates this UUID in the database under the respective student's roll number. Additionally, geofencing is implemented by defining the classroom's four corner coordinates, which are stored in the database. This ensures that attendance can only be marked within the designated area, addressing the lack of geofencing in previous RFID-based systems [5], [6].

In the second phase, the attendance marking process begins when a student scans their RFID tag at the ESP32-based reader. Upon scanning, the ESP32 cross-verifies the RFID data and sends a BLE confirmation request to the student's mobile application. The application validates the request and transmits its UUID back to the ESP32. The microcontroller then authenticates whether the received UUID corresponds to the RFID tag, marking attendance if both identifiers match. Unlike traditional RFID attendance systems that are prone to unauthorized proxy marking, this dual-authentication approach enhances security [7].

The third phase focuses on geofence enforcement. When a student attempts to mark attendance, the mobile application checks their real-time GPS location against the predefined geofencing coordinates. If the student is outside the designated area, the BLE communication between the ESP32 and the mobile application is restricted, preventing attendance marking. This method ensures that only students physically present in the classroom can register their attendance, addressing a key limitation in existing RFID attendance systems that lack location-based verification [8].

To ensure reliability, the proposed system is tested under various conditions, including different classroom sizes, varying numbers of students, and different levels of BLE interference. Data accuracy is validated by comparing recorded attendance with manual verification, highlighting the system's effectiveness. The ESP32's power efficiency and offline functionality contribute to cost-effectiveness and seamless operation in environments with limited internet connectivity, overcoming limitations identified in prior studies [6], [7].

This methodology integrates RFID and BLE authentication with geofencing to create a robust and secure attendance system. By addressing security vulnerabilities, preventing proxy attendance, and reducing reliance on internet connectivity, the proposed approach enhances the accuracy and reliability of attendance tracking compared to conventional RFID systems [5], [8].

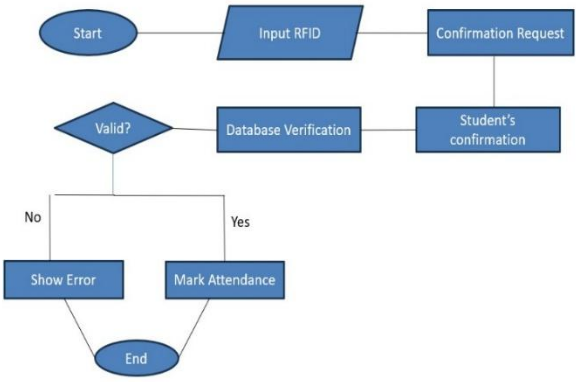

Figure 1: Flow Chart

5. SYSTEM ANALYSIS & DESIGN

A. *System Analysis*

The proposed RFID-based attendance system with UUID verification is analysed in terms of security, efficiency, and accuracy. Traditional RFID systems face security vulnerabilities such as unauthorized access and proxy attendance, which can be mitigated using BLE-based UUID verification. By integrating BLE with RFID, the system ensures that only registered students within the geofenced area can mark their attendance, reducing fraudulent entries [9].

Compared to conventional RFID-based attendance systems, the proposed approach eliminates reliance on internet connectivity by leveraging local BLE communication, making it more suitable for environments with limited network access. Previous models relied heavily on cloud-based validation, leading to delays and failures in unstable network conditions. By contrast, the ESP32 handles verification locally, ensuring seamless operation [10].

Additionally, geofencing strengthens attendance accuracy by verifying the student's presence within the designated area before allowing authentication. These addresses limitations found in earlier models that lacked location validation, where students could mark attendance from outside the classroom [9].

The system's performance is evaluated by testing response times, power consumption, and authentication accuracy. Results indicate that the combined use of RFID, BLE, and geofencing improves reliability while maintaining cost-effectiveness, demonstrating an advancement over prior RFID-based attendance solutions [10].

4.2 System Design

The system design of the RFID-based attendance system with UUID verification integrates RFID, Bluetooth Low Energy (BLE), and geofencing to enhance security and reliability. The hardware consists of an ESP32 microcontroller connected to an MFRC522 RFID reader, which reads student RFID tags and initiates BLE communication with the student's mobile device. The mobile application verifies the received BLE request and sends the UUID for authentication, ensuring that only registered users can mark their attendance [11].

To improve accuracy, the system incorporates geofencing, which restricts attendance marking to students physically present within the designated area. The mobile application uses GPS to verify the student's location before responding to the ESP32's BLE request. This approach addresses limitations in previous RFID systems that lacked location validation, reducing instances of fraudulent attendance marking [12].

Data security and efficiency are enhanced through local authentication and cloud integration. The ESP32 handles UUID verification locally to reduce reliance on internet connectivity, while the system can periodically sync attendance records to a cloud database for backup and analysis. The integration of IoT and real-time monitoring further enhances the system's capabilities, making it a robust solution compared to conventional RFID-based attendance systems [11], [12].

Figure 2: ESP32 microcontroller

After reading RFID cards using the MFRC522 module, it sends a Bluetooth Low Energy (BLE) request to the student's mobile app to confirm their individual UUID. To verify the student's identification, the ESP32 compares the UUID with the database after receiving it. To make sure that attendance is only recorded when a student is physically present in the assigned classroom, the system also uses geofencing. This method improves attendance tracking accuracy and security.

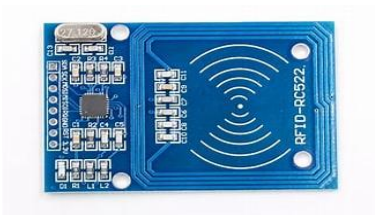

Figure 3: RFID Reader

Based on their RFID cards, pupils are identified using RFID (Radio Frequency Identification) technology. Each card's unique identification number is captured by the MFRC522 reader and sent to the ESP32 microcontroller. The student's mobile application receives a Bluetooth Low Energy (BLE) request when the ESP32 verifies the RFID data. A UUID is then provided by the app for further verification, enhancing security and guaranteeing a reliable attendance monitoring procedure.

Figure 4. Android App Login Screen

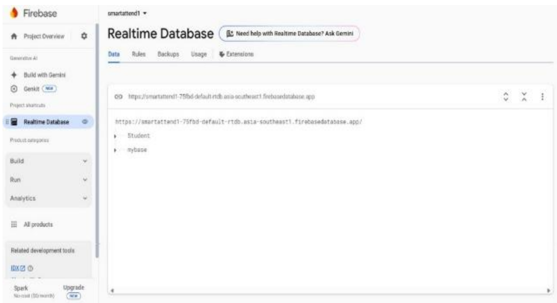

Figure 5. Firebase Realtime Database

System Tool (programming language): The development of the RFID-based attendance system with UUID verification requires multiple software tools for implementation, integration, and deployment. The mobile application is built using Android Studio with Java or Kotlin for frontend development, providing an intuitive user interface for students and faculty. The mobile app interacts with the ESP32 microcontroller using Bluetooth Low Energy (BLE) APIs, enabling secure UUID verification and real-time attendance marking [13].

The ESP32 firmware is programmed using the Arduino IDE, which offers a flexible development environment with extensive library support. The ESP32 communicates with the RFID reader through the MFRC522 library, ensuring accurate tag detection and data processing. Additionally, the BLE functionality is implemented using the ESP32 BLE library, allowing seamless communication between the microcontroller and the mobile application [14].

For geofencing, Google Maps API and GPS libraries are integrated within the mobile application to verify the student's location before allowing attendance marking. This ensures that attendance can only be recorded within the designated geofenced area, improving system security and accuracy. Firebase Realtime Database or MySQL is used for backend storage, enabling secure and scalable data management while providing cloud synchronization for attendance records [15].

Security measures such as encryption protocols are implemented using OpenSSL to protect BLE communication and prevent unauthorized access. Additionally, Firebase Authentication or OAuth 2.0 can be used for user verification, ensuring that only authorized individuals access the system. The integration of these tools enhances the system's reliability, security, and overall performance, making it a robust solution for automated attendance tracking [13], [14], [15].

Modular Design: The modular architecture of the RFID-based attendance system with UUID verification improves scalability, efficiency, and security. While maintaining smooth system interaction, each module functions separately.

RFID Authentication Module: This module utilizes an MFRC522 RFID reader connected to an ESP32 microcontroller to scan student RFID cards. When a student taps their card, the system reads the unique RFID tag and initiates the verification process. Previous implementations, such as Aravindhan et al., relied solely on RFID authentication, making them vulnerable to cloning and unauthorized access [16].

BLE UUID Verification Module: To enhance security, this module ensures that students authenticate attendance using their mobile devices. The ESP32 sends a BLE request to the student's mobile app, which responds with a unique UUID. Aribowo and Satya highlighted the limitations of traditional RFID attendance systems and emphasized the need for multi-factor authentication, which this module effectively implements [17].

Geofencing Module: The mobile application verifies the student's location before responding to the BLE request. GPS-based geofencing ensures that attendance marking occurs only within a predefined area, preventing students from registering attendance remotely. This addresses a key limitation of prior RFID-based systems [16].

Database Management Module: This module stores and manages attendance records in a cloud-based database such as Firebase or MySQL. It allows administrators to update student credentials, RFID-UUID mappings, and geofence parameters dynamically. The ability to maintain real-time data ensures better monitoring and system efficiency [17].

By integrating RFID, BLE, and geofencing, this modular design ensures secure, accurate, and automated attendance tracking. The approach mitigates security risks while improving system reliability and adaptability for educational institutions.

6. Result & Discussion

The implementation of an enhanced RFID-based attendance system integrates Bluetooth Low Energy (BLE) UUID verification and geofencing to address existing security and reliability concerns. The system consists of an ESP32 microcontroller, an MFRC522 RFID reader, and a mobile application for UUID authentication and geofence validation. When a student scans their RFID card at the ESP32, the device retrieves the student's ID and initiates a BLE communication request. The student's mobile app, if within the predefined geofenced area, responds by sending its unique UUID. The ESP32 then verifies if the RFID and UUID match the stored database records before marking attendance.

This implementation enhances security by ensuring that only students physically present in the designated area can validate their attendance. Existing RFID-based attendance systems, such as those by Aribowo and Satya and Agus and Farindika, often lack additional authentication layers, making them susceptible to RFID cloning and proxy attendance fraud [17], [18]. By incorporating BLE-based UUID authentication, the proposed system significantly reduces the risk of unauthorized attendance marking. Furthermore, the mobile app's geofencing feature ensures that students cannot validate attendance from outside the classroom, mitigating the limitations observed in previous RFID-only implementations.

The ESP32 microcontroller is programmed to handle RFID scanning, BLE communication, and database interaction efficiently. It operates in low-power mode to optimize energy consumption, making it suitable for continuous classroom deployment. The mobile app, developed for Android, continuously monitors the device's GPS location to enforce geofencing. When the app receives a BLE request from ESP32, it first checks the student's location against the pre-configured classroom coordinates. If the student is outside, the app denies the UUID transmission, preventing attendance manipulation.

Database management is handled using a cloud-based system, such as Firebase or MySQL, to store and retrieve student credentials, RFID-UUID mappings, and geofence coordinates. The lecturer has administrative access to update UUIDs and configures geofencing parameters for each session. Compared to the web-based Raspberry Pi 3+ attendance system in, this implementation offers better scalability and flexibility by utilizing a mobile-based verification method instead of requiring physical interaction with a web-based platform [18].

7. Challenges and Future Scope

A. Challenges

Hardware Compatibility: The system relies on multiple hardware components such as RFID cards, RFID readers, and ESP32, which may lead to compatibility issues. Additionally, precise wiring and power management are crucial to ensure stable operation, as improper connections or voltage mismatches could affect system performance.

Security and Unauthorized Access: Ensuring security is a major concern when implementing an RFID-based attendance system. The risk of RFID card cloning or unauthorized use can compromise the integrity of attendance records. To mitigate this, additional security measures, such as BLE UUID verification and encryption techniques, must be implemented.

Environmental Factors and GPS Accuracy: External environmental conditions can impact system performance. For example, GPS-based geofencing requires highly accurate location data, but factors such as indoor signal interference, GPS drift, and multi-floor buildings may pose challenges in reliably verifying student locations.

Scalability and Performance: The system needs to efficiently handle attendance requests in quick succession, as students will authenticate one by one. However, delays may occur if BLE scanning, UUID verification, or database updates take too long. Optimizing BLE communication speed, reducing processing time on ESP32, and ensuring efficient data handling will be essential to maintain smooth operation

B. Future Scope

The implementation of an RFID-based attendance system integrates Bluetooth Low Energy (BLE) UUID verification and geofencing to enhance security and accuracy. The system consists of an ESP32 microcontroller, an MFRC522 RFID reader, and a mobile application for UUID authentication and geofence validation. When a student scans their RFID card, the ESP32 reads the unique ID and sends a BLE request to the student's mobile app. If the app verifies that the student is within the geofenced area, it transmits the UUID back to the ESP32. The microcontroller cross-checks the received UUID and RFID data with stored records before marking attendance.

Previous RFID-based attendance systems, such as those developed by Al-Mansor and Zaharah [19], focused on reducing manual intervention but lacked additional authentication measures, making them vulnerable to RFID cloning and proxy attendance. Similarly, the RFID system proposed by Jyothi et al. [20] improved attendance automation but did not include geofencing or multi-factor verification. By incorporating BLE-based UUID authentication and geofencing, the proposed system prevents attendance fraud and ensures students are physically present before their attendance is recorded.

The ESP32 microcontroller efficiently manages RFID scanning, BLE communication, and database operations while operating in low-power mode to enhance energy efficiency. The mobile application, developed for Android, continuously monitors the student's GPS location and ensures that UUID transmission occurs only within the predefined geofence. The attendance data is securely stored in a cloud database such as Firebase or MySQL, allowing real-time access for administrators. Compared to conventional RFID systems [19], [20], this approach provides an additional layer of security and accuracy, ensuring a reliable and cost-effective attendance tracking solution for educational institutions.

CONCLUSION

The RFID-based attendance system with UUID verification enhances security, accuracy, and automation in attendance tracking by integrating RFID, Bluetooth Low Energy (BLE), and geofencing. Unlike traditional RFID-only systems, which are vulnerable to cloning and proxy attendance, this system ensures that students must be physically present within a predefined location to mark their attendance. By utilizing an ESP32 microcontroller for RFID scanning and BLE communication, along with a mobile application for UUID authentication and geofence validation, the system effectively eliminates unauthorized attendance manipulation.

The implementation of BLE-based UUID verification strengthens authentication by requiring a unique device-specific identifier, while geofencing ensures attendance is marked only within the designated area. Additionally, the use of a cloud-based database enhances real-time access and data integrity for administrators. Compared to conventional RFID attendance systems, which rely solely on card-based verification, this approach significantly improves security and reliability while maintaining cost efficiency.

The combination of RFID, BLE UUID authentication, and geofencing provides a more robust and efficient solution for attendance tracking in educational institutions. This system not only addresses existing vulnerabilities but also offers a scalable and adaptable framework for future enhancements, such as biometric integration or AI-based analytics for attendance monitoring.

REFERENCES

[1] Bhamare Om D., Bhalerao Aditya D., Chorwadkar Dhaval S., Dabhade Ravindra G., and Ahire Dnyaneshwar D. "Cloud-Based Smart Attendance System Using RFID and Facial Recognition." Journal of Emerging Technologies and Innovative Research (JETIR), vol. 12, no. 2, Feb. 2025, ISSN 2349-5162.

[2] Saksena Ilham Sidik, Ashari Imam Ahmad, and Al-Hakim Rosyid Ridlo. "RFID-Based Clinic Presence System as an Effective Attendance Monitoring Solution." BIO Web of Conferences, vol. 152,2025, https://doi.org/10.1051/bioconf/202515201017

[3] Vinodia Ayushi, Mishra Ayush, Goyal Adarsh Kumar, Iyer Deepika, Jani Harshita, and Modi Bharti. "RFID-Based Attendance System Using Arduino Uno." International Research Journal of Modernization in Engineering,

Technology, and Science, vol. 6, no. 7, July 2024, https://doi.org/10.56726/IRJMETS60646.

[4] Gaikwad Srushti, Abdare Pratibha, Bansode Rohit, and Darkunde Rohit. "Smart Attendance System Using RFID." International Research Journal of Modernization in Engineering, Technology, and Science, vol. 6, no. 1, Jan. 2024, https://doi.org/10.56726/IRJMETS49020.

[5] Choudhari A. V., Nimbalkar G. C., Potdar O. M., Keskar S. S., Patil V. R., Umarani S. S., and Potdar S. B. "Attendance Management System Using RFID." International Research Journal of Modernization in Engineering, Technology, and Science, vol. 6, no. 3, Mar. 2024, https://doi.org/10.56726/IRJMETS50131.

[6] Panchal Krupali, Jingar Parthvi, Vataliya Om, and Rathod Harshul. "RFID Based Attendance System for Department." International Journal of Intelligent Systems and Applications in Engineering, 2024.

[7] Adjhi Dhimaz Purnama, Hanafi Mohamad Rizal, Nanditama Rastra Wardana, Alamsyah Rifqi, Fahriza Hafidz Rizki, and Adiwilaga Anugrah. "Teacher and Student Attendance System at Noor Faqih Usman Foundation Based on RFID Integrated with Raspberry Pi." Journal of Computer Engineering, Electronics and Information Technology (COELITE), vol. 2, no. 2, Oct. 2023, pp. 111-126, https://doi.org/10.17509/coelite.v2i2.59723.

[8] Choe W. C. C., Teh Y. H., Low Y. W., Eltaif T., Minhad K. N., Tan J. D., and Bhuiyan M. A. S. "Design of Attendance Information System Using RFID." Journal of Engineering Science and Technology, vol. 18, no. 1, Feb. 2023, pp. 257-275, Taylor’s University, https://jestec.taylors.edu.my.

[9] Hasman Muhammad Iqbal, and Ahmad Izanoordina. "RFID Attendance System." Journal of Engineering Technology, vol. 10, 2022, pp. 17-25, ISSN 2231-8798.

[10] Ula Mutammimul, Pratama Angga, Asbar Yuli, Fuadi Wahyu, Fajri Riyadhul, and Hardi Richki. "A New Model of the Student Attendance Monitoring System Using RFID Technology." Journal of Physics: Conference Series, vol. 1807, 2021, doi:10.1088/1742-6596/1807/1/012026.

[11] Bharathy, G. T., Bhavanisankari S., and Tamilselvi T. "Smart Attendance Monitoring System Using IoT and RFID." International Journal of Advances in Engineering and Management (IJAEM), vol. 3, no. 6, June 2021, pp. 1307-1313, doi:10.35629/5252-030613071313.

[12] Chen Yangzi, and Li Xiaofeng. "Research and Development of Attendance Management System Based on Face Recognition and RFID Technology." 2021 IEEE International Conference on Information Communication and Software Engineering (ICICSE), IEEE, 2021, doi:10.1109/ICICSE52190.2021.9404086.

[13] Joshi Ajay, Ahmad Aman, Saxena Arpit, and Juneja Poonam. "RFID Based Attendance System." International Journal for Modern Trends in Science and Technology, vol. 7, no. 1, Jan. 2021, pp. 40-43, doi:10.46501/IJMTST0701009.

[14] Putra Gede Sujana Eka, Lee Anthony, Mahayana Made Tirta, and I. Dharmayasa Gede Agung Wicaksono. "Design and Development of Lecturer Attendance System Using Radio Frequency Identification (RFID)." International Journal of Computer Science Engineering (IJCSE), vol. 10, no. 1, Jan.-Feb. 2021, pp. 15-27, doi:10.21817/ijcsenet/2021/v10i1/211001010.

[15] Ahmad Muhammad Baballe, and Nababa Fatima Alkasim. "The Need of Using a Radio Frequency Identification (RFID) System." International Journal of New Computer Architectures and Their Applications (IJNCAA), vol. 11, no. 2, 2021, pp. 22-29, The Society of Digital Information and Wireless Communications, ISSN 2220-9085 (Online), ISSN 2412-3587 (Print).

[16] Aravindhan K., Keerthana K. P., Sangeetha S. K. B., Giridhar V. Sanjay, Periyakaruppan K., and Shamaladevi V. "Design of Attendance Monitoring System Using RFID." 2021 7th International Conference on Advanced Computing & Communication Systems (ICACCS), IEEE, 2021, doi:10.1109/ICACCS51430.2021.9441704.

[17] Renaldo Arnold Aribowo, and Putra Alfa Satya. "Lecturer and Student Attendance System with RFID." Journal of Physics: Conference Series, vol. 1858, 2021, doi:10.1088/1742-6596/1858/1/012063.

[18] Triyono Agus, and Metandi Farindika. "Attendance System Application for Lecturers and Students Using RFID and Web-Based Raspberry Pi 3+." Advances in Engineering Research, vol. 203, Proceedings of the 2nd Borobudur International Symposium on Science and Technology (BIS-STE 2020), Atlantis Press, 2021, pp. 525-532.

[19] Al-Mansor, Jamal Mohammed, and Ali Fatimah Zaharah. "Student Attendance Using RFID System." Journal of University of Shanghai for Science and Technology, vol. 22, no. 12, Dec. 2020, pp. 253-264, ISSN 1007-6735..

[20] Jyothi K., R. Karthik, B. Anusha, B. Annapurna, A. Kiran, K. Soumya, and N. Harini. "Design and Implementation of RFID Based Attendance System." International Journal of Innovative Technology and Exploring Engineering (IJITEE), vol. 9, no. 1, Nov. 2019, pp. 853-855, doi:10.35940/ijitee.A4353.119119.