

Automated Transport Management System: Route Optimization and Attendance Tracking for Institutions

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Abstract

Educational institutions face significant challenges in managing student transportation, such as inefficient route planning, manual attendance tracking, and the lack of real-time communication. These issues contribute to delays, operational inefficiencies, and safety concerns, leaving students, parents, and administrators with limited access to critical information about transportation logistics. Existing literature highlights advancements in transportation management through IoT, RFID, GPS, and AI, revealing both the potential of these technologies and their limitations in addressing hardware dependencies, network constraints, and manual interventions. Notable research includes IoT-based systems for bus tracking and attendance, Wi-Fi-enabled attendance solutions, and multiagent routing optimization algorithms, which underscore the effectiveness of real-time tracking and automation but reveal gaps in scalability, cost-effectiveness, and hardware reliability. To bridge these gaps, this project introduces the Automated Transport Management System (ATMS), a comprehensive platform designed to enhance efficiency, safety, and communication in student transportation. ATMS integrates GPS for real-time route visualization, barcode-based automated attendance logging, and proactive notifications accessible through a user-friendly web interface. This approach minimizes manual errors, reduces wait times, and ensures reliable service even in areas with variable connectivity, providing an efficient and flexible solution for educational institutions. By continuously evolving its features, ATMS aims to establish a new standard in transportation management, promoting student safety and operational effectiveness.

Keywords: Automated Transport Management System; Student Transportation; Attendance Tracking; Real-Time Tracking; IoT, Web-Based Solutions

1. Introduction

For educational institutions, managing student mobility efficiently is a top priority. The use of antiquated traditional techniques to manage attendance and keep an eye on bus routes presents serious difficulties for both teachers and kids. The labor-intensive and error-prone nature of manual attendance recording leads to inefficiencies that can impede the educational process. Furthermore, kids usually have no idea when buses will arrive, which

can cause confusion and even delays at bus stops. The Automated Transport Management System (ATMS) is a creative approach that uses contemporary technology to expedite transportation procedures in order to address these problems. In addition to offering real-time information on bus positions, the ATMS combines automated attendance tracking with route optimization to guarantee that children are appropriately accounted for. By providing prompt

updates on bus timetables, this web-based technology improves communication between parents, students, and school administrators. The ATMS wants to make transportation more organized by putting an emphasis on student safety and operational efficiency. The system's integration of GPS technology and web development tools minimizes the need for manual operations by providing accurate tracking and administration of student transportation. The ATMS's ultimate goal is to raise the standard of student transportation overall by creating a dependable and user-friendly atmosphere for all parties.

2. Literature Survey

Shah et al. propose a thorough approach to automating public transportation through the Internet of Things (IoT). Real-time bus tracking and ticket booking automation are the main goals of their technology. RFID is the main technology utilized, enabling the system to monitor the points of entry and departure for passengers. The fare is then calculated using this data and taken out of an e-wallet that is controlled by a mobile application. The device also gives passengers real-time location updates on the bus, which facilitates better travel planning. By offering resources for examining bus frequency and consumption trends to enhance scheduling, this approach greatly enhances conventional bus ticketing techniques by providing a paperless and more effective alternative [1]. Banepali et al. introduce a Wi-Fi-based attendance system. It uses the Raspberry Pi's capabilities to automate attendance in the classroom. The method links students' MAC addresses to attendance records by using the signal strength from Wi-Fi-enabled devices to identify their presence. This provides a quicker and more precise solution by doing away with the requirement for biometric devices or manual checks. The system's effective adoption in a variety of educational contexts, with an accuracy rate of over 94%, is discussed in the paper. For effective attendance tracking, it is reasonably priced and simple to incorporate into current academic systems [2]. Vincent et al. propose a GPS and RFID-based real-time college bus tracking system. As students get on and off the bus, the system provides functions including automated attendance logging, route

mapping, and real-time bus location tracking. Parents and administrators can check the whereabouts of the bus and its projected arrival times using a smartphone application. The system also has security elements, like live video feeds, to ensure pupils' safety while being transported. This study shows how IoT may be used to enhance security and transportation management in educational environments [3]. For increased security, Srinidhi and Roy suggest a sophisticated attendance tracking system that combines biometric and RFID technology. Using RFID tags for identification and biometric information to guarantee accuracy, their technology records student location and attendance data in real-time. Through a web-enabled interface, the system's remote accessibility enables parents and school officials to track students' movements and attendance in real time. High security and accuracy are ensured by the integration of RFID and biometric data, especially in delicate settings like colleges and universities [4]. Gadekar et al. discuss an intelligent bus tracking system that tracks school buses' movements using QR codes. Administrators and parents can view real-time updates on bus positions and expected arrival times by scanning the QR codes. The system's main goals are to protect students and give parents comfort by letting them keep an eye on their kids' transportation. The study emphasizes how crucial it is to develop an intuitive system that works with mobile devices and boosts productivity by eliminating manual communication between parents and drivers [5]. Daugherty et al. observe how multiagent routing algorithms can be used to optimize transport systems. Their research pertains to guidpath-based transport systems, which are frequently employed in automated material handling settings like warehouses and airports. The authors suggest algorithms that decrease the possibility of congestion and increase route efficiency. Although the emphasis is on improving agent-based transport systems, the methods covered can also be used to enhance public transportation systems, such as college or school buses, by more effectively controlling traffic and routes [6]. Chowdhury and Hadi develop a mobile application, Companion, made to handle several school-related duties, such as

scheduling buses, keeping track of attendance, and sending out parent notifications. For students, parents, and school administrators, the app offers a one-stop shop. In addition to enabling the registration of complaints and notices, it offers real-time updates on bus schedules and student attendance. The importance of mobile applications in boosting communication between parents, students, and the school as well as in improving the overall administration of school services is highlighted in this study [7]. For school buses, Mahfouz et al. propose an integrated solution that combines biometric-based attendance with route mapping. In addition to giving parents and administrators real-time location tracking, the system makes sure that only approved pupils board the bus. By using biometric information, the likelihood of fraud or error is decreased, and attendance records are guaranteed to be accurate. By giving precise information on bus routes and student movement, this dual capability increases operational efficiency and improves student safety and security [8]. Salim et al. develop a cutting-edge college bus attendance system that integrates facial recognition and RFID technology. Apart from automated attendance, the system also has a payment feature that enables students to make digital fare payments. Students are instantly signed in when they enter the bus thanks to RFID technology, and face recognition adds an extra degree of protection. This study focuses on the ways that cutting-edge technologies might improve security and streamline operations in campus transit systems [9]. Ali and Yusoff deliver a tele-monitoring system that automates attendance tracking through the use of RFID and photo-cell technology. The system is intended for use in settings like schools or expansive campuses where remote monitoring is necessary. Students are registered using RFID tags as they move through specific zones, and photo-cell sensors make sure the information is correct. Additionally, the technology offers administrators real-time data transmission, providing the most recent statistics on student mobility and attendance [10]. Fadzir et al. focused on enhancing school bus security through the integration of GSM and RFID technologies. Their technology uses GPS and GSM modules to track the

whereabouts of buses in real-time, and RFID verification ensures that only authorized students board the bus. The study highlights how parents and school officials may be kept updated on the position and status of the bus at all times by using GSM to transmit alerts and messages [11]. Habadi and AbuAbdullah suggest an intelligent school bus system that improves safety by fusing carbon dioxide monitoring with RFID technology. The technology tracks the quality of the air inside the bus using carbon dioxide sensors and employs RFID to ensure that only registered pupils are allowed on the bus. The system notifies school officials and the driver if harmful carbon dioxide levels are detected. The significance of integrating various technologies to enhance school transportation security and safety is emphasized in this research [12]. Albert Mayan et al. present a system that tracks the movement and attendance of employees using GPS. The solution is intended for large enterprises where it can be difficult to manage staff attendance. When employees enter or exit defined zones, it automatically tracks their attendance and uses GPS to monitor their location in real-time. Additionally, the system may produce comprehensive reports for administrators that offer information on staff attendance and mobility trends [13]. Toudjeu and Sotenga design an RFID-based smart attendance register. The technology is intended to automate the attendance process in enterprises, educational institutions, and schools. Every person is given an RFID tag, and as soon as they enter the building, their presence is instantly recorded. The system offers a more dependable and effective way to manage attendance data by reducing the likelihood of fraud and error that come with manual attendance methods [14]. Hussain et al. propose a vehicle tracking system that provides real-time location updates by fusing GPS and GSM technologies. The system is intended for use on public transit, such as school and college buses, where real-time tracking is essential for efficiency and safety. The location of the bus is tracked using GPS, and the data is sent to a central server via GSM, enabling administrators and parents to monitor the bus's condition in real-time [15], shown in Table 1.

3. Comparative Table

Table 1 Comparative Table

S. No	Author Name	Title of Paper	Year & Journal	Methodology	Merits	Demerits
1.	M. J. Shah, R. P. Prasad and A. S. Singh	IoT Based Smart Bus System	2020, IEEE	Uses RFID technology for entry and exit scanning of passengers. Incorporates GPS modules for real-time bus location tracking. Automated fare calculation is linked to an E-wallet managed through a mobile app.	Real-time bus tracking improves user convenience Automated ticketing system reduces manual errors. Paperless system supports sustainability.	Reliance on continuous GPS and network connectivity Initial installation costs for RFID and GPS modules. Data privacy concerns due to real-time tracking.
2.	Banepali, R. Kadel, D. B. Guruge and S. J. Halder	Design and Implementation of Wi-Fi Based Attendance System Using Raspberry Pi	2019, IEEE	WLAN with RSS and MAC-based attendance; threshold set by RSS; MySQL database and LMS integration Threshold: -69 dBm (lab), -71 dBm (lecture hall), -65 dBm (tutorial room); 94% accuracy	The system automates attendance without requiring additional applications on student devices, saving time and reducing attendance fraud.	The system's accuracy may vary based on the placement of the WAP, as RSS values fluctuate due to room layout and interference, affecting reliability in different physical settings
3.	B. Vincent, J. Sabu, C. Mathew, S. S. Nair, S. B. George, S. D	Live College Bus Tracking and Route Mapping Using Internet of Things	2023, IEEE	Uses GPS for bus tracking and ReactJS for user interfaces. RFID for attendance marking when students board and alight. Live video feed for enhanced safety monitoring.	The system enhances safety with real-time tracking and attendance, reduces waiting times through estimated arrival notifications, and allows parents to monitor student activity on the bus via live video feed.	Dependence on stable GPS and internet connectivity may limit functionality in areas with poor signal, affecting real-time data updates. It have Privacy Issues Bcos of live feed.
4.	Srinidhi MB and R. Roy	A web enabled secured system for attendance monitoring and real time location tracking using Biometric and Radio Frequency Identification (RFID) technology	2015, IEEE	Combines biometric fingerprint scanning and RFID for secure attendance. Tracks real-time location of students within the campus. Integrated with SMS and email notifications for parents.	Dual verification. Automated notifications for parents keep them informed. Centralized database for efficient attendance management.	High costs for biometric and RFID devices. Requires secure data management. Dependency on reliable internet and power sources.
5.	Gadekar, A. Kandoi, G. Kaushik and S. Dholay	QR scan based Intelligent System for School Bus Tracking	2020, IEEE	The system uses GPS to monitor the bus route, sending alerts to the driver and school authorities if the bus deviates over 1 km or skips a scheduled stop, ensuring security and compliance	It offers accurate attendance tracking, real-time updates, and predictive scheduling, enhance both student safety and bus route efficiency	If the internet connection is not good it may have Delay prediction: Random Forest 11.64% error rate.
6.	G. Daugherty, S. Reveliotis and G. Mohler	Optimized Multiagent Routing for a Class of Guidepath-Based Transport	2019, IEEE	Uses multi-agent algorithms for optimizing bus routes. Agents communicate to find the most efficient guidepath for transport.	Keeps parents informed about their child's daily progress and attendance. The app improves efficiency, and user feedback shows over	Heavy use might slow down the app if not well supported.

		Systems		Focuses on minimizing travel time and maximizing resource usage.	62% satisfaction with its design and over 65% approval of its features.	
7.	M. Chowdhury and N. Hadi	A Convenient Mobile Application For School Students Attendance, Registration, Notice, Bus Schedule, Complaint, and Parent Alert Services	2023, IEEE	This study proposes a mobile application to assist schoolchildren in Bangladesh by digitizing essential services, including attendance, course registration, fee payments, notifications, and complaint handling.	Keeps parents informed about their child's daily progress and attendance. The app improves efficiency, and user feedback shows over 62% satisfaction with its design and over 65% approval of its features.	Heavy use might slow down the app if not well supported.
8.	K. Mahfouz, S. M. Rameshi, M. Rafat, M. Elsayed, M. Sheikh and H. Zidan	Route Mapping and Biometric Attendance System in School Buses	2020, IEEE	A biometric-based attendance system for school buses, using fingerprint recognition to track students' boarding and exiting	Alerts the bus driver and authorities if a student is missing or hasn't exited the bus.	Storing biometric data raises privacy issues
9.	R. P. Salim, J. Varghese, N. M. Jacob, F. Benny, R. A. George and A. Rameez	Automated RFID and Face Recognition Based College Bus Attendance Marking System with Payment Module	2024, IEEE	Dual authentication with RFID and YOLOv8-based facial recognition; fare calculation based on route distance.	The system allows administrators and students to monitor attendance and payment statuses in real-time, enhancing overall efficiency	High costs due to YOLO and RFID hardware; limited functionality in areas with weak network connectivity.
10.	M. A. H. Ali and N. A. Yusoff	Development Of Tele-Monitoring Attendance System Using RFID and Photo-Cell	2018, IEEE	A tele-monitoring system using RFID and photocells to automate attendance tracking, detecting entry/exit and preventing cheating.	Accurately detects attendees' entry/exit improving reliability and preventing cheating.	Potential hardware limitations when scaling up from prototype to larger, more complex environments.
11.	T. M. A. M. Fadzir, H. Mansor, T. S. Gunawan and Z. Janin	Development of School Bus Security System Based on RFID and GSM Technologies for Klang Valley Area	2018, IEEE	Combines RFID for student identification and GSM for communication. Sends SMS alerts to parents regarding student boarding and exit. GPS tracking integrated for real-time location updates.	Provides immediate SMS alerts to parents on student entry/exit. Simple design with low power consumption, suitable for bus environments.	SMS alerts may fail in areas with low GSM signal, causing unreliable notifications. GSM module still draws power, potentially draining the bus battery on long trips
12.	A. Habadi and Y. S. AbuAbdullah	Intelligent Safety School Buses System Using RFID and Carbon Dioxide Detection	2018, IEEE	RFID for attendance tracking and CO ₂ sensor for air quality monitoring; automatic window ventilation if CO ₂ exceeds 4500 ppm.	Enhances student safety with air quality monitoring. Prevents students from being left behind on the bus. Sends immediate notifications to parents and staff in emergencies.	High cost for additional CO ₂ sensors. System could send alerts for students who may have forgotten their tags, causing confusion. The system heavily relies on technology that could fail or require frequent maintenance.
13.	Albert	GPS Enabled	2015,	Uses GPS for location	Efficient employee	GPS accuracy can vary

	Mayan J., M. Y. Khan, Md. Sabeelur Rahman K and S. P. Avinaash Ram	Employee Registration and Attendance Tracking System	IEEE	tracking and RFID for employee check-in. Automated attendance system with web and mobile interfaces. Centralized data management for HR and reporting purposes.	tracking and attendance. Reduces manual effort and increases accuracy. Real-time updates for better management.	based on location. Privacy concerns for continuous tracking. Dependence on internet connectivity.
14.	T. Toudjeu and P. Z. Sotenga,	Design and Implementation of an RFID Based Smart Attendance Register	2017, IEEE	RFID-based system for automated attendance. Data stored in a centralized database. Integrated with web interfaces for real-time monitoring.	Reduces manual errors in attendance logging. Cost-effective compared to biometric systems. Easy integration with existing school or office systems.	Relies on proper handling of RFID cards. Limited data security measures without additional encryption. Requires regular maintenance for optimal functioning.
15.	S. T. Hussain, M. Fadhil, T. A. Taha, O. K. Ahmed, S. A. Ahmed and H. Desa,	GPS and GSM Based Vehicle Tracking System	2023, IEEE	Combines GPS for real- time location tracking and GSM for data transmission. Provides route tracking and monitoring through web and mobile platforms. Generates reports for route analysis and management.	Real-time vehicle tracking improves planning and resource allocation. Reduces waiting time and increases efficiency. Cost-effective communication through GSM	Dependence on GPS and GSM signal strength.Potential privacy issues for tracked individuals. Regular updates and maintenance required.

4. Methodology

The Automated Transport Management System (ATMS) follows a structured approach to enhance the safety, efficiency, and convenience of student transportation. At its core, the system integrates GPS technology to continuously track the real-time location of buses. This data is processed and displayed on a web-based platform, allowing students, parents, and administrators to monitor live bus locations and receive accurate arrival estimates. By providing real-time route visualization, the system helps reduce wait times and improves planning for all stakeholders involved. Attendance management is automated through barcode scanners installed on buses. As students board and exit, their unique barcodes are scanned, and attendance data is instantly logged into the system. This eliminates manual errors and ensures accurate and up-to-date records. All data, including location and attendance details, is securely stored in a centralized database. To protect user privacy and ensure data security, encryption is used during both storage and transmission. To further enhance safety and communication, the system includes a notification module that sends timely alerts to students and

parents. These alerts provide updates on bus arrivals, delays, or route changes, ensuring that everyone stays informed in real time. Additionally, ATMS uses advanced route optimization techniques, considering factors such as traffic conditions, student locations, and distances, shown in Figure 1. This reduces travel times and operational costs while improving efficiency. The system also features a user management module that provides role-based access for students, parents, drivers, and administrators. Administrators can create and manage accounts, assign roles, and monitor overall system usage. To support decision-making, the system generates detailed reports, offering insights into attendance trends, route efficiency, and operational performance. Security remains a key focus of the ATMS methodology. User authentication ensures that only authorized individuals can access the system, maintaining the integrity and reliability of data. By integrating these features into a cohesive solution, ATMS addresses the traditional challenges of student transportation, providing a robust, scalable, and user-friendly platform that prioritizes safety and operational excellence.

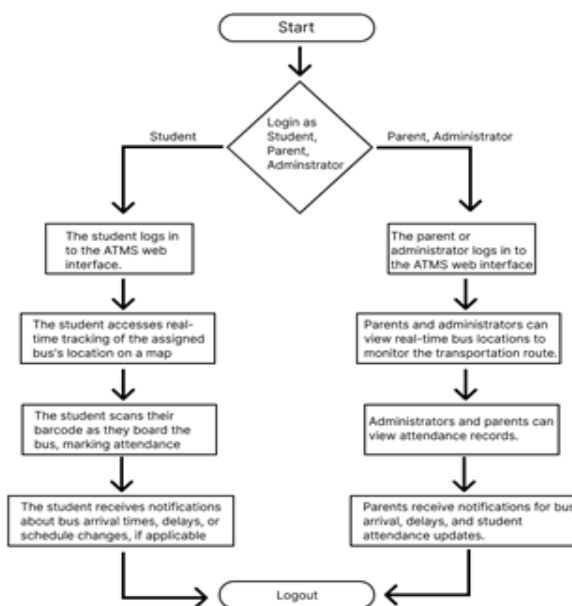


Figure 1 Architecture Diagram

5. Discussion

Automated transportation and attendance systems have brought significant advancements to educational institutions, but challenges like hardware dependence, network issues, and manual intervention still limit their effectiveness. Systems using RFID, GPS, and IoT technologies, as highlighted in the literature, have improved real-time monitoring and security but often come with high maintenance costs and operational inefficiencies. The proposed system addresses these challenges by reducing hardware dependencies and leveraging web-based and cloud technologies, making it more cost-effective and easier to maintain. By automating processes such as real-time GPS tracking, attendance logging, and notifications, the system ensures seamless communication between parents, administrators, and students. This reduces manual work for staff, enhances scalability, and improves the overall user experience, offering a reliable and efficient solution for student transportation and attendance management.

Conclusion

The Automated Transport Management System (ATMS) is designed to address the critical challenges faced by educational institutions in managing student transportation. By integrating real-time GPS

tracking, barcode-based attendance logging, and a user-friendly web interface, the system provides a comprehensive solution that enhances safety, efficiency, and communication. Unlike traditional systems, ATMS reduces manual errors, minimizes hardware dependencies, and ensures reliable performance even in areas with inconsistent network connectivity. The implementation of this system simplifies daily operations for administrators and ensures parents and students have access to real-time updates, reducing uncertainty and delays. By automating routine tasks such as attendance tracking and route visualization, the system lightens the workload for staff and improves overall efficiency.

Looking forward, ATMS provides a scalable foundation for future enhancements, such as predictive analytics for route optimization and dynamic scheduling based on real-time data. This project not only addresses existing gaps in transportation management but also sets a benchmark for reliable, user-centric solutions that prioritize the safety and convenience of students, parents, and administrators alike.

References

- [1]. M. J. Shah, R. P. Prasad, and A. S. Singh, "IOT Based Smart Bus System," 2020 3rd International Conference on Communication System, Computing and IT Applications (CSCITA), Mumbai, India, 2020, pp. 130-134, doi: 10.1109/CSCITA47329.2020.9137816.
- [2]. Banepali, R. Kadel, D. B. Guruge, and S. J. Halder, "Design and Implementation of Wi-Fi Based Attendance System Using Raspberry Pi," 2019 29th International Telecommunication Networks and Applications Conference (ITNAC), Auckland, New Zealand, 2019, pp. 1-6, doi: 10.1109/ITNAC46935.2019.9077985.
- [3]. B. Vincent, J. Sabu, C. Mathew, S. S. Nair, S. B. George, and S. D., "Live College Bus Tracking and Route Mapping Using Internet of Things," 2023 2nd International Conference on Computational Systems and Communication (ICCSC), Thiruvananthapuram, India, 2023, pp. 1-7,

- doi: 10.1109/ICCSC56913.2023.10143028.
- [4]. Srinidhi MB and R. Roy, "A web enabled secured system for attendance monitoring and real time location tracking using Biometric and Radio Frequency Identification (RFID) technology," 2015 International Conference on Computer Communication and Informatics (ICCCI), Coimbatore, India, 2015, pp. 1-5, doi: 10.1109/ICCCI.2015.7218103.
- [5]. Gadekar, A. Kandoi, G. Kaushik, and S. Dholay, "QR scan based Intelligent System for School Bus Tracking," 2020 Third International Conference on Smart Systems and Inventive Technology (ICSSIT), Tirunelveli, India, 2020, pp. 1074-1080, doi: 10.1109/ICSSIT48917.2020.9214161.
- [6]. G. Daugherty, S. Reveliotis, and G. Mohler, "Optimized Multiagent Routing for a Class of Guidepath-Based Transport Systems," in IEEE Transactions on Automation Science and Engineering, vol. 16, no. 1, pp. 363-381, Jan. 2019, doi: 10.1109/TASE.2018.2798630.
- [7]. M. Chowdhury and N. Hadi, "Companion: A Convenient Mobile Application For School Students Attendance, Registration, Notice, Bus Schedule, Complaint, and Parent Alert Services," 2023 Annual International Conference on Emerging Research Areas: International Conference on Intelligent Systems (AICERA/ICIS), Kanjirapally, India, 2023, pp. 1-6, doi: 10.1109/AICERA/ICIS59538.2023.10420262.
- [8]. K. Mahfouz, S. M. Rameshi, M. Rafat, M. Elsayed, M. Sheikh, and H. Zidan, "Route Mapping and Biometric Attendance System in School Buses," 2020 Advances in Science and Engineering Technology International Conferences (ASET), Dubai, United Arab Emirates, 2020, pp. 1-4, doi: 10.1109/ASET48392.2020.9118199.
- [9]. R. P. Salim, J. Varghese, N. M. Jacob, F. Benny, R. A. George, and A. Rameez, "Automated RFID and Face Recognition Based College Bus Attendance Marking System with Payment Module," 2024 1st International Conference on Trends in Engineering Systems and Technologies (ICTEST), Kochi, India, 2024, pp. 01-06, doi: 10.1109/ICTEST 60614.2024.10576119.
- [10]. T. M. A. M. Fadzir, H. Mansor, T. S. Gunawan, and Z. Janin, "Development of School Bus Security System Based on RFID and GSM Technologies for Klang Valley Area," 2018 IEEE 5th International Conference on Smart Instrumentation, Measurement and Application (ICSIMA), Songkhla, Thailand, 2018.
- [11]. M. A. H. Ali and N. A. Yusoff, "Development Of Tele-Monitoring Attendance System Using RFID and Photo-Cell," 2018 IEEE International Conference on Automatic Control and Intelligent Systems (I2CACIS), Shah Alam, Malaysia, 2018.
- [12]. Habadi and Y. S. AbuAbdullah, "Intelligent Safety School Buses System Using RFID and Carbon Dioxide Detection," 2018 1st International Conference on Computer Applications & Information Security (ICCAIS), Riyadh, Saudi Arabia, 2018.
- [13]. Albert Mayan J., M. Y. Khan, Md. Sabeelur Rahman K, and S. P. Avinaash Ram, "GPS enabled employee registration and attendance tracking system," 2015 International Conference on Control, Instrumentation, Communication and Computational Technologies (ICCICCT), Kumaracoil, India, 2015.
- [14]. T. Toudjeu and P. Z. Sotenga, "Design and implementation of an RFID based smart attendance register," 2017 IEEE AFRICON, Cape Town, South Africa, 2017.
- [15]. S. T. Hussain, M. Fadhil, T. A. Taha, O. K. Ahmed, S. A. Ahmed, and H. Desa, "GPS and GSM Based Vehicle Tracking System," 2023 7th International Symposium on Innovative Approaches in Smart Technologies (ISAS), Istanbul, Turkiye, 2023.