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The Evolution of Student Monitoring Systems in School Buses: A Detailed Review

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Abstract

In modern educational institutions, ensuring the safety and well-being of students during transportation is paramount. To address this, we propose a comprehensive Student Monitoring System for buses, designed to enhance safety, efficiency, and communication between stakeholders. The system utilizes advanced technologies such as GPS tracking, RFID tags, and real-time data processing to monitor students' location, track bus routes, and provide instant notifications to parents and school administrators. By integrating these technologies, the system offers features including real-time location tracking, attendance recording, emergency alerts, and optimized route planning. Moreover, the system facilitates seamless communication between parents, drivers, and school authorities through mobile applications and web interfaces. This paper outlines the design, implementation, and evaluation of the Student Monitoring System, highlighting its effectiveness in ensuring the safety and security of students during their commute. Additionally, ethical considerations, privacy safeguards, and future enhancements are discussed to address concerns and further improve the system's functionality and usability.

Keywords: GPS tracking, RFID Tags, Real Time Data Processing, Mobile Application, biometric scanners

INTRODUCTION

In today's fast-paced world, ensuring the safety and well-being of students during their commute to and from school is paramount. Introducing our innovative student monitoring system for buses, designed to provide real-time tracking and comprehensive oversight of students' transportation experience. By leveraging cutting-edge technology, we aim to enhance security, streamline communication, and foster peace of mind for parents, educators, and students alike.

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It involves GPS technology to track the location of school buses in real-time. This helps ensure that buses stay on schedule and allows parents to track the whereabouts of their children. It integrates with student databases to track student attendance on the bus. This could be done through RFID cards, biometric scanners, or even a mobile app where students check in when boarding the bus. It monitors driver behaviour such as speed, route adherence, and adherence to safety protocols. This helps ensure the safety of students during + transportation. It also sends notifications to parents when their child boards or exits the bus, providing peace of mind and allowing for better coordination of pickup and drop-off times. This system provides a mechanism for quickly notifying authorities and parents in case of emergencies such as accidents, breakdowns, or unexpected delays. It utilizes

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cameras or sensors to monitor student behaviour on the bus, ensuring a safe and orderly environment. This can help address any issues that arise during transit. It uses data analytics to optimize bus routes and schedules, minimizing travel time and fuel costs while maximizing efficiency. This system integrates seamlessly with existing school management systems, allowing for easy access to student information and enabling administrators to track attendance and monitor bus performance. It can provide customizable reports and analytics tools for administrators to track key metrics such as on-time performance, attendance rates, and safety incidents. This will ensure the privacy and security of student data through encryption, access controls, and compliance with relevant regulations such as GDPR and COPPA.

LITERATURE SURVEY

By utilizing the OBD/CAN interface, the system put out by E. Badawy, A. Elhakim, et al. communicated with the bus directly. Thanks to the OBD/CAN standard, an external device can gather data about a vehicle's state, including speed and acceleration. The three primary parts of the system are the following: bus attendance and usage monitoring by RFID, real-time location tracking via GPS, and real-time vehicle state supervision via OBDII module [1].

Sankar, J., and Raj, J. T. [2] The suggested solution lets parents know when their child gets off or gets on the bus and gives real-time information about a number of vehicle aspects, including location, route, speed, passenger count, driver adherence to schedule, and much more. To guarantee the safety of the pupils, it is crucial for every school to have a reliable and secure transport service. It assists the school administration in safely overseeing their fleet of buses and may even lower the number of accidents.

Gadade and colleagues developed a system that would allow for real-time surveillance and monitoring of pupils' movements to and from school, thereby improving their safety and accountability. The primary processing unit of the system is the ESP32 microcontroller, which coordinates data interchange and communication among the many parts of the system [3].

Contemporary security issues demand contemporary remedies. With the right information and technological advancements, it is now simpler than ever to obtain one's identity, password, and passcodes through eavesdropping, hacking, spying, fishing, and theft methods that are fundamental to engaging in illegal activities [4].

The purpose and applications of the technology discussed before in managing pandemic scenarios were discussed by Thigale et al. A comprehensive grasp of the possible applications, challenges, and potential reach of IoT-assisted robotic systems in healthcare services has been provided. This will help future academics create thorough thoughts for applying the previously mentioned technology to improve healthcare services in the future [6].

The 8051 controller is the circuit's primary component. Kolekar et al presented a system in which the password is entered using a 4×3 keypad. The entered password and the predetermined password are compared. The system rotates the door motor to open the door if the password is entered correctly, and an LCD shows the current condition of the door. The door stays closed and an LCD screen indicates "pwd is wrong" if the password is incorrect [7].

Nagane et al project shows how to use MATLAB for object tracking and detection [8].

In order to track school vehicles, GPS tracking is incorporated into the proposed architecture by Ranjan Das et al. The children's presence inside and outside the car is simultaneously recorded by passive radio frequency identification, or RFID [14].

Problem Statement

A student monitoring system for buses could include problem statements such as:

- Attendance Tracking
- Efficiency
- Communication
- Behavioral Monitoring
- Driver Accountability
- Parental Oversight
- Data Security
- Integration
- Feedback Mechanism

Objectives of Project

The work of the system starts with the aim of the implementation of GPS technology to track the bus's location in real-time, ensuring accurate monitoring of students' whereabouts and to develop a system to automatically record students' attendance as they board and disembark the bus, reducing manual effort and errors. This system could enable automatic notifications to parents/guardians regarding their child's boarding and disembarking from the bus, enhancing transparency and safety. This system utilizes data analytics to optimize bus routes, ensuring efficiency and timely transportation for students.

Object Tracking

The process of identifying moving objects in a series of video frames is called object tracking. In the fields of computer vision, motion-based recognition, automated surveillance, traffic monitoring, augmented reality, and object-based video compression, among others, real-time object tracking is a difficult problem to solve. Accurate object detection is a critical component of performance at higher levels. The object detection method is being designed and implemented on a variety of platforms [9]. It covers things like openCV, MATLAB, Simulink, and C programming. Because of its many features, MATLAB programming is the most widely used of these. Using matrix data processing, a collection of toolboxes and Simulink blocks encompassing all technological domains, and simple programming are some of these features [7].

Security is always in danger it might be institutional, organisational, personal, or perhaps both, depending on the situation. We require a strategy to deal with these security-related issues with systems that use passcodes, passwords, and tamper-proof RFID cards. With the use of facial recognition technology, this is possible [5].

RFID Tags

When paired with GPS tracking technology, RFID tags significantly increase the efficacy of student monitoring systems used in school buses [10–13]. They guarantee the safety of each kid while in transportation by adding an extra degree of security and precision to the tracking process. For school transport systems, the integration of RFID and GPS technology provides a strong solution for operational efficiency, real-time monitoring, and attendance control. Further developments in RFID and GPS integration as technology progresses will probably result in even more advanced and dependable student monitoring solutions, guaranteeing the greatest levels of security and safety for students.

Implications

The system could include features such as GPS tracking, surveillance cameras, and panic buttons to ensure the safety and security of students while they are on the bus. It could automate the process of taking attendance, reducing the likelihood of errors and ensuring accurate records of student ridership. Parents would have the ability to track the location of the bus and receive notifications when their child boards or exits, providing them with reassurance about their child's safety during the commute. The system could facilitate communication between bus drivers, school administrators, and parents in real-

time, allowing for quick responses to any incidents or changes in schedule. School administrators could generate reports on various aspects of bus operations, such as route efficiency, student behaviour, and maintenance needs, to identify areas for improvement and allocates the resources more effectively. Integration with existing school databases and management systems could streamline administrative tasks related to student transportation, such as updating student information, managing bus assignments, and coordinating with other school activities also. The system could incorporate features to accommodate students with special needs which is important, such as wheelchair-accessible buses, audio announcements, and visual indicators for stops. By providing transparency and accountability in the transportation process, the system could foster trust and collaboration between schools, parents, and the broader community also.

RESULTS

The system construction involving the utilization of biometric authentication to verify students' identities when they get on and off the bus as shown in Figure 1. creating a smartphone app that will allow parents to monitor the school bus's whereabouts in real time and get alerts when their child arrives and departs. Incorporating camera systems into the bus to keep an eye on student conduct and guarantee their security while travelling This involves analysing bus routes and improving scheduling using machine learning methods to increase efficiency. employing blockchain technology to store student data and bus attendance records in a transparent and safe manner. creating a dashboard so that school administrators can track the performance of the bus fleet, evaluate the effectiveness of the routes, and quickly resolve any problems. This will help in coordinating with local authorities to include emergency response elements, including automated notifications or panic buttons, in the event of mishaps or emergencies. The safety of their children when riding the school bus is the main worry of parents. The demanding work environments and busy schedules of parents make it challenging for them to stay in touch with their kids. In order to ensure the safety of youngsters, this article outlines the design and development of a prototype. In order to keep track on schoolchildren in cars and notify priority contacts via SMS in the event of an emergency or dangerous circumstance, the authors developed a tracker programme.

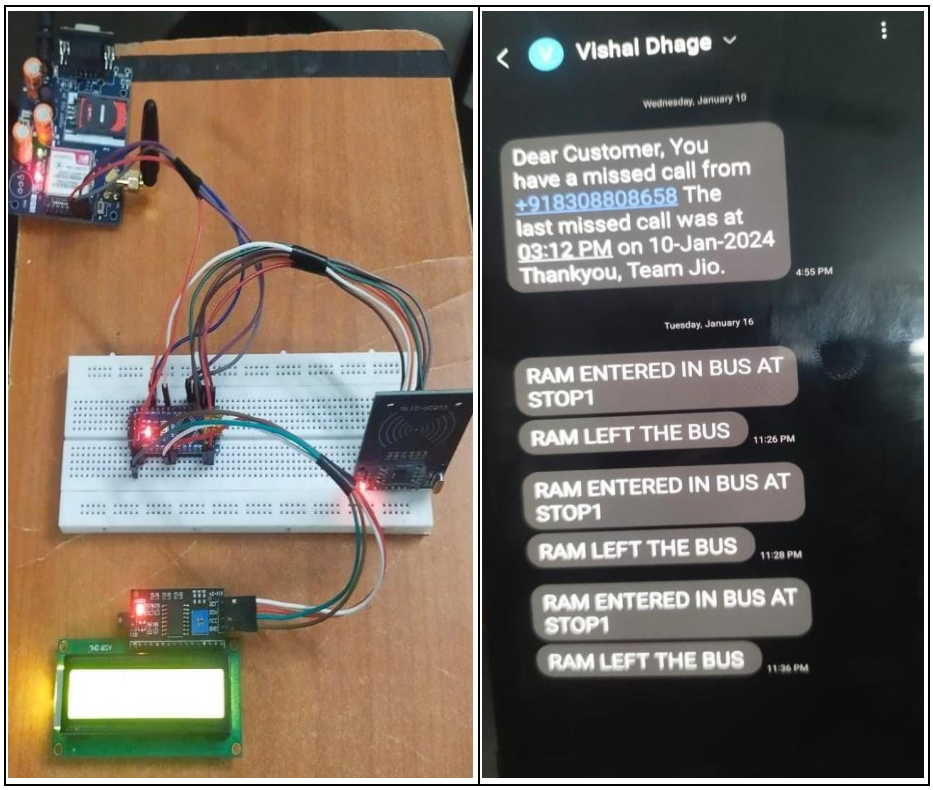

Figure 1. Experimental Set-up.

CONCLUSION

In conclusion, the development of a student monitoring system for buses without plagiarism involves the creation of original solutions tailored to the specific needs of tracking students' transportation. This may include the integration of technologies such as GPS tracking, biometric authentication, camera systems, and machine learning algorithms to ensure accurate monitoring and the enhance safety and efficiency. Collaboration with stakeholders, adherence to privacy regulations, and ongoing updates are essential for the successful implementation and maintenance of such a system. By prioritizing innovation and integrity, a robust student monitoring system can be established to meet the evolving demands of school transportation management.

By developing original software and hardware solutions, we ensure the integrity of the system while meeting the unique requirements of student transportation management.

Incorporating advanced technologies such as biometric authentication and GPS tracking not only enhances safety but also provides real-time monitoring capabilities, improving overall efficiency.

Collaboration with educators, parents, and transportation authorities is essential to design a system that addresses the concerns and priorities of all stakeholders involved.

Regular audits and updates are necessary to maintain the system's effectiveness and compliance with evolving privacy regulations, ensuring the continued trust and support of the community.

Ultimately, the successful implementation of a student monitoring system without plagiarism fosters a safer, more secure, and efficient transportation environment for students, parents, and school administrators alike.

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