**QR SCAN BASED INTELLIGENT SYSTEM FOR SCHOOL BUS TRACKING**

**ABSTRACT**

In the present day, it is not uncommon for parents and guardians to worry about the well-being and safety of their child or children. With the advent of numerous technologies, schools that can afford, implement extensive and costly measures to ensure the security of their students. However, such technologies remain inaccessible to the not so wealthy. This paper proposes an efficient and reliable school bus tracking cum safety solution in the form of an android application coupled with a website. The system incorporates location tracking, a simple but fool-proof authentication and notification mechanism, and anomaly detection techniques for raising alerts in case of unusual activity. Such a system allows for the parents to be aware of their child in unprecedented as well as known circumstances. The school authorities are also able to monitor the status of their buses via a website. As additional features to improve the travel, this paper implements route optimization and traffic-based delay prediction.

**INTRODUCTION**

In today’s world, ensuring safety and security is a major concern and top priority. There have been a lot of reports of mishaps with children during travel. Child safety is always the main concern for parents as well as the school authorities, especially when they are away from their child. They are always eager to ensure that all necessary precautions are being taken. For example, parents are always concerned about their child coming late from school. The presence of conductors and caretakers on buses is being employed to ensure someone keeps a watch over children and their safe boarding and leaving the bus. However, not all schools have enough personnel and often parents at work need live updates of their child’s whereabouts.

Another common problem faced by the people in India is relying on the ever-busy streets for daily commutes. Traffic especially affects heavy vehicles like buses which are prone to delay. For schools facilitating buses as a mode of transport, they need to know how early the buses should depart to pick up the students for school. In case of delay, the entire school schedule gets disrupted.

Observations from a survey with the local school authorities and the parents of school-going children revealed that there is a lack of such a system. However, there was general agreement towards the existence of such a system being of good use. It is of particular value to those who travel from far to get to the school and also to those who travel through congested routes. A study of the existing literature on the topic reveals the existence of numerous tracking technologies, which keep track of the student's activity, the location of the route of the bus. Some of these also implement additional security measures. However, these suffer from the requirement of hardware components and complicated use, while some are one dimensional and have loopholes.

Therefore, a solution is needed which can :

• Provide reliable information about the whereabouts of a child from the point of pick-up to drop-off.

• The application should be as automated as possible, reducing the work of bus staff

• The proposed solution shall also give additional information such as estimated arrival time

• The application should be intelligent and be able to issue alerts in case of a deviation from the norm.

• The application should be easy to use and should not involve any complicated or expensive hardware.

The paper proposes an android based solution that uses QR code scanning to authenticate each child and log their entry or exit from the bus. The solution uses this logged information, along with location and route information using google APIs, to monitor the live status of the bus and the children. The system communicates via REST APIs with a Django backend server and dispatches notifications to parents. The authors have also integrated features to alert the conductor and school authorities in case of any mistakes in boarding, leaving or route.

The application is reliable, easy to use and inexpensive. To address the problem of traffic-induced delays, this study also presents work on an additional feature in the system to predict the bus delays due to road anomalies to suggest to the school authorities what time the school buses should leave in the morning to pick up the children. This paper is distributed in seven sections. Section II of this paper discusses the related literature behind previous solutions of student safety in buses, as well as routing and travel algorithms. Section III introduces the proposed methodology, which is split into two parts: the first part dealing with the actual mobile application for parents and bus staff, while the second explains our approach for predicting time delays. In Section IV the results obtained through this work are summarized. Section V goes over certain limitations and challenges in this study. The paper concludes with Section VI and VII which detail the conclusion and future scope, respectively.

**SYSTEM ANALYSIS**

EXISTING SYSTEM

The existing system for school bus tracking often relies on expensive and extensive technologies, making it inaccessible for schools with budget constraints. Parents and guardians are understandably concerned about the safety of their children during school bus transportation. While some schools can afford advanced security measures, others lack access to such resources. This project aims to address this disparity by proposing an efficient and affordable school bus tracking cum safety solution. The system consists of an Android application paired with a website, incorporating location tracking, a QR-based authentication mechanism, and notification features. Additionally, anomaly detection techniques are employed to raise alerts in case of unusual activities, ensuring an extra layer of security. The proposed system not only keeps parents informed in both known and unforeseen circumstances but also allows school authorities to monitor bus status through a dedicated website. To enhance the overall travel experience, the system implements route optimization and traffic-based delay prediction as additional features. This comprehensive approach seeks to make school bus tracking and safety measures accessible to a broader range of educational institutions, promoting the well-being of students without imposing a financial burden.

**LIMITATIONS**

**Cost Constraints:** The existing school bus tracking systems often come with high implementation and maintenance costs, making them unaffordable for schools with limited budgets. This financial barrier restricts the accessibility of advanced safety measures, leaving many educational institutions with conventional and less secure methods of student transportation.

**Limited Authentication Methods:** Many existing systems rely on conventional authentication methods, such as manual attendance or basic RFID cards. These methods can be prone to errors or unauthorized usage, potentially compromising the safety of students during bus journeys. Lack of advanced authentication measures can be a limitation in ensuring fool-proof security.

**Inadequate Anomaly Detection:** Some current systems may lack sophisticated anomaly detection mechanisms, making them less capable of identifying and responding to unusual activities or emergencies effectively. This limitation can pose challenges in promptly addressing safety concerns, especially in critical situations.

**Scalability Issues:** As the number of students and buses increases, scalability becomes a significant concern for some existing systems. Scalability issues can lead to performance degradation, delays in data processing, and decreased overall system efficiency, hindering the system's ability to handle a growing student population.

**Limited Accessibility for Parents:** Existing systems may not provide real-time and user-friendly interfaces for parents to monitor their child's bus journey. Limited accessibility to accurate and timely information about the bus location, expected arrival times, and potential delays can create anxiety and inconvenience for parents, impacting their ability to stay informed about their child's safety.

**LIMITATIONS OF EXISTING SYSTEM**

**PROPOSED SYSTEM**

The proposed system aims to overcome the limitations of the existing school bus tracking systems by introducing a comprehensive and cost-effective solution. Our system incorporates advanced features to enhance the overall security and efficiency of student transportation. Through the integration of QR code scanning for authentication, we address the limitations of traditional methods, ensuring a more fool-proof and secure verification process.

To improve anomaly detection, the proposed system implements sophisticated techniques that can swiftly identify and respond to unusual activities or emergencies, thereby enhancing the overall safety measures. The use of GPS-based location tracking provides real-time and accurate information about the school buses, enabling parents to monitor their child's journey conveniently through a user-friendly Android application and a dedicated website. This ensures that parents are well-informed about their child's whereabouts, fostering a sense of security.

Moreover, the system focuses on scalability to accommodate the growing needs of educational institutions, ensuring optimal performance even as the student population and the number of buses increase. By incorporating route optimization and traffic-based delay prediction, our system not only prioritizes safety but also enhances the efficiency of the school bus transportation system, providing a more streamlined and reliable service for both parents and school authorities. The proposed system thus presents a holistic approach to school bus tracking, addressing the limitations of the existing systems and promoting a safer and more accessible environment for students.

**ADVANTAGES**

**Enhanced Security Measures:** The proposed system leverages QR code scanning for authentication, offering a more robust and secure verification process compared to traditional methods. This advanced authentication mechanism reduces the risk of unauthorized access and ensures that only authorized individuals, such as students and school staff, are allowed on the school buses.

**Real-Time Tracking and Monitoring:** With the integration of GPS-based location tracking, the system provides real-time and accurate information about the school buses. Parents can easily monitor their child's journey through a user-friendly Android application and a dedicated website. This real-time tracking enhances parental awareness and contributes to the overall safety and security of students during transportation.

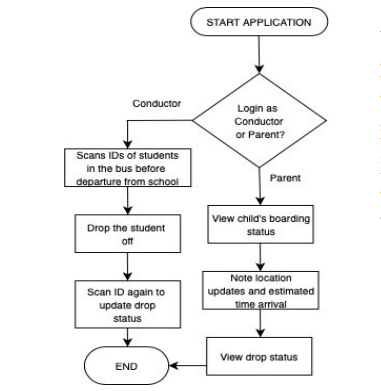
**Sophisticated Anomaly Detection:** The proposed system incorporates advanced anomaly detection techniques, enabling swift identification and response to unusual activities or emergencies. This feature enhances the overall safety measures, ensuring that any potential issues are addressed promptly. The system's ability to detect anomalies contributes to a safer environment for students during their bus commute.

**Scalability and Efficiency:** Addressing scalability concerns, the system is designed to handle an increasing number of students and buses without compromising performance. This scalability ensures optimal system efficiency, making it suitable for educational institutions of varying sizes. The system's ability to scale contributes to its long-term viability and effectiveness in accommodating the evolving needs of schools.

**Route Optimization and Delay Prediction**: The inclusion of route optimization and traffic-based delay prediction features improves the overall efficiency of the school bus transportation system. By optimizing routes, the system minimizes travel time and fuel consumption, leading to cost savings for the school. Additionally, predicting and addressing traffic-based delays ensures a more reliable and punctual transportation service, contributing to a positive experience for both students and parents.

**ADVANTAGES OF PROPOSED SYSTEM**

**SYSTEM ARCHITECTURE**

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**MODULES**

**Authentication Module:** The Authentication module is responsible for implementing the QR code scanning mechanism to verify the identity of students and school staff boarding the buses. This module ensures a secure and fool-proof authentication process, reducing the risk of unauthorized access and enhancing overall safety.

**Location Tracking Module:** The Location Tracking module utilizes GPS technology to continuously monitor and track the real-time location of school buses. This information is crucial for parents, school authorities, and the system itself to ensure that buses are on the correct route, provide accurate arrival times, and enhance the overall visibility of the bus fleet.

**Anomaly Detection Module:** The Anomaly Detection module employs advanced techniques to identify unusual activities or emergencies during bus journeys. This module plays a crucial role in raising alerts in real-time, allowing for prompt responses to potential safety concerns. By monitoring deviations from normal patterns, the system enhances overall security measures.

**User Interface Module (Android Application and Website):** The User Interface module provides an intuitive and user-friendly interface for both parents and school authorities. It includes an Android application for parents to track their child's bus and receive notifications, as well as a website for school staff to monitor the overall status of the buses. This module ensures accessibility and ease of use for all stakeholders.

**Optimization and Prediction Module**: The Optimization and Prediction module focuses on enhancing the efficiency of the school bus transportation system. It includes features such as route optimization to minimize travel time and fuel consumption, and traffic-based delay prediction to anticipate and address potential delays. This module contributes to cost savings and ensures a more reliable and punctual transportation service.

**HARDWARE REQUIREMENTS**

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| MINIMUM (Required for Execution) | | MY SYSTEM (Development) |
| System | Pentium IV 2.2 GHz | i3 Processor 5th Gen |
| Hard Disk | 20 Gb | 500 Gb |
| Ram | 1 Gb | 4 Gb |

**SOFTWARE REQUIREMENTS**

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| Operating System | Windows 10/11 |
| Development Software | Python 3.10 |
| Programming Language | Python |
| Domain | Image Processing & Cloud Computing |
| Integrated Development Environment (IDE) | Visual Studio Code |
| Front End Technologies | HTML5, CSS3, Java Script |
| Back End Technologies or Framework | Django |
| Database Language | SQL |
| Database (RDBMS) | MySQL |
| Database Software | WAMP or XAMPP Server |
| Web Server or Deployment Server | Django Application Development Server |
| Design/Modelling | Rational Rose |

**REFERENCES**

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[2] Snehal P. Umratkar, Prof. Ram Kumar SecureChild - Children Tracking Android Application March 2015