

Original Article

TRACK MY BUS: A COMPREHENSIVE ANDROID SOLUTION FOR REAL-TIME COLLEGE TRANSPORT SURVEILLANCE

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ABSTRACT

Campus transportation systems often suffer from inefficiencies caused by static schedules, lack of real-time information, and limited safety mechanisms. These challenges lead to prolonged waiting times, uncertainty among students, and difficulties in transport administration. This study presents Track My Bus, an Android-based real-time bus tracking and safety application designed for institutional transportation systems. The system utilizes Google Maps API for live route visualization and Firebase Realtime Database for low-latency data synchronization. A dedicated driver module continuously transmits GPS coordinates using the FusedLocationProvider service, while student users receive live updates through real-time listeners. In addition to tracking, the system integrates an emergency alert mechanism providing one-touch access to essential helplines. Experimental evaluation demonstrated average synchronization latency below 500 milliseconds with stable background tracking exceeding four hours. The results indicate that the proposed solution enhances transparency, operational efficiency, and commuter safety while remaining scalable and cost-effective.

Keywords: Real-Time Bus Tracking, Android Application, Firebase, Campus Transportation

INTRODUCTION

Reliable transportation is a fundamental requirement for educational institutions. Conventional campus bus systems depend primarily on static schedules and manual communication, which often fail to reflect real-time conditions such as traffic congestion, delays, or vehicle breakdowns. The absence of live location visibility increases uncertainty among commuters and limits administrative control.

Recent advancements in mobile computing and cloud technologies have enabled the development of intelligent transportation systems without the need for specialized hardware. Leveraging smartphone sensors and cloud-based databases, real-time tracking solutions can be implemented with minimal infrastructure cost. Track My Bus was developed to address these challenges by providing continuous location monitoring, live map visualization, and integrated safety support tailored specifically for campus environments.

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LITERATURE REVIEW

Intelligent Transportation Systems (ITS) have gained significant research attention due to their role in improving transport efficiency, safety, and service transparency. Early vehicle tracking studies relied on GPS and GSM hardware modules to transmit positional data to centralized servers. [Lee and Gerla \(2010\)](#) proposed a vehicular sensing framework capable of real-time monitoring; however, the requirement for dedicated hardware increased deployment complexity.

IoT-based transportation systems were later introduced to improve automation. [Kumar and Prakash \(2016\)](#) developed an IoT-enabled public bus monitoring system integrating GPS sensors with microcontrollers. While effective in fleet supervision, hardware dependency and scalability limitations restricted adoption in smaller institutions.

The widespread availability of smartphones enabled mobile-based tracking systems. [Silva et al. \(2018\)](#) implemented an Android-based tracking platform using Google Maps API, demonstrating improved accessibility and reduced infrastructure cost. Nevertheless, continuous background tracking and power efficiency remained challenges. [Al-Hamadani et al. \(2019\)](#) reported inconsistent performance under fluctuating mobile network conditions.

Cloud-supported architectures further enhanced synchronization performance. [Chen et al. \(2020\)](#) demonstrated the suitability of Firebase Realtime Database for low-latency mobile data exchange. However, safety mechanisms and institutional access control were not considered. Recent studies emphasize the need for integrated safety services within student transportation systems [Sharma and Gupta \(2021\)](#).

The reviewed literature indicates that most existing systems focus primarily on location monitoring while neglecting campus-specific requirements such as controlled fleet size, role-based access, safety integration, and background service stability. The proposed Track My Bus system addresses these gaps through smartphone-based sensing, real-time cloud synchronization, and emergency alert support.

PROBLEM STATEMENT

Existing campus transportation systems lack real-time visibility of bus movement, leading to extended waiting times, inefficient route supervision, and limited commuter safety. Manual communication mechanisms fail to provide timely responses during emergencies.

RESEARCH OBJECTIVES

- To design a real-time campus bus tracking system using mobile and cloud technologies.
- To provide accurate live location visualization for students.
- To implement continuous background location sharing for drivers.
- To integrate emergency alert functionality for enhanced safety.
- To evaluate system performance under real operational conditions.

SIGNIFICANCE OF THE STUDY

The proposed system demonstrates how low-cost smartphones combined with cloud infrastructure can replace expensive GPS hardware. The solution improves transportation reliability, enhances commuter safety, and offers a scalable framework adaptable to various institutional environments.

MATERIALS AND METHODS

The application was developed using Android Studio with Java as the primary programming language and XML for interface design. Firebase Authentication provides secure role-based access control for drivers and students. Firebase Realtime Database enables continuous low-latency synchronization of GPS coordinates. Google Maps API facilitates interactive visualization, while the FusedLocationProvider service ensures accurate and power-efficient location acquisition.

SYSTEM ARCHITECTURE

The system follows a three-tier architecture consisting of mobile clients, cloud backend, and external APIs. Driver devices publish GPS coordinates to the Firebase backend, while student devices subscribe through real-time listeners to display live bus locations on digital maps.

RESULTS AND DISCUSSION

Field testing was conducted under real operational conditions. The system achieved location accuracy within five meters and average synchronization latency below 500 milliseconds. Background tracking services remained stable beyond four hours of continuous operation. User feedback confirmed reduced waiting uncertainty and improved confidence in transportation reliability.

LIMITATIONS

- Dependence on stable mobile internet connectivity.
- Increased battery consumption during continuous GPS usage.
- Absence of ETA prediction in the current implementation.

FUTURE ENHANCEMENTS

Future enhancements include ETA prediction using Google Directions API, geofencing-based arrival alerts, offline caching during network loss, and development of a web-based administrative dashboard for analytics and fleet monitoring.

CONCLUSION

The Track My Bus system demonstrates an efficient and scalable solution for real-time campus transportation management. By integrating mobile sensing, cloud synchronization, and safety mechanisms, the application improves transparency, operational efficiency, and commuter safety while maintaining low deployment cost.

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