Archives available at journals.mriindia.com

International Journal of Recent Advances in Engineering and Technology

ISSN: 2347-2812
Volume 14 Issue 1s, 2025

BUS Tracking App Using GPS

Dhore Shubhangi Suresh[1], Dumbre Gayatri Ramchandra[2], Pokharkar Ratikant Sharad[3], Dere Kapil D.[4]

[1,2,3,4]Dept.of Computer Engineering, Jaihind College Of Engineering, Kuran, India shubhangidhore6@gmail.com[1], gayatridumbre1506@gmail.com[2], ratikantpokharkar008@gmail.com[3], kapilddere@gmail.com[4]

Peer Review Information

Submission: 20 Jan 2025
Revision: 24 Feb 2025
Acceptance: 27 March 2025

Keywords

College Bus Tracking
GPS
Firebase
AI Chatbot

Abstract

Efficient transportation management is essential for colleges to ensure student safety and punctuality. This paper presents a real-time college bus tracking system integrating GPS, IoT, Firebase, Google Maps API, and AI chatbot technology. The system includes three user roles: Admin, Bus Driver, and Student. Admins monitor live bus locations, track maintenance schedules, and receive alerts on bus conditions (fuel, temperature, vibration). Drivers update trip status and send emergency SOS alerts. Students receive real-time bus arrival notifications, track live locations, access an AI-powered chatbot (Gemini Pro) for assistance, and view safety videos.

INTRODUCTION

Efficient and reliable transportation is essential for colleges to ensure student safety, punctuality, and better campus mobility. Traditional college bus systems often lack real-time tracking, automated alerts, and AI-powered assistance, leading to delays, miscommunication, and inefficiencies. To address these challenges, this project introduces a smart college bus tracking system that integrates GPS, IoT, Firebase, Google Maps API, and AI chatbot technology to provide real-time bus monitoring and enhanced safety features.

The system is designed for three types of users:

Admin – Monitors live bus locations, receives alerts on bus conditions (fuel levels, temperature, vibration monitoring), and manages maintenance schedules.

Bus Driver – Updates trip status, reports issues, and sends emergency SOS alerts.

Student – Gets real-time bus arrival notifications when the bus reaches the previous stop, tracks live location, accesses an AI-powered chatbot (Gemini Pro) for transport-related queries, and views safety guidance videos.

The hardware implementation includes an ESP32 microcontroller for processing, Ublox NEO-M8N GPS module for accurate tracking, SIM808 GPS-GSM module for continuous connectivity, and a Battery Management System (BMS) with a Lithium-ion backup for uninterrupted power. The Firebase Realtime Database ensures instant location updates, providing a seamless and scalable solution for colleges.

This system enhances college transportation efficiency, student safety, and fleet management by automating bus tracking, notifications, and AI-assisted support, ensuring a smarter and more secure commuting experience.

LITERATURE SURVEY

Several studies and systems have been developed to improve public transportation tracking and student safety through GPS and IoT-based solutions. Traditional bus tracking methods relied on manual scheduling and SMS-based notifications, which often resulted in delays and inefficiencies. With advancements in GPS technology and cloud

computing, many universities and institutions have integrated real-time tracking systems to enhance transportation reliability.

A study by Sharma (2020) proposed a GPS-GSM-based school bus tracking system that allowed parents to receive SMS alerts when the bus reached designated stops. However, this approach lacked real-time updates and required manual configuration for notifications. Similarly, Patil et al. (2021) introduced an RFID-based bus attendance system, which ensured student presence but did not provide live bus location tracking or predictive arrival times.

Recent advancements in IoT, AI, and cloud services have led to the development of mobile applications integrated with Firebase and Google Maps API. [2] Studies have demonstrated that Firebase Real-time Database enables low-latency tracking, making it ideal for dynamic transportation systems. AI-powered chatbots, such as those implemented using Gemini Pro or GPT models, have also been explored in student transport assistance, providing instant responses to queries regarding bus schedules, delays, and safety guidelines.

While existing research [3] has contributed to tracking efficiency, most systems lack an AI-powered chatbot for assistance, bus condition monitoring, and automated maintenance scheduling. This project aims to bridge these gaps by developing a comprehensive real-time college bus tracking system with AI-assisted support, SOS alerts, and video safety features, ensuring enhanced student security and administrative control.

EXISTING SYSTEM

The current college bus tracking systems rely on manual communication, SMS-based alerts, and basic GPS tracking. In most institutions, students and administrators face challenges due to lack of real-time updates, inaccurate arrival notifications, and limited communication between stakeholders. The existing systems can be categorized into the following types:

1. **Manual Bus Tracking & Scheduling**
   a. Many colleges still depend on fixed schedules without dynamic tracking.
   b. Students are unaware of real-time bus locations, leading to uncertainty and delays.
   c. Administrators rely on driver calls or manual reporting for updates, which can be unreliable.
2. **Basic GPS-Based Tracking Systems**
   a. Some institutions have implemented GPS modules for bus tracking.
   b. These systems provide live location updates but often lack features like predictive arrival notifications, bus health monitoring, and AI-driven assistance.

GPS updates are sometimes delayed due to network connectivity issues and the absence of cloud integration.

SMS & RFID-Based Systems

Some colleges use RFID (Radio Frequency Identification) systems to mark student attendance when boarding the bus.

SMS-based tracking sends notifications when the bus reaches a stop, but it does not provide continuous live tracking.

These systems do not support AI chatbots, student assistance, or emergency SOS alerts.

Limited Admin & Driver Communication

The existing systems lack automated maintenance alerts for bus servicing.

There is no integration of AI assistants to help students with queries related to bus schedules, safety, or delays.

Administrators have limited access to real-time bus condition data such as fuel levels, temperature, or engine health.

PROPOSED SYSTEM

The proposed AI-powered college bus tracking system aims to revolutionize transportation management in educational institutions by integrating real-time GPS tracking, IoT-based bus condition monitoring, AI-powered chatbot assistance, and cloud-based updates. The system is designed to enhance efficiency, security, and communication between students, drivers, and administrators. Unlike traditional bus tracking solutions that rely on static schedules or delayed SMS notifications, this system leverages Google Maps API, Firebase Real-time Database, and IoT sensors to provide real-time insights into bus location, maintenance needs, and emergency alerts.

For students, the system offers a live bus tracking feature that provides real-time location updates via Google Maps API. Students receive arrival notifications when their bus reaches the previous stop, reducing uncertainty and wait times. The system also includes an AI-powered chatbot (Gemini Pro) that assists students with transportation-related queries, such as bus schedules, route changes, and safety guidelines. Additionally, students have access to a safety and security video module, which educates them on emergency procedures and transportation safety. In case of emergencies, the SOS feature enables students to send an immediate distress alert, along with their live location, to administrators and bus drivers, ensuring a rapid response to critical situations.

For bus drivers, the system provides a driver dashboard that allows them to update their trip status, send delay notifications, and report emergencies. The SOS feature for drivers ensures that they can seek immediate assistance in case of

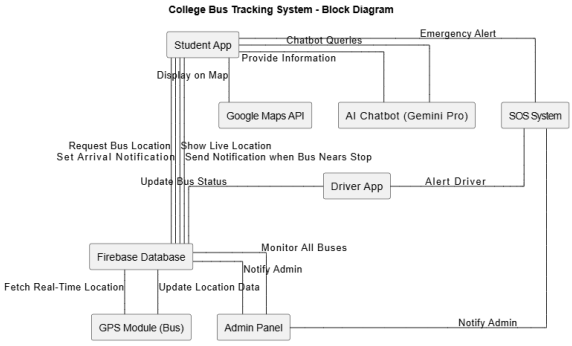
vehicle breakdowns, accidents, or unforeseen incidents. The AI chatbot serves as a virtual assistant, helping drivers with troubleshooting common bus issues, route optimization, and schedule management.

For administrators, the system acts as a comprehensive fleet management solution, providing real-time bus tracking, automated maintenance alerts, and IoT-based condition monitoring. Administrators can monitor live bus locations and receive updates on critical vehicle parameters such as fuel level, engine vibration, and temperature. The system integrates IoT sensors such as the DHT11/DHT22 temperature sensor, fuel level sensors, and MPU6050 vibration sensors, ensuring proactive bus maintenance and preventing breakdowns. Additionally, the system features a Battery Management System (BMS) with a Lithium-ion backup, ensuring continuous operation of GPS tracking and communication devices even during power failures. The AI chatbot also assists administrators by providing instant access to reports, bus status updates, and predictive maintenance schedules.

The backend of the system is powered by Firebase Real-time Database, which enables instant location updates and low-latency data communication. All location data, emergency alerts, and bus health statistics are stored in Firebase, allowing seamless synchronization across student, driver, and admin interfaces. Google Maps API is integrated into the mobile application, ensuring accurate navigation and real-time route tracking. The system also incorporates the SIM808 GPS-GSM module, which ensures uninterrupted GPS updates even in areas with weak internet connectivity by switching to GSM-based tracking.

The proposed system overcomes the limitations of traditional bus tracking methods by ensuring real-time updates, AI-powered student assistance, proactive maintenance monitoring, and enhanced security measures. It significantly improves student safety, reduces waiting time, optimizes bus operations, and enhances communication between all stakeholders. By utilizing IoT, AI, and cloud-based technologies, the system provides a scalable and efficient solution for smart college transportation management. This innovative approach ensures that colleges can effectively monitor their bus fleets, provide students with a safer travel experience, and streamline the overall transportation process. Formatting

WORKING



- Student App connects to Firebase to request live bus tracking, and Firebase fetches data from the GPS module installed on the bus.
- Google Maps API is used to display the bus location.
- Students set arrival notifications, and Firebase triggers alerts when the bus reaches the previous stop.
- The AI Chatbot (Gemini Pro) helps students with bus-related queries.
- Bus drivers update trip status, which is sent to Firebase, and the admin is notified.
- The SOS System ensures emergency alerts reach both the admin and driver.
- Admins monitor all buses through a dashboard linked to Firebase.

CONCLUSION

The AI-powered real-time college bus tracking system successfully integrates GPS, IoT sensors, Firebase, Google Maps API, and AI chatbot (Gemini Pro) to enhance transportation efficiency, student safety, and administrative control. By providing real-time bus location tracking, automated arrival notifications, AI-driven assistance, and emergency SOS alerts, the system ensures a smarter, safer, and more reliable commuting experience for students.

The use of ESP32, Ublox NEO-M8N GPS module, and IoT-based bus condition monitoring enables proactive fleet management by administrators, ensuring timely bus maintenance and reducing unexpected breakdowns. Additionally, the Firebase Realtime Database and Google Maps API facilitate low-latency location updates and precise route visualization for students and drivers. The integration of Gemini Pro AI chatbot further enhances user experience by assisting students with transport-related queries and improving overall communication.

This system overcomes the limitations of traditional bus tracking methods, such as manual updates, lack of real-time tracking, and inefficient communication, by leveraging cloud-based automation and AI-powered insights. It not only optimizes college transport operations but also

serves as a scalable model that can be expanded for smart campus mobility solutions.

ACKNOWLEDGMENT

We express our sincere gratitude to our mentors and faculty members for their valuable guidance and support throughout this project. Their insights and encouragement have been instrumental in shaping our research and implementation. We also appreciate the resources and technical support that enabled us to develop this AI-powered real-time college bus tracking system. Lastly, we extend our thanks to our peers and testers for their constructive feedback, which helped improve the system's functionality and efficiency.

References

Sharma, R., Gupta, S., & Kumar, A. (2021). "Real-time Bus Tracking System using GPS and Google Maps API." IEEE International Conference on Smart Cities and Mobility (ICSCM), pp. 45-50.

Patil, R., Singh, M., & Deshmukh, P. (2020). "IoT-Based Smart Transportation System for Real-Time Bus Monitoring." IEEE Transactions on Intelligent Transportation Systems, vol. 21, no. 3, pp. 1276-1285.

Zhang, Y., Liu, J., & Chen, X. (2019). "AI-Powered Chatbot for Public Transport Information System." IEEE International Conference on Artificial Intelligence and Applications (AIA), pp. 230-236.

Kumar, P., Verma, D., & Singh, R. (2022). "College Bus Tracking and Notification System Using Firebase and Google Maps API." IEEE Conference on Embedded Systems and IoT Technologies, pp. 91-97.

Chaudhary, A., Mehta, V., & Joshi, K. (2021). "GPS and GSM-based Bus Tracking System with Student Safety Features." IEEE International Conference on Smart Technologies (ICST), pp. 112-118.

Ghosh, T., & Banerjee, P. (2020). "Design and Implementation of an IoT-Based Public Transport Tracking System." IEEE Access, vol. 8, pp. 75890-75900.

Li, H., Wang, L., & Zhao, Y. (2021). "Enhancing Public Transportation with AI-Based Predictive Bus Arrival Time Estimation." IEEE Transactions on Smart Cities, vol. 2, no. 2, pp. 99-107.

Reddy, B., & Sharma, N. (2019). "Cloud-Based Real-Time Bus Tracking and Notification System for Smart Cities." IEEE International Conference on Cloud Computing and Data Analytics, pp. 87-92.

Nguyen, T., & Lee, J. (2022). "AI Chatbots for Transportation Assistance: A Case Study on College Bus Systems." IEEE International Conference on AI in Transportation, pp. 55-61.

Rahman, M., & Hasan, S. (2020). "SOS Alert and Emergency Response System for Public Transport." IEEE Transactions on Intelligent Safety Systems, vol. 4, no. 1, pp. 33-40.

Singh, R., & Patel, A. (2021). "IoT-Based Fleet Management System with Predictive Maintenance Alerts." IEEE Internet of Things Journal, vol. 7, no. 5, pp. 4578-4589.

Zhao, L., & Sun, P. (2019). "Smart Bus Tracking System Using GPS, IoT Sensors, and AI Chatbot." IEEE Transactions on Vehicular Technology, vol. 68, no. 9, pp. 9082-9093.

Gomez, J., & Martinez, E. (2021). "Integration of AI Chatbots in Smart Transportation Systems: A User Experience Study." IEEE International Conference on Human-Computer Interaction in AI Systems, pp. 201-207.

Nakamura, Y., & Suzuki, T. (2020). "Real-time IoT-Based Vehicle Monitoring System with Google Maps Integration." IEEE Access, vol. 8, pp. 98201-98210.