Smart Bus System.

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ABSTRACT

Public transportation users often face difficulties in knowing the real-time location of buses, estimated arrival time, upcoming bus stops, and receiving timely information during emergencies. To address these challenges, this project proposes a **Smart Bus System** that integrates GPS, an embedded controller, wireless communication, and a web application to provide real-time bus tracking and passenger information.

The proposed system continuously obtains the bus location using GPS and transmits the information to a server, where the live location of the bus can be monitored through a web application. The system also calculates and displays the estimated arrival time (ETA), remaining distance, current stop, and next stop. Inside the bus, an electronic display provides visual information while a speaker provides automatic voice announcements of the current and upcoming stops.

Key Words: Smart Bus System, GPS Tracking, IoT, Real-Time Bus Tracking, Estimated Arrival Time (ETA), Passenger Information, Wireless Communication, Web Application, Voice Announcement, Transportation Safety.

1. INTRODUCTION

Public transportation plays an important role in daily travel, but passengers often face difficulties in obtaining accurate information about the location of buses, upcoming stops, remaining distance, and estimated arrival time. Lack of real-time information can increase waiting time and may cause passengers to miss their desired destination. In crowded or emergency situations, passengers may also require a quick method to request assistance.

To overcome these limitations, the proposed **Smart Bus System** integrates GPS, an embedded controller, wireless communication, and a web application to provide real-time information about bus movement. The GPS module continuously determines the location of the bus, and the location data is transmitted to a server through wireless communication. The live position of the bus can then be monitored through a web application.

The system also focuses on improving passenger convenience inside the bus. An electronic display provides information such as the current bus stop, next bus stop, remaining distance, and estimated arrival time (ETA). A speaker provides automatic voice announcements about the current and upcoming stops, helping passengers follow their journey and avoid missing their destination.

In addition to passenger information and tracking, the proposed system provides a platform for integrating future safety features. These include an emergency SOS button, blind-spot detection, accident notification, passenger monitoring, door-lock interlocking, rear obstacle and pedestrian detection, and driver alcohol detection with ignition interlock.

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2. LITERATURE SURVEY

1. **Desingu et al. (2023) – "Locate My Bus: IoT-Driven Smart Bus Transit"**
   The authors proposed an IoT-based smart bus transportation system using **GPS, machine learning and real-time tracking**. The system focuses on monitoring bus locations and predicting bus arrival times. Such an approach improves passenger convenience by providing information about the expected arrival of buses. This work is closely related to the proposed Smart Bus System because both systems use real-time location information and arrival-time prediction. However, the proposed system additionally focuses on **in-bus passenger information through an electronic display and automatic voice announcements**, along with planned safety features.
2. **Saravanan et al. (2025) – "Real-Time Bus Tracking and Management System with IoT, Chatbot Integration and Accident Zone Prediction"**
   This research presents an IoT-based bus tracking and management approach integrating **GPS, IoT and GSM**. The work aims to provide real-time information for effective bus management and also considers accident-zone prediction. The study demonstrates how communication technologies can be integrated with

transportation systems for improved monitoring and management. The proposed Smart Bus System follows a similar IoT-based tracking concept but extends the passenger-side functionality with **current-stop/next-stop information, ETA, remaining distance and voice announcements**. Future extensions of the proposed system also include accident alerts and SOS assistance.

3. **Gunathilake and Sharanjah (2024) – "Real-Time GPS-Based Bus Tracking System to Improve Public Transportation in Sri Lanka"** This study developed a GPS-based bus tracking system to improve public transportation. The system provides **real-time bus tracking, ETA prediction, mobile passenger information and smart bus-halt ETA display**. The research demonstrates that GPS-based monitoring can help passengers obtain useful information about bus movement and arrival times. The proposed Smart Bus System adopts similar real-time GPS tracking and ETA concepts, while incorporating **an in-bus electronic display and automatic audio announcements** to improve passenger awareness during the journey.
4. **Real-Time GPS Bus Tracking Systems** Existing GPS-based bus tracking systems primarily concentrate on determining the current location of buses and transmitting this information through wireless communication to a web or mobile application. These systems help passengers identify the current position of a bus and plan their travel accordingly. The proposed system also uses this basic concept, with the bus location continuously transmitted to a server and displayed through a web application.
5. **Bus Arrival Time Prediction Systems** ETA prediction systems generally use parameters such as **real-time GPS location, vehicle speed, route information and distance** to estimate when a bus will reach a particular stop. These systems can reduce passenger waiting time and provide better journey planning. The proposed Smart Bus System incorporates ETA and remaining-distance information as important passenger information features.
6. **Passenger Information and Next-Stop Announcement Systems** Passenger information systems combine GPS/location information with **electronic displays and audio units** installed inside buses. They provide current and upcoming stop information, helping passengers identify their destination and avoid missing their stop. The proposed project adopts this concept by displaying the current stop, next stop, remaining distance and ETA while simultaneously providing automatic voice announcements.

3. PROPOSED SYSTEM

The proposed system is an integrated Smart Bus System designed to improve the efficiency, safety, and convenience of public transportation. The system combines GPS-based real-time bus tracking, route information, estimated time of arrival (ETA), remaining distance, passenger information, and in-bus navigation features through a web-based application and onboard electronic devices.

The proposed system continuously obtains the current location of the bus using a GPS module. The collected location data is processed by the system and made available through the web application. Passengers can use the website to view the live location of the bus, selected route, upcoming stops, estimated arrival time, and remaining distance. This helps passengers plan their journey and reduces unnecessary waiting time at bus stops.

The proposed system mainly consists of the following modules:

3.1 Web-Based Passenger Application

A web-based application is developed to provide passengers with real-time information about the bus. The website displays the live bus location, route information, upcoming bus stops, estimated time of arrival, and remaining distance. This provides passengers with an easy and convenient way to monitor the bus journey using a mobile phone or computer.

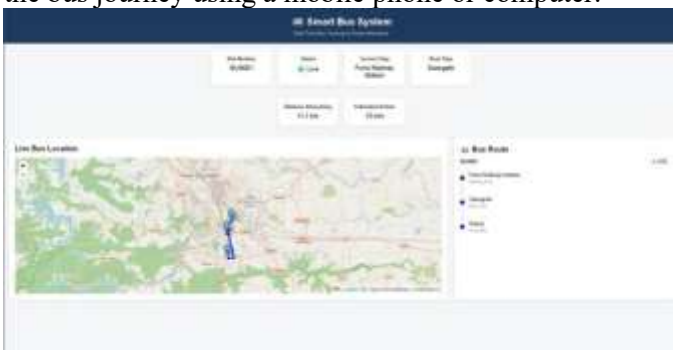


Figure 1: Screenshot of the proposed Smart Bus System web application

The website acts as the main passenger information interface and provides real-time transportation information in a simple and user-friendly manner.

3.2 GPS-Based Real-Time Bus Tracking

A GPS module is used to determine the current geographical location of the bus. The location data is continuously processed and transmitted to the web application. Based on the current position of the bus and its predefined route, the system provides the passenger with the live bus location, remaining distance, upcoming stop, and estimated time of arrival.

This feature helps passengers know where the bus is currently located and approximately how long it will take to reach their selected stop.

3.3 In-Bus Passenger Information System

An onboard display is provided inside the bus to show the current stop and the next upcoming stop. The system automatically updates the displayed information according to the movement of the bus along its predefined route.

Along with the display, an automatic voice announcement system provides audio announcements for the current and upcoming stops. This improves accessibility and helps passengers identify their destination without continuously checking their mobile phones.

3.4 Smart Safety and Monitoring Features

The proposed system can be extended with intelligent safety and monitoring features to improve passenger and vehicle safety. These include emergency/SOS alerts, accident detection, passenger monitoring, blind-spot and rear-obstacle detection, door safety interlocking, and driver safety monitoring.

These features are designed as an integrated part of the Smart Bus System so that transportation information and passenger safety can be managed through a common system.

3.5 Overall Working of the Proposed System

The GPS module obtains the real-time location of the bus and sends the location information to the processing and communication unit. The system compares the current location with the predefined bus route and determines the upcoming stop, remaining distance, and estimated arrival time.

The processed information is simultaneously provided to the web application for passengers and to the onboard display and voice announcement system inside the bus. Thus, the proposed system provides real-time information both to passengers outside the bus and to passengers travelling inside the bus.

The proposed system therefore provides a scalable platform for smart public transportation by integrating real-time tracking, passenger information, onboard navigation, and safety features into a single system.

4. BLOCK DIAGRAME

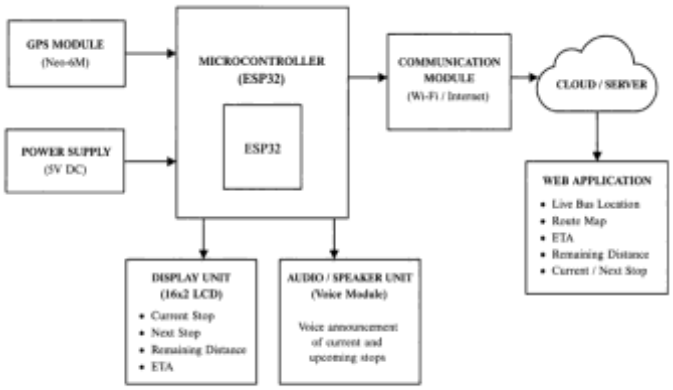


Fig. Block Diagram of Smart Bus Route and Tracking System

5. CONCLUSION

The proposed Smart Bus System provides an efficient and user-friendly solution for improving public transportation services. The system integrates real-time GPS-based bus tracking with a web-based passenger application to provide important information such as the current location of the bus, route details, upcoming bus stops, estimated time of arrival, and remaining distance. The onboard passenger information system further improves the travelling experience by displaying the current and upcoming stops and providing automatic voice announcements. The proposed system reduces passenger waiting time, improves accessibility to transportation information, and helps passengers plan their journeys more effectively.

By integrating real-time tracking, passenger information, onboard navigation, and smart safety features into a single platform, the proposed system has the potential to make public transportation more reliable, convenient, and intelligent. The developed web application demonstrates the practical implementation of the proposed concept and provides a foundation for further development of a complete smart public transportation system.

In the future, the system can be enhanced by incorporating AI and machine learning for accurate ETA prediction, dynamic route and schedule optimization, traffic-based route adjustment, passenger-density monitoring, predictive maintenance, and advanced safety features. Thus, the proposed Smart Bus System can contribute towards the development of a safer, smarter, and more efficient public transportation network.

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