

GPS Based Ticketing System With Real Time SMS Updates

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Abstract—Public transportation system often face challenges in manual ticketing, such as long queues, human errors, and lack of real time monitoring. To overcome these limitations, this project proposes the design and implementation of an Automatic Bus Ticketing System using GSM, GPS, RFID, and Arduino technology. GPS technology and mobile communication is to offer real-time location tracking, automated tracking, and instant SMS alerts, streamlining the entire travel process the growing demand for efficient and intelligent transportation systems has led to the development of innovative solutions that combine automation, real-time data, and user convenience. One such innovation is the GPS Based Ticketing System with Real-Time SMS Updates, a smart transport management solution designed to enhance the public transportation experience for both passengers and service providers.

Keywords—GSM and GPS module, Node MCU, RFID module, SMS

I. INTRODUCTION

The GPS Based Ticketing System with Real Time SMS Updates is a way to buy tickets for public transport. It uses GPS to track where the buses or shuttles are so people know when they will arrive. The GPS Based Ticketing System is meant to make buying tickets easier for people who use transport like buses or shuttles. This system is good because it helps people know what is happening with their bus or shuttle. The main goal of the GPS Based Ticketing System is to make buying tickets easy and to do it all online. The GPS Based Ticketing System with Real Time SMS Updates is a thing, for people who use public transport. Instead of waiting in long queues or dealing with paper tickets, passengers can simply book their tickets through a mobile app or website. As soon as the booking is completed, they

receive an instant SMS with the ticket details, including the vehicle's location, estimated arrival time, and any updates about delays or route changes

This system makes things easier for people. It also helps the people in charge of transport run things more smoothly. They have to do work and they make fewer mistakes. When people know where the bus or train is they can plan their trip better. They do not have to wait long and they are not as unsure about when it will arrive. The system also sends messages to peoples phones so even if they do not have a phone or internet they can still get the information they need. This system is really helpful in cities and towns where people need to know what is going on with the transport so they can get around quickly. The transport system is very important, in these areas. This solution helps the transport system work better. The idea of transportation is really about making things easier for people. It is about using cashless transactions, digital communication and intelligent mobility services to make things better. This project is a way to make daily commuting better by using modern technology to deliver good service.

We need to make public transportation better. This means we need ticketing systems that work well and can change quickly when things happen. Old ways of collecting fares are not good because they are manual or do not change when things happen. These old ways can be wrong waste time. Do not help passengers very much. Smart transportation and its services like cashless transactions and intelligent mobility services are very important, for this. With the advancement of embedded systems and location-aware technologies, there is a growing opportunity to redesign ticketing mechanisms to be both intelligent and user-centric.

To make things easier for passengers we can use text messages to keep them updated in time. This way passengers get messages away with information about their tickets how much they paid and if their trip is

confirmed. This makes the whole travel process more open and clear.

The good thing about using text messages is that they work when the internet is not available. This means that everyone can use this system no matter where they are.

We have an idea for a ticketing system that uses GPS. This system uses location tracking, processing and wireless communication to make a solution, for smart travel systems. The GPS-enabled ticketing framework is a solution because it combines these things to make travel easier. By improving operational efficiency, reducing revenue loss, and enhancing passenger experience, the system demonstrates strong potential for deployment in smart city environments and next-generation public transport infrastructures

II. Literature Survey

The application of Global Positioning System (GPS) technology in public transportation has been widely studied to improve operational efficiency and passenger convenience. GPS is one of the biggest technologies that people have studied for Automatic Vehicle Location (AVL) systems. With AVL systems, we can track the location of buses anywhere and anytime they are operating. The AVL systems allow us to provide information to users of the system when they are waiting for the bus because we can tell them how long the bus will take to arrive as well as show them where the bus is located along its route. AVL systems are also very important for many other applications.

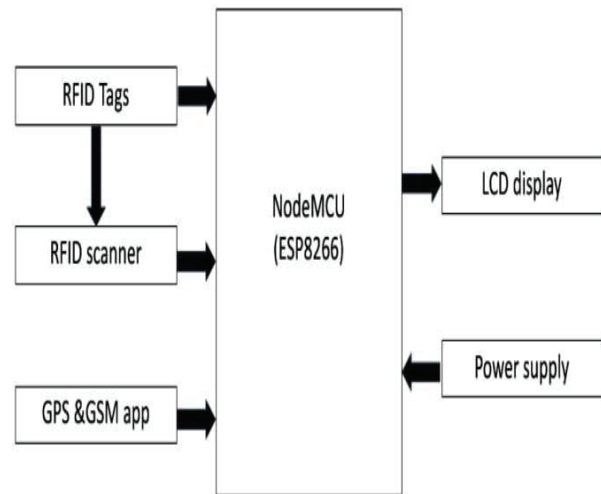
Many people have researched using GPS and GSM communication to relay the location of a vehicle to a main computer or directly to the people who need to know. The Short Message Service that uses GSM communication also known as SMS is a form of communication, especially in areas where not many people have smartphones or the mobile data is not very good. When people receive their messages on time, it helps them know when the bus is going to arrive, if it is late, or if the route has changed, which makes people feel better because they know what is going on with the bus and they do not have to wait as long. GPS and GSM communication are a great combination to relay the location of a vehicle to a server or directly to users and this is very beneficial, for people who use buses..

At the same time, other research has been done on electronic and automated ticketing systems to eliminate manual ticketing. Current technologies available include Electronic Ticketing Machines (ETMs), RFID fare systems, and mobile ticketing applications. Integrating GPS data with ticketing systems allows each transaction to be associated with the bus location and time, improving transparency, reducing revenue leakage, and enabling better operational analysis.

III. Proposed System

Core concept: Using GPS to track passengers and issue tickets based on the distance travelled with real time SMS updates.

GPS Module: Installed on buses to track location and distance



traveled.

Fare Calculation Module: Calculates fares based on

Fig 1: Proposed System

The distance that people travel or the specific roads they take to get from one place to another. Sometimes it is the distance traveled that matters or maybe it is the routes taken that are important, like the distance traveled or the specific routes taken.

The Contactless Payment System is really cool because it lets people pay for their fares in an easy way. They can use cards or mobile apps to do this. The Contactless Payment System is what makes all of this possible.

- * The Contactless Payment System is used by passengers to pay fares

- * People can pay using cards

- * They can also pay using apps

The Contactless Payment System is very helpful, for passengers.

The SMS Notification System is really helpful because it sends you updates away. You get to know about the fare deductions and your travel history. It also tells you about your account balances. The SMS Notification System is very useful, for keeping track of these things.

The Central Server is what manages all the information that comes from the GPS modules and the fare calculation modules and the payment systems. This is the system that stores all the data and checks if the fares are correct and sends out messages when they need to be sent. The Central Server also works when the internet is not available by saving the ticket information on the bus and then sending it to the system when the internet is working again. This way the Central Server helps to make sure the system always works and does not lose any information when the internet is not working. The Central Server is an important part of the system. The system that is being proposed is a solution, for public transportation because it is affordable and it works

well and it is easy for people to use. The Central Server makes the system reliable. The system improves the lives of passengers by using GPS to locate where the bus is, and tickets and messages are sent to people's phones in real time. This helps reduce the number of things that need to be done manually and ensures that the transport system flows smoothly.

The GSM module is what enables the bus and the main computer to communicate. The bus sends its location and ticket details to the computer at regular intervals, and the main computer stores this data and reviews it. The system relies on the GPS data it receives to determine the location of the bus and the distance it has traveled. The system relies on GPS to determine the location of the bus and the GPS data to determine how far the bus has traveled. Critical updates, such as ticket validation, arrival of the bus, or delay, are sent to the passengers through SMS messages. The use of SMS ensures that the system remains accessible to users without smartphones or mobile internet connectivity

IV. Hardware Requirements

The following are the hardware components used in GPS based ticketing system with real time SMS updates

NODEMCU: There are publicly available, open-source designs for prototyping boards compatible with the NodeMCU firmware. The name "NodeMCU" is a combination of the words node and microcontroller unit (MCU). Technically, the term specifically refers to the firmware and not the associated development boards. Both the firmware and prototyping board designs are open for public use. The firmware is programmed using the Lua scripting language and was built upon the Esp if Non-OS SDK for the ESP8266, drawing from the e-Lua project. It integrates several open-source components like SPIFFS and lua-cjson. Due to hardware limitations, users typically select only the essential modules for their application and customize the firmware accordingly. The system has also expanded to support the 32-bit ESP32 platform

LCD, or Liquid Crystal Display, is a widely used flat-panel display technology that has become an essential part of modern electronic devices. It operates by manipulating liquid crystals that align in response to an electric current, which then modulates light to produce visible images. LCD technology is commonly found in computer monitors, televisions, smartphones, tablets, calculators, digital watches, and a variety of other electronic gadgets due to its lightweight design and versatile display capabilities. An LCD module is an electronic display unit primarily used for presenting text, numeric values, and simple graphics. One of the most commonly used types in embedded and microcontroller-based projects is the LCD 2x16 display, which can present information across two lines, with each line capable of displaying up to 16 characters. Due to their minimal power consumption, LCDs are especially well-suited for portable and battery-powered devices, helping to extend battery life and reduce energy costs in continuous operation environments.

An RFID reader is a device connected to a network that can be either mobile or fixed, depending on the specific needs of the

system. When stationary, RFID readers are typically placed in key locations such as doors, warehouses, or conveyor belts, where they can continuously scan and monitor items as they pass by. In contrast, mobile RFID readers are portable, allowing operators to move around and scan items at different locations. This flexibility makes RFID readers essential tools in industries like logistics, retail, and access control, providing efficient and versatile solutions for tracking management. RFID readers send out radio signals - tags on items pick them up. When a tag catches the wave it fires back its RFID code. This chat happens through invisible energy fields. Info flows from object to reader without touching. This system enables fast and accurate identification and tracking of objects, making RFID technology widely applicable for applications such as asset management, supply chain monitoring, and secure access control.



Fig 2:Hardware Components



Fig 3:Hardware Connections

V. Software Requirements

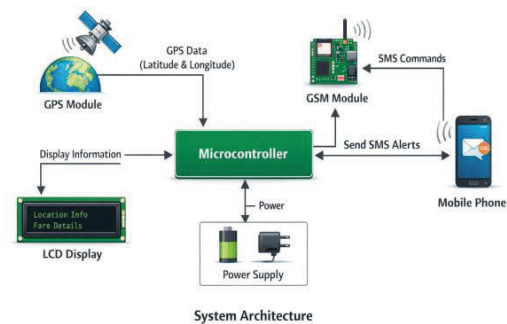
The open-source Arduino IDE makes coding and sending programs to Arduino boards way easier. It serves as the main hub for creating projects, letting people type, check, then push their code straight onto devices. Instead of being stuck on one system, this tool runs on Linux, macOS, and Windows - so folks can use what they already have. Because it works everywhere, more makers stick with it, whether tinkering at home or building serious gear. Arduino IDE works mainly with C or also C++ - both common choices when building stuff for small computers inside devices. These options handle hardware tasks pretty well, so they fit perfectly when coding tiny chips. "IDE" actually means you get everything needed - like editing plus sending programs - all packed together neatly in a single app. The Arduino IDE plays a pivotal role in simplifying the development and deployment of the proposed system's firmware, particularly for prototyping and testing the integration of hardware components like the Atmega16 microcontroller, IR sensors, and RFID readers. Its user-friendly interface allows developers to write, debug, and upload code efficiently, reducing the learning curve for implementing complex functionalities such as real-time passenger counting and fare deduction. The IDE's built-in libraries, such as those for serial communication and I/O pin management, streamline the coding process by providing pre-tested functions for interfacing with the NodeMCU module and LCD display. This accelerates the development cycle, enabling rapid iterations during the system's experimental validation phase.

The use of Embedded C in the software industry is widespread, especially when it comes to creating software for electronic devices. Fine-tuned for tiny computers inside gadgets, Embedded C gives direct control over hardware - making things run smoothly. From basic stuff like ovens to high-end gear like factory bots, today's electronics depend on built-in code, usually crafted in Embedded C. The role of Embedded C lies in letting processors handle particular jobs within embedded setups. Instead of general-purpose devices, these systems focus on single functions while dealing with tight deadlines and low computing strength. With this language, coders manage hardware, memory, usage timing more precisely - so everything works smoothly without wasting resources

The software development for the proposed GSM and GPS-based system is carried out using the Code-Blocks integrated development environment (IDE). Code-Blocks is an open-source, cross-platform IDE that supports C and C++ programming and is widely adopted for embedded system application development. Its modular architecture and compiler support make it suitable for writing, compiling, and debugging firmware for microcontroller-based systems interfaced with GSM and GPS modules. Within the development environment, application logic is implemented to handle serial communication protocols, enabling reliable data exchange between the microcontroller and external GSM and GPS hardware.

The software processes real-time location data received from the GPS module and formats relevant information for transmission through the GSM module. Efficient memory management and structured programming techniques are employed to ensure stable system performance under continuous operation.

The use of Code Blocks simplifies program development by providing features such as syntax highlighting, error detection, and step-by-step debugging, which improve code reliability and reduce development time. As an open-source platform, it offers flexibility for customization and easy integration with embedded toolchains, making it a practical choice for developing real-time location tracking and communication-based applications



.Fig 4:Software setup

An LCD module is incorporated into the system to provide local visual feedback. It displays essential information such as system status, GPS signal availability, and operational messages, allowing users or operators to monitor system functionality directly. The GSM module is connected to the microcontroller through serial communication interfaces and is responsible for transmitting processed information to the user via SMS. Once valid GPS data is obtained, the microcontroller formats the data and sends command instructions to the GSM module, enabling real-time message delivery without the need for internet connectivity.

The software architecture, implemented using Code::Blocks, manages module coordination, data parsing, and communication control. The GPS and GSM modules work together well because of good programming logic. This means that the system is utilizing power and running very smoothly. The system is also flexible. Can be expanded in size if required. This makes it ideal for applications such as tracking something in time, making tickets, and smart transport systems that have to communicate with each other. The GPS and GSM modules are essential in such applications.

The microcontroller is the central part of the architecture, which serves as the control unit. It is connected to the GPS module to obtain the location information in the form of latitude and longitude values. These values are constantly observed and processed by the software to obtain the system parameters such as position update and travel status. The whole system is powered by a power supply unit that regulates the power to the hardware components

VI. Result and Analysis

The GPS-based bus ticketing system using RFID, NodeMCU, LCD display, and real-time SMS updates is a modern, technology-driven solution designed to automate and improve the efficiency, accuracy, and transparency of public transportation. Traditional ticketing methods often involve manual fare collection, which is slow, prone to human error, and vulnerable to ticket fraud or disputes between passengers and conductors. To overcome these issues, this system integrates Internet of Things (IoT) components—specifically an RFID module for passenger identification, a GPS module for live location tracking, an LCD screen for visual information, and a GSM/SMS interface for real-time messaging—all controlled by the NodeMCU microcontroller

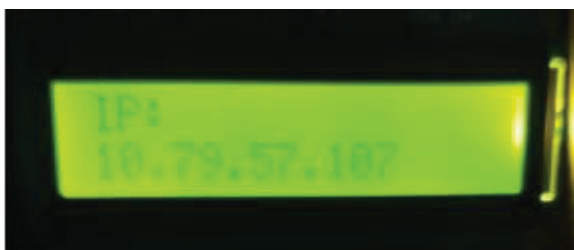


Fig 5: IP address for GPS



Fig 6: Boarded LCD display



Fig 7:Address being fetched from boarded location



Fig 8:Available balance in the smart card

The project aims to streamline the bus ticketing process by automatically recording a passenger's entry and exit points using GPS coordinates, calculating the distance traveled,

computing the fare accordingly, and instantly sending SMS notifications to both passengers and administrators. The system begins operating the moment a passenger boards the bus and taps their RFID card on the RFID reader (commonly the RC522 module).

SMS notification sent to the passengers regarding boarding, deboarding, fare deduction and amount of balance .

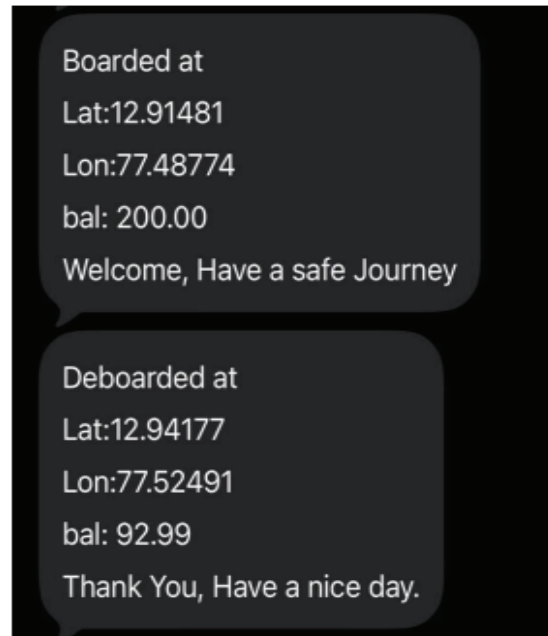


Fig 9: SMS notification sent to passenger example (1)

Each RFID card contains a unique identifier linked to the passenger's profile or account. When the RFID tag is detected, the NodeMCU reads the unique ID and simultaneously retrieves the live GPS location from the GPS module, usually a NEO-6M or similar unit capable of providing accurate latitude and longitude data. This boarding information—RFID ID, GPS location, date, and time—is temporarily stored in the NodeMCU's memory or optionally uploaded to a cloud database for remote monitoring.

The GSM module demonstrated reliable communication performance by transmitting SMS notifications containing ticket details, fare information, and journey status to the registered mobile number. Message delivery was observed to be timely, with negligible delay under normal network conditions. This validates the effectiveness of SMS-based communication for real-time passenger updates, particularly in areas with limited internet connectivity

The LCD module accurately displayed system status information, including GPS signal availability, ticket confirmation, and operational messages. This local display facilitated easy monitoring of system functionality and aided in debugging during testing. The embedded software developed using Code::Blocks maintained stable performance, with efficient handling of serial communication between GPS and GSM modules.

Power consumption analysis indicated that the system operates efficiently under standard voltage conditions, making it suitable for long-duration usage in embedded and

portable applications. Overall, the results demonstrate that the proposed system achieves reliable ticket generation, accurate fare calculation, and effective real-time communication, validating its applicability for intelligent transportation and smart ticketing solutions.

Overall, the experimental results validate that the proposed system delivers accurate location tracking, timely SMS updates, and stable performance. These findings confirm the effectiveness of the GPS-based ticketing system as a reliable and scalable solution for intelligent transportation and smart ticketing applications.

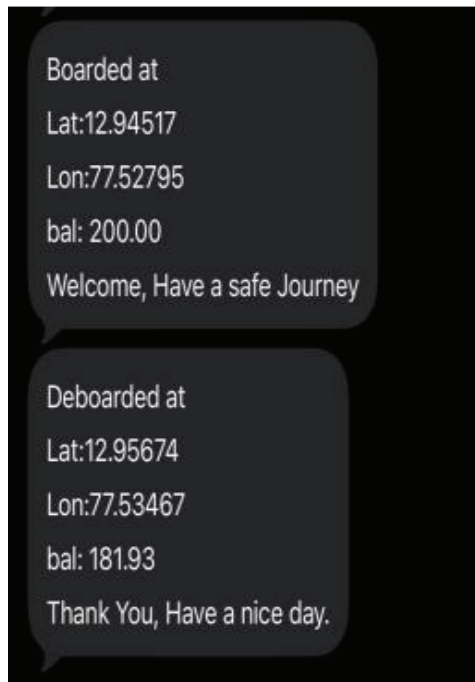


Fig 10:SMS notification sent to passenger example(2)

VII. CONCLUSION

This paper is about a ticketing system that uses GPS and sends messages to peoples phones. The system uses GPS to figure out how far someone has traveled and it automatically calculates the fare. This way people do not have to do anything. The system also sends updates about tickets and journeys to peoples phones using SMS so they get the information they need even if they are not connected to the internet. The GPS-based ticketing system is really good for transportation because it makes things more efficient and transparent. The GPS technology makes sure that the distance traveled is accurate and the fare is correct. The system is also very helpful for passengers because they get all the information they need about their tickets and journeys, on their phones.

The new system makes things easier to run it reduces mistakes in ticket prices. It makes things better for passengers because it does things automatically and people can get the information they need. The system is designed to

work all the time and it does not use a lot of power which is good for using it in big transportation systems, like buses and trains.

In future implementations, the system can be enhanced by integrating mobile applications and cloud-based platforms to provide advanced features such as digital payment options, travel history analysis, and real-time vehicle tracking. The inclusion of IoT connectivity and data analytics can further improve route optimization, passenger demand prediction, and operational planning. Additionally, incorporating secure authentication mechanisms and scalable architectures would enable the system to support large transit networks, contributing to the development of fully automated and intelligent public transportation systems.

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