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GPS Based Real-Time Bus Positioning System

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ABSTRACT

In the contemporary era, passengers face limited access to up-to-date information regarding bus locations and arrival times. This often results in uncertainty, extended waits at bus stops, and challenges in planning journeys. Passengers are compelled to depend on fixed schedules, which may not precisely represent the actual movements of buses, leading to frustration and inefficiencies in transportation. The introduced GPS bus tracking system seeks to improve student transportation by sending timely notifications to students when the college bus is within 2km of their location. This system utilizes GPS technology to monitor the real-time whereabouts of buses, allowing for accurate predictions of arrival times. By integrating this data with a messaging system, students receive notifications on their devices, ensuring they are well-informed and prepared for the impending bus arrival. Consequently, this solution aims to streamline student commuting, enhance efficiency, and improve the overall transportation experience.

I. Introduction

Initially, vehicle tracking systems were primarily introduced in the shipping industry to fulfill the need for real-time location information about each vehicle. However, in the current era of rapidly advancing technology, automated vehicle tracking systems are now employed in various capacities to monitor and display real-time vehicle locations.

Nevertheless, the bus transportation service currently grapples with a deficient transportation information system. Passengers lack precise arrival times for buses and are only aware of the scheduled approximate arrival time. The existing bus transportation service lacks an effective system to track the positions of all buses and provide accurate arrival times at each bus stop. These challenges stem from the absence of real-time tracking technology in the current bus service system and a platform to disseminate the latest bus traffic information to users [1].

To address these issues and improve the existing bus service system, the implementation of a real-time bus tracking system is imperative. This system involves connecting bus position data in real-time, transmitting it to a central server for processing, and extracting transit information. The primary technology utilized in this system is the Global Positioning System (GPS), which receives object positions from space-based satellite navigation systems through a GPS receiver [2].

For wireless data transmission, commonly used technologies include GSM and SMS. The SMS technology, facilitated through the GSM network and GSM modem,

provides users with vehicle location information. In contrast, the bus tracking system employs a smartphone application, rather than SMS, to track and monitor a bus's location obtained from an in-vehicle tracking device. The bus location is automatically displayed on Google Maps, facilitating easier vehicle tracking and providing users with more accurate vehicle location information [2].

II. Literature Survey

Manini Kumbhar, Meghana Survase, and Pratibha M. Avdhut Salunk introduced a Real-Time Web-Based Bus Tracking System to minimize waiting times for remote users [3]. The system tracks bus locations at any time, storing real-time data on a server and providing access via a web-based application. While the system is web-based, the authors acknowledge the prevalent use of Android apps due to their portability. They highlight the practicality of mobile applications for users waiting at bus stops, acknowledging the convenience and wider usage of smartphones in today's world.

M. A. Hannan, A. M. Mustapha, A. Hussain, and H. Basri implemented the Intelligent Bus Monitoring and Management System, utilizing Artificial Intelligence and RFID technology to automate tasks in the Bus-Management & Monitoring System [4]. The RFID module tracks buses as they pass bus stops, providing an approximate location due to project limitations. While the system enhances efficiency, the drawback lies in the inability to display the exact bus location, emphasizing the importance of accuracy in today's context.

In the paper "A Smart Bus Tracking System based on location-alert service and QR code" by Süleyman Eken and Ahmet Sayar, the authors describe a bus tracking system where passengers with smartphones can check the estimated bus position [5]. QR codes at bus stations allow users to access the current bus location. However, a limitation of the project is that users must physically be present at the bus stop to check the QR code, introducing some constraints to its usability.

In the paper titled "Real-Time Bus Track and Location Update System" by A. Deebika Shree, J. Anusuya, and S. Malathy [6], the authors emphasize the significant role of the public transportation system in economic development. They highlight the challenges of tracking, monitoring, scheduling, and surveillance currently faced by this system. The project aims to address these challenges by automating public transport buses with real-time tracking using RFID tags and readers at bus stands. Arduino serves as the central regulator, employing GSM modules to send tracking updates to authorized personnel. GPS is utilized for bus location, and IoT ensures users receive bus tracker information. RFID reader data is processed on Arduino, with processed data sent to the cloud as an interface between users and the system.

In the paper titled "Location Tracking in GPS using Kalman Filter through SMS" by Mohammad Zahaby, Pravesh Gaonjur, and Sahar Farajian at IEEE EUROCON in 2009, the authors describe a method where the travel-worthy area for buses is depicted using a pixel representation. The 1' pixel represents the suitable bus travel area, while the 0' pixel denotes the remaining space [7]. The proposed approach involves refining estimated observations obtained from the measurement output, considering inherent errors and other noises. This

refinement is achieved through a weighted average, assigning higher weight to estimates with greater accuracy.

In the work titled "GPS Track System" by El Gouhary, Amany, Richard Wells–Richard, and Anthony Thatcher in 2006, the authors detail the utilization of web servers for receiving and interpreting data transmitted by GPS devices. The data is then stored in a mySQL database [8]. The dynamic web page generated extracts information from the database, specifically the current and previous positions, and overlays them onto a map sourced from an online database, creating a visual representation of the estimated positions.

III. Internet of Things (IoT)

The Internet of Things (IoT) is an emerging paradigm that enables seamless communication between electronic devices and sensors over the internet, ushering in transformative changes across various aspects of our everyday existence. This innovative concept leverages the power of smart devices and the internet to provide creative solutions spanning a multitude of global industries [9]. As IoT continues to evolve, it converges intelligent systems, devices, and sensors, driving advancements in storage, sensing, and processing capabilities, particularly through the integration of quantum and nanotechnology. This interconnected network of devices not only enhances efficiency and connectivity but also paves the way for unprecedented possibilities in how we interact with and harness technology.

The integration of the IoT into bus GPS tracking systems represents a transformative leap in public transportation management. With IoT, buses equipped with GPS devices become part of a connected network, providing real-time location data and operational insights. This technological synergy enables precise tracking of buses, allowing commuters to access accurate arrival times and optimize their travel plans. Moreover, IoT in bus GPS tracking enhances operational efficiency, enabling transit agencies to monitor and manage fleets seamlessly. This intelligent connectivity fosters a more responsive and data-driven approach, leading to improved commuter experiences, reduced wait times, and a streamlined public transportation system [10].

IV. Existing System

The existing Bus Tracking systems are designed for real-time monitoring and management of bus movements. This involves the installation of GPS devices on buses, which continuously transmit their location data to a central server or a cloud-based platform. Subsequently, this information is processed and made accessible through user interfaces, such as mobile apps or web portals.

In the current setup, users are required to install an application to track bus locations and consistently use the app to check for bus arrivals. To address this inconvenience, the GPS bus tracking system has been enhanced to automatically send messages to individuals waiting at their respective bus stops. This eliminates the necessity for passengers to install any specific applications, as they will automatically receive messages notifying them of the approaching bus when it is within a 2 km radius of their bus stop. This improvement streamlines the user experience by providing timely and automated notifications without the

need for manual intervention.

V. Proposed Method

The system is designed by leveraging Thingspeak and MIT App Inventor to develop a mobile application with dual functionality [12] [13]. Firstly, it serves as a repository for storing latitude and longitude values, and secondly, it acts as a storage platform for the phone numbers of designated individuals. Through this application, precise latitude and longitude data are transmitted to an IoT cloud platform.

The IoT cloud platform plays a crucial role in verifying the received location coordinates against predefined latitude and longitude values associated with specific bus stops. Simultaneously, the system cross-references the stored phone numbers linked to each bus stop. When the location data indicates that a bus is within a 2 km proximity to a particular stop, the system triggers an automated process. It then sends a targeted message to the specific person associated with that bus stop, utilizing the respective phone number [11].

In essence, the system employs Thingspeak and MIT App Inventor to create a sophisticated mobile app that seamlessly integrates with an IoT cloud platform [12] [13]. This integration facilitates the real-time monitoring of bus locations, ensuring that timely and personalized messages are sent to individuals connected to specific bus stops before the bus arrives within a 2 km radius.

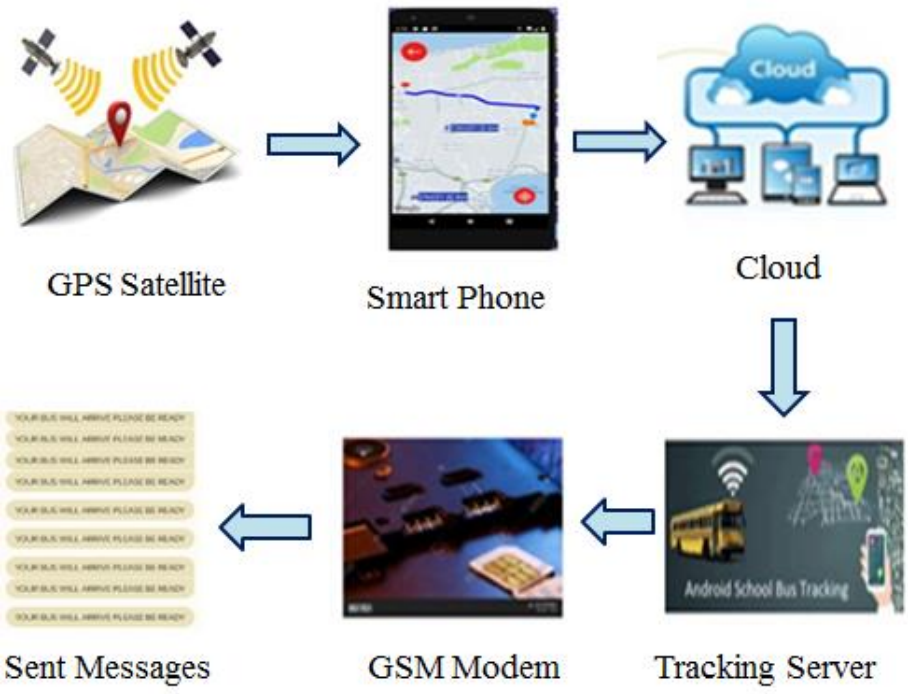

Figure 1: Architecture of GPS based Bus tracking system

The system boasts various advantages compared to traditional bus tracking systems. Users benefit from enhanced convenience, utilizing their personal smartphones to receive messages. The system also excels in accuracy and security, employing full-proof

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mechanisms. Moreover, its seamless integration capability extends to other IoT systems, including access control and security systems.

VI. Software Used

This paperwork involved the utilization of Thingspeak and MIT App Inventor. Thingspeak served the purpose of creating fields to store latitude and longitude values, each associated with different and unique keys and URLs for various users. The data organization in Thingspeak is structured by channels, with each channel representing data from a specific device or process. Within each channel, there are eight data fields, three dedicated to location information (latitude, longitude, and elevation), and an additional field for a status report. Writing numeric values into these fields, be they integers or floats, results in Thingspeak displaying the numerical data in field charts on the channel view.

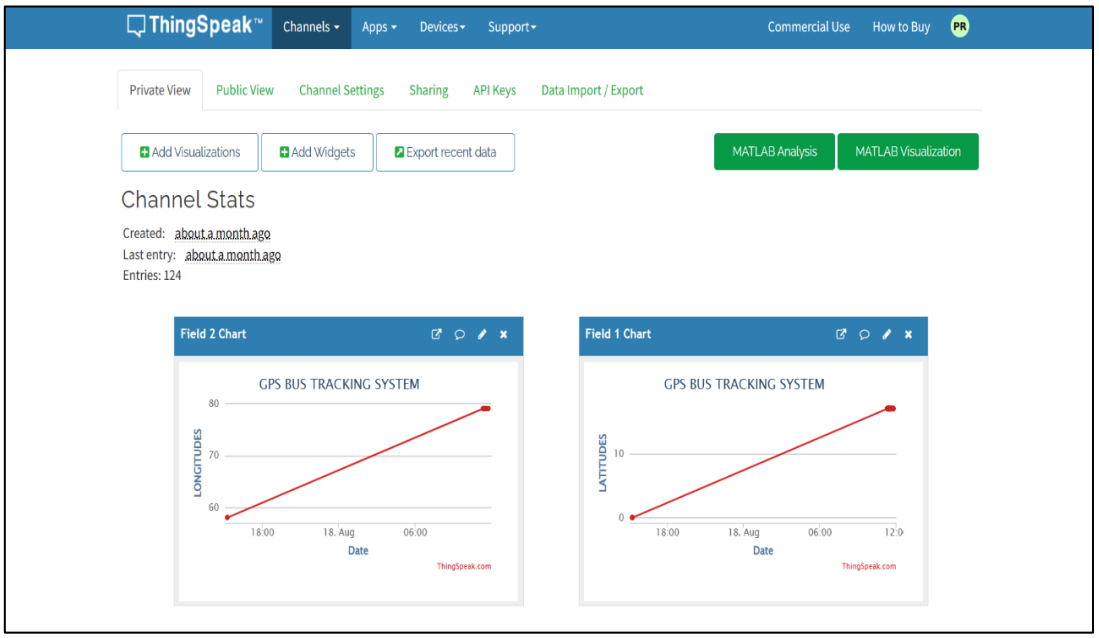

Figure 2: Channel Outputs

MIT App Inventor stands as a web-based platform that empowers users in crafting Android applications through a visual programming language. Originating under Google's development, it was subsequently transferred to the Massachusetts Institute of Technology (MIT). Through MIT App Inventor, we fashioned a mobile application tasked with assigning phone numbers to designated bus stops' latitude and longitude values. This application enables the development of a messaging feature, facilitating the sending of messages to individuals associated with specific bus stops.

VII. Results

Our system serves the critical function of verifying the latitude and longitude coordinates of designated bus stops. This is achieved through a meticulous process that ensures accuracy in location information. The primary objective is to provide timely notifications to individuals patiently waiting at these stops. The system is designed to

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automatically dispatch messages to the respective individuals as the bus approaches their designated stop, ensuring that they receive the information well before the bus is within a 2-kilometer radius.

This proactive approach allows recipients to adequately prepare for the impending arrival of the bus, significantly reducing waiting times and enhancing overall efficiency in the transportation process. By receiving these timely alerts, individuals can optimize their time management, ensuring a seamless and prompt boarding process. The incorporation of this feature aims to streamline the commuting experience, aligning with the broader goal of improving the effectiveness and user-friendliness of the transportation system.

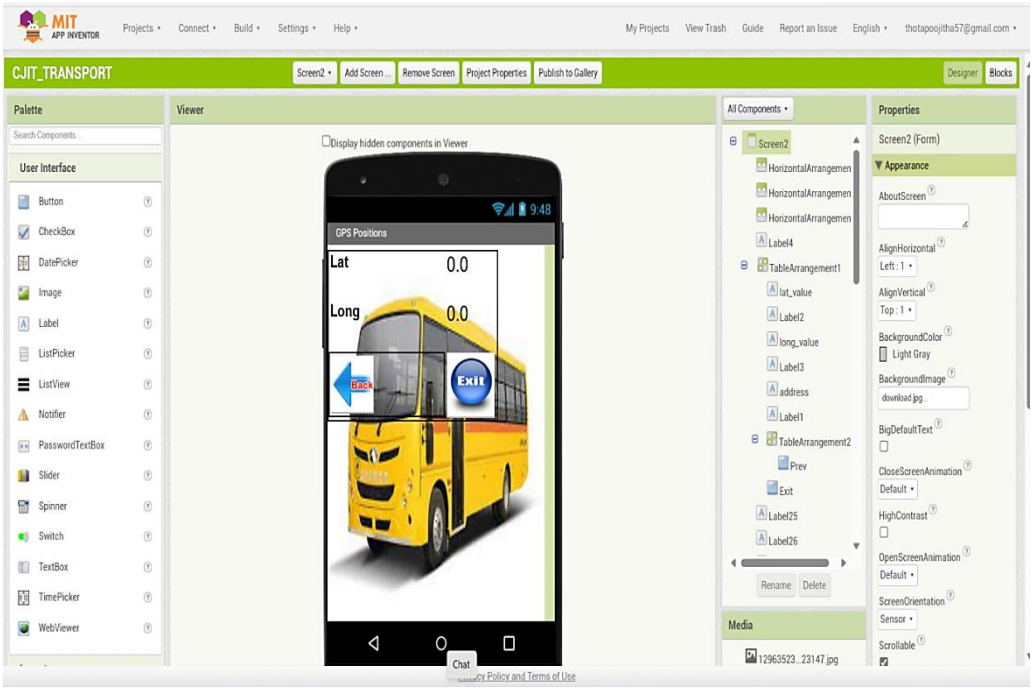

Figure 3: Main Menu

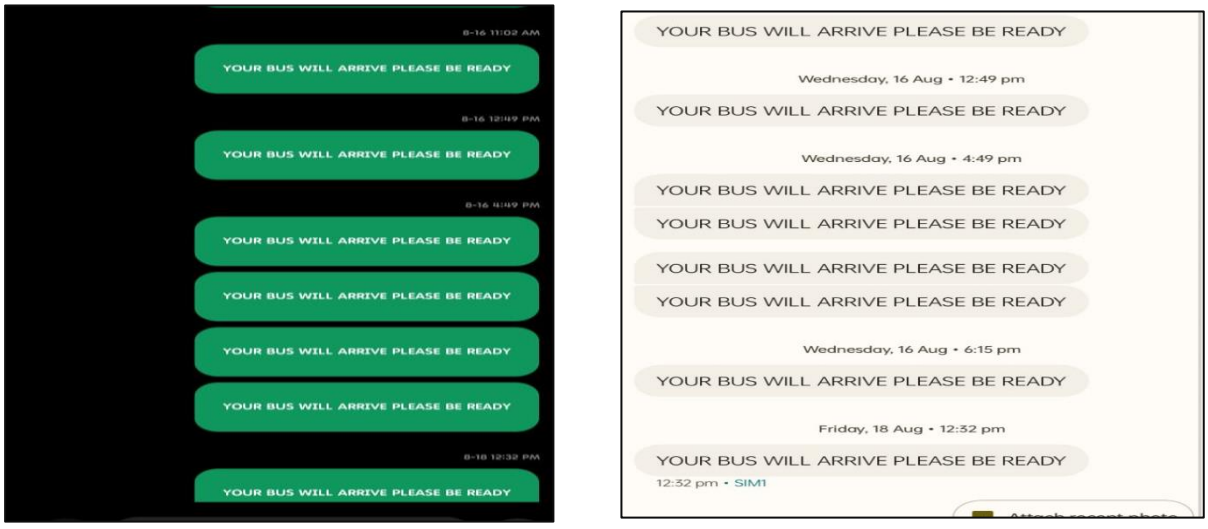

Figure 4: Sending end and Receiving end messages

VIII. Conclusion

The GPS bus tracking system offers real-time information on bus arrival times while also proactively sending timely messages to individuals waiting at their stops, notifying them when the bus is approximately 2 kilometers away. This messaging feature proves invaluable in ensuring that individuals can efficiently catch the bus without unnecessary waiting. Diverse geographical locations possess distinct latitude and longitude values, and leveraging this geographical data, we can develop an application using MIT App Inventor. This application encompasses latitude and longitude values corresponding to different locations, along with associated phone numbers. By utilizing this information, automated messages are sent to individuals as the bus approaches their location, signaling them well in advance before the bus is within a 2-kilometer range.

Specifically designed to enhance student transportation, the GPS bus tracking system employs GPS technology to accurately track the real-time location of buses, allowing for precise predictions of arrival times. Integration with a messaging system ensures that students receive notifications on their devices, keeping them informed and ready for the bus's arrival. This comprehensive solution aims to optimize student commuting by reducing waiting times, improving overall efficiency, and enhancing the overall transportation experience.

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