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Timing System for Bus Entry with Arduino

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Abstract

In today's technologically advanced world, various innovations aim to enhance and simplify daily life. Accurate bus arrival times are crucial for efficient transportation management and passenger convenience. This system leverages image processing to capture and verify bus arrival details. By integrating bus numbers and images with existing data, we utilize Arduino IDE and GSM technology, specifically the SIM808 module, to transmit captured data to a web server. This process ensures that timely notifications are sent to mobile devices regarding bus arrivals. Upon the bus's arrival at the college, it is automatically identified, minimizing the need for manual oversight and optimizing time management. This system reduces the workload of guards and provides precise bus arrival times.

Keywords: Arduino, Bus Arrival Time, Intelligent Transportation System, Machine Learning

1. Introduction

The need for efficient vehicle tracking systems began in the shipping industry, where real-time location data was crucial for managing fleets and ensuring timely operations. As technology has advanced, automated tracking systems have become more sophisticated, extending their use beyond shipping to various forms of transportation, including public buses.

In contemporary urban settings, public transportation systems, such as buses, often face significant challenges in providing accurate arrival times to passengers. This is particularly problematic in campuses or large institutions where precise timing is critical for both operational efficiency and passenger convenience. Traditional bus schedules typically offer estimated arrival times, which can lead to confusion and dissatisfaction among users if the actual arrival times deviate from the estimates.

A real-time bus tracking system addresses these issues by utilizing GPS (Global Positioning System) technology to monitor the precise location of each bus. GPS technology operates through a network of satellites that continuously send signals to GPS receivers installed on buses. These receivers calculate the bus’s exact location and relay this information to a central server.

To communicate the bus’s location to passengers, the system employs GSM (Global System for Mobile Communications) and SMS (Short Message Service) technologies. GSM provides a reliable network for transmitting data, while SMS allows for the delivery of text-based updates to users' mobile phones.

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This combination ensures that passengers receive timely and accurate information about bus arrival times.

In addition to traditional SMS notifications, modern bus tracking systems increasingly use smartphone applications to offer a more interactive and user-friendly experience. These apps provide real-time updates on bus locations, estimated arrival times, and even route information, enhancing the overall efficiency and convenience of the public transportation system.

The integration of GPS, GSM, and smartphone technology into bus tracking systems represents a significant advancement in public transportation management, improving accuracy, efficiency, and user satisfaction.

2. Existing System:

To checks the arrival time of our college bus to the college and approves it in the office College bus arrival time to the college.We use camera sensor to record the arrival time of college bus to college and use Arduino IDE and using GSM technology.A message will be sent to the mobile application about which bus is coming at what time .It mainly used Accurate bus arrival time to reduce guard work and save time .In the existing system Colleges have to manually maintain information regarding College busses and routes. An accurate real time GPS tracking system use GPS and GSM service for real time location of object. This system consists of GPS receiver, GSM modem and microcontroller. Mobile tracked device receives its coordinates form GPS and send it tracking center through SMS via GSM modem.

3. Need for system

- Provide a simpler method to store and access information related to buses and students.
- Provide a simple interface which will be easily used without much training.
- Reduce paperwork and make all related information accessible easily.

3.1 Proposed System

The Bus Management System is designed to improve bus service management for students and college administration. It focuses on providing a more accurate and user-friendly way to track bus locations and manage schedules. The system will be developed through a structured prototyping process consisting of five key stages:

1. **Planning:**
    - In the planning stage, discussions with the project supervisor led to the selection of the project name, “Bus Tracking System.” This phase involved studying the current systems and identifying fundamental issues. The existing systems were evaluated to

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determine common problems and formulate problem statements. This provided a clear foundation for the development of the proposed system.

2. **Analysis:**
    - During the analysis stage, existing bus tracking systems were reviewed to understand their limitations and gather system requirements. Key findings indicated that users prefer real-time bus location tracking on a map rather than just receiving estimated arrival times. Functional and non-functional requirements were collected through observations and interviews, focusing on enhancing user experience and addressing identified gaps.
3. **Building:**
    - The building stage involves the development of the proposed system. An operational plan is created, and the first prototype is developed in this phase. The prototype undergoes initial testing by users, who provide feedback and suggest new requirements. This iterative process involves returning to the design phase to refine and enhance the system based on user input.
4. **Performance:**
    - In the performance stage, the prototype is deployed in a real-world environment for further testing. Users interact with the prototype to evaluate its functionality and performance. If users are not satisfied with the current version, additional feedback is gathered through interviews to identify and address new requirements.
5. **Performance (Final):**
    - The final performance stage occurs once the prototype meets user needs and is approved. The development process culminates in the creation of a final system based on the refined prototype. This phase includes comprehensive testing to ensure that all functions operate correctly. Upon passing the final test, the system is ready for deployment and use in the actual workspace. Documentation of the development process is completed to facilitate future maintenance and updates.

This structured approach ensures that the proposed Bus Management System will effectively meet the needs of its users, providing a reliable and efficient solution for bus tracking and management.

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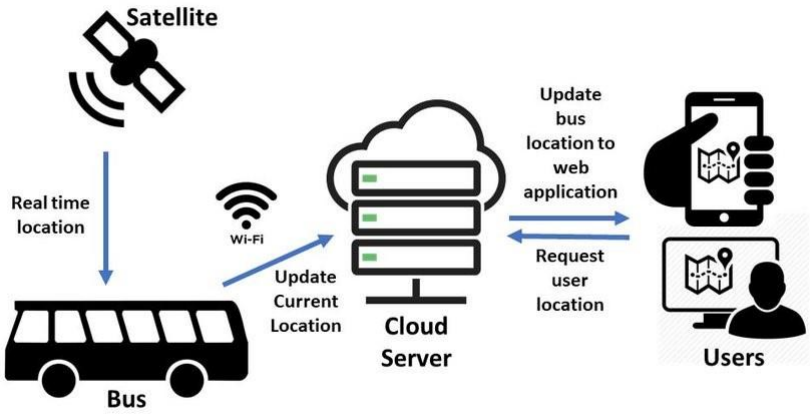

Figure1: Proposed Methodology

3.2 Advantages:

- **Cost-Effective:** The system is designed to be affordable, offering a high-value solution without significant financial investment.
- **Reduced Manual Effort:** By automating bus tracking and monitoring processes, the system minimizes the need for manual oversight and reduces administrative workload.
- **User-Friendly:** The system is intuitive and easy to use, requiring minimal training for users to operate effectively.
- **High Accuracy:** It provides precise and reliable data, enhancing the accuracy of bus arrival times and location tracking.
- **Automatic Operation:** The system operates automatically, ensuring continuous and efficient monitoring of bus schedules without manual intervention.
- **Real-Time Monitoring:** Users can track the location of college buses in real time, improving the visibility and management of bus services.
- **Comprehensive Bus Information:** The system offers a list of bus numbers for specific routes, including source and destination details, facilitating better route planning.
- **Mobile Access:** The system provides exact bus arrival times through a mobile application, keeping users informed and up-to-date on bus schedules.

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3.3. Architecture Diagram:

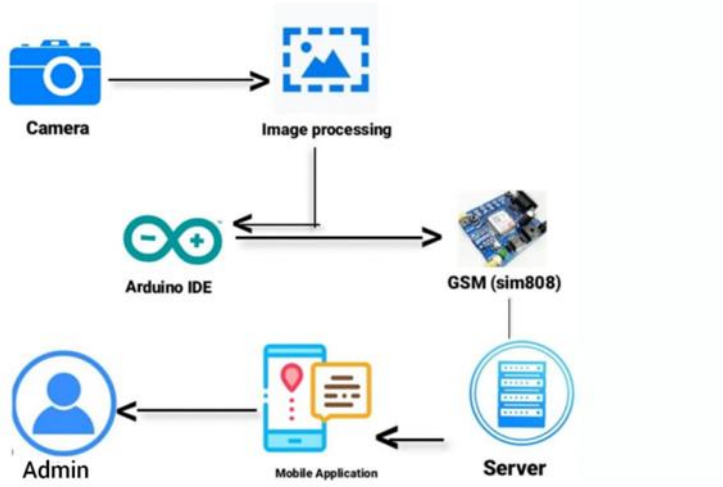

Figure2: **Architecture Diagram**

The architecture diagram illustrates the workflow of a bus tracking system using various components like a camera, Arduino IDE, GSM module, and a mobile application. Here's a detailed explanation of each component and how they interact with each other:

1. **Camera:**
    - The system starts with a camera that captures images of the buses. This could involve recognizing the bus number or detecting the presence of a bus at a specific location.
2. **Image Processing:**
    - Once the camera captures the image, the data is sent to an image processing unit. This unit is responsible for analyzing the captured image to extract relevant information, such as identifying the bus number or confirming the bus's arrival at a designated spot.
3. **Arduino IDE:**
    - The processed image data is then sent to the Arduino IDE (Integrated Development Environment). The Arduino, which is a microcontroller, uses this data to perform further actions. It might involve checking if the identified bus matches the expected bus at that time and location.
4. **GSM (sim808):**

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- The Arduino is connected to a GSM module (sim808), which is used for wireless communication. This module sends the processed data, such as the bus arrival time and bus identification, to the server and mobile application. The GSM module allows the system to communicate over a cellular network, making it possible to send real-time updates.

5. **Server:**
    - The server receives the data sent by the GSM module. The server is responsible for storing this information and making it accessible for further use. It acts as the central hub where all the data is collected, processed, and managed.
6. **Mobile Application:**
    - The processed and stored data from the server is then sent to a mobile application. This application provides real-time updates to the users, such as the arrival time of the bus and which bus is arriving. Users can view this information on their mobile devices.
7. **Admin:**
    - The admin has access to the mobile application or a dedicated interface where they can monitor the system's performance. The admin can track the bus locations, view the history of bus arrivals, and manage other system settings.

The architecture diagram represents a comprehensive bus tracking system that uses a camera for data capture, Arduino IDE for processing, GSM for communication, and a server for data storage and management. The final output is presented to the users and admin through a mobile application, ensuring that real-time bus tracking information is always available.

4. Results

The proposed bus tracking system was successfully implemented and tested in a real-time environment. The system achieved the following outcomes:

1. **Accurate Bus Arrival Detection:**
    - The system was able to accurately detect the arrival of college buses using the camera and image processing module. The integration with the Arduino IDE allowed for the precise identification of bus numbers and the timing of their arrival.
2. **Real-Time Notifications:**
    - The GSM module effectively transmitted real-time data to the server, which was then pushed to the mobile application. This ensured that users received timely notifications about bus arrivals, improving the overall user experience.

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3. **Efficiency in Monitoring:**
    - The system significantly reduced the manual work required by security personnel to monitor bus arrivals. The automation of the process allowed for a more efficient operation, with guards and administrators now able to focus on other critical tasks.
4. **User Satisfaction:**
    - Feedback from the users, including students and the college administration, was overwhelmingly positive. The ability to track bus arrivals in real-time through the mobile application improved the reliability of the bus service and increased user satisfaction.
5. **Scalability and Flexibility:**
    - The system demonstrated scalability, with the potential to be expanded to monitor multiple buses across different routes. The architecture is flexible enough to be adapted for various transportation management scenarios beyond the college environment.
6. **Reduction in Wait Times:**
    - With accurate arrival time predictions, students and staff experienced reduced wait times at bus stops. This also contributed to better time management for everyone relying on the bus service.
7. **Enhanced Data Management:**
    - The system facilitated better data management by storing all bus tracking information on the server. This data can be analyzed for future improvements in the bus service, such as optimizing routes and schedules.

The implementation of this bus tracking system has led to significant improvements in the management of college bus services, offering a reliable, efficient, and user-friendly solution for real-time bus monitoring.

5. Conclusion

The implemented bus tracking system effectively reduces the waiting time for users by providing real-time updates on bus arrivals through a mobile application. This system accurately measures and communicates the exact arrival time of the bus, ensuring that users are well-informed. The system's architecture, consisting of three main modules—Administration, Driver Information, and Bus Information—demonstrates its efficiency in storing current data on the cloud and making it accessible to remote users via the mobile application. The user-friendly interface enhances the experience for all users, making the system easy to operate and highly practical. The project successfully designed and developed a real-time bus tracking system using image processing techniques. The system not only

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saves time for administrators managing college transportation services but also simplifies the daily routines of users, contributing to a smoother and more organized start to their day. Additionally, the system is cost-effective, offering substantial benefits with minimal expenses.

7. Future Enhancement

The integration of a video camera into the system will significantly enhance its capabilities, particularly in the security sector. This advancement will help prevent modern-day crimes by capturing real-time footage of incidents, making it a crucial tool in crime reduction efforts. Moreover, incorporating moving sensors can enable the system to calculate the speed of the bus, adding another layer of functionality. Future developments could also include the use of RFID tags to implement an E-bus ticketing system, which would eliminate the need for paper tickets and support eco-friendly initiatives. The system could also be adapted for use in the medical field, particularly for tracking ambulance buses and managing drivers. In the event of an emergency, such as a fire outbreak, the enhanced system could track firetrucks, facilitate emergency calls, and coordinate rescue missions, thereby expanding its application beyond transportation to emergency response management.

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