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Transport Management System for Intra-City E-Transport

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ABSTRACT

This project aims to develop a comprehensive Public Transport Management System that incorporates ticket booking, live GPS location tracking, and real-time people counting inside buses. The system is designed to enhance the overall efficiency and safety of public transportation services.

The backend of the system is built using PHP and MySQL database, utilizing XAMPP server to handle ticket booking functionalities. Users can seamlessly book tickets through a user-friendly interface, and the information is securely stored and managed in a MySQL database. Live GPS location tracking is implemented using a Raspberry Pi equipped with a GPS module and interfaced with a Python backend. Pyrebase, a Python wrapper for the Firebase Realtime Database, is employed to securely transmit and store location data in Firebase. This allows both transport authorities and passengers to track the real-time location of buses, improving transparency and enabling better route planning.

To enhance passenger safety and optimize bus capacity, a people counting system is integrated using a TensorFlow model with the COCO (Common Objects in Context) dataset. This model is deployed on edge devices within the buses, such as a Raspberry Pi with a camera. The TensorFlow model processes the video feed in real-time, accurately counting the number of passengers on board. This information is then transmitted to the Firebase Realtime Database, providing insights into bus occupancy levels.

Keywords— Route optimization, real-time tracking, fleet management, traffic analysis, scheduling, vehicle maintenance, cost efficiency, GPS integration, logistics, last-mile delivery.

Introduction

An effective and streamlined Transport Management System (TMS) is essential to improving the entire intra-city travel experience in the quickly changing urban transportation sector. The examination that follows dives into essential elements of a strong TMS, emphasizing GPS tracking, people monitoring, and ticketing.

The core component of a successful TMS is its ticket booking system, which provides travellers with an easy-to-use and smooth way to schedule and reserve their travels. Passengers can now easily order tickets online and through mobile devices, which makes the process hassle-free and time-efficient. This digital revolution helps to improve the overall efficiency of intra-city transit by decreasing wait times and streamlining the booking procedure.

Furthermore, the incorporation of GPS tracking devices s in public transport vehicles is a game-changer in optimizing route efficiency and providing real-time updates to commuters. This technology not only aids in route planning but also enables passengers to track the precise location of their transport, minimizing uncertainties and delays. The result is a more punctual and reliable public transportation system that aligns with the dynamic needs of modern urban life.

Beyond the physical movements of vehicles, TMS also incorporates people tracking and monitoring systems to ensure passenger safety and security. Through the use of advanced technologies such as surveillance cameras and automated monitoring tools, transit authorities can oversee crowd density, identify potential issues, and respond promptly to emergencies. This enhances the overall safety net of public transportation, fostering a sense of security among commuters.

Moreover, the TMS's capability to gather and analyze data is a valuable asset for city planners and transportation authorities. By leveraging insights from ticketing, GPS tracking, and people monitoring systems, decision-makers can optimize routes, allocate resources more effectively, and make informed decisions to enhance the overall efficiency of intra-city travel.

In conclusion, a well-implemented Transport Management System is essential for the seamless functioning of intra-city transportation. The integration of ticket booking, GPS tracking, and people monitoring systems not only enhances the convenience of commuters but also contributes to the optimization of routes, increased safety, and informed decision-making for urban transport authorities. As cities continue to evolve, an adaptable and technology-driven TMS remains integral to shaping the future of efficient and sustainable intra-city travel.

RELATED WORK

Several studies and projects have contributed to the development and enhancement of transportation management systems for intra-city travel. Research in the field often focuses on improving traffic flow, reducing congestion, and enhancing overall urban mobility. Existing works include the implementation of intelligent traffic signal systems, as explored in studies such as "Smart Traffic Light Control for Urban Traffic Management" (2019), which aims to optimize traffic signal timings based on real-time conditions. Additionally, projects like "Integrated Public Transportation Management Systems" have investigated the integration of various public transportation modes to create a more cohesive and efficient urban transit network. The development of dynamic route planning algorithms has been addressed in works like "Real-Time Traffic Adaptive Route Planning for Urban Transportation" (2018), focusing on adapting travel routes based on live traffic information. Ride-sharing and carpooling platforms have been subject to research, examining their impact on reducing individual vehicle usage and alleviating traffic congestion. These related works collectively contribute valuable insights and solutions to the ongoing efforts in developing effective transportation management systems for intra-city travel.

PROPOSED METHOD

Ticket Booking System: Provide commuters with an easy-to-use mobile and web application that makes it simple for them to plan and reserve their trips. Establish reliable and effective payment gateways to facilitate smooth transactions and promote a convenient and cashless ticketing experience. Use individualised features to improve customer engagement and customise services according to user preferences, such as user profiles and trip history.

GPS Tracking System: To give precise and current location information, integrate real-time GPS tracking devices in public transportation vehicles. Reduce travel time and fuel consumption by using machine learning algorithms to forecast and optimise routes based on historical and current traffic data. Provide a user-friendly interface that lets travellers track their transportation in real time, lowering uncertainty and promoting transparency.

People Tracking and Monitoring System: Install surveillance cameras and sensors in public transport vehicles and stations to monitor passenger density and behavior. Utilize artificial intelligence to analyze surveillance data for early detection of potential issues, ensuring a proactive response to security concerns. Implement an emergency alert system that allows passengers to report incidents or seek assistance, promoting a safer and more secure travel environment.

The created programme is intended to be integrated as a module into already-running apps with API integration or utilised as a stand-alone application for any use case requiring human detection and computation of the number of people in a specific area. Because the feed should respond to responses immediately, it is expected to yield findings more swiftly.

MATERIALS USED

Hardware Components:

To build a Raspberry Pi-based project with GPS capabilities, you'll need several essential hardware components. Firstly, the core of the system is the Raspberry Pi, which includes the mainboard with a CPU, RAM, GPIO pins, and HDMI ports. You'll also require a microSD card for storage and a micro USB power supply to operate the Raspberry Pi. For GPS functionality, incorporate a GPS module that consists of a GPS receiver module and an antenna for signal reception. Connect these components using a breadboard, which is a plastic board with a grid of holes for circuit building. Use metal clips and jumper wires for connections. Finally, to power up your project, install the Raspbian OS on the microSD card. Ensure internet access during the initial setup for downloading and updating the operating system. These materials collectively form the foundation for a Raspberry Pi-based system with GPS capabilities, suitable for various applications.

Software Components:

When developing a web application, several key software components are commonly utilized. HTML (Hypertext Markup Language) serves as the fundamental structure for web pages, defining elements and their relationships. CSS (Cascading Style Sheets) is crucial for styling and formatting, allowing the design and layout of the HTML elements. A front-end framework called Bootstrap makes design work easier by offering pre-made elements and responsive layouts that improve the user interface as a whole. To enable dynamic and asynchronous interactions with the server, AJAX (Asynchronous JavaScript and XML) is employed, allowing seamless data exchange between the client and server without reloading the entire page. Integrating HTML for structure, CSS for styling, Bootstrap for design consistency, and AJAX for dynamic content creates a robust foundation for developing modern and responsive web applications and layout of the HTML elements. A front-end framework called Bootstrap makes design work easier by offering pre-made elements and responsive layouts that improve the user interface as a whole. To enable dynamic and asynchronous interactions with the server, AJAX (Asynchronous JavaScript and XML) is employed, allowing seamless data exchange between the client and server without reloading the entire page.

Integrating HTML for structure, CSS for styling, Bootstrap for design consistency, and AJAX for dynamic content creates a robust foundation for developing modern and responsive web applications.

METHODOLOGY

System Design: Create a modular architecture for the system. Design a user-friendly interface for ticket booking with secure payment options. Integrate GPS tracking for real-time location updates. Implement a robust system for people tracking and monitoring.

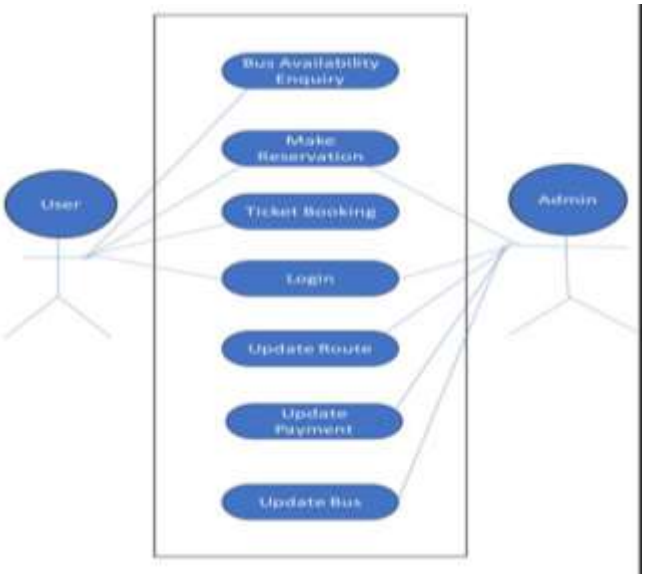
Ticket Booking System: Develop a centralized platform for users to book tickets. Include features like seat selection, fare calculation, and confirmation alerts. Implement secure authentication and payment gateways.

GPS Tracking System: Integrate GPS technology to track vehicles in real-time. Display live vehicle locations on a map for both operators and users. Ensure data accuracy and reliability for efficient routing.

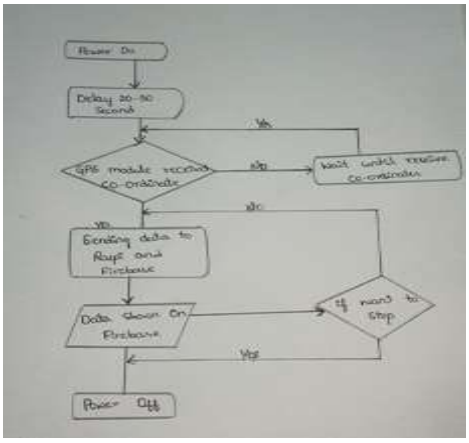
People Tracking and Monitoring System: Implement a system to monitor passenger count and demographics. Ensure privacy compliance and data security. Use analytics to optimize routes and enhance user experience.

IMPLEMENTION OF MODULE

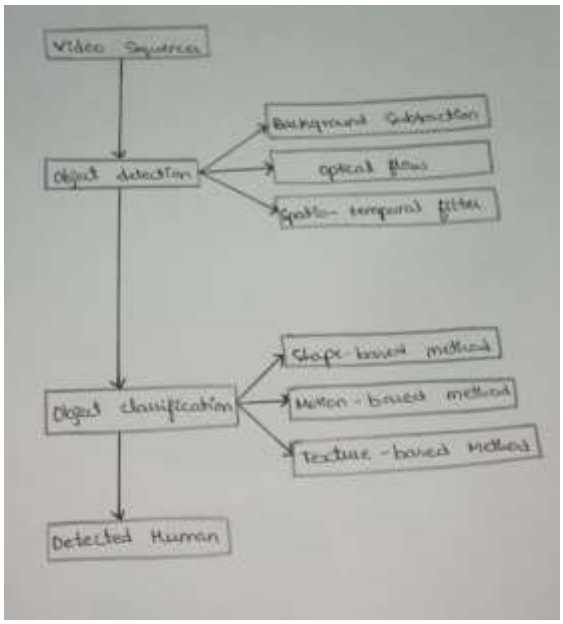
Ticket Booking System: The PHP backend uses secure coding practices to handle user authentication, ticket booking transactions, and data storage in the MySQL database. The XAMPP server provides a robust environment for hosting the web application.



GPS Live Location Tracking: The Raspberry Pi, with a GPS module, runs a Python script to capture location data and updates the Firebase Realtime Database through the Pyrebase library. The frontend interface displays the live locations of buses using the Firebase API.



People Counting with TensorFlow: Cameras installed inside buses capture images processed by a TensorFlow model based on the COCO architecture. The passenger count is sent to the backend for storage and analysis. This data is valuable for optimizing routes and improving passenger safety.



CONCLUSION

The development and implementation of a Transport Management System (TMS) for an intra-city project incorporating ticket booking, GPS live location tracking, and people detection and monitoring systems offers a comprehensive solution to enhance the efficiency and effectiveness of urban transportation.

Furthermore, the implementation of such a system aligns with the broader goals of smart city initiatives by promoting sustainable and efficient urban mobility. It not only improves the overall commuter experience but also contributes to reducing traffic congestion, lowering carbon emissions, and fostering a more interconnected and accessible transportation network within the city.

In conclusion, the Transport Management System integrating ticket booking, GPS live location tracking, and people detection and monitoring systems represents a pivotal step towards modernizing intra-city transportation. Its multifaceted approach addresses key aspects of efficiency,

convenience, safety, and data-driven decision-making, paving the way for a more connected, responsive and sustainable urban transport ecosystem.

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