**Public Transportation Optimization**

**Problem definition:**

The objective of this project is to enhance the efficiency, reliability, and user experience of public transportation through the implementation of Internet of Things (IoT) technologies. By leveraging real-time data and smart devices, the aim is to optimize various aspects of public transport systems, including route planning, vehicle tracking, passenger experience, and overall operational efficiency.

**Detailed Explanation:**

* **Real-time Vehicle Tracking:** Implement GPS and IoT sensors on public transport vehicles to provide real-time location tracking. This allows for accurate arrival and departure predictions.
* **Dynamic Route Planning:** Utilize data analytics to optimize public transport routes based on real-time traffic conditions, historical data, and user demand. This can improve the efficiency of the system and reduce travel time.
* **Passenger Information Systems:** Develop a system to provide passengers with real-time information about bus/train locations, expected arrival times, and any delays. This can be accessible through mobile apps, digital displays at stops, or other communication channels.
* **Condition Monitoring and Maintenance:** Equip vehicles with IoT sensors to monitor their condition in real time. This can help predict and prevent breakdowns, optimize maintenance schedules, and extend the lifespan of the vehicles.
* **Occupancy Monitoring:** Use sensors to monitor the occupancy of vehicles in real time. This information can be used to optimize routes, allocate resources efficiently, and enhance the overall passenger experience.
* **Integration with Other Modes of Transport:** Develop interfaces to integrate public transport systems with other modes of transportation, such as ride-sharing services or bike-sharing programs, to provide users with a seamless and interconnected travel experience.

**Design thinking:**

**Project objectives:**

* To reduce delays, improves route efficiency, and provides real-time information, collectively reducing the overall travel time for passengers.

**IoT sensor design:**

* Generate ideas for a system that incorporates IR sensors, level sensors, speed sensors, temperature and humidity sensors, GPS module, Wi-Fi module, and an LCD interface.
* Create a physical prototype, connecting IR sensors for obstacle detection, level sensors for fluid monitoring, speed sensor, temperature, and humidity sensors for environmental conditions, GPS module for location tracking, and Wi-Fi module for data transmission.

**Real time transit Information platform:**

* The web-based real-time transit information platform aims to provide a comprehensive, user-friendly, and secure experience for passengers. Continuous improvement through iterative testing and user feedback ensures that the platform remains responsive to changing needs and technological advancements.

**Integration approach:**

* ThinkSpeak is a popular Internet of Things (IoT) platform that allows users to easily build and control IoT projects through a user-friendly mobile app. It provides a simple way to connect various hardware devices, sensors, and microcontrollers to the internet and control them remotely.

**Work Flow:**

* When system is powered up, it goes through initializing phase during which it sets the baud rate for connected devices communicating a Universal Asynchronous Received Transmitted (UART) serial connected devices such as Wi-Fi module, GPS, and serial monitor as well initializes the LCD and DHT sensor.
* After that microcontroller scans all the sensors and reads both analogue and digital sensors.
* The microcontroller then performs analogue to digital conversion for all analogue read sensors. It then processes the data read and computes passenger count, calculate bus speed, compute GPS coordinates, passenger count, temperature, and humidity.
* All computed parameters are displayed on the LCD locally.
* The same values are also sent to serial monitor for testing and debugging purpose.
* These parameters are sent to the ThingSpeak cloud over the internet using ESP8266 module.
* The data sent to cloud is fetched from the cloud and displayed in a web browser for user visualization. In the next step data is fetch from the cloud using channel ID and API key which is then analyzed using the MATLAB.

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