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**DEPARTMENT OF
ELECTRONICS AND COMMUNICATION ENGINEERING**

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Internet of Things – Group 3

**Phase 5–SUBMISSION & DOCUMENTATION
PUBLIC TRANSPORT OPTIMIZATION**

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PUBLIC TRANSPORT OPTIMIZATION

(Documentation & submission)

INTRODUCTION:

public transport optimization stands at the forefront of modern city planning. With the goal of enhancing the efficiency, accessibility, and environmental sustainability of public transit systems, public transport optimization employs advanced technologies, data analytics, and innovative strategies to revolutionize the way people move within cities. This pursuit of excellence in public transportation is not only a catalyst for reduced congestion and emissions but also a driver of economic growth and improved urban living. In this exploration, we delve into the multifaceted world of public transport optimization, uncovering the strategies and cutting-edge solutions that are shaping the future of urban mobility.

PROJECT'S OBJECTIVES:

- **Route Optimization:**

Develop algorithms and strategies to optimize public transport routes based on passenger demand, traffic conditions, and urban development, aiming to reduce travel times and enhance service quality.

- **Smart Ticketing and Fare Systems:**

Upgrade ticketing systems to enable contactless payments and dynamic pricing, improving convenience for passengers and optimizing fare revenue.

- **Real-time Information Systems:**

Develop mobile apps and information displays that provide real-time updates on bus/train locations, arrival times, and service disruptions to enhance the passenger experience.

- **Data Analytics and Predictive Maintenance:**

Utilize big data analytics to predict maintenance needs, improve asset management, and anticipate passenger demand, leading to cost savings and enhanced service quality.

- **Reduced Emissions and Electrification:**

Set goals for reducing emissions and transitioning to electric or zero-emission vehicles to align with sustainability objectives.

IOT SENSOR DEPLOYMENT:

- These sensors, strategically integrated across vehicles and infrastructure, provide real-time insights and data-driven solutions. Equipped on buses, trains, and at stations, IoT sensors monitor passenger counts, vehicle locations, occupancy rates, and even predict maintenance needs, enabling dynamic route adjustments and responsive scheduling.
- Surveillance cameras and IoT security sensors enhance safety and security, while data analytics and predictive maintenance improve asset management and operational cost savings.
- This multifaceted approach, driven by IoT sensor data, empowers public transport systems to be more agile, accessible, and environmentally sustainable, ultimately providing a higher quality of service to passengers and a smarter, greener future for urban mobility.

PLATFORM DEVELOPMENT:

- This integrated platform leverages cutting-edge technologies, including data analytics, IoT sensors, AI algorithms, and seamless communication systems, to orchestrate a symphony of public transport services.
- It facilitates real-time data collection and analysis to optimize routes, schedules, and maintenance, all while ensuring seamless passenger experiences with user-friendly mobile apps, contactless payments, and real-time updates.
- Multimodal integration becomes a reality, bridging buses, trams, subways, and shared mobility options, while fostering sustainability through green technologies and electrification.

CODE IMPLEMENTATION:

ROUTE OPTIMIZATION USING NETWORKS

```
import networkx as nx
G.add_node("stop A")
G.add_node("stop B")
G.add_edge("stop A","stop B",weight=5)
Shortest_path=nx.shortest_path(G,"stop A","stop B")
Print("shortest path:",shortest_path)
```

IOT SENSOR DATA PROCESSING:

```
import pandas as pd
Sensor_data=pd.read.csv("sensor_data.csv")
```

REAL-TIME INFORMATION SYSTEM:

```

    from flask import flask,request,jsonify
    App=flask(__name__)
    @app.route("/realtime_info",methods=["GET"])
    def get_realtime_info():
        return jsonify({"bus_arrival_time":"10 minutes","current_occupancy":
    if __name__=="__main__":
        app.run()

```

PROGRAM:

```

#define BLYNK_TEMPLATE_ID "TMPL26V4fGv5q"
#define BLYNK_TEMPLATE_NAME "Test"
#define BLYNK_AUTH_TOKEN "XEHxNF_Ur1Nt2p7wB5B20dNI1ZUwj34P"

#include <WiFi.h>
#include <WiFiClient.h>
#include <BlynkSimpleEsp32.h>

int duration1 =
int distance1 = 0;
int duration2 = 0;
int distance2 = 0;
int dis1 = 0;
int dis2 = 0;
int dis_new1 = 0;
int dis_new2 = 0;
int entered = 0;
int left = 0;
int inside = 0;
#define LED 2
#define PIN_TRIG1 15
#define PIN_ECHO1 14
#define PIN_TRIG2 13
#define PIN_ECHO2 12
BlynkTimer timer;

char auth[] = BLYNK_AUTH_TOKEN;
char ssid[] = "Wokwi-GUEST"; // your network SSID (name)
char pass[] = "";
#define BLYNK_PRINT Serial

long get_distance1() {
    // Start a new measurement:
    digitalWrite(PIN_TRIG1, HIGH);
    delayMicroseconds(10);

```

```

    digitalWrite(PIN_TRIG1, LOW);

    // Read the result:
    duration1 = pulseIn(PIN_ECHO1, HIGH);
    distance1 = duration1 / 58;
    return distance1;
}

long get_distance2() {
    // Start a new measurement:
    digitalWrite(PIN_TRIG2, HIGH);
    delayMicroseconds(10);
    digitalWrite(PIN_TRIG2, LOW);

    // Read the result:
    duration2 = pulseIn(PIN_ECHO2, HIGH);
    distance2 = duration2 / 58;
    return distance2;
}

void myTimer() {
    Serial.println("100");
    dis_new1 = get_distance1();
    dis_new2 = get_distance2();
    if (dis1 != dis_new1 || dis2 != dis_new2){
        Serial.println("200");
        if (dis1 < dis2){
            Serial.println("Enter loop");
            entered = entered + 1;
            inside = inside + 1;
            digitalWrite(LED, HIGH);
            Blynk.virtualWrite(V0, entered);
            Blynk.virtualWrite(V2, inside);
            dis1 = dis_new1;
            delay(1000);
            digitalWrite(LED, LOW);
        }
        if (dis1 > dis2){
            Serial.println("Leave loop");
            left = left + 1;
            inside = inside - 1;
            Blynk.virtualWrite(V1, left);
            Blynk.virtualWrite(V2, inside);
            dis2 = dis_new2;
            delay(1000);
        }
    }
}

```

```

    }

}

}

void setup() {
  Serial.begin(115200);
  pinMode(LED, OUTPUT);
  pinMode(PIN_TRIG1, OUTPUT);
  pinMode(PIN_ECH01, INPUT);
  pinMode(PIN_TRIG2, OUTPUT);
  pinMode(PIN_ECH02, INPUT);
  Blynk.begin(auth, ssid, pass, "blynk.cloud", 8080);
  timer.setInterval(1000L, myTimer);

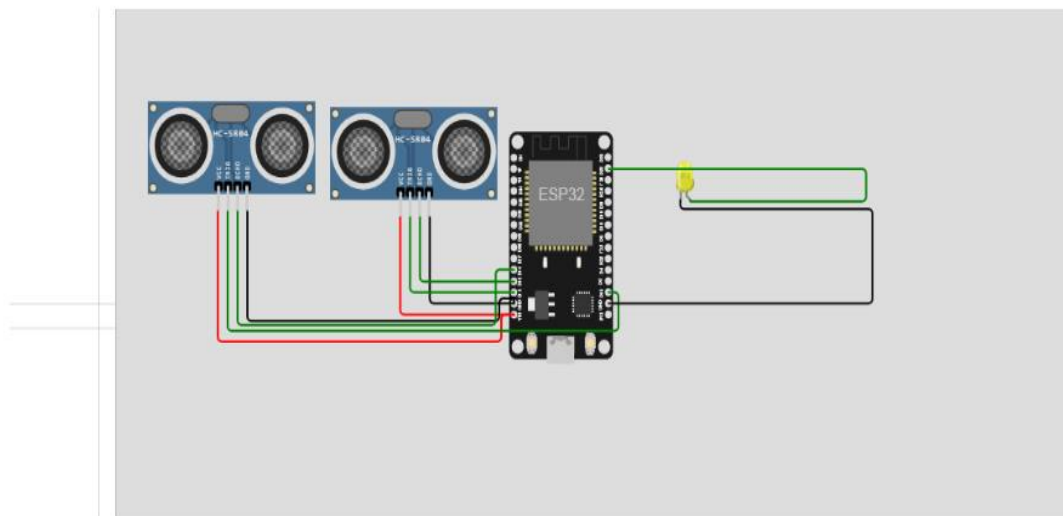
}

void loop() {
  Blynk.run();
  timer.run();
} 0;

```

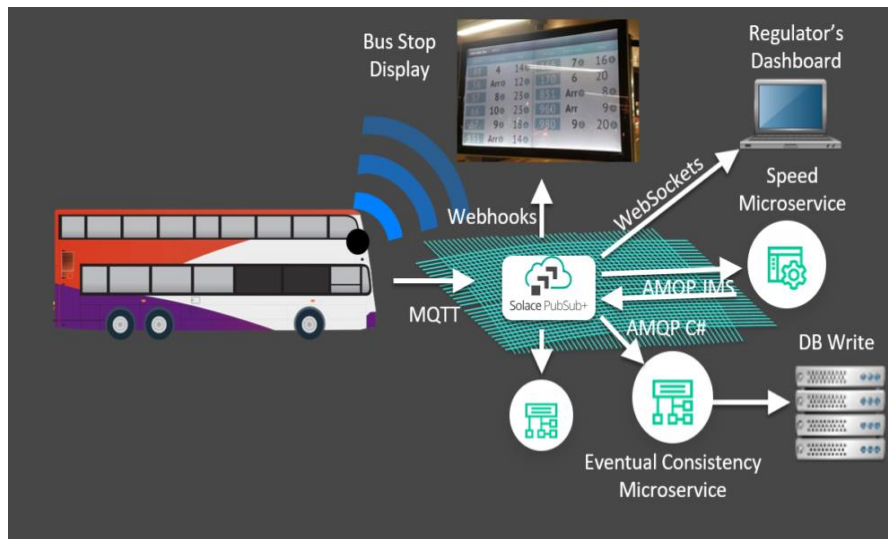
CIRCUITS DIAGRAMS:

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SCHEMATICS:

- Data Ingestion
- Data analysis
- Optimization engine
- User interface
- IOT infrastructure
- Integration with multimode transport



SCREENSHOTS OF IOT SENSORS:

ULTRASONIC SENSORS: ultrasonic sensor emits high-frequency sound waves and measures the time it takes for them to bounce off an object and return, enabling accurate distance measurement. These sensors are non-contact, versatile, and commonly used in applications like robotics and obstacle detection



TRANSIT INFORMATION PLATFORM:

A transit information platform in the context of public transport optimization typically refers to a system or software solution designed to improve the efficiency and effectiveness of public transportation services. These platforms are often used by public transit agencies, cities, or companies to manage and optimize various aspects of their public transportation operations.

- **Real-time Data Integration:**

Transit information platforms often incorporate real-time data from various sources, including GPS-equipped vehicles, passenger counts, and weather conditions, to provide up-to-date information to both operators and passengers.

- **Route Planning and Optimization:**

They help in designing and optimizing bus or train routes to minimize travel time, reduce congestion, and enhance overall service efficiency.

- **Scheduling:**

These platforms can assist in creating and managing transit schedules that balance service frequency and capacity while minimizing operational costs.

- **Passenger Information Systems:**

For the benefit of passengers, transit information platforms often provide real-time arrival and departure information, service alerts, and trip planning tools via various channels, including mobile apps, websites, and electronic displays at transit stops.

- **Fare Management:**

They can handle ticketing and payment systems, including contactless payment options and fare integration with multiple modes of transportation.

- **Analytics and Reporting:**

These platforms provide valuable insights through data analysis, which can inform decision-making, performance evaluation, and future planning.

- **Environmental and Sustainability Considerations:**

Some platforms may include features to support environmentally friendly practices, such as electric vehicle adoption or route optimization for reduced emissions.

These transit information platforms can significantly improve the quality of public transportation services, enhance the overall passenger experience, and contribute to more sustainable and efficient urban mobility. They are an important tool for modernizing and optimizing public transport systems in cities around the world.

REAL –TIME DATA DISPLAY:

Real-time data display refers to the continuous and immediate presentation of data as it is generated or updated, allowing users to monitor and analyze information as it changes in real time. This concept is essential in various fields, including finance, IoT (Internet of Things), monitoring and control systems, and data analytics

Data Sources:

Real-time data can come from various sources, such as sensors, databases, streaming APIs, or user inputs. These sources continuously provide updates or new data points.

Data Processing:

Data processing is necessary to validate, clean, and transform the incoming data into a format suitable for display. This step might involve filtering, aggregating, and calculating metrics.

Visualization:

The most common way to display real-time data is through visualizations such as charts, graphs, dashboards, and heatmaps. These visuals make it easier to understand and interpret the data quickly.

User Interface:

Real-time data display often includes a user interface that allows users to interact with and customize the way they view the data. This can include zooming, panning, filtering, and selecting specific time periods.

Alerting:

Real-time data systems may include alerting mechanisms to notify users when certain conditions or thresholds are met, allowing for quick response to important events.

Security:

Ensuring the security and integrity of real-time data is crucial, as sensitive information may be involved. Implementing authentication, authorization, and encryption is essential.

Use Cases:

Real-time data display is used in a wide range of applications, including stock market trading platforms, weather monitoring, social media analytics, and industrial control systems.

To implement a real-time data display system, you'll need a combination of software tools, databases, and visualization libraries, depending on your specific requirements and technology stack. Popular tools and frameworks for real-time data display include Apache Kafka, Elasticsearch, Grafana, and various JavaScript libraries for building interactive web-based dashboards .

IMPROVE PUBLIC TRANSPORTATION SERVICES AND PASSENGER EXPERIENCE:

A real-time transit information system plays a crucial role in improving public transportation services and enhancing the passenger experience in several ways:

Accurate Arrival Information:

Real-time transit systems provide accurate and up-to-date information about when the next bus, tram, subway, or train will arrive. Passengers can plan their journeys more efficiently, reducing wait times and minimizing uncertainty.

Reduced Wait Times:

Passengers can check real-time schedules and arrival predictions through mobile apps or digital displays at transit stops. This reduces the time passengers spend waiting for transportation and makes public transit more convenient.

Optimized Route Planning:

Real-time systems can suggest the best routes and connections based on real-time data, helping passengers choose the most efficient and cost-effective options for their journeys.

Crowd Management:

By providing information on vehicle occupancy and expected passenger loads, transit agencies can help passengers choose less crowded options or plan their trips during off-peak hours, improving comfort and safety.

Service Alerts and Updates:

Real-time systems can push notifications to passengers about service disruptions, delays, or changes in real-time. This keeps passengers informed and minimizes inconveniences caused by unexpected disruptions.

Accessibility Features:

Real-time systems can provide information about accessibility features for passengers with disabilities, ensuring they have a smooth experience when using public transportation.

Multi-Modal Integration:

Some real-time transit systems integrate various modes of transportation, including buses, subways, trams, and even shared mobility options like ride-sharing or bike-sharing. This seamless integration enhances the passenger experience and encourages the use of public transit for the entire journey.

User-Friendly Apps:

Transit agencies often provide mobile apps that offer real-time information, route planning, and payment options. These apps can be user-friendly and enhance the passenger experience by simplifying ticketing and making transit information easily accessible.

Improved Safety and Security:

Real-time data can be used for monitoring and ensuring the safety and security of passengers. Surveillance cameras, emergency communication systems, and real-time tracking can help transit agencies respond quickly to incidents.

Reduced Environmental Impact:

By helping passengers make more informed transportation choices and reducing congestion on the roads, real-time transit information systems contribute to reducing greenhouse gas emissions and environmental impact.

Data for Service Improvement:

Transit agencies can use real-time data to monitor the performance of their services and make data-driven decisions to improve operations, route planning, and service quality.

Customer Feedback:

Real-time systems can include features for passengers to provide feedback or report issues. This feedback loop helps transit agencies address passenger concerns and continuously improve their services.

Increased Ridership:

A more predictable, convenient, and efficient public transportation system is likely to attract more riders, reducing the number of private vehicles on the road and easing congestion in urban areas.

In summary, a real-time transit information system enhances the passenger experience by providing timely and accurate information, reducing wait times, and offering an overall more convenient and reliable transportation service. It not only benefits passengers but also helps transit agencies optimize their operations and contribute to more sustainable and efficient urban transportation systems.