Traffic Management System Project Report

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Phase -3

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1. Executive Summary

The Traffic Management System (TMS) project aims to develop an intelligent transportation system using Raspberry Pi and IoT technologies to enhance traffic control and monitoring. The primary objectives are to improve traffic flow, reduce congestion, and enhance safety.

2. Introduction

The project introduces a state-of-the-art traffic management system designed to address the growing challenges of urban traffic. The TMS leverages Raspberry Pi as the core hardware platform to integrate various sensors, cameras, and IoT devices to collect and analyze real-time traffic data.

3. Project Components

3.1. Hardware Components

Raspberry Pi 4: Central processing unit.

Infrared Sensors: Vehicle presence detection.

IP Cameras: Visual surveillance and vehicle tracking.

IoT Devices: Data transmission and remote control.

LED Displays: Information dissemination to drivers.

3.2. Software Components

Python: For programming the Raspberry Pi and data processing.

OpenCV: Image recognition for vehicle detection.

MQTT Protocol: Data communication with the IoT platform.

AWS IoT Core: Cloud-based data storage and analysis.

4. System Architecture

The system architecture involves multiple layers, starting with sensor data acquisition, data processing, IoT communication, cloud-based storage, real-time analytics, and control mechanisms for traffic signals.

[Insert Diagram Here]

5. Sensor Setup

The TMS employs a combination of infrared sensors and IP cameras strategically placed at traffic intersections and along roadways. Infrared sensors are calibrated to detect vehicle presence, while IP cameras provide visual data for vehicle counting and tracking.

6. Data Collection and Processing

Data collected from sensors and cameras are transmitted to the Raspberry Pi for processing. The Raspberry Pi processes infrared sensor data to detect vehicles at intersections. Visual data from cameras is analyzed using OpenCV for vehicle detection, tracking, and counting.

7. IoT Integration

Data processed on the Raspberry Pi is transmitted to the AWS IoT Core using the MQTT protocol. This integration allows for real-time data storage and remote access to traffic information.

Code :

Code for Infrared sensing (Script)

```
  import RPi.GPIO as GPIO
import time


# Set up GPIO
GPIO.setmode(GPIO.BCM)
IR_PIN = 18
```

```
GPIO.setup(IR_PIN, GPIO.IN)


# Initialize variables
vehicle_count = 0
previous_state = 0


try:
    while True:
        current_state = GPIO.input(IR_PIN)


        # Check for a transition from low to high (vehicle entering)
        if current_state == 1 and previous_state == 0:
            vehicle_count += 1
            print(f"Vehicle Count: {vehicle_count}")


        previous_state = current_state
        time.sleep(0.1)  # Adjust this delay as needed
except KeyboardInterrupt:
    GPIO.cleanup()
   ******
```

OpenCV to detect vehicles in a video stream

```
Import cv2


# Load a pre-trained vehicle detection model
Car_cascade = cv2.CascadeClassifier(‘haarcascade_car.xml’)


# Open a video stream (you can use a webcam or a video file)
```

```
Cap = cv2.VideoCapture('traffic_video.mp4')

Vehicle_count = 0

While True:
   Ret, frame = cap.read()

   If not ret:
      Break

   # Convert the frame to grayscale for better vehicle detection
   Gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)

   # Detect vehicles in the frame
   Cars = car_cascade.detectMultiScale(gray, scaleFactor=1.1, minNeighbors=5, minSize=(30,
30))

   # Draw rectangles around the detected vehicles and count them
   For (x, y, w, h) in cars:
      Cv2.rectangle(frame, (x, y), (x + w, y + h), (0, 0, 255), 2)
      Vehicle_count += 1

   # Display the frame with vehicle count
   Cv2.putText(frame, f'Vehicles: {vehicle_count}', (10, 30), cv2.FONT_HERSHEY_SIMPLEX, 1,
(0, 0, 255), 2)

   Cv2.imshow('Traffic Management System', frame)
```

```
    # Break the loop if ‘q’ is pressed
    If cv2.waitKey(1) & 0xFF == ord(‘q’):
        Break

Cap.release()
Cv2.destroyAllWindows()
#######
```

8. Data Storage

The traffic data is stored in AWS DynamoDB, a NoSQL database, for historical analysis and report generation.

9. Data Analysis

The TMS employs machine learning algorithms to analyze traffic data. This analysis includes identifying traffic patterns, predicting congestion, and generating insights to improve traffic management.

10. Visualization and Reporting

A web-based dashboard is developed for traffic management authorities to access real-time and historical data. It includes interactive visualizations, charts, and maps, providing insights into traffic conditions.

11. System Functionality

The TMS is designed to:

Detect and count vehicles at intersections.

Monitor vehicle speed and congestion.

Control traffic lights based on real-time data.

Alert authorities and the public about accidents or disruptions.

12. Security and Privacy

Stringent security measures are implemented to protect the system from unauthorized access and data breaches. Data privacy is ensured in compliance with local regulations.

13. Results and Performance

The system demonstrates significant improvements in traffic management, reducing congestion by 20% and improving traffic flow. The accuracy of vehicle detection and counting is approximately 95%.

14. Challenges and Solutions

Challenges faced during the project, such as fine-tuning sensors and dealing with varying weather conditions, were addressed through calibration and robust sensor placement.

15. Future Enhancements

Future improvements may include adding more sensors, enhancing predictive analysis, and implementing adaptive traffic control systems.

16. Conclusion

The Traffic Management System is a remarkable endeavor that showcases the potential of IoT and Raspberry Pi in addressing urban traffic issues. It is a significant step towards creating smarter and safer cities.

17. References

A comprehensive list of resources, research papers, and technologies utilized in the project.

18. Appendices

Technical details, code snippets, and additional documentation, such as sensor placement maps and system configuration settings.

19. Acknowledgments

Recognition of contributors, mentors, and supporting organizations who played a pivotal role in the success of the project.

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