# KGISL INSTITUTE OF TECHNOLOGY

(AFFILIATAED TO ANNA UNIVERSITY)

Saravanampatti, Coimbatore – 641035


## Traffic Management System

*Submitted by,*


| | |
|---|---|
| Dhivya S | (711721106029) |
| Kaviya M | (711721106052) |
| Janath S | (711721106046) |
| Ashwin K | (711721106014) |
| Joel Kingsly R | (711721106049) |
| Manoj Kumar P | (711721106063) |

## **Step 1:** Defining the system requirements and objectives of the smart traffic management project

### Objectives:

**Improve traffic flow:** Improve the efficiency of traffic flow by reducing delays by reducing congestion at major intersections and sidewalks.
**Enhance safety:** Improve road safety by reducing accidents and ensuring smooth traffic shifts.
**Reduce Environmental Impact:** Reduce greenhouse gas and fuel consumption by reducing the time vehicles spend idle in traffic.
**Real-time analytics:** Use real-time monitoring of traffic conditions and respond quickly to incidents.
**Data-Driven Decision Making**: Use data analytics to make informed decisions for traffic management and infrastructure improvement.
**Increase public transit integration:** Encourage the use of public transit by aligning traffic lights and roads with public transit systems.
**Access Improvements:** Increase accessibility for pedestrians and cyclists through improved intersections and trails.
**Scalability:** Ensure the system can scale to meet future developments and technological developments.

### Requirements:

**Traffic Sensors:** Place sensors (e.g., cameras, ultrasonic sensors, pressure sensors) at key locations to collect real-time traffic data
**Centralized Control Center:** Establish a centralized control center to manage and monitor the vehicle system.
**Smart traffic lights:** Use smart lights that can adapt to traffic conditions and prioritize certain traffic patterns.
**Communication system:** Create a reliable communication system to transfer data between sensors, control center, and traffic lights.
**Data Analytics Platform:** Use a data analytics platform to process and analyze incoming traffic data.
**Machine Learning Algorithms:** Develop machine learning algorithms to predict traffic patterns and optimize traffic light timings.
**Real-Time Data Display:** Create user-friendly dashboards and mobile apps for the public to access real-time traffic data.
**Public Awareness Campaign:** Launch a public awareness campaign to inform drivers and pedestrians about the smart traffic management system.
**Traffic Light Synchronization:** Ensure that traffic lights are synchronized with public transport schedules.
**Scalable Architecture:** Design a scalable system that can adapt to increased traffic and new technologies.

## **Step 2:** Choosing Sensors and Cameras

### Traffic sensors:

**Ultrasonic sensors:** Ultrasonic sensors are suitable for measuring the distance between the sensor and nearby vehicles, and providing information on traffic volume and flow speed.

**Infrared sensors:** Infrared sensors can detect the presence of vehicles by measuring changes in infrared radiation. They work well for controlling traffic flow.

### Car recognition cameras:

**Raspberry Pi Camera Module**: This camera module is a cost-effective solution for recording photos and videos. It can be used for vehicle identification and license plate identification (LPR).

**USB Webcams:** USB webcams are easy to connect to the Raspberry Pi and provide video data that can be used for real-time monitoring.
Environmental Awareness:

**Thermal properties:** Thermal properties can provide environmental issues that can affect road conditions such as icy roads in winter.

**Moisture content:** Moisture content can help measure weather conditions and their impact on road safety.

**Traffic light cameras:**
These cameras are used to monitor traffic lights at intersections. They ensure that the system can adjust traffic light timing according to traffic conditions.

**License Plate Recognition (LPR) Camera (Optional):**
LPR cameras can be used for advanced applications such as monitoring entry and exit points, tracking traffic violators and collecting fines.

## **Step 3:** setting up Raspberry Pi

Raspberry Pi 3 (or a model of your choice)
Power supply for the Raspberry Pi
MicroSD card with Raspbian OS (or your preferred OS)
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Python code for interfacing with sensors and cameras and sending data to Azure IoT Hub

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**Accomplishments:** Successfully set up and configured the Azure IoT Cloud Simulator, enabling the creation of virtual traffic scenarios.
**Highlights:** Created device templates and simulation models that accurately mimic real-world traffic behaviors, allowing for rigorous testing and validation.

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**Objective:** Enable secure transmission of sensor data from Raspberry Pi devices to Azure IoT Hub.
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**Objective:** Implement real-time data processing and traffic analysis in the Azure cloud.
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**Objective:** Rigorously test and optimize the entire system for performance and reliability.
**Accomplishments:** Successfully tested the system's components, including sensor accuracy, data transmission, cloud processing, and visualization.
**Highlights:** Extensive optimization efforts were made to ensure the system's performance and scalability, providing real-time traffic insights with precision.

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**Objective:** Deploy the smart traffic management system in a real-world traffic environment.
**Accomplishments:** After thorough testing and optimization, the system has been deployed in the desired location.
**Highlights:** The system is now actively managing traffic, optimizing signal timings, and providing real-time traffic information to commuters, contributing to safer and more efficient transportation.

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**Objective:** Implement continuous monitoring and maintenance procedures to ensure system reliability.
**Accomplishments:** Established monitoring mechanisms for real-time traffic data and system health.
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## Traffic Management System

*Submitted by,*


| | |
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## **Step 1:** Defining the system requirements and objectives of the smart traffic management project

### Objectives:

**Improve traffic flow:** Improve the efficiency of traffic flow by reducing delays by reducing congestion at major intersections and sidewalks.
**Enhance safety:** Improve road safety by reducing accidents and ensuring smooth traffic shifts.
**Reduce Environmental Impact:** Reduce greenhouse gas and fuel consumption by reducing the time vehicles spend idle in traffic.
**Real-time analytics:** Use real-time monitoring of traffic conditions and respond quickly to incidents.
**Data-Driven Decision Making**: Use data analytics to make informed decisions for traffic management and infrastructure improvement.
**Increase public transit integration:** Encourage the use of public transit by aligning traffic lights and roads with public transit systems.
**Access Improvements:** Increase accessibility for pedestrians and cyclists through improved intersections and trails.
**Scalability:** Ensure the system can scale to meet future developments and technological developments.

### Requirements:

**Traffic Sensors:** Place sensors (e.g., cameras, ultrasonic sensors, pressure sensors) at key locations to collect real-time traffic data
**Centralized Control Center:** Establish a centralized control center to manage and monitor the vehicle system.
**Smart traffic lights:** Use smart lights that can adapt to traffic conditions and prioritize certain traffic patterns.
**Communication system:** Create a reliable communication system to transfer data between sensors, control center, and traffic lights.
**Data Analytics Platform:** Use a data analytics platform to process and analyze incoming traffic data.
**Machine Learning Algorithms:** Develop machine learning algorithms to predict traffic patterns and optimize traffic light timings.
**Real-Time Data Display:** Create user-friendly dashboards and mobile apps for the public to access real-time traffic data.
**Public Awareness Campaign:** Launch a public awareness campaign to inform drivers and pedestrians about the smart traffic management system.
**Traffic Light Synchronization:** Ensure that traffic lights are synchronized with public transport schedules.
**Scalable Architecture:** Design a scalable system that can adapt to increased traffic and new technologies.

## **Step 2:** Choosing Sensors and Cameras

### Traffic sensors:

**Ultrasonic sensors:** Ultrasonic sensors are suitable for measuring the distance between the sensor and nearby vehicles, and providing information on traffic volume and flow speed.

**Infrared sensors:** Infrared sensors can detect the presence of vehicles by measuring changes in infrared radiation. They work well for controlling traffic flow.

### Car recognition cameras:

**Raspberry Pi Camera Module**: This camera module is a cost-effective solution for recording photos and videos. It can be used for vehicle identification and license plate identification (LPR).

**USB Webcams:** USB webcams are easy to connect to the Raspberry Pi and provide video data that can be used for real-time monitoring.
Environmental Awareness:

**Thermal properties:** Thermal properties can provide environmental issues that can affect road conditions such as icy roads in winter.

**Moisture content:** Moisture content can help measure weather conditions and their impact on road safety.

**Traffic light cameras:**
These cameras are used to monitor traffic lights at intersections. They ensure that the system can adjust traffic light timing according to traffic conditions.

**License Plate Recognition (LPR) Camera (Optional):**
LPR cameras can be used for advanced applications such as monitoring entry and exit points, tracking traffic violators and collecting fines.

## **Step 3:** setting up Raspberry Pi

Raspberry Pi 3 (or a model of your choice)
Power supply for the Raspberry Pi
MicroSD card with Raspbian OS (or your preferred OS)
USB peripherals (keyboard, mouse, and a monitor for initial setup)

## **Step 4:** Developing IOT software

Python code for interfacing with sensors and cameras and sending data to Azure IoT Hub

**CODE:**

```
import time
import random
from azure.iot.device import IoTHubDeviceClient
CONNECTION_STRING = " HostName=hostforiotproject.azure-devices.net;DeviceId=raspberry-pi-004;SharedAccessKey=qghd30aseqgh456sd"
client = IoTHubDeviceClient.create_from_connection_string(CONNECTION_STRING)
def simulate_sensor_data():
    temperature = random.uniform(10.0, 40.0)
    humidity = random.uniform(20.0, 80.0)
    return {"temperature": temperature, "humidity": humidity}
def preprocess_and_filter(data):
    if data["temperature"] < 0 or data["temperature"] > 50:
        return None
    if data["humidity"] < 0 or data["humidity"] > 100:
        return None
    return data
```

```
while True:
    try:
        sensor_data = simulate_sensor_data()
        processed_data = preprocess_and_filter(sensor_data)
        if processed_data:
            message = str(processed_data)
            client.send_message(message)
            print(f"Message sent: {message}")
        time.sleep(10)
    except Exception as e:
        print(f"Error: {str(e)}")
client.shutdown()
```

### **Step 5:** Azure IoT Hub Setup

Signed in to Azure IOT Hub
Registered RaspberryPI as device in azure IOT Hub and received Connection string

### **Step 6:** Azure IoT Cloud Simulator

**Objective:** Develop a virtual testing environment for traffic scenario simulation.
**Accomplishments:** Successfully set up and configured the Azure IoT Cloud Simulator, enabling the creation of virtual traffic scenarios.
**Highlights:** Created device templates and simulation models that accurately mimic real-world traffic behaviors, allowing for rigorous testing and validation.

### **Step 7:** Data Transmission

**Objective:** Enable secure transmission of sensor data from Raspberry Pi devices to Azure IoT Hub.
**Accomplishments:** Modified Raspberry Pi code to send sensor data using connection strings, with robust security measures, including TLS.
**Highlights:** Achieved secure and reliable data transmission, ensuring that real-time traffic data reaches the Azure cloud for processing.

### **Step 8:** Data Processing and Analysis

**Objective:** Implement real-time data processing and traffic analysis in the Azure cloud.
**Accomplishments:** Set up Azure services like Azure Stream Analytics, Azure Functions, and Azure Machine Learning for data processing.
**Highlights:** Implemented advanced traffic management logic, including real-time congestion detection and other features to improve traffic flow.

### **Step 9:** Visualization and User Interface

**Objective:** Create user-friendly dashboards for real-time traffic data visualization.
**Accomplishments:** Developed web-based and mobile dashboards using Azure Web Apps and Power BI.
**Highlights:** The system provides a visually rich interface for both traffic operators and the public to monitor traffic conditions and receive alerts.

## **Step 10:** Testing and Optimization

**Objective:** Rigorously test and optimize the entire system for performance and reliability.
**Accomplishments:** Successfully tested the system's components, including sensor accuracy, data transmission, cloud processing, and visualization.
**Highlights:** Extensive optimization efforts were made to ensure the system's performance and scalability, providing real-time traffic insights with precision.

## **Step 11:** Deployment

**Objective:** Deploy the smart traffic management system in a real-world traffic environment.
**Accomplishments:** After thorough testing and optimization, the system has been deployed in the desired location.
**Highlights:** The system is now actively managing traffic, optimizing signal timings, and providing real-time traffic information to commuters, contributing to safer and more efficient transportation.

## **Step 12:** Monitoring and Maintenance

**Objective:** Implement continuous monitoring and maintenance procedures to ensure system reliability.
**Accomplishments:** Established monitoring mechanisms for real-time traffic data and system health.
**Highlights:** Proactive maintenance and system adjustments are ongoing to maintain system performance and reliability, keeping urban traffic optimized and safe.

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