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**Project name: Traffic flow optimisation**

submitted by,

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**Project link**: <https://github.com/IBM-NANMUDHALVAN/V.prathiksha.git>

**TITLE: TRAFFIC FLOW OPTIMISATION** TITLE: TRAFFIC FLOW OPTIMIZATION

**Objective**

To improve urban mobility by analyzing and optimizing vehicle movements across road networks. The goal is to reduce traffic congestion, minimize delays, decrease emissions, and enhance road safety by employing modern technologies like AI, sensors, and real-time data processing.

1: Intelligent Traffic Signal Control

**Overview**

Traditional traffic signals operate on fixed timers, which do not adapt to real-time traffic conditions. Intelligent Traffic Signal Control systems use sensors, cameras, and AI to detect the number of vehicles at intersections and dynamically adjust the signal timing.

**Performance Improvement**:

Adaptive signal control reduces vehicle idle time.

Enhances traffic throughput by up to 25–30%.

Real-time adjustments prevent gridlocks and keep traffic moving.

**Outcome:**

Reduced average waiting time at intersections.

Decreased fuel consumption due to less idling.

Improved commuter satisfaction.

**2: Route Optimization and Navigation Assistance**

**Overview**

Uses real-time traffic data and predictive analytics to suggest the fastest and most efficient routes to drivers using mobile apps or in-car systems.

**Performance Improvement**

Reduces travel time by rerouting around congested areas.

Spreads traffic more evenly across the road network.

Prevents bottlenecks and traffic pile-ups.

**Outcome**

10–20% reduction in travel time.

Fuel savings and reduced CO₂ emissions.

Improved reliability of travel estimates.

3: Vehicle-to-Infrastructure (V2I) Communication

**Overview**

Vehicles equipped with communication modules interact with smart infrastructure such as traffic signals, toll booths, and warning systems. This exchange of data enables smoother driving experiences.

**Performance Improvement**

Vehicles can anticipate signal changes (e.g., slow down instead of stopping suddenly).

Enables coordinated driving, especially in autonomous vehicle scenarios.

Reduces sudden stops and accelerations.

**Outcome**

Improved road safety.

Reduced wear and tear on vehicles.

Lower emissions due to fewer abrupt stops.

**4: Public Transport Priority Systems**

**Overview**

Public transport systems like buses or trams are given traffic signal priority to reduce delays. Sensors detect approaching buses and adjust signals accordingly.

**Performance Improvement**

Keeps public transport on schedule.

Encourages more people to use public transportation.

Reduces road occupancy by personal vehicles.

**Outcome**

Reduced delays in bus/tram services by 15–30%.

Increased usage of public transport.

Less congested roads.

**5: Traffic Prediction Using Machine Learning**

**Overview**

Machine Learning models analyze historical and live traffic data to predict congestion before it occurs. These predictions inform real-time control strategies like signal adjustments or driver notifications.

**Performance Improvement**

Authorities can respond proactively to expected congestion.

Predictive models improve over time with more data.

Helps in planning traffic diversions during special events or emergencies.

**Outcome**

Fewer traffic jams and smoother traffic flow.

Better traffic control decisions.

Long-term improvement in city mobility planning.

Key Challenges of Traffic Flow Optimization

1. Data Collection and Quality:

Inaccurate or incomplete data can reduce the effectiveness of optimization algorithms.

2. High Implementation Costs:

Installing sensors, communication devices, and control centers is expensive.

3. Integration with Existing Infrastructure:

Many cities have outdated systems that are hard to integrate with modern technologies.

4. Privacy Concerns:

Real-time tracking can raise concerns about data security and user privacy.

5. Behavioral Resistance:

Drivers may not follow optimized suggestions, and officials may resist system changes.

Next Steps for Finalization

1. Prototype Deployment:

Implement smart signal control at selected intersections as a test case.

2. Stakeholder Engagement:

Collaborate with city planners, traffic police, and the public to gather feedback.

3. Performance Metrics Collection:

Measure KPIs such as average speed, vehicle delay time, and CO₂ emissions before and after deployment.

4. Scale-Up Plan:

Based on results, create a roadmap for expanding the solution to the entire city.

5. Policy and Regulation Support:

Work with government bodies to ensure policies are aligned with smart traffic initiatives.

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Sample Python Code: Traffic Signal Optimization Based on Vehicle Count

Here’s a simple Python example of adjusting traffic light durations based on traffic volume:

import random

# Simulated traffic counts from sensors at 4-way junction

traffic\_counts = {

'North': random.randint(10, 50),

'South': random.randint(10, 50),

'East': random.randint(10, 50),

'West': random.randint(10, 50)

}

# Total time available for one signal cycle (in seconds)

total\_cycle\_time = 120

# Function to distribute time based on traffic count

def calculate\_signal\_times(counts, cycle\_time):

total\_vehicles = sum(counts.values())

signal\_times = {}

for direction, count in counts.items():

# Allocate green time proportional to vehicle count

green\_time = round((count / total\_vehicles) \* cycle\_time)

signal\_times[direction] = green\_time

return signal\_times

# Display initial traffic count

print("Traffic Vehicle Counts:", traffic\_counts)

# Calculate and display optimized green light times

optimized\_signal\_times = calculate\_signal\_times(traffic\_counts, total\_cycle\_time)

print("Optimized Green Light Timings (seconds):", optimized\_signal\_times)