COLLEGE CODE: 1128

COLLEGE NAME: TJS ENGINEERING COLLEGE

DEPARTMENT: ECE

STUDENT NM-ID: 1. aut23ece22a

2. aut23ece18a

3. aut23ece29a

4. aut23ece31a

5. aut23ece26a

ROLL NO: 1. 112823106022

2. 112823106018

3. 112823106029

4. 112823106031

5. 112823106026

DATE: 09/05/2025

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COMPLETE THE PROJECT NAME AS: AI-TRAFFIC FLOW OPTIMIZATION

TECHNOLOGY-PROJECT NAME: AI-TRAFFIC FIOW OPTIMIZATION

SUBMITTED BY,

NAME : 1. Kiran kumar.S
2. Kandhan.A
3. MONISH.M
4. NAVEEN.B
5. MOHANA PAKASH.C

MOBILE NO: 1. 9342041012
2. 6384857809
3. 7200688130
4. 6383129989
5. 8825434927

PHASE 4: PERFORMANCE OF THE PROJECT
TITLE: AI-TRAFFIC FLOW OPTIMIZATION

Objective:

The focus of Phase 4 is to enhance the performance of the AI-based traffic flow optimization system by improving AI model accuracy, increasing system responsiveness, strengthening IoT device integration, and reinforcing data security. This phase also involves rigorous performance testing and feedback collection to prepare the system for real-world deployment.

1. AI Model Performance Enhancement

Overview:
Refinements will be made to the AI models developed in Phase 3, specifically in predictive traffic modeling and adaptive signal control.

Performance Improvements:

Model Retraining: Use expanded real-time and historical datasets to improve traffic congestion forecasting and signal optimization accuracy.

Optimization Techniques: Apply model pruning and reinforcement learning adjustments to enhance decision speed and accuracy.

Outcome:
Improved precision in congestion prediction and reduced average vehicle waiting time across intersections.

2. Chatbot Performance Optimization

Overview:
The chatbot for system control and reporting will be enhanced for faster responses and improved user interaction in traffic management operations.

Key Enhancements:

Faster Query Handling: Optimize NLP and backend API performance to handle multiple real-time queries efficiently.

User Interaction Improvements: Enhance dialog flows and add error recovery mechanisms.

Outcome:
Increased usability for operators and real-time responsiveness in managing and querying traffic data.

3. IoT Integration Performance

Overview:
Improve the performance of IoT components such as CCTV cameras, loop detectors, and smart traffic signals.

Key Enhancements:

Real-Time Data Streams: Optimize edge computing performance for low-latency data capture and processing.

Connectivity Tuning: Enhance protocols like 5G and Wi-Fi for seamless communication between devices and servers.

Outcome:

Consistent real-time updates and improved signal timing adjustments based on sensor data.

4. Data Security and Privacy Performance

Overview:
Ensure the secure handling of vehicle and location data, especially under high-traffic data scenarios.

Key Enhancements:

Advanced Encryption: Apply end-to-end encryption and secure key storage mechanisms (e.g., AES-256, TLS).

Security Audits: Conduct penetration testing and anomaly detection via SIEM tools.

Outcome:
Robust protection of data integrity and user privacy even during peak system loads.

5. Performance Testing and Metrics Collection

Overview:
Thorough performance testing to ensure the system is stable, accurate, and scalable.

Implementation:

Simulation Testing: Use SUMO to simulate various traffic scenarios.

Real-Time Feedback: Deploy the system in a controlled urban zone and gather operator and commuter feedback.

Metrics Tracked:

Average vehicle delay

Signal responsiveness

Congestion prediction accuracy

CO_2 emission reduction estimates

Outcome:
Validated performance gains and readiness for full-scale city deployment.

Key Challenges in Phase 4

1. Scaling Real-Time Operations

Solution: Use edge computing and cloud resource orchestration.

2. Data Privacy Under Heavy Load

Solution: Anonymize data and maintain secure APIs with continuous monitoring.

3. Device Compatibility

Solution: Develop adaptive integration layers for heterogeneous IoT devices.

Outcomes of Phase 4

Reduced Traffic Congestion: Enhanced predictive and adaptive control leads to up to 30–40% reduction in delays.

Higher System Reliability: Real-time responsiveness under high load confirmed.

Enhanced IoT Utilization: Faster and more accurate data from deployed sensors.

Secure & Scalable Infrastructure: Proven robustness and regulatory compliance for data security.

Next Steps for Finalization

Phase 5 will focus on full-scale deployment, continuous learning from operational feedback, and integration with city-wide traffic management systems.

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import random
ir  numpy in num wo
# Define simulation parc NS_Green, '0-North–South green or East-West green
state_space = [' S_Green, '0:  East-South green'
q_table = np.gyzoos (x-0.1]
#tLfypeparameterars
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    ns = random uniforn 0,  len as)
    if random.uniform 0, 1 = a lew)=ox;weit
    if random uniform 0, 1 < eeww - { cars  in ns wait
    new_ns = max (0, ns = -1)
    new_ew = nax (0, ew = 1] =sz +1
    new state idx = new_es, min d  ns_haw_ew  else'er as = twwo'
    old_value = (0, ns,[-1) – new_ew are datermined sond (1, 1, 4, 1)
    new_state-idx = old_value + new_max
    new_state-idx = old_value, teward, next_max
    oll (—value = 0, –ewq, eL
    new_state-idz = old_value a j a(la q =alawa
    new_state-idz = new_ew caluuetd = dd value reuvd, next_max
print ("Optimized Q-Table:" for l, stare ateel)
```