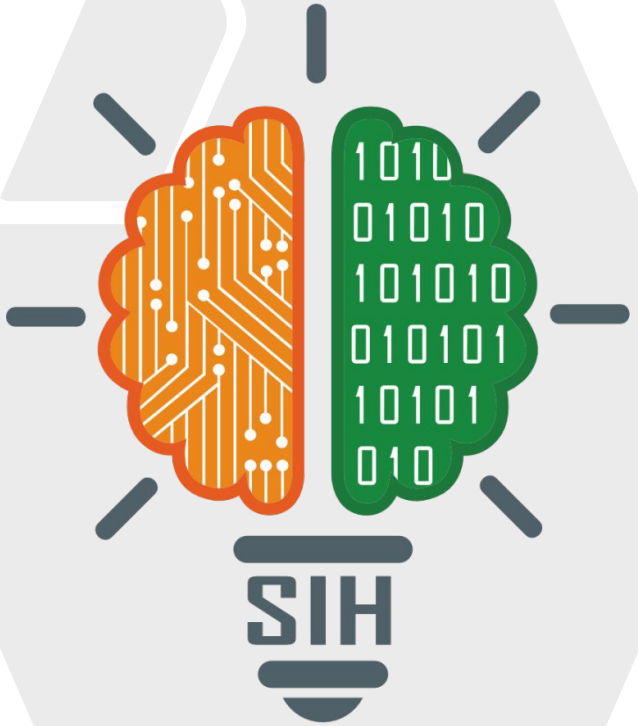
SMART INDIA HACKATHON 2025

AI-Driven Traffic Optimization in VANETs



- **Problem Statement ID - SIH25050**
- **Problem Statement Title - Smart Traffic Management System for Urban Congestion**
- **Theme - Transportation & Logistics**
- **PS Category- Software**
- **Team ID- BMS/SIH2025/54**
- **Team Name (Registered on portal) - FlowGuardians**

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AI-Driven Traffic Optimization in VANETs

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Proposed Solution/Idea

- AI-driven **traffic optimization system** in VANET.
- **Real-time data** from cameras & IoT sensors, processed via **YOLO and OpenCV**.
- **Reinforcement Learning (DQN/PPO)** for dynamic signal phase & duration control.
- **RSUs (200m intervals & intersections):** act as relays & lightweight edge processors.
- **Emergency vehicle prioritization:** automatic **green-wave creation**.
- **Integrated dashboard**: heatmaps, manual overrides, emergency tracking.
- Simulation with **SUMO + TraCI**, benchmark against baseline systems.

Key Benefits

- **Reduced Congestion:** Adaptive, self-learning signals cut commute time by ≥ 10%.
- **Faster Emergency Response:** Priority signaling enables rapid green paths for ambulances/fire trucks.
- **Scalable & Transparent Control:** Edge-enabled RSUs lower latency, while a unified dashboard ensures monitoring.

Unique Value Propositions(UVP):

- **AI + VANET + Edge integration** with **Google Maps → SUMO** for realistic road networks.
- **Adaptive signals & proactive emergency handling** via automated green-wave routing.
- **Authority dashboard** for monitoring, overrides, and decision-making.

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TECHNICAL APPROACH

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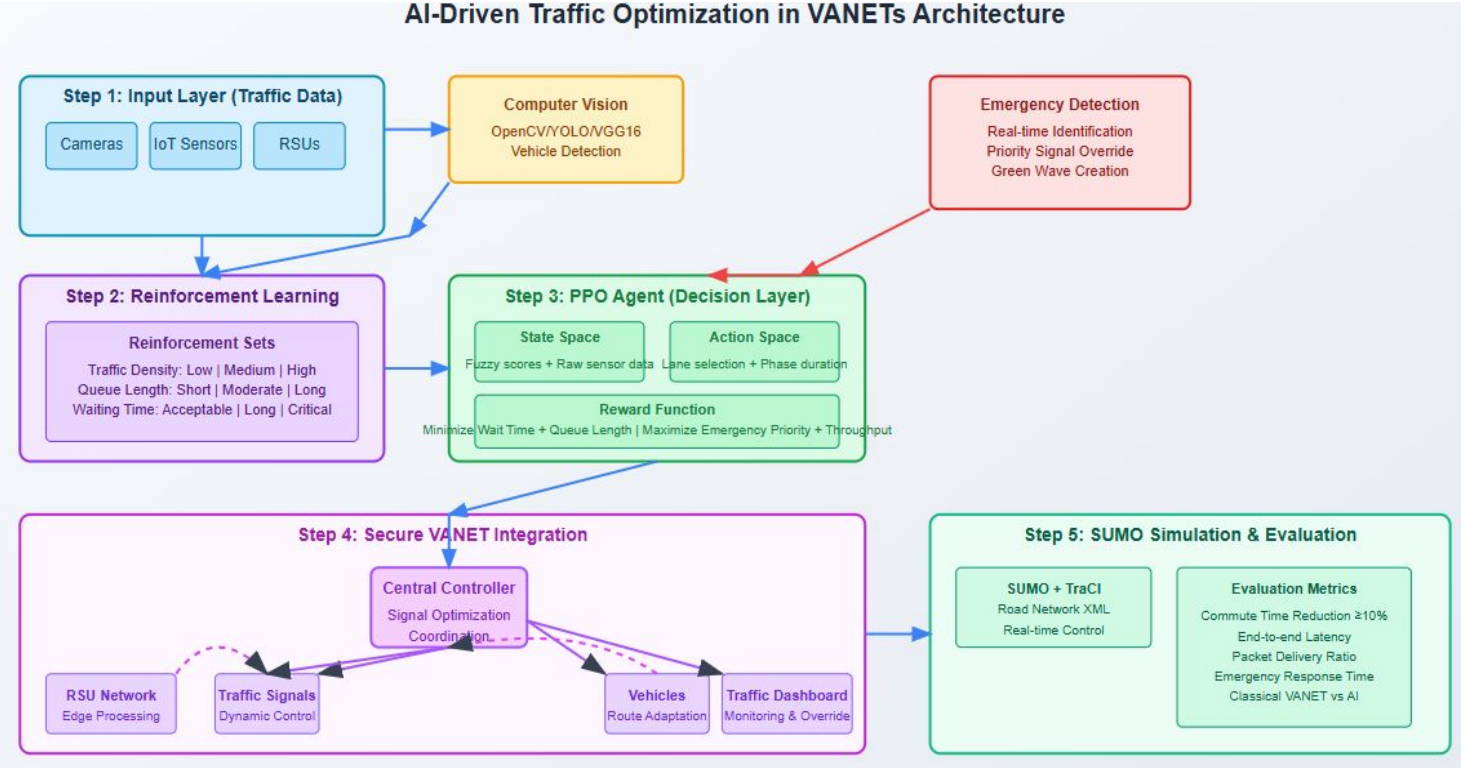
Technologies Used:

- **Programming Languages & APIs:**
  Python (for SUMO+TraCI), TensorFlow and PyTorch (for RL), OpenCV (for vehicle detection), Google Maps API (for route prediction).
- **Frameworks & Tools:**
  SUMO (traffic simulation), TraCI (signal control), Flask(backend), React (dashboard).
- **Hardware & Infrastructure:**
  RSUs (edge devices with 200m coverage, deployed at intersections), IoT Sensors, Cameras.
- **Database & Cloud:**
  MongoDB for logging simulation data, REST APIs for integration.



Implementation Status: 50% of the build is completed and further steps - RL agent training, dashboard visualization along with evaluation metrics is in progress

FEASIBILITY AND VIABILITY

Feasibility Analysis

- Existing tools like **SUMO, RSUs, AI/ML** are **viable**.
- **Increasing adoption** of IoT, VANETs, 5G and Wimax makes real-time edge processing practical.

Potential Challenges

- **Heterogeneous data format** of Google map and SUMO.
- GPS inaccuracies and delayed communication can impact routing by **increasing latency**.
- **Packet sniffing** on wireless media leading to security issues.
- High initial **set up costs** for RSU and sensors.

Strategies

- Deploying the system in **emergency prone areas** and regions with high traffic.
- Deploying **light weight ML models** and **hierarchical cloud-component** coordination.
- Implement **strong authentication** in data communication to prevent intrusion.

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IMPACT AND BENEFITS

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Improved Travel Safety

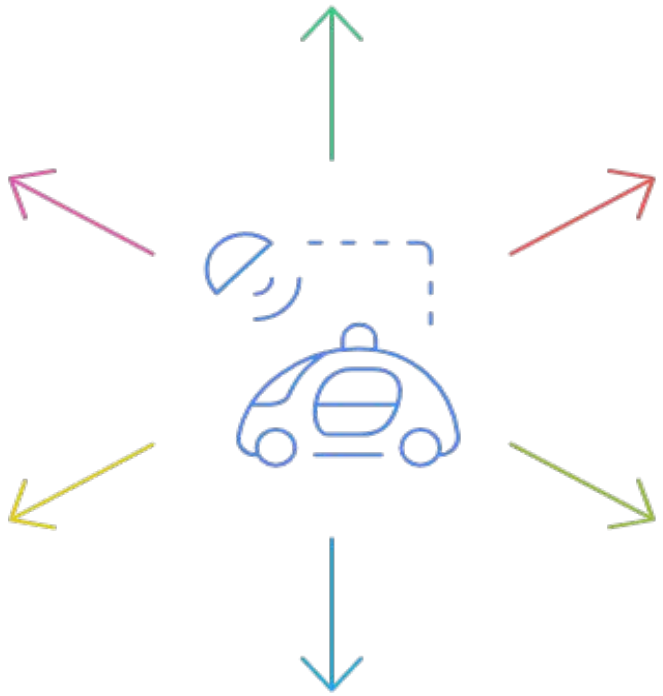
Enhances road safety through V2V and V2I communication

Environmental Benefits

Lowers emissions and promotes clean air

Reduced Response Time

Speeds up emergency services response with real-time data



Economic Savings

Reduces costs from fuel, delays, and congestion

Sustainable City Growth(SDG 11)

Supports urban sustainability through data-driven insights

Enhanced Public Safety

Increases community safety and well-being

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RESEARCH AND REFERENCES

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