Team Hexagon6

Ministry/Organization Name/Student Innovation: Department of Science and Technology

PS Code: 1607

Problem Statement Title: A smart AI based solution for traffic management on routes with heavy traffic from different directions, with real-time monitoring and adaptation of traffic light timings.

Team Name: Hexagon6

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Institute Name: Netaji Subhas University of Technology

Category: Software

Theme Name: Smart Automation

Team Member Details

Team Leader Name: Archit Jain

Branch : BTech **Stream : IT** **Year: III**

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Branch : BTech **Stream : IT** **Year: III**

Team Member 2 Name: Chirag Agrawal

Branch : BTech **Stream : IT** **Year: III**

Team Member 3 Name: Chirag Chauhan

Branch : BTech **Stream : IT** **Year: III**

Team Member 4 Name: Chaitanya Rawat

Branch : BTech **Stream : IT** **Year: III**

Team Member 5 Name: Jyotika Sachdeva

Branch : BTech **Stream : IT** **Year: III**

Approach & Analysis

We adopted a structured approach to thoroughly examine the project, emphasizing the following critical components:

01. **Opportunity**

02. **Market**

03. **Solution**

04. **Business Model**

Opportunity

Exploring the key drivers that shape the landscape of opportunities in this domain.

Urban Growth & Congestion

Rapid urbanization leads to increased traffic, creating a need for smarter management solutions.

Current System Limitations

Traditional traffic lights use fixed timings, lack real-time adaptability, and are inefficient in heavy traffic.

AI & Real-Time Data

Advances in AI allow for adaptive, real-time traffic management, offering dynamic solutions to congestion.

Market Demand

Growing interest in smart city solutions and government support for reducing congestion and emissions.

Benefits

Improved traffic flow, reduced emissions, enhanced safety, and long-term cost savings

Market Studies

Global Smart Traffic Management Market

- Valuation: Estimated to reach $18 Billion by 2028, CAGR rate of 12.5%
- Growth Drivers: Urbanization, increasing traffic congestion, and the push for smart city initiatives.

Target Customers

- Municipal Governments: Looking for scalable and efficient traffic management systems.

Competitive Landscape

- Established Companies: Major tech firms expanding into smart city and traffic management solutions.

Key Segments

- Urban Areas: High demand in cities with complex traffic patterns.
- Government Initiatives: Significant investments in smart infrastructure and traffic management solutions

Regional Focus

- High-Growth Regions: India is a high-growth market within the Asia-Pacific region, with significant adoption of smart city initiatives and government investment in traffic management solutions.

Solutions

01.

AI-Driven Traffic Management

1. Adaptive Traffic Lights: AI algorithms adjust traffic light timings in real-time based on live traffic data, optimizing flow from multiple directions.

2. Predictive Analytics: Anticipates traffic patterns using historical data and real-time inputs, minimizing congestion before it builds up.

02.

Emergency Vehicle Detection

1. The system is equipped with capabilities that can detect special emergency vehicles such as ambulances and fire brigade vehicles.

2. Upon detection, the system can manipulate traffic signals to prioritize their passage, ensuring they reach their destinations without delay.

03.

Helmet Detection & Traffic Violation Management

1. The system is equipped with capabilities to detect motorcyclists who are not wearing helmets.

2. Upon detection, the system can capture images of the violators and automatically issue fines, ensuring compliance with road safety regulations.

Solutions

04. Security

1. Federated Learning:: To ensure security in the system and prevent AI system domination, federated learning is employed. This technique, allows AI models to be trained across multiple edge devices without transferring sensitive data to a central server. This approach enhances data privacy and security, as no raw data leaves the local environment.

05. Reliability

1. In the event of irregularities or unexpected behavior, the system can automatically switch to a normal operational mode, ensuring continuous and stable traffic management.
2. For anomaly detection we are using Isolation Forests algorithm. the system has the capability to restart both manually and automatically.

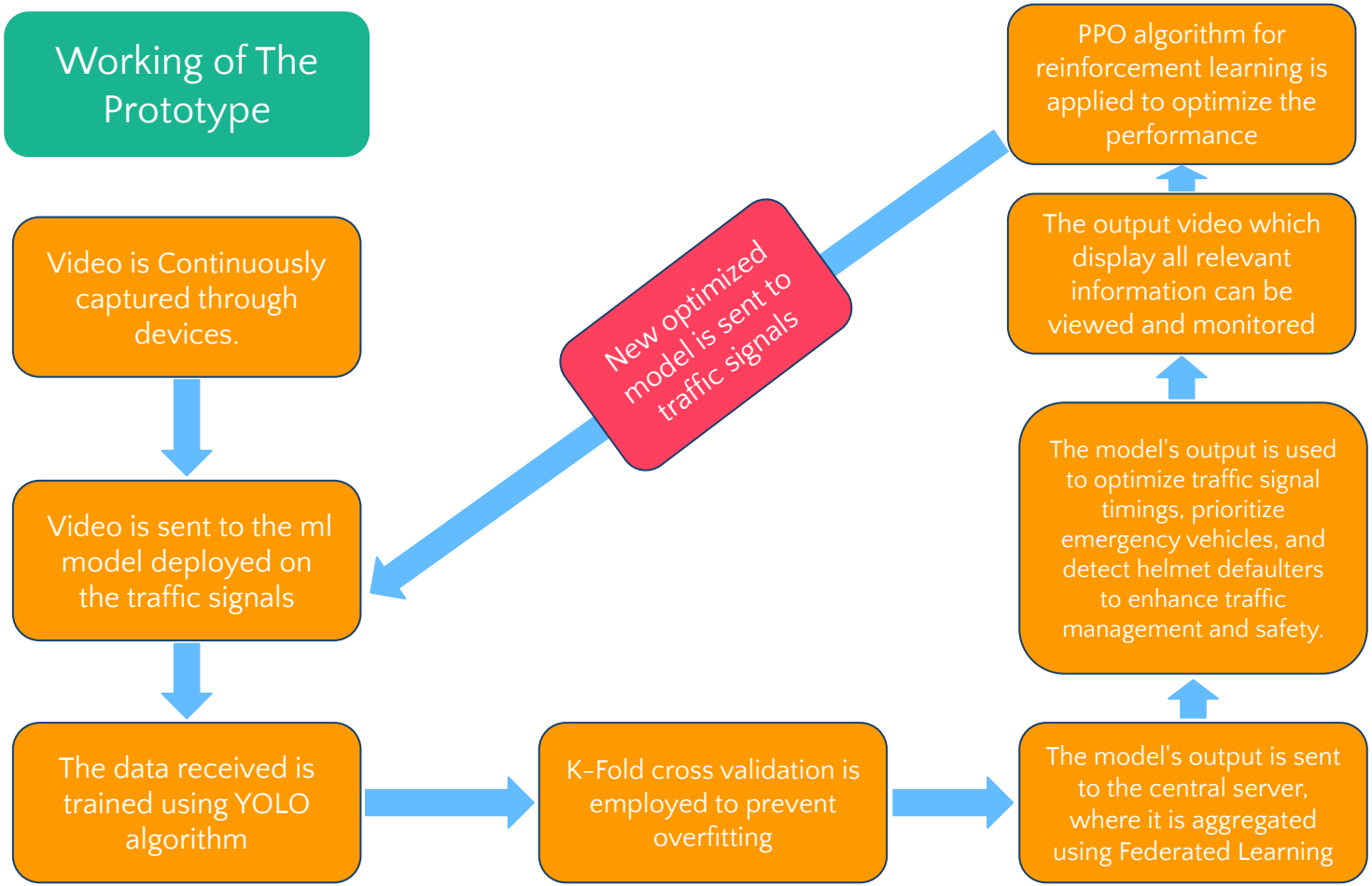
06. Scalability

1. In real-world scenarios, the system will scale by connecting directly to traffic signals. During development, Docker can be used to achieve scalability through containerization and horizontal scaling.

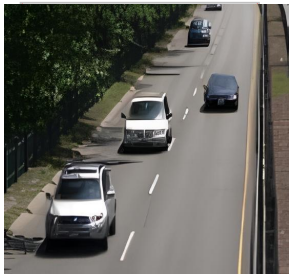
07. Adaptability and Optimization

1. To enhance the adaptability and optimization of the traffic management system, we are deploying the Reinforcement Learning algorithm. For this we are using Policy proximation optimisation technique.

Working of The Prototype



INPUT



YOLO OBJECT DETECTION

PREPROCESSING

RESIZE AND NORMALIZATION

FEATURE EXTRACTION

ACTIVATION FUNCTIONS

GRID DIVISION

BOUNDING BOX

POST-PROCESSING

NMS & THRESHOLDING

FEDERATED LEARNING

LOCAL TRAINING

MODEL AGGREGATION

GLOBAL MODEL UPDATE

PPO REINFORCEMENT LEARNING

COLLECT EXPERIENCE

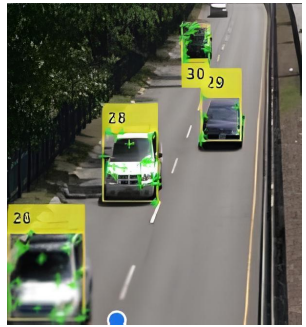
COMPUTE ADVANTAGE

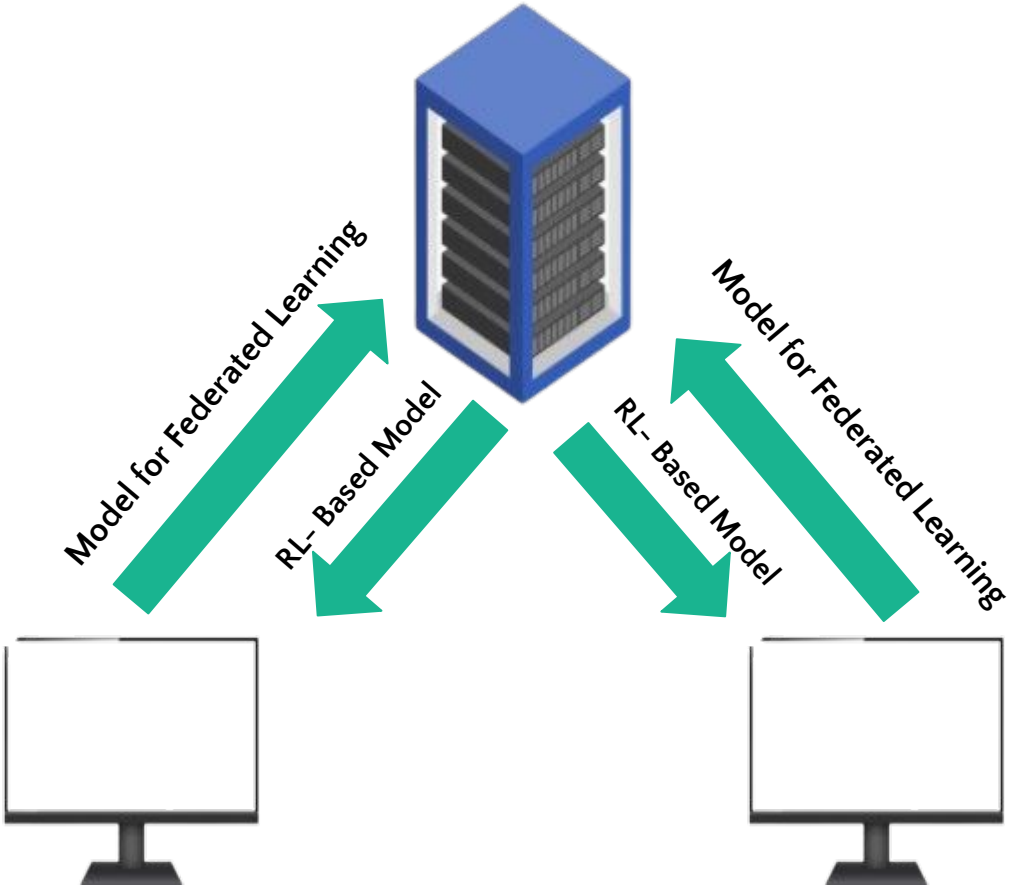
UPDATE POLICY

VALUE NETWORK

POLICY EVALUATION

OUTPUT





Technology Used

- Framework
  - PyTorch, TensorFlow, Scikit-Learn ,Flower, OpenAI Gym, ONNX, TensorRT
- Frontend & Backend
  - Flask ,NodeJS, NextJS, Figma, Tailwind CSS
- Languages
  - Python, Javascript

Business Model

Revenue Streams

- For our revenue streams, we will charge organizations a small fee based on the number of motorcyclists not wearing helmets. This approach ensures a scalable and performance-based pricing model. Our other plan of revenue includes pricing tiers and real time-data sales to business.
- Pricing Tiers: - Basic Package: Essential features for smaller cities. - Advanced Package: Enhanced features for medium-sized cities. - Premium Package: Comprehensive solutions for large metros.

Value Proposition

- Our solution addresses congestion in rapidly growing cities, effectively saving both time and money.Additionally, the Emergency Vehicle Detection feature enhances the movement of emergency vehicles, ensuring faster response times and improved public safety.
- **Value Proposition:** - Efficient Traffic Management: Reduces congestion in growing cities. - Cost Savings: Automated system lowers operational costs. - Scalability: Adaptable to various city sizes. **- Customer Support:** - 24/7 Support: Localized service and maintenance. - Training: Workshops for government staff.

Partnerships

- To enhance our market reach and capabilities, we will establish partnerships with central and state governments through strategic contracts.

Customer Retention

- Customer retention is a key focus of our solution, which offers enhanced features, security, reliability, and adaptability. By incorporating reinforcement learning into our system, we ensure that our software continuously evolves and improves over time.