Techfest™
17th - 19th December, 2024

Qualcomm VisionX

CHALLENGE : OBJECT DETECTION AND TRAFFIC MANAGEMENT

DEVELOP AN OBJECT DETECTION MODEL THAT CLASSIFY- LOCALIZE MULTIPLE OBJECTS ON IMAGE /VIDEO FRAME.

IMPLEMENTING REAL-TIME OBJECT DETECTION FOR TRACKING AND DYNAMICALLY ADJUST TRAFFIC SIGNALS AND REROUTE VEHICLES, REDUCING CONGESTION AND IMPROVING OVERALL TRAFFIC EFFICIENCY

MEET OUR TEAM

Piyush Joshi

Piyush develops both frontend and backend, integrates machine learning models, and ensures a smooth UI/UX design.

Rajtilak Joshi

Rajtilak builds and optimizes machine learning models for accuracy and performance.

Abhishek Yadav

Abishek designs user-friendly interfaces and creates seamless user experiences.

Hitesh Patel

Hitesh handles research and content creation, providing valuable insights and documentation.

Problem statement

01 **Develop an object detection model that can accurately detect, classify, and localize multiple objects within an image or video frame.**

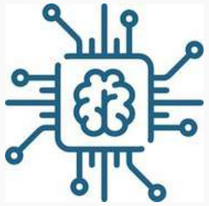
02 **Urban traffic congestion causes longer commutes, more pollution, and delays. Fixed signal timings make it worse by ignoring real-time traffic needs.**

03 **Bottleneck Situation Explanation :** Traffic bottlenecks happen when obstructions like large vehicles or accidents block flow, causing delays and higher emissions. Real-time detection and signal adjustments can help clear these quickly.

Proposed Solution

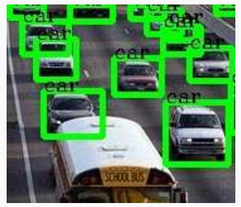
Using CCTV installed at traffic signals

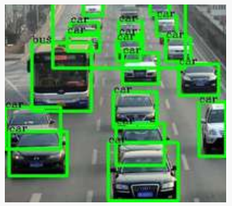
1



Machine Learning Model

2

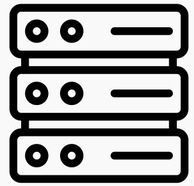




Detecting vehicles and counting the number of vehicles

3

Vehicles count sent to server for calculating green signal time for next signal

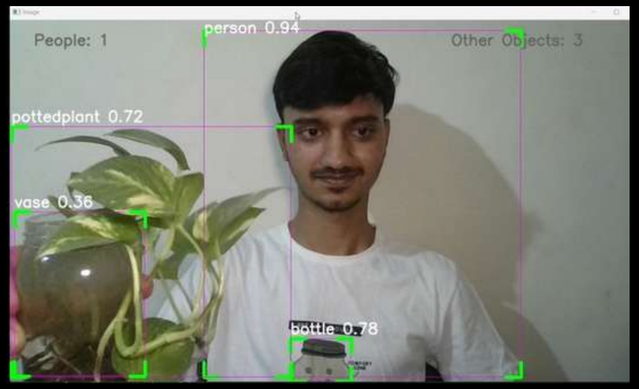


4

Using this time scheduling is done

5

Traffic signal timer is updated



Object Detection Model

- **Overview:** Our solution tackles traffic flow optimization using real-time vehicle detection and dynamic traffic signal adjustments.
- **YOLO-Based Vehicle Detection:** We use CCTV feeds and YOLO to classify vehicles at intersections. The data is processed to dynamically adjust signal timings.
- **Ambulance Priority System:** A LoRa-based communication system prioritizes ambulances by automatically switching the signals to green when they are within a 50-meter range.
- **Bottleneck Management:** We can also detect bottlenecks caused by large vehicles parked improperly, ensuring traffic signals are adjusted to ease congestion.

Our Services:

Dynamic Traffic Signal Adjustment

- Real-time vehicle detection via YOLO and CCTV adjusts signal timings.
- Ensures smoother traffic flow by adapting to varying traffic loads.

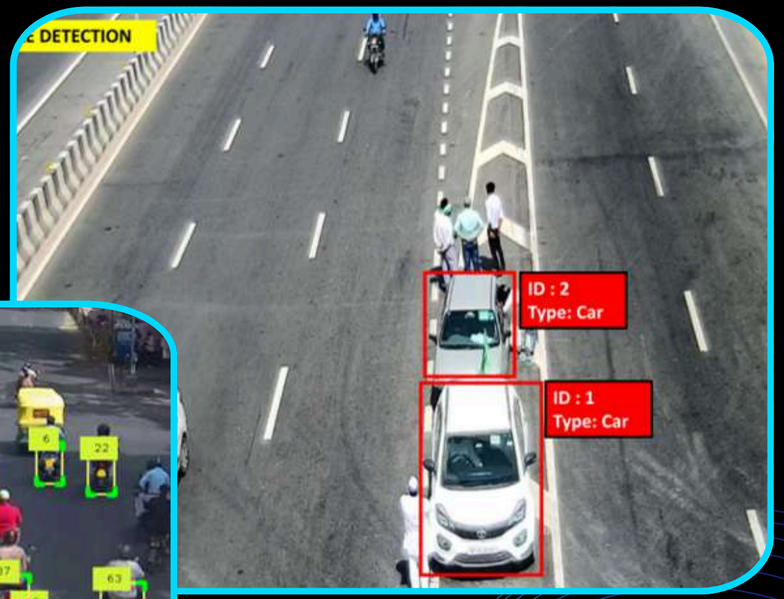
Ambulance Priority System

- LoRa-based communication prioritizes ambulances within a 50-meter range.
- Automatically switches traffic lights to green for faster emergency response.

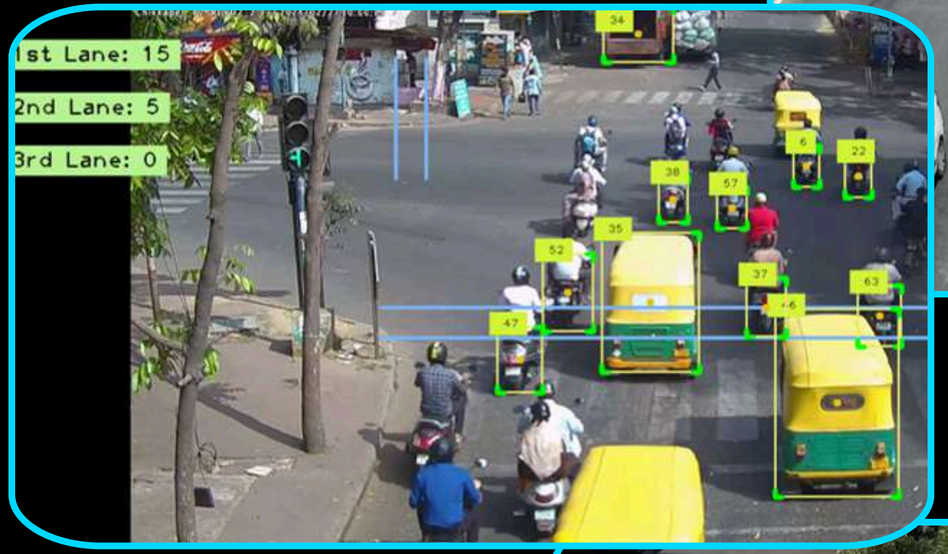
Bottleneck Detection and Management

- Identifies congestion caused by large vehicles or obstructions.
- Adjusts signal timings to alleviate traffic bottlenecks and improve flow.

Bottleneck Situation alert



Green signal Time Prediction



Emergency Ambulance

The Size and Nature of Market

Feature	Predicted system	Current Traffic System
Real-Time Signal Adjustment	✓	✗
Traffic Flow Efficiency	✓	✗
Scalability	✓	✗
Automatic Illegal Parking Alerts	✓	✗
Cost-Effectiveness	✓	✗
Environmental Impact	✓	✗
Priority To Ambulance	✓	✗

Market Size:

- **Market Demand:** Expected to surpass $30 billion by 2027, driven by urbanization and congestion in major cities.
- **Target Segments:** Includes municipalities, emergency services, and smart city projects needing optimized traffic flow and emergency prioritization.

Benefits:

- Increase in the optimization is about 20% in the time from previous Model
- **Social:** Reduced stress and frustration for drivers.
- **Economic:** Lower fuel consumption and reduced wear and tear on vehicles.
- Reduces workload of traffic officer and manpower requirement

Feasiblity & Scalablity of Our Product:

Scalability :

- Our solution is scalable and can be implemented at various intersections, making it suitable for urban areas with different traffic patterns and densities.

- This scalability enhances its potential impact on traffic management and congestion reduction.

Feasiblity :

- Real-time Data Utilization: We adjust signal timings instantly for a dynamic response to traffic changes.

- Adaptive Algorithms: Our approach optimizes traffic flow and minimizes congestion in real-time.

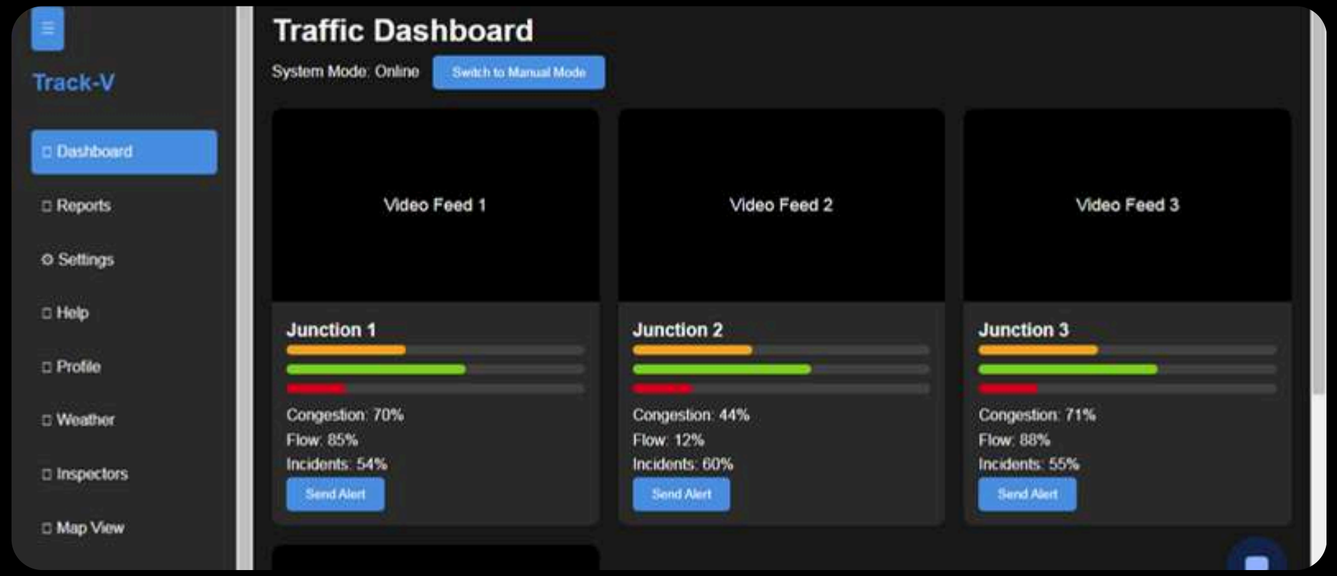
- Comparative Analysis: By comparing real and ideal traffic scenarios, we identify areas for improvement and offer actionable insights.

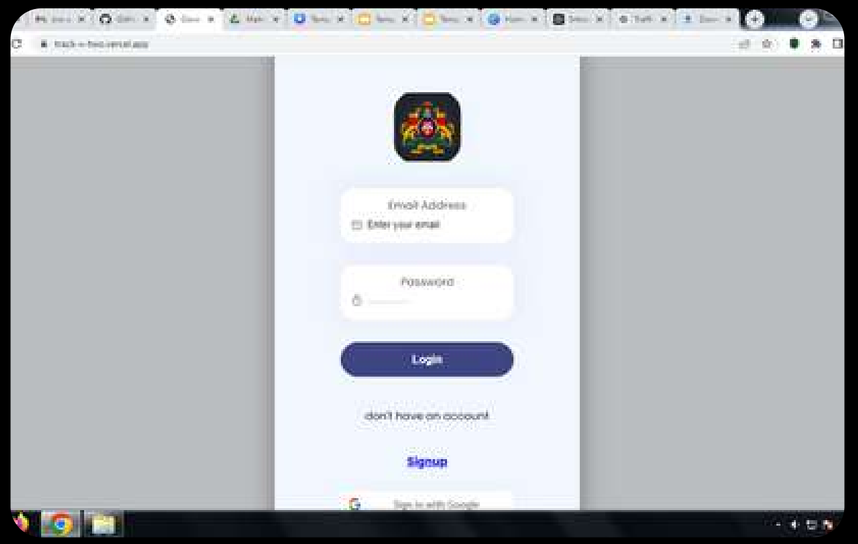
Current Situation (Indira Nagar)						
Cycle No.	Lane 1 (CMH ROAD) count/Time	Lane 2 (100ft road) count/Time	Lane 3 (OLD MADRAS	Lane 4 (HALSOOR) count/Time	Total count	Total Time
1	65/35	84/50	70/30	87/40	306	155
2	53/35	88/50	85/30	68/40	294	155
3	62/35	92/50	62/30	72/40	288	155
4	69/35	83/50	60/30	68/40	280	155
5	51/35	73/50	40/30	59/40	223	155
6	76/35	82/50	30/30	50/40	238	155
7	67/35	98/50	63/30	65/40	293	155
					1922	1085

Predicted System (Indra Nagar)						
Cycle No.	Lane 1 (CMH ROAD) count/Time	Lane 2 (100ft road) count/Time	Lane 3 (OLD MADRAS ROAD)	Lane 4 (HALSOOR) count/Time	Total Count	Total Time
1	65/35	84/50	70/30	87/40	306	155
2	53/35	88/50	85/30	68/40	294	155
3	59/36	83/46	77/27	77/35	296	142
4	61/38	88/46	72/25	73/33	295	145
5	60/37	87/48	69/25	69/30	285	139
6	60/37	82/45	54/20	66/29	263	131
7	65/35	79/44	44/15	62/27	250	121
					1989	833

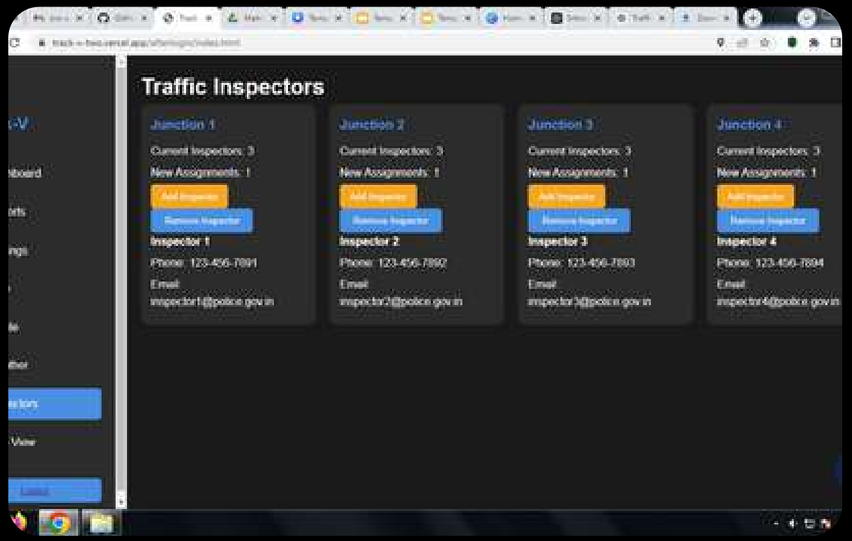
The proposed system reduces processing time from 1085 to 833 seconds, making it 20% more efficient while handling the same workload.

Prototype


Traffic Dashboard
Track-V
Dashboard
Reports
Settings
Help
Profile
Weather
Inspectors
Map View
System Mode: Online
Switch to Manual Mode
Video Feed 1
Video Feed 2
Video Feed 3
Junction 1
Congestion: 70%
Flow: 85%
Incidents: 54%
Send Alert
Junction 2
Congestion: 44%
Flow: 12%
Incidents: 60%
Send Alert
Junction 3
Congestion: 71%
Flow: 88%
Incidents: 55%
Send Alert


Email Address
Enter your email
Password
Login
don't have an account
Signup


Reports
Track-V
Dashboard
Reports
Settings
Help
Profile
Weather
Inspectors
Map View
Junction 1 Report
Junction 2 Report
Junction 3 Report


Traffic Inspectors
Junction 1
Junction 2
Junction 3
Junction 4

System Dependancy (Challenges)

Cloud Platform & Storage:

- AWS Lambda for serverless execution.
- S3 for video storage and DynamoDB for traffic data.

Lightweight ML Module:

- Develop an optimized ML model for vehicle counting.
- Use TensorFlow Lite for fast, low-latency inference.

Video Processing & Analytics:

- Leverage OpenCV / Rekognition for real-time detection.
- Provide dashboards with live traffic data and trends.

Scalability & Security:

- Auto-scaling with AWS Lambda .
- IAM roles and data encryption .

OUR RESEARCH

Our research focuses on leveraging smart technologies to optimize traffic flow and enhance emergency management in urban environments. The integration of real-time data analytics, and machine learning models aims to reduce congestion, improve road safety, and prioritize emergency vehicles.

References

Watch our visit to the Traffic Police Station :

https://youtu.be/7UK4cyfaoGQ

Smart controlling for traffic light time. (2017, October 1). IEEE Conference Publication | IEEE Xplore.

https://ieeexplore.ieee.org/abstract/document/8257768 [2]

Improving traffic light control by means of fuzzy logic. (2018, September 1). IEEE Conference Publication IEEE Xplore.

https://ieeexplore.ieee.org/document/8534692[5]