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AdaptiSync: AI-based Real Time Adaptive Traffic Control using Edge Computing

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175 YEARS OF IIT ROORKEE Estd. 1847

BACKGROUND AND MOTIVATION

- **Urban intersections** - hot spots for crashes, congestion, and emissions.
- In India, intersections account for **30% of total crashes** and **26% of total fatalities** (MoRTH, 2020).
- In 2021, Mumbai had a congestion level of **53%**, followed by Bengaluru and New Delhi (both **at 48%**) and Pune (at **42%**) (TomTom, 2021).
- **9036 liters** of petrol, diesel, LPG, and **5461 kg** of CNG is wasted every day due to the idling of motor vehicles at controlled intersections in Delhi alone (Tiwari et al., 2013; Sharma et al., 2019).

Drawback with current traffic system

1. **Hardware Rigidity and Complexity**
2. **Inefficient and expensive intrusive/ non-intrusive sensing of traffic flow**
3. **Lack of integration with new technology**
4. **Higher installation and maintenance costs**
5. **Expensive**
6. **Malfunction and technical issues**

Adaptive Traffic Control System
- Algorithms/ Software
- Hardware

However, the development on the hardware side is still limited.

GOAL & OBJECTIVES

Design and Development of a Wireless, Edge Computing enabled device for Adaptive Traffic Control System

- ✓ **Design, configure, and implement an edge module capable of real-time video processing using a customized computer vision algorithm for accurate vehicle detection, classification, and counting at traffic intersections.**
- ✓ **Develop a comprehensive system that establishes seamless wireless communication between the edge module and a cloud-based platform, allowing the cloud to analyze vehicle counts and determine adaptive traffic signal timings, which are then sent back in real-time to control traffic lamps at the edge for responsive and dynamic traffic management.**

DATA COLLECTION

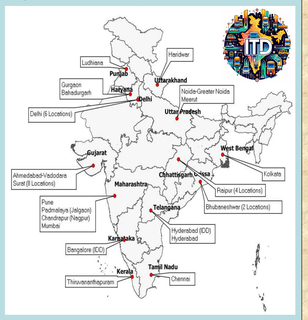
341,000 - Total Annotated objects
17,666 : Annotated images (9888 images from IDD)
7,778 : Novel images
14 States and UT

- ✓ **21 locations from variety of areas (Urban, Semi-urban, Rural)**
- ✓ **Daytime and Several months**

Different Class of Roads: Expressways, Highways, Major district roads, Arterial, Sub-arterial, Collector

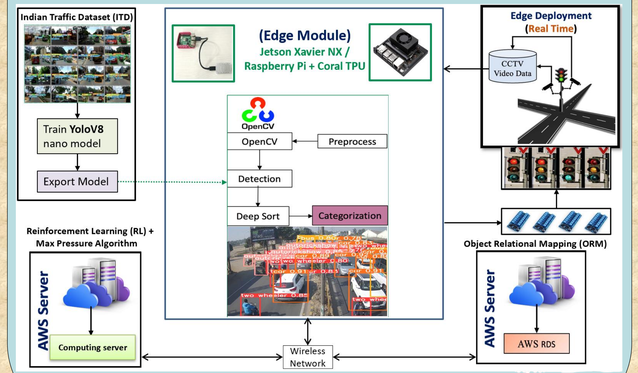
Vehicle Classes based on Indian Highway Capacity (INDO-HCM)

Auto-rickshaw (ARW), Bus, Car, Cycle, Light Commercial Vehicle (LCV), Motorized Two-wheeler (MTW), Truck & Pedestrian

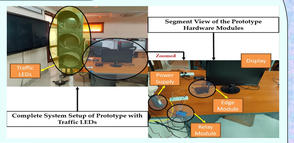


Diverse Traffic Conditions

ARCHITECTURE



HARDWARE SETUP



❑ Database Schema

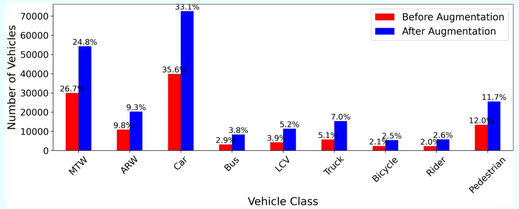
id	device_id	latitude	longitude	corridor_id	intersection_id	location
0	1YXWKL					
1	2WPQM5					

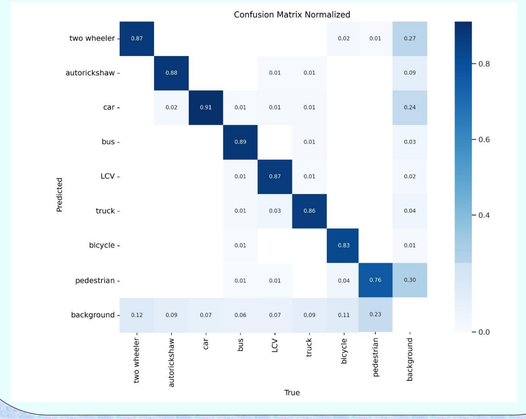
id	car	MTW	bus	LCV	truck	bicycle	ARW	pedestrian	epochs	device_key	PCU
1	15	20	10	5	1	3	2		1926784	0	52.5
2	25	0	15	5	6	0	5		1926784	1	45.0
3	50	3	2	0	3	5	7		1928560	0	37.8

Cloud-computing: AWS-RDS Setup

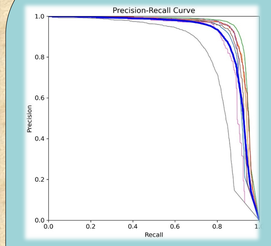
RESULTS

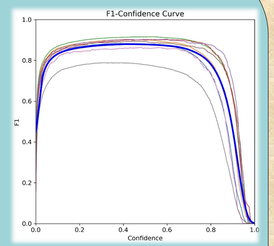
ITD (objects in the novel images before and after Augmentation)



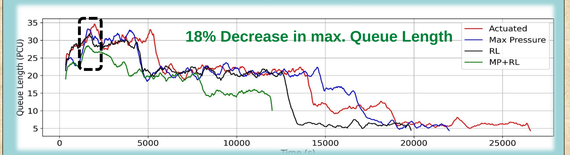


Results contd.





Results of RL based Traffic Optimization



Queue Dissipation Time reduced by 55%

CONCLUSION

AdaptiSync revolutionizes traffic optimization with edge computing, custom AI algorithms, and seamless connectivity. Swift decision-making, cloud-based traffic analysis, and adaptive traffic light timings form an efficient, closed-loop system for data-driven congestion management in cities.

Which make our product: Scalable, Transferable, Sustainable

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