

Project Title: Traffic Governance System

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Proposal Presentation URL:  Proposal Traffic Governance System

Final Presentation URL:  Traffic Governance System

Project Code URL:

https://github.com/AkshayPatel8140/CS531-Project-Traffic_Governance_System

Project Overview:

The traffic governance is the project that deals with the traffic on the crossroads. This will work as the cameras on the crossroads will detect it with the help of image processing and getting the count of vehicles will help to detect the heavy lane. After detecting the heavy lane the timer for that particular will increase and the other lane's timer will be balanced accordingly.

Key Objectives:

- Optimize traffic flow through the implementation of intelligent signal control, dynamic lane management, and real-time traffic information.
- **Realistic Traffic Signals:**
 - Our simulation captures the nuances of real-world traffic signals, including their timing patterns and impact on traffic flow.
 - This enables a comprehensive analysis of signal optimization strategies, signal coordination, and their effects on overall network performance.
- **Diverse Sensor Simulation:**
 - The simulation replicates a wide range of sensor types, such as loop detectors and cameras, to provide a rich and realistic data set.
 - This allows researchers and engineers to test and evaluate different sensor technologies and their impact on traffic management strategies.
 - It also enables the simulation of advanced sensor fusion techniques, which combine data from multiple sensors to enhance accuracy and reliability.
- **Adjustable Control Policies:**
 - The simulation allows users to create and test various traffic management strategies, such as signal timing optimization, adaptive traffic signal control, and ramp metering.
 - This provides a flexible framework to assess the effectiveness of different control policies and identify the most efficient strategies for optimizing traffic flow and minimizing congestion.
 - It also enables the evaluation of the impact of traffic demand variations, special events, and incidents on traffic performance.

Project Features:

- **Advanced Technologies:**
 - a. **Image Processing:** Analyze real-time camera feeds to detect and classify vehicles, pedestrians, and other objects on the road.
 - b. **Computer Vision:** Enhance image understanding by identifying patterns and anomalies, improving accuracy and reliability.
 - c. **Artificial Intelligence (AI):** Use machine learning algorithms for predictive analysis, forecasting traffic patterns, and optimizing signal timing.
 - d. **Intelligent Controls:** Implement adaptive traffic signal control systems that respond to changing traffic conditions in real-time.
- **Real-time Data Collection:**
 - a. **Sensors:** Collect data on traffic volume, speed, and occupancy using sensors like loop detectors, radar sensors, and cameras.
- **Priority-based Decisions:**
 - a. **Prioritize Emergency Vehicles:** Grant priority to emergency vehicles by adjusting signal timing to minimize delays and ensure timely response.
 - b. **Pedestrian and Cyclist Safety:** Prioritize pedestrian and cyclist crossings to enhance safety and encourage sustainable modes of transportation.
- **Traffic Routing and Optimization:**
 - a. **Dynamic Routing:** Provide real-time traffic information to drivers through mobile apps and in-vehicle navigation systems, enabling them to choose optimal routes.
 - b. **Signal Coordination:** Coordinate traffic signals along arterial roads and intersections to minimize congestion and improve traffic flow.

Project Benefits:

- **Reduced traffic congestion:** The system will mitigate traffic congestion, resulting in shorter travel times, improved air quality, and reduced fuel consumption.
- **Enhanced safety:** Advanced traffic monitoring and incident response systems will improve safety, reduce accidents, and save lives.
- **Improved mobility:** A seamless, interconnected traffic network will facilitate efficient movement of people, access to services, and participation in economic activities.
- **Environmental sustainability:** By promoting eco-friendly transportation options and optimizing traffic flow, the system will contribute to the reduction of greenhouse gas emissions.
- **Economic growth:** Efficient traffic management will stimulate economic growth by facilitating the movement of goods and services, attracting businesses, and creating employment opportunities.

System Features:

- **User:** User can view notifications sent by the admin and take necessary actions.
- **Admin:** The admin can detect traffic at crossroads by video analysis.
- **Database:** Database stores the data and performs analysis on the data to generate the required result.
- **WebPage:** Upload Video and get the timing of the signal for the each video

Tools and Technologies:

- **Frontend:** HTML, CSS, Bootstrap, JS
- **Backend:** Python, Flask (Web Framework)
- **Machine Learning Tools:** YOLO-v3, OpenCV, dlib
- **Cloud Tools:** Docker, Kubernetes

References:

<https://www.w3schools.com/python/>

https://www.tutorialspoint.com/artificial_intelligence_with_python/index.htm

https://www.python-course.eu/python3_course.php

<https://www.computer.org/csdl/proceedings-article/afips/1969/50730529/12OmNzC5TqA>

<https://www.fullstackpython.com/flask.html>

<https://numpy.org/doc/stable/reference/index.html#reference>

<https://pypi.org/project/imutils/#description>

<https://pypi.org/project/dlib/>

<https://pypi.org/project/opencv-python/>

<https://amsterdamsmartcity.com/projects/smart-traffic-management>

<https://www.bloomberg.com/news/articles/2013-02-05/how-virtual-traffic-lights-could-cut-down-on-congestion>

<https://www.linkedin.com/pulse/transforming-indias-urban-landscape-power-intelligent-traffic#:~:text=ITMS%20optimizes%20traffic%20flow%20through,travel%20times%20and%20fuel%20consumption.>