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Plagiarism Scan Report

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1. INTRODUCTION (1 page)-

In the dynamic urban environment of today, we grapple with issues like traffic jams, accidents, and environmental degradation. The Smart Traffic Management System emerges as a transformative technological solution designed to overhaul traffic control. This initiative combines state-of-the-art technologies and advanced data analytics to streamline traffic patterns, bolster safety measures, and mitigate environmental repercussions. Our aim is to revolutionize urban transportation through digital ingenuity and strategic traffic management solutions, encouraging the active involvement of stakeholders in building a more sustainable and streamlined future. Our suite of services will include cutting-edge features such as lane detection, intelligent lane recommendations, camera-based speed limit checks, identification of high-traffic pathways and traffic violation detection system.

Lane detection involves leveraging advanced technology to precisely identify and monitor the lanes on roads, contributing to enhanced traffic management and safety. The intelligent lane recommendation system provides real-time suggestions for drivers to optimize their route, suggesting the most efficient lane for smoother navigation.

Our speed limit checking service will ensure that vehicles adhere to prescribed speed limits, promoting safer driving practices and reducing the risk of accidents. Additionally, our system will excel in detecting busier paths or roads, allowing for proactive measures to be implemented, such as traffic rerouting or adjustments to traffic signals, to optimize the overall flow and alleviate congestion in high-traffic areas. These services collectively will contribute to a more efficient, secure, and streamlined urban mobility experience.

The surge in urban car numbers leads to traffic congestion, property damage, and accidents. To mitigate these risks, real-time traffic violation detection systems are essential. These systems enforce regulations continuously, aiding authorities in swiftly identifying and addressing violations like signal, parking, and wrong-direction infractions. Equipped with user-friendly interfaces, they streamline monitoring and intervention processes for safer roads.

1.1 Motivation

The motivation behind the Smart Traffic Management System project stems from the urgent need to address pressing challenges in today's urban landscapes. Rising levels of traffic congestion, frequent accidents, and escalating environmental pollution have underscored the necessity for innovative solutions to transform the way we manage urban mobility. This project is driven by a commitment to harness cutting-edge technologies and data analytics to optimize traffic flow, enhance safety measures, and reduce the environmental impact associated with urban transportation.

The overarching goal is to revolutionize the traditional approach to traffic control by integrating digital innovation and strategic management solutions. By doing so, the project aspires to reshape urban mobility, making it more sustainable, efficient, and conducive to a higher quality of life for residents. Ultimately, the Smart Traffic Management System seeks to create a smarter and more responsive urban infrastructure that adapts to the evolving needs of modern cities, promoting a safer, greener, and more seamless transportation experience.

The motivation behind implementing real-time traffic violation detection systems lies in the urgent need to address the negative consequences of urban car proliferation. By proactively identifying and managing traffic violations such as signal disregard, illegal parking, and wrong-way driving, these systems aim to enhance road safety, minimize property damage, and reduce the occurrence of accidents. With user-friendly interfaces facilitating efficient monitoring and intervention, authorities can enforce traffic regulations more effectively, ultimately creating safer roadways for all users.

1.2 Objective

The primary objective of our comprehensive project is to integrate various advanced features, including lane detection, intelligent path optimization, object detection (specifically cars) on the road, speed limit monitoring, efficient traffic control and ensure that traffic rules are followed. By amalgamating these cutting-edge technologies, our aim is to create a unified system that actively contributes to the reduction of traffic congestion, improved traffic management, and a decrease in environmental pollution.
The project envisions a holistic approach to urban mobility, where the detection of lanes ensures orderly traffic flow, and intelligent path optimization suggests the most efficient routes, minimizing bottlenecks and congestion. Object detection, specifically for cars, enhances safety by providing real-time awareness of vehicles on the road. Simultaneously, speed limit monitoring through advanced camera systems encourages adherence to traffic regulations, reducing the likelihood of accidents. The primary objective of a traffic violation system is to ensure the smooth and safe movement of traffic by preventing rule violations. By enforcing traffic regulations effectively, such systems contribute to enhancing road safety and minimizing the risk of accidents, ultimately promoting the safety and well-being of all road users.
By combining these elements into a single, cohesive project, we strive to create a smarter, more responsive urban transportation system. The overarching goal is to promote a more sustainable and efficient future, where traffic is managed effectively, pollution is minimized, and residents experience a smoother and safer commuting environment. Through this integration, our project seeks to contribute significantly to the overall improvement of urban mobility, making cities more livable and environmentally friendly.

2. Existing Work / Literature Review

The long-standing integration of artificial intelligence and computer vision in traffic management has significantly improved systems. AI algorithms analyze real-time data for optimized traffic flow, adaptive signal control, and enhanced safety measures. Computer vision aids in object detection and tracking, allowing for efficient vehicle monitoring and proactive responses to traffic conditions. These technologies collectively contribute to the ongoing improvement of urban transportation systems, making them more responsive, safer, and capable of addressing the challenges of modern traffic management.

Methodology:

1) Grayscaling and blurring: As the part of preprocessing the input frame got from the CCTV footage, the image is grayscaled and blurred with Gaussian Blur method. ** Background Subtraction.
2) Background subtraction : method is used to subtract the current frame from the reference frame to get the desired object’s area. equation (1) shows the method. dst(I) = saturate(|scr1(I) − scr2(I)|).
3) Binary Threshold : Binarization method is used to remove all the holes and noises from the frame and get the desired object area accurately. equation (2) shows how the binary threshold works. dst(x, y) = maxVal if scr(x, y) > thresh else 0
4) Dilation and find the contour : After getting the thresholded image, it is dilated to fill the holes and the contour is found from the image. drawing rectangle box over the contours desired moving objects are taken.

Vehicle Classification :

From the preprocessed image moving objects are extracted. A vehicle classification model is used to classify those moving objects into three class - Car, Motobike and Non-vehicle. The classifier model is built with mobilenet v1 neural network architecture.

Fig-2: Trainning hyperparameters. Transfer learning approach is used to training the model with our dataset.The dataset consists of 500 images per class. The training parameters are mentioned in table (2).

Violation detection

After detecting the vehicles three violation cases arises-

- Signal violation: if a vehicle crosses a predefined line on the road while there is red signal, it is detected as a signal violation.
- Parking violation: if a vehicle stands still in no parking zone for a predefined time, it is detected as a parking violation.
- Direction violation: when a vehicle comes from a wrong direction,it is detected by tracking the vehicle. The direction of the vehicle is determined using its current position and previous few positions.

Database Structure

We have used SQLite database with python to manage the whole data of our application. Here, in the relational database we have used BCNF of 5 tables. The tables are:

1) Cars
2) Rules
3) Cameras
4) Violations
5) Groups

** Here are the descriptions of each tables: **

- Cars: This table will hold the recorded cars by the camera. A car entity is a car with a unique identifier(id), color(color), license-number of the car(license), where the car is first sighted (first_sighted), an image of the license number (license_image), an image of the car(car_image), number of rules broken so far(num_rules_broken) and the owner of the car (owner).
- Rules: This table holds all the rules, their description(name) and fine for breaking that rule (fine).
- Camera: Camera table holds a unique identifier for the camera(id), location description(location), the longitude(coordinate_x) and the latitude(coordinate_y) of the location of the camera, where the camera will feed its data video(feed) and in which group the camera is in(group).
- Camera_group: This table simply holds the unique group names of the camera groups(name). Violations: This table takes all the ids of other tables as foreign key and creates a semantic record like this: A car with this id has broken that rule at this time, which is captured by this camera.

The core working principle of our project is centered on leveraging advanced technologies to address key challenges in urban transportation, ultimately leading to reduced congestion, pollution, and accidents. Here's how our project achieves these goals:

1. Traffic Flow Optimization:
- Our system continuously monitors real-time traffic conditions by utilizing AI algorithms and computer vision.
- The collected data is analyzed to identify congestion points and traffic patterns.
- Intelligent decision-making processes, guided by AI, dynamically optimize traffic signal timings and lane configurations to alleviate congestion and enhance overall traffic flow.

2. Efficient Route Planning:
- Our project incorporates intelligent path optimization based on real-time data.
- By recommending the most efficient routes, it minimizes bottlenecks and guides drivers to less congested lanes, reducing overall traffic on busy roads.

3. Safety Measures and Accident Reduction:
- Object detection through AI-driven algorithms enables the identification and tracking of vehicles on the road.
- This real-time monitoring allows for the swift detection of potential safety hazards and proactive measures to prevent accidents.
- Improved traffic flow and adherence to speed limits, facilitated by the system, contribute to overall road safety.

4. Environmental Impact Mitigation:

- Efficient traffic management reduces idling time and smoother traffic flow, directly addressing pollution concerns.
- By minimizing congestion and optimizing traffic patterns, our project aims to lower vehicle emissions and contribute to a cleaner urban environment.

5. Dynamic Speed Limit Monitoring:

- Computer vision capabilities monitor vehicle speeds.
- AI algorithms analyze the data to ensure that vehicles adhere to prescribed speed limits, promoting safer driving practices and reducing the risk of accidents.
- They help check the speed of a vehicle and also tell if the vehicle is overspeeding.

In essence, our project combines the power of AI, and computer vision to create a holistic and responsive traffic management system. By actively addressing congestion, pollution, and accidents, our solution strives to enhance the overall efficiency, safety, and sustainability of urban transportation.

Sources