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Smart Congestion Management Using Traffic Control System

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ABSTRACT:

A smart city's traffic management system is regarded as one of its primary components. Traffic jams are a common sight on the roadways in metropolitan areas due to the rapid increase in population and urban mobility. In order to address road traffic management issues and assist authorities with appropriate planning, an intelligent traffic management system utilizing the Yolo algorithm and Open CV approach is proposed in this project. A workable model for counting automobiles in traffic was developed using image processing as the basis. image processing methods classified and tallied moving vehicles in traffic scene video streams captured by stationary cameras. The following is the detection and tracking methodology. The adaptive background subtraction technique is initially used to separate the moving vehicles from the traffic scene. Using videos to isolated picture blobs are recognized as individual vehicles once the background is subtracted. Following blob identification, vehicles in a certain area are counted and classified. A count of vehicles was observed with an accuracy of ideal camera calibration. To support the goal, data is gathered from video footage of vehicles traveling toward and away from the camera in order to count and use signal switching. The created system's results demonstrate that, with more enhancements, it applicable to count and categorize vehicles in real-time. After that, an optimization framework makes use of these predictions to dynamically modify signal timings in response to shifting traffic conditions. The optimization method seeks to increase overall traffic flow efficiency, decrease delays, and shorten travel times. To sum up, utilizing real-time traffic data to optimize signal control presents a viable approach to improving urban traffic management. This method makes use yolo techniques to facilitate the creation of flexible and effective traffic control, which in turn helps to create more sustainable and seamless urban transportation networks.

Keywords: Image classification, Video tracking, Information analysis, Vehicle detection, Signal Switching.

1. Introduction:

The need to manage the transportation system and population is growing daily, which coincides with their growth. The world is populating so quickly. As a result, the number of any type machines including automobiles increased at the same period. Managing the current traffic situation is the primary objective of the vehicle counting traffic management system. The latest Object detection and tracking is one of the many components of an intelligent transport system. This method is used to identify traffic signs, lanes, automobiles, and vehicle detection. The suggested method counts the number of vehicles using real-time traffic analysisfrom the cameras at intersections using object identification and image processing. Modules make up this system: signal alteration, vehicle detection module. This camera footage is sent to vehicle detection method which uses Yolo. To determine signal, the count of vehicles in every category such as cars, bikes, buses, trucks counted. The signal alteration algorithm takes into account for determining the green signal time. In accordance, green to yellow and take a constant value for others like yellow to red and red to green. One average time taken under consideration to formulate green signal time. This project aims to create an intelligent solution over traffic signal optimization. The use of tracking for counting and switching signal algorithms in traffic control is the main topic of this research. This technology yields useful insights into traffic dynamics by precisely counting vehicles, which facilitates the development of adaptive signal management strategies. Based on real-time traffic statistics, this method provides a systematic framework for optimizing signal timings by utilizing advances in computer vision and data analytics. Traffic managers can react quickly to changes in traffic circumstances by integration of vehicle counting into signal control systems. Through the use of vehicle counts and traffic flow patterns, the system is able to dynamically modify signal timings in order to reduce congestion and increase throughput. The context for vehicle counting based on traffic

signal alteration is established in this introduction. The methods, algorithms, and technologies used to put this strategy into practice will all be covered in detail in the sections that follow. Furthermore, case studies and empirical assessments will be provided to show how the suggested methodology works and is feasible in actual urban settings. In conclusion, traffic signal regulation may be made dynamic and adaptable by utilizing the power of vehicle counting techniques, which will help to create more sustainable, and effective urban transportation systems.

2. Review of Literature

[1] Lavanya, Kumaravel, Prasanna Venkatesan, Karunakaran, "Vehicle Classification And Counting For Traffic Video Monitoring" 2023.

Research has investigated a range of approaches, such as conventional computer vision methods, machine learning algorithms, and deep learning models, to precisely identify and tally automobiles in traffic surveillance footage. Shape, color, size, and motion characteristics are frequently utilized features for classification, whereas counting techniques frequently depend on object identification, background subtraction, or optical flow analysis. Recent developments in deep learning have improved the accuracy and resilience of tasks involving the classification and counting of vehicles. Research is also ongoing in areas including complicated traffic circumstances. Emerging approaches to increase the dependability and effectiveness of traffic video monitoring systems include the integration of several sensors and the fusion of data from various sources. To solve these issues and create more reliable and scalable solutions for implementation in the real world this research is required.

[2] Md. MilonRana, Tajkurana AkterTithy, Md. MehediHasan, "Vehicle Detection And Count In The Captured Stream Video Using OpenCV In Machine Learning" 2022.

Vehicle recognition and counting in video streams using OpenCV and machine learning techniques were likely reviewed by the authors of the literature study with a focus on these techniques' application to OpenCV. Together with datasets frequently used for training and evaluation, they would have looked at several algorithms, including Haar cascades, HOG+SVM, and deep learning-based techniques. Numerous issues arise when the vehicle detection modules are operating. The first issue is that there should be no noise during the video recording. Because the entire frame is moving when a video isn't still, the OPEN CV can't accurately identify the moving object and will instead detect many still objects because of the moving object. We wish to use solely night vision cameras for the presice capture of the moving vehicles within the streaming night light footage because it is difficult to distinguish moving vehicles in the dark. It took several hours to scan multiple images using the Google program called Collab. This is a laborious process that takes time. which, when applied to numerous huge input photos, yield the most effective outcomes and provide good accuracy.

[3] ShenglinLi, HwanSikYoon, "Vehicle Localization in 3D World Coordinates Using Single Camera at Traffic Intersections" 2023

This research offered a straightforward and efficient method to compensate for a mistake in the localization of count of vehicle identified by a camera using the YOLO object identification technique. Regression models of two distinct kinds linear and neural were used to rectify the discrepancy among center of a vehicle box boundaries and actual position of vehicle projected on the route in image boundaries. The models output was the computed center error, which was trained using boxy figure images p

3. Methodology:

Existing Methodologies

Current Techniques

Traffic police manual intervention or fixed-time traffic signals are the mainstays of traditional traffic control systems.

Traffic signals don't take into account the actual vehicle density; instead, they follow preset schedules.

Vehicles can be monitored manually or with simple sensors (such as RFID, infrared, or inductive loops), which can be costly and error-prone.

Reactive management of traffic congestion frequently results in delays before corrective action is implemented.

Automation, image processing, or artificial intelligence techniques are used sparingly or not at all to optimize traffic flow.

Older systems don't incorporate real-time vehicle tracking or traffic sign recognition.

Proposed Methodology

Use image processing and deep learning (such as the YOLO algorithm) to implement a computer vision-based traffic control system. CCTV and video feeds are used for real-time vehicle detection and counting in order to dynamically monitor road conditions.

Instead of using set timers, traffic signal optimization is based on the current traffic density. automated traffic sign and signal recognition to improve road safety and deliver alerts in a timely manner.

To reduce congestion, use signal optimization algorithms that adaptively modify light timings. automation of traffic monitoring duties, which lessens the need for traffic cops to perform manual labor.

To guarantee long-term effectiveness and support implementation, do a benefit-cost analysis. Create a scalable system that can accommodate future growth in traffic and integrate with smart city infrastructure.

4. Results:

4.1 Vehicle Counting

At an intersection, cameras are fixed and utilised to record live video in order to count the number of vehicles. Cameras continuously count the number of vehicles and track them. Image processing is used for vehicle detection. The adaptive background detection approach was applied to retrieve a stable background image. In the identifying procedure, camera calibration is crucial. To convert the picture coordinates to world coordinates, camera calibration is done. For the vehicle classification, this is crucial. The following presumptions were made in this work. The road is straight. The road is level.

1. Data Collection: Using a real-time traffic data is first gathered to start the process. Typically cameras placed at intersections are used to count the number of vehicles. At intersections, these cameras identify and follow moving vehicles as they approach, pass through, or queue up.

2.Vehicle Detection and Tracking:

To precisely identify and track vehicles in the monitored area, computer vision techniques are used. In order to identify the presence of vehicles, count the number of vehicles, and monitor their progress, these algorithms examine video feeds.

3. Data Processing and Analysis: To glean important information regarding traffic conditions, the gathered data is processed and examined. Finding traffic volumes, levels of congestion, and patterns of vehicle movement are all part of this investigation. With the use of yolo algorithms, traffic conditions can be predicted using real-time inputs.

4. Feedback Loop: The system gathers input from the junction and continuously assesses how well the signal timings are working. Over time, this feedback loop aids in the optimization algorithm's improvement and performance enhancement. Additionally, it makes it possible for the system to adjust to shifting traffic patterns and other influences like construction projects or special occasions.

5. Implementation and Evaluation:

At the intersection, the optimized signal timings are put into practice, and simulations and field testing are used to assess how well they work. The efficacy of the signal control approach is evaluated using metrics including intersection throughput, trip time, delay, and queue length

4.2 Signal alteration

The Signal Alteration method uses the count given by the vehicle detection modules to set and renew the green signal time. In accordance with the time will be vary based on count, The signal alteration happens in cyclic manner. As previously mentioned, the description receives input as the vehicle identification data and count for each class of vehicle to analyzed to determined and assigned, the green signal times or the other signals are modified correspondingly. The technique is scalable to any number of lights at an intersection, either up or down. When creating the algorithm, the following variables were taken into account

1. This algorithm's processing time for determining green signal the length of the green light This determines when the count must be obtained.

2. Count will applicable for all the vehicles class, including trucks, cars, motorbikes, bus etc.

3. Set a standard average time for the vehicle taking speed and distance accordance to all class of vehicles.

4. Switching over yellow to Red , Red to Green can be taken ideally as we looked for Green to Yellow:

$$GST = \sum(No\ of\ vehicles + Avg\ Time)\ No\ of\ Lanes + 1$$

Where: GST (Green Signal Time.) Number of Vehicles is the count of vehicles traversing the signal that image processing has identified. The average time for the vehicles traveling through the camera remains constant. There is only one lane.

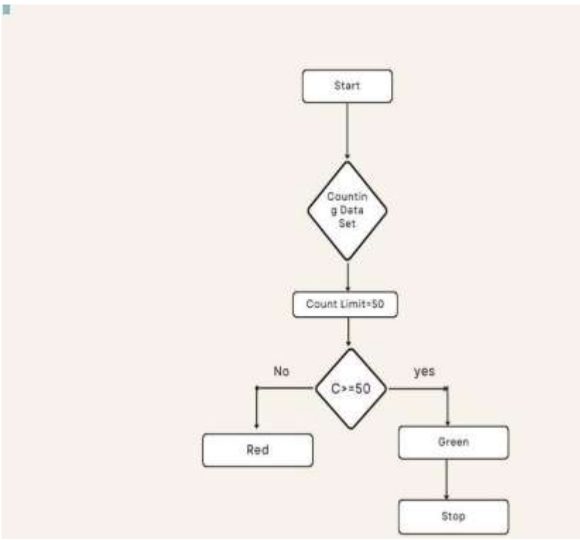

Fig 4.2.1 Flow chart

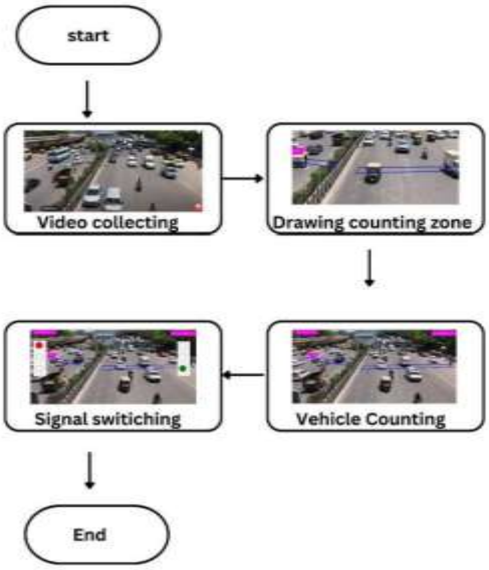

Fig 4.2.2 Block Diagram

5. Conclusions:

Ultimately, the paper's conclusion stated that, in the first place, image processing used to identify moving objects from a certain chosen area. Using this technique, a practical model for counting vehicles in traffic was constructed. Initially, the moving vehicles are separated from the traffic scene using the adaptive background subtraction technique. By removing the background from recordings, isolated visual blobs can be identified as distinct vehicles. Vehicles inside a specific area are tallied and classed after blob recognition. With perfect camera calibration, a count of vehicles was detected. Data is collected from video footage of vehicles moving toward and away from the camera in order to support the objective. These forecasts are then used by an optimization system to dynamically adjust signal timings in response to changing traffic circumstances. The number of vehicles will determine how long the green light lasts. Both the yellow and red signals will stay in place. The optimization technique aims to reduce delays, cut travel times, and improve overall traffic flow efficiency. In conclusion, optimizing signal control through the use of real-time traffic data offers a workable strategy for enhancing urban traffic management. Through the application of yolo techniques, this method helps to develop more sustainable and seamless urban transportation networks by facilitating the creation of flexible and effective traffic control.

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[3] ChengJian, Lin,ShiouYun,Jeng, HongWeiLioa “A Real Time Vehicle Counting Speed Estimation And Classification System Based On Virtual Detection Zone And Yolo” 2021.

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