OPTIMAL TRAFFIC CONTROL SYSTEM FOR TRAFFIC CONGESTION

LAKSHMI PRIYA
B.TECH CSE
(Dr MGR EDUCATIONAL AND RESEARCH INSTITUTE CHENNAI)
chennai, TAMIL NADU
jakkapriya32@gmail.com

KUMARI JULI
B.TECH CSE
(Dr MGR EDUCATIONAL AND RESEARCH INSTITUTE CHENNAI)
chennai, TAMIL NADU
immissjuli2017@gmail.com

NAGA PAVANI
B.TECH CSE
(Dr MGR EDUCATIONAL AND RESEARCH INSTITUTE CHENNAI)
chennai, TAMIL NADU
mandavapavani177@gmail.com

CHINCHU NAIR
ASSITANT PROFESSOR
(Dr MGR EDUCATIONAL AND RESEARCH INSTITUTE CHENNAI)
chennai, TAMIL NADU
chinchunair.cse@dmgrdu.ac.in

Dr.V.SAI SHANMUGA RAJA
PROFESSOR
(Dr MGR EDUCATIONAL AND RESEARCH INSTITUTE CHENNAI)
chennai, TAMIL NADU
saishanmugaraja.cse@drmgrdu.ac.in

Dr.G GUNASEKARAN
PROFESSOR
(Dr MGR EDUCATIONAL AND RESEARCH INSTITUTE CHENNAI)
chennai, TAMIL NADU
gunamgrcse@gmail.com

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 analysis from 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. LITERATURE SURVEY

[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 produced different viewing and distance perspectives.

[4] Supriya, Sreelatha, Sushmitha, Chiranjeevi Nayak. "Automatic Vehicle Counting For Traffic Management System Using Image Processing And IOT".

One essential element of intelligent city administration is road traffic management. By accurately estimating count of cars anticipated to flow through a congested crossroads in advance, traffic congestion can be effectively managed. Using image processing and other techniques, the apparatus can anticipate number of vehicles well previous to it reaches the intended junction of traffic targeted. Moreover, monitoring data can be sent to a remote power hub located all over the city over the internet. Including the help of carefully positioned cameras, the device takes photographs of vehicles while integrating seamlessly with current traffic control systems. To accurately count the cars in these pictures, image processing techniques are then applied. A centralized administration system receives the gathered data for traffic analysis and real-time monitoring. In addition, the technology optimizes the timing of traffic signals and gives drivers access to real-time data, which significantly reduces congestion and improves traffic flow while also yielding significant insights into traffic management.

[5] MinjungKim, MaxSchrader, HwanSikYoon, Joshuta. "Optimal Traffic Signal Controll Using Priority Metric Based On Real Time Measured Traffic Information" 6 May 2023.

The objective of this research is to create the best signal system algorithm viable in order to reduce the overall fuel usage of a transportation network. To achieve this, an optimized weighting factor-based traffic signal management algorithm based on priority metrics was created, the direction was tested in the SUMO traffic imitation surroundings. Four other facets of this study will be added in the future. Initially, in order to separate big vehicles from light vehicles for more priority, vehicle mass will be taken into account as an extra factor in the priority metrics. It is anticipated that the different car models and the related Radar and video sensors are useful for accurately estimating the mass of a vehicle. Secondly, the overall fuel consumption can be further decreased by optimizing the weights in the priority metrics for different traffic capacity throughout the web. Gain scheduling will further increase overall energy efficiency of the network without requiring a significant amount of processing load during operation, despite the fact that it will require a significant degree of optimization.

3. REQUIREMENT ANALYSIS

Using computer vision techniques, a traffic control system based on image processing intends to oversee and control traffic more effectively and efficiently. In addition to assessing traffic conditions, image processing can be used to detect and track automobiles on the road. After that, this data can be utilized to control traffic flow, change traffic signals, and spot possible issues.

Reducing traffic congestion: Image processing can assist in reducing traffic congestion and improving traffic flow by keeping an eye on traffic conditions and modifying traffic signals accordingly.

Increasing productivity*:* A lot of the jobs that traffic engineers and police officers presently do by hand can be automated using image processing. This can increase the overall effectiveness of traffic control systems while also giving them more time to concentrate on other duties.

Real-time vehicle detection and counting: can be accomplished by image processing. Traffic flow management and signal adjustments can be made with the use of this data.

Recognition of traffic signs and signals*:* One method for recognizing traffic signs and signals is image processing. Drivers can utilize this information to assist them navigate safely by informing them about impending traffic conditions.

Signal Optimization: Real-time traffic signal timing is optimized using the data analysis. An optimization algorithm considers current traffic conditions, traffic patterns. It is frequently based on optimization techniques like yolo algorithms.

Benefit-Cost Analysis: To evaluate the long-term advantages of the traffic control system and to justify the expenditure, perform a cost-benefit analysis.

Scalability: Create a scalable system that can accommodate more traffic or more monitoring.

4. WORKING

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.

6. 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.

7. 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:

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

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.

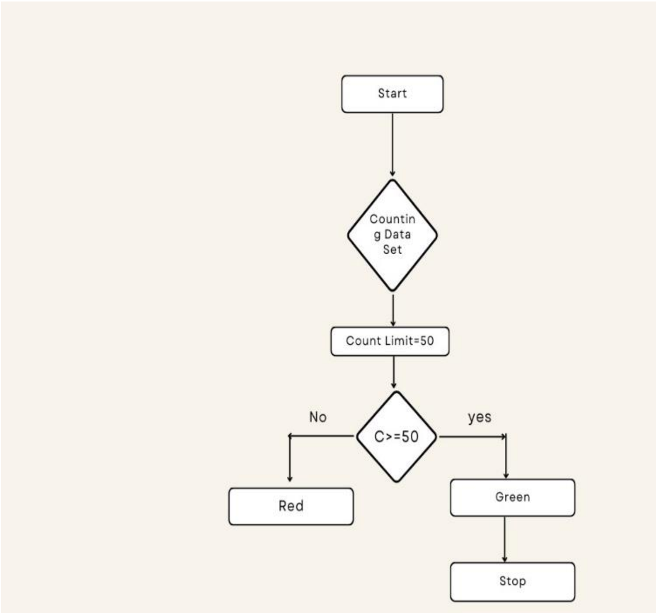

Fig 4.2.1 Flow chart

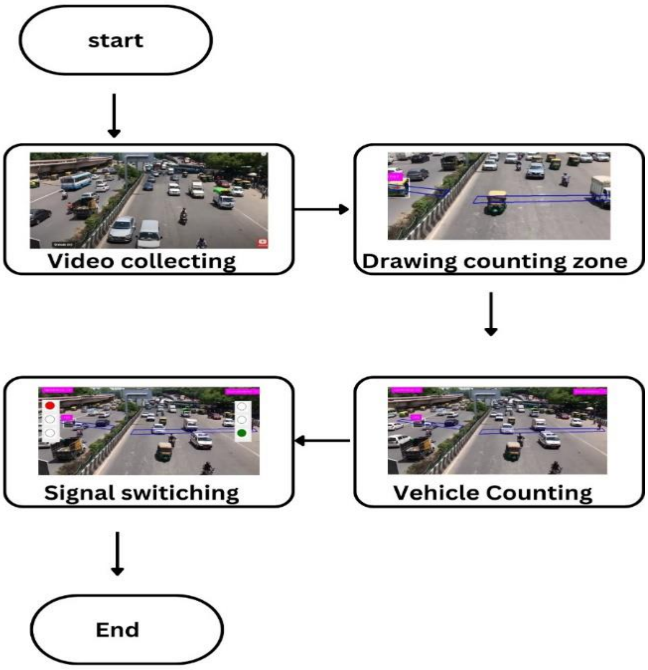

Fig 4.2.2 Block Diagram

5. CONCLUSION

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.

6. REFERENCE

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