TO DEVELOP AN EFFICIENT “CRITICAL VEHICLE SEAMLESS MOVEMENT” TECHNIQUE USING AI AND ML METHODS

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ABSTRACT

Traffic congestion is becoming one of the critical issues by posing significant hurdles to critical vehicles, to nature by posing significant pollution. Traffic congestion can not only hinder the movement of vital vehicles, but also causing additional delays and stress for drivers, as well as increasing fuel consumption and pollution levels. Traffic congestion harm megacities the most, despite the fact that they appear to exist everywhere. Its ever-increasing nature requires the calculation of real-time road traffic density for better signal control and traffic management. One of the most important variables affecting traffic flow is the traffic controller. As a result, there is a need to improve traffic control in order to better meet this growing demand. The goal of our proposed system is to use live images from traffic junction cameras to calculate traffic density using image processing and AI. It also focuses on the algorithm for switching traffic lights depending on the movement of critical vehicles and vehicle density to alleviate congestion, allowing critical vehicles movement and people to go faster while simultaneously lowering pollution.

Keywords: Traffic Control, Traffic Light System, Traffic Management, Intelligent Transport Systems, Smart Surveillance, Computer Vision, Machine Learning, Object Detection, YOLO.

I. INTRODUCTION

Traffic congestion is one of the numerous issues that the world is facing as a result of growing population and rapid expansion in the number of vehicles. In countries like India, the rate of road expansion is only one-third that of vehicular growth. According to statistics, the present annual growth rate of automobiles is over 11%, while the annual road extension rate is just about 4%. The consequences of increased traffic congestion are numerous. Congestion stifles economic progress by delaying services, wasting fuel, and harming the environment. According to studies, traffic congestion wastes 2.5 lakh liters of non-renewable fuel in a single day. Not only would this cause delays in vehicle transit, but it might also impede the movement of emergency vehicles. It is difficult for an emergency vehicle to cross through a signal due to traditional traffic signals. Emergency vehicles play an important role in saving lives as every second is as important as a life. Many lives and properties have been lost as a result of the emergency fireman services being delayed in an emergency situation. We can alleviate these issues by implementing an intelligent automated system that is integrated with a traffic control system and detects and prioritises emergency vehicles. We need to create a system that can recognise vehicles and classify them as emergency or non-emergency vehicles. The challenge is handled in this study by using CCTV footage of the road to detect the emergency vehicle. With the use of a CCTV camera, images are taken at regular intervals. They categorised each vehicle as an emergency vehicle or an ordinary vehicle after detecting it. Our project focuses on the serious impact that traffic congestion has on the emergency vehicle transportation system. Critical vehicles have a tough time navigating through traffic in places like India, where the road width and length make it hard to build a dedicated lane for emergency vehicles.

II. LITERATURE SURVEY

Arduino-UNO based traffic control system

Vogel, I. Oremović, R. Šimić and E. Ivanjko proposes an Arduino-UNO based system that aims to reduce traffic congestion and waiting time. This system acquires images through the camera and then processes the image in MATLAB, where the image is converted to a threshold image by removing saturation and hues, and traffic density is calculated. Arduino and MATLAB are connected using USB and simulation packages, which are

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Vehicle Detection using Image Processing. Kanungo, A. Sharma and C. Singla, makes use of a support vector machine algorithm along with image processing techniques. From live video. images in small frames are captured and the algorithm is applied. Image processing is done using OpenCV and the images are converted to grayscale images before SVM is applied. This system not only detects traffic density but also detects red light violations.

Comparing Various existing methods

Ms. Saili Shinde, Prof. Sheetal Jagtap, reviews various techniques used for traffic light management system. This paper observes that each technique has a common architecture: choose input data, acquire traffic parameters from input data, process it, determine density, and update parameters.

In the first method, VANETS are used to get information and location of every vehicle, which in turn is passed on to the nearest Intelligent Traffic light with the help of installed GPS. Further, these ITLs will update the statistics and sent it to nearby vehicles. In case of accidents, the information would be sent to drivers to choose an alternate route to avoid congestion. However, this technique is not feasible as its deployment is quite expensive.

In the second method, infrared sensor-based microcontrollers are used, which capture the unique ID of every car using transmitter and receiver. In case of an emergency situation, vehicle’s radio frequency tags can be used to identify them and let other vehicles move. This method detects red light violations. However, this technique is not flexible due to the fact that infrared sensors need to be in sight.

The third method employs the fuzzy logic methodology, which employs two fuzzy logic controllers, one for signal optimization and the other for extending the green phase of a road in an intersection. Video cameras are utilised to collect input data and are placed at the incoming and outgoing lines. The controller then uses the data gathered by these sensors to make the best judgments possible and minimise the objective function.

In the fourth method, fuzzy logic is used, and the system takes in the number of vehicles and the average speed of traffic flow in each direction as the input parameters. The number of vehicles and the average speed of traffic flow can be determined using sensors placed on the road.

In the fifth method, photodetector sensors are used, which are set at some distance apart, to capture data and send it to the traffic cabinet, which calculates the weight of each road and then set the traffic light accordingly. However, the maintenance cost is quite high.

In the sixth method, video imaging is used to capture the data. Dynamic background subtraction and various morphological operations are performed to capture a clear image of the vehicle. Every time a new vehicle enters the area of interest, a new rectangle is drawn, and vehicle count is incremented. The algorithm is easy to implement but does not handle occlusion and shadow overlapping.

Smart Traffic system using ANN and fuzzy controller

Renjith Soman proposes a smart traffic light system using ANN and fuzzy controller. This system makes use of images captured from cameras installed at traffic site. The image is first converted to a grayscale image before further normalization. Then, segmentation is performed using sliding window technique to count the cars irrespective of size and ANN is run through the segmented image, the output of which is used in fuzzy controller to set timers for red and green light using crisp output. Results had an average error of 2% with execution time of 1.5 seconds.

Simulation Environment.

According to A. Maria, a simulation is an imitation of a model based on a real-world system. A simulation model can be used to adjust many parameters and then test a system that is expensive or complex to build. Different states can be investigated using a simulation model. In comparison to the current FCTL system, a simulation
environment can be constructed to show the situation using the new traffic light application. It can also use the new programme to simulate operations in various traffic conditions.

### III. METHODOLOGY

Our proposed system takes images from the CCTV cameras at traffic junctions as input for real-time critical vehicle detection and traffic density calculation using image processing and object detection. This image is initially sent to the vehicle detection algorithm. The number of vehicles in each class, such as ambulance, cars, bicycles, buses, and trucks are calculated. The traffic density is then calculated using the weightage allotted to different classes of vehicles. The signal switching algorithm uses this density, along with a few other factors including the presence of critical vehicles, to determine the green signal time for each lane. The red signal times have been modified to reflect this. In order to prevent lane starvation, the green signal time is limited to a maximum and minimum value. To demonstrate the system’s effectiveness, a simulation is created.

**This project can be broken down into 4 modules:**

**Vehicle Detection Module**

This module is in charge of detecting class of vehicles and number of vehicles in the image using YOLO algorithm. More specifically, each class of vehicle is given a specified weightage based on its importance, size, and the approximate number of passengers that may travel in it, so that a realistic traffic density can be determined. The dataset for training the model will be prepared by scraping images from google and labelling them manually. YOLO is a smart convolutional neural network (CNN) that can conduct real-time object detection. The technique divides the image into areas and predicts bounding boxes for each region using a single neural network applied to the entire image.
Signal Switching Module

This algorithm updates the red, green, and yellow timers of all signals. These timers are set bases on the count of vehicles of each class received from the vehicle detection module and several other factors such as the number of lanes, average speed of each class of vehicle, and so on. The findings from the vehicle detection module are used to distinguish critical vehicles from other vehicles. The signal would then be changed based on the critical vehicles’ position.

Simulation Module

To simulate traffic lights and automobiles moving across a traffic intersection, a simulation is created from scratch using the Pygame module. Pygame is a set of cross-platform Python tools for creating video games. It offers sound and graphics libraries that can be utilised with the Python programming language.

The simulation contains a four-way intersection with four traffic lights. On top of each signal is a timer that displays the amount of time until the signal changes from green to red or red to green. Cars, bicycles, buses, trucks, and rickshaws arrive from all directions. Some of the vehicles in the rightmost lane turn to cross the intersection to make the simulation more realistic.

IV. CONCLUSION

By following the above-mentioned steps and performing image processing, we can be able to achieve the following results:

1. This Adaptive Traffic Signal Timer uses live images from the cameras at traffic junctions for traffic density calculation using YOLO(You Only Look Once) object detection and sets the signal timers accordingly.
2. It can detect the emergency vehicles such as Ambulance and adapt to the given situation accordingly thus reducing the traffic congestion for the critical vehicles. Thus Signal switching would reduce the amount of time it takes for critical vehicles to pass.
3. People can anticipate to spend substantially less time stuck in traffic if the dynamic traffic control system is implemented, and they can use the timers to turn off their engines, decreasing fuel consumption and emissions accordingly and Reducing the amount of time spent at a traffic signal can help people be more productive. This idea can be implemented for a larger network by using algorithms to ensure safety and stability of systems. Also, the extended time can be calculated by the system itself. By keeping records of traffic patterns and using an algorithm, the timing can be chosen according to the traffic patterns.

V. FUTURE WORK

The project can be further expanded to include the following functionalities to improve traffic management and reduce traffic congestion:

1. Identification of vehicles violating traffic rules: Vehicles going through red lights can be spotted in an image or video stream by drawing a violation line and capturing the number plate if the line is crossed when the signal is red. Similarly, lane switching can be recognised. Background subtraction and image processing techniques can be used to accomplish these results.
2. Accident or breakdown detection: Intersections are prone to serious wrecks because numerous types of injurious collisions, such as angle and left-turn collisions, frequently occur there. As a result, precise and timely identification of accidents at junctions has enormous benefits in terms of saving property and lives while also reducing congestion and delay. This can be accomplished by identifying automobiles that remain motionless for an extended period of time in an inconvenient location, such as in the middle of the road, while excluding parked vehicles.
3. Synchronization of traffic signals at multiple intersections: Synchronizing traffic signals along a street can help commuters since once a vehicle enters the street, it can continue without halting.

VI. REFERENCES


