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Distributed Trafic Control System

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***Abstract*—** If we live in a metropolitan city, traffic is an immense problem of our day to day life. The fundamental explanations for this is, increase of individual vehicles, poor street infrastructure, absence of appropriate road and old ordinary methods for managing traffic. We need to spend a lot of time in rush hour gridlock. Also this leads to a lot of fuel combustion which is a major cause of pollution and health hazards. We have seen that even though amount of vehicles along a particular traffic signal is less, it runs according to a particular allotted time. By using this algorithm we will predict the exact optimal time required by a traffic signal to be made green based on the amount of vehicles present in its lane. In this paper we are trying to minimize traffic clog issue with the assistance of distributive traffic control, using object identification strategy (YOLO) for vehicle counting. The productivity of our proposed framework lies in the fact that this system (DTCS) manages traffic signals depending on the present circumstance of vehicular volume present in its lane and not on pre-assigned time. We have compared two different techniques for counting vehicles which is edge detection and the current state of the art YOLO algorithm.

***Keywords*—** Traffice Congestion, Distributed traffice control, edge detection, You only Look Once (Yolo)

I. INTRODUCTION

India is a developing nation where white collar class populace is on the ascent. White collar class of India, who is having enough cash to go through consistently, is moving far from open transport to owing individual vehicle. This expansion in number of vehicle, joined with lack of infrastructure is prompting an immense traffic issue.

Expanding road infrastructure is extremely troublesome and tedious because of the population and land scarcity in Indian Metro cities. Managing traffic in an effective way is the only solution which we can adopt.

Vehicle counting is a procedure to calculate the street traffic density to survey the traffic conditions for distributed traffic management system. With the broad use of cameras in urban transport frameworks, availability of images is the main information source. Additionally, much research is going on for managing real time traffic due to the accessibility of portable cameras and big-data analysis. In this work, we propose image based vehicle counting technique; image will be caught using signal cameras. The processing of an image is accomplished in three phases, 1) image get resized to 448 X 448, 2) runs a solitary convolutional network on the image, and 3) thresholds the resulting detections by the model’s confidence. YOLO accomplished exceptional result in the object detection area, and achieved greater accuracy and competitive speed in tracking.

The aim of this current research is to develop a distributed traffic control system, which can process images recorded from stationary cameras over roads e.g. CCTV cameras installed near traffic signals and counting the number of vehicles on the signal.

A simple approach was carried out to tackle the problem by using YOLO object detection for counting number of vehicles and then timing of a traffic signal.

At Last comparison between Edge Detection technique and YOLO is shown.

II. RELATED WORK

There are several analog parameters used by the analysts to control and detect traffic near signals. These incorporate, figuring out density of traffic by using smoke detection sensors. Smoke produced on fuel consumption near a signal can be effectively used to measure force of traffic [1]. Likewise individuals have utilized a matrix of infrared light on one side of the street and infrared detection sensor on the opposite side, to measure the amount of traffic by analysing the light hindered by the vehicles.

Adaptive Traffic Control System takes data from the sensors present in the vehicle to screen the traffic. Likewise with the assistance of intelligent remote communication system, sensors can speak with the nearby traffic signal and can react accordingly. Intelligent Traffic signal can send cautioning messages to the vehicles, in case there is an occurrence of a crisis. Several traffic control calculations are used to screen such circumstances.

In fields related with Image Processing, individuals have utilized an unfilled street picture as there reference and determined the rate change between the old picture and new picture which is loaded up with vehicles. This rate change is to decide the time length of the traffic signal [2]. This thought of utilizing Distributed Traffic Control basically centres on edge location system of the picture preparing device to decide the quantity of vehicles present almost a traffic flag.

In the ongoing long stretches of researches, different methodologies have been tried in this specific zone of recognizing vehicle information yet at the same time the gap is there as it needs improvement in recognition and tracking for precise detection. Mithun et al. [3] used the strategy of virtual line based detector which for the most part utilizes various time-spatial images (TSIs), every one acquired from a multiple virtual detector line (MVDL) on the frames of a vehicle video. MVDL-based strategy might be very successful in intelligent transportation framework yet precision could conceivably be agreeable in complex rush hour gridlock circumstances. Lin et al. [4] used the procedure of identifying conceivable vehicles in the predetermined vulnerable side region by incorporating the appearance-based highlights and edge based highlights yet the outcomes are marginally inadmissible due to the complex background. Feed-forward neural network has been utilized to recognize the vehicles by P. Rajesh for taking care of issues, for example, classification, clustering, and function approximation work yet it needs clear image frame contribution to stop mis-recognition of vehicles [5]. In Petrovska, N., and Stevanovic, A. suggested utilization of image processing to decide traffic density. They showed the data on traffic clog in different areas utilizing their application for cell phones. For doing this they utilize Google's API for interfacing with the traffic layer of the Google maps. The traffic density in various locations is then shown utilizing color codes each signifying exceptionally high blockage to no clog.

Huang et al. [6] exhibited a component based technique for vehicle examination and including for bi-directional streets in a constant traffic observation system yet it isn't certain that the amount it is impeccable in the situations of expanded traffic volume. Hashmi et al. [7] proposed an alternate methodology dependent on measurable parameters to decide the traffic circumstance at vigorously jam-packed intersections in urban regions and this strategy need enhancement in parameters for example color, shape, size and characterization of vehicles. Nandyall and Patil[8] utilized programmed vehicle discovery and characterization dependent on pair savvy geometrical histogram and edge highlights to depict the model of vehicle type. At that point these highlights are trained with neural network which works fine however tallying of vehicles is subject to threshold value and may not be exact in overwhelming rush hour traffic. Kota and Rao [9] suggested the edge contrast technique to distinguish the moving areas with various time instances to classify and count the vehicles. In any case, the execution of this system is altogether influenced by the thresholds. A dream based discovery and trait based pursuit of vehicles in thick rush hour traffic monitoring has been displayed by Feris et al. [10] utilizing various identifiers and can be reached out to huge scale adjustment. Huang and Ma [11] proposed moving object detection calculation from video for confinement of vehicle by separating current image and background image and applying network and relabeling procedure to count vehicles. In spite of the fact that the methodology has shifted background noise from video utilizing opening task, still it has some noise clustering which can't be separated effectively.

III. METHODOLOGY

Since we cannot reduce the number vehicles on the road, we can try to manage the impact of growing traffic on the travel time due to traffic congestion. Main aim of this system is to manage the traffic control intelligently with the traffic flow optimization strategies. By using optimization strategies we will try to reduce the travel time that every common person faces by getting stuck in the traffic jams for long time on roads which are becoming congested due to increased number of vehicles and less amount of space. This particular system will be installed on traffic signals. For finding better results we performed object detection using edge detection and YOLO, comparison is shown in section IV.

A. Edge Detection Technique

To identify the top of a vehicle, canny edge identification method is utilized. Canny edge location method is a decent device to separate critical data out of a given picture with the goal that the need to process an extensive amount of information is decreased. Steps associated with the shrewd edge location procedure are as per the following:

1. First we apply Gaussian haze to make the picture smooth and diminish commotion.
2. In request to distinguish an edge we should know the adjustment in force. In this way we compute the power angle of the picture.
3. After this we use non-greatest concealment, to expel counterfeit reaction of edge recognition.

4. We utilize twofold edge so as to decide potential edges.
5. We likewise track an edge dependent on hysteresis: Finalize the discovery of edge by removing powerless edges or edges which are not associated with any solid edge.

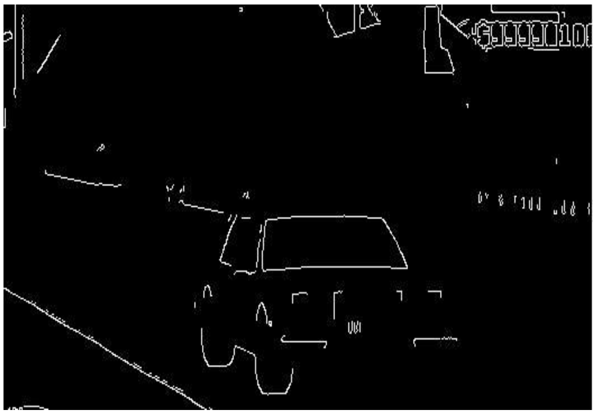

Figure 1. Canny Edge Detection of a Car

Number of Cars can be located using background separation technique. We need a clear background image with no vehicles. This image is used as a reference for other images. Other image is subtracted from this image to get locations of different vehicles. After that Blobbing technique is used to count different vehicles.

B. YOLO ALGORITHM

YOLO stands for You Only Look Once. It is a newly designed approach for object detection. YOLO is refreshingly simple and extremely fast. YOLO reasons globally about the image when making predictions. Not at all like sliding window and region proposal based methods, YOLO sees the whole picture while training phase and test phase so it encodes relevant data about classes just as their appearance. Fast R-CNN, a top detection technique [12], mistakes background patches in a picture for object since it can't see the larger context. YOLO makes less than half the number of background errors compared to Fast R-CNN

Earlier for object detection, classification based machine learning algorithms were used. But YOLO is designed as a regression problem. Difference between the two is Classification works with unordered data where training sample is free from output and your main aim is to divide it into clusters of similar class. But on the other hand a Regression problem is a mathematical function like problem where training data is divided into input as well as output set. Error is calculated for each iteration, between the actual output and the predicted output, which is then used to adjust parameters.

This system will consists of an input device in the form of a camera, a raspberry pi-3 along with neural stick to run YOLO algorithm for image-processing part and other electrical necessities. Camera present on the traffic light will take shots at regular intervals. Image will be sent to an open CV application to detect the edge of the roof of different cars using masking techniques. And the Second one is:-

YOLO deep neural net algorithm for localizing and detecting the number of vehicles present in the picture.
, thereby minimizing the required waiting time.
Second approach is more accurate in deciding the exact number.

Consider this image in Figure 2. This image will be divided into SxS grids. Each Grid will predict only one object.

Figure 2. Traffic Image

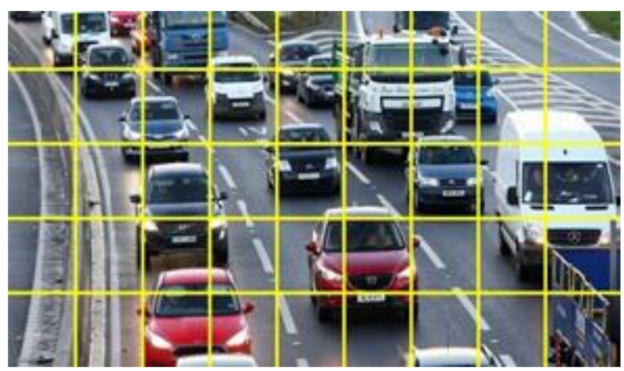

Figure 3. Traffic Image divided into SxS grids

If there is an overlap of two bounding boxes, then one with higher confidence score is taken. Yolo ignores the objects which are very close to each other and count them as one. Therefore it’s a drawback of this algorithm which does not properly count objects is close vicinity.

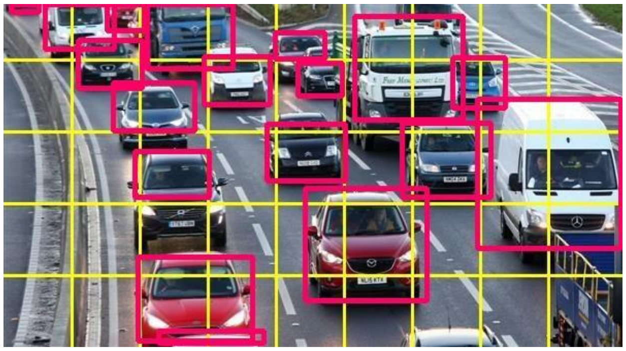

Figure 4. Predicted Vehicle

For each Grid cell YOLO predicts:

1. B number of boundary boxes with respective confidence score.
2. Regardless of number of boxes, it only predicts one object per grid box.
3. It also predicts class of object (around 20 different classes), but we have restricted it to predict only vehicles.

Each bounding box consists of 5 elements, (topleft_x, topleft_y, bottomright_x, bottomright_y) and the confidence score of a particular class. Therefore for each grid cell of size SxS yolo prediction has a shape of (SxSx(B*5 + 20))

Where 20 is the total number of classes of objects which yolo predicts.

Main backbone of YOLO is the Convolutional Neural Network which predicts a tensor of size (SxSx(B*5 + 20)) for each grid cell.

In total yolo have 24 convolutional layers along with 2 fully connected layers in the end. Last convolutional layer output a tensor of size (SxSx1024) which is then passed to 2 fully connected layers and gets converted into a tensor of size (SxSx(B*5 + 20)).

IV. COMPARISON BETWEEN EDGE DETECTION AND YOLO

The experimental result comprises of vehicle counting from 100 traffic images using edge detection technique and YOLO. Here we are showing few results. In this table, Edge detection technique is counting somewhat less than the actual number of vehicle due to congestion and heavy traffic in some images. Sometime edge detection technique counts more numbers of vehicles than the actual number of vehicle in image due to the false positive error factor. As compare to edge detection technique, vehicle count by YOLO was more close to the actual number of vehicles present in the image. Table 1 shows the experimental results obtained by the proposed methods and the comparison done with the similar purpose methods.

Table 1 Comparison between Vehicle count from Traffic Images using Edge Detection Technique and *YOLO*.

Initial Data		Edge Detection			YOLO		
Traffic Image	*Actual No of Vehicles in Image(a)*	*No Vehicle Calculated by System(b)*	*Error Rate in %*	*Success Rate in %*	*No Vehicle Calculated by System(c)*	*Error Rate in %*	*Success Rate in %*
1	8	6	25.00	75.00	7	12.50	87.50
2	12	8	25.00	75.00	12	0.00	100.00
3	17	21	23.53	76.47	14	17.65	82.35
4	24	31	29.17	70.83	20	16.67	83.31
5	26	28	7.69	92.31	24	7.69	92.31
6	31	36	16.13	83.87	31	0.00	100.00
7	37	31	16.22	83.78	34	8.11	91.89
8	39	44	12.82	87.18	36	7.69	92.31
9	43	40	6.98	93.02	41	4.65	95.35
10	47	53	12.77	87.23	42	10.64	89.36
Average				**82.47**			**91.44**

V. ALGORITHM

Every traffic control system is designed by standard signs which make sure when to move or stop. For example, proceed signs always have a green background which is octagonal in shape [17-20]. These Standards are allowed a passengers to move quickly and continuous operation. There are three types of traffic light signs are used for controlling the traffic congestion. It contains standard colors and shape used for identification and deciding on the appropriate course of action. A red lamp indicates the vehicles to stop in the lane at allotted time interval, an amber lamp indicates passengers is ready or start to progress in the lane. A green lamp is used for vehicles to move from the lane. In present situation, traffic lights are set on the different directions with fixed time delay, following a particular cycle while switching from one signal to other. [13-20]

This algorithm will depend on number of vehicles as the input parameter. When there is no vehicle on road the traffic signal will run normally. Taking Number of vehicles as an input we can create a direct relationship with the timing of a traffic signal.

Table 2 Relation Between percentage and timing of traffic signal.

Percentage	Timing
0-30%	Normal Timing
30-50%	10 seconds increment
50-70%	20 seconds increment
70-100%	30 seconds increment

A. Flow Diagram

As the number of vehicles increases, function which relates it with time must be in such a way that it increases beyond a threshold value. Let 30% be the threshold. It implies that beneath 30%, traffic lights will work typically. Be that as it may, when vehicle continues to increase along a signal, the lights will pursue the pattern as observed in Figure 5. We have utilized a direct connection between the rate and timing increment, yet we can choose different increasing functions depending on the type of traffic.

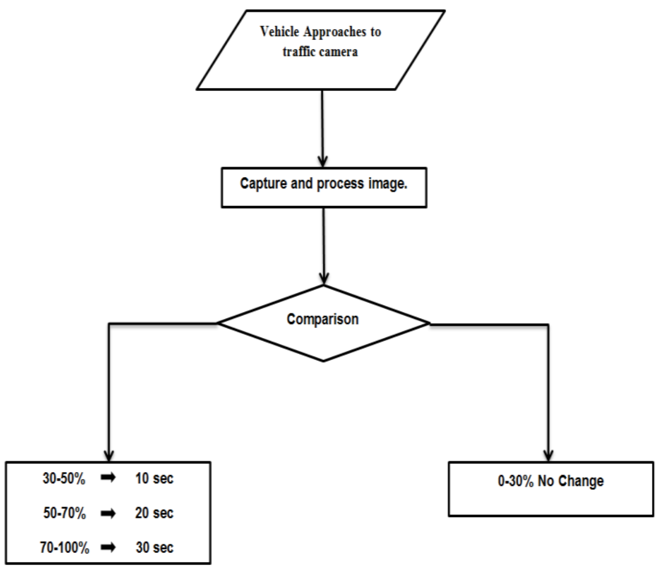

Figure 5. Flow chart of proposed System

B. ADVANTAGES OF DISTRIBUTED TRAFFIC CONTROL

Distributed Traffic Control system in a nation like India can be exceptionally helpful. Individuals regularly stall out in the rush hour gridlock as is it not appropriately managed. In any case, by this system each signal will get a specific running window of green light by processing the quantity of vehicles present there. We likewise hear a great deal of cases in which individuals lose their life because of congested roads. This issue will likewise be settled by utilizing the DTC strategy. Also traffic jams lead to lot of air pollution and other health hazards. This system will be very effective in eradicating such problems.

VI. CONCLUSION

This system will give successful outcomes by avoiding massive delays, noteworthy decrease in travel time and fuel wastage will be limited. This arrangement of Distributed Traffic Control will help in proper grid lock management, thereby reducing the waiting time and increasing productivity. Yolo ignores the objects which are very close to each other and count them as one. Therefore it's a drawback of this algorithm which does not properly count objects is close vicinity. Because the model like YOLO has great application potential and the detection capability of real-time detection, it has a very large space for improvement in detection accuracy.

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