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Dynamic Traffic Signalling using Video Analytics

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ABSTRACT:*As the traffic became the one of the most important part of the daily life. Our precious time in every-day life is mostly spent in the traffic. This is one of the important problems in the various cities of country like India. This is due to several reasons like improper monitoring of traffic in various junctions and also providing static signalling time at the junctions. Video surveillance plays an important role in traffic controlling by providing the dynamic control over the traffic. The traditional computer vision techniques are unable to analyze the visual data generated in real-time. So, there is a need for video analytics which involves processing and analyzing visual data such as videos to find the vehicles and count of vehicles that are useful for interpretation. We propose a framework for Dynamic Traffic Controlling System. In this various techniques are used in order to avoid the traffic by recognizing vehicles in a particular way, and design automatic signalling process in order and save the time for people at junction. Identifying the vehicles and then counting the vehicles involves, implementation of algorithms like cascading algorithm and then frame a framework for the dynamic controlling of traffic. This system plays an important part in development of smart cities.*

KEYWORDS: *Traffic control; Static; Dynamic; cascading algorithm; video analytics; vehicles count;*

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I. INTRODUCTION

1.1. Video Analytics

Video content analysis is the capability of automatically analyzing video to detect and determine temporal and spatial events. This technical capability is used in a wide range of domains including entertainment, health-care, retail, automotive, transport, home automation, flame and smoke detection, safety and security. The algorithms can be implemented as software on general purpose machines, or as hardware in specialized video processing units.

Much different functionality can be implemented in VCA. Video Motion Detection is one of the simpler forms where motion is detected with regard to a fixed background scene. More advanced functionalities include video tracking and ego motion estimation.

Based on the internal representation that VCA generates in the machine, it is possible to build other functionalities, such as identification, behavior analysis or other forms of situation awareness. VCA relies on good input video, so it is often combined with video enhancement technologies such as video denoising, image stabilization, unsharp masking and super-resolution. In this process the objects may be detected by applying several algorithms like haar like features and adaboost algorithms [1].To date many frameworks are proposed for road traffic monitoring using surveillance cameras. A traffic monitoring system includes object detection and tracking, behavioural analysis of traffic patterns, number plate recognition, and automated security and surveillance on video streams captured by surveillance cameras. T. Abdullah [4] presented a framework for stream processing in cloud that is capable of detecting vehicles from the recorded video streams. This framework provides an end-to-end solution for video stream capture, storage, and analysis using a cloud based graphics processor unit (GPU) cluster. It empowers traffic control room operators by automating the process of vehicle identification and finding events of interest from the recorded video streams.

Feature tracking based and histogram based traffic congestion detection systems are developed by Ozgur Altun and Kenan Aksoy[3]. In this histogram based traffic congestion algorithms were implemented. This method mainly ORB (oriented Fast and rotated brief) were used to solve the traffic congestion problem. Automatic detection of bike-riders without helmet by Dinesh Singh, C. Vishnu and C. Krishna Mohan also serve for prevention of traffic accidents [2]. In this the importance is given to detection of bike riders and identifies the riders without helmet. An automatic license plate recognition system is presented by Y. Chen [5] using cloud computing in order to realize massive data analysis, which enables the detection and tracking of a target vehicle in a city with a given license plate number. It realizes a fully integrated system with a surveillance network of city scale, automatic large scale data retrieval and analysis, and combination of pattern recognition in order to achieve contextual information analysis. In this paper we propose a framework for dynamic control over the traffic by automatically detecting the vehicles using the haar-like and HOG, SIFT, SURF all are well represented features use to classify and detect the vehicles [6] and then using the count obtained by counting the number of vehicles, we would propose the dynamic signalling time for each way based on the count of the vehicles. This paper describes progress toward a system which can detect vehicles regardless of pose reliably and in real-time based on Haar-like features. Haar-like features are introduced by Viola et al.[1] Object detection by Viola Jones algorithm is a real – time process. In this method, four key elements are AdaBoost, Haar-Like feature, cascaded classifier and integral image. Haar - Like is a rectangular simple feature that is used as an input feature for cascaded classifier. AdaBoost algorithm (a machine learning meta-algorithm) in choosing features and improving the performance is repeatedly used. AdaBoost in order to construct a strong classifier combined many weak classifiers. Integral image is a quick method for calculating the Haar-Like feature. Viola & Jones has used this technique and they recognized which Haar-Like feature among the other Haar-Likes is in each image. Integral image is sum of all pixel values in above and left of the position (x, y). Cascaded classifier is used for fast rejection of error windows and improving the processing speed. In every node of trees there is a non-vehicle branching, it means that the image will not be vehicle. The training cascade generates an XML file when the process is completely finished. After generation of xml file, we can identify vehicles by viola Jones algorithm. The count variable is used to count vehicles and proposed algorithm is implemented and gives the output as dynamic signalling for all ways accordingly.

In this way for each way accordingly the time will be saved and they would be no problem of traffic congestion. This makes the dynamic control over the traffic.

The remainder of this paper is organized as follows: Section II presents the proposed approach for Dynamic signalling of traffic using video analytics. The proposed visual big data framework is presented in Section III. In Section IV discusses experiments and results. The conclusion is provided in section V.

II. PROPOSED FRAMEWORK

This framework consists of three different sections defined in the figure.

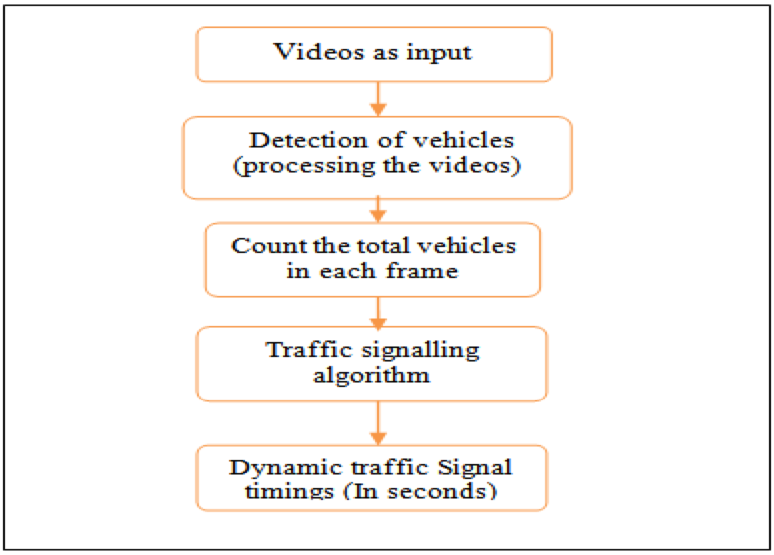

Fig: 1 Proposed Framework

2.1 Detection of vehicles

In the first part of the framework, the detection of vehicles is done. This detection is mainly based on cvhaarcascade features for vehicle detection in this for every video is considered to be taken as one way and in our experiment it is considered to be four ways and each way has a video. In this videos the vehicles are detected individually and all the videos are processed simultaneously. cvHaarcascade algorithm is implemented in order to detect the vehicle. Opencv is used to implement the in-built functions of the cvhaarcascade algorithm. Firstly, the videos are loaded using cvload functions and then cvcreateimage function is used to create image which is used as frame. Detect function implemented in order to detect and count of vehicles are known. This process is carried out simultaneously until the video ends. In this detect function in background the xml file that is created or loaded, it contains of various positive and negative images of the vehicles. This haarcascade features are implanted on the current frame if it matches then the vehicle will be detected. This xml files contains all the features that are required to indentify the vehicle. In this way using cvHaarcascade features vehicle is detected.

2.2 Counting of vehicles

Counting gives the number of vehicles detected particularly in that frame. This is implemented simultaneously for all the four different videos individual count is identified. This count resets after every time limit. In our project we reset the count for every 10 frames. As the frames are repeated or similar vehicles are identified in the consecutive frames, the average count is considered. In this, four count variables (c1, c2, c3, c4) are used for four different ways as shown in eq(1). This four count variables are considered as input to the proposed algorithm. Prepare Your Paper Before Styling

2.3 Dynamic signalling

The count of the vehicles that are identified are taken as input. They are arranged in an ascending order such that the least number of count is considered first. Accordingly they are named with the ways and gives the way along with their individual count. Then go-signal and stop-signal is implemented. GO-signal gives the green signal timings for a particular way individually. STOP-signal gives red signal timings accordingly for each way. GO-signal is implemented by allocating the green signal to the least way which as the least count, next to higher count way. Stop-signal is implemented by assigning zero time for the first road or way and for the next road go time of first road and stop time of first road. Similarly for third road, stop time of second road added with go-time of second road. Time for the go-signal is calculated using logic of average number of vehicles that cross the signal per particular time(in seconds). Using this logic the stop and go signal timings are generated which leads to the dynamic control of traffic. This provides the dynamic control without any manual operation. This process of detecting and then providing dynamic signaling will be a continuous process carried out until the video ends.

2.4 Equations

In order implement algorithm we considered four count variables C_1, C_2, C_3, and C_4. The equation is given as

$C_i=C_i+\text{count}$ (1)

Where i=1, 2, 3, 4;

This count is calculated for each way or video. The total amount of time saved per each way is calculated using the following equation,

saved time = static time allocated – Array[i] (2)

Array[i] = dynamic time allocated by the algorithm for that particular i^{th} way.

TTS = saved time + TTS (3)

TTS = Total time saved

The Stop-signal equation consists of the parameters of go-signal time. The equation for the STOP-signal is given as the following,

Stop[0] = 0 (4)

Stop[n] = go[n-1] +go[n-2]+….+go[0] (5)

Stop[0] gives the stop signal for first way which zero seconds for first way (i.e., immediate green signal for first way).

Stop[n] = stop signal time for n^{th} way. go[n-i] is the go-signal time for $(n-i)^{th}$ way. Similarly for all the four roads are go and signal time are calculated individually and provide signal timings dynamically. This gives a solution to traffic congestion.

III. PROPOSED ALGORITHM

After detection process, count of vehicles are obtained then this algorithm is implemented.

3.1 Traffic signalling Algorithm:

```
signaltime( c1, c2,….,c3, cn)
{
        a[n], c[n], g[n], f[n];
        b, save;
        Timesave = 0;
        a[0..n] = c1,c2,…,cn;
        c[0..n] = c1,….cn;
        For i= 0 to n //arranging count
in ascending order
        {
                For j = i + 1 to n
                {
                        If (a[i] > a[j])
                        {
                                b = a[i];
                                a[i] = a[j];
                                a[j] = b;
                        }
                }
        }
```

```
for i=0 to n //logic to find stop signal timing
        {
                For j=0 ton
                {
                        if (a[i] == c[j])
                        {
                        save = (60 - a[i]);
                        timesave = timesave + save;
                        print"GO Signal time for road : " a[i]
                        g[i] = j;
                        print"time saved : " save
                        c[j] = -999;
                        }
                        continue;
                }
        }
print"Total saved time :"ts" seconds "
        f[0] = 0;
        f[1] = a[0];
        f[2] = a[1] + a[0];
        f[n] = a[1] + a[2] +….+ a[n-1];
        for i = 0 to n
        {
                Print"STOP Signal time for road "g[i]: f[i]
        }
}
```

This is the proposed traffic signaling algorithm which consists of four arrays used in different cases for identifying the ways along with the count. For go and stop signal two different arrays are used a[] and f[]. This algorithm consists of arranging the count variables in ascending order as the first part. Then the logic for go and stop-signal are implemented as second part. The logical equations used to get the go and stop signal timings.

In this algorithm three ‘for’ loops are used one for ascending order and remaining two are for stop and go signal timing. Time complexity is in the order of O(N).

IV. EXPERIMENT AND RESULTS

In this paper, all used videos are from real scene traffic in different light positions, the videos formats are AVI.

In order to prove the effectiveness of algorithm, we use Microsoft visual studio and OpenCV to simulate the experiment.

4.1 Cvhaarcascade algorithm for detection of vehicles

Using cvhaarcascade algorithm detection as been carried out, where the accuracy is better than the other algorithms like SVM, KNN, NN, 1D-DBN, DCNN. The accuracy, completeness, and quality rates of this method were about 94%, 92%, and 87%, respectively [33].

4.2 Traffic signalling Algorithm for Dynamic traffic signalling

This algorithm is efficient to implement dynamic traffic signaling without any manual operation using cascading algorithm. On an average about 75% of time can be saved apart of regular traffic (compared to static signal timings for each signal is considered as one minute). On an average one minute of time is saved per one traffic signal.

Following figure shows the sample output of the experiment that has been implemented on real time videos.

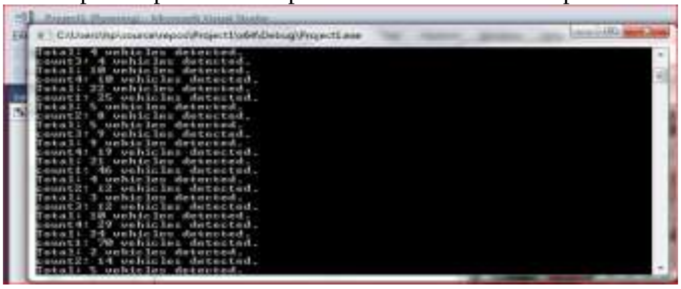

Fig.2. count of vehicles for each video

Above output shows the count of the vehicles that are detected individually for different ways. This is done simultaneously for all the four videos. In order to avoid the overlapping of frames and similar detection of vehicles in continuous frames the average is taken and value three is taken as the parameter to average the count integer (three frames average count is considered as one count value) in this experiment. This count is calculated with an accuracy of 95%.

Following figure shows the output for GO-signal and STOP-signal timing considered final output as the dynamic signal timing

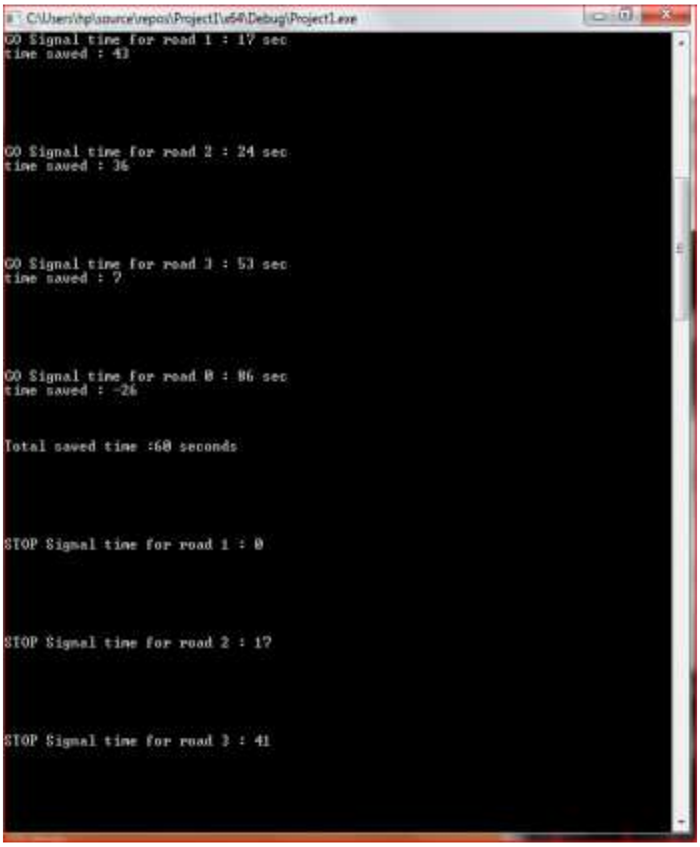

Fig. 3.final output

4.3 Analysis

Below graph shows the time allotted for each signal in present system vs. proposed system. The difference between both the graphs gives the time saved overall signaling over the four roads. Overall saved time is over 75% and on an average one minute at every traffic signal is saved at each time.

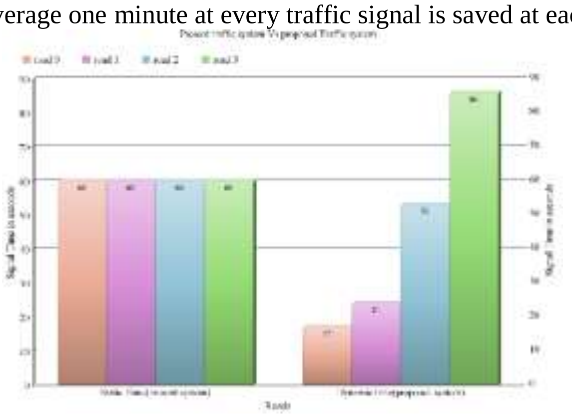

Fig.4. Graph of present system vs. proposed traffic system

V. CONCLUSION

Automatic detection system provides prevention of traffic without a manual traffic controller (police). The proposed system may be improved by applying advanced techniques that are implemented in future. This is well suited for country like India since the datasets are of Indian based roads. Totally an unknown amount of time will be saved using this proposed model. This model provides a basic solution to the Indian traffic problem. This application can be used in implementing smart traffic system, dynamic traffic controlling purpose.

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