Vehicle Detection Mechanism for Traffic Control using Video Processing: Software Implementation

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Abstract— Due to increase in traffic day by day, we need an intelligent video processing system for quick and accurate results to maintain flexibility and minimize noise ratio. In this paper, we are providing the overview of video processing based on tracking approach. We are describing the requirements for the real time implementation with the help of concepts of morphology, an efficient blob detection algorithm and edge detection operator, Sobel. We are analyzing vehicle detection and vehicle tracking with respect to density flow and its average traffic speed. With the help of camera/sensor, we are capturing the real time images to manage traffic lights in more effective and efficient manner.
Key words: traffic lights; density flow; video processing; traffic analysis

I. INTRODUCTION

Traffic management with the help of video processing for estimating the traffic parameters in real time traffic with respect to its noise ratio is quite complicated task. But with the help of concept of morphology, it will bring number if advantages for efficient traffic management which include classification of specific vehicles part according to their shape like circle, square , etc i.e the structuring element. Extracting the images on the basis of their shapes helps to find the flow of traffic during the specific period of time.

This motion based tracking[1] can control the traffic more effectively than the static image processing. With the result of efficient and accurate traffic information we can control complex traffic more easily at a particular period of time. We are focusing on two concept, vehicles shapes and their parameters to extract the required information at particular point.

Analyzing the queue length inside the frame provide the information to get the threshold value of current traffic on the road. We are trying to eliminate the shadow of the vehicles to bring accurate results for analyzing purpose. We are going to discuss vehicle detection techniques for real time traffic analysis. Based on research of vehicle detection techniques on video camera capturing is working later from 1970s till now. So, the need of advanced and intelligent traffic analysis device with the help of computer vision has now become more demanding for any developing country like India, where traffic controlling system is quite a big issue with respect to large population increasing day by day. Already various research and projects has been working for finding the solution of this problem. We are aiming to provide the cost effective technique to bring more accurate solution to this problem.

Using Sobel, we can extract the most efficient output from the video. The general overview of this paper is based on camera based detection using convex hull and Sobel[2] operator, we are calculating the blobs count and switching the traffic lights accordingly. We are aiming to design a system for intelligent management of traffic using video processing which is more efficient with respect to time and quality parameters. Video processing is more flexible, accurate and reliable.

Algorithms like edge detection extracts outlines/shapes of objects to calculate pixel density. Sobel, Perwitt and Canny[3] are commonly used edge detection operators. Sobel operator produces more accurate results than the other two (Perwitt and canny) operators, so we will use Sobel operator for efficient processing.

Another technique, which is Morphology[4] in the field of video processing plays an important role in reducing noise as compared to other methods and hence, help in improving the extracted image quality after video processing. It extracts images on the basis of structuring element which can be disk, circle, square, etc i.e. this algorithm detects objects according to some predefined shapes. So, morphology will be used for extracting images in more accurate way.

II. RELATED WORK

In [5] Background Subtraction is used for traffic management system. Implementation of this algorithm extracted the region of interest from a particular image. Traffic light switching is further calculated by calculating blobs density.

In [6], automatic control over brake is an additional feature provided to the vehicles which will reduce accidents on the road. Further, an alert system is added to the system which sounds if traffic rule is violated and a GPS/GSM tracker which incorporates in tracking a vehicle in case it is stolen or used for some fraudulent purpose.

In [7] a system has been proposed where traffic control is done with raspberry pi module using image processing to control traffic light delays. A camera source has been installed at the light posts for capturing images and further analyzing it for traffic control.

In [8] Canny edge detection algorithm is used for noise reduction and detect pixels more efficiently and calculating blob density for controlling switching between traffic lights.

We have already implemented this project using image processing for calculating binary largest object from the static traffic images and obtained the blobs count on the basis of the shape of vehicles[9], which in turn is used to calculate delays between traffic lights.

Ouput is shown as below:

Fig. 1: Showing different Blob Density on four lane traffic

Now, we are extending this technique to the video image processing and find this as the best solution for real time visualization and analyzing the real time traffic density.

III. LITERATURE SURVEY

A. Video Image Processing:

Analyzing moving object in the video frames with the help of computer vision helps to process the images of vehicles like cars, buses, trucks, motorcycle under the various traffic conditions during the peak hours or mid-day traffic etc with respect to different lightning conditions such as daylight, sunny, raining, etc.

B. Edge Detection -Sobel operator:

Sobel[10] operator is used in edge detection algorithm. It is more efficient than the other two i.e. canny and Perwitt operators

Advantage of Sobel over Perwitt operator is that in Sobel, coefficient of masks are not fixed and hence adjustable as per our need, until and unless any property of derivative mask is not violated.

Two types of edges can be detected in an image using Sobel operator : Horizontal direction and Vertical direction.

C. Horizontal Direction:

-1	-2	-1
0	0	0
1	2	1

Table 1:

Edges in horizontal direction will be extracted. It would prominent the horizontal edges in the picture when the mask will be convolved onto the image. "It has 2 and -2 as a center element of first and third row". Difference among pixel intensities(above and below) of a particular edge is calculated instead of original values of an edge as mask[11] consist of zeroes in center row. Sudden change of intensities makes the edge more visible.

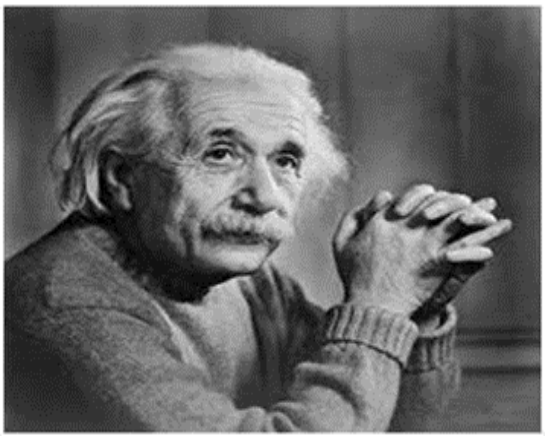

Fig. 2: Sample Image

Fig. 3: Horizontal mask example

D. Vertical Direction:

-1	0	1
-2	0	2
-1	0	1

Table 2:

Edges in vertical direction[12] will be extracted. It would prominent the vertical edges in the picture when the mask will be convolved onto the image. "It has 2 and -2 as a center element of first and third column". Difference among pixel intensities (above and below) of a particular edge is calculated instead of original values of an edge as mask consist of zeroes in center row. Sudden change of intensities makes the edge more visible.

Fig. 4: Vertical mask example

E. Morphology:

Morphology is used to extract useful components from an image on the basis of some predefined shape like circle, disk, square, etc, which is known as the structuring element, also known as kernel.

Four basic operations in morphological algorithm [13] are : Erosion, Dilation, Opening and Closing.

F. Erosion:

It erodes the boundaries of background pixels, which in turn makes "holes" of those areas larger. This can be implemented by AND operation.

G. Dilation:

Dilation enlarges the background pixels, which in turn, shrinks "holes" of those areas . This can be implemented by OR operation.

H. Opening:

It produces more efficient result than the above mentioned operations, as it incorporates the combination of both. Opening is erosion followed by dilation.

I. Closing:

Closing is just the opposite of Opening. It is performed by dilation followed by erosion[14].

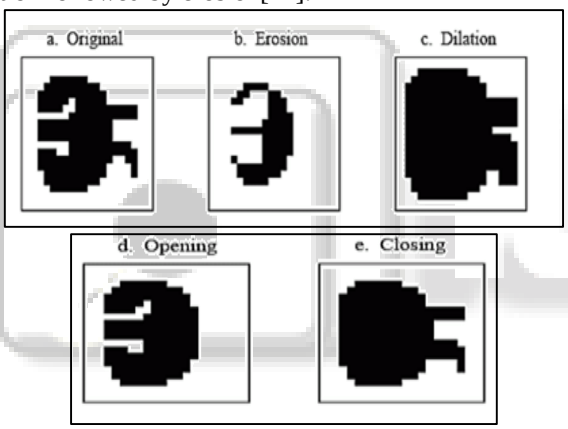

Fig. 5: Morphology examples

IV. OUR PROPOSED SYSTEM

Our system is implemented in Visual Studio using OpenCv which supports wide range of image processing operations with help of some libraries. As discussed in Section I, Sobel operator,an edge detection algorithm and morphology is used for object detection.
Steps involved are:

A. Capture real time traffic:

A camera is installed at a height to capture real time images from the traffic. Images of four lane road with different density is captured from the live traffic.

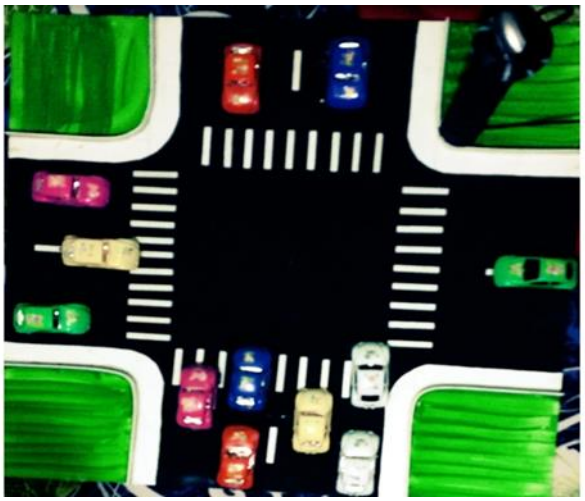

Fig. 6: Four lane road traffic with varying densities

B. Get Blob Density:

After extracting images from the live video, we calculate the blob density of each lane with different densities.
Code is as follows:

```
ExtractBiggestBlob fil2 = new ExtractBiggestBlob();
        fil2.Apply(aq);
        label2.Text = Convert.ToString(i);
```

C. Control red light duration by comparing each lane:

Further, we click on the Compare button to control the delay between the traffic lights which depends on the blob count of each lane. More the traffic, less will be the duration of the red light.
This will efiiciently manage the traffic.
Output is shown as :

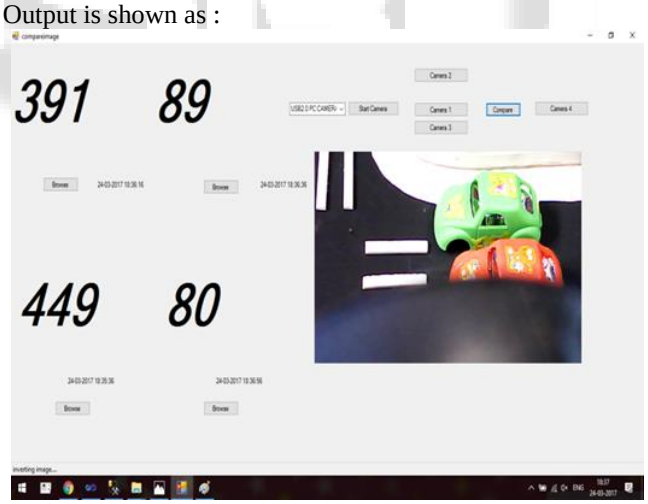

Fig. 7: Timer control after comparison of blob densities

V. CONCLUSION

In this paper, we have compared various tracking methods Edge Detection, Morphology,etc for object detection and we have concluded that morphological operations and Sobel l algorithms are less susceptible to noise than all other blob detection algorithms. Morphological operations are more efficient in terms of detecting edges, improving signal to noise ratio and noise susceptibility whereas other techniques are inaccurate in terms of time and quality constraints.

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