Traffic Routing Control System at Cross Road Using Image Processing Techniques

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***Abstract*—The flexibility and fast optimistic result trends of image processing has made it an eminent tool for research in recent scenario. The features of image processing are envisaged for video image processing which estimates the traffic density at cross roads and research of real time traffic control has been proposed in this paper. The processed data have been used to synchronize traffic lights with variable time delays. The paper is enriched with complete control scheme and its implementation. The analysis of statistical data has been done to make the system more adaptive in real time atmosphere. The working performance of a control system has been carried out in MATLAB tool. The paper has been concluded with different prospective of research and highlights of future scope.**

***Keywords*—Traffic congestion, video image processing, adaptive control system, control algorithm..**

I. INTRODUCTION

Enormous increase in traffic costs man hours and time. Present traffic controlling scheme includes either manual control of traffic or a conventional fixed timer based control system, which is still incapable of handling traffic efficiently. Many research work has been done in this area. Image processing is one of the most familiar field which provides solution with ease. To develop such efficient control system, it requires proper diagnosis of problem. There are basically two main objectives: (1) Detection of vehicle density and (2) controlling algorithm for traffic lights. With the help of image processing an effort is made to bring a new approach for the detection of vehicle density. Many methods have been proposed so far for the detection of vehicle density. These Methods involves counting of total no of pixel, direct subtraction method, counting total no of edges. In this paper a combine approach is made which is composed of counting total no pixel value. Next section illustrates the general overview of whole control system. The description of vehicle detection method is explained in section three. Final control algorithm is explained in section four and lastly a brief conclusion and future work has been discussed.

II. OVERVIEW OF PROPOSED CONTROL SYSTEM

In this section a general overview of proposed system is explained with the help of block diagram. Explanation of each block is elaborated. All these processes have been carried out in MATLAB tool.

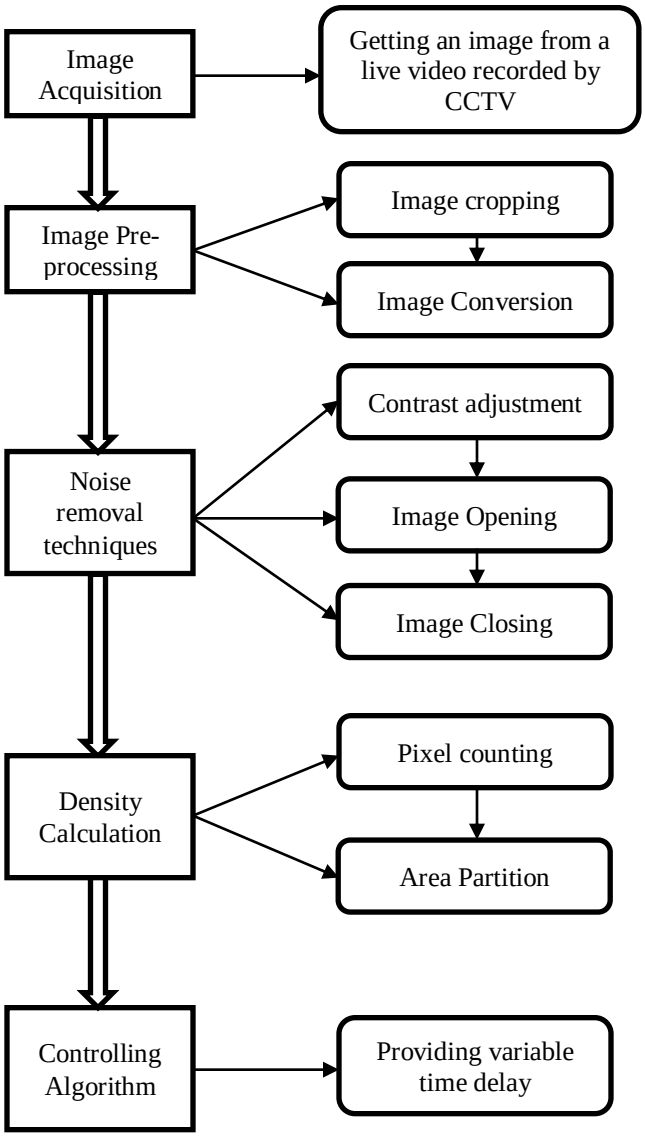

Fig. 1. General block diagram of traffic control system based on image processing techniques

A. Image Acquisition

The primary step for the calculation of vehicle densityis to acquire an image of traffic in particular lane. CCTV cameras have been installed at the cross road and in a mid-way of specific lane for safety and governing purpose. From CCTV online monitoring can is possible. From online video a snapshot is taken, which is basically one of the frames of that video.After getting a single image following processes is operated.

B. Image Pre-processing

Image pre-processing includes various pixel based sequential operations.

1) Image Cropping

Installed CCTV camera can cover more area other than road lanes. This additional area simply cause additional computational time and create complexity in density calculation.Hence, cropping of image is essential which includes only road lanes.

2) Image Conversion

Performing Processes on colored image requires more amount of computational time than the gray scale image. Colored image is composed of three basic color forms namely red, green, and blue. So operator needs to perform all processes on these three forms of pixels, which increases computational time. So to avoid such extra calculation image is to be converted to gray scale image, which converts colored image into gray color bands.

C. Noise Removal Techniques

1) Contrast Adjustment

Image is composed of high and low frequency components. Noises are often contained in high frequency band. Such noises is known as shadow. To remove shadow effect from an image, contrast adjustment is done. Contrast adjustments eliminates range of pixel which are falling into shadow gray band. Most of the noise is reduce by just adjusting contrast of an image.

2) Image Opening

Image opening and closing both are operations of morphology. Both of these operations are normally performed on binary scale images The basic effect of an opening is similar to erosion in that it tends to remove some of the foreground (bright) pixels from the edges of regions of foreground pixels [7]. This operation is performed by choosing appropriate size of filter element.

3) Image Closing

Closing is considered as special operator in mathematical morphology. It can be derived from the fundamental operations of erosion and dilation. Closing is similar in some ways to dilation in that it tends to enlarge the boundaries of foreground (bright) regions in an image (and shrink background color holes in such regions), but it is less destructive of the original boundary shape. As with other morphological operators, the exact operation is determined by a structuring element. The effect of the operator is to preserve *background* regions that have a similar shape to this structuring element, or that can completely contain the structuring element, while eliminating all other regions of background pixels [7].

D. Density Calculation

Density calculation has been carried out using two important methods.

1) Counting the total no of pixels

After processing various noise removal techniques an image is sent for the pixel counting algorithm [1]. In case of direct subtraction method total number of pixels directly infers as traffic density. But in our case we are counting total no of pixel (P) for the estimation of total no of vehicles.

2) Area Partition

Camera is installed at certain height, which covers the area at certain angle from the horizontal road as shown in figure.

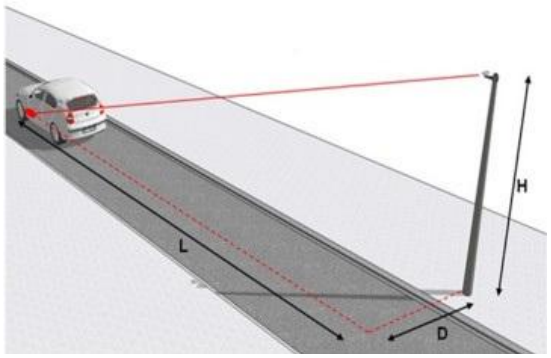

Fig. 2. Installation of CCTV camera at certain angle

The objects which is close to camera seems bigger in size and contain more number of pixels in acquired image. Same way objects which are at distant, looks smaller in size and occupies less number of pixel. In order to get total no of cars which infers total vehicle density a

Fig. 3. Vehicle counting by calculating total number of pixel range-wise.

Relationship between length L, angle and height H is necessary. As shown in figure-3, in the range of line 1,

number of pixels occupied by vehicles are more compared to other range of lines. By calculating pixel range wise gives total number of vehicles.
This relationship can be found by doing offline monitoring of several video frames. By using these statistical data we can infer total no of pixels covered by particular vehicle.

E. Controlling Algorithm

After getting total number of cars from an image. Application of controlling algorithm is done. The controlling algorithm works as described.

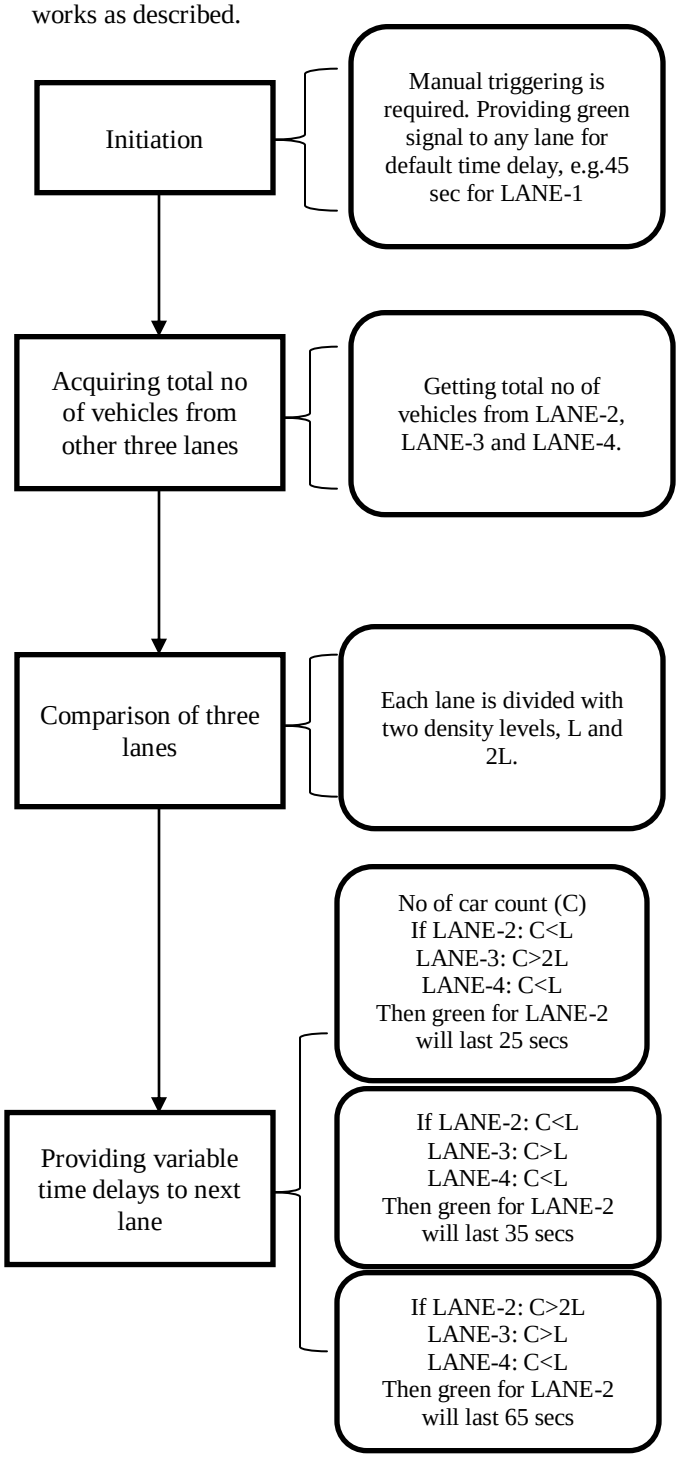

Fig. 4. Block- Diagram of controlling algorithm

The priority is given to the lane who has density greater than 2L.
So if lane-2 is having density greater than 2L then more 20 seconds is provided for the green light. If any other lane contain density more than 2L then there are two possibilities:
1). If lane 2 has density < L then minus 20 seconds from 45.
2). If lane 2 has density <2L then minus 10 seconds from 45.
And last possibility is if all three lane contains same traffic density then each one will be provided 45 seconds. By this way variable timing delay will be provided sequence wise.

III. HARDWARE IMPLEMENTATION

Image acquisition is done with the help of CCTV camera. Online monitoring can be done using MATLAB Simulink library for Image acquisition. After getting an image all image processing techniques is done in MATLAB and application of algorithm done via MATLAB. MATLAB sends control signal to traffic light via any embedded tool like arduino or any other arm processor which are supported by MATLAB tool [9].

IV. CONCLUSION AND FUTURE SCOPE

The proposed control system is able to eliminate the drawbacks occurred by conventional fixed timer based control technique. It can eliminate dead lock conditions as continuous monitoring is carried out. It is more efficient as it can provide variable timing delays which can save man hours as well as natural resources like petrol consumption. In future scope additional formality can be carried out for the case like if any lane goes empty before completion of given green signal time then it switches directly from green to red and controlling action will be provided for next lane.

V. REFERENCES

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