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Traffic Density Analysis Using Canny Edge Detection Algorithm

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Abstract

Traffic monitoring and controlling has always been a challenge. The vehicular traffic is increased exponentially that causes traffic congestion and road accidents . Improved traffic density estimation would help to curb the traffic before it becomes critical problem. The proposed image processing based traffic density analysis system reads a video captured by web cam and background subtraction would be applied on the converted frames. This process would lead us to get a binary image which would be processed for vehicle detection and further analysis. The software required is OpenCV. The hardware required is Arduino, USB web camera, traffic light module, etc. The existing system is inefficient for the humongous traffic currently present on the roads and the non-linear behaviour of the traffic cannot be completely analysed. In the proposed system the moving objects or vehicles are distinguished and hence vehicles would be detected easily. It can also reduce the traffic congestion rate.

Keywords—*Image processing, background subtraction, traffic density estimation, reduced traffic rate.*

I. INTRODUCTION

One of the biggest problem faces in the developing city is traffic- jam. Day-by-day, traffic density is rapidly increasing and it is very difficult to find traffic density in real time nature. Also scheduling the traffic signal for control and providing effective routing for traffic is difficult. The root cause of this can be of different situations like congestion in traffic like insufficient Road width, Road conditions due to weather, uncontrolled demand, huge delay of Red Light etc. The inadequate capacity and uncontrolled demand is correlated and the delay faced by the respective lights is fixed and doesnot depend on traffic density. Indeed, manual control is must, Therefore, in order to reduce man's power and to satisfy increasing demands, the traffic control signals needs to be optimized and simulated. Technology in the last few years using image processing for surveillance and safety, is largely deployed in vehicle and traffic control for traveller information. The traffic density estimation can also be achieved using Image Processing. The solution we provide for Traffic management by having a special intelligence which the images of road feed from the cameras (webcam or IP camera) at traffic intersection, the traffic density is calculated on a real time basis using image processing . It also concentrates on the algorithm where the traffic light is switched based on vehicle density on the roads, thereby intended to reduce the traffic congestion on roads so the number of accidents is minimised. Also it will provide safe movement for people, reduced fuel consumption and waiting time .

The rest of the paper is organised as follows. The next section discusses the Literature survey on the existing taffc density algorithms. Section III presents

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the Proposed Architecture for the traffic density analysis algorithms.. Section IV discusses working principle proposed system architecture. Section V deals with the methodology followed. Section V shows the experimental setup and results. Finally conclusions are given in section VI.

II. LITERATURE SURVEY

A number of techniques are proposed to detect traffic density to control traffic signal based on image processing algorithms. The image processing algorithms used many mathematical methods to detect traffic density. The proposed method uses canny edge detection algorithm to measure traffic density. The traffic signals are controlled using Perwitt edge detection and fuzzy logic. The proposed method uses a background subtraction based traffic density estimation method which focuses on providing an intelligent traffic control system which controls traffic light based on traffic density.

TaqiTahmid, EklasHossain[1] have presented a strong requirement for the introduction of modern technology and equipment to improve the need for traffic control. The present methods based on timers or human control are evident to be a good solution to eliminate this difficulty. In this paper, canny edge detection with digital image processing is proposed and a system is designed to control the traffic by measuring the real-time traffic. This traffic control system offers good results in response time, management of vehicle, automation, reliability and efficiency over the old systems. Apart from these, the whole technique from image acquisition to edge detection and finally allotting green signals using four tested images of different traffic conditions is illustrated and the final results are implemented by a hardware.

Mohammad ShahabUddin , Ayon Kumar Das , Md.AbuTaleb[2] explains a method for traffic density estimation on a real time basis using image processing and an intelligent traffic control system is designed. The Vehicles density is estimated based on the area occupied by the edges.

The traffic density of each road is calculated automatically by estimating the areas of different live roads so that the duration of each traffic light can be estimated. Traffic signal control system with the proposed traffic density estimation technique has better performance than the existing timer based system. A new technique is developed in this paper where the traffic congestion is controlled by detecting the traffic density based on the edges of vehicles. The traffic density is detected by using specialized algorithm, morphology and images captured with cameras.

Anil Atvar, Yusuf OguzhanArtan ,ŞafakOzturk[3] presented the analysis of video on low/high resolution security camera images. Traffic density estimation from Traffic camera images can be used to estimate traffic density is considered as one of these subjects. The traffic density on roads is estimated by utilising the GPS data from commercial vehicle fleets. Image processing and classification algorithms on traffic camera images have been used to estimate traffic density. In this study, a simple method is proposed to estimate traffic density on roads that does not require high computational processing power.

Md. FahimChowdhury, Md. Ryad Ahmed Biplob, JiaUddin[4] have given a traffic control system where the real time video feeds and image processing is used to measure the traffic density at the intersections . A sample video is collected and background subtraction method is done by the mixture of Gaussian algorithm and foreground detection to keep the count of the cars in each lane. The line of centroid is used to detect the vehicles. The presence of vehicle is confirmed by the movement in centroid. From the video feeds, based on the condition of traffic, the traffic light at the intersection will change accordingly. The number of vehicles entering and leaving each intersection is

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counted by the multiple cameras. Also the vehicle is restricted to take right turn at the intersection..

III. PROPOSED ARCHITECTURE

In this paper, a system is designed for traffic density analysis based on image processing techniques. Here we use web cameras which provide frames at fixed rate. It is the input given to the system. Background subtraction algorithm is applied on these frames. The output from background subtraction process is processed to calculate density on traffic. Based on the density estimation it sends control signals to traffic control module. The advantages are reduced congestion rate, minimized road accidents, provide safe movement time for people, reduced power consumption and wait time for the people. The diagram of the entire proposed system is as shown in the Fig.1.

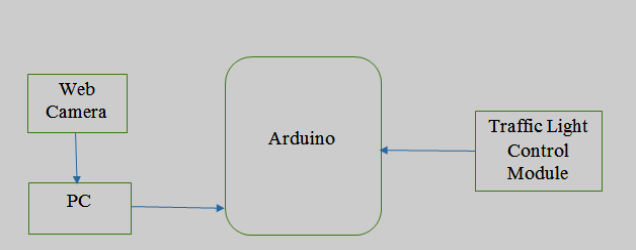

Fig. 1:Flow diagram of proposed architecture

IV. WORKING PRINCIPLE

The web camera is placed on the either side of the roads. During camera setup process the static frame of interested area is fixed. These cameras provide frames at fixed rates. These frames are then processed using background subtraction algorithm. Background subtraction algorithm results in a binary image which shows the objects on each frame. The output obtained from background subtraction process may contain broken edges. These edges are joined with the help of dilation process. It also enhances the edges of the object. The dilated image is then processed by applying contours to estimate the objects on the each frame. Based on the estimation the control signals are sent to the traffic light control module.

V. METHODOLOGY

The Web camera provides frames at fixed rate which is fed as input to the system. These frames are then processed using background subtraction algorithm. The output obtained from the background subtraction process is dilated and applied contours to estimate the traffic density on specific frame. Based on the estimation the interrupts are sent to the Arduino. Arduino is interfaced with control module of traffic light. Depend on the interrupts sent to Arduino, the control signals are sent to the traffic light control module.

PREPROCESSING

At the lowest level of process, pre-processing is done for both input and output images where the intensity is good. The aim of pre-processing is an improvement of the image data. The unwanted distortions is suppressed or some image features are enhanced for further processing.

1. CAMERA SETUP

The input data for the system is the frames produced by the camera at a fixed frame rate. In the first step, the static scene with interesting points should be manually marked once. New vehicles can appear or disappear in the interesting points. Another possibility is to mark only the roads themselves can only be marked as interesting areas if the interested thing is the vehicles on the road.

2. BACKGROUND SUBTRACTION

In this step, background model is generated and all foreground objects in the current frame is displayed using a binary mask. This technique also results in elimination of shadows.

3. DILATION

Dilation means enhancing the pixels across the boundary of the object in the frames. The detected frames from the above step may contain broken

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edges. The outline of the vehicles does not dilate the broken edges. The gaps between the edges are filled by dilation operation.

4. APPLYING CONTOURS AND DENSITY ESTIMATION

This step leads to density estimation. Contour which is a rectangular box is applied across all the dilated frames. These contours will cover all the dilated objects on the frames. This will results in the number of objects in a specific frame.

5. DECISION MAKING

In this step we will make a decision based on the above steps. If the estimation for cam 1(in case of two cam system) is greater than estimation for cam2,the the control signal to traffic control module is changed according to the estimation and vice versa.

VI. EXPERIMENTAL SET-UP

CASE 1: Traffic Density in Camera 2 is greater than Camera 1

In the result below, camera 1 is focusing on any one of the directions (here we have taken it has east) and camera 1 is focusing on opposite direction (say west) with respect camera 1.It is found that camera 1 is with low density when compared to camera 2. Fig 2 depicts the above scenario.

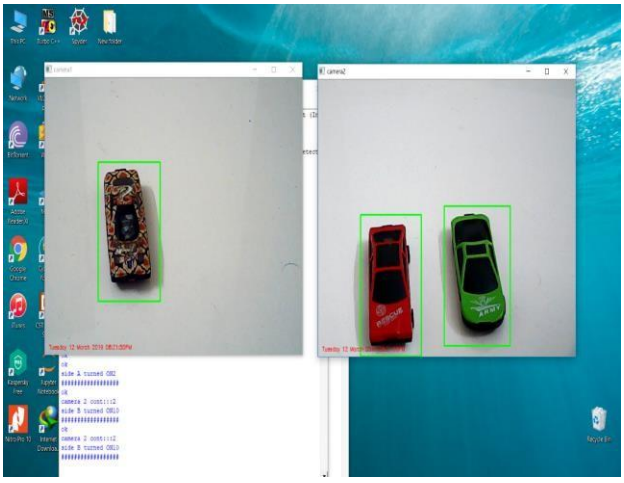

Fig.2: Traffic Density in Camera 2 is greater

So the signal favouring to traffic on west direction is made green and that of the east is made red.

Based on the given delay it checks alternatively. In this north and south direction are made always red as we didn't take into account for density estimation. Fig. 3 shows the above traffic condition.

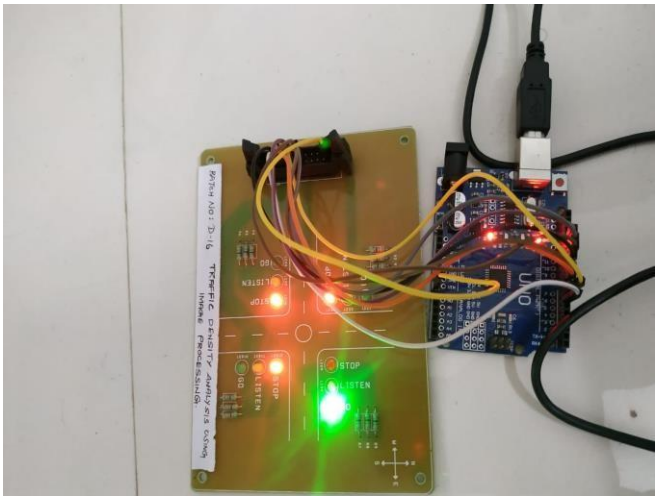

Fig.3: Signalling status when traffic density in Camera 2 is greater

CASE 2: Traffic Density in Camera 1 is greater than Camera 2

In the result below, camera 1 is focusing on any one of the directions (here we have taken it has east) and camera 1 is focusing on opposite direction (say west) with respect camera 1.It is found that camera 2 is with low density when compared to camera 1. Fig.4 depicts the above scenario.

Fig.4: Traffic Density in Camera 1 is greater

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So the signal favouring to traffic on east direction is made green and that of the east is made red. Based on the given delay it checks alternatively. In this north and south direction are made always red as we didn't take into account for density estimation. Fig.5 shows the above traffic condition.

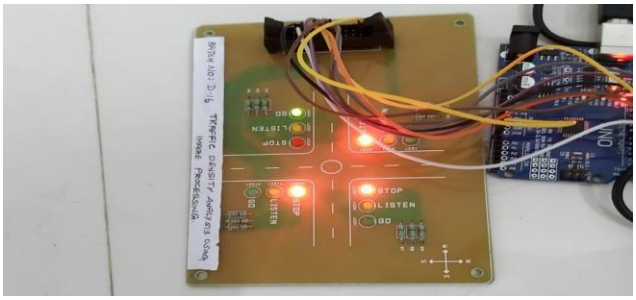

Fig.5: Signaling status when traffic density in Camera 1 is greater

VII. CONCLUSION

The proposed system is tested with the toy cars and the snapshots of the result where shown above section. The results were more accurate than the existing system. Even at equal heavy traffics on both sides it minimizes the traffic rate by releasing the signal at regular intervals. Therefore it minimizes the traffic congestion rate, minimizes the wait time of the people, reduces the road accidents, etc. the system is bit slow when compared to the existing system due to processing of images which can be resolved using high end image processing processor. Position of camera is much more important because wrong position may lead to improper results. As a future scope we can also add ambulance detection along with this system. When an ambulance is detected and the density of traffic is less on comparing to other side then the side with the ambulance is given more priority than the other side.

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