

Time To Cross – Traffic Light Control System using Image Processing

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Abstract – Over the past decades, increasing traffic volume poses many challenges in the society. There are many accidents happening these days due to careless behavior of the pedestrians and vehicles at the traffic signal. In this paper we bring an idea of smart traffic control system using image processing by integrating it into an existing CCTV camera commonly installed on street poles. The cameras placed on the street poles, one will be focusing on the pedestrian and other on vehicles. Both cameras will be capturing images. Then using image processing the density of pedestrian and vehicle in respective images are taken and compare. If the traffic density of vehicles is more than a particular limit and density of pedestrian is normal, then vehicle mode will be on. If the traffic density of pedestrian is more than a particular limit and density of vehicle is normal, then pedestrian mode will be on. When pedestrian mode happened, the microcontroller will send the signal to the connecting speaker to notify those pedestrians about crossing time. If the density of both pedestrian and vehicle more than limit, then there will be a traffic cycle which gives equal time interval for both teams to cross the signal. The system was composed of camera, PIC microcontroller for traffic signal and recorded voice notifier using a portable speaker. The motto behind this research is to reduce the conflict at the traffic by giving equal importance to both vehicles and pedestrian.

Key Words: traffic volume, smart traffic control system, traffic density

1. INTRODUCTION

Traffic mobbing is a major problem in developed cities. In this traffic mobbing scenarios peoples are wasting vehicles fuel and unable to utilized their time [2]. High utilization of present road capacity by managing traffic efficiently is very important. Due to these traffic congestion people's daily schedules getting disturbed as well as some are going through critical cases [3][5]. If we take example of ambulance having patient in critical conditions and if there is traffic jam on that road, then there are high chances that ambulance will not be able to reach hospital in time. Due to situations like these human lives are in danger. That's why there is need of dynamic intelligent traffic control system who can able to handle these traffic conditions efficiently to circumvent traffic crowding and accidents situations [4][5].

As the problem of urban traffic congestion spreads, there is a pressing need for the introduction of advanced technology

and equipment to improve the state-of-the-art of traffic control. Traffic problems nowadays are increasing because of the growing number of vehicles and the limited resources provided by current infrastructures. The simplest way for controlling a traffic light uses timer for each phase. Another way is to use electronic sensors in order to detect vehicles, and produce signal that cycles. Besides, the highway and roads are incapable of meeting the requirement of increasing number of vehicle. Instead of working on roads to accommodate the growing traffic various techniques have been devised to control the traffic on roads like embedded controllers that are installed at the junction.

We propose a system for controlling the traffic light by image processing. The system will detect the density of vehicles and pedestrians through images instead of using electronic sensors embedded in the pavement. Cameras will be installed alongside the traffic light or street poles. They will capture image sequences. The image sequence will then be analyzed using digital image processing for vehicle and pedestrian density, and according to the density of both pedestrian and vehicle on the road traffic light can be controlled.

2. SYSTEM DESIGN

The work is dividing into 4 parts. The first part is to process the video signal of pedestrian and vehicle captured through the existing cameras using Image Processing. The second part is to changing timer according to density of the traffic after the image processing. The third part is to send the signals to the Microcontroller for control the traffic lights. The final part of this work is to send the signal to the speaker to notify the people about the traffic light. Block diagram of the proposed system is given below.

A. Real Time Image Processing

A system having the cameras which connected to the processor is installed on the traffic light. In a traffic light area two cameras are installed, one is to monitor the vehicles on that lane and other is for pedestrians. Camera will give the traffic images to the processor. In processor, Image Processing algorithms were there which will process the image to extract out the needful information in short span of time.

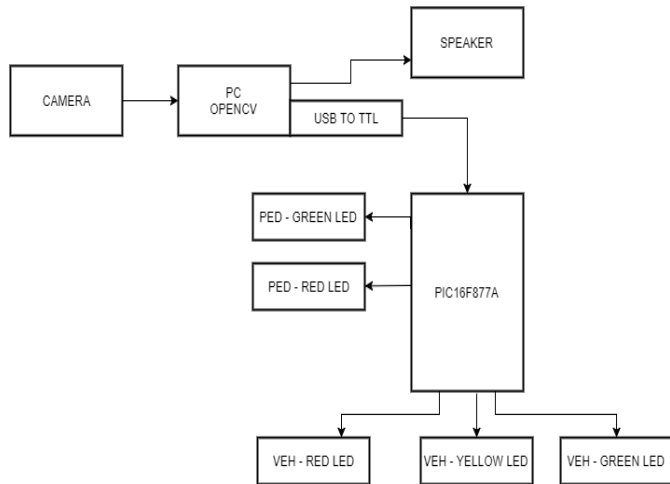


Fig - 1 : Proposed traffic control system model

In this system OpenCV(Open Computer Vision) is used for the image processing. It is the field of informatics which teaches the computers to see. It is a way computers gather and interpret visual information from the surrounding environment.

B. Changing Timer according to traffic density

Timers for the traffic signals are changing according to the output of algorithms. Two cases are made out from the above algorithms.

- 1) Using Cascade classifier gives the vehicle density count on the road as shown in Fig 2. Cascade classifier is used to detect the objects in the video stream. This algorithm is capable of differentiating vehicles from different objects.
- 2) Using Histogram of Oriented Gradient, gives the pedestrian count on the road as shown in Fig 3. According to the observation, the timer for the pedestrian on the traffic will change.

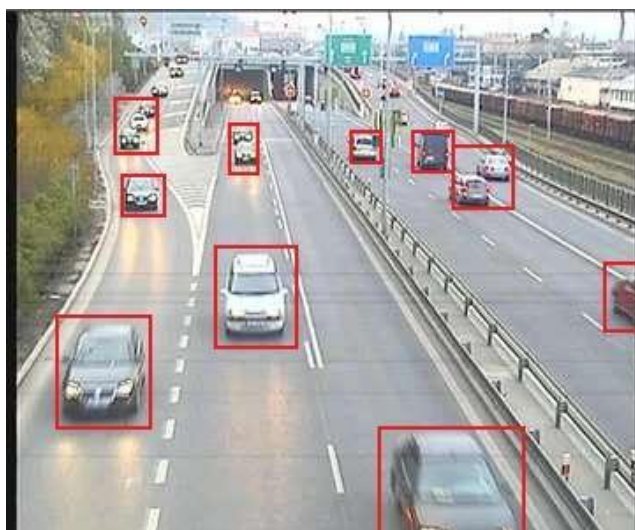


Fig - 2: Cascade Classifier applied on running video

According to the traffic density obtained after Image processing, the corresponding signal is sent to the microcontroller attached with the traffic light. It will control the traffic light according to the signal from the processor. Only one microcontroller is used to control the traffic light for both pedestrian and vehicle.

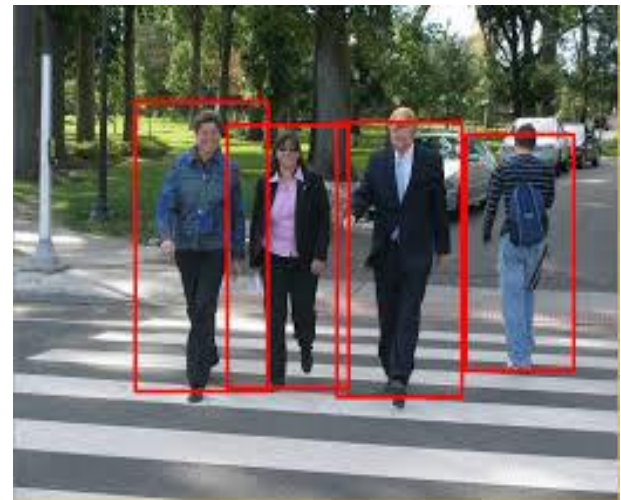


Fig - 3: Human Detection Using HOG

C. Sending signals to the Speaker

This system notifies the user about the traffic light. A portable speaker is attached with the system. According to the traffic mode coming next the signal is sent to the speaker to notify the users about it. The aim of using this voice notification is to notify the blind people who are waiting at the traffic to cross the road.

3. WORKING AND EXPERIMENTATION

In this paper, we used two algorithms to manage traffic signal lights. We have implemented these in OpenCV : Cascade classifier and Histogram of Oriented Gradient(HOG) algorithms. Through object recognition, total number of vehicles in front of the cameras can be found out. The count of vehicles and pedestrian are given to the microcontroller. According to the count, the microcontroller will change the timer of traffic light on that lane. Cascade classifier needs to be trained for accurate result after processing. This method is used for the detection of the vehicles on the lane. The reason behind using this method is it will give high level of precision and recall when detecting objects in images. In this system cascade classifier is used to detect the vehicles in the lane. Second method is Histogram of Oriented Gradient(HOG), in which object appearance and shape can be described by pixel gradient distribution. This algorithm is used in this project, to take the count of pedestrian who are waiting at the signals to cross the road.HOG is the best algorithm for the human detection, is the reason behind using this algorithm. For traffic density, there is a particular limit for both the vehicles and pedestrian. Based on this limit,the traffic timer is changed for the signals.

With the help of Microcontroller, image processing the problems at the traffic intersection can be solved. Processor

will do the image processing part. The second part is to change the traffic timer according to the traffic density, microcontroller will do this. Third part is to send the signals to the speaker to notify the people in the traffic to cross the road. The flow diagram for the system is given in Fig 4.

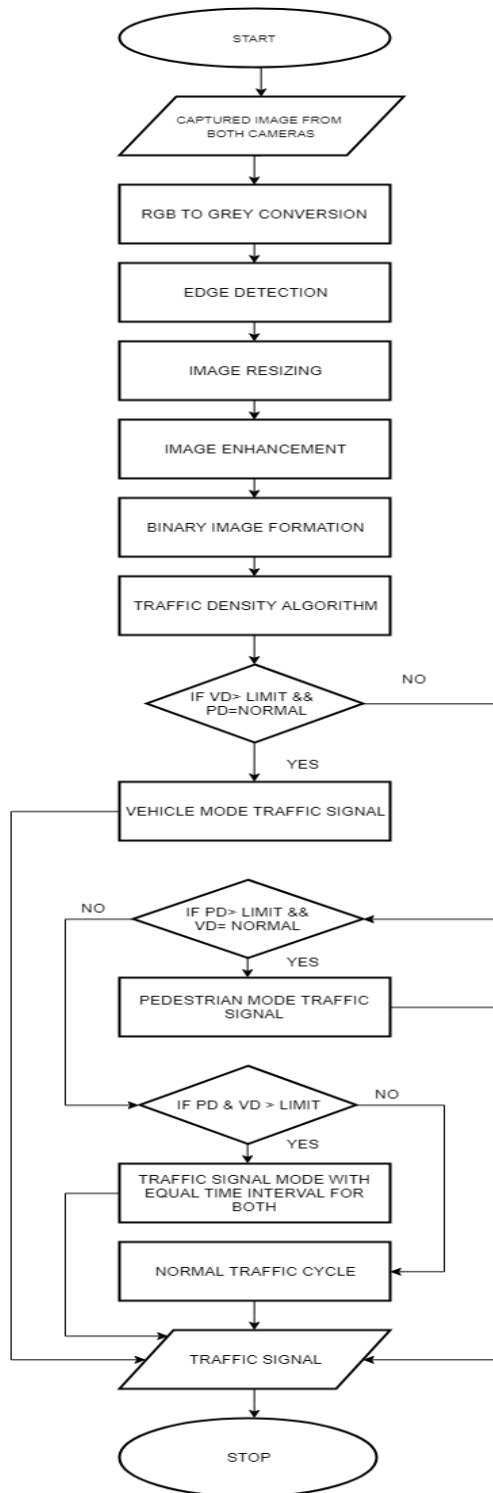


Fig - 4 : Flowchart of the system

To implement traffic control system, we have used PIC microcontroller with OpenCV. This system mainly consist of two parts ie., Hardware part and Software part. In hardware part, two cameras are attached to traffic lights in the system which is attached to the microcontroller. Camera and microcontroller is connected to the processor through a wired medium. The cameras will feed the processor with the image of both vehicles and pedestrian at the traffic. The processor responsibility is to process the image and give useful output from these images. From image one can extract out many details like time taken by vehicles to pass the signal, waiting time of vehicles, route which is more suitable, cars present on the lane, empty area of the lane etc.

Management of traffic and coordination of traffic lights (in case of intersection) is possible because of these results. Traffic timers can be changed according to the output of the OpenCV algorithm. The traffic light are managed and coordinated in such a way that it will reduce the conflict at the traffic by giving equal importance to both pedestrian and vehicles.

4. RESULT

In our experiment, we have used a set of videos to demonstrate the switching of traffic light signals. The video set consist of both pedestrian and vehicles. The system detects the vehicles and pedestrian as shown in fig 5.

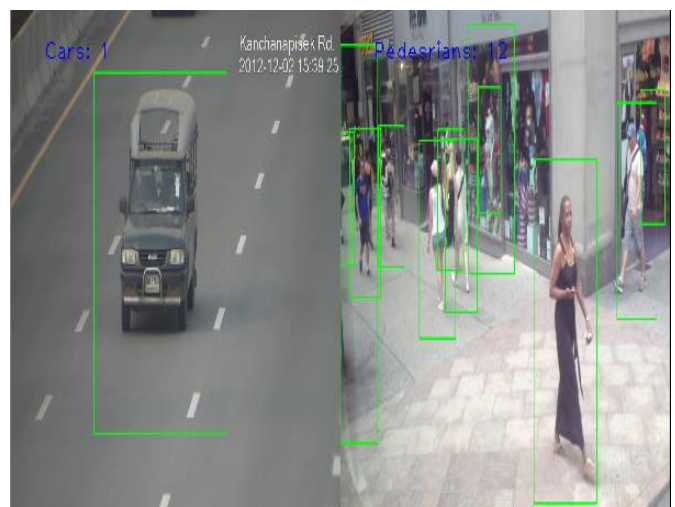


Fig - 5: Object detection by the system

These densities are compared with predefined limit of vehicles and pedestrian respectively. If the pedestrian density is greater than the predefined limit of pedestrian and vehicle density is normal, then pedestrian mode is on along with an audio alerting the pedestrian to cross the road. If the vehicle density is greater than the predefined limit of vehicle and pedestrian density is normal, then vehicle mode is on. The following table shows the experimental result of the system.

Table 1: Experimental Results

Vehicle Density	Pedestrian Density	Vehicle Mode	Pedestrian Mode
10	2	On	Off
15	7	On	On
2	7	Off	On
5	3	On	Off
1	3	Off	On

5. CONCLUSION

Traffic condition on roads is one of the big issue especially for the pedestrian. It is observed that pedestrian needs to spend lot of time to cross the road near the traffic light. Nowadays every smart traffic control system tries to solve the problems of vehicles only. But our current system is a solution to this problem by giving equal priority to both the pedestrian and vehicles. The project guarantees that the average waiting time vehicles and pedestrian at the traffic signals can be reduced. This system can reduce the conflicts between the vehicles and pedestrian at the traffic.

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