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Application of Image Processing In Road Traffic Control

Ankita Panda[1], Ankit Naik[2], Purushottam Patel[3]
Student,CSE, Kirodimal Institute of Technology, Raigarh,India[1]
Lecturer CSE, Kirodimal Institute of Technology, Raigarh,India[2]
HOD CSE, Kirodimal Institute of Technology, Raigarh,India[3]

Abstract: As we know the population of city and number of cars is increasing day by day. With increasing urban population and hence the number of cars, need of controlling streets, highways and roads is vital. In this paper, a system that estimates the size of traffic in highways by using image processing has been proposed and as a result a message is shown to inform the number of cars in highway. This project has been implemented by using the Matlab software and it aims to prevent heavy traffic in highways. Through this paper we intend to present an improvement in existing traffic control system at intersection. System is made more efficient with addition of intelligence in term of artificial vision, using image processing techniques to estimate actual road traffic and compute time each time for every road before enabling the signal. System is clever enough to provide priority to authorized emergency vehicles with the help of GSM at a particular intersection.

Keywords: - Traffic Control System (TCS), Image Processing.

I. INTRODUCTION

The number of vehicles on the road increases day by day therefore for the best utilization of existing road capacity, it is important to manage the traffic flow efficiently. Traffic congestion has become a serious issue especially in the modern cities. The main reason is the increase in the population of the large cities that subsequently raise vehicular travel, which creates congestion problem. Due to traffic congestions there is also an increasing cost of transportation because of wastage of time and extra fuel consumption [6].

Traffic jams also create many other critical issues and problems which directly affect the human routine lives. [3] Traffic system is at the heart of civilized world and development in many aspects of life relies on it. Excessive number of traffic on roads and improper controls of that traffic create traffic jam. It either hampers or stagnates schedule, business, and commerce. Automated traffic detection system is therefore required to run the civilization smooth and safe- which will eventually lead us towards proper analysis of traffic, proper adjustment of control management, and distribution of controlling signals [4]

There are lots of techniques proposed to design an intelligent traffic system, for example, fuzzy based controller and morphological edge detection technique are proposed in . This technique is based on the measurement of the traffic density by correlating the live traffic image with a reference image. The higher the difference is, higher traffic density is detected. In another technique is proposed to design an intelligent traffic system, which is based on four lane system in which time is allocated according to the number of vehicles on the lane.[3]

Automatic traffic monitoring and surveillance are important for road usage and management. Traffic parameter estimation has been an active research area for the development of intelligent Transportation systems (ITS). For ITS applications traffic- information needs to be collected and distributed. Various sensors have been employed to estimate traffic parameters for updating traffic information[5]

In another technique is proposed to control the traffic signal by using image processing, in which they first selected the reference image which is the image with no vehicles or less vehicles and every time matching real time images with that reference image.[3]

Motivation

Recognizing that vehicle safety is a primary concern for motorists, many national and international companies have undertaken specialized research projects to investigate new technologies for improving safety and accident prevention. Looking at the statistical projection of traffic fatalities concerning the first nine months of 2012 show that around 25,580 people die in traffic crashes relating to motor vehicles. This represents an increase of nearly 7.1 percent from the 23,884 fatalities that occurred in the first nine months of year 2011. Majority of accidents involve collision between vehicles. Due to recent advent in technology and extensive research in the fields of VANET it is now possible and even convenient to transfer data and information between vehicles.[4]

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Image Processing :

Mostly, automated systems need interaction with a computer that requires an algorithm to meet the specific requirements. Human eye can easily detect whether there is a traffic jam or not. Within less than a second, human brain processes the image of the traffic, detects and analyzes objects, and thereafter comes to a decision. However, implementation of such a thought process requires some special steps. Computers can process only binary data. A picture of the road can be represented as a digital image, which is actually binary data. This image is used as primary input. But, an image, when it is captured from natural environment, is raw and unformatted. Programmers have to process the data and extract relevant information from images for efficient processing. Frequent need of extracting information from images has led to the development of several fields (e.g. Image processing, Computer Vision, Object recognition etc) in computing industry. The field of digital image processing comprises of methods involving processing digital images by means of a computer. A digital image is composed of a finite number of elements, each of which has a particular location and value. These elements are called picture elements or pixels. Image processing revolves around issues related to image representation, their compression and various other complex operations, which can be carried out on the image data. The operations that come under image processing are image enhancement operations such as sharpening, blurring, brightening and edge enhancement [4].

II. System Model

The work is divided into 4 parts. The first part is to process the video signal and image acquisition from fixed camera using MATLAB. The second part is to select the target area where the vehicles could be present by using image cropping technique. The third part is the object detection which is performed by enhancing features of the image. Finally, the last part is the density counting, where the number of vehicles are being counted.

1.Processing of Video Signal and Image Acquisition

The work starts with processing the live video using MATLAB software. The video camera is stationary, which is mounted on the pole near the traffic signal. The next stage is to extract the frames continuously from the real time video coming from the stationary camera. This raw digital data is further processed by converting the images from RGB (Red-Green-Blue) to grayscale in order to further process the images. Initially the system captures the image of a vacant road when there is no vehicle present; this image is used as a reference image.

The next section explains the procedure to select region of interest where the vehicles are present.

2. Image Cropping

The second step is to select the targeted area by designing image cropping algorithms in MATLAB. The purpose of cropping is to identify the road region where the vehicles are present and exclude the unnecessary background information. This unnecessary information is fixed in every frame of the live video because the camera is stationary. To crop the required area, reference image has been used, Fig. 1(a), which has no road traffic. First, a binary image of having the same dimensions is created, as in the reference image, then the road area has been shaded white, and the leftover region as black, as shown in Fig.1(b). Finally, the multiplication of the reference image with the cropping black and white image results in the final desired target area which is illustrated in Fig1(c).

Fig 1(a)

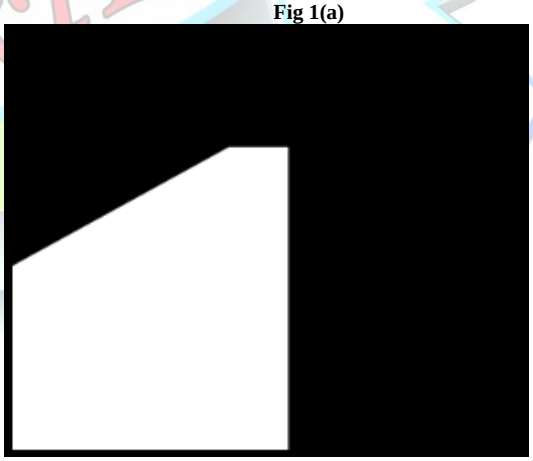

Fig.1(b)

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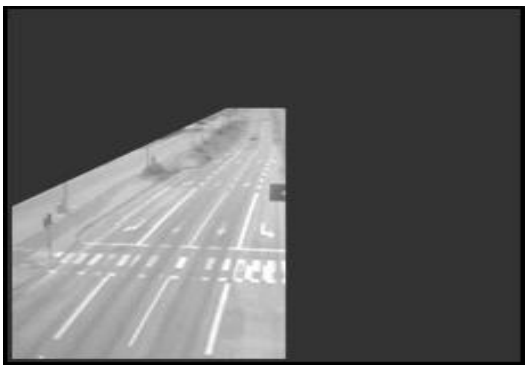

Fig.1(c)

3. Object Detection

The third step is the object or vehicle detection in order to identify and count the vehicles which are present in the targeted area shown in Fig. 1(c). To perform the object detection, first the frame from the real time video sequence is extracted as illustrated in Fig 2(a). The next step is to convert both images; the reference image and the real time image into grayscale and then the absolute difference of two images will be determined. Since the dimensions of the road are fixed therefore the difference image only highlights the presence of vehicles in the desired target area.

Fig 2(a)

In order to improve the visibility of the vehicles, the difference image is converted to a binary image based on a threshold value. In order to determine only vehicles in the desired area, multiplication of the cropped image, Fig. 1(b), with the enhanced version of the difference image, Fig. 3(a), is carried out. The product image is illustrated in Fig. 3(b). In Fig. 3(b), the unnecessary information is filtered out and it only highlights the presence of vehicles in the desired area.

Fig 3(a) Binarization of the difference Image,

Fig 3(b) Image highlighting the presence of vehicles in the targeted area

4. Traffic Density

The next step is to calculate the traffic density in the desired target area. In order to determine the traffic density, the vehicles are marked first and then their numbers are counted. The algorithm search for a set of connecting pixels. In order to consider a connected region as a vehicle, a minimum threshold has been defined. However, it is possible that more than one region of a vehicle is detected using the above criteria. This problem could be overcome by finding the overlapping bounding boxes of the selected regions and thus smaller and highly overlapping regions are filtered out. The results are shown in Fig. 4, where each detected vehicle is surrounded by a bounding box and the top-left region shows the number of vehicles detected on the road, as currently it is 6.[3]

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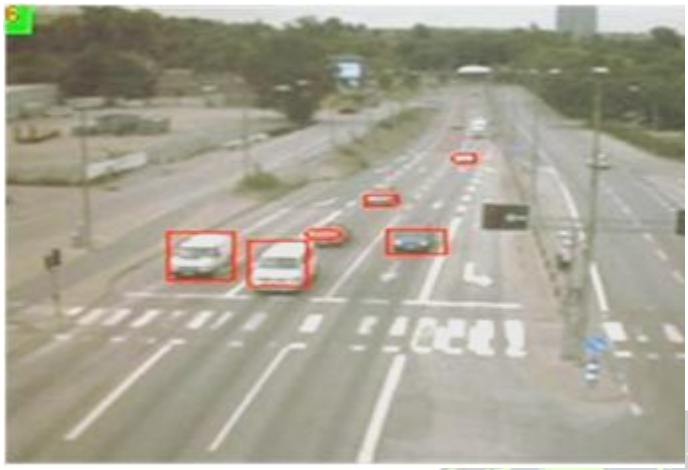

Fig 4: Image shows the detected and counted vehicles

5. Emergency

GSM technique is used to handle emergency. The authorized emergency vehicle like Police, firefighter or ambulance are given priority to cross the intersection after the request raised by them with the help of SMS send as it approach the intersection. The signal remains on till it crosses the junction and can be put off to resume the normal operation by sending other SMS. At vehicle end we have GSM transmitter and at Intersection we have receiver. Correct lane number to intersection will have to be transmitted to raise priority. In case of more than one emergency arise, then first come first serve mechanism is exercised in setting the priority. This scenario is rare but provision is made to make system more clever decision.[2]

III. Conclusion

The study showed that image processing is a better technique to control traffic jam. It is also more consistent in detecting vehicle presence because it uses actual traffic frames. It visualizes the reality so it functions much better than those systems that rely on the detection of vehicles metal content. The analysis can thus be improved with multiple sequential cameras along a highway which in addition to localized congestion control, analyzes the congestion build up from the starting point to the end point. With the aggregate image data, the congestion [4]

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