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Traffic Density Count by Optical Flow Algorithm using Image Processing

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ABSTRACT: Due to the rapid increase in the number of vehicles, traffic congestions and traffic jams are happening very often during peak hours. Hence managing the traffic issues is necessary in rapidly growing cities. The poor traffic management often creates traffic jams which results in many other critical issues like life loss and also affects the human routine lives. One of the methods to overcome the traffic problem is to develop a traffic control system by measuring the traffic density on a road using video capturing and Real time image processing techniques. The Existing image processing systems work well in free-flowing traffic, but not with the traffic congestion**.** The suggested algorithm will determine the number of vehicles on the road and to control the traffic by calculating the traffic density only on the targeted area. The Optical Flow algorithm works by comparing the reference image (real time frame of live video) with the vehicles captured only in the region of interest (i.e., road area). In order to intelligently control the traffic signal the measured vehicle density can be compared with other direction of the traffic.

KEYWORDS: Traffic density, image processing, density count

I. INTRODUCTION

A steady increase in metro-city population, the number of automobiles and cars increases rapidly and metro traffic is growing crowded which leads to the traffic jam problem.Thus the number of vehicles on roads is increasing in our day today life therefore it is important to efficiently manage the traffic flow. Traffic system plays a vital role in this civilized world and many aspects of life that relies on it. The reason of traffic is an inefficient controlling of traffic signals that affects the traffic flow. Consider for example if one side of the road has less traffic and the other side with huge traffic but the duration of green light for both sides is same then this will create the current resources to go inefficient. But when the higher traffic density side switches on the green signal light for a longer period than lesser density side. Traffic congestion has become a serious issue in big cities. The main reason is the increase in the population that subsequently raises vehicular travel, which creates congestion problem [1-5]. These further results in an expensive transportation due to the extra fuel and time consumption [2]. This problem can be controlled by the proper analysis of traffic, proper adjustment in the controlling of traffic management. The proposed system consists of cameras that are fixed in lanes which are prone to traffic jam. The camera continuously monitors the traffic by capturing videos. The system will extract frames at particular time intervals. The consecutive frames are compared and based on some parameters we determine whether there is a traffic jam. The system is flexible, reliable and cost-effective. For example if there is an emergency vehicle like ambulance on the road. In that situation if an ambulance get caught in a heavy traffic jam then there are high chances that the patient cannot reach the hospital on time. So it is very important to design an intelligent traffic system which controls traffic intelligently to avoid accidents, collisions and traffic jams [7-8]. Increasing number of traffic and poor controls of this traffic also reason for traffic jams [13].

II. SYSTEM MODEL

The work is divided into 4 stages. The first stage is to process the video signal and get input from the fixed camera using MATLAB. The second stage is to select the target area with vehicles using image cropping technique. The third stage is the object detection. Finally, the last stage is the density (vehicle) counting. Fig.1 shows the overall block diagram of the proposed system.

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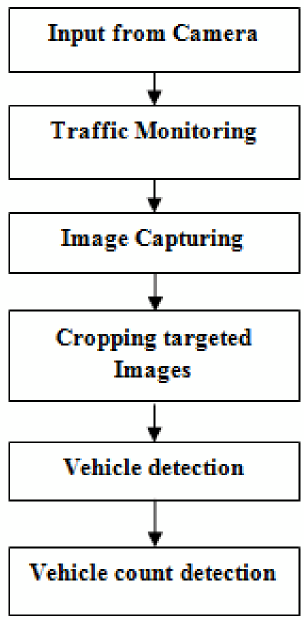

Fig 1: System Flow for the Proposed Model

III. STEPS INVOLVED FOR VEHICLE COUNT

A. Traffic Monitoring and Image Capturing

The first stage of the work using MATLAB software that process the live video of the traffic. The video camera is on the pole near the traffic signal. The next step is to extract the frames continuously from the real time video from the fixed camera. This digital data is processed by converting the images from RGB (Red-Green-Blue) to gray scale. Initially the camera captures the image of a vacant road when there is no vehicle present; this image is then used as a reference image for the entire system processing. Fig 2(a) shows the reference image which is captured with the absence of vehicles on a road.

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Fig 2: (a) Reference Image taken from the Live Video from [12]

B. Image Cropping

The second stage is to crop the region of interest with the reference image by designing image cropping algorithms using MATLAB. The need for this cropping is to focus the road where the vehicles are present and exclude the unnecessary background information that are captured in the camera. This unnecessary information is fixed in every frame of the live video because the camera is kept fixed. Thus with the help of reference image, the targeted region is cropped by eliminating the unwanted regions Fig. 2(a), which has no road traffic. Firstly, a binary image of having the same dimensions are created with the reference image, then the road area has been shaded white, and the leftover region as black, as shown in Fig. 2(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 Fig 2 (c).

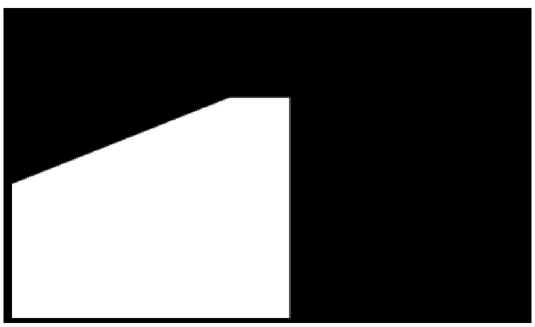

Fig 2: (b) Defining the region of interest

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Fig 2: (c) Selection of the target area

C. Vehicle Detection

The third stage is the vehicle detection in order to identify the vehicles which are present in the targeted area shown in Fig.2(c) which is used to count the vehicle in the specified area. To perform this, first the frame from the real time video sequence is extracted as illustrated in Fig 3(a).

Fig 3: (a) Real-time image extracted from the live video taken from [12]

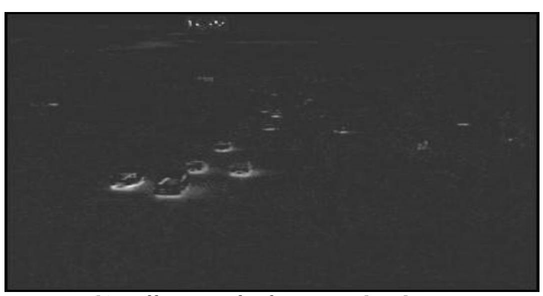

Fig 3: (b) Difference of reference and real time image

The next step is to convert both the reference image and the real time image into grayscale and then the difference of these two images will be found. Since the dimensions of the road are fixed therefore the difference image only highlights the presence of vehicles in the desired area. The difference image is illustrated in Fig. 3(b).

Fig. 3(b) shows the presence of vehicles in the desired target area but the visibility of the vehicles is not clear. In order to improve the visibility of the vehicles, the difference image is converted to a binary image based on a threshold value. The resulting binary image is shown in Fig. 4(a), where the presence of any object is much more improved. In order to determine only vehicles in the desired area, multiplication of the cropped image, Fig. 2(b), with the enhanced version of the difference image, Fig. 4(a), is being carried out. The multiplied image is illustrated

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in Fig.
4(b). In Fig. 4(b), the unnecessary information is filtered out and it only highlights the presence of vehicles in the desired area.

Fig 4: (a) Binarization of the difference Image

Fig 4: (b) Image highlighting the presence of vehicles in the targeted area

D. Traffic Density

The next stage is to find the number of vehicles present in the desired target area. In order to determine the vehicle count, the vehicles are marked first [here rectangular shape with red colour] and then their numbers are counted. The algorithm search for a set of connecting pixels to detect a vehicle.

In order to consider a connected region as a vehicle, a minimum threshold has been found. However, it is possible that more than one region of a vehicle is detected using the above algorithm. This problem could be overcome by finding the overlapping bounding boxes of the selected regions and from that only smaller and highly overlapping regions are filtered out.

IV. RESULT AND DISCUSSION

The system starts with an image capturing process in which the live video is processed by the fixed camera, mounted on any pole for capturing the required traffic direction. Captured video is divided into one frame per second which continuously extracted from the live video and each frame is processed by converting it into gray scale. For the reference image an empty road image was selected with the absence of vehicles, that is when there is no traffic on the road.

The second stage is the image cropping in which, the targeted area is selected, the area where the vehicles are present and filtered out unnecessary surrounding background information. Next stage, determines the presence of objects in live video by taking the absolute difference of each extracted frame with the reference image.

Then the presence of objects is enhanced by Binarization of the difference image. Then the final step is to calculate the traffic density in the desired target area by counting the number of vehicles in the targeted region. To perform this, first, the vehicles are marked in the targeted region by scanning all the connected objects, and filtering out smaller and overlapping objects. In order to eliminate the noise added due to different lighting conditions at different times of the day, a set of reference images have been captured and stored at different time slots of the day and is kept in the pole. The system cycles through these reference images according to the current time of the day. The results is shown in Fig. 5, 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.

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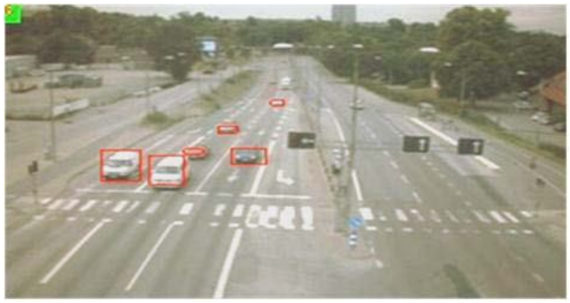

Fig 5: Image shows the detected and counted vehicles

V. CONCLUSION

This paper discusses a method for estimating the traffic density on the lane by using image processing through optical flow algorithm. The advantages of this proposed technique is that there is no need to use complex sensor or aerial imagery based systems.

Our proposed system is very cost effective as it does not require any installation of additional devices, such as RFIDs. This work can be enhanced further by proposing a system by using pressure sensor on roads to count the vehicles. Secondly, the system which identifies the presence of emergency vehicles (like an ambulance) and by giving preference to those emergency vehicles.

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