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Traffic Surveillance by Counting and Classification of Vehicles from Video using Image Processing

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Abstract: ***This paper presents a novel algorithm for advance Traffic Surveillance by vehicle counting and classification, based on the image processing theory. Vehicle counting is done by Background subtraction and finding the centroid. Classification is done by thresholding method. A reference frame is initially used and considered as background information. While a new object enters into the frame, is detected by background subtraction. The foreground information and background information are identified using the reference frame as background model. Video sequences have been captured and tested with the proposed algorithm. Experimental results, which demonstrate the system's performance, are also shown.***

Keywords: Background subtraction, Edge detection, Thresholding technique.

I. INTRODUCTION

The increasing traffic volume over the last decades poses high challenges on today's traffic research and planning.[8]. Detection, Counting and classification of vehicles in a video has become a potential area of research due to its numerous applications to video-based intelligent transportation systems[7]. For most traffic surveillance systems, major stages are used to estimate desired traffic parameters, i.e., vehicle detection, Counting, tracking, and classification [6]. Each year, motor vehicle crashes account for about thousands deaths, more than million injuries. Counting vehicles over a period of time on a busy intersection will help the concerned authority to efficiently control the duration of traffic signal on road thus reducing the level of traffic congestion during rush hours. It helps in minimizing the possibilities of fraudulent activities in toll collection. It is necessary to provide better traffic surveillance to reduce the accidents. So the main Goal of our paper is to provide better traffic surveillance.

For traffic surveillance application generally fixed cameras are used with respect to static background (e.g. stationary surveillance camera) and a common approach of background subtraction is used to obtain an initial estimate of moving objects. First perform background modeling to yield reference model. This reference model is used in background subtraction in which each video sequence is compared against the reference model to determine possible variation. The variations between current video frames to that of the reference frame in terms of pixels signify existence of moving objects.

The main objective of this paper is to develop an algorithm that can count and classify the vehicles for better traffic surveillance. We carry out various tasks such as edge detection, background subtraction and Thresholding techniques.

The paper organized as follows. Section II for Edge detection and Background Subtraction. The proposed method is explained in Section III. In section IV, we present the experimental results and in section V we conclude the paper.

II. SECTION – II

2.1. EDGE DETECTION.

Edge detection refers to the process of identifying and locating sharp discontinuities in an image. The discontinuities are abrupt changes in pixel intensity which characterize boundaries of objects in a scene [12]. There are number of edge detection methods like Prewett, Sobel, canny, Robert. Out of this Canny Edge detection gives the better result. Therefore we use Canny Edge Detection Method.

2.1.1. Canny Edge Detection Algorithm

Step 1:-

In order to implement the canny edge detector algorithm, a series of steps must be followed. The first step is to filter out any noise in the original image before trying to locate and detect any edges. And because the Gaussian filter can be computed using a simple mask, it is used exclusively in the Canny algorithm.

Step 2:-

After smoothing the image and eliminating the noise, the next step is to find the edge strength by taking the gradient of the image.

Step 3:-

The direction of the edge is computed using the gradient in the x and y directions.

Step 4:-

Once the edge direction is known, the next step is to relate the edge direction to a direction that can be traced in an image.

Step 5:-

After the edge directions are known, non-maximum suppression now has to be applied. Non-maximum suppression is used to trace along the edge in the edge direction and suppress any pixel value (sets it equal to 0) that is not considered to be an edge. This will give a thin line in the output image.

Step 6:-

Finally, hysteresis is used as a means of eliminating streaking. Streaking is the breaking up of an edge contour caused by the operator output fluctuating above and below the threshold.

Edge detection of all four types was performed on Figure 2.1 and the results are shown in Figure 2.2. This figure 2.2 shows that Canny yielded the best results.. Canny yielded the best results. This was expected as Canny edge detection accounts for regions in an image. Canny yields thin lines for its edges by using non-maximal suppression.

Visual Comparison of various edge detection Algorithms

Figure.2.1.Image used for edge detection analysis (wheel.gif)

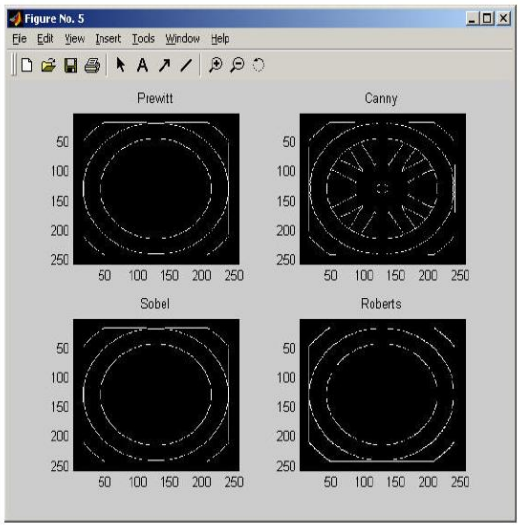

Figure.2.2. Results on Edge Detection on fig 2.1.

2.2. BACKGROUND SUBTRACTION:

Background subtraction is a technique in the fields of image processing and computer vision wherein an image's foreground is extracted for further processing (object recognition etc.). Generally an image's regions of interest are objects (humans, cars, text etc.) in its foreground. After the stage of image preprocessing (which may include image denoising etc.) object localisation is required which may make use of this technique. Background subtraction is a widely used approach for detecting moving objects in videos from static cameras. The rationale in the approach is that of detecting the moving objects from the difference between the current frame and a reference frame, often called “background image”, or “background model”. Background subtraction is mostly done if the image in question is a part of a video stream. The background is assumed to be the frame at time t. This difference image would only show some intensity for the pixel locations which have changed in the two frames. Though we have seemingly removed the background, this approach will only work for cases where all foreground pixels are moving and all background pixels are static. Background subtraction is a popular technique to segment out the interested objects in a frame. This technique involves subtracting an image that contains the object, with the previous background image that has no foreground objects of interest. The area of the image plane where there is a significant difference within these images indicates the pixel location of the moving objects [2]. These objects, which are represented by groups of pixel, are then separated from the background image by using threshold technique.

III. SECTION – III

3.1. CENTROID:

The centroid or geometric centre of a two-dimensional region is, informally, the point at which a cardboard cut-out of the region could be perfectly balanced on the tip of a pencil (assuming uniform density and a uniform gravitational field). Formally, the centroid of a plane figure or two-dimensional shape is the arithmetic mean ("average") position of all the points in the shape. The definition extends to any object in *n*-dimensional space: its centroid is the mean position of all the points in all of the coordinate direction. Figure.3.1 shows the flowchart for vehicle counting.

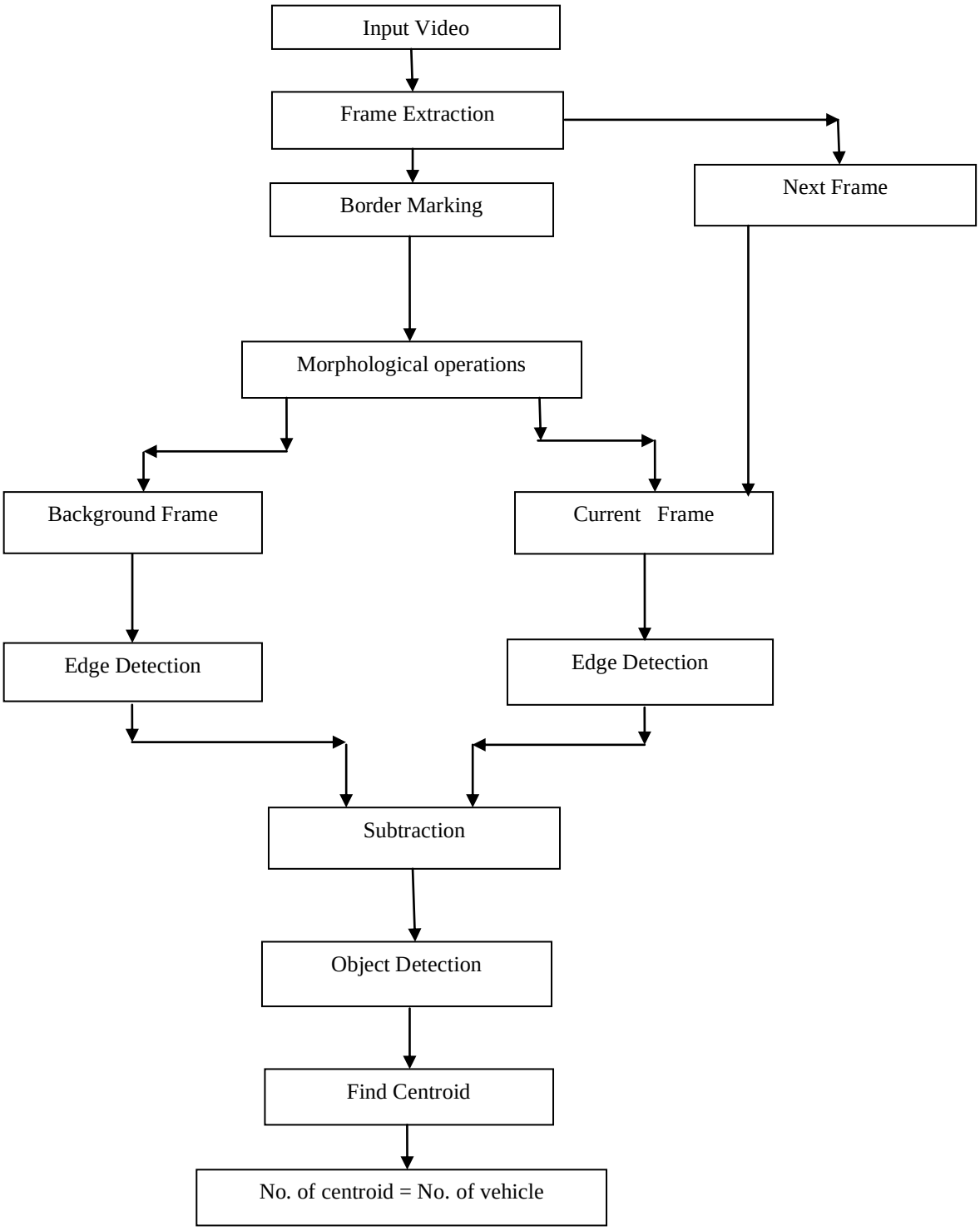

Figure.3.1: Flowchart for vehicle counting

3.2 THRESHOLD TECHNIQUE:

Threshold means a region marking a boundary. It is also defined as the line determining the limits of an area. Thresholding techniques are often used to segment images. The threshold image in general is defined as,

$$g(x,y) = \begin{cases} 1, & if\ f\ (x,y) > T \\ 0, & if\ f(x,y) \geq T \end{cases} \qquad \text{.....equation 3.1}$$

3.2.1. Threshold Selection:

The key parameter in the thresholding is the choice of threshold value. Several different methods for choosing a threshold exist. User can manually choose a threshold value or a thresholding algorithm can compute a value automatically, which is known as automatic thresholding[14]. In our work we are using the Thresholding technique on the area of the vehicle.

IV. EXPERIMENTAL RESULT

For the testing, we used the video for the counting and classification of vehicle for the Traffic Surveillance. Fig. 4.1. Shows an image of video used for the testing. The video has duration of 5 sec.

Figure. 4.1: Video used for testing the performance of our approach for vehicle counting and classification.

In this chapter, the results are shown in figure 4.2 for the counting and classification of vehicle for traffic surveillance system using image processing.

Figure 4.2. Test Result

Table No.4 shows the four test results with relative error**.** From table, it results that the overall accuracy of the system is 91%.

Sr.No	Actual Count	Testing Count	Relative error
1.	07	07	0%
2.	05	04	20%
3.	06	05	16%
4.	03	03	0%

Table No.4. Test data & Actual data

V. CONCLUSION

In the project, we have presented a computer vision system which uses a video to count and classify vehicles with the aim of replacing ILDs, particularly on highways. Additionally, this system distinguishes itself from other computer-vision-based approaches in the way in which it can handle the system without the need for any hardware other than cameras, such as GPS. This makes the system inexpensive to use.

In this, we have presented two different parameters for the traffic surveillance system, one is counting the vehicles and other is classification of the vehicles. The processing is carried out on pre recorded video. Vehicle counting is done by finding the centroid and the distance between the marked border and the vehicle. Classification is done by finding the area and thresholding method.

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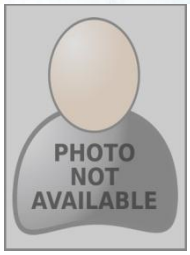

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