An Adaptive Method For Vehicle Counting Using Digital Image Processing Techniques

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Abstract: In developing nations, many cities are facing challenges that result from the massive number vehicles. So, information about flow of traffic is required for management of traffic. Collecting real-time, reliable and accurate information is crucial for traffic management. The main goal of this paper is to develop an adaptive model that can assess the real-time vehicle counts on roads using digital image processing techniques. By classification and counting the vehicles, estimation of traffic density can be done. Vehicle counting is demanding task due to problems like blurs, varying image resolution etc This paper presents a technique by using digital image processing methods like detecting edges, frame differentiation, filtering analysis etc., The proposed technique has been implemented by using MATLAB. The performance of this method is highly accurate.

Keywords: **Vehicle Counting, Vehicle Detection, Traffic Analysis, Object Detection, Video Processing.**

I. INTRODUCTION

Now-a-days traffic issues are expanding because of the rapidly developing number of vehicles. Traffic flow analysis can plays a major role in collecting data about roads and passing vehicles. These information can be helpful for recognizing flow of traffic at peak times or analyzing the influence of vehicles and pedestrians in traffic flow. This helpful data can likewise be utilized for better traffic management techniques, for example, changing the timings of traffic lights dependent on traffic flow. There are many ways to check the number of vehicles passed in a particular time period, and therefore analyse the traffic flow, for example, utilizing portable counters, manual counters and observers. But, these days it is shown that utilizing camera-based frameworks are better choices for traffic flow estimation purposes.

In the previous decade, image handling and several algorithms have been applied for streets/highway traffic analysis as an elective technique which neither sensor or camera which is placed is controlled by human. In these software based vehicle identifiers, the use of video cameras are installed alongside roadways are handled. Tracking moving vehicles gives us complete information about traffic flow. Tracking vehicles is the process of tracking the location of object in each frame of the video sequence.

This article focus on a software based novel procedure for detecting vehicle in roadways and characterization of passed vehicles in various determined types. This method identifies vehicles in the input video stream, and assigns a identifier for every one of them, characterizes every vehicle on its unique vehicle-type and counts the detected objects finally. As it is a software based approach, the error rate will be less and better accuracy is obtained. This paper is organized as follows. Section III gives appropriate information about previous works. Section IV discuss about proposed method and methodologies. Section V explains about experimental results followed by conclusion.

II. Related Work:

The traffic flow estimation and vehicle detection by using image processing and various detection methods has grabbed a huge attention over several years. Vehicle detection can be done by using any of the following methods like image segmentation, feature matching, feature extraction, point detection etc., Some researchers have developed a various algorithms for object detection using machine learning methods which can identify and classify moving objects by both color and type. The above mentioned approaches have their both advantages and disadvantages. There are some disadvantages with the existing methods which are

i) Accuracy levels are low;
ii) During traffic jams detecting and counting methods are not efficient;
iii) Their performance cannot meet the standards during bad weather conditions.

So, in order to overcome these disadvantages, the proposed method is implemented by using new techniques which is described below.

III. Proposed Method:

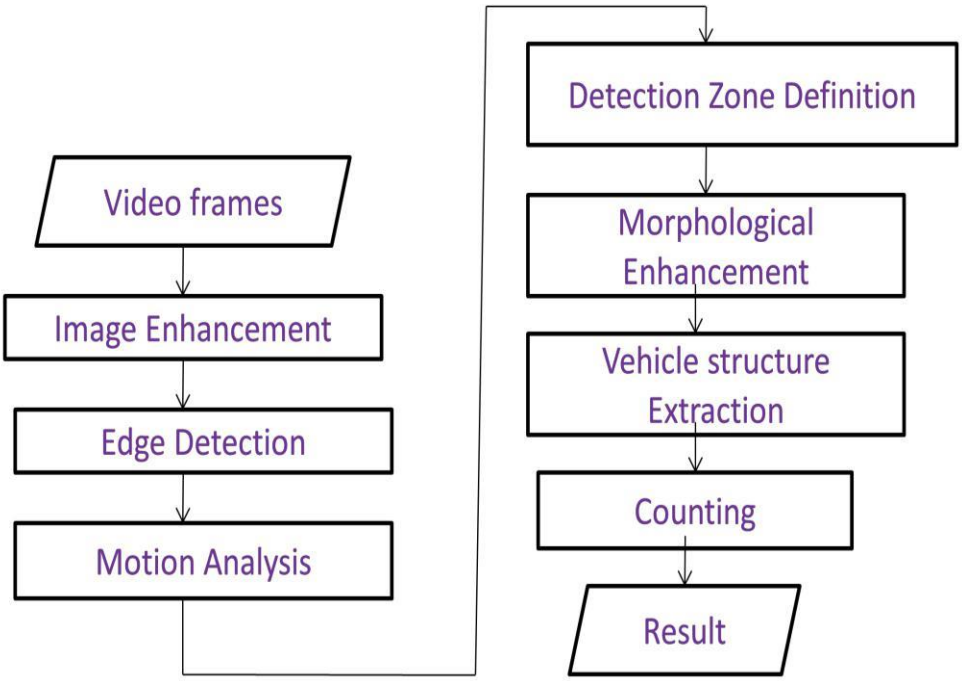

Figure: Flow diagram of proposed technique

Video Processing:
Video processing is a subcategory of Digital Signal Processing methods where the input and output signals are video streams. In PCs, by using digital image processing methods, the best results of video analysis in each frame is obtained. By comparing sequential frames, the movements of the objects are observed. Video processing incorporates pre-channels, which results in changes in contrast and noise suppression along with pixel size conversions. By using video processing methods, elimination of unwanted camera effects, lighting effects are performed.

RGB to Grayscale Conversion:
In the analysis of video, changing over RGB image to grayscale mode is made by image handling techniques. The principle objective of this conversion is that processing the grayscale pictures can give progressively satisfactory outcomes in contrast with the original RGB image . In video processing ,video frames which are captured should be transformed from RGB color mode to a 0 to 255 gray level. While changing over a RGB picture to a grayscale mode, the pixel value of RGB image should be taken, and a the value which represents the pixel brightness percentage should be considered as an output.

Image Enhancement:
To provide better contrast and more clear image enhancement operation is performed..The main aim of the image enhancement operation is to improve the visibility and perceptibility of the regions of the image. The tasks include cleaning a image which is affected by various types of noises, enhancing the contrast of certain regions etc., This produces a clear image when compared to non-enhanced one. There are several techniques to perform image enhancement operation like Filtering with morphological operators, Histogram equalization, Linear contrast adjustment, Median filtering etc.,

Edge Detection:
Every video frame has three important features to achieve detection which include edges, points and contours.
Edges are nothing but points in digital images at which brightness of image or gray levels changes suddenly in amount. Main task of this is finding all pixels of the image that corresponding to the edges of the object. Here we perform detection of edges using canny edge detection technique.

- Canny Edge detection: It is an image processing method which is used to detect the edges in an image and the noise is suppressed at the same time. This technique gives important structural information about the image or the object .This method provides good and reliable detection.

The general criteria for edge detection include:

- Detection of edge with low error rate, which implies that the detection ought to precisely get however many edges appeared in the image as would be prudent

- The edge point distinguished from the operator ought to precisely restrict on the center point of the edge.
- A given edge in the image should just be checked once, and where possible, image noise ought not make false edges.

The algorithm steps of the canny edge detection method are as follows:

- Grayscale Conversion
- Gaussian Blur
- Determination of intensity gradients
- Non-Maximum suppression to thin out the edges
- Double Thresholding
- Tracking edge by hysteresis
- Cleaning up

Motion Analysis:

- In this step we consider moving object edges from sequential video frames and perform operations to get the resulting information of edges to obtain number of passing vehicles. Motion Analysis is performed in order to find whether the object is stationary or moving this technique is performed. To determine the movement of objects between the adjacent video frames this analysis is performed. Using frame differentiation technique, object motion detection is performed.
- By making use of threshold, the stationary parts of sequential video frames will be cleaned/removed. The main challenge here is that the performance of image suffers from darkness, blur, or bad illumination at night, which may cause strong noises. So that, the grayscale image may not be specified under these circumstances and make the identification task more unpredictable.
- Edges fundamentally separate two various regions which are stationary region (the roadway) and dynamic region (moving vehicles). The stationary background is deleted to locate moving objects in each frame. Thus, moving objects are identified and obtained.

Detection Zone:

- The detailed boundaries of the objects are defined after detecting the moving objects. Next we perform the kalman filtering process to enhance the detected moving object boundaries. As a perception (detection) zone, a region should be characterized to show moving vehicle's edges in at the time that the vehicle enters it. By using backward subtraction method the moving vehicle is detected in three sequential frames. The details of the zone can be known by drawing bounding boxes which defines the vehicle edges. Here we specify a detection zone, when the vehicle enters the detection zone, the objects are detected in the current frame. In this way, tracking process continues till the vehicle exits from the zone. By using blob analysis block, statistics for labeled regions or bounding boxes is computed. This block gives statistics about area, centroid, perimeter etc.,
- After enhancing the moving object boundaries, now we classify the moving and stationary objects.
- Morphology is defined as the processing images by image processing operations based on shapes. It describes about the geometrical structure of image objects. Morphological processing is theoretical concepts, non linear filters, design methodologies and various applications. This enhancement can be achieved in various ways like suppressing the noise, contrast sharpening etc.,
- The process of applying a structuring element to an input image and obtaining an output image of the same size is the main feature of morphological operations. In a morphological operation, the value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbors. By choosing the size and shape of the neighborhood, you can construct a morphological operation that is sensitive to specific shapes in the input image.
- The basic morphological operations are dilation and erosion. Dilation is nothing but addition of pixels to the object boundaries in an image, where as erosion is the process of removing pixels on object boundaries.
- The length and width of the bounding box represents the type of the vehicle. Each vehicle bounding box is represented by using special rectangular color. Thus in this way vehicle structure is extraction is done.
- All the stationary objects are omitted and only moving objects are counted. Now, all the moving objects which are in bounding boxes are counted. Finally, the result of the moving objects and their count is displayed on the screen.

IV. Results:

The following are the results which are obtained

1. The video is given as input and first process the first video frame as shown (Figure 1)

Figure 1:Input video frame

2. After processing the video frame the objects edges are determined which is as shown (Figure 2.1) and if noise is present in the image then it is removed by using Wiener filter and displayed (Figure 2.2)

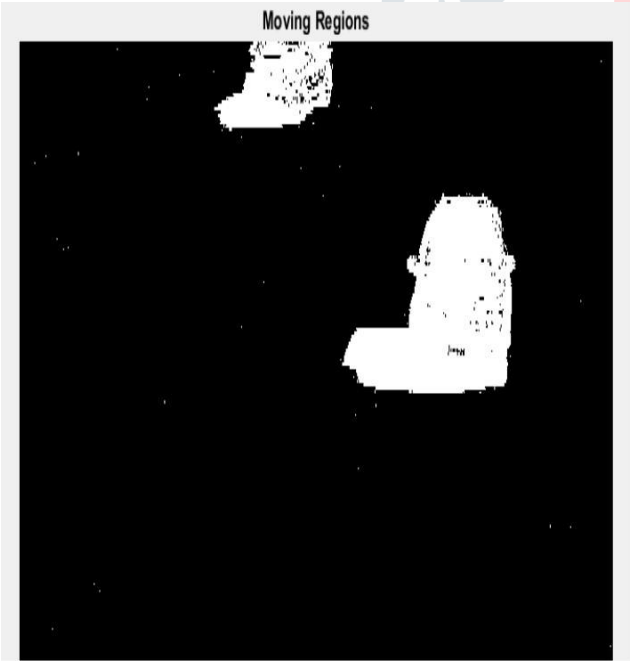

Figure 2.1:Edges of moving objects

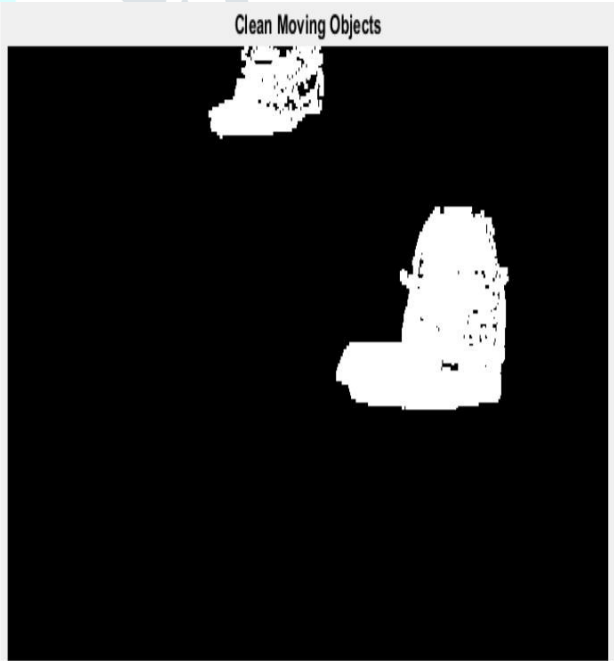

Figure 2.2: Clean moving objects

3. The detected vehicles are represented in bounding boxes (Figure 3.1) and count of the vehicles is represented at the top corner of the figure window (Figure 3.2 & 3.3)

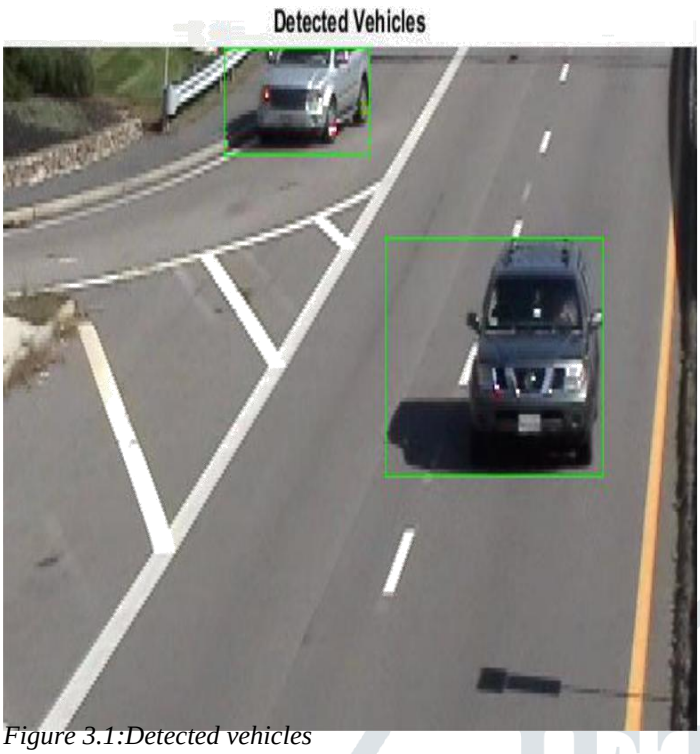

Figure 3.1:Detected vehicles

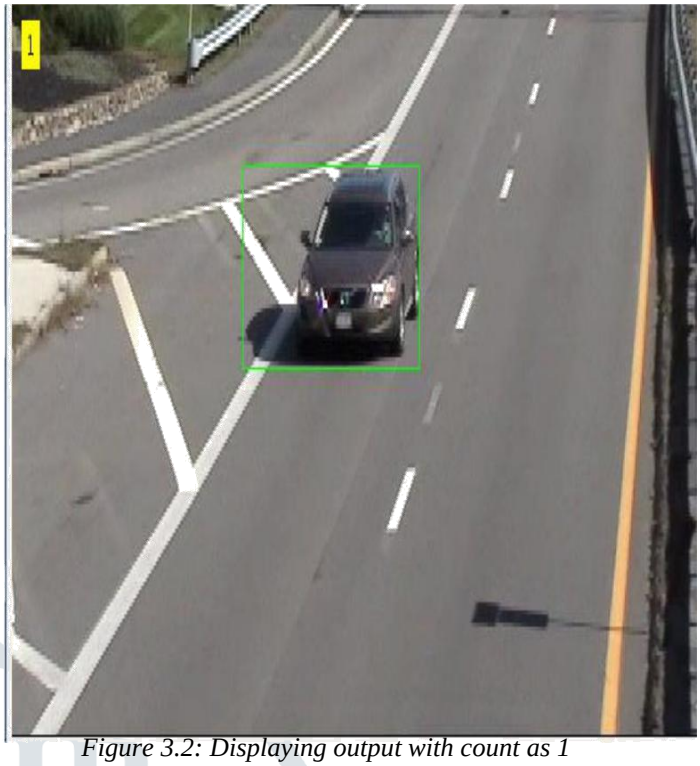

Figure 3.2: Displaying output with count as 1

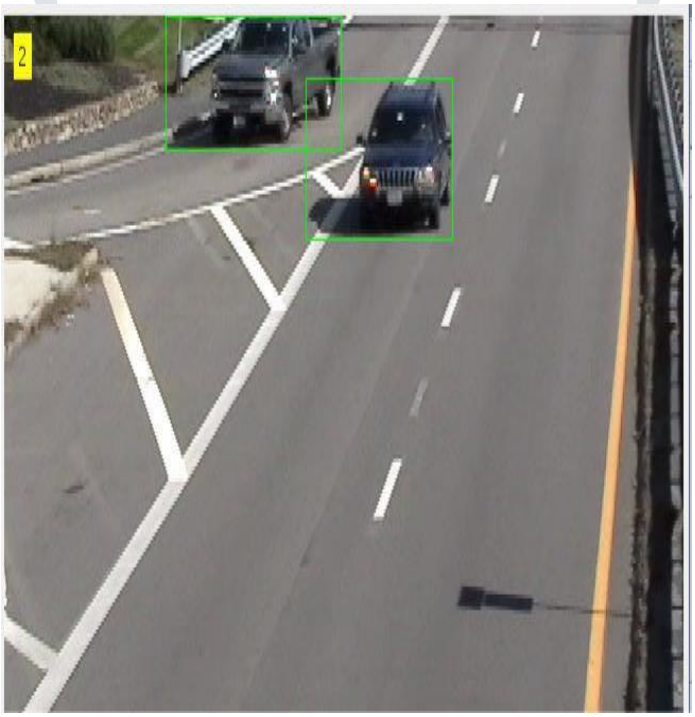

Figure 3.3: Displaying output with count as 2

V. Conclusion:

In this paper an adaptive method for vehicle counting based on digital image processing techniques has been presented. As it is software based approach implemented by using Matlab this method led to reduce the costs. Provides reliable count. By using Digital image processing methods like background subtraction, morphological analysis, classification and counting of vehicles has performed accurately. The Experimental results indicated that the method which is presented worked effectively which made it suitable for vehicle detection and traffic flow analysis purposes.

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