ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Detection and Counting of Vehicles in a High Way Traffic Videos

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Abstract:
Automatic detecting and counting vehicles in unsupervised video on highways is a very challenging problem in computer vision with important practical applications such as to monitor activities at traffic intersections for detecting congestions, and then predict the traffic flow which assists in regulating traffic. Manually reviewing the large amount of data they generate is often impractical. The background subtraction and image segmentation based on morphological transformation for tracking and counting vehicles on highways is proposed. This algorithm uses erosion followed by dilation on various frames. Proposed algorithm segments the image by preserving important edges which improves the adaptive background mixture model and makes the system learn faster and more accurately, as well as adapt effectively to changing environments.

Key words:
Vehicle detection, background subtraction, morphological operator, traffic analysis.

1. Introduction:

In recent year, as the result of the increase in vehicle traffic, many problems have appeared. For example, traffic accidents, traffic congestion, traffic induced air pollution and so on. Traffic congestion has been a significantly challenging problem. It has widely been realized that increases of preliminary transportation infrastructure e.g., more pavements, and widened road, have not been able to relieve city congestion. As a result, many investigators have paid their attentions on intelligent transportation system (ITS), such as predict the traffic flow on the basis of monitoring the activities at traffic intersections for detecting congestions.

To better understand traffic flow, an increasing reliance on traffic surveillance is in a need for better vehicle detection such at a wide-area. Automatic detecting vehicles in video surveillance data is a very challenging problem in computer vision with important practical applications, such as traffic analysis and security. Vehicle detection and counting is important in computing traffic congestion on highways. A system like the one proposed here can provide important data for a particular design. The main objective of our study is to develop methodology for automatic vehicle detection and its counting on highways. A system has been developed to detect and count dynamic objects efficiently. Intelligent visual surveillance for road vehicles is a key component for developing autonomous intelligent transportation systems. The algorithm does not require any prior knowledge of road feature extraction on static images. We present a system for detecting and tracking vehicles in surveillance video which uses segmentation with initial background subtraction using morphological operator to determine salient regions in a sequence of video frames. Edges will be counting which shows how many areas are of particular size then particular to car areas we locate the points and counting the vehicles in the domain of traffic monitoring over highways.

2. Related Work:

A brief survey of the related work in the area of video segmentation and traffic surveillance is presented in this section. Chen et al., [1], [2] have addressed the issues regarding unsupervised image segmentation and object modeling with multimedia inputs to capture the spatial and temporal behavior of the object for traffic monitoring.

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In [3] algorithms for vision-based detection and classification of vehicles in monocular image sequences of traffic scenes are recorded by a stationary camera. Processing is done at three levels: raw images, region level, and vehicle level. Vehicles are modeled as rectangular patterns with certain dynamic behavior. Daniel et al., [4] presents the background subtraction and modelling technique that estimates the traffic speed using a sequence of images from an un-calibrated camera. The combination of moving cameras and lack of calibration makes the concept of speed estimation a challenging job.

Cheng and Kamath [5] compare the performance of a large set of different background models on urban traffic video. They experimented with sequences filmed in weather conditions such as snow and fog, for which a robust background model is required. Kanhere et al., [6] applies a feature tracking approach to traffic viewed from a low-angle offaxis camera. Vehicle occlusions and perspective effects pose a more significant challenge for a camera placed low to the ground. Deva et al., [7] proposes a concept to automatically track the articulations of people from video sequences. This is a challenging task but contains a rich body of relevant literature.

It can identify and track individuals and count distinct people. Toufiq P. et al., in [8] describes background subtraction as the widely used paradigm for detection of moving objects in videos taken from static camera which has a very wide range of applications. The main idea behind this concept is to automatically generate and maintain a representation of the background, which can be later used to classify any new observation as background or foreground. In [9] background subtraction also involves computing a reference image and subtracting each new frame from this image and thresholding the result. This method is an improved version of adaptive background mixture model, it is faster and adapts effectively to changing environments.

3. Architecture:

In the present algorithm, we assume that the first frame is background for the video clips considered. The architecture of the proposed algorithm is shown in Figure 1.The flow of the algorithm for background elimination is as follows. Video clip is read and it is converted to frames. In the first stage difference between frames are computed i.e. FR1and FR1+j. In the next stage these differences are compared, and in the third stage pixels having the same values in the frame difference are eliminated.

The fourth phase is the post processing stage executed on the image obtained in third stage and the fifth phase is the vehicle detection .and vehicle tuning .And final stage is counting vehicles. Background Registration A general detecting approach is to extract salient regions from the given video clip using a learned background modelling technique. This involves subtracting every image from the background scene .here first frame is assumed as initial background and thresholding the resultant difference image to determine the foreground image.

Here we go by the fact that vehicle is a group of pixels that move in a coherent manner, either as a lighter region over a darker background or vice versa. Often the vehicle may be of the same colour as the background, or may be some portion of it may be camouflaged with the background, due to which detecting the object becomes difficult. This leads to an erroneous vehicle count.

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Block Diagram:

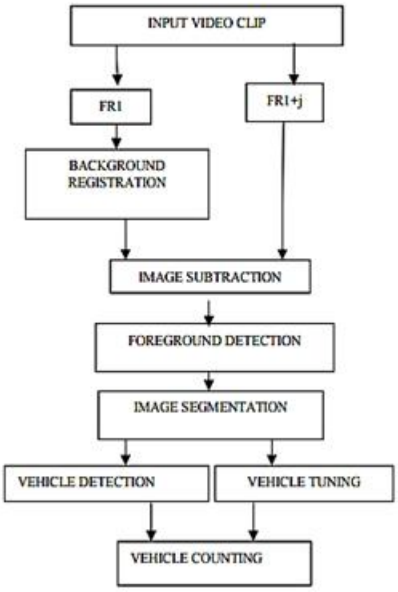

Fig1: Block diagram

Foreground Detection:

Detecting information can use to refine the vehicle type and also to correct errors which are caused due to occlusions. After registering the static objects the background image is subtracted from the video frames to obtain the foreground dynamic objects. Post processing is performed on the foreground dynamic objects to reduce the noise interference.

Image Segmentation:

In general, three steps are used in this study. The first step is segmentation to object regions of interest. In this step, regions which may contain unknown objects have to be detected. The second step focuses on the extraction of suitable features and then extraction of objects. The main purpose of feature extraction is to reduce data by means of measuring certain features that distinguish the input patterns. The final step is classification. It assigns a label to an object based on the information provided by its descriptors. In this paper, investigation is made on the mathematical morphology operators for segmentation of a gray-scale image.

Vehicle Tuning:

Usually due to the irregular object motion, there always exist some noise regions both in the object and background region .Moreover, the object boundaries are also not very smooth, hence a post processing technique is applied on the foreground image. Filters termed median filters are used, whose response is based on ordering (ranking) the pixels contained in the image area encompassed by the filter. The final output of the object tuning phase is a binary image of the objects detected

Vehicle Counting:

The tracked binary image mask1 forms the input image for counting. This image is scanned from top to bottom for detecting the presence of an object. Two variables are maintained i.e., count that keeps track of the number of vehicles and count register *countT*, which contains the information of the registered object. When a new object is encountered it is first checked to see whether it is already registered in the buffer, if the object is not registered then it is assumed to be a new object and count is incremented, else it is treated as a part of an already existing object and the presence of the object is neglected. This concept is applied for the entire image and the final count of objects is present in variable count. A fairly good accuracy of count is achieved. Sometimes due to occlusions two objects are merged together and treated as a single entity.

4. Algorithm:

Four major functions are involved in the proposed technique. The first function is to read and divide a video clip into number of frames. Second function is to implement the major procedures like finding frame differences and identifying the background registered image .Next post-processing is performed, and the background is eliminated thus maintaining only the foreground objects. The last function assists in counting the detected objects. The aim of the algorithm is to design an efficient counting system on highways.

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Given a video clip, the initial problem is segregating it into number of frames. Each frame is then considered as an independent image, which is in RGB format and is converted into Gray scale image. Next the difference between the frames at certain intervals is computed. This interval can be decided based on the motion of moving object in a video sequence .If the object is moving quite fast, then the difference between every successive frame is considered. Imdilate and imerrosion the morphological operator used for segmenting the objects edges will be counting with bwfill which shows how many areas are big in size, then particular to car areas we locate the points then above the car areas them counter will be incremented step are again repeat till the end of video sequence.

Mathematical morphology is used for analyzing object shape characteristics such as size and connectivity, which are not easily accessed by linear approaches. Morphological operations are used for image segmentation. The advantages of morphological approaches over linear approaches are direct geometric interpretation, simplicity and efficiency in hardware implementation. Basic operation of a morphology-based approach is the translation of a structuring element over the image and the erosion and/or dilation of the image content based on the shape of the structuring element. A morphological operation analyzes and manipulates the structure of an image by marking the locations where the structuring element fits. In mathematical morphology, neighborhoods are, therefore, defined by the structuring element, i.e., the shape of the structuring element determines the shape of the neighborhood in the image. The fundamental mathematical morphology operations dilation and erosion, based on Minkowski algebra are used (Eq. 1 & 2)

Dilation

$$D(A,B) = A \oplus B = \bigcup_{\beta \in B} (A + \beta) \qquad (1)$$

Erode:

$$E(A,B) = A \ominus (-B) = \bigcup_{\beta \in B} (A - \beta) \qquad (2)$$

Where

$$-B = \{-\beta | \beta \in B\}$$

While either set A or B can be thought of as an "image”, A is usually considered as the image and B is called a structuring element. The new intensity value of the center pixel is determined according to the following rules.

1) For dilation, if any pixel of the rectangle fits at or under the image intensity profile, the center pixel of the rectangle is given the maximum intensity of the pixel and its two neighbors in the original image; otherwise the pixel is set to zero intensity.

2) For erosion, if the whole rectangle fits at or under the image intensity profile, the center pixel is given the minimum intensity of the pixel and its two neighbors in the original image; otherwise the pixel is set to zero intensity. In short dilation causes objects to dilate or grow in size; erosion causes objects to shrink. The amount and the way that they grow or shrink depend upon the choice of the structuring element.

Steps to count vehicle:

1. Traverse the mask1 image to detect an object.
2. If object encountered then check for registration in countT.
3. If the object is not registered then increment count and register the object in countTlabelled with the new count.
4. Repeat steps 2-4 until traversing not completed.

5. Implementation and Performance analysis:

A. Simulation Software:

Simulation is performed using MATLAB Software. This is an interactive system whose basic data element is an array that does not require dimensioning. It is a tool used for formulating solutions to many technical computing problems, especially those involving matrix representation.

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This tool emphasizes a lot of importance on comprehensive prototyping environment in the solution of digital image processing. Vision is most advanced of our senses, hence images play an important role in humans' perception, and MATLAB is a very efficient tool for image processing.

Fig2: Background image obtained

Fig3: current video frame

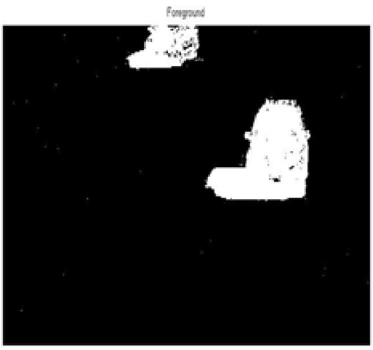

Fig4: Foreground image Obtained after background subtraction

Fig5: clean Foreground image Obtained after filtration

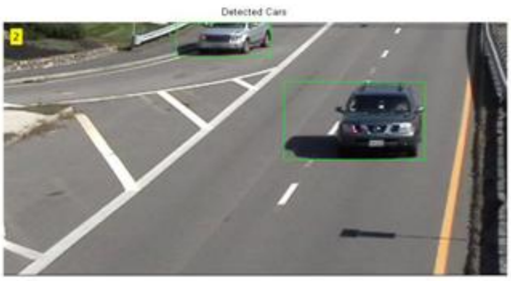

Fig6: Detected vehicles

B. Performance Analysis:

We have tested the algorithm on image sequences on different scenarios like traffic junction intersection, highways etc. All the videos chosen for vehicle tracking have same light intensity and have been taken during day time. We convert the color video frames to gray scale images. Techniques are used to count the number of vehicles passing through the highway intersection in a given time duration. This algorithm was applied on different video sequences

6. Conclusion:

In this paper, we present a background registration technique and segmentation using morphological operator A system has been developed to detect and count dynamic objects on highways efficiently. The system effectively combines simple domain knowledge about object classes with time domain statistical measures to identify target objects in the presence of partial occlusions and ambiguous poses, and the background clutter is effectively rejected. The experimental results show that the accuracy of counting vehicles was 96%, although the vehicle detection was 100% which is attributed towards partial occlusions. The computational complexity of our algorithm is linear in the size of a video frame and the number of vehicles detected. As we have considered traffic on highways there is no question of shadow of any cast such as trees but sometimes due to occlusions two objects are merged together and treated as a single entity.

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