International journal of imaging science and engineering

ISSN: 1934--9955 www.ijise.net

Vol-17 Issue-01 Mar 2022

Methods for Detecting Moving Vehicles in Images: A Comprehensive Review

Haritha K

India

Abstract: In many traffic management systems, vehicle recognition and counting is crucial. Here are the steps involved: i) identifying what kinds of cars are present in the scenario, and ii) tallying them all. A comprehensive analysis of existing techniques for vehicle identification and counting is presented in this research.

Keywords: Detection and counting of vehicles

1. Introduction

A relatively new area that is rapidly developing around computer vision methods is video analysis. When it comes to traffic monitoring, intelligent transport systems (ITS), and public safety, this technology is crucial. The need for effective traffic monitoring and management has arisen due to the exponential growth of modern urban and national road networks throughout the last 30 years. The first stage in gathering data is identifying moving objects in video frames. One widely used method for foreground segmentation is background removal. Sensors and electromagnetic microwave detectors, the standard tools for measuring traffic, are cumbersome, costly, and unable to pick up on cars that are moving slowly or temporarily stopped.

An essential tool for determining and monitoring traffic and ensuring safety is video surveillance. Traffic monitoring has grown in significance in recent years because to the useful data it offers for transportation planning and traffic management, including data on average lane share, vehicle speed, and the volume of vehicles in a given location. To enhance the accuracy rate and efficiency, study is needed on the different ways of vehicle flow estimate. The most significant parameter is vehicle flow or vehicle density in a certain region. Some common approaches for detecting vehicles include statistical methods, trajectory-based detection, optical flow, temporal differencing, and background removal. This is in addition to the approaches already mentioned, such as the mean shift method, the edge detection method, and the color space model based detection.

2. Review of Vehicle Detection Techniques

In the literature, there are many models for moving vehicle detection. The most common and widely used model is the background subtraction model.

Background subtraction techniques: Background subtraction is particularly a commonly used technique for detecting moving vehicles. It is used to detect moving regions by subtracting the current image pixel-by-pixel from a reference background image that is created by averaging images over time in an initialization period. The pixels where the difference is above a threshold are classified thenas foreground. The reference background is updated with new images over time to adapt to dynamic scene changes as in case of videos.

Another method for background subtraction is the median based method. Assuming that background is more likely to appear in the scene, the median of the previous „n“ frames is used as the background model. The median is calculated by first sorting all the pixel values from the surrounding neighborhood into numerical order and then replacing the pixel being considered with the middle pixel value [1]. The main

International journal of imaging science and engineering

ISSN: 1934--9955 www.ijise.net

Vol-17 Issue-01 Mar 2022

advantage of this method is that it handles slow movements of the objects. But this method cannot differentiate between noise and fine details of the image and removes the details along with the noise. Also, it uses a global threshold for all the pixels in the image which is not feasible.

The most widely used background subtraction method is the Gaussian mixture model based method. A Gaussian Mixture Model (GMM) is a parametric probability density function which is represented as a weighted sum of Gaussian component densities. Instead of modeling the values of all the pixels as one particular type of distribution, the pixel is modeled as a mixture of Gaussian. Based on the parameters such as mean, weight and the variance of each of the Gaussians of the mixture, it is determined whether it corresponds to background colors or foreground. Each time the parameters of the Gaussians are updated, the Gaussians are evaluated using a simple heuristic to hypothesize which are most likely to be part of the "background process." Pixel values that do not match one of the pixel"s "background" Gaussians are grouped using connected components [2].

In[3], an improvised background subtraction technique is used to detect the moving vehicles. It works for real time tracking and also solves the problems of shadow detection using chromatic color representation. A connected component labeling technique is introduced after background subtraction to label the different objects so as to bifurcate between the two objects and each region is labeled with the different label values.

Bhaskar et.al [4] have used a combination of Gaussian mixture model (GMM) and blob detection to detect the moving vehicles from a video. GMM is used to separate the foreground and background from the image. The output ofGMM is the foreground pixels which are then grouped in the current frame using contour detection algorithm. This result in disconnected classes of pixels called the Candidate blob (CB).The positions of the CB, in current frame, is compared using the k-Means clustering that detects the centers of clusters. The input samples CB are then grouped around the clusters to identify the vehicles in each region.

Frame differencing is another method to find the moving object by finding the difference between two consecutive frames. But the disadvantage of this method is it is sensitive to noise. In [5], a combination of the frame differencing method and the background subtraction method is used to get more accuracy. In this model, the system automatically chooses between FDM and background subtraction as the condition arrives

Statistical technique: The basic background subtraction (BBS) model faces problems of illumination changes in case of dynamic background. To overcome this, in[6][7] a pixel intensity based background subtraction (PIBB) technique is used. In this method, first the background modeling is done based on the pixel intensities in the initial frames iteratively. Then once a background model is obtained, the pixel intensities from modeled frame are subtracted from the corresponding current frame pixels to obtain a difference frame. Adaptive threshold is used to classify the pixel as foreground or background pixel. The background model is updated with each upcoming foreground frame so as to avoid the illumination changes.

Optical flow based method: Optical flow methods make use of the flow vectors of moving objects over time to detect moving regions in an image. They motion in video sequences even from a moving camera can also be detected. In[8], first the video frame is converted into gray scale image to avoid the intensity changes. The optical flow estimation is done after this. The optical flow describes the direction and time rate of pixels in a time sequence of two consecutive images[8]. A two dimensional velocity vector, carrying information on the direction and the velocity of motion is assigned to each pixel in a given place of the picture. The result of optical flow estimation gives various objects in the scene. Blob analysis is then performed to obtain the vehicles depending upon the blob size from the objects detected.

International journal of imaging science and engineering

ISSN: 1934--9955 www.ijise.net

Vol-17 Issue-01 Mar 2022

In[9], the mean shift method is used to detect the moving vehicles. In this method, initially an object mask is obtained using the adaptive Gaussian mixture model. Then the original mask is improved by using mean shift(MS) segmentation. The holes will be filled and the object boundary will be better aligned with true object boundary.

Trajectory based method: Trajectory based methods are used to detect moving vehicles. One of the methods based on trajectory is used by[10],a set of candidate object locations is generated and an initial set of points that can vote for possible object centers via a regression step is generated. Dense moving points from the video are extracted which further vote for object centers.

Color and texture based vehicle detection: Color and texture are two most important attributes in image processing application. Visual color contrast is used to filter informationpresent in each color component and to distinguish among similar gray-scale intensities. The color of the road is homogenous and they have the same texture throughout. You can easily detect vehicles making use of this fact. The color of the vehicle will show a huge variation when compared with the color of the road. But problem comes when the color of the vehicle is similar to the color of the road which can be solved by taking the texture into account[11]

Head light detection: During night time, the detection of vehicles become difficult as the brightness is low and the colors are not distinctly visible. Therefore different technique is used to detect vehicles at night time. This technique uses the headlights of the vehicles to detect the vehicle distinctly. A fast segmentation process based on an adaptive threshold is applied to effectively extract bright objects of interest. The extracted bright objects are then processed by a spatial clustering and tracking procedure that locates and analyzes the spatial and temporal features of vehicle light patterns, and identifies and classifies moving cars and motorbikes in traffic scenes [12].

3. Vehicle Counting Techniques

Vehicle counting is required to draw an estimate about the number of vehicles in a particular region.

Every vehicle has its own trajectory. In [13], an approach for counting vehicles is proposed by tracking feature points in the scene and clustering their trajectories into separate vehicles. If there is only a single vehicle path in the traffic scene, feature points into objects according to the estimated average vehicle sizes. In this method, trajectory clusters are assigned into different paths and connected by integrating multiple cues, including the spatiotemporal features of trajectories, the spatial distributions of vehicle paths, and the models of sources and sinks.

In [14], a simple method to count the total number of vehicles is used. In this approach, the centroid or the center of mass of each detected vehicle is found. The total count of vehicles is the total number of centroids.

In[15], an imaginary line is drawn on the video. Whenever the vehicle crosses this line, the count is incremented.

Most of the vehicle counting techniques used the centroid of the vehicle to count the total number of vehicles present.

4. Conclusion

This article presents a number of approaches to the problem of vehicle identification and counting. Due to its low computing burden and ease of implementation, the background subtraction approach has become the de facto standard for vehicle detection. However, abrupt changes in lighting might throw off the

International journal of imaging science and engineering

ISSN: 1934--9955 www.ijise.net

Vol-17 Issue-01 Mar 2022

background subtraction process. Therefore, in order to get superior results, the background subtraction approach is integrated with additional methods. Despite its accuracy, the optical flow approach is quite computationally intensive.

.

References

The article "Survey on Background Identification Using Various Algorithms" was published in 2015 and can be found in volume 4, issue 1, pages 222-225.
The paper "Adaptive background mixture models for real-time tracking" was published in 1999 by C. Stauffer and W. E. L. Grimson in the Proceedings of the IEEE Computer Society Conference on Computer Vision and Pattern Recognition (Cat. No. PR00149), volume 2, pages 246-252.
The paper "Improvised approach using background subtraction for vehicle detection" was presented at the 2015 5th IEEE International Advanced Computing Conference (IACC) and can be found on pages 303–308 in the proceedings.
pp. 1–5 of the 2014 International Conference on Computer Science and Information, published by P. K. Bhaskar and S.-P. Yong, is cited as [4].
(5) "Moving Object Detection in Dynamic Backgrounds for Surveillance Systems," no. 978, pp. 1476–1479, 2014, written by W. Hossain and M. N. Das.
"Moving Object Detection in Real-Time Visual Surveillance using Background Subtraction Technique," no. 1, pp. 79-84, 2014, by D. K. Yadav, L. Sharma, and S. K. Bharti.
[7] "Intensity Range Based Background Subtraction for Effective Object Detection," published in 2013, volume 20, issue 8, pages 759–762. [8] K. K. Hati, P. K. Sa, and B. Majhi.
In his 2015 paper "Moving Vehicle Detection Based on Optical Flow Estimation of Edge," Y. Chen discusses this topic at length (pp. 754–758).
The paper "New Object Detection, Tracking and Recognition Approaches for Video Surveillance over Camera Network" was published in 2014 and was co-authored by S. Zhang, C. Wang, S. C. Chan, and X. G. Wei.
In their 2015 paper titled "Object Detection in Surveillance Video from Dense Trajectories," M. Zhai, L. Chen, J. Li, M. Khodabandeh, and G. Mori discuss the topic on pages 12–15.
The authors of the 2009 paper titled "Color-based Texture Image Segmentation for Vehicle Detection" are R. Mejía-iñigo, M. E. Barilla-pérez, and H. A. Montes-Venegas.
"An automated nighttime vehicle counting and detection system for traffic surveillance" (G. Salvi, 2014) was published in the proceedings of the 2014 International Conference on Computer Science and Artificial Intelligence (CSCI 2014), volume 1, pages 131–136.
IEEE Transactions on Intelligent Transportation Systems, vol. 14, no. 2, pp. 1016-1022, 2013, by R. Zhao and X. Wang.
[14] "Subtraction Technique and Prewitt Edge Detection," in Volume 6, Issue 10, Pages 8-12, 2015, by R. Javadzadeh, E. Banihashemi, and J. Hamidzadeh.
"Vehicle Detection and Counting Based on Color Space Model," pp. 447-450, 2015, by G. N. Swamy and S. Srilekha.