Identification and Feature Extraction of Moving Vehicles in LabVIEW

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Abstract—In recent years, video monitoring and surveillance systems have been widely used in traffic management. The image sequences for traffic scenes are recorded by a stationary camera. The video clip is sent to LabVIEW program to convert into image frames. NI LabVIEW vision assistant module is used to detect the moving vehicle. The method is based on the establishment of correspondences between regions and vehicles, as the vehicles move through the image sequence. Background subtraction is used which improves the adaptive background mixture model and makes the system learn faster and more accurately, as well as adapt effectively to changing environments. The resulting system robustly identifies vehicles, rejecting background and tracks vehicles over a specific period of time. Once the (object) vehicle is tracked, the attributes of the vehicle like width, length, perimeter, area etc are extracted by image process feature extraction techniques. In proposed system we use LabVIEW and Vision assistant module for image processing and feature extraction. The project will benefit to reduce cost of traffic monitoring system and complete automation of traffic monitoring system.

Index Terms—Image processing, Feature extraction, Segmentation, Threshold, Filter, Morphology, Blob, LabVIEW, NI, VI, Vision assistant

I. INTRODUCTION

Closed-circuit television cameras are becoming increasingly common on freeways and are used for traffic management; the cameras allow operators to monitor traffic conditions visually. As the number of cameras increase, monitoring each of them by operators becomes a difficult task hence videos are recorded and such the videos are usually only monitored after an event of interest (e.g. an accident) has been known to occur within a particular camera’s field of view. Manually reviewing the large amount of data they generate is often impractical. Thus, algorithms for analyzing video which require little or no human input are a good solution. Automatic detecting and tracking vehicles in video surveillance data is a very challenging problem in Image processing with important practical applications, such as traffic analysis and security. With suitable Image processing and analysis it is possible to detect and extract a lot of useful information on traffic from the videos, e.g., the number, type, and speed of vehicles using the road. After detecting the vehicle in a video frame, image features are needed to be extracted for further processing. The image features is the original characteristics or attributes of the image. Some of them are the directly felt natural features, such as the regional brightness, edges, texture or color; Some are the human characteristics that obtained by transformation or measurement, such as transform spectrum, histogram, moment and so on [1].

The necessary background and research work made on feature extraction of vehicles in past is presented in Section II. Section III presents the necessary materials & methods used for present research work. Section IV shows the experiments made and displays the results. Section V concludes the work giving benefits of project and the future work.

II. BACKGROUND

A vehicle tracking and classification system made by Lipton et al., [2] identifies moving objects as vehicles or humans, but however it does not classify vehicles into different classes. A vision-based algorithm was developed for detection and classification of vehicles in monocular image sequences of traffic scenes are recorded by a stationary camera. The processing is done at three levels: raw images, region level, and vehicle level. Vehicles are modeled as rectangular patterns with certain dynamic behavior [3].

Daniel et al., [4] presents the background subtraction and modeling technique that estimates the traffic speed using a sequence of images from an uncalibrated camera. The combination of moving cameras and lack of calibration makes the concept of speed estimation a challenging job. Toufiq P. et al., in [5] 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

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978-1-4799-3357-0

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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 [6], 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. Karmann and Brandt [7] discuss the segmentation approach using adaptive background subtraction that uses Kalman filtering to predict the background. Segmentation requires vehicles to be accurately separated from the background with minimal amount of initialization. Aiyan Lu et al [8] uses the combination of background subtraction method and three frame differencing method for moving vehicle detection, and designs the geometric parameters and combined parameters for vehicle classification for a tunnel monitoring video in China.

Chen et al., [9], [10] have addressed the issues regarding unsupervised image segmentation and object modelling with multimedia inputs to capture the spatial and temporal behavior of the object for traffic monitoring. D.Beymer et al., [11] proposes a real time system for measuring traffic parameters that uses a feature-based method along with occlusion reasoning for tracking vehicles in congested traffic areas. Here instead of tracking the entire vehicle, only sub features are tracked. This approach however is very computationally expensive. Cheng and Kamath [12] 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., [13] applies a feature tracking approach to traffic viewed from a low-angle off-axis camera. Vehicle occlusions and perspective effects pose a more significant challenge for a camera placed low to the ground. Vehicle consists of many noise sources, and environmental noise can also be significant. The key to efficient vehicle classification is choosing the optimal feature extraction method. Gorski.M and Zarzycki,J [14] present three methods each relating to properties of vehicle noise.

The moving-target identification and feature-aided tracking approach described in [15] combines kinematic association hypotheses with accumulated target classification information obtained from high range resolution (HRR), inverse synthetic aperture radar (ISAR), and synthetic aperture radar (SAR) signatures, to obtain improved classification and association. The vehicles are detected using mathematical modeling in [16]. In [17], rule based reasoning is used for vehicle detection, in which the results highly depend on the rules decided by humans. Automatic Traffic Density Estimation and Vehicle Classification for Traffic Surveillance System using Neural Networks were done with real traffic videos obtained from Istanbul Traffic Management Company (ISBAK) [18].

### III. MATERIALS AND METHODS

The vehicle identification system was implemented in following steps:
- Grabbing traffic video clip using by NI smart camera and image acquisition
- Obtaining image frames from video clip in LabVIEW environment
- Back ground image registration in LabVIEW
- Fore ground object (vehicle) detection in LabVIEW which is obtained by subtracting background image from the given input video frame. The difference between the frames at certain intervals is computed to detect the moving object.
- Image processing and vehicle attributes feature extraction (width, height, perimeter and area) with vision assistant in LabVIEW

The total architecture for vehicle classification system used in proposed project is shown in Fig 1.

(i)LabVIEW is graphical programming software that allows for instrument control, data acquisition, and pre/post processing of acquired data. With Graphical Programming Environment there is no need to write lines of program code
(ii)NI Vision Assistant module of LabVIEW provides step-by-step instructions for prototyping a vision application. To prototype an image processing application, build custom algorithms with the Vision Assistant scripting feature. The scripting feature records every step of the processing algorithm. After completing the algorithm, you can test it on other images to make sure it works.
IV. EXPERIMENTS AND RESULTS

The road with traffic was identified at Ballat city center of Abha, Saudi Arabia and arrangements are made on top of a building with NI smart cameras at a fixed point in a clear day light environment. The duration of traffic video recorded for about 2 minutes. The next step is to divide the video clip into image frames. For this purpose a LabVIEW VI for converting AVI file to a series of JPEG images is made and show in Fig 2. The video clip in avi format is sent as input to the VI. The output generated is a set of images.

The stationary image without vehicles is selected as background image registration is shown in Fig 3. The image with vehicle (Current image) is selected from set of images is shown in Fig 4.

The LabVIEW VI for comparing and finding difference between two images to identify vehicle in image is shown in Fig 5.

We have to give current images as input. We get the image of only road with cars in image out window. The output is a gray scale image is presented in Fig 6. Save the image for further image processing and feature extraction in LabVIEW vision assistant module.
After the vehicle detection step, the image is in gray scale. Load image into Vision Assistant module of LabVIEW by open image and give file path of the image as shown in Fig 7.

(i)Step – I : Threshold -Select ranges of pixel values in grayscale images, after applying threshold the image is converted into binary image. To perform this step, in grayscale tab select threshold function. The screen shot after applying the threshold value on the grayscale image is shown in Fig 8.

(ii)Step – II Particle filter - Removes or keeps particles in an image as specified by the filter criteria. To perform this step, in binary tab select particle filter function. Fig 9 shows screen shot after applying the particle filter on binary image.

(iii)Step – III Advance morphology - performs high level operations on blobs in binary images. To perform this step, in binary tab select Advanced Morphology function. First remove small particles in the image by selecting the option remove small objects. The screen shot after applying the remove small particles on binary image is presented in Fig 10. Next step is to compute Convex Hull of Objects in Convex option. Fig 11 shows a screen shot after applying convex hull.

(iv)Step – IV Particle analysis - Displays measurement results for selected particles measurements performed on the image in Fig 11. To perform this step, in binary tab select Particle Analysis function select the feature width, height, perimeter, area of the object (vehicle) to the measurements in pixels.

The vision assistant script file with all steps is presented in Fig 12. After performing feature extraction, the data is sent to excel sheet and recorded. Table 1 presents summarized features extracted from vehicle images from different frames.
The vehicle identification system is used to automate the process of traffic monitoring system by making identification and feature extraction of moving vehicles on road. The system uses LabVIEW for image processing of vehicle sample images to extract the features (area, perimeter, width, length). In next step the features can be used to build a classifier model to classify the vehicles.

V. CONCLUSIONS

The vehicle identification system is used to automate the process of traffic monitoring system by making identification and feature extraction of moving vehicles on road. The system uses LabVIEW for image processing of vehicle sample images to extract the features (area, perimeter, width, length). In next step the features can be used to build a classifier model to classify the vehicles.

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