Vehicle Detection and Traffic Control Using Embedded System

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ABSTRACT:

Vehicle detection plays an important role in highway traffic surveillance control, management and urban traffic planning. Vehicle detection process on road are used for vehicle tracking, counts, average speed of each individual vehicle, traffic analysis and vehicle categorizing objectives and may be implemented under different environments changes. Vehicle flow detection appears to be an important part in traffic monitoring system. The traffic flow shows the traffic state in fixed time interval and helps to control the traffic. This paper proposes an automatic traffic monitoring system which is used for estimating the important traffic parameters from video sequences through vision based cameras, and also used to detect the traffic flow in different lanes. presents a powerful algorithm of computer vision methods to traffic flow monitoring, vehicle detection and traffic analysis, which intend to develop the vehicle count system using an image processing technique in CCTV video outputs. This software-based vehicle counter can detect all vehicles through images instead of using expensive electronic sensors or cameras embedded in the sidewalks. This system processes captured video, detects vehicles in each frame, classifies the vehicles into four types and counts all of them, all by image/video processing techniques.

Keywords: Traffic monitoring system, video processing, Noise removal, Vehicle flow detection, lanes detection, traffic parameters

INTRODUCTION:

Intelligent transportation system provides an attractive alternative to the traditional traffic systems, which depend almost on the facilities of the system for traffic circulation and safety. A video camera, coupled with computer vision techniques, makes up of a video-based intelligent transportation system. Detection of moving objects is the first relevant step in this system. To meet the special requirements of efficiency and accuracy of a successful video-based system, moving objects detection algorithm should be characterized by some important features, such as accuracy, real-time-ness, etc. The accuracy of detection is a basic requirement of the system. In general, the accurate detection is time-consuming. Moreover, a real time system ensures that the detection information is provided in time, and the management commands from the control center are responded timely. In fact, a precise moving object detection method makes tracking more reliable and faster, and supports correct classification, which is quite important for a system to be successful. Nowadays, there is an urgent need for the robust and reliable traffic surveillance system to improve traffic control and management with the problem of urban congestion spreads. Many traffic state parameters can be detected through traffic surveillance system, including traffic flow density, the length of queue, average traffic speed and total vehicle in fixed time interval. To achieve these goals, in past decades.
LITERATURE REVIEW:

Raad Ahmed Hadi et al (2014) present a concise overview of image processing methods and analysis tools which used in building these previous mentioned applications that involved developing traffic surveillance systems. More precisely and in contrast with other reviews, we classified the processing methods under three categories for more clarification to explain the traffic systems.

Gian Luca Foresti et al (2011) addresses some of the indications of the European Union for road safety by proposing a real-time traffic monitoring system for vehicle detection and tracking in bad illuminated scenarios. Several urban and extra-urban roads during the night or tunnels are characterized by low illumination, light spots, shadows, light reflections, etc. The main objectives of the proposed system are: (a) to monitor the traffic flow, (b) to estimate the vehicle’s speed or determine the state of the traffic.

Zhen Yu et al (2009) propose a new method to detect moving objects in a non-stationary, complex background for an automatic traffic monitoring system. As a pre-treatment, the square neighborhood algorithm is adopted to compensate the disturbance caused by shaking of camera. Then, an improved temporal difference method is applied to obtain the moving areas. Some post-treatments are used to optimize the detection by eliminating noise from the moving areas.

OBJECTIVES:

1. To study the Vehicle detection methods of the traffic monitoring system
2. To study the Vehicle Detection application for Intelligence Transportation system
3. To find possible vehicle location in an image quickly for further vehicle detection
4. To introduce a system which detects all kind of violations at a street intersection such as speed violation, stop line violation and lane violation during red light running

Background: Video based object or motion detection and tracking are two tasks that play a fundamental role in video surveillance systems, transportation systems, military applications, gaming systems, etc. This section mainly focuses on the problem of video based vehicle detection and tracking for ITS applications. Vehicle detection is a process of detecting the presence or absence of a vehicle in the video sequence. Vehicle tracking is defined as finding the location of a vehicle in each frame of the video sequence. Typically the result of detection is used as initialization process for tracking. Video based vehicle detection and tracking systems for ITS applications are performed using: 1) static or moving cameras, 2) single or multiple cameras, 3) fixed or Pan-Tilt-Zoom (PTZ) cameras. The efficiency of any vehicle detection system is based on the systems readiness to handle loss of information, noise in video, complexity of vehicle motion, vehicle occlusion, shape complexity, illumination changes and real-time processing.
MOTION VEHICLE DETECTION

The detection of moving object's regions of change in the same image sequence which captured at different intervals is one of interested fields in computer vision. An important large number of applications in diverse disciplines are employed the change detection in its work, such as video surveillance, medical diagnosis and treatment, remote sensing, underwater sensing and civil infrastructure. One of the video surveillance branches is the traffic image analysis which included the moving/motion vehicle detection and segmentation approaches. Even though various research papers have been showed for moving vehicle detection (background subtraction, frame differencing and motion based methods) but still a tough task to detect and segment the vehicles in the dynamic scenes.

Vehicle Detection Techniques:

It consists of three main approaches to detect and segment the vehicle, as mentioned below:

1. Background Subtraction Methods.
2. Feature Based Methods.
3. Frame Differencing and Motion Based methods.
4. Edge Detection

Background Subtraction Methods

The process of extracting moving foreground objects (input image) from stored background image (static image) or generated background frame form image series (video) is called background subtraction, after that, the extracted information (moving objects) is resulted as the threshold of image differencing. This method is one of widely change detection methods used in vehicle regions detection. An advanced background subtraction technique used to detect and extract features for vehicles in complex road scenes in traffic surveillance. This innovative technique uses a filtering method based on a histogram which collects information from sequences of frames of scatter background. This proposed background subtraction algorithm depicted a well performance under different conditions including various view-angles, overcrowding and illumination.

A new method for vehicle detection based on shadows underneath vehicles information has proposed by. This method extracts the size features of vehicles from information that gathered form the distance between ends of front and rear tires for underneath shadow of vehicles to distinguish the existence of vehicles on the lanes. In this paper, the information represented as traffic movement images which obtained from a camera assembled on a low position such as the roadside, sidewalk, and etc. Moreover, this method has accurate vehicle detection because it is used the functions to generate and improve a background image, in addition, approximate and modernize the value of threshold of background subtraction images binarization automatically.
Fig 1: Shows the underneath shadow (a) the measurement area and the lowest horizontal line (b) A region of vehicles and their shadows

Also, a novel well-organized idea based on suggested filters which are used for mobile vehicles detection have presented by. In this research, the two filters are used to eliminate swinging trees and raindrops from forefront entities respectively, and the swinging trees filter is used to decrease the calculation difficulty of consequent vehicle tracing. In addition, a shade removal method is combined with a versatile background deletion approach to take out the mobile vehicles in background images.

**Feature Based Methods:** Another trend which the researchers investigate and motivate on sub-features like the edges and corners of vehicles, the moving objects segmented from background image by collecting and analyzing the set of these features from the movement between the subsequent frames. Furthermore, the feature based method supports the occlusion handling between the overlapping vehicles and compared with background subtraction method represents a less level from the computational difficulty view.

A subregion is a technique used to locate the local features which used for recognition non-occluded and partially occluded vehicles. Principal components analysis (PCA) weight vector used to pattern the low-frequency components and an independent component analysis (ICA) coefficient vector used to pattern the high-frequency components, these two vectors were generating by subregions.

**Fig 2: Eigen-window method.**

**Motion-based Methods:** All the cues discussed so far use spatial features to distinguish between vehicles and background. Another cue can be employed is
motion of vehicles via the calculation of optical flow. Pixels on the images appear to
be moving due to the relative motion between the sensor and the scene. The vector
field of this motion is referred as optical flow. Motion-based vehicle detection methods
use characteristics of flow vectors of moving objects over time to detect moving
regions in an image sequence. Optical flow based method can be used to detect
independently moving vehicles from camera. However, most flow computations are
computationally complex and very sensitive to noise for it’s not very easy to derive a
reliable dense optical flow estimate under a stationary camera. It’s hard to be applied
to analysis the video streams in real-time without specialized hardware.

![Image of optical flow](image_url)

**Fig 2: Motion Based Detection**

**Edge Detection:** Vehicle detection is done by Image matching functions using edge
dilatation. We know that each image has 3 key features to achieve detect goals:
Edges, Lines, and Points.

Among them, the best option is to use edges, which can be detected from the sudden
change in the gray level. One of the most common ways to find the borders (edges) of
an image is using Sobel factor, which has been used in our present task. Edges
essentially separate two various regions, which are static region (the roadway) and
dynamic region (the moving vehicles). So the main task of Edge detection method is
to locate all pixels of the image that correspond to the edges of the objects.

**Capture of live video feed:** Live video feeds from CCTV cameras monitoring
freeways and arterials are captured for video frame processing by a USB frame
capture device. The video feeds are captured at various locations at different time of
the day. Also, the CCTV cameras are pan-tilt-zoom cameras with varying camera
field of view. Also, the height of the camera mounted is unknown.

**Pre-processing of video frames:** Using a GUI tool developed as part of our vehicle
detection system, the user can select the region of interest on the captured video
frame. The detection and tracking algorithms are only performed on this cropped
image region to reduce the processing time of the system. The user is required to
specify detection and speed zones using horizontal virtual reference lines. The
detection zones are areas where the interest points are evaluated, vehicles detected
and vehicle counts are incremented. The speed zones are adjacent to the detection
zones, where the interest points are re-evaluated and vehicles are detected. As a rule
of thumb, the detection zone length should be less than the vehicle length as seen in the video feed and the speed zone length should be just greater than the vehicle length as seen in the video feed.

**Implementation**: The developed vehicle detection system was evaluated on a series of video feeds (8 sets) of 1 min. interval that was recorded at many locations around the Las Vegas valley. The video feeds vary by location, illumination (recorded during different times of the day), road dimension, camera view angle and region of view. The system was evaluated for vehicle count and speed. Vehicle speeds during video recording were determined using radar technology.

![Fig 3: Detected Harris-Stephen corner interest points on vehicles](image)

![Fig 4: Detected of Harris-Stephen corner interest points on vehicles at different lanes](image)

**Vehicle Detection Application for ITS:**

The developed video based vehicle detection system was employed for advanced warning of congestion and queues at work zones and on freeways during special events. The advance warning system consists of a series of video monitoring stations equipped with video recording devices and our video based vehicle detection system. Vehicle queue lengths, speed and counts were monitored before work zones or special event locations and real-time information regarding congestions were transmitted.
using Radio Frequency (RF) modules with directional antennas to a portable variable message sign trailer few miles downstream.

CONCLUSION:

This paper provides a summarizing study on the proposed techniques which have used in traffic video. It focuses in these areas, namely vehicle detection, tracking, and classification with appearance of shadow and partial occlusion. Also, we present and classify the traffic surveillance systems to three types based on specific methods which used for developing it. The experimental results on real traffic video data show that our vehicle detector has strong abilities to deal with different weather and illuminating conditions. For vehicle detection research the precision on a pixel level other than an object level is desired. In the future, we will improve our algorithm to be more precise. Vehicle detection based on imaging technologies has attracted much attention in past decades, and will remain an active research area in the coming years. From different vehicle detection approaches summarized above, we get the conclusion that each method is suitable to one or two specific conditions, and there is a lack of universal method to automatically detect vehicles under varying environments.

REFERENCES: