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Vehicle Detection and Tracking for Traffic Surveillance Applications: A Review Paper

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***Abstract*—** Immediately Automatic video analysis from traffic surveillance cameras is a fast-emerging field based on computer vision techniques. It is a key technology to public safety, intelligent transport system (ITS) and for efficient management of traffic. An accurate and efficient tracking capability at the heart of such a system is essential for building higher level vision-based intelligence. Tracking is not a trivial task given the non-deterministic nature of the subjects, their motion, and the image capture process itself. The task of reliably detecting and tracking moving objects in surveillance video, which forms a basis for higher level intelligence applications, has many open questions. In this paper, we present an overview of the state of vehicle detection and tracking techniques and describes the different terminology to produce specification according need of current generation.

***Keywords*—**Vehicle Detection, Video Surveillance, Object Recognition, Intelligent Traffic, Object Tracking

I. INTRODUCTION

The introduction of new technologies such as autonomous intelligent cruise control or collision avoidance schemes to road vehicles necessitates a high degree of robustness and reliability. As digital cameras and computers have become wide-spread, the number of applications using vision techniques has increased significantly. One such application that has received significant attention from the computer vision community is traffic surveillance. In the field of video processing, digital video surveillance system plays a major part in monitoring interested objects (e.g., vehicles, people) [1] [2].

The escalating increase of contemporary urban and national road networks over the last three decades emerged the need of efficient monitoring and management of road traffic. Conventional techniques for traffic measurements, such as inductive loops, sensors or EM microwave detectors, suffer from serious shortcomings, expensive to install, they demand traffic disruption during installation or maintenance, they are bulky and they are unable to detect slow or temporary stop vehicles. On the contrary, systems that are based on video are easy to install, use the existing infrastructure of traffic surveillance. Furthermore, they can be easily upgraded and they offer the flexibility to redesign the system and its functionality by simply changing the system algorithms [3] [4].

One of the significant applications of video-based supervision systems is the traffic surveillance. So, for many years the researches have investigated in the Vision-Based Intelligent Transportation System (ITS), transportation planning and traffic engineering applications to extract useful and precise traffic information for traffic image analysis and traffic flow control like vehicle count, vehicle tracking, vehicle classification, traffic density, traffic lane changes, license plate recognition, etc. [5].

However, the traditional vehicle systems may be declines and not recognized well due to the vehicles are occluded by other vehicles or by background obstacles such as road signals, trees, weather conditions, and etc., and the performance of these systems depend on a good traffic image analysis approaches to detect, track and classify the vehicles [5].

The main objective of this paper is: To present various aspect of vehicle detection and tracking which is immensely surveillance traffic system in various areas; to review some late and existing procedures of object tracking using different approaches; to give generalize problem formulation in the aspects of available object recognition scenario.

The remainder of paper is organized as follows. Section II describes the background scenario on vehicle detection and relevance terminology. Related work is described in section

III. Finally the summery of whole review is summarized as conclusion in Section IV

II. BACKGROUND

The background of a study is an important part of our research paper. It provides the context and purpose of the study. Hence there is need for background study that contributes to prepare proposed system.

A. Vehicle Detection and Recognition

Object detection and recognition are important and challenging tasks in many computer vision applications such as surveillance, vehicle navigation, and autonomous robot navigation. Video surveillance in a dynamic environment, especially for humans and vehicles, is one of the current challenging research topics in computer vision. It is a key technology to fight against terrorism, crime, public safety and for efficient management of traffic [6].

With the continuously growing number of motor vehicles over the last few decades, traffic accidents have become an important cause of fatalities. In Object Detection and Tracking we have to detect the target object and track that object in consecutive frames of a video file. Video sensors become particularly important in traffic applications mainly due to their fast response, easy installation, operation and maintenance, and their ability to monitor wide areas. Research in several fields of traffic applications has resulted in a wealth of video processing and analysis methods. Two of the most demanding and widely studied applications relate to traffic monitoring and automatic vehicle detection [7].

B. Challenges of Object Detection and Tracking

Object tracking fundamentally entails estimating the location of a particular region in successive frames in a video sequence. Properly detecting objects can be a particularly challenging task, especially since objects can have rather complicated structures and may change in shape, size, location and orientation over subsequent video frames. Various algorithms and schemes have been introduced in the few decades, that can track objects in a particular video sequence, and each algorithm has their own advantages and drawbacks. Any object tracking algorithm will contain errors which will eventually cause a drift from the object of interest. The better algorithms should be able to minimize this drift such that the tracker is accurate over the time frame of the application In object tracking the important challenge that has to consider while the operating a video tracker are when the background is appear which is similar to interested object or another object which are present in the scene. This phenomenon is known as clutter [8]. The other challenges except from cluttering may difficulty to detect interested object by the appearance of the that object itself in the frame plane due to factors which are described as follows [9]:

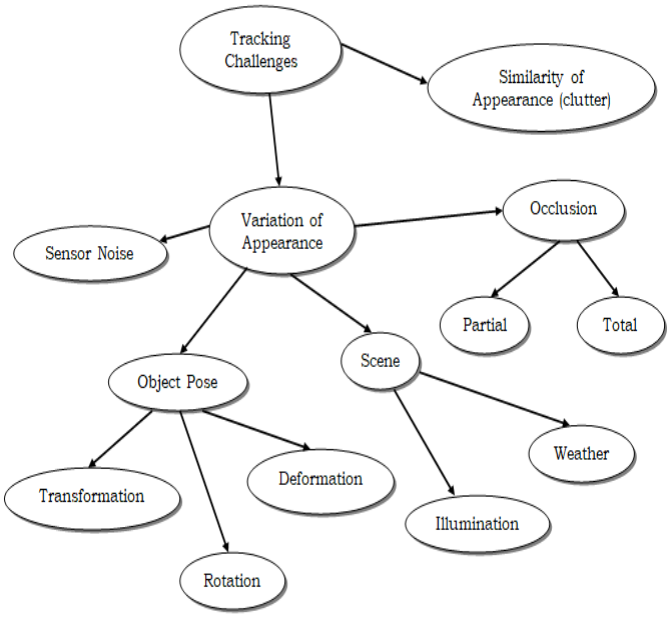

Figure 1: Main challenges in video Tracking

- ✓ **Object poses in the video frame:** In a video file, since the object is moving so the appearance of an interested object may vary its projection on a video frame plane.
- ✓ **Ambient illumination:** In a video, it is possible to change in intensity, direction and color of ambient light in appearance of interested objects in a video frame plane.
- ✓ **Noise:** In the acquisitions process of video, it may possible to introduce a certain amount of noise in the image or video signal. The amount of noise depends upon sensor qualities which are used in acquitting the video.
- ✓ **Occlusions:** In a video file, moving object may fall behind some other objects which are present in the current scene. In that case tracker may not observe the interested object. This is known as occlusion.

C. Video Surveillance Systems

Video surveillance systems are widespread and common in many environments. Video surveillance is an active area of research. Object detection and tracking in video surveillance systems are commonly based on background estimation a subtraction. The primary focus of today's video surveillance systems act is the application of video compression technology to efficiently multiplex or store images from a large number of cameras onto mass store devices (video tapes, discs) [10]. From the perspective of real-time threat detection, it is well know that human visual attention drops below acceptance levels, even when trained personal and

assigned to the task of visual monitoring [11]. On the other side, video analysis technologies can be applied to human operator in real-time threat detection. Specifically, multi-scale tracking technologies are the next step in applying automatic video analysis to surveillance systems.

D. Visual Surveillance

Visual surveillance is an active research topic in computer vision that tries to detect, recognize and track objects over a sequence of images and it also makes an attempt to understand and describe object behavior by replacing the aging old traditional method of monitoring cameras by human operators. A computer vision system, can monitor both immediate unauthorized behavior and long term suspicious behavior, and hence alerts the human operator for deeper investigation of the event. The video surveillance system can be manual, semi-automatic, or fully-automatic depending on the human intervention.

III.LITERATURE SURVEY

This section provides the recently made contribution and the research work performed for improving software quality by fixing bug by prediction technique. Thus different research articles and papers are included in this section.

Mahammad Abdul HANNAN et al. [12] introduces an automatic vehicle classification for traffic monitoring using image processing. In this technique the fast neural network (FNN) as a primary classifier and then the classical neural network (CNN) as a final classifier are applied to achieve high classification performance. The FNN gains a useful correlation between the input and the weighted neurons using a multilayer perceptron to provide detection with a high level of accuracy. The Fourier transform is used to speed up the procedure. In the CNN, a lighting normalization method is employed to reduce the effect of variations in illumination. The combination of the FNN and CNN is used to verify and classify the vehicle regions. False detection is added to the training procedure using a bootstrap algorithm to get nonvehicle images. Experimental results demonstrate that the proposed system performs accurately with a low false positive rate in both simple and complex scenarios in detecting vehicles in comparison with previous vehicle classification systems.

Zebbara Khalid et al. [13] presented a new vehicle detection method from images acquired by cameras embedded in a moving vehicle. Given the sequence of images, the proposed algorithms should detect out all cars in real-time. Related to the driving direction, the cars can be classified into two types. Cars drive in the same direction as the intelligent vehicle (IV) and cars drive in the opposite direction. Due to the distinct features of these two type authors suggest to achieve this method in two main steps. The first one detects all obstacles from images using the so-called association combined with corner detector. The second step is applied to validate each vehicle using AdaBoost classifier. The new method has been applied to different images data and the experimental results validate the efficacy of our method.

A. Psyllos et al. [14] deals with a novel vehicle manufacturer and model recognition scheme, which is enhanced by color recognition for more robust results. A probabilistic neural network is assessed as a classifier and it is demonstrated that relatively simple image processing measurements can be used to obtain high performance vehicle authentication. The proposed system is assisted by previously developed license plate recognition, a symmetry axis detector and an image phase congruency calculation modules. The reported results indicate a high recognition rate and a fast processing time, making the system suitable for real-time applications.

Video detection is one of the primary collection means of traffic states in Parallel traffic Management Systems (PtMS). In order to accurately and automatically obtain road areas in highway surveillance videos, **Qing-Jie Kong et al. [15]** presented an automatic detection algorithm based on the frequency-domain information of video images. This algorithm uses the frequency domain feature that is produced by the vehicles passing through road areas in videos, to realize automatic segmentation and recognition of the road areas. The experiment comparing with the traditional vehicle-tracking-based method, which uses the information in the time-space domain, illustrates the advantages of the proposed algorithm.

In intelligent transportation system, research on vehicle detection and classification has high theory significance and application value. According to the traditional methods of vehicle detection which can't be well applied in challenging scenario, **Yiling Chen et al. [16]** proposes a novel Bayesian fusion algorithm based on Gaussian mixture model. Authors extract the features of vehicle from images, including shape features, texture features, and the gradient direction histogram features after dimension reduction. In vehicle classification part, authors adopt fuzzy support vector machine, and design a novel vehicle classifier based on nested one-vs-one algorithm. Finally, experimental tests show excellent results of our methods in both vehicle detection and classification.

IV.PROBLEM DOMAIN

In recent years, traffic congestion has become a significant problem. Sensing Vehicles ahead and traffic situations during driving are important aspects in safe driving, accident avoidance, and automatic driving and pursuit. The fundamental problem here is to identify vehicles in changing environment and illumination. Although there have been

numerous publications on general object recognition and tracking, or combination of them, not many of these techniques could be successfully applied in real-time for the in-car video, which has to process the input on-the-fly during the vehicle movement.

V. CONCLUSION

This paper provides a summarizing study on the different vehicle object recognition techniques which have used in traffic video. Object tracking is a very interesting research area that can lead to numerous intelligent applications. The quest for better traffic information, and thus, an increasing reliance on traffic surveillance, has resulted in a need for better vehicle detection such as wide-area detectors.

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