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VEHICLE DETECTION SYSTEMS: A REVIEW

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Abstract: — In intelligent transportation system (ITS) identification of moving vehicles at nighttime is a necessary process. The foremost step in monitoring the speedy vehicles on the highway is the detection of vehicle. Vehicle identification is utilized to recognize the vehicles in any video or picture record. The vehicle detection method is used to calculate different traffic parameters such as speed of vehicle, flow rate of traffic, required travelling time, volume, density, congestion levels. These vehicle detection methods can be applied for classification, tracking and traffic monitoring at nighttime. By using vehicle detection traffic safety can be improved. Various nighttime vehicle detection methods have been proposed by researchers. Review of different techniques for detection of vehicle using image processing is the main objective of this paper and also to provide brief study of these techniques.

Keywords: *intelligence transportation system (ITS), images, sensors, Vehicle-detection.*

I INTRODUCTION

In recent years detecting and recognizing vehicles at nighttime has played an important role for traffic control surveillance applications and autonomous driving. Vehicle identification is utilized on streets, roadways, stopping or some other place to identify or track the quantity of vehicles introduce on the spot. In terms of reflection of the light on the body of vehicle, color of the vehicle, environmental lightning the appearance of vehicle is different as compared to daytime. Detection and recognition of vehicle is a challenging research area in automated driving system (ADS), advanced driver assistance system (ADAS) and intelligent transportation system (ITS). The numbers of different techniques are available for object detection and tracking. For extraction of various features such as shape, color, size, edges these object detection methods can be used and for recognizing the instances of object class, learning algorithm is used. Most of the nighttime vehicle detection system uses feature detection techniques such as headlights (HL), taillights (TL) and brake lights.

There are various problems to detect vehicles at nighttime. For effective detection of vehicle at nighttime several requirements can be considered such as Different environmental conditions, different traffic conditions, different road Symbols, accuracy in vehicle detection, effective real time operations. Moving vehicle detection is the study of motion of the vehicle in the captured video.

II VEHICLE DETECTION

There are several nighttime vehicle detection algorithms that use headlights and taillights of the vehicle as the main feature in the detection of the vehicle. The general template for the vehicle detection at nighttime is as shown in figure 1 which consists of mainly four phases namely the preprocessing phase, feature extraction and classification to detect the vehicles.

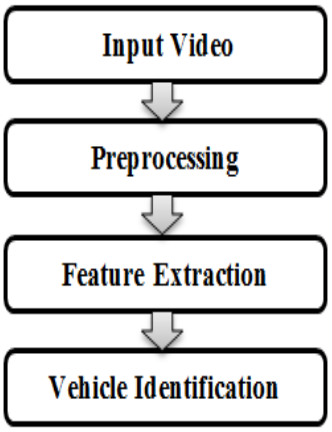

Figure 1 General methodology for nighttime vehicle detection

As shown in the figure, system takes video as a input then in preprocessing phase video is converted into images after that image detection method can be used and features can be extracted and based on that moving vehicle is detected and finally displays output. The information at the output phase can be used for evaluation of various traffic parameters and also it can be applied for various road traffic applications.

Applications of Vehicle detection:

1) Evaluation of vehicular density for traffic shaping
2) Aerial surveillance of the vehicular objects.
3) Automatic parking system to decide type of vehicle.
4) Vehicle tracking

III VEHICLE DETECTION SYSTEMS

There are lots of techniques available for detecting and recognizing vehicle at nighttime and daytime. Some of them are as follows:

P.F. Alcantarilla et.al. [1] Introduced an advantageous system for vehicle identification in front of a camera- assisted vehicle (preceding vehicles traveling in the same direction and oncoming vehicles traveling in the opposite direction) during nighttime conditions. This technique is used to change the head lights of the vehicle automatically between high beams and low beams and also helps to avoid glares for the drivers. An effective automatic control of the vehicle is proposed by author which is based on the identification of taillights and headlights during nighttime scenes.

A. Headlight detection

Figure 2 shows the sample in which two objects are correctly classified and identified, that are vehicle (at a distance of approximately 70m) and sign.

Figure 2 Detection of headlights at 70 m [1]

A. Taillight detection

As compared to headlight, taillights are more difficult to detect because taillights have lower luminance. Figure 3 shows a sample in which taillights of one vehicle are detected at a distance of 35m.

Figure 3 Detection of taillights at 35 m [1]

J.Wng et.al. [2] Proposes an algorithm for detection of vehicle based on region tracking using image processing. At the nighttime the brightness of the taillights is the typical feature and existing global detection algorithm is used to detect and pair taillights. To predict the possible region and the position of the vehicle in a next frame, a time series analysis model is introduced. To avoid the false pairing between bright spots which are present in and out of the possible region (PR), this proposed technique can be used. Figure 4 shows the flow diagram of vehicle detection algorithm based on region tracking.

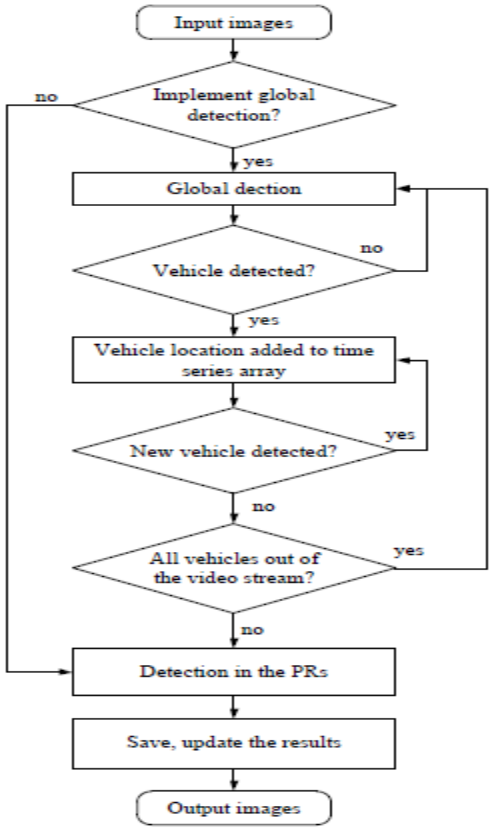

Figure 4 The flow diagram of vehicle detection algorithm based on region tracking. [2]

Darko Juri´c et.al [3] provides a novel method for tracking and detecting vehicles and is able to correctly track and detect headlights of the vehicle in urban and rural areas.

Based on joint probability data association (JDAF) a tracking method is used. Figure 5 shows the structure of the tracking algorithm.

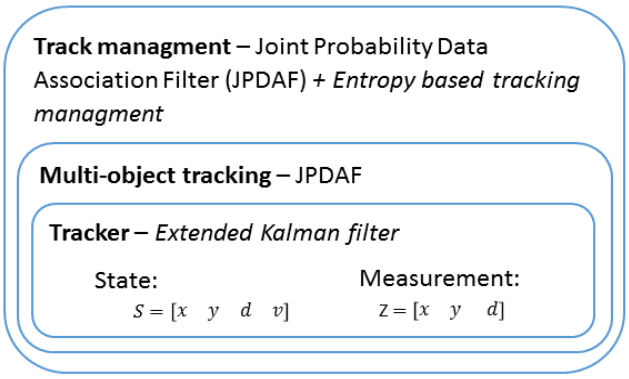

Figure 5 The structure of the tracking algorithm. Multiple object tracking is done by JPDAF. [3]

Sevekar et.al. [4] reviews different methods for nighttime vehicle detection for intelligent headlight control. Authors discussed two approaches for detection of vehicle as:

A. Image based approach

Four main steps are considered in a general flow of image based approach

- Detection of light
- Pairing
- Tracking
- Classification

B. Sensor based approach

To detect the presence of incoming traffic in night scenes, Sensor based approach uses a light intensity sensors.

In [5], author proposes, a novel approach of Edge Boxes to generate object bounding box proposals directly from edges. Similar to segments, edges provide a simplified but informative representation of an image. In fact, line drawings of an image can accurately convey the high-level information contained in an image using only a small fraction of the information. They also discussed the use of edges offers many computational advantages since they may be efficiently computed and the resulting edge maps are sparse. In this work we investigate how to directly detect object proposals from edge-maps. Figure 6 shows the qualitative example of object proposal.

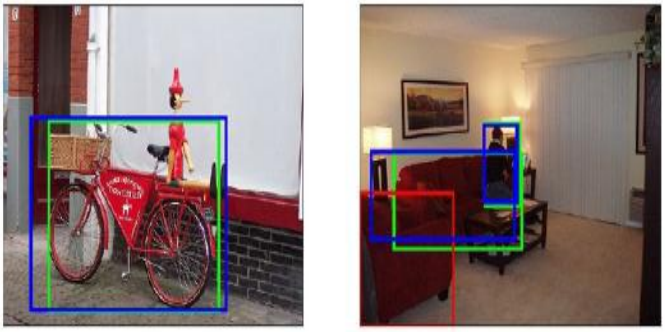

Figure 6 Qualitative examples of our object proposals. [5]

R. O'Malley et.al [6] present a novel system to track and detect rear lamp pairs of the vehicle in forward-facing color video. To improve the robustness and to deal with distortions caused by other light sources in automotive environment a tracking based detection method is introduced. In this technique color cross-correlation symmetry analysis is used for pairing lamps and Kalman filter is used to track them.

Kostia Robert in [7] introduced a new framework based on a hierarchy of feature detection and fusion for vehicle detection. The first layer of the hierarchy extracts the features of images. To detect the features of vehicles, the next layer fuses the features of image. A last layer can fuse the vehicle features to detect a vehicle with more accuracy. To handle the occlusions challenges, the constant acceleration tracking model is used. Figure 7 shows the steps of algorithm and interaction as

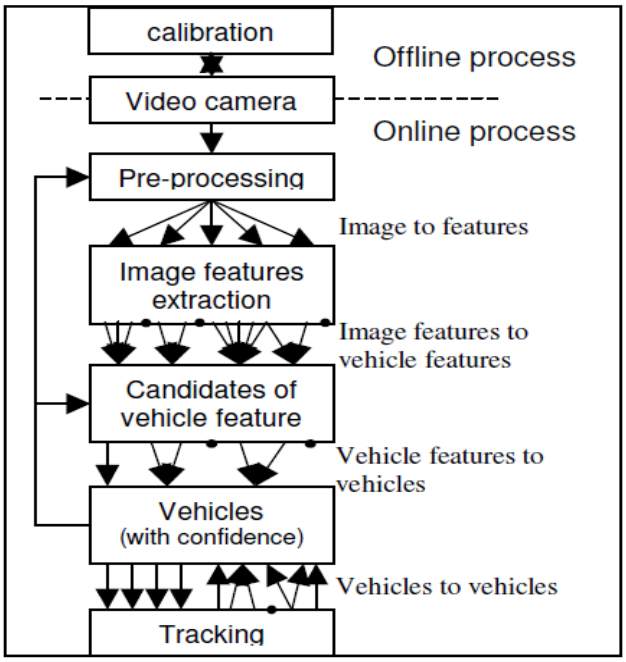

Figure 7 Steps of algorithm and interactions. [7]

Output of the system in [7] at day and night is shown in figure 8

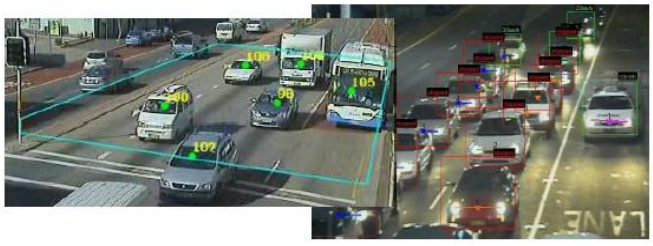

Figure 8 Output of the system at day and night. [7]

Wei Zhang et.al. [8] proposes a nighttime traffic surveillance system which consists of detection, tracking and pairing of headlights and also estimation of vehicle and camera calibration. The method in [8] can be used to detecting, tracking and pairing the headlights of the vehicle in

nighttime traffic scenes. Figure 9 shows the Basic workflow of the proposed method.

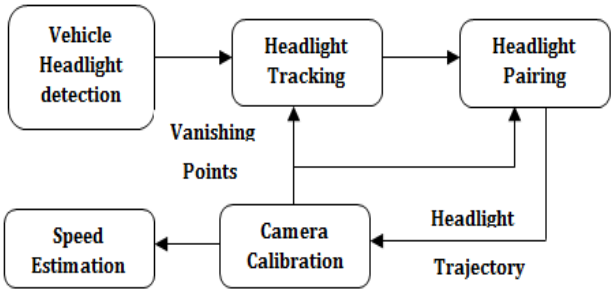

Figure 9 Basic workflow of the proposed method [8]

Yen-Lin Chen et.al. [9] Proposed an effective technique for traffic surveillance for tracking and detecting moving vehicles in nighttime traffic scenes. The proposed method detects the vehicles, by locating and detecting taillights and headlights of the vehicle using segmentation of image and techniques of pattern analysis. Figure 10 shows block diagram of the proposed nighttime traffic surveillance system.

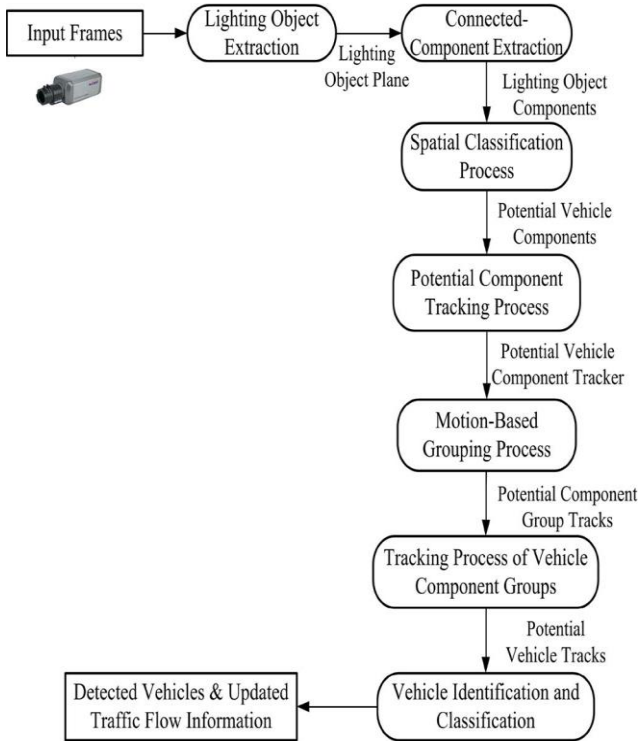

Figure 10 Block diagram of the proposed nighttime traffic surveillance system. [9]

IV CHALLENGES

There are many techniques available for detecting vehicle at nighttime but most of the accidents are caused by heavy vehicles. The vehicle detection methods are not used for heavy vehicles because the taillights of the heavy vehicles are different than the cars and motorcycles also their height is different. By using computer vision techniques this task can be possible but it requires high cost.

V CONCLUSION

This paper reviews different techniques used for vehicle detection and identification. This paper consists of image processing techniques that are most widely used in vehicle detection such as segmentation, image edge detection, filtering and enhancement of an images. By combining these techniques the vehicles can be detected at nighttime and it will be helpful to reduce accidents.

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