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COMPARISON OF VEHICLE DETECTION AND TRACKING TECHNIQUES

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Abstract - *Vehicle detection is one of the techniques used in the autonomous car to avoid road crashes and it is a solution to avoid a forward collision. This feature is more useful in highway traffic and urban traffic control. This technique is used for vehicle detection, tracking, traffic analysis, and individual vehicle's average speed. Different techniques are used to detect vehicles on-road. This paper describes various methods for vehicle detection.*

Keywords -*Vehicle detection, vehicle tracking, image analysis, histogram of gradient (HoG), unmanned aerial vehicle (UAV)*

I. INTRODUCTION

Most of the road accidents are occurred due to the distracted driving and human error. Consequently autonomous cars are appeared to ensure road safety and vulnerable road user's safety. Advanced Driver Assistance System (ADAS) are designed and implemented to assist the driver during driving. Lots of active and passive safety features are implemented in ADAS system. As population increases, the vehicle users are also increasing. Nowadays, most of the drivers and passengers are ending their life on the roads due to vehicle crashes. Excessive speed is one of the main reason for all the fatal crashes. In traffic surveillance system as well as in the autonomous technology, vehicle detection and tracking will play a vital role. Hence more research is carried out on vehicle detection in autonomous cars which can reduce road accidents. Innovative work endeavors in environmental perception, automatic sensing technologies, and advanced driver assistance systems try to spare lives and decrease the quantity of on-road accidents. From decades, research is going on to develop the autonomous driver assistance systems and completely autonomous vehicles, which are helpful to improve the safety and for monitoring the on-road condition. In order to efficiently work the autonomous vehicle, vehicle detection and tracking is essentially achieved in the systems. Specifically, on-road vehicle detection has been an enthusiasm subject to analysts. Vehicle detection and tracking is as shown in Fig.1. To detect the on-road vehicles, various sensing modules are available including lidar, radar, and computer vision. Cameras used for detection on vehicles are less expensive, smaller and of higher quality.

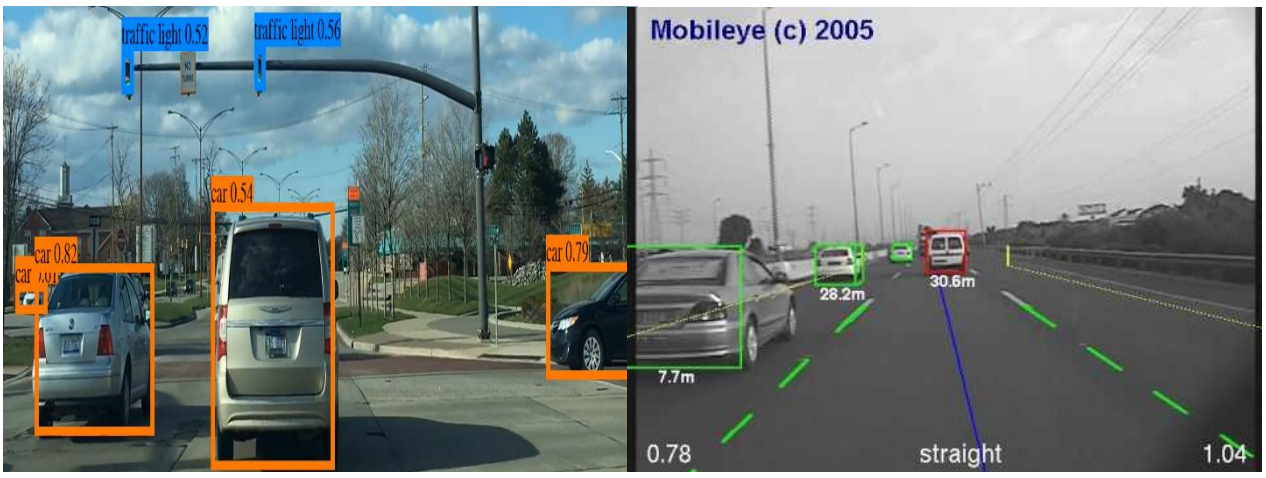

Fig 1. Vehicle Detection and Tracking

The general block diagram of vehicle detection and tracking is shown in the Fig 2. The input to the processor is captured using the video camera installed in the car. The captured video is then converted into multiple frames and passed to the filter. At first, the background of the captured image is filtered out and then noise is removed in the remaining frame using the different algorithms. Once the image is filtered out, then the required feature will be extracted using the techniques stated in the literature survey and the vehicle is detected. By repeated application of these technique, vehicle detection along with the vehicle tracking is achieved through the different algorithms.

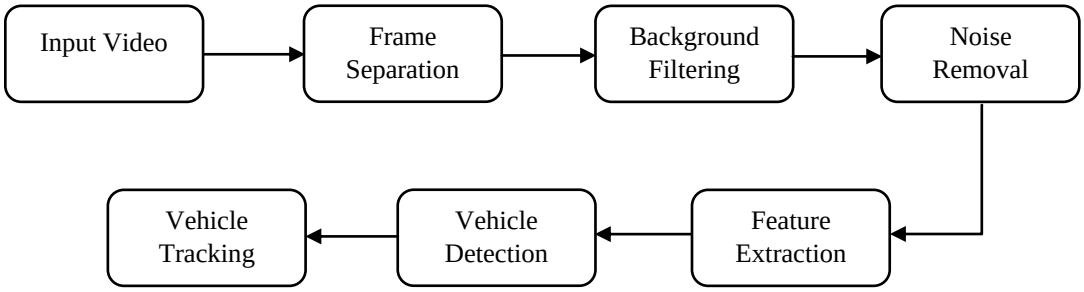

Fig 2. General Block Diagram of Vehicle Detection and Tracking

II. LITERATURE SURVEY

Sivaraman. S [1] has proposed "Integrated lane and vehicle detection, localization, and tracking: A synergistic approach". A synergistic approach is introduced to an integrated lane and tracking vehicle to assist the driver. The approach used in this paper will enhance the performance of vehicle tracking as well as lane tracking. The novel approach is introduced for localization and tracking the other vehicles. Vehicle detection has accomplished a sufficient level of accuracy. The consequence of the proposed model is achieved by an improved execution of vehicle and path tracking.
Moranduzzo. T [2] has presented the "Automatic car counting method for unmanned aerial vehicle images". The UAV images are portrayed by an algorithm that was used for counting cars automatically. The proposed system incorporates various advances, for example, the initial step is utilized for asphalted zones screening which helps in detecting the vehicle where exactly it is present and diminishes the false alerts. The effectiveness and accuracy of feature extraction are very high. The last advance of the technique is focused on gathering the key points belonging to a similar vehicle so as to get a relationship "one key point – one car".
Bhaskar. P. K [3] has projected "Image processing based vehicle detection and tracking method". The proposed method was developed as an algorithm to detect and track the vehicle by using the blob detection method and the Gaussian mixture model. In frames, the foreground is separated by the background. The foreground identifier recognizes the object and a binary calculation is carried out to bring rectangular regions around the detected object. Few morphological operations are used to recognize the moving object and to eliminate the noise. At that point, the counting is done by detecting the tracking the objects and their regions. By this method, the average accuracy obtained is 91 percent.

Li Xing [4] has established a "Vision-based method for forward vehicle detection and tracking". The proposed model has used a single camera to improve the execution of vehicle detection and vision-based technique for frontward vehicle detection and tracking. Histogram analysis technique was used to segment the vehicles underneath shadow accurately and also used to detect the vehicle in the daytime. To improve the system execution in tracking the detected vehicle Kalman filters are used. The technique could be adjusted to various illumination conditions powerfully and it has 95.78 percent of detection rate and 1.97 percent of the false rate in regular light condition.
Tse-Shih Chen et.al. [5] has established an "Intelligent urban video surveillance system for automatic vehicle detection and tracking in clouds". The smart and novel video surveillance system targeting to bring the automatic license plate recognition engines and cloud computing innovation so as to acknowledge enormous data analysis and empower detection and tracking of the objective vehicle with a given license tag number. Driver interaction with the system is required to identify a suspicious threat. With the help of automated techniques, the different potential security issues are identified. Even in uncontrolled environmental conditions, the vehicles can be detected and categorized. This is the advantage of the proposed method.
Sivaraman.S [6] has projected "Looking at vehicles on the road: A survey of vision-based vehicle detection, tracking, and behavior analysis". The proposed model describes the vehicle detection, behavior, analysis, and tracking in real time scenarios. According to the author, the branch of vehicles can be classified further which refers to spatiotemporal measurements and trajectory tracking. The author also developed an algorithm for the detection of on-road vehicles. The proposed model, with the further classifications, provide better accurate results and the efficiency is also high.
Moranduzzo. T [7] has presented "Detecting cars in UAV images with a catalog-based approach". The proposed model exhibits a new technique for detecting the cars automatically in UAV images obtained over urban situations. For a faster and robust car detection process, the asphalted areas are identified in a screening operation. Filtering operation in vertical and horizontal directions are used to extract the histogram of gradient feature. In 36 possible directions, the image points can identify the potential cars. Due to the high perseverance of UAV image, the vehicle which is recognized by more than one

point is converging to a single point. Hence the proposed strategy gives the quality of vehicles in a single picture with high accuracy.

Tuermer.S [8] has introduced "Airborne vehicle detection in dense urban areas using HoG features and disparity maps". By the application of HoG features along with Disparity Map, the vehicles in the dense urban location are detected. Real-time processing is analyzed and described, that is the main objective of the proposed model. Road database, a global DEM, and data of exterior orientation are used as the input data. This technique will give a better outcome in dense urban locations.

Table 1. Comparison of different vehicle detection and tracking techniques

Sl.No.	Proposed Techniques	Merits	Demerits
1	Recognition of vehicle, localization, and tracing.	Sufficient precision for vehicle recognition	The model works with 11fps video but to capture the vehicle which is moving in higher speed, speed cameras shall be used.
2	UAV images used for automatic car counting.	The accuracy of positioning is just 2cm for car counting.	Improved false positive ration but still not valuable.
3	Detection and tracking of the vehicle using a Gaussian mixture model and blob detection method	91 percent average accuracy obtained.	False positive is higher
4	Vision-based method of detecting the vehicles.	Improves the accuracy in forward vehicle detection. The SVM technique can remove the non-vehicle regions such as buildings, clouds, flowers, effectively. Accurate under different light conditions.	Good positive rate but less accurate in abnormal environmental condition.
5	Automatic detection and tracking of a vehicle using urban video surveillance.	Higher accuracy with positioning.	Due to stumpy frames per second, the process is very sluggish.
6	Detection of vehicles based on the vision process.	Trajectory tracking and measurement of spatiotemporal is very effective for greater accuracy.	Detecting vehicles by the vision-based technique are slower and path tracking is less accurate.
7	Vehicle recognition by UAV images.	In 36 possible directions, the potential cars can be identified with high accuracy.	False positive proportion is higher because positioning error in 38cm is very high.
8	Vehicle detection by a Histogram of oriented gradients (HoG).	The outcome achieved is accurate and faster.	To detect similar color objects as the background, the HoG Descriptor is less efficient.

III. LIMITATIONS

1. In two successive frames if the distance between the vehicle position is more, then tracking database unable to identify the vehicle in the second frame and will try to track it in the subsequent frame.
2. In edge detection image if the noise is present then it is unable to track the vehicle.

IV. CONCLUSION

The vehicle detection feature is one of the efficient techniques used in autonomous cars to prevent road accidents. Several researchers published their view on vehicle detection techniques as explained in the literature survey which are efficient and accurate in many conditions. But still, vehicle detection and tracking in some different conditions needs to be performed. The review on vehicle detection using different techniques has shown that most of the scholars have ignored the problem of the fog and noise in the images. Hence the changes in the environmental conditions will affect the accuracy of the surviving systems. Future work can be done on tracking the vehicle near the occluding edges. In a double lane road, if the two vehicles can be traced one on each lane then crossing velocity can also be intended.

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