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A study on Lane Departure Warning System and Object Detection on Roads for Forward Collision Avoidance

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Abstract: There are thousands of car accidents in the every year across the world. These accidents claim many lives and lots of properties. There are many different types of accidents, including rear end collisions, side swipes, head on collisions, collisions with stationary objects, accidents while changing lanes, and driving off the road. Seat belt usage, air bags, cruise control, rumble strips, and stricter vehicle safety requirements have all helped to reduce the number of accidents and fatalities. However, it is now possible to do more, by using intelligent driver assistant systems. In this paper, we propose a design lane departure warning system with object classification on road so that the driver can take smart and corrective measures to avoid the deviation from the lane as well as to avoid collision with the vehicle ahead of it. This safety system of Advanced Driver's Assistance System (ADAS) can help in checking the road accidents. The system highly relies on the Open CV for lane line detection as Lane Departure Warning system (LDWS). The second part of the paper is object detection at the front of the vehicle for collision avoidance. It uses stereo camera as vision sensor. The real image obtained from vision system gives more accurate information to detect the target vehicle and gives satisfactory result. The output from the stereo vision sensor is fed to the controlling unit. Yolo (You Only Look Once) based real time object detection is used to determine the presence of the vehicles in the frame. Depth map for the vehicles located in the vision frame is obtained with help of stereo camera System Development Kit (SDK).

Keywords: LDWS, ADAS, Collision Avoidance, YOLO, SDK.

I. INTRODUCTION

Automobile accidents injure between 20 to 50 million people and kill at least 1.2 million individuals worldwide each year [1]. Among these accidents, approximately 60% are due to driver inattentiveness and fatigue. Such accidents have prompted the development of many advanced driver assistance systems (ADASs), such as the onboard lane departure warning systems (LDWS) and forward collision warning systems. Nowadays, dozens of LDWSs are proposed and exist in the market place eg Takata India pvt ltd [2], Fig 1. These LDWSs are based on some different kinds of platforms. Many of these systems are used only on highways in India due to ignorance of the people in following traffic rules. Also on hazy weather condition drivers tend to misidentify the object ahead of the vehicle.

Fig 1 LDW from Takata India Pvt Ltd

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This paper aims at presenting a noble approach to solve the road accidents by creating an improved lane finding algorithm and forward object detection to avoid the forward collision using stereo camera and deep learning. Further, the algorithm crops the unwanted portion of the image captured such the sky, trees and provides only the required portion of the image.

II. RELATED WORKS

Paper [3] presents a camera-based lane departure warning system implemented on a field programmable gate array (FPGA) device. The system is used as a driver assistance system, which effectively prevents accidents given that it is endowed with the advantages of FPGA technology, including high performance for digital image processing applications, compactness, and low cost. The main contributions of this work are threefold. In [4] the author presents a system which has the potential to reduce fatalities which are caused by a particular type of crash: Run-Off-Road (ROR), which is also known as Single Vehicle Road Departure (SVRD) by employing a generic driver's behaviour model. ROR crashes involve a single vehicle, which departs the road and then impacts something such as a tree or a bridge abutment. Paper [5] presents LDW system based on the Hough transform and Euclidean distance. The histogram equalization is used to enhance the contrast level of input image. Hough transform [6] is used for lane detection in which left and right lane marking are detected independent of each other. Finally, lane departure identification is carried out using lane related parameters, estimated on the basis of Euclidean distance.

III. METHODOLOGY

First we take image from one centre of the stereo camera and remove the distortion using camera calibration parameter value. There is separate code for camera calibration. The distortion values are found and save in parameter file. Next, task is to remove the distortion of the frame using Open CV cv2.undistort() function with the help of the parameter we saved before. The output will be an undistorted image. Fig 2.

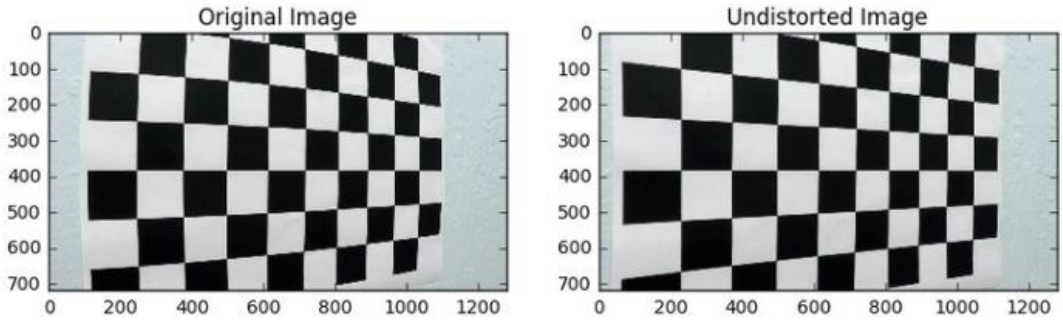

Fig 2 Distorted and Undistorted Images

The next step is cropping of the unwanted portion of the image using Open CV Crop API function. The image so obtained is BGR. We have to convert it into HSV because it isolates color (hue), amount of color (saturation) and brightness (value). After this, the next task is to filter the white or yellow colour which are the colours usually used for marking the lane. The yellow or white pixel will be 1 and rest will be 0. The output will be a binary image. Fig 3.

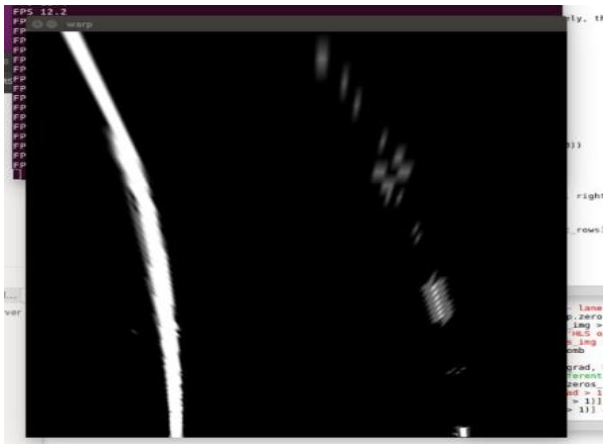

Fig 3 Binary Image

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The next task is to convert the binary image to Birds Eye View Fig 4 using Open CV function warp.

Fig 4 Bird's Eye View

Next is to find the lane using second order polynomial to fit the lane: x = ay**2 + by + c in order to better estimate where the lane is and curvature of the lanes and vehicle position with respect to the centre [7]. The last task to accomplish is the detection and identification of the object ahead of the vehicle. This would help the driver to take smart and timely corrective measures to avoid the forward collision warning at adverse weather conditions. This task would be carried out using the stereo camera and Open CV. The frame will be stored in one variable. The image will be given to the YOLO (You Only Look Once)[7] which is a Deep Learning Model [8] for object identification.

IV. RESULT

Fig 5 Image showing the left curve

Fig 6 Image Showing the straight line

Fig 7 Image Showing Right Curve and object (car) detected

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V. CONCLUSION

The proposed system has been designed to help in eradicating the road accidents by adhering to the traffic norms so that drivers do not deviate from the lane. This would also help in maintaining road discipline and avoid traffic congestion especially in countries like India where people lack traffic morality. Further, with the advancement of autonomous vehicle, the system could be improved in near future by incorporating driver behaviour algorithm so that it becomes more adaptive.

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