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Vision-Based Forward Collision Warning System

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ABSTRACT -One significant worry in the advancement of clever vehicles is to improve the driving security. It is likewise a fundamental issue for future independent driving and shrewd transportation. In this undertaking, we are building up a Vision-based Forward Collision Warning (V-FCW) framework. A front camera is received for visual detecting and climate insight. The object is to keep away from potential car crashes due to advance impact, and help the drivers or self-driving vehicles to perform safe driving. Our model will screen the former vehicles and at the same time it will figure the distance between the vehicles. Presently, on the off chance that the former vehicle gets excessively close, our model will caution that driver of an approaching accident. The driver of the vehicle will basically be alarmed by any perceptible sign in the wake of arriving at the edge distance between the vehicles. This model will be a lot of accommodating, particularly for the students. This estimation of the distance between the vehicles will be finished by Convolutional Neural Network (CNN) based. Previously, analysts utilized these advances like ADAS and FCW framework which are completely reliant on the equipment and savvy also. Thus, we are utilizing CNN in FCW framework as opposed to utilizing the equipment like radars.

KEYWORDS - Safety, collision warning system, object detection, forward collision warning, alert message, object tracking**.**

I. INTRODUCTION

Exploration on Advanced Driver Assistance Systems (ADAS) has acquired incredible energy as of late in tending to expanding worries on vehicle wellbeing. Forward impact notice (FCW) framework is one of the common uses of ADAS, planned with the expect to forestall approaching front crash by giving a notice sign to drivers. Vision-Based Forward Collision Warning (V-FCW) framework, by utilizing ease cameras as a detecting gadget, has gotten colossal consideration these days and become extremely appealing and functional to the market. This is basically because of not just its ease advantage contrasted with RADAR or LiDAR, yet additionally the innovative headway and development in Image Processing (IP), Pattern Recognition (PR). Dissimilar to RADAR-based FCW frameworks, vision-based frameworks, when joined with object distinguishing proof and path identification, may additionally upgrade the presentation of forward object discovery, along these lines, the exhibition of forward impact notice. When suitably mounted and adjusted, vision-based FCW may additionally be incorporated with a path takeoff cautioning framework to shape better wellbeing assurance to drivers from both longitudinal and parallel bearings without additional equipment cost.

Be that as it may, vision-based FCW framework, because of its detecting limit on goal and preparing limit on calculation, likewise faces extraordinary difficulties in object recognition, and especially, in object estimation on distance and speed. Other major affecting elements on its exhibition incorporate different driving situations, like states of climate, lighting or enlightenment, traffic status, surfaces and material of the items.

II. LITERATURE SURVEY

"Forward Collision Prediction with Online Visual Tracking" by Surya KollazhiManghat, and Mohamed El-Sharkawy [1] - proposes a way to deal with actualize FCW with an online Multi-Target Tracking technique by following a proficient strategy for continuous usage. A large portion of the complex Multi Object Tracking techniques accomplish high effectiveness at the expense of run time execution. Be that as it may, for a self-governing vehicle the ongoing handling is basic. The FCW framework proposed is viewed as this in each phase of its execution and lessens the handling intricacy by eliminating appearance highlights from tracker calculations.

"FCW: A Forward Collision Warning System Using Convolutional Neural Network" by

Shivam Kumar, Vivek Shaw, Janapriyo Maitra, and Raja Karmakar [2] - actualized CNN to make a model to recognize the distances between the first vehicles and to keep a protected distance and in the event that the vehicle by one way or another passes the boundary distance, it creates an alert to caution the driver. Quite possibly the limit distance for various models of various vehicles can be diverse as the forward portion of the vehicle.

"Front Moving Vehicle Detection and Tracking with Kalman Filter" by Vannat Rin, and ChaiwatNuthong [3] - notices the vision-based front moving vehicle discovery and following methodology utilizing recordings on metropolitan organized streets in Thailand. The works make out of two primary situations which are front moving item identification and article following. In the discovery cycle, the proposed study utilizes moving three edge contrasts with a blend of Sobel edge locator calculation. The moving casing idea is to guarantee that the framework performs well progressively situation. As indicated by the exploratory outcomes, the exhibition of recognition and the right discovery rate are improved when the objective item begins following Kalman channel.

"Continuous Car Detection and Driving Safety Alarm System with Google Tensorflow Object Detection API" by Cheng-Hsiung Hsieh, Dung-Ching Lin, Cheng-Jia Wang, Zong-Ting Chen and Jiun-Jian Liaw [4] - introduced a constant vehicle discovery and security alert framework dependent on Google Tensorflow Object Detection (GTOD) API. The proposed framework comprised of two fundamental parts: vehicle recognition and driving state segregation. In the vehicle discovery, frontal vehicles were boxed and their widths were determined. At that point a wellbeing factor was acquired through the container width. In the driving state separation, three states were considered by the security factor. Also, an expected distance was given for every security factor.

"Vision Based Driver Assistance for Near Range Obstacle Sensing under Unstructured Traffic Environment" by C S Arvind, R Jyothi, K Mahalakshmi, C K Vaishnavi, and U Apoorva [5] – a novel pipeline was proposed utilizing monocular camera which can constantly recognize the impediment which are entering the drive locale or in the drive area inside 15 meters. The proposed strategy just gives the driver a visual ready which probably won't be seen by the driver.

"Ongoing Forward Collision Warning framework utilizing settled Kalman channel for monocular camera" by Qun Lim, Yichang He, and U-Xuan Tan [6] - utilized a monocular camera which can be utilized on stages, for example, telephones or customer gadgets which can be effectively mounted on a bike or cruiser. The paper exhibited continuous Forward Collision Warning framework with the utilization of a settled Kalman channel to acquire security and diminish bogus positives with YOLO for ongoing location.

III. EXISTING SYSTEM

Existing framework utilizing optical stream, Kalman channels, or surface coordinating calculations to following articles in the video. These strategies are giving high precision, however this strategy devouring more computational force. For instance, in settled Kalman channel, it utilizes state grid and ceaselessly increasing those networks to foresee the future state, we realize that the framework chain augmentation will devouring more computational force.

IV. PROPOSED SYSTEM

In this proposed algorithm we are using the latest 2 frames for object tracking. To map objects in 2 different frames, in the first step objects are clustered into groups based on the type of the object. Then, to find matches in each cluster we are using Gale-Shapley algorithm with a custom priority list. We are generating the priority list based on the distance between objects in the cluster. Why we are using Gale-Shapley algorithm is that because the Gale-Shapley algorithm is faster than matrix chain multiplication.

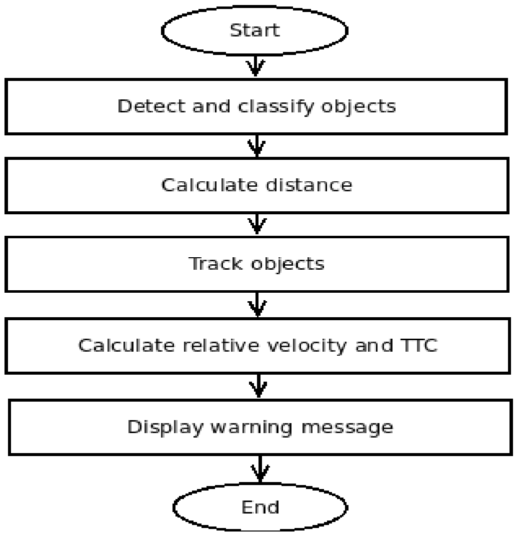

Fig 1: Flow Diagram

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V. WORKING PRINCIPLE

Object detection

For object detection we are using TensorFlow Object Detection API.The TensorFlow Object Detection API is an open-source framework built on top of TensorFlow that makes it easy to construct, train and deploy object detection models. There are already pre-trained models in their framework which are referred to as Model Zoo. It includes a collection of pre-trained models trained on various datasets such as the COCO (Common Objects in Context) dataset, the KITTI dataset, and the Open Images Dataset. In this project we are using 'ssdlite_mobilenet_v2_coco' pre-trained model. This model has 22mAP (mean average precision) score and 27ms execution time. Also, the COCO is a dataset of 300k images of 90 most commonly found objects so the model can recognise 90 objects.

Calculating distance from image

The distance of the vehicle detected can be estimated directly from the video with a known vehicle width. This method of estimating distance is used as it only assumes the width of a vehicle and it is dynamic in the sense that the camera can be placed at different altitudes and it does not depend on detection of vertical coordinates of horizon and lane width detection for the distance estimation. The width of the vehicle detected is used instead of the height the variance of car width is smaller than the variance of car height (e.g. sports car compared to SUV). The algorithm is as follows:

$$distance = \frac{object\ width \times focal\ length}{object\ width\ in\ the\ image}$$

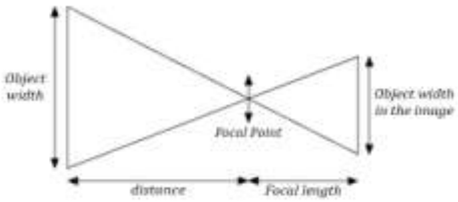

Figure 2 Calculating distance from image

Object tracking

In this proposed algorithm we are using the latest 2 frames for object tracking. To map objects in 2 different frames, in the first step objects are clustered into groups based on the type of the object. Then to find matches in each cluster we are using Gale-Shapley algorithm with a custom priority list based on the distance between objects in the cluster.

Calculating relative speed and time-to-collision

For calculating relative speed (or relative velocity), there are two different scenarios. The first scenario is the object has no matching, in this scenario relative speed is assumed as 0. The second scenario is the object has a match; in this scenario the relative speed is calculated using the following formula.

$$speed = \frac{distance\ in\ current\ frame - distance\ in\ last\ frame}{time\ differenct\ between\ two\ frames}$$

After calculating the distance and relative speed we are calculating the time-to-collision value using the following formula.

$$Time\ to\ Collision\ (TTC) = \frac{distance\ in\ current\ frame}{relative\ speed}$$

Display warning messages

Based on the estimated value, the warning signal for each object is given with 3 different colors; green for 'safe to go', blue for 'proceed with caution' and red for 'stop the vehicle'. The warning signal and message is displayed with the help of OpenCV. Let us see how the warning signals are classified based on distance, speed and time-to-collision values.

- If the distance is less than 5 meters or time-to-collision value is less than 2 minutes then the red signal will be displayed.
- If the distance is less than 20 meters or time-to-collision value is less than 10 minutes then the red signal will be displayed.
- In all other cases green signals will be displayed.

VI. RESULTS

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Above diagrams shows the result of the proposed algorithm. In those images the objects are represented with boxes and the class of the object along with distance and speed is displayed above the object.

VII. CONCLUSION

In this project we proposed an algorithm for vision-based forward collision warning system which uses a low-cost camera as an input device. This algorithm takes the video stream from the camera and recognizes and categorizes objects and marks them like boxes in each frame with help of TensorFlow Object Detection API. Then the objects are tracked with the help of objects in the last 2 frames. After that, distance and approximate speed difference between objects and the vehicle are calculated. With help of the distance and speed difference values, expected collision timing will be estimated. Based on the estimated collision time, the system will give a warning signal to the driver with respect of some threshold values. The warning signal given with 3 colours; green for ‘safe to go’, yellow for ‘proceed with caution’ and red for ‘stop the vehicle’.

VIII. FUTURE WORKS

In future, we are planning to enhance the object detection part and converting this project into collision avoidance systems.

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