SPEED MANAGEMENT OF VEHICLES TO PREVENT VEHICLES ACCIDENTS USING IMAGE PROCESSING TECHNIQUES

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Abstract—In today's world it is essential to monitor the surroundings in order to alert the drivers while driving the cars to drive more safely. This paper uses' camera to detect the location of vehicles. In this paper there were two different algorithms tested in vehicle detection system, including Haar with Adaboost and HOG-PCA with SVM methods. The preliminary results of this paper have been successfully detected vehicle, track vehicle location and manages the speed to avoid accidents by providing forward collision warning. In addition to this it successfully displays the Bird Eye Plot. The vehicle tracking section has presented an improved version of particle filter.

Keywords—*Vehicle detection; HOG features; Vehicle tracking; Bird Eye Plot*

I. INTRODUCTION

The increasing number of cars in cities can cause high volume of traffic, and implies that traffic violation become more critical nowadays. However, the death and injuries caused by traffic accidents also increased. In order to ensure the safety of driving, it is very common to install a dashboard camera in a vehicle. This paper carry out the study in the identification and tracking of front vehicles through image recognition and processing methods. This paper guides the driver how to manage the speed by providing forward collision warning. It also displays a Bird Eye Plot, which is used for displaying data recorded in vehicle coordinates on two dimensional maps for analyzing sensor coverages, detection, and tracking results.

Initially, the principle of Automotive Collision Avoidance System is to use infrared to measure the distance between the drivers own car and the front car, and then calculate the relative speed between the two cars. Finally, it is to remind the driver to make security measures to the man-machine interface.

On the vehicle detection, with the implement of image recognition technology, Histogram of Oriented Gradient (HOG) feature was used for car detection. In this, first to assume the location of car with HOG, then to verify by using gradient features and the symmetry of the car, the result got very high accuracy. After detecting and tracking of a vehicle, the relative speed between the cars, along the lane is calculated to manage the speed of the car. Then finally, in this paper Bird Eye Plot was used for displaying data recorded in vehicle coordinates on a 2-dimensional map around ego car for analysing sensor coverages, detections and tracking results.

II. DESIGN OF SYSTEM

A. Vehicle detection

Vehicle detection was to read the information of the classified trained by the vehicle image collection and training system, and the ROI image was captured by Haar feature with AdaBoost algorithm for vehicle image detection. When the area of the vehicle was detected, the image would be calculated by HOG-PCA. Then reduced features of the dimension was identified with SVM whether it was the vehicle.

The accuracy of vehicle detection result was not ideal only through the Haar feature classifier, so there had been a lot of misjudgement. Therefore, there were two kinds of classifier used in this paper. (1) The cascade classifier, generated through Haar, could quickly exclude a large number of non-vehicle blocks, and

(2) Calculating the features of the image by the HOG method, reducing the dimensions of the image via PCA, and classifying images of vehicles. Figure 1 is the block diagram of vehicle detection classifier.

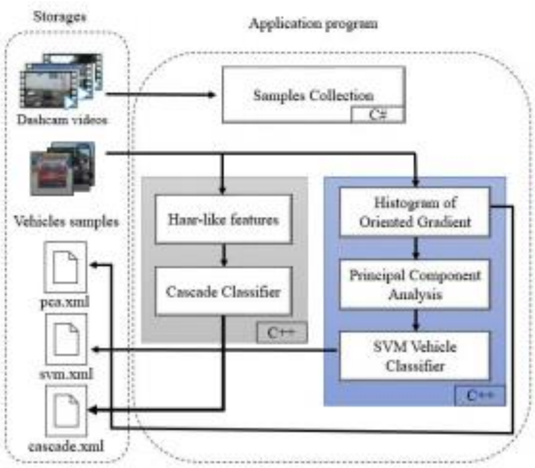


Fig. 1. The block diagram of the vehicle detection classifier.

b. Vehicle trajectory tracking

Vehicle trajectory tracking: in order to solve vehicle tracking failure because of excessive changes in light only with RGB histogram, this paper also added a vehicle identification algorithm to improve the accuracy of matching. As this paper used the film that was actually recorded on the roads, in addition to the particle filter was used as the main algorithm.

As shown in Figure 2(a). the particle filter information need to be initialized when using the particle filter in this paper, such as the pixel coordinates of the vehicle, vehicle samples, particle weight values and other information. Then after reading the next image, the Gaussian function was randomly distributed according to the pixel coordinates of the vehicle. After capturing image of the coordinates of each particle, particle images and vehicle samples were performed a correlation comparison and calculated the weight value.

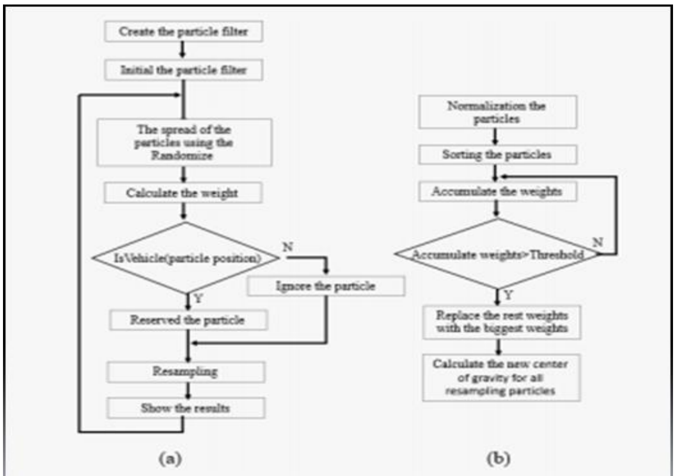


Fig 2 Particles tracking flow, (a)create the particlessteps, (b)resampling steps

Besides, this paper first calculated the weight through the RGB histogram, then added the HOG-PCA with SVM classifier to perform assessment of vehicle images tracked by particle filter. The evaluation results determined whether the particle is to be reserved. Figure 2(b), calculating the weight of all particles, then resampling of each particle, and finally the resampled particles were new targets for tracking, and repeat the above process to keep tracking.

B. Forward Collision Warning

Forward Collision warning is an important feature in driver assistance and automated driving systems, where the goal is to provide correct, timely, and reliable warnings to the driver before an impending collision with the vehicle in the front. The following steps will provide the forward collision warning

1. Obtain the data from the sensors.
2. Fuse the sensor data to get the list of tracks, i.e., estimate positions and velocities of the objects in front of the car.
3. Issue warnings based on tracks and FCW criteria. Consider the relative distance and relative speed of the object in front of the car.

Detecting the Most Important Object and Issuing a Forward Collision Warning

The most important object (MIO) is defined as the track that is in the ego lane and is closest in front of the car, i.e., with the smallest positive x value. In order to lower the probability of false alarms, confirmed tracks were only considered.

Whenever the MIO is found, then the relative speed between the car and MIO is calculated. The relative speed and relative distance determine the forward collision warning. There are 3 cases of FCW

1. Safe (green): There is no car in the ego lane (no MIO), the MIO is moving away from the car, or the distance to the MIO remains constant
2. Caution (yellow): The MIO is moving closer to the car, but is still at a distance above the FCW distance.
3. Warn (red): The MIO is moving closer to the car, and its distance is less than the FCW distance.

The distance calculation is as follows

$$d_{FCW} = 1.2 * v_{rel} + \frac{v_{rel}^2}{2a_{max}}$$

Where:

d_{FCW} is the forward collision warning distance.

v_{rel} is the relative velocity between the two vehicles.

a_{max} is the maximum deceleration, defined to be 40% of the gravity acceleration.

C. Bird eye plot

It is important to display the data recorded in vehicle coordinates on a 2-dimensional map around the ego car for analysing sensor coverages, detections and tracking results.

In this paper Bird Eye Plot is used to display a snapshot of this information for a certain time or to stream data and efficiently update the display. This BEP reads pre-recorded sensor data and tracking results. It includes the following

Lane information

Vision objects

Radar objects

Positions, velocities and labels of the tracks.

Most important objects.

1. Defining Scene Limits and Sensor Coverage

Configuring a bird's-eye plot takes two steps. In the start, the bird's-eye plot is made, that sets up the coordinate system represented on top of, where the x-axis is directed upwards and y-axis is directed to the left. It is potential to outline the axes limits in every direction. In this forward wanting example, we tend to outline the scene up to 90 meters before of the ego vehicle and 35 meters on all sides.

In the second step, the bird's-eye plotter's square measure is created. The bird's-eye plot offers the following variety of plotters, each configured for plotting a specific data type. They include:

Coverage Area Plotter- Plot sensor coverage areas

Detection Plotter- Plot object detections

Track Plotter - Plot tracks, track uncertainties, and history trails

Lane Boundary Plotter - Plot lane boundaries

Path Plotter –plot object trajectory

The vision sensor is positioned 3.30 meters in front of the origin (rear axle) at the centre of the car, with a range of 150 meters and a FOV of 38 degrees.

The radar is positioned 3.38 meters in front of the origin at the centre of the car. The radar long-range mode has a range of 174 meters and a FOV of 20 degrees, while the medium-range mode has a range of 60 meters and a FOV of 90 degrees. Note that the coverage areas are truncated at ninety meters ahead of the ego vehicle and thirty five meters on either side.

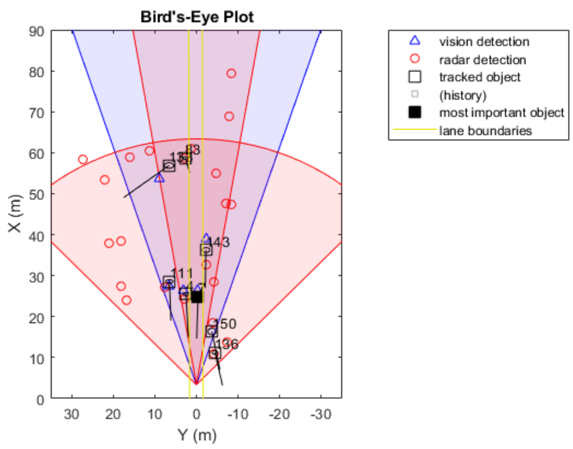
2. Plotting Detections

Next, produce plotters to show the recorded vision and radar detection

3. Plotting Tracks and Most-Important Objects

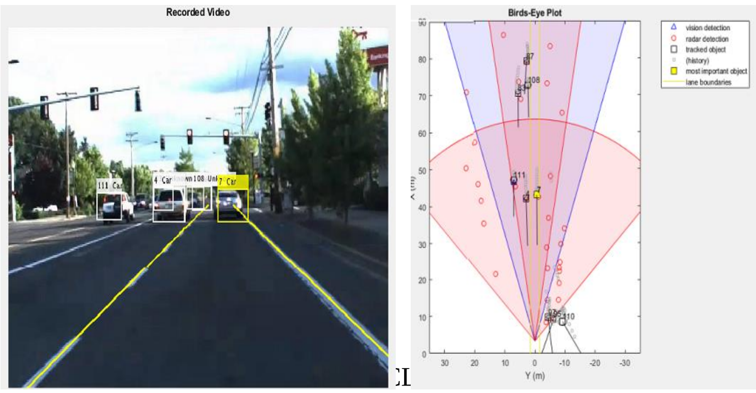
When adding the tracks to the Bird's-Eye Plot, we offer position, rate and position covariance info. The plotter takes care of displaying the track history path, however since this is often one frame, there'll be no history.

Plotting lane boundaries will utilize the parabolic Lane Boundary object. To use it, we have a tendency to the lane boundaries as parabolic Lane Boundary objects, and call the plotter with it.



III. RESULT

The preliminary results of this paper have been successfully detect the vehicle, track vehicle location and issue forward collision warning for managing the speed to prevent accidents. It also displays a Bird Eye Plot to display the sensor coverages and tracking results.



IV. CONCLUSION

In fact, in order to provide dangerous road hazard warnings, it should be able to detect vehicle, track the vehicle trajectory and the distance between the vehicles. The results of this paper successfully detect vehicle, track vehicle location and issue the forward collision warning. It also displays the Bird Eye Plot, a 2-dimensional map used to display sensor coverages and tracking results.

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