Safe Driving By Detecting Lane Discipline and Driver Drowsiness

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Abstract— **In the modern day world, road accidents have become very common. They not only cause damage to property, but also keep at risk the lives of people travelling. Road safety is an issue of national concern, looking at its magnitude and the incidental negative impacts on the economy, public health, safety and the general welfare of the people. These road accidents may be due to many reasons like rash driving, drink and driving, inexperience, jumping signals, ignoring signboards. Since, road accidents is an important issue to be addressed, this paper will be concentrating on avoiding the road accidents by concentrating mainly on-Drunk driving or drowsiness and lane discipline. The paper has two parts. Firstly, lane detection using Hough Transform. Secondly, eye detection of driver for drowsiness detection. Thus, the main focus is on the fatigue of the driver and his maintenance of lane discipline.**

Keywords-Hough Transform, Driver Drowsiness, Lane Detection, Eye Detection

I. INTRODUCTION

Road accidents are a human tragedy. They involve high human suffering and monetary costs in terms of untimely deaths, injuries and loss of potential income. Although there have been plenty of initiatives undertaken and many road safety techniques have been implemented but still our overall situation is far from satisfactory. During the calendar year 2010 in India, there were close to 5 lakh road accidents in India with 1.5 lakh people killed. Whereas in 2011 the number of deaths decreased to 1.42 lakh. This paper proposes a method that provides with a proper safety for a driver having fatigue. The driver safety is divided in two parts-Lane detection and Eye detection. The paper identifies and addresses the causes of poor driving by combining sight and sound with real-time, predictive analytics. The program mentioned in the paper will help drivers understand and improve their driving attitude, also protecting them from being wrongfully blamed.

II. DESCRIPTION

A. Lane Detection

Presently, there are mainly two methods to cope with the detection of structured road: model-based and the feature-based method.[1] Existing techniques in study of lane detection technology have diversity analysis angle and variety of advantages, disadvantages. The fundamental aspects of lane detection approaches are based on different features, including the road color and texture features based detection, the road edge features based detection and template matching detection.[2]. Standard Hough Transform [3] is a robust technique for detecting discontinuous lines that can be used very efficiently in lane detection but it's computational cost is expensive. The lane detection, mentioned in the paper, is efficient and conveniently applicable for any car system. This paper proposes an idea of Hough lane detection technique which can detect discontinuous lanes as well.

The lane boundaries near the camera always show themselves line-like in the image, while the parts far from the camera probably contain curve-like shapes.[1] They thus divided the image in near field and far field region.

Fig. 1: The road, having the lane markings

B. The Hough Transform

Hough transforms mainly concentrates on finding the lines in an image. Hough transform is a method for estimating the parameters of a shape from its boundary points. Thus now, Hough transform has been extended to identifying positions of arbitrary shapes, most commonly circles or ellipses. In the Hough transform for straight line and the straight line equation is

$$y = mx + c$$

Which is transformed and written as

$$x \cos \theta + y \sin \theta = r$$

in its parametric form.

Every point in picture is a sinusoid wave in the parameter space and every point in parameter space is a line in picture/image. Points which are co-linear in image have their sinusoids intersect at unique point.

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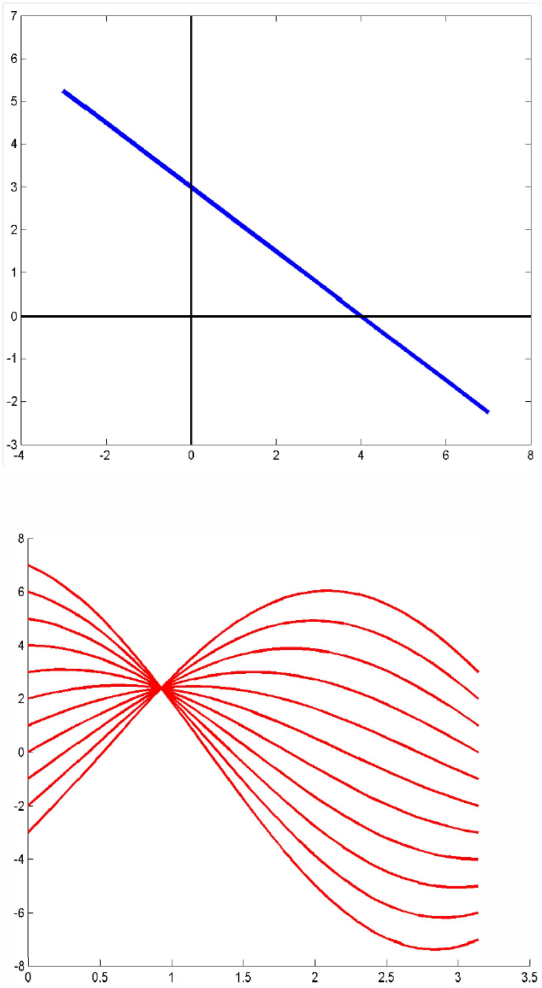

Fig.2: Hough Transform for line, the line and its sinusoid in parameter space

Hough transform for circle detection is of the same procedure. The Hough transform can be used to determine the parameters of a circle when a number of points that fall on the perimeter are known. A circle with radius R and centre (a, b) can be described with the parametric equations

$$x = a + R\cos(\theta)$$
$$y = b + R\sin(\theta)$$

When the angle sweeps through the full 360 degree range the points (x, y) trace the perimeter of a circle

Fig.3: Hough transform to find circle, here, the circle is shown along with the center marked and its radius.

C. *Eye Detection*

Eyes are not symmetrical on face. And there are plenty of applications of eye detection. Here, the eye detection is used to check the driver fatigue, i.e. whether the driver is sleepy or not. There is supposed to be a blinking time in this technique. For example if the driver closes his eye for more than 10 to 15 seconds, an alarm showing red alert will glow. By using object detection circular region of human eyes are detected.

There are many techniques invented for eye detection. The commonly used approaches for passive eye detection include the template matching method, Eigen space method, and Hough transform-based method [5,6], [4].

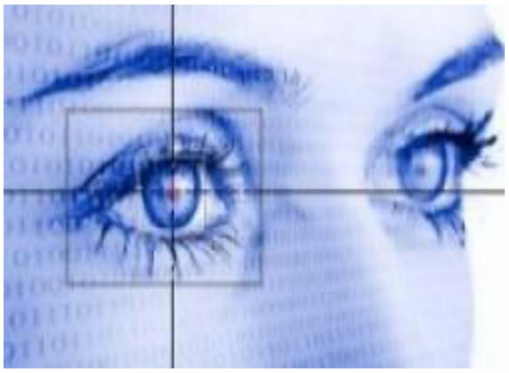

Fig.4: Human eye detection

III. SYETEM DESIGN AND APPROACH

This paper has two different parts and each sub division have an approach explained below.

A. *Lane Detection*

Lane detection basically involves detection of the lane markings made on the road. So, whenever a driver has to cross the lane, he has to give a signal and proceed with changing the lane. If at all, the car changes the lane without signal, then the system takes this as an error, and sends the warning signal, to avoid a possible accident.

The lane markings are detected using the following method:

1. The parameter space is quantized between appropriate value of ρ and θ.
2. An accumulator array is formed whose elements are initially zero.
3. Each point in gradient image is formed in such a way that, its value exceeds a threshold value. These points are incremented and stored in the accumulator array.
4. Local maxima in the accumulator array now correspond to collinear points in the image; the value in the accumulator matrix provides the measure of number of points on the line.

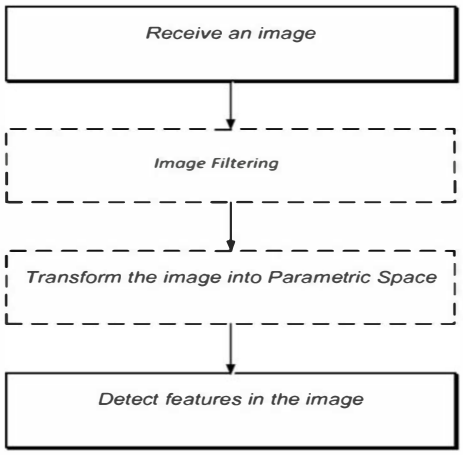

Fig. 5: flow chart showing the prototype.

Using the algorithm as mentioned, the video as obtained from the camera attached in the car is first divided into frames. Now, each frame is taken and Hough Transform for line detection is applied to it. Then according to the values present in the accumulator array, the lines are plotted on the original image to show the lanes. The results are shown in Fig. [6], [7], [8] and Fig. [9], [10], [11].

B. Driver Drowsiness Detection

It is a hard test of endurance for drivers to take long distance driving. It is very difficult for them to pay attention to driving on the entire trip unless they have very strong willpower, patience, and persistence. Thus, the driver fatigue problem has become an important factor of causing traffic accidents. Driver drowsiness is a significant factor in a large number of vehicle accidents.

Thus, here the drowsiness or fatigue is detected by continuously monitoring the eyes of the driver. The method applied is as follows:

1. Capture one frame of the video
2. Perform Viola-Jones eye localization
3. Discard the top 40% of the image
4. Perform binary thresholding using Otsu threshold
5. Perform edge detection on the thresholded image with Canny edge detection
6. Perform Hough circle detection and pick the most likely circle
7. Process the next frame (back to 1)

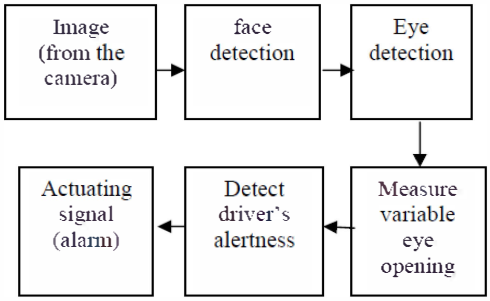

Fig. 6: Flowchart showing the driver drowsiness detection

Face detection here is done using the viola jones detection. From the detected image, the eyes are selected using image segmentation. Now, Otsu thresholding is applied to this cropped out image and the canny edge detection is applied to get the edges of the eyes. Now, to this, Hough circle detection is applied to detect the iris.

Now, this is repeated for each frame that is captured from the video. The processed image is continuously monitored. If the driver's eyes are found to be closed for more than 10 frames, then he is considered to be sleeping and thus, a warning signal is given, either to wake the driver up, or try and switch off the ignition of the vehicle. If the eyes are found to be closed for less than 10 frames, then it is taken into consideration as blink of eyes or other situations, when eyes are closed momentarily. Thus, in this way, the drowsiness of the driver can easily be detected and possible accidents maybe avoided.

The results for eye detection are shown in Fig. [13] to [20].

IV. RESULTS

IV A. Lane Detection

Fig.7: Image of a road

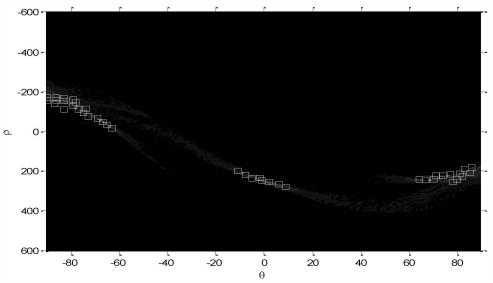

Fig.8: It's Hough Transform in parameter space

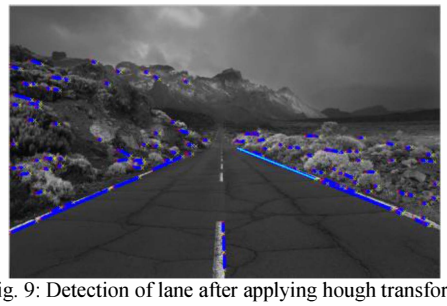

Fig. 9: Detection of lane after applying hough transform

Fig. 10: Image of road

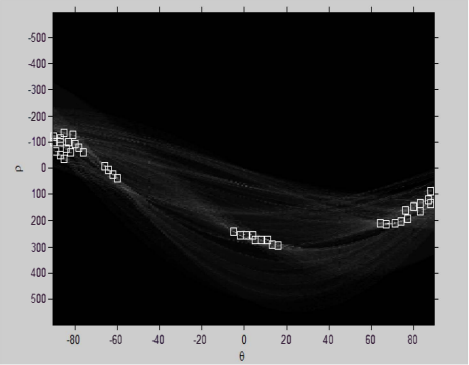

Fig. 11: It's Hough Transform in parameter space

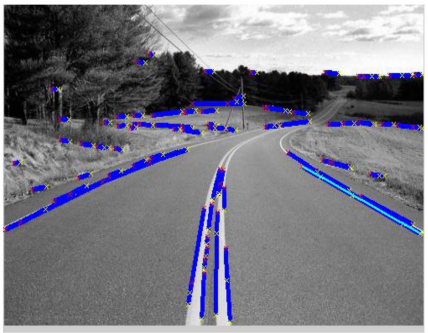

Fig. 12: Detection of lane after applying hough transform

Eyes Detection

IV B. Results for eye detection

Fig. 13: Image of face

Fig. 14: The eyes being cropped out using Voila Jones method

Fig. 15: The canny edge detector image of cropped eyes

Fig. 16: The open eyes detected using Circular Hough Transform

Fig. 17: The image of driver with closed eyes

Fig. 18: The cropped image of the eyes using Voila Jones method

Fig. 19: The edge canny image of the eyes detected

Fig. 20: The closed eyes detected image

The proposed system, is supposed to have two webcams, one to detect the lane and the other to monitor the face of the driver. Now, whenever the car starts, the webcam will continuously shoot video, and the system will be sampling the videos into frames of pictures. Each picture will be fed to the processor, where using hough transform, the lanes as well as the eyes will be detected as shown in the figures of the results above. Now, whenever the car crosses the lane marking without signalling, either a alarm signal will sound, or else, a brake will be applied to the wheels, to slow down the speed, just in order to avoid a possible accident. Similarly, the frames of eyes, will be continuously monitored for detecting open eyes. If, the system detects more than 10 continuous frames of closed eyes, as shown in Fig.19, then again the system sounds an alarm or sends a braking signal to the engine to slow down the vehicle. On the other hand, if the closed eyes are detected for less than 10 frames, then it will not be considered as drowsiness, as it maybe a blink or for some other reason. Thus, through this system many possible accidents can be averted.

V. CONCULSION

This paper presents a real time lane detection and driver fatigue or driver drowsiness detection system, which can effectively detect the anomaly while driving. The system uses Hough Transform to detect lanes on the road as well as tacks the eyes to detect if they are open or closed. The Hough transform used is simple and faster for adequate detection of lanes of the road. For eyes detection, first voila jones method is used to detect face, then image segmentation is done, Otsu thresholding is performed and Canny edge detection is done, the result obtained is then applied with Circle detection Hough Transform, to detect the eyes. This is a foolproof method for detecting the eyes, and the accuracy is very high. Since, it uses ostsu thresholding and canny edge detection, the eyes are detected even in the low light conditions as shown in Fig. 16. This system will be particularly useful for drivers travelling on long routes, night drivers and for people who drink and drive.

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