Driver Fatigue Detection Using Image Processing and Accident Prevention

Ramalatha Marimuthu¹, A. Suresh², M. Alamelu³ and S. Kanagaraj⁴
¹Department of ECE
²,³,⁴Department of IT
Kumaraguru College of Technology

Abstract

Driving at night has become a tricky situation with a lot of accidents and concerns for the transport authorities and common man especially because of the increasing heavy vehicle movement. The drivers are forced to drive with minimal rest which takes a toll on their driving capability after a few days of continuous driving leading to reduction in their reflexes and thus causing accidents. In most of the cases of accidents, fatigue is found to be the reason for nodding off. In this paper, a system is developed to detect if the driver is sleepy through eye movement detection of the driver who is driving the car. Analysis and detection is carried out by means of image processing and alert system to alert the driver as well as others is developed in hardware along with a control system to stop the car after ascertaining the position of the car and nearby vehicles.

Keywords— Fatigue, Sleepy eyes detection, accident prevention, alert system, car movement control

1. Introduction
Driving a vehicle in a crowded road has become a nightmare because of the road conditions, excess traffic, poor weather conditions, haste to reach the destination and other pressing reasons. But apart from this the fatigue of the driver also creates a lot of accidents in roads, even when all the above said reasons do not hold good. Fatigue reduces reflexes of a person and for a driver for whom every sense has to be in super alert condition always, the slow reflexes mean injury, possible death not only for him but also for the people who have been unfortunate to be on the roads at that instant.

Even though improvements in road and vehicle design concentrates more on safety based issues, the total number of serious crashes is still increasing. A recent Study has shown of the Road traffic accidents that occur more than 70% are caused by driving under dizziness or tiredness as a recent of various factors which resulted in over speeding and loss of attention which resulted in an accident.

This paper proposes a method for detecting the eyes on the face of the driver and by the movement of the eye lids calculate the sleepiness on the driver and alerts the driver and the nearby vehicles. In addition, the vehicle is controlled by an automatic mechanism to slow down and it is driven to safety.

2. SLEEPY EYES DETECTION

A. Literature Survey

Suhas Katkar et al. (2016) developed a system which uses IR sensor to sense fatigue and alcohol sensor for drunkenness and provides alarm, stops engine and sends message with location to owner.[4] Raees Ahmad et al. (2015) developed a system using a web camera to record the head movements of the driver to detect drowsiness and alert the driver using a signal. [5]

Aishwarya S.R et al. (2015) used IR sensors to sense drowsiness and alert the subject during the state of drowsiness and alert others using Internet of Things (IOT) enabled sensors
developed a vehicle auto control system for sleepy and drunk drivers. [6]

Susanna Leanderson Olsson et al. (2012) simulated blink behavior based indicators and a lane position monitoring system to alert the owners using vibrations in the steering wheel.[8]

Xiao Fen et al., (2010) used a Gabor based representation with dynamic facial image sequences for detecting and monitoring the human fatigue. It uses feature extraction, fusion and Adaboost algorithm to select the most discriminative feature to identify fatigue. [1] M.Eriksson et al.(2002), used face symmetry detection to identify sleepiness and alert the driver [2]

Abhi R.Varma et al. (2012) uses remotely located charge-coupled-device cameras for acquiring the video images of the driver’s face and for illumination uses active infrared lights. Different visual cues like the movements of the eyelid, gaze and head along with facial expression are used to determine fatigue condition.[9]

B. Proposed System

The system proposed uses the following flow chart. IR sensor detection is performed first and if sleepiness detected, it triggers the image capturing of the driver’s face to confirm it. Using Embedded control system unit on detecting the fatigue from the input, alert and car control are activated. Image processing to ascertain the level of fatigue is explained in the following sections.

![Flow chart for sleepy eyes detection and control](image-url)

**Fig 1.** Flow chart for sleepy eyes detection and control
C. Face Detection

Here face detection is done using skin color mapping and feature extraction. For this $Y C_b C_r$ color space detection is used to segment the face and the exact location of the eyes. D.Chai et al proposes a face segmentation algorithm using $Y C_b C_r$ color space by detecting the pixels of the picture to indicate human skin using the human skin color map. [3] The face image is separated from the background and then extraction of eye location is done.

D. Extracting Exact Eyes Locations

Image cropping is employed to restrict the area of work nearer to the eyes since the activity of the eyes we concentrate on. The total area of picture is reduced by cropping the image to two fifth to three fifth of the total area of the picture on the upper region with the result that the separation of eyes is performed. After cropping, gray level conversion of the image is applied thus creating the black and white image of the eye area alone as shown in Fig. 2 and Fig 3.

Fig. 2. (a) open status , (b) open status in gray

Fig. 3. (a) close status, (b) close status in gray level

For recognising the exact coordinates of eyes region, canny operator edge detection is used. In this image the boundaries of the eyebrow and eye are shown as white lines as shown in Fig. 4. The lines are just indicative of the position of the eyes with lines to indicate the middle as well as the corner of the eyes.
E. Fatigue Detection

For fatigue detection frequency of eye blinking is taken as the indication. For this the place between the lids is checked for white pixels to ascertain whether the eye is open. By continuously checking the difference, we can say whether the number of white pixels indicates eye closed condition or not. For consecutive frames, it is calculated and if the data returns an eye closed condition for more than 4 frames, it is taken to be indicative that the driver is fatigued.

3. ALERT & STOPPING THE CAR

When detected with fatigue, a buzzer or an alarm or a vibrating device is triggered that can be placed in the seat. This was simulated using Proteus 8 and the results are shown here.
F. Determination of threat level:

From the output of the fatigue detection system, the threat level is determined by counting the number of frames for which the driver’s eyes are closed. For the Human eye each blink is at an interval of 2 to 10 seconds irrespective of other factors[5].

Hence if eye closure is detected for more than 30 frames continuously it can be considered abnormal but could happen naturally, Hence on the first occurrence a counter is incremented which is initially set to 0. Depending the counter value, the seriousness of the fatigue and the alert system to be triggered is then determined as shown by the table below.

**TABLE I. THREAT LEVEL DETERMINATION FROM COUNTER**

<table>
<thead>
<tr>
<th>Counter Value(C)</th>
<th>Threat Level</th>
<th>Control Device</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&lt;=C&lt;=5</td>
<td>Level 1</td>
<td>Light Alarm</td>
</tr>
<tr>
<td>5&lt;=C&lt;=9</td>
<td>Level 2</td>
<td>Vibration In Seat &amp; Voice Warning</td>
</tr>
<tr>
<td>C&gt;=9</td>
<td>Level 3</td>
<td>Speed Reduction By Cruise Control</td>
</tr>
</tbody>
</table>

G. Cruise Control at Level 3(Highest Threat level)

Cruise control is an automatic control system in the car to navigate without human intervention. For this a servo motor was used which was triggered by the control system of the setup.

H. Overall Block Diagram

![Block Diagram](image-url)
The set up was developed and the images of the initial condition of the vehicle and the movement of the vehicle in response to the output of the camera are shown.

Fig 7. The initial set up  Fig 8. Alert and cruise control

1. Results and Conclusion

The system uses a hybrid technology where the IR detection of sleepiness was corroborated by the result from processing the image of the face of the driver. Either of the inputs were programmed to trigger the control system of the car and the alert. The alert used was a buffer and a red LED to give visual as well as an audio alert to the drivers of the nearby vehicles. The control of the car was checked for left cruise movement and obstacle detection.

References


