IOT Based System for Driver Drowsiness Warning

Stuti Ahuja[1], Seema Redekar[2]
[12] SIES Graduate School of Technology, Deapartment of Information Technology, Navi Mumbai, India
[1]ahuja.stuti@siesgst.ac.in, [2]seema.redekar@siesgst.ac.in

Abstract: Driver inattentiveness is an important cause for most accident related to the vehicles crashes. Driver fatigue resulting from sleep deprivation or sleep disorders is an important factor in the increasing number of the accidents on today's roads. Driver drowsiness warning system can form the basis of the system to possibly reduce the accidents related to driver's drowsiness. The purpose of such a system is to perform detection of driver fatigue. By placing the camera inside the car, we can monitor the face of the driver and look for the eye-movements which indicate that the driver is no longer in condition to driver is no longer in condition to drive. In such a case, a warning signal should be issued. This report describes how to find and track the eyes. We also describe a method that can determine if the eyes are open or closed. The main criterion of this system is that it must be highly non-intrusive and it should start when the ignition is turned on without having at the driver initiate the system. Nor should the driver be responsible for providing any feedback to the system. The system must also operate regardless of the texture and the color of the face. It must also be able to handle diverse condition such as changes in light, shadows, reflections etc.
Keywords: Drowsiness, Haar cascade, Internet of Things, Image Processing, Warning System

Introduction

The innovations in the automobile industry over the last hundred years have made our vehicles more powerful, easier to drive and control safer more energy efficient, and more environmentally friendly. Majority of the accidents caused today by cars are mainly due to the driver fatigue. Driving for a long period of time causes excessive fatigue and tiredness which in turn makes the driver sleepy or loose awareness. With the rapid increase in the number of accidents seems to be increasing day to day. Therefore a need arises to design a system that keeps the driver focused on the road. Data on road accidents in India are collected by Transport Research Wing of Ministry of Road Transport & Highways.

The aim of this paper is to develop a prototype of drowsy driver warning system. Our whole focus and concentration will be placed on designing the system that will accurately monitor the open and closed state of the driver's eye in real time. By constantly monitoring the eyes, it can be seen that the symptoms of driver fatigue can be detected early enough to avoid an accident. This detection can be done using a sequence of images of eyes as well as face and head movement. The observation of eye movements and its edges for the detection will be used. Devices to detect when drivers are falling asleep and to provide warnings to alert them of the risk, or even control the vehicle's movement, have been the subject to much research and development. Driver fatigue is a serious problem resulting in many thousands of road accidents each year. It is not currently possible to calculate the exact number of sleep related accidents because of the difficulties in detecting whether fatigue was a factor and in assessing the level of fatigue. However research suggests that up to 25% of accidents on monotonous roads in India are fatigue related. Research in other countries also indicates that driver fatigue is a serious problem.

Young male drivers, truck drivers, company car drivers and shift workers are the most at risk of falling asleep while driving. However any driver travelling long distances or when they are tired, it is at the risk of a sleep related accidents. The early hours of the morning and the middle of the afternoon are the peak times for fatigue accidents and long journeys on monotonous roads, particularly motor-ways, are the most likely to result in a driver falling asleep. In this paper the algorithms for face detection and eye tracking have been developed on frontal faces with no restrictions on the background .The proposed method for eye tracking is built into five stages. Using frontal images obtained from a database, the probability maps for the eyes region are built etc.

Objectives

Drowsiness warning systems (DWS) have been proposed as specific countermeasures to reduce collisions associated with driver fatigue. These devices employ a variety of techniques for detecting driver drowsiness while operating a vehicle and signal a driver when critical drowsiness levels are reached. However, the

detection of driver fatigue using valid, unobtrusive, and objective measures remains a significant challenge. Detection techniques may use lane departure, steering wheel activity, ocular or facial characteristics.
Along with this of course, Drivers have a duty not to exceed speed limits, exceed maximum work limits or breach minimum rest requirements. Complementing this, entities within the chain of responsibility must take reasonable steps to prevent driver fatigue or situations that lead to drivers breaching speed limits. It provides extensive information on the alertness, driving performance, and physiological and subjective states drivers.

Existing System

Driver Fatigue is among the most common reason for fatal road accidents around the world. This shows that in the transportation industry especially, where a driver of a heavy vehicle is often exposed to hours of monotonous driving which causes fatigue without frequent rest period. Due to the frequent occurrence of driver fatigue this has become an area of great socio economic concern. Detecting driver's drowsiness has been a research topic for many years, with many approaches being studied thus so far.
The work presented in takes advantage of some mouth geometrical features to detect yawning. The work in proposes the detection of the face region using the difference image between two images. Driver's yawn is then detected based on the distance between the midpoint of nostrils and the chin. Uses Gravity-center template to detect the face. It then uses grey projection and Gabor wavelets to detect the mouth corners. Finally LDA is applied to classify feature vectors to detect yawning. It presents a system where the face is located through Viola-Jones face detection method in a video frame. Then, a mouth window is extracted from the face region; in which lips are searched through spatial fuzzy c means (s-FCM) clustering. In there is an advantage of two cameras: a low resolution camera for the face and a high resolution one for the mouth. It then uses haar- like features to detect driver's mouth and yawning is detected by the ratio of mouth height and width. In a method is adopted for yawning detection based on the changes in mouth geometric features.
The work in driver's drowsiness is determined using vehicle based measures, behavioral measures and psychological measures which makes this a hybrid drowsiness detection system. Shows detection of drowsiness based on head movement and geometrical features of mouth is proposed. Experiment was conducted on sample size of 50 video clips and observed that head movement contributes about 8% and yawning contributes about 49 %.

Proposed System

The driver's face is continuously recorded using a video camera that is installed under the front mirror. In order to detect the yawn, the first step is to detect and track the face using the series of frame shots taken by the camera. Then the location of the eyes is detected and the mouth in the detected face. The closed eye gesture is detected along with closed eyes for yawning detection. This makes segmentation procedure more robust to false detections. The mouth and eye geometrical features are then used to detect the yawn. The system will alert the driver of his fatigue by use of beep or buzzer and the improper driving situation in case of yawning detection.

Modules

1. Video Acquisition:

OpenCV provides extensive support for acquiring and processing live videos. It is also possible to choose whether the video has to be captured from the in-built webcam or an external camera by setting the right parameters. As mentioned earlier, OpenCV does not specify any minimum requirement on the camera, however OpenCV by default expects a particular resolution of the video that is being recorded, if the resolutions do not match, then an error is thrown. This error can be countered, by overriding the default value, which can be achieved, by manually specifying the resolution of the video being recorded[1].

2. Dividing into frames:

Once the video has been acquired, the next step is to divide it into a series of frames/images. The first step is to grab a frame from the camera or a video file, in our case since the video is not stored, the frame is grabbed from the camera and once this is achieved, the next step is to retrieve the grabbed frame. While retrieving, the image/frame is first decompressed and then retrieved. However, the two step process took a lot of processing time as the grabbed frame had to be stored temporarily. To overcome this problem, we came up with a single step process, where a single function grabs a frame and returns it by decompressing[1].

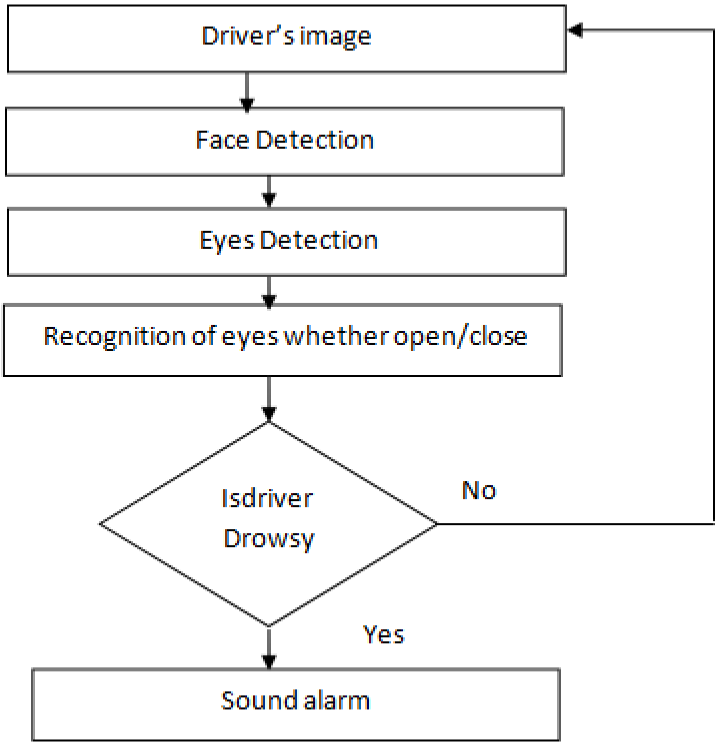

Figure 1. System Flow Diagram

3. Face Detection:

Once the frames are successfully extracted the next step is to detect the face in each of these frames. This is achieved by making use of the Haar cascade file for face detection. The Haar cascade file contains a number of features of the face, such as height, width and thresholds of face colors. It is constructed by using a number of positive and negative samples. For face detection, we first load the cascade file. Then pass the acquired frame to an edge detection function, which detects all the possible objects of different sizes in the frame. To reduce the amount of processing, instead of detecting objects of all possible sizes, since the face of the automobile driver occupies a large part of the image, we can specify the edge detector to detect only objects of a particular size, this size is decided based on the Haar cascade file, wherein each Haar cascade file will be designed for a particular size [1]. Now, the output the edge detector is stored in an array. Now, the output of the edge detector is then compared with the cascade file to identify the face in the frame. Since the cascade consists of both positive and negative samples, it is required to specify the number of failures on which an object detected should be classified as a negative sample. In our system, we set this value to 3, which helped in achieving both accuracy as well as less processing time. The output of this module is a frame with face detected in it.

4. Eye Detection:

After detecting the face, the next step is to detect the eyes; this can be achieved by making use of the same technique used for face detection. However, to reduce the amount of processing, we mark the region of interest before trying to detect eyes. The region of interest is set by taking into account the following:
The eyes are present only in the upper part of the face detected. The eyes are present a few pixels lower from the top edge of the face.

Once the region of interest is marked, the edge detection technique is applied only on the region of interest, thus reducing the amount of processing significantly. Now, we make use of the same technique as face

detection for detecting the eyes by making use of Haar cascade Xml file for eyes detection. But, the output obtained was not very efficient, there were more than two objects classified as positive samples, indicating more than two eyes [1].
To overcome this problem, the following steps are taken:

- Out of the detected objects, the object which has the highest surface area is obtained. This is considered as the first positive sample.
- Out of the remaining objects, the object with the highest surface area is determined. This is considered as the second positive sample.
- A check is made to make sure that the two positive samples are not the same.

Now, we check if the two positive samples have a minimum of 30 pixels from either of the edges.
Next, we check if the two positive samples have a minimum of 20 pixels apart from each other. After passing the above tests, we conclude that the two objects i.e. positive sample

5. Drowsiness Detection:

Once the eyes are detected, the next step is to determine if the eyes are in closed or open state. This is achieved by extracting the pixel values from the eye region. After extracting , we check if these pixel values are white, if they are white then it infers that the eyes are in the open state, if the pixel values are not white then it infers that the eyes are in the closed state. This is done for each and every frame extracted. If the eyes are detected to be closed for two seconds or a certain number of consecutive frames depending on the frame rate, then the automobile driver is detected to be drowsy. If the eyes are detected to be closed in nonconsecutive frames, then we declare it as a blink. If drowsiness is detected, a text message is displayed along with triggering an audio alarm. But, it was observed that the system was not able to run for an extended period of time, because the conversion of the acquired video from RGB to grayscale was occupying too much memory. To overcome this problem, instead of converting the video to gray scale, the RGB video only was used for processing.
This conversion resulted in the following advantages,

- Better differentiation between colors, as it uses multichannel colors.
- Consumes very less memory.
- Capable of achieving blink detection, even when the automobile driver is wearing Spectacles. Hence there were two versions of the system that was implemented; the version 1.0 involves the conversion of the image to gray scale. Currently version 2.0 makes use of the RGB video for processing.

Screenshots

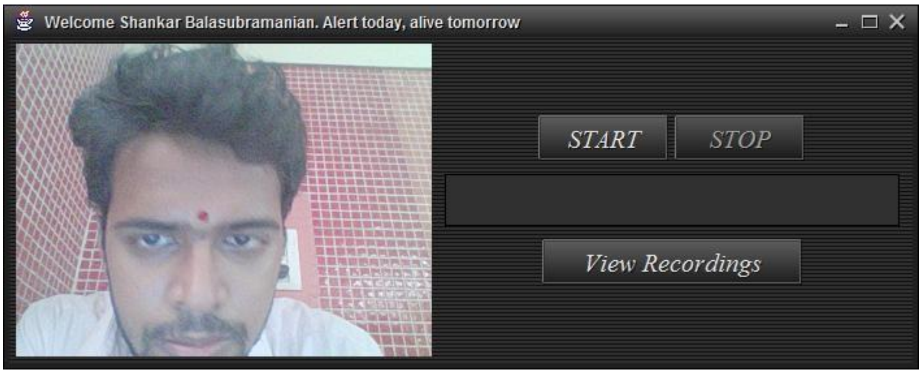

Figure 2. HOME SCREEN

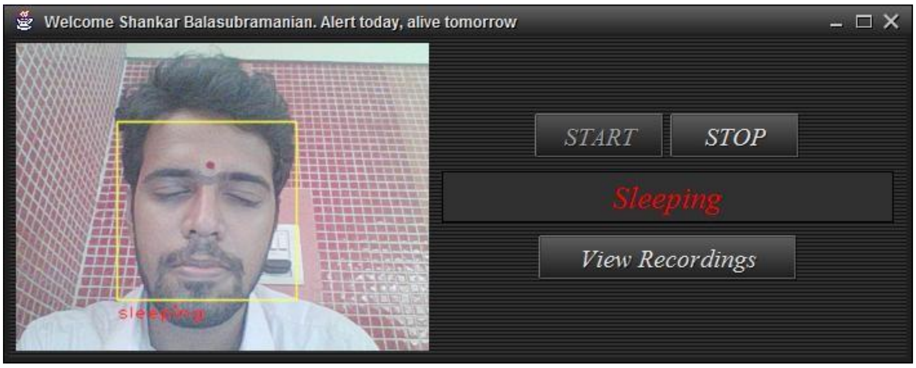

Figure 3. DROWSINESS DETECTION

Conclusion:

In this paper, we have reviewed the various methods available to determine the drowsiness state of a driver. Although there is no universally accepted definition for drowsiness, the various definitions and the reasons behind them were discussed. This paper also discusses the various ways in which drowsiness can be manipulated in a simulated environment. The various measures used to detect drowsiness include subjective, vehicle-based, physiological and behavioral measures; these were also discussed in detail and the advantages and disadvantages of each measure were described. Although the accuracy rate of using physiological measures to detect drowsiness is high, these are highly intrusive. However, this intrusive nature can be resolved by using contactless electrode placement. Hence, it would be worth fusing physiological measures, such as ECG, with behavioral and vehicle-based measures in the development of an efficient drowsiness detection system. In addition, it is important to consider the driving environment to obtain optimal results.

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