Driver State Analysis And Drowsiness Detection Using Image Processing

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Abstract

Driver drowsiness and inattentiveness are the major reason for road accidents. The impact of such accidents can be reduced by effectively implementing a driver assistance system. The system must be able to detect the state of the driver and act accordingly. The proposed system includes a real time system that detects whether the driver is drowsy or inattentive, and if so the system generates an alarm to alert the driver. The system includes gabor ordinal measures and block matching algorithm for detecting the driver state. These techniques have the advantage of working at low lighting environment. Various preprocessing techniques used reduces the fault detection and noise. The system detects the state of the driver more accurately. Continuous monitoring improves the effectiveness of the proposed system.

Keywords: Block Matching, Gabor ordinal Measures.

1. Introduction

Major accidents that occur are due to driver drowsiness and inattentiveness. Drivers who are driving for a long time without rest are at a risk to become drowsy. Hence a driver assistance system that alerts the driver is very helpful in reducing the impact of the accidents that are about to happen. The system should detect the state of the driver as early as possible and the false detection rate should be reduced. The system uses gabor ordinal measures in order to detect the face. The driver inattentiveness is detected by continuously monitoring the driver face. When the system fails to detect the face then it decides that the driver is inattentive. For detecting whether the driver is drowsy an effective algorithm called block matching is used. This algorithm is similar to our human cortex system. If the driver is drowsy or inattentive then the alarm goes on with an alert message.

The system uses a video camera to continuously capture the face of the driver. The video is converted to frames and certain preprocessing are done. This improves the effectiveness in detecting the driver state. The frames are then matched in order to detect the state of the driver. The system is effective in detecting the driver drowsiness and the false detection rate is comparatively reduced. According to a study by the American Automobile Association, 37 percent of drivers have been reported of having fallen asleep while driving at some point in their lives. The survey also says that there were approximately 300000 crashes have been taken place cause of drowsy drivers, out of which 6400 are fatal. Driver fatigue condition and inattention contribute to safety concerns, which the driver attention alert system is intended to address. The system cannot reduce the cause but it reduces the impact of accident on early detection.

2. Methods

A. Overview

Major accidents that happen are due to driver state. Although the effect cannot be completely removed, certain techniques can be implemented to reduce the impact of the accidents. This include the early detection of driver state. In the proposed method the driver was continuously monitored by using a video camera. The driver drowsiness and inattentiveness are determined by block matching algorithm and a novel method called Gabor Ordinal Measures respectively. On detection, an alert is given to the driver. This will thereby reduce the number of accidents that occur due to driver drowsiness and inattentiveness.

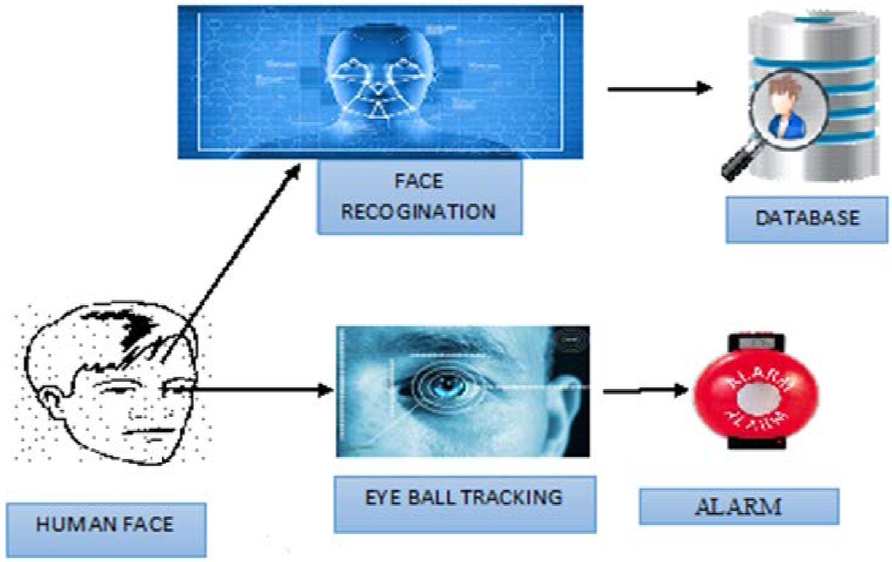

Figure 1. Overview Of Proposed Method

B. Eye Ball Tracking

Eye tracking is the process of continuously monitoring the movement of eye and determine the gaze. A device eye tracker can be used in finding the eye movement.

1. Block Matching Algorithm

The proposed system detects the eye state, that is, whether the eye is closed or not. Normal eye blink may be wrongly detected. Hence the system detects the eye state continuously and if the eye is closed for more than three seconds then it is decided that the driver is drowsy. Thereby false detection is reduced. The average blinking duration while a person is normal is of 100-150 milliseconds. The closing time that exceeds 1000ms is determined as micro sleeps.

The Eyeball tracking system includes block matching algorithm and low rank technique. Eye parameters are used to detect the state of person. If the eye is not detected for a certain period of time it is concluded that the driver is drowsy. Then the driver is alerted by using an automatic alarm system. The block matching algorithm includes a method of locating matching macroblocks. The method includes dividing the frames into macroblocks. Each macroblocks are compared with the previous macroblocks. A search parameter is used that locates the corresponding region of macroblock. A larger parameter value is effective in detecting the drowsiness of the driver.

Initially the center of the image is taken as the search location. An effective search size and search parameter value are provided. Searching includes eight locations from the center. Including the center location there are nine search locations. Now the location with minimum cost function is determined. This location is now marked as the center and again the locations are determined. The method involves a steady decrease in the step size value. The new step size is determined by dividing the previous step size value by two. The process is repeated till the step size value reaches one. The resulting location that contributes to the value, as one for step size is said to be, the one with minimum cost function. Block matching matches the pixels in the macroblock in the current frame with the previous frame.

C. Gabor Ordinal Measures

The driver who is not attentive is at a high risk to cause an accident. Hence it is important to alert the driver while he is not attentive. The continuous monitoring thereby reduces the effect. The driver is continuously monitored. The video is converted into video frames and the frames are initially normalized. The pixel are resized and the distance between the fiducial points are noted. Fiducial points here are determined as some important location on the image. The ordinal measures derived from gabor images are named as Gabor Ordinal Measures. The gabor features are distinctive and the ordinal measures are robust. This GOM combines the effectiveness of both. The ordinal measures are derived from magnitude, phase, real and imaginary components of Gabor images. The method can handle intra-class variations and inter-class similarities. The term ordinal measure determines the measure of relative degree of difference between the object in the image. The ratio between them are not considered.

The GOM method uses di-lobe and tri-lobe ordinal filters to effectively encode gabor magnitude and phase images.Ordinal measures extracted on feature level are more discriminative than those extracted on image level. Higher accuracy of face recognition can be achieved with better setting of the GOM parameters.

Gabor filters act very similar to mammalian visual cortical cells so they extract features from different orientation and different scales. Gabor features are calculated at different scales and different orientation. The filters for different orientation and scale are obtained. Now the image and the filters are convolved and different representation of same image are obtained. Each image gives a feature vector.

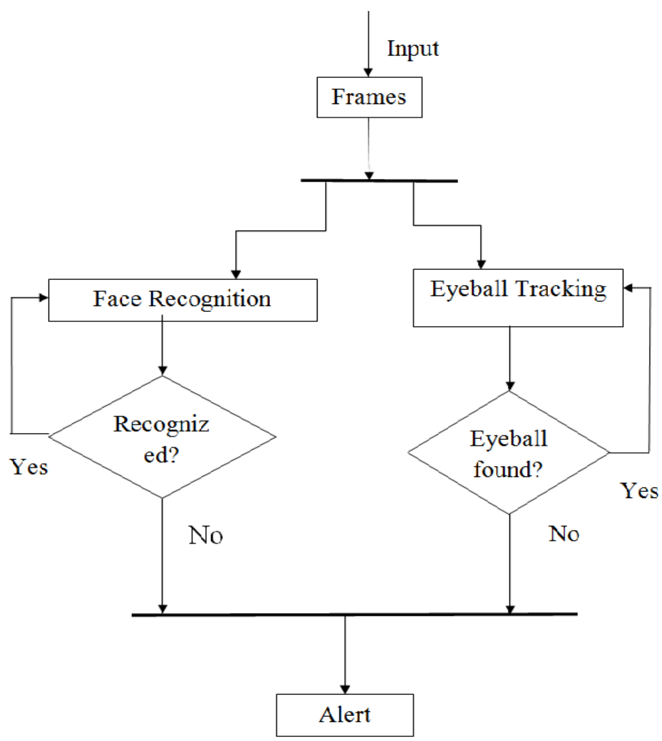

Figure 2. Data Flow Diagram

3. Experiment

The system considerably reduces the fault error rate since it works effectively even in low lighting condition. It requires comparatively lesser processing time than the available techniques. The frames are processed with high speed and the results are accurate.

The driver face is continuously monitored and the driver state is detected. The rate of detection is tabulated. This determines the considerable decrease in false error rate. Hence the proposed system is highly effective in detecting the drowsiness and inattentiveness of a driver.

Table 1. Result Of Face Detection

Total Frames	**Tracking Failure**	**Correct Rate**
52	4	95
110	6	89
156	7	81

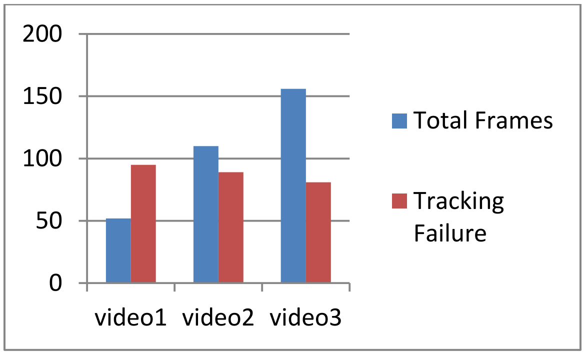

Figure 3. Result Of Face Detection

4. Discussion

The system detects drowsiness and inattentiveness of the driver continuously. If detected then the driver is given an alert. The system can be implemented in real time environment. It uses a video camera and the video stream is given as the input to the system. The video is processed instantly by dividing it into frames and the driver state is determined effectively. The GOM method provides a promising solution for face image analysis and the matching process is highly efficient. The computational complexity is high however the GOM method provides high accuracy.

5. Conclusion

The system gets the instant video as input using the camera. The video includes frames that are matched to determine the driver state and attentiveness level. The method includes some algorithm that are gabor ordinal measure, block matching and low rank algorithm to determine the driver state. If the state of the driver is not normal then the driver gets an alert message. And if it continues for more than three frames then the loop gets stopped and an alarm goes on and alerts the driver.
The system on detection of drowsiness or inattentiveness, the system will let the driver know by:
1. Sounding an audible alarm
2. Displaying an alert message "See the road".

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