Fatigue Detection to Prevent Accidents

Vishwanath Burkpalli*[1], Karishma Illal[2], Soumya Keely[3], Sushmita Solshe[4]

[1, 2, 3,4]P.D.A College 0f Engineering College, Kalaburgi – 585102, India.

[1]vishwa_bc@rediffmail.com

Abstract

Today, Accident congestion is biggest problem in smart cities. In this paper a real time eye tracking system for drowsiness detection of a driver is developed. The purpose of the project is to implement a real-time feature tracker with the Driver drowsiness detection HCI (Human Computer Interface) using eye. A Drowsy/Fatigue Driver Detection System has been developed, using a non-intrusive machine vision based concepts. The system uses a small monochrome security camera connected to the Raspberry pi board that points directly towards the driver's face and monitors the driver's eyes in order to detect fatigue, by using the platform of Opencv for image processing of the collected data leads to the calculation of intensity of eyes and detect the drowsy state of the driver. Thus if drowsy state is detected patient is alerted by a buzzer Alarm.

Keywords: Raspberry Pi, Webcam, Opencv, Alarm

1.Introduction

Driver fatigue is a significant factor in a large number of vehicle accidents. The project is designed to combat narcolepsy and micro sleep. Micro sleep strikes quickly. You probably don't even realize you're in the process of falling asleep, and almost certainly don't notice that you are blinking for longer than usual. Sleep alert uses your raspberry webcam to monitor your blink rate and average blink duration. If your eyes stay closed for long periods of time, then the program lets you know that a sleep is imminent. Research indicates that this is one of the most effective ways to predict impending micro sleep. Driver drowsiness detection is a car safety technology which helps prevent accidents caused by the driver getting drowsy. Recent statistics estimate that annually 1,200 deaths and 76,000 injuries can be attributed to fatigue related crashes. The aim of this project is to develop a prototype drowsiness detection system. The focus will be placed on designing a system that will accurately monitor the open or closed state of the driver's eyes in real-time. By monitoring the eyes, it is believed that the symptoms of driver fatigue can be detected early enough to avoid a car accident.

Detection of fatigue involves a sequence of images of a face, and the observation of eye movements and blink patterns.

In this work we focused on the localization of the eyes, which involves looking at the entire image of the face, and determining the position of the eyes, by a self developed image-processing algorithm. Once the position of the eyes is located, the system is designed to determine whether the eyes are opened or closed, and detect fatigue.

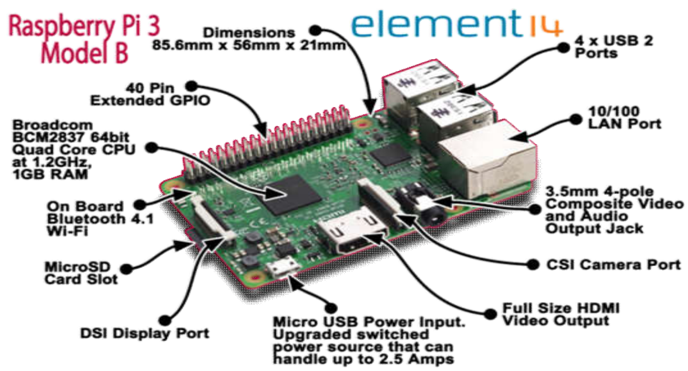

Fig 1: **Raspberry Pi 3**

2.System Architecture

The proposed system comprises of three phases.
1. Capturing: Eye Camera mounted on the dashboard is used for capturing the facial image of the driver
2. Detection: The analysis of the captured image is done to detect the open/closed state of the eyes. The driver's current driving behavior style is deduced using inbuilt HARR classifier cascades in OpenCV.
3. Correction: This phase is responsible for doing the corrective actions required for that particular detected abnormal behavior. The corrective actions include in-vehicle alarms and displays. The Raspberry pi single board computer which is connected serially to the PC performs the necessary corrective actions.

RASPBERRY PI SINGLE BOARD COMPUTER

Raspberry Pi is a credit card sized single-board computer. It has 5 models. Model A, Model A+, Model B, Model B+, Generation 2 Model B. Model A has 256Mb RAM, one USB port and no network connection. Model A+ has 256Mb RAM, one USB port and network connection. Model B has 512Mb RAM, 2 USB ports and an Ethernet port. Model B+ has 512Mb RAM, four USB ports, Ethernet port and HDMI and camera interface slot. Generation 2 Model B also has 4 USB ports, 1 GB RAM, 2 camera interface and 1HDMI interface. We implemented raspberry pi tablet using Model B+.
Technical Specification:

- Broadcom BCM2837 64bit ARMv7 Quad Core Processor powered Single Board Computer running at 1.2GHz
- 1GB RAM
- BCM43143 WiFi on board
- Bluetooth Low Energy (BLE) on board
- 40pin extended GPIO
- 4 x USB 2 ports
- 4 pole Stereo output and Composite video port
- Full size HDMI
- CSI camera port for connecting the Raspberry Pi camera
- DSI display port for connecting the Raspberry Pi touch screen display

- Micro SD port for loading your operating system and storing data
- Upgraded switched Micro USB power source (now supports up to 2.4 Amps)

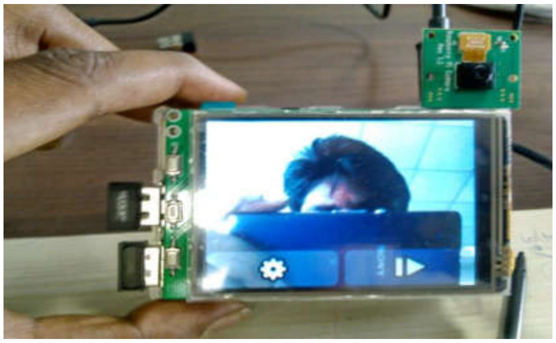

Fig2: Display of monitoring image

3.Drowsiness Detection Techniques

Face detection is a complex computer vision task due to the dynamic nature of human faces and high degree of variability of them. According to research, there are multiple categories of technologies that can detect driver fatigue. The first is the use of cameras to monitor a person's behavior Different face detection techniques are characterized by different face detection rates. Analysis of a number of the most popular techniques. The system performs a real-time processing of the input image stream so to compute the level of fatigue of the driver. The analysis is based on calculating a number of frames of the data stream where the driver eyes are closed. The result of the processing is sent to the alarm board, which activates an alarm signal when the drowsiness index exceeds a pre specified parameter. The face and eye tracking depends on light intensity and face illumination, the background should not contain any other high brightness objects or direct light sources.

In order to effectively capture the face, the webcam is placed onto the vehicle dashboard and is approximately 20cm away from the driver's face. At this distance, the webcam captures the most of the driver's face. The camera and processor are positioned in the car. Possible techniques for detecting drowsiness in drivers can be generally divided into the following categories: sensing of physiological characteristics, sensing of driver operation, monitoring the response of driver.

Procedure

The system performs a real-time processing of the input image stream so to compute the level of fatigue of the driver. The analysis is based on calculating a number of frames of the Data stream where the driver eyes are closed. The result of the Processing is sent to the alarm board, which activates an alarm signal when the drowsiness index exceeds a pre-specified Parameter. Because the face and eye tracking depends on light intensity and face illumination, the background should not contain any other high brightness objects or direct light sources. Every frame of the input video and performs the required image processing so to determine in a real-time the state of the driver's eyes: open or closed. Based on the number of frames where the eyes are opened and closed, the processor calculates the drowsiness index

Fig 3 presents the basic architecture for the proposed system. A web camera capable of capturing an image without blurring them with a resolution of six mega pixel minimum is used. Alarm is used to generate the output.

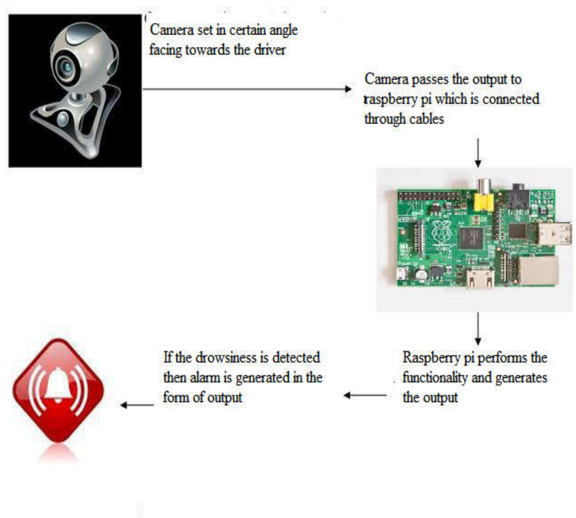

Fig3: Architecture of proposed system

Camera settings and initialization

The camera must be placed at a distance of 40 cm to 50 cm from a driver. This distance is approximately equal to the distance between the car steering and the driving seat. The camera must be placed at an angle of 45 degrees from the driver's face. At an angle between 35-50 degrees the face can be captured with perfection and ease.

The first step is initialization of a camera and video processing unit, It acquires an image of the driver's face. Therefore, it is assumed that the eye is a plane Perpendicular to the optical axis of the camera, which is a photo eye 'in the central part of the frame.

Video Frames

When the system is initiated a delay of two to three seconds is experienced for capturing the image for the first time. This results in losing the data from the first three frames. The segment of video thus obtained from the camera is then used to extract each segment of video frame i.e. 30 frames per second.

Face Detection

The system actually starts its execution once the face has been detected. The images obtained from the frames are now subjected to face detection part of the system.

Eye detection

The face is horizontally divided into two segments i.e. upper segment and a lower segment. Upper segment contains the image between the forehead to the eyes, and lower segment contains the image between the nose to the chin. We take into account the upper segment and lower segment is discarded. The upper segment again is divided horizontally into 2 segments, this time upper up segment from the forehead to an eyebrow and the upper lower segment from eyebrow to a lower eyelash. After the eyes have been extracted from the image it is then that the current frame is replaced by a new one. The eyes extracted are now categorized in two parts through vertical calibration -the left eye and the right eye.

Check condition for open and closed eyes

After the eye has been detected, the next step is to detect the eyes condition either they are open or close, so for this purpose intensity values are used. A graph is plotted which calculates the intensity distance in the eye separately through the eye lashes and eye brow and check the state of an eye on this intensity distance. If distance is large, eye is close and when distance is less, eye is open. The distance can be evaluated by analyzing the samples of images. Both the eyes are binarized to determine the threshold value and then the results are produced. If the system encounters five consecutive frames with the eyes closed the alarm is triggered for the next five frames

4. Implementation

The flow model depicted in Fig 4 shows the stepwise execution of system and will be discussed in the following subsections. When the system is initiated a delay of two to three seconds is experienced for capturing the image for the first time. This results in losing the data from the first three frames. The sys-tem actually starts its execution once the face has been detect-ed. Each face detected is stored for half a second to crop the image in order to detect the eye. After the eyes have been extracted from an image, the current frame is replaced by a new one. The eyes extracted are now categorized in two parts ***-the left eye and the right eye***. Both the eyes are binarized to determine the threshold value and then the results are produced. If the system encounters five consecutive frames with the eyes closed the alarm is triggered for the next five frames.

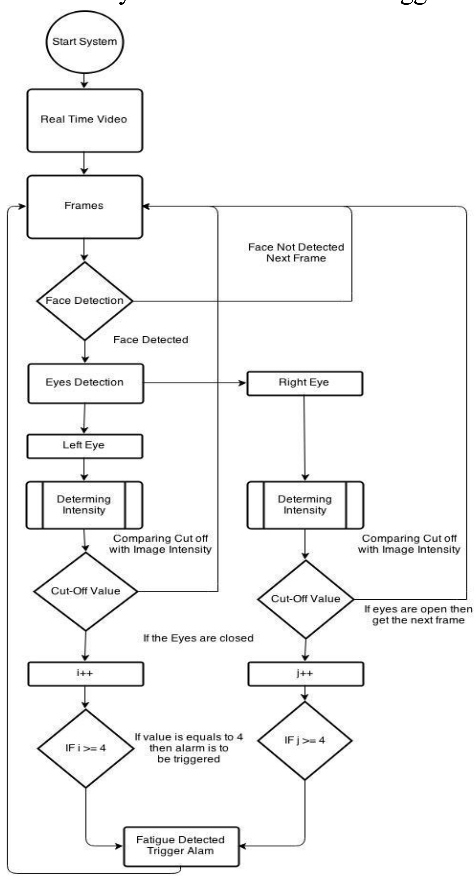

Fig 4 : Flow chart of implemented idea

Creating a real time system means high speed processing. Thus it was decided after generating several results that our proposed system will not be storing the old results as they had no significance and consumed a lot of space therefore slowing down the whole system. So we have taken each frame, generating and saving the results and replacing the previous frame with the current new frame. Once an image is obtained from a real time detection camera its analysis takes a couple of seconds to generate the results and the accumulation of many frames together will only result.
In a degraded real time system, so it was concluded that for each second a frame rate should be decided. A frame rate on the average of four frames per second is taken in for processing.

5. Conclusion

The drowsiness detection and correction system developed here is capable of detecting drowsiness in a rapid manner. The system which can differentiate normal eye blink and drowsiness can prevent the driver from entering the state of sleepiness while driving. The system works well even in case of drivers wearing spectacles and under low light conditions also. The proposed system is used to avoid various road accidents caused by drowsy driving. This report involves a system that is used to avoid accidents by calculating the intensity of eye of the driver which alerts the driver by a buzzer alarm if they feel drowsy or are sleeping state.

7. References

1. M. J. Flores, J. M. Arming and A. de la Escalera, "Real-time drowsiness detection system for an intelligent vehicle," IEEE Intelligent Vehicles Symposium, June 4-6, 2008, The Netherlands, pp. 637-642.

2. Arum Sahayadhas, Kenneth Sundaraj, ”Detecting Driver Drowsiness Based on Sensors A Review”,pp.16937-16953, ISSN 1424-8220, Malaysia 2012 http://djhurij4nde 4r.cloudfront.net/images/images/000/005/91 7/fullsize/eskandarian.png?1386903510

3. Karamjeet Singh, Rupinder Kaur, „Physical and Physiological Drowsiness Detection Methods‟, (IJIEASR), International Journal of IT, Engineering and Applied Sciences Research, Volume 2, No. 9, September 2013 ISSN: 2319-4413

4. Toshinori Kagawa, Nobuo Nakajima.” Robust Wrist-Type Multiple Photo-Interrupter Pulse Sensor” Latest Advances in Biology, Environment
and Ecology June 13-15, 2012.

5 Ueno H., Kanda, M. and Tsukino, M. “Development of Drowsiness Detection System”, IEEE Vehicle Navigation and Information Systems Conference Proceedings, (1994), ppA1-3, 15-20.