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Drowsiness detection and alarm system using Raspberry Pi

Dr.A.ShobhaRani[1], Komal G Singh[2], Vishnu BT[3], Sai Mukunda S[4], Vinayaka Bhat[5]

[1]*(Electronics & Communication Engineering, BMS Institute of Technology& Management/VTU, India)*

Abstract: The increasing mortality rate can be posed due to several factors with road accidents being one of the foremost reasons. Road accidents could be attributed to the drivers speeding, recklessness or drivers fatigue resulting from sleep deprivation or sleep disorders. A module which analysis, detects and warns the driver forms the basis of a system that could considerably reduce road accidents. This paper talks about one such module constructed which captures and analysis the eye movements using the functions in the Open CV library, this includes the open or closed state of eyes, and then fatigue is determined based on the various states of eye. Next the data is processed using a specific technique known as the Haar-cascade technique through a series of algorithms and outputs the result as a warning using a buzzer. Vision based driver fatigue detection using image processing method is an easy, non-intrusive and convenient technique to monitor driver's vigilance.

Keywords: Drowsiness, Eye closure, Haar-cascade, Image processing, Open CV

1. INTRODUCTION

Based on current survey conducted about 50% of road accidents are attributed to the driver's fatigue. Using technology to detect driver fatigue/drowsiness is an exciting task that would help curb the problem of accidents to a considerable extent. In the past various efforts have been proposed in literature on the approaches for drowsiness detection of automobile driver. In the last several years, many countries have begun to pay great attention to the severity of this problem. Researchers have been working on the detection of driver's drowsiness using several techniques, such as physiological detection, road monitoring techniques. Physiological detection techniques use facts and proposed theories that prove sleep rhythm of a person is strongly correlated with brain and heart activities. However, all the research conducted counter the feasibility of this approach as they need electoral contacts on the automobile drivers' head, face, or chest making it problematic, intrusive and non-implementable, in real world scenarios. Lane monitoring is one of the most commonly used technique, systems based on this approach, include active Attention assistance by Mercedes, Fatigue Detection System by Volkswagen, driver alert by ford, driver alert control by Volvo. All the mentioned techniques monitor the road and drivers behavioural patterns to detect the drowsiness of the driver. This approach is inherently flawed as monitoring the road to detect stupor is more of an indirect approach and also lacks accuracy.

The aim of this paper is to develop a prototype of drowsy driver warning system for accident avoidance using image processing. The entire focus and concentration will be placed on designing a module that will accurately monitor the open and closed state of the driver's eye in real time. By constantly monitoring and analysing the eye movement, it can be seen that the symptoms of driver fatigue can be detected early enough to avoid an accident. Initially the camera mounted captures the eye image of the driver, several frames of images of the eye are taken for accurate reading. The captured images are processed using several algorithms to generate the results in the form of a warning.

2. METHODOLOGY

2.1 Existing Methodology

2.1.1 A survey on driver's drowsiness detection system using steering wheel movement:

Based on the data collected from the gyroscope, the slight changes in the angular movement is calibrated and simultaneously the steering grip is supervised to detect the drowsy state of the driver.

2.1.2 Drowsiness detection using Electroencephalography (EEG) technique:

The driver has to wear a helmet which contains Electrodes that detect the brainwaves which are excited when the driver is drowsy.

2.1.3Drowsiness detection using heart rate monitoring:

The slight changes in the heart rate when a person is drowsy is considered in this technique. The normal heart rate of the driver is set as standard which will be compared with the heart rate of the driver during driving in regular intervals.

2.2 Proposed Methodology

In this method, the web camera which is placed in front of the driver's line of sight captures the images of the driver in regular intervals of time (30FPS).The captured images undergo image processing using open CV with the help of Raspberry pi processor. The processed images helps to detect the face and eye of the driver using an algorithm called haar--cascade. With the use of this method, the eye closure of the driver is monitored, when the eyes of the driver cannot be detected it is concluded as the driver's eyes are closed and the eye closure duration is calculated. The eye closure of the driver is compared with the standard eye blinking rate which is 0.3 to 0.4 seconds, when the driver is drowsy the eye closure of the driver will be greater than the standard eye blinking rate and excites the buzzer to alert the driver, if not it will process the next set of images.

3. HARDWARE AND SOFTWARE REQUIREMENT

- Raspberry pi processor 3
- Web camera
- Buzzer
- Power supply
- Coding ground (coding platform)
- Python command prompt
- Open CV
- LED

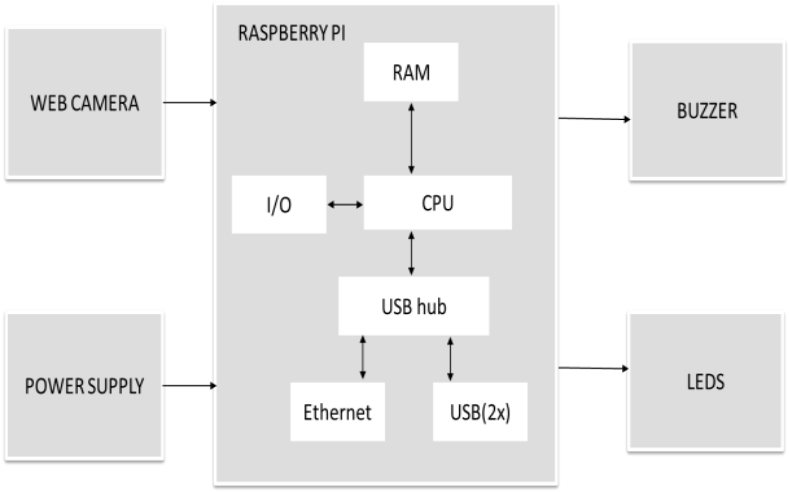

Fig.1 proposed block diagram

3.1 Principle of image processing:

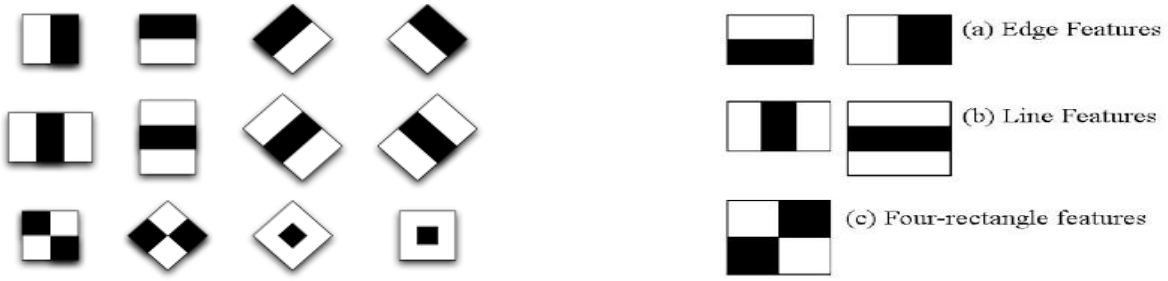

Fig.2haar like features

Haar-cascade algorithm uses haar like features to extract the digital image features for object detection. Adjacent rectangular region are considered in these haar-like features at a specific location in a detection window, sums up the pixel intensities in each region and calculates the difference between these sums. This difference is then used to categorize subsections of an image. Rectangle features are computed very rapidly using the integral image which is an intermediate representation. The integral image at location pixels (x, y) contains the sum of the upper left pixels of the original image, inclusively. The value of the integral image at

location 1 is the sum of the pixels in rectangle A, the value at location 2 is A+B, location 3 is A+C and at location 4 is A+B+C+D. Then, the sum within D is computed as 4 + 1 – 2 – 3 that means the sum of the pixels within rectangle D is computed with four array references. Integral image provides the advantage of fast feature evaluation. Ad boost is used to select a small set of features and train the classifiers.The learning algorithm for weak classifiers is designed to select the single rectangle feature best separating the positive and negative examples. For each feature, the weak classifier determines the optimal threshold. Many such weak classifiers are cascaded to obtain a strong classifier which determines the exact object in the image.

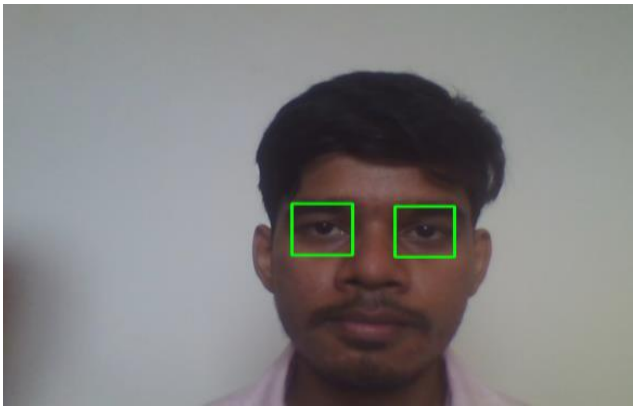

Fig.3 detection of eyes

Fig.4 closure of eyes

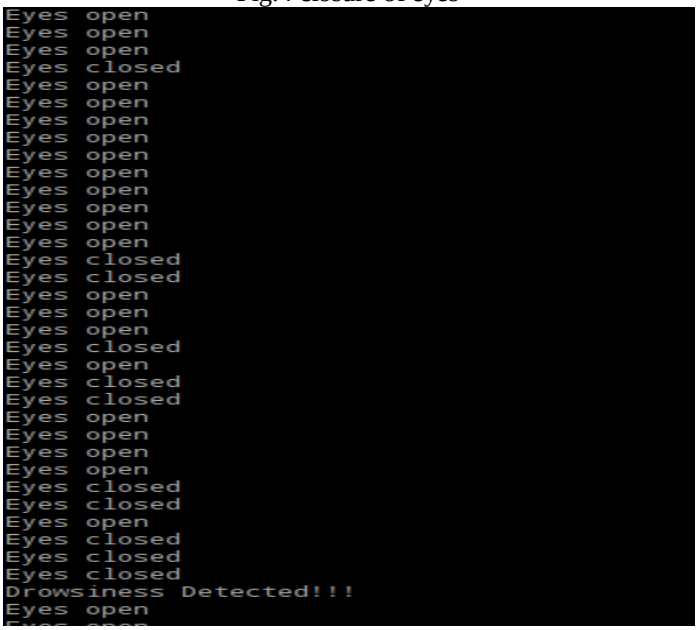

Fig.5- command window of real time readings

4. ALGORITHM

• Images of the driver are taken using the camera.
• Image processing with the help of Raspberry Pi.
• Detect the face of the driver.
• If face is detected, the eye region of the driver is detected and then the eyes are detected.
• The eye closure is monitored.
• When the eyes of the driver cannot be detected the eyes are considered to be closed.
• Eye closure > Normal blinking time(0.3or 0.4), driver is drowsy.
• A buzzer is excited to alert the driver.

5. CONCLUSION

There are several methods of implementing drowsiness detection system. The proposed work shows that raspberry pi and open CV is more suitable for this application, since it gives more accurate readings, also reliable in terms of detecting the eye and face. The operations are performed on live webcam. The result varies during un-even lighting condition, however the output still gives accurate reading even in low dim light and alarms the driver. By this an emergency warning is given before any impact of accident happens and this time is enough for people take necessary precautions and stay safe.

6. FUTURE WORK

The application can be modified by adding yawning detection. Nodding the head to turn of the alarm can be made. Slowing down the speed of the vehicle and turning on the hazardous light or parking light indicating that the person is drowsy can also be accomplished for future work.

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