International Journal of Scientific Research in Engineering and Management ((IJSREM)
Volume: 04 Issue: 08 | August -2020 ISSN: 2582-3930

Driver Drowsiness Detection System

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Abstract - Drowsy driving is one of the major causes of road accidents and death. Hence, detection of driver's fatigue and its indication is an active research area. Most of the conventional methods are either vehicle based, or behavioral based or physiological based. Few methods are intrusive and distract the driver, some require expensive sensors and data handling. Therefore, in this study, a low cost, real time driver's drowsiness detection system is developed with acceptable accuracy. In the developed system, a webcam records the video and driver's face is detected in each frame employing image processing techniques.

Facial landmarks on the detected face are pointed and subsequently the eye aspect ratio, mouth opening ratio and nose length ratio are computed and depending on their values, drowsiness is detected based on developed adaptive thresh holding. Machine learning algorithms have been implemented as well in an offline manner.

Introduction- The increase in the number road accidents is a matter of concern as it is a threat for mankind. Every day in the news we get to hear about road accidents and the loss it has caused. Everywhere road accidents are a common phenomenon. These accidents lead to loss of lives, fatal injuries and economic losses. According to the Daily Star, at least 2,297 people died in road accidents. Thus, it can be concluded that a large number of these accidents happen due to the drowsy state of drivers. Therefore, it is very necessary to develop a system that can detect the drowsiness of the drivers and implement vehicles.

Accidents due to drowsy driving occur mostly in vehicles like trucks and buses that travel at night are more susceptible to this problem.
Driver drowsiness is an overcast nightmare to passengers in every country. Every year, a large number of injuries and deaths occur due to fatigue related road accidents. Hence, detection of driver's fatigue and its indication is an active area of research due to its immense practical applicability. The basic drowsiness detection system has three blocks/modules; acquisition system, processing system and warning system. Here, the video of the driver's frontal face is captured in acquisition system and transferred to the processing block where it is processed online to detect drowsiness. If drowsiness is detected, a warning or alarm is send to the driver from the warning system.

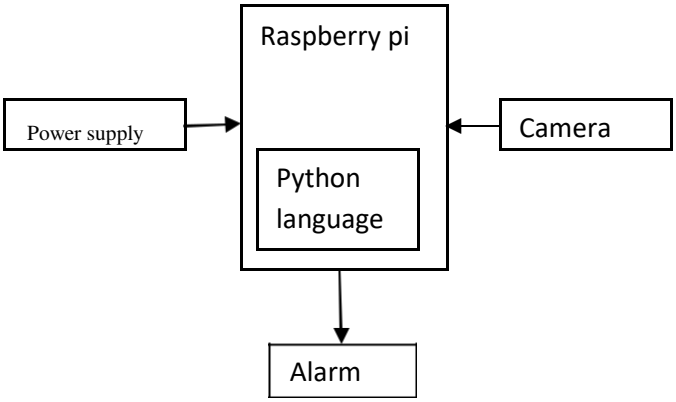
Driving with drowsiness is one of the main reasons causing traffic accidents. Drowsiness will impair driver's abilities of reaction, information processing, and judgment. It is very helpful to remind them of resting or improving vigilance when drowsiness comes. Visual detection of driver's fatigue as a non-intrusive method is a promising but challenging work. Micro sleep is a typical characteristic of driver drowsiness, which features on seconds of eye closure. So most of previous research focuses their methods on eye blinking detection.

It is a common sense that yawning is another cue of drowsiness. The system will be more robust if yawning together with eye blinking or other cues is integrated to make joint decision. To the best of our knowledge, little research has been made on this aspect, Yawning detection is intractable because of inter-person difference of appearance, variant illumination, and especially complex expression and widely varying pattern of mouth. Lip corners are detected and tracked in. We mount a single camera on car dashboard to monitor the appearance of driver. Eye blinking and yawning are two cues for driver drowsiness detection. Aspect ratio of eye and mouth bounding rectangle is defined to describe degree of eye and mouth openness.
From our research, we found many different methods to detect the drowsiness such as monitoring the head

position, steering wheel pattern, eyelid movement, heart rate, lane deviation. But in our device we have decided to implement two methods. One is the eyelid position monitoring and other is the yawn detection.

Proposed System - Drowsy driving warning system will be implemented on camera with the help of Haar Cascade algorithm. Drivers face expression such as eye blinking, yawn, will continuously be monitored by camera. If the face expression match with drowsy parameter then it alerts the driver.

System Architecture



The architecture of the driver drowsiness system has been shown in the above Fig. The camera captures the image and sends to the Raspberry pi which consists of 32 bit memory card installed with Open CV which helps in image processing.

Drivers face is continuously monitored using a video camera. In order to detect the drowsiness the first step is to detect the face using the series of frame shots taken by the camera. Then the location of the eyes and mouth is detected and is continuously monitored.
The captured image is sent to the Raspberry Pi board for image processing. The system is capable of detecting the drowsiness condition within the duration of more than two seconds. After the detection of abnormal behaviour it is alerted to the driver through alarms which reduces the accidents due to drowsiness of the driver.

There are 3 major system modules of driver drowsiness detection System.
1. Camera - It is used for capturing the video in real time and monitors a stream for faces. In order to effectively capture the face, the camera is placed onto the vehicle dashboard and is approximately 20cm away from the driver's face. At this distance, the camera captures the most of the driver's face. The captured video is sent to the Raspberry Pi for further processing.
2. Raspberry Pi - The Raspberry Pi is a small single-board computer. Python is main programming language for Raspberry Pi. It performs a processing of the input video stream 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 and mouth are closed. Video segments whose average eye and mouth state point exceeds the thresh hold value are detected as drowsy.
3. Alarm - When the drowsiness index exceeds a pre-specified parameter or when the signal falls below the specified threshold it activates an alarm signal. Loud Alarm is buzzed to alert the driver indicating that he is drowsy and is dangerous to drive in this state and that he must take a break.

Implementation

Here the proposed system includes three modules they are as follows

- Detection of face
- Detection of eyes condition
- Yawning detection

1. Detection of face

This is the very first module in which the face is segmented from the input image that is initially whatever the video that is recorded by the camera will be fragmented into the frames and then into the image, this image will be given as input for segmenting the face. The partial segmentation of the image by selecting the appropriate threshold is based on dividing the image into the background and foreground classes. Thresh holding is primarily concerned

with selecting an appropriate threshold according to image histogram. That is, the value of thresh holding or border as the brightness intensity is considered as the basis of the division and the brightness intensities greater and less than threshold is equal to 1 and 0 respectively. The purpose of face detection is to minimize the error rate in identifying facial expressions. The importance of this part is to measure the position of the eyes and mouth.

2. Detection of eyes condition

Important factor which helps detect driver fatigue is the state of eyes, i.e. whether they are open or closed. In the state of fatigue, eyelid muscles subconsciously attempt to accelerate the process of going to sleep. Using this property, determining whether eyes are open or closed is done by relying on the difference of brightness intensity of the pupil in the image and its symmetry. Locating the position of the eye in the frame taken from the drivers face is difficult. The position of the eye can be identified by drawing on geometry properties and symmetry. Edging is concerned with locating the position of areas or pixels where the brightness intensity has considerably increased. The position of the driver's eye is determined by using appropriate threshold. These two areas are separated using edge detection and in accordance with as well as the symmetrical properties of the eye, the gravity center of the eye is determined. If eyes are open then it is treated as the normal state during which the alarm is set off. If eyes are closed then it is treated as the fatigue state during which the alarm is set on.

3. Yawning detection

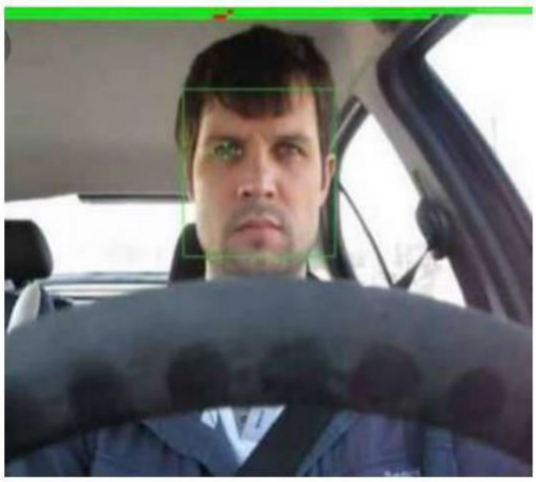
Yawning is an involuntary intake of breath through a wideopen mouth; usually triggered by fatigue or boredom. This technique is also one of the nonintrusive techniques for detecting driver drowsiness by applying computer vision. In this approach, detecting drowsiness involves two main phases to analyze the changes in facial expressions properly that imply drowsiness. First, the driver's face is detected by using cascade classifiers and tracked in the series of frame shots taken by the camera. After locating the driver's face, the next step is to detect and track the location of the mouth. For mouth detection the researchers have used the face detection algorithm proposed by Paul Viola and Michael J. Jones. Afterwards, yawning has been analyzed to determine the level of the drowsiness. This is presumed to be modeled with a large vertical mouth opening and changes in the driver's mouth contour. Mouth opens wide and the distance between its counters gets larger. Yawning mouths have a higher chance of being detected, as they are bigger than a normal mouth. Broadly, many researches detect yawning based on opening rate of mouth and the amount of changes in mouth contour area. According to the surveyed studies, the overall accuracy of this technique is about 80%

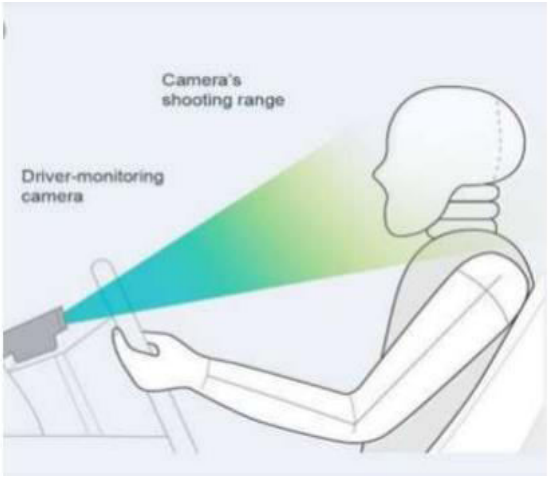
Result

• The purpose of this project is to reduce the number of road accidents caused by drivers when they are drowsy

• Driver must be alerted or warned when systems detect that he/she is sleeping using eye and mouth detection algorithm

SNAPSHOTS





Conclusion

In this project we have implemented a low cost, real time driver drowsiness monitoring system based on visual behavior. Here, visual behavior features like eye aspect ratio, mouth opening ratio are computed from the streaming video, captured by a camera. An adaptive threshold technique has been developed to detect drowsiness of the driver. The high fatalities of road accidents, which is primarily due to human errors committed out of fatigue, justifies the use of this system to alarm drivers at the time of driving. High-speed data processing and great accuracy distinguish this system from the similar ones. The development of this system can save the lives of millions of people annually. Also, this system will be implemented in hardware to make it portable for vehicles and validate on real time with drivers.

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