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Raspberry Pi Based Drowsiness Detection System

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Abstract:
With the growth in population, the occurrence of automobile accidents has also seen an increase. A detailed analysis shows that, around half million accidents occur in a year, in India alone. Further, around 60% of these accidents are caused due to driver fatigue. Driver fatigue affects the driving ability in the following 3 areas, a) It impairs coordination, b) It causes longer Reaction times, and, c) It impairs judgment. Through this paper, we provide a real time monitoring system using image processing, face/eye detection techniques. Further, to ensure real-time computation, Haarcascade samples are used to differentiate between an eye blink and drowsy/fatigue detection.

Keywords:
face detection, Eye Detection, Real-time system, Haar cascade, Drowsy driver detection, Image Processing, Image Acquisition.

INTRODUCTION:

The driver fatigue results in over 50% of the road accidents each year. Using technology to detect driver fatigue/drowsiness is an interesting challenge that would help in preventing accidents. In the past various efforts have been reported in the literature on approaches for drowsiness detection of automobile driver. In the last decade alone, many countries have begun to pay great attention to the automobile driver safety problem.

Researchers have been working on the detection of automobile driver's drowsiness using various techniques, such as physiological detection and Road monitoring techniques. Physiological detection techniques take advantage of the fact that sleep rhythm of a person is strongly correlated with brain and heart. Frequently, the loss of driver's control over the vehicle results in the road accidents. Most of the times, even if the vehicles are flawless; the human errors may result in the fatal consequences. Vehicle drivers lose their control on the vehicle when they are feeling sleepy or when they are consuming liquors. Road accidents cause damage to property as well as life. Thus there is need of development of methods for avoiding hazardous effects of drowsiness on roads [1]. Effective method for the correct identification of drowsiness is iris scan. Researchers have been developing several prototypes and modules for iris scanning. When there is drowsiness, blinking of eyes is abnormal. Detection of frequency of opening and closing rate of eye is fundamental objective kept for developing the prototype. Drowsiness is intermediate stage between wakefulness and sleep that has been defined as the state of progressive impaired awareness associate with the desire or inclination to sleep [2]. In driving drowsiness adds to the probability of accidents. Many traffic surveys shows that driver drowsiness causes 22% and alcoholism cause 33% road accidents [2-4]. Researchers have been trying to prepare different drowsiness detectors [5]. The alcohol detectors to avoid drunk and drive accidents have also been the fascinating research issue.

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Methodology:

The system performs a 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.

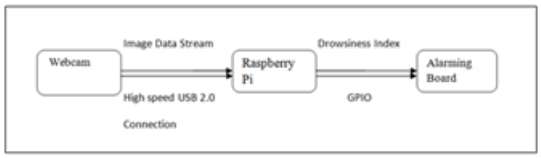

Figure.1: System architecture

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 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 positions 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, sensing of vehicle response, monitoring the response of driver.

LITERATURE REVIEW

Ovidiu Stan et.al. Says in the paper [1] "Eye-Gaze Tracking Method Driven by Raspberry PI Applicable in Automotive Traffic Safety" that This paper comes as a response to the fact that, lately, more and more accidents are caused by people who fall asleep at the wheel. Eye tracking is one of the most important aspects in driver assistance systems since human eyes hold much in-formation regarding the driver's state, like attention level, gaze and fatigue level. The number of times the subject blinks will be taken into account for identification of the subject's drowsiness. Also the direction of where the user is looking will be estimated according to the location of the user's eye gaze. The developed algorithm was implemented on a Raspberry Pi board in order to create a portable system. The main determination of this project is to conceive an active eye tracking based system, which focuses on the drowsiness detection amongst fatigue related deficiencies in driving.

Kulkarni S. S. et.al. Says in the paper [2] "Application of raspberry pi based embedded system for real time protection against road accidents due to driver's drowsiness and/or drunk and drive cases" that Present work deals with the application of raspberry pi CPU based sensing system to the detection of driver's lethargy and alcoholism in order to avoid the road accidents. The embedded system consists of 5 megapixel digital camera, alcohol detection sensor and the buzzer interfaced to the microcontroller. The embedded system is controlled by Raspbian operating system. The system detects real time situation of the driver's vigilance and control over the vehicle. If alcoholic and / or drowsiness tests are positive, it

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switches on the alarm, (ii) turn off the vehicle's engine via microcontroller based program controlling ignition power source and (iii) sends a SMS to the person close to the driver's location.

SYSTEM ARCHITECTURE

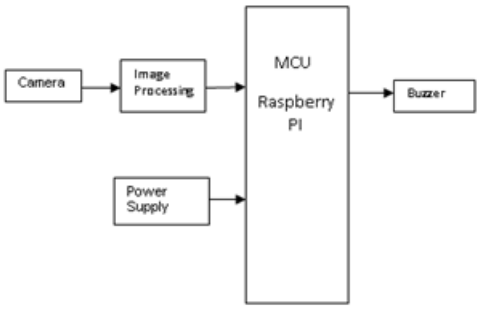

Figure 2. Block diagram of system

Working of the system

1. Power on the system.
2. We are using the raspberry pi processor this is the heart of the drowsiness detection system.
3. Camera is used to monitor the status of the driver.
4. If camera detect the drowsiness of driver then buzzer will give beep.

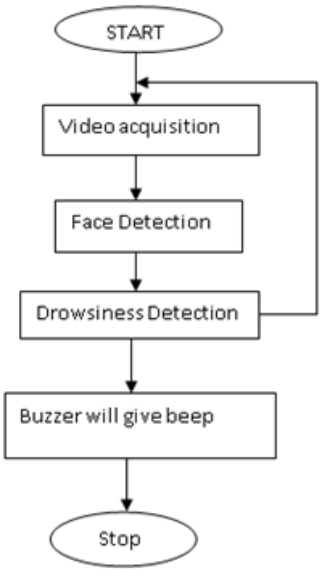

Figure 3. Flow chart

SYSTEM REQUIREMENTS

HARDWARE REQUIREMENT

- Raspberry PI
- Buzzer
- Crystal

SOFTWARE REQUIREMENT

- PROGRAMMING LANGUAGES: Python
- Os Platform - Linux

RASPBERRY PI

The Raspberry Pi is a small single-board computer develops by the Raspberry Pi Foundation. It features a Broadcom System on Chip (SoC) with a 700MHz, ARM1176JZF-S processor, ARMv6 instruction set, and 512MB of RAM. It also includes Video Core IV GPU. For booting & storing data SD card is used, no hard disk or solid state drive is provided. On the board there are many interfaces, for example USB, Ethernet, video and audio and 26 (GPIO) General Purpose Input Output pins [2]. Some of the GPIO pins are for power and some have special functions, such as UART Universal Asynchronous Receiver/Transmitter, SPI Serial Peripheral Interface Bus and I2C Inter-Integrated Circuit. Python is main programming language for Raspberry Pi.

PYTHON LANGUAGE

Python language is general purpose, high level programming language. Its design philosophy emphasizes code readability, and its syntax allows programmers to express concepts in fewer lines of code than would be possible in languages such as C. Python language supports multiple programming paradigms, including object-oriented, functional programming and structured programming. Python is dynamic type system and automatic memory management. It has a large comprehensive standard library. Python is often used as scripting language & non scripting contexts. Python code can be packed into standalone executable programs. Python interpreters are available for many operating systems.

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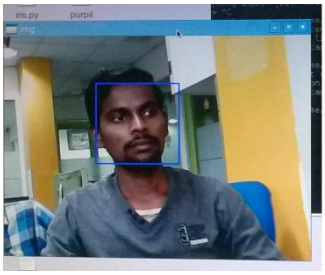
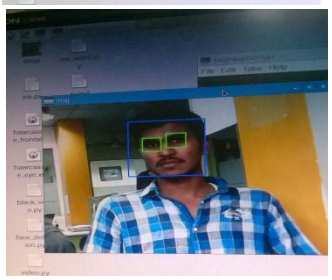
Results

The movement of inventory can be tracked

Parameters	Existing System	Proposed system
Video Acquisition	Not Available	Available
Image Processing	Not used	used
Sound Alert , Indication	Not Available	Available





Conclusion AND FUTURE SCOPE

Eye closure rate is used as the indicator of drowsiness in this thesis. We extract the video data to its frames and the frames are input to the part eye region extractor. Eye regions found by eye region extractor are gray scaled, resized to [12 18] and histogram equalized. After this process, every right and left eye image is input to neural networks separately which are trained with the subject's eye region images. The outputs of right and left eye neural networks are both digitized and merged in order to estimate the eye state of the subject. After eye state estimation process is completed for all of the frames of the video segment, each frame is tagged as open (0), semi-closed (0.5), closed (1) and "no valid estimation". We take the mean of the eye states for which valid estimation could be performed, we call this value "average eye state point".

Video segments whose average eye state point exceeds the threshold value are detected as drowsy and video segments whose average eye state point does not exceed the threshold value are detected as alert. We are discarding about 20% of the frames in eye state estimation process. That is, in 20% of the frames, right and left neural networks do not agree. We do not use that 20% in drowsiness prediction. Since video segments used are 30 fps, this does not prevent us from accurately detecting drowsiness. However, when fps rate of a video to be tested decreases, this might be a problem. That's why, we are planning to increase this rate as a future study. Forming the ground truth for eye states was a challenging task. During this process, we managed difficulties in distinguishing semi-closed versus open eyes, and semi closed versus closed eyes. For each frame, increasing the number of persons forming the ground truth will increase the accuracy of the ground truth.

This method can be used to form a much reliable eye state database as a future study. When we analyze the drowsy videos, we realized that drowsiness has stages and the situation is the same in alert videos, as well. As a future study, both drowsy and alert states can be divided into 2 categories resulting in totally 4 categories for the subject's condition. Since eye shapes differ from person to person, using 4 subjects is not enough to train neural networks for across subject recognition; that is the reason for low accuracy in across subject recognition tests. As a future study, the number of subjects can be increased and the accuracy in across subject recognition can be increased. The objective of this thesis is to accurately detect drowsiness and the method we proposed achieves this objective. In the future, this thesis will be a part of a safety system being used in vehicles and help us save many lives.

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