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Driver Drowsiness Detection System Using Raspberry Pi

Driver Fatigue Based On Robust Visual Analysis

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Abstract: *Driver & Road protection system is included for this proposed program. The driver's face is projected from a color picture shot in a vehicle, based on computer vision techniques. Face recognition is then used to identify the regions of the driver's eyes which are used in corresponding frames as the templates for eye tracking. Photos from the tracked eye are used for the identification of drowsiness to produce warning alerts. The method suggested has three phases: Eye recognition, eye identification and prediction of drowsiness. The function of image processing is to identify the driver's face, and then remove the driver's eye image for drowsiness detection. The algorithm for hair face detection takes image frames captured as input and then the face observed as output. This method can be inferred as a low cost and reliable way to minimize the number of injuries related to the driver's Drowsiness in order to improve the health of travel.*

Keywords: *Raspberry pi, Eye tracking, Driver.*

I. INTRODUCTION

Drowsy driving is one of the most important factors behind deadly road crashes. Some of the latest study indicates that one out of five traffic accidents are caused by drowsy driving, which is around 21 percent of road injuries, and this figure is growing annually according to the 2015 global road safety status survey, based on data from 180 different countries. This definitely underlines the fact that the overall number of road traffic deaths globally is very high due to the drowsiness of the car. Driver exhaustion, drink-and-drive and carelessness surface as key factors for these injuries on the lane. Because of this, many lives and communities across various countries are being affected. Real-time drowsy driving monitoring is one of the biggest possible significance that can be introduced to help drivers make them mindful of drowsy driving conditions.

These conductor behavioral state monitoring program may help identify the driver drowsy states early and can likely prevent mishaps. With this paper, we present technique for detecting driver somnolence using Open CV, raspberry pi and image processing. Several experiments have demonstrated various potential strategies capable of identifying drowsiness in the pilot. Such identification of driver drowsiness can be assessed using physiological measurements, ocular measurements, and efficiency measurements. More precise results can be given from these physiological measurements and ocular measurements. Physiological tests include blood waves, heart rhythm, pulse rate tests and these include some sort of physical link to the patient, such as attaching the electrode to the patient 's body. But this leads to uneasy driving conditions. But assessment of the ocular may be performed without physical contact.

Ocular assessment to assess driver's eye disease and potential eye closure-based vision is ideally suited for real-world driving conditions because it can monitor the open / closed eye non-intrusively using a mirror. In Real Time Driver Drowsiness System using Image Processing, computer vision-based drowsiness detection systems were used to capture drivers' eye status by analyzing the eye closure interval and developing an algorithm to detect the driver's drowsiness in advance and warn the driver in vehicle alarm.

This segment motivates how facial detection is performed and how eye detection is performed for automotive use, and their identification is required to determine driver drowsiness.

II. LITERATURE SURVEY

According to many researches drowsiness is related to thousands of traffic accidents each year, the accidents produces approximately 50% of death or serious injuries [1], as they tend to be impacts at high speed because the driver who has fallen asleep cannot brake or deviate to avoid or reduce impact. To mitigate these accidents,this work was supported by the Universidad de las Fuerzas Armadas, Sangolquí – Ecuador. Eddie E. Galarza (IEEE member), Franklin M. Silva, Paola M. Velasco and Eddie D. Galarza work at the University of the Fuerzas Armadas at the campus in Latacunga City. Fabricio D. Egas is an Electronic Engineer graduated in that university. manufacturers have developed drowsiness detection systems that recognize signs of possible drowsiness, alerting the driver to their condition [2].

In the research: "A smartphone-based driver safety monitoring system using data fusion. Sensors", Lee and Chung [3] propose a method to monitor driver safety levels using a data fusion approach such as: eye characteristics, variation of biological signals, temperature inside the vehicle and vehicle speed. This system is developed as an application for an

Android-based smartphone, where measuring security-related data that does not require additional costs or additional equipment. The system has an efficiency of 96% to detect that the driver is awake and 97% to detect that he is asleep. This information allows knowing the signs that shows a sleepy driver.
In work "Detection of fatigue using Smartphone aims to use a smartphone (with Android operating system or IOS) to detect fatigue in the driver" [4] Roberson and others uses the front camera of the smartphone to capture images of the driver and then uses advanced algorithms of computer vision to detect his face and eyes. Rotation and tilting of the head and blinking of the eyes are detected as indicators of fatigue. The smartphones is used to assist driver using front and rear camera [5], for drowsy driving detection system [6], for the wavelet analysis of heart rate variability and a support vector machine classifier [7], and for identification of dangerous driving situations [8].
The PERCLOS (Percent of the time Eyelids are CLOSed) metrics is used to measure drowsiness in the work "Eye tracking based driver fatigue monitoring and warning system" [9]. The system estimates with a non - parametric methods for detecting drowsiness, the vehicle steering wheel variability is considered to determine the amount of drowsiness because drivers makes variability greater as driver become more drowsy. The PERCLOS metrics for alerting driver is used in [10] to detect drowsiness in heavy vehicles, to monitor and alert the driver [11], for line departure warnings [12] and to detect drowsiness conditions in drivers [13].
The HCI systems allows to interrelate the human being with an electronic device (computer) which is capable of giving solutions to a great number of problems that can affect him. The development and use of HCI has been very important, so it must be implemented with adequate usability criteria [14] and satisfy users' needs efficiently [15]. A relevant aspect is that not only sought a simple interaction also sought to assist humans with special skills to satisfy their needs even overcoming their limitations and can be implemented using low cost systems. The smart phones being mass-use are actually a low-cost computer, if are used in an HCI would allow to massify its use and therefore offer greater solutions to improve the quality of life of any person satisfying their needs even if the person presents some limitation in one or more of their senses.

III. SYSTEM ARCHITECTURE

The suggested framework displayed in Fig.1 focuses mainly on the faster diagnosis and treatment of drowsiness data.The number of frames that hold the eyes closed is tracked, and then counted. If the number of frames reaches a threshold value, then a alert message will be produced on the monitor indicating the detection of drowsiness. Despite the driver's eye tone and appearance, spectacles used by the pilot, and the amount of darkness inside the car, the device would be able to spot drowsiness. The design of the framework using correct classifiers in OpenCV for eye closure detection has fulfilled all these goals well.
In this algorithm, the camera acquires an image of a driver for processing first. In OpenCV the driver's expression face detection is done first followed by eye detection. The eye tracking system only senses the eyes open. The algorithm then counts the number of open eyes in each frame, and determines the drowsiness identification criterion. If the conditions are fulfilled then it is assumed that the driver is drowsy. The system-connected monitor and buzzer perform acts to correct anomalous conductor behaviour.
The facial and eye classificators are required for this system. The HARR Classifier Cascade files embedded on OpenCV contain different face recognition and eye detection classificators. The OpenCV xml built in individual frames, "haarcascade frontalface alt2.xml" is used to scan and identify the facials. The classifier "haarcascade eye tree eyeglasses.xml" helps to distinguish eyes from the identified face in the open environment. The system fails to detect in closed eye mode.
For each frame of the driver's facial image obtained from the camera, the face detection and open eye detection were done. The Eyestotal variable is assigned to store the number of open eyes (0 , 1 and 2) detected within each frame. The vector Drowsycount is allocated while Eyestotal < 2 rises to store the amount of consecutive frames in which the eyes were Drowsycount. On an eye twitch, the amount of Drowsycount amounts to 1. If the eyeblink is for over 4 frames, i.e. Drowsycount > = 4, then the blackness condition is met.

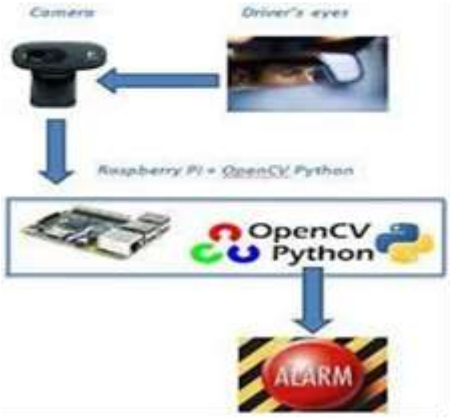

Fig.1. System Diagram For Proposed Method

The proposed system comprises of three phases.

Face Detection:

The proposed method would begin with one-by-one capturing of the video frames. OpenCV gives enough assistance for Live Video transmission. The device can identify the face for every frame in the frame picture. This device uses the Viola-Jones object detector which is a visual object detection solution to machine learning (Paul Viola, 2004 and Paul Viola, 2001). It is achieved using the Haar algorithm for facial recognition. Haarcascade is a well-known, robust algorithm based on features that can effectively detect the face image.
Using stages cascade applications, Haar algorithm is capable of eliminating non-face candidates. So each stage consists of a variety of different hair characteristics, and a Haar attribute classifier classifies each attribute in turn. The file "haarcascade frontalface alt2.xml" built-in OpenCV xml is used to scan and identify the face in individual photos. This file includes a variety of aspect features and is created from a combination of positive and negative samples.
First load the cascade file and then transfer the acquired frame to an edge detection feature which detects all possible objects in the frame of different sizes. Because the driver's face occupies a significant part of the image, rather than detecting objects of all conceivable sizes, define the edge detector to detect only objects of a particular scale , i.e. for the face area. Next, the edge detector data is stored, and this information is compared to the cascade file in order to define the face in the frame. This module 's output is a frame with a face detected therein.
The only disadvantage in the Haar algorithm is that it can not extrapolate and does not function properly if the face is not in front of the camera axis. After identification of the driver's face, the eye detection feature tries to detect the driver's eyes.

Eye detection:

Once the driver's face detection feature has been detected, the eye detection system attempts to detect the eyes of the car occupant. After face detection locate region of the eye by assuming that eyes are present only in the upper part of the face and from the top edge of the nose, extract eyes Region of Interest (ROI) by cropping mouth and head, we mark this region of interest. By considering the region of interest, the amount of processing required can be that and the processing can also be accelerated to get exact eyes.
After the region of interest has been labelled, the edge detection technique is applied only to the area of interest. Instead eye scan in ROI; Circular Hough Transformation is used here to locate eye shape (Rhody Chester, 2005). The main advantage of the Hough transform method is that differences in object boundary definitions are expansive and are fairly uninfluenced by image noise, unlike edge detectors.
The HoughCircles) (feature in OpenCV is used to find circles in an image of an object. CHT make sure two eyes find at most. They will only be able to detect the open state of eyes with the eye detection technique.

Drowsiness Detection:

The algorithm then counts the number of open eyes forming each frame after receiving eyes and determines the somnolence. If the criteria are fulfilled then it is said that the driver is drowsy. The system-connected buzzer executes actions to correct irregular conductor behavior.
The eye and the facial classifiers are required for this device. The built-in HARR Classifier Cascade files with the Open CV contain different facial and eye detection classificatory. The built-in Open CV xml "haar cascade frontal face alt2.xml"and" Hough circles) ("function is used to search and detect the face that is followed by the frames. Face detection and open eye detection were performed on every frame of the facial image captured by the driver.
The total Eyes element is allocated to store the number of open eyes that are found in each frame. A vector will store the number of successive frames that saw the eyes closed with values such as 0 , 1, 2, 3 ... etc. This number is initially set to 0.When all eyes are open, and then the count for Drowsy is set to be 0.
Drowsy count increases when the number of eyes is < 2. The value of Drowsy count for an eye blink is raised by 1. If the eye blinks in more than 4 frames, i.e. the vector count is greater than or equal to 4, then the drowsiness condition is met, and an alert is triggered in real time.

IV. RASPBERRY PI 3 MODEL B

Raspberry Pi is a single-board computer powered by credit cards. There are 5 models. Model A, Model A+, Model B, Model B+, Model B Version 2. Model A has 256 Mb RAM, one USB port and no network connection. Model A+ is fitted with 256Mb RAM, one USB port and network access. Model B comes with 512Mb Rom, 2 USB ports and an Ethernet port. Model B+ has 512Mb Rom, four USB ports, Ethernet port, HDMI socket, and video card interface. Generation 2 Model B is also equipped with 4 USB ports, 1 GB RAM, 2 camera controller and 1 HDMI. Raspberry pi tablet was introduced using Platform B+. IT has a chip-based Broadcom BCM2835 system that includes ARM1176JZF-S 700 MHz, Video Core IV GPU, and SD card. Blu-ray image replay is possible with the GPU using H.264 at 40MBits / s.

It has access to a fast 3D core using the provided libraries Open GL ES2.0 and Open VG. The chip offers HDMI directly, and there is no VGA support. The foundation provides ARM updates for Debian and Arch Linux, and also support for BBC BASIC, C and Perl for Python as the main programming language.

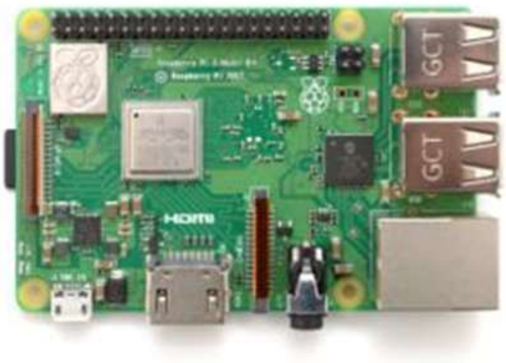

Fig.2. Raspberry Pi 3 Model B

V. VISION TO RASPBERRY PI

The Raspberry Pi Camera Board plugs directly into the CSI connector on the Raspberry Pi. It's able to deliver a crystal clear 5MP resolution image, or 1080p HD video recording at 30fps The Raspberry Pi Camera Board features a 5MP (2592×1944 pixels) Omni vision 5647 sensor in a fixed focus module. The module attaches to Raspberry Pi, by way of a 15 Pin Ribbon Cable, to the dedicated 15-pin MIPI Camera Serial Interface (CSI), which was designed especially for interfacing to camera.

INTERFACING CAMERA

The following are steps to be used for interfacing the camera:

Power up raspberry pi and login as “pi" and password as “raspberry”.

At the command prompt enter the following command as “sudo raspi-config” and navigate to “ENABLE”.

CAPTURING IMAGE

“Raspistill” is the command line tool for capturing still photographs with the camera module. With the camera module connected and enabled, enter the following command in the LX Terminal to take a picture:“raspistill -o cam.jpg”

RESULTS:

The proposed drowsiness detection system detects the drowsiness of the driver when the eyes are closed for 4 frames or more (i.e., more than 2 seconds). The detection system differentiates the normal eye blink and drowsiness. The system is non-intrusive and can be easily equipped with any vehicle.

The Visual Studio Express simulation results of the drowsiness system are illustrated in the following figures. In Fig.3, the normal state of the driver is shown in which the open eyes are detected. In Fig.3, the driver eyes have been kept closed for successive 4 frames. The system is capable of detecting drowsiness in spite of the spectacles worn by the driver. The condition of the driver wearing spectacles is shown in Fig 3. In normal driving conditions, the open eyes are detected. The drowsiness is detected when the eyes have been kept closed for successive 4 frames.

It is shown in Fig.5, that the number of open eyes for normal driving is 2 and the number of successive frames for closed eyes. The number of open eyes is 0 when the eyes are closed in one frame and the number of closing frames decreases by 1. If this condition lasts for continuous 4 frames and more, then the execution window displays observed drowsiness. This also measures the time the eyes were held closed for. During the case of closed eyes the device is capable of sensing drowsiness for more than 2 seconds.

VI. RESULT

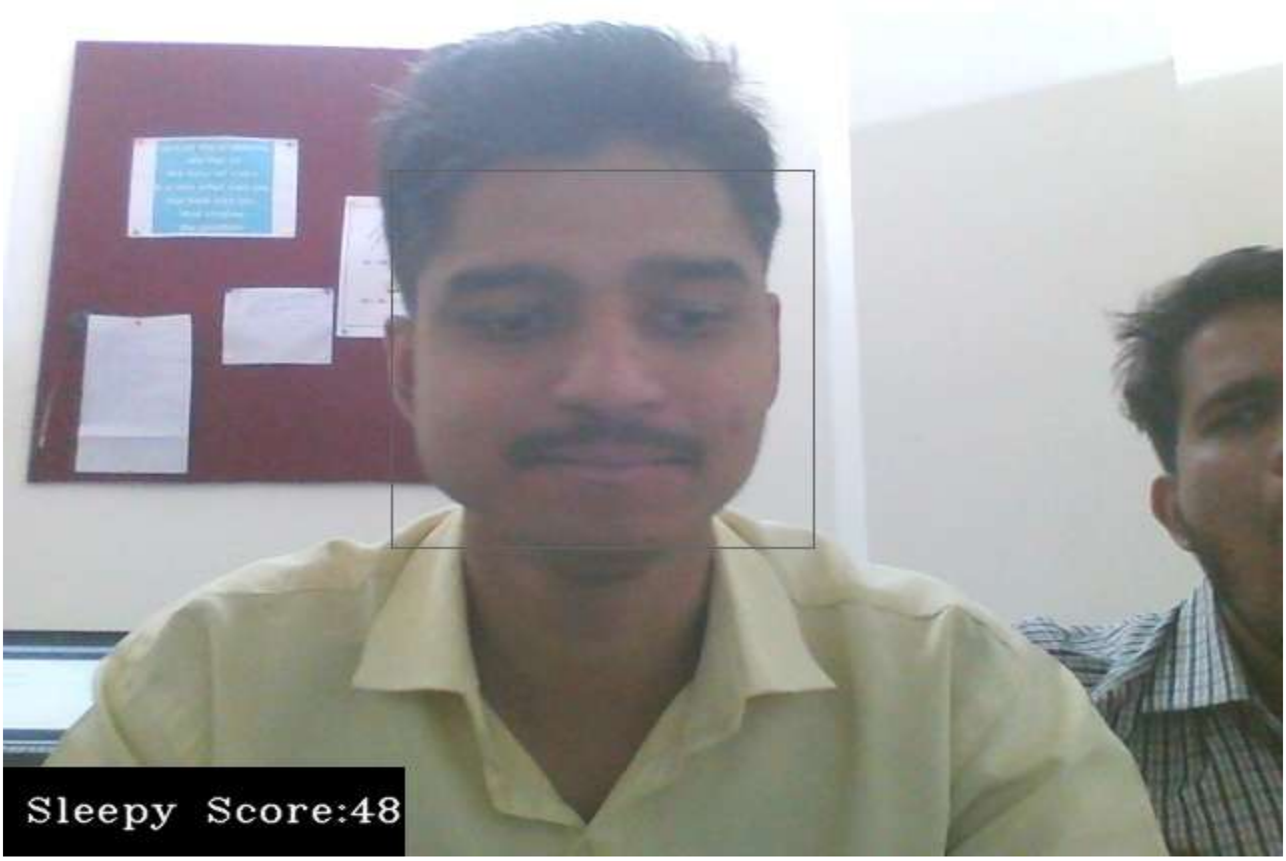

Fig.3. Face detection

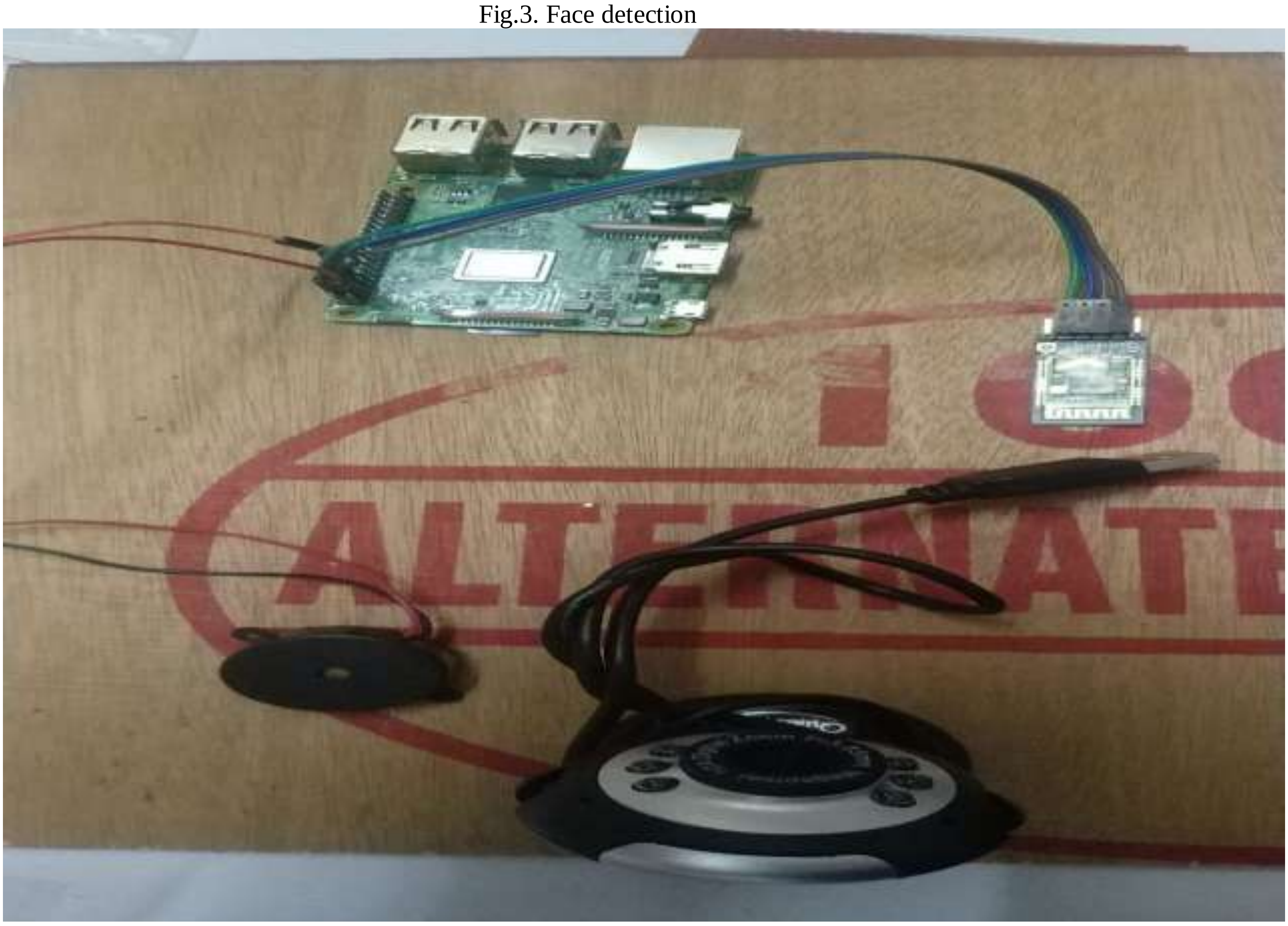

Fig.4. Hardware Setup

VII. CONCLUSION & FUTURE SCOPE

Developed vehicle condition tracking system is capable of detecting driver's drowsiness, drinking, and careless activities in a short time. Developed on the driver's eye closure basis, the Drowsiness Detection System can distinguish normal eye blink and drowsiness and detect drowsiness while driving. The system proposed will prevent accidents Being asleep while driving. The machine performs well even when drivers are wearing spectacles, and even when the camera produces decent performance in low light conditions. Information about the location of the head and eyes is obtained by different self-developed algorithms for the image processing. The machine should be able to determine if the eyes are opened or closed during the tracking. A alarm alert is given when eyes are closed for too long. Processing assesses the level of alertness of the driver based on continuous closures of the eyes.

In the future it should be possible to introduce drowsiness monitoring in aircraft to alert the pilot.

• The alcoholic sensor also applies to drunk drivers
• In the future, drowsiness detection in schools and colleges can be implemented to alert staff to find a drowsy student in the classroom.

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