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Real Time Driver Identity and Alertness Monitoring

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ABSTRACT: In India alone, around 100,000 accidents per year are caused by the drowsiness of the driver. To add to the seriousness of the matter, no such accurate and reliable tests exist to determine sleepiness as there is for intoxication detection. Another major cause of accidents in India, mainly in transport sector (Bus/ Truck) is someone else driving other than the driver assigned by the company.

This paper deals with technique to reduce such accidents by first verifying the facial details of the driver with that of a predefined one. Secondly, the consciousness of the driver is constantly monitored and an audio warning is actuated once the drowsiness is detected. Furthermore, the GSM module is used to alert the employer of the vehicle from time to time.

KEYWORDS: Haar Cascade, Voila Jones, Eye Aspect Ratio, OpenCV

I. Introduction

Car accidents are a major problem for society, with statistics for the rate of injury or death as the result of a car accident rising. There is a fatal car accident about every 25 seconds. Sixteen Indians died in road accidents every hour. According to the Global Road Safety Report 2015, total 141,526 persons were killed and approximately five lakh people injured in India because of road crashes. However, this number is not properly estimated because all accidents are not reported to the police. In today's world, every human being uses a vehicle. It is often considered as luxury but it has now become a necessity in a common man's life. People are very much concerned about their safety and also the vehicles safety is it in case of theft or in case of an accident. There is numerous non-driver related causes of car accidents including road conditions, the weather and the mechanical performance of a car. However, a significant number of car accidents are caused by driver error. Driver error includes drunkenness, fatigue, and drowsiness. Many factors can affect a driver's ability to control a motor vehicle, such as natural reflexes, recognition and perception. The diminishing of these factors can eventually reduce a driver's vigilance level. Statistically, drowsiness by drivers results in an estimated 1,550 deaths, 71,000 injuries, and $12.5 billion in monetary losses.

During the years, several real-time face and eye detection techniques have been developed for monitoring the driver drowsiness. This paper aims to evaluate drivers' Eye Aspect Ratio (EAR) to determine their drowsiness. The authors have implemented a Raspberry Pi device programmed with an innovative algorithm. This algorithm allows a Raspberry Pi camera module to be able to detect the face and eyes, which are considered two of the most significant activities when driving that can serve as factors to gauge the drowsiness of drivers.

II. LITERATURE SURVEY

Some efforts have been reported in the literature on the development of the not-intrusive monitoring drowsiness systems based on the vision.

Tian et Qin built a system that checks the driver eye states. Their system uses the Cb and Cr components of the YCbCrcolor space. This system locates the face with a vertical projection function, and the eyes with a horizontal projection function. Once the eyes are located the system calculates the eyes states using a function of complexity.

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Bhowmick et Kumar used the Otsu thresholding to extract face region. The localization of the eye is done by locating facial landmarks such as eyebrow and possible face centre. Morphological operation and Kmeans is used for accurate eye segmentation. Then a set of shape features are calculated and trained using non-linear SVM to get the status of the eye.

Hong et al. defined a system for detecting the eye states in real time to identify the driver drowsiness state. The face region is detected based on the optimized Jones and Viola method. The eye area is obtained by a horizontal projection. Finally, a new complexity function with a dynamic threshold to identify the eye state.

Malla et al. developed a light-insensitive system. They used the Haar algorithm to detect objects and face classifier implemented by in OpenCV libraries. Eye regions are derived from the facial region with anthropometric factors. Then, they detect the eyelid to measure the level of eye closure and thereby analyse the alertness level of the driver and conclude whether he is drowsy or not.

Summary of Survey

1. The presently accessible methods for face detection and recognition rely primarily on being still and lacked mobility. These methods are computationally heavy and require large durations to train their respective models.

2. The currently available mechanisms for drowsiness detection rely on eye blink pattern over a period of time rather than being instantaneous.

In this paper, we have proposed to combine facial recognition along with drowsiness detection into a single system and the identification of drowsiness is instantaneous with the help of Eye Aspect Ratio (EAR). Furthermore, we have also used a GSM Module for sending real time alerts to Employer.

III. OBJECTIVES

- To verify if the person driving the vehicle is the one assigned by the company
- To cut off ignition system if face is not matched
- To alert the driver in case it is found that he is getting drowsy.
- To alert the employer of the vehicle using GSM Module in case the driver is found drowsy.

IV. ALGORITHMS

A. Facial landmark prediction (FLP) algorithm

Every Human Face has 68 distinct points on his face. The position on each of these 68 facial points is stored in a matrix. So, with the help of this algorithm, the positions of both left eye and right eye can be obtained.

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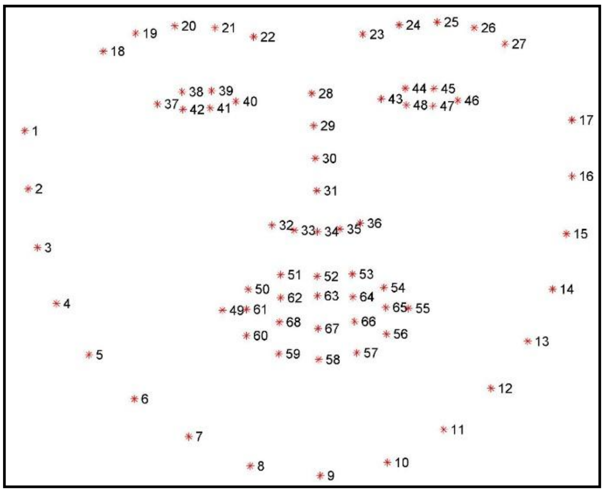

Figure 1. 68 points of FLP Algorithm

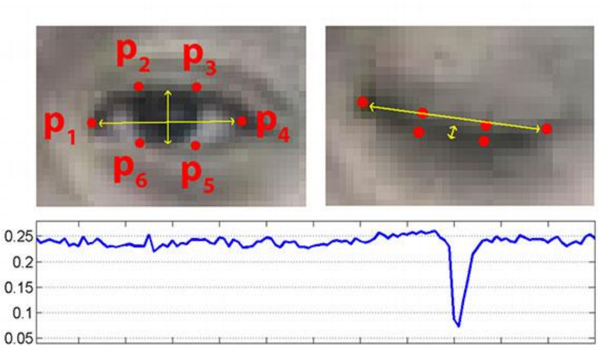

Figure 2: EAR value for eye close/open

B. Eye Aspect Ratio (EAR) Algorithm

Eye Aspect Ratio is the ratio of vertical height and horizontal length of the eye. When an eye is open, the EAR value is above 0.3 for typical Indian people. However, when eyes are closed, the EAR value falls to 0.19 or even less.

V. HARDWARE DESCRIPTION

A. Raspberry Pi Camera:

The Raspberry Pi camera module can be used to take high definition video, as well as still photographs. This module has 5 megapixel fixed-focus camera that supports 1080p30, 720p60 and VGA 90 video modes, as well as stills capture. The camera consists of small (25mm by 20mm by 9mm) circuit board, which connects to the Raspberry Pi's Camera Serial Interface (CSI) bus connector via a flexible ribbon cable of length 15cm.

Figure 3: Pi Camera Module

Figure 4: Raspberry Pi 3 Model B+

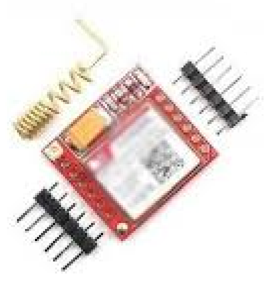

Figure 5: SIM800L GSM Module

B. Raspberry Pi 3 Processor:

The Raspberry Pi is a series of small single-board computers developed in the United Kingdom by the Raspberry Pi foundation. The processor speed ranges from 700MHz to 1.4GHz. The on-board memory ranges from 256MB to 1GB RAM. Secure Digital (SD) cards are used to store the operating system and program memory in either SDHC or Micro SDHC sizes. For video output, HDMI and composite video are supported, with a standard 3.5mm phone jack for audio output. Lower level output is provided by a number of GPIO pins which supports I2C.

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Raspberry Pi 3 has a 64-bit quad core processor and is equipped with an on-board Wi-Fi 802.11n, Bluetooth and USB boot capabilities.

C. GSM Module:

A GSM module or a GPRS module is a chip or circuit that will be used to establish communication between a mobile device or a computing machine and a GSM or GPRS system**.**

GSM (Global System for Mobile Communications, originally GroupeSpécial Mobile)**,** is a standard developed by the European Telecommunications Standards Institute (ETSI). It was created to describe the protocols for second-generation (2G) digital cellular networks used by mobile phones and is now the default global standard for mobile communications with over 90% market share, operating in over 219 countries and territories.

D. Buzzer:

A buzzer or beeper is an audio signalling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

VI. SOFTWARE DESCRIPTION

The programming language being used in our is **Python.** Python is an interpreted high-level programming language for general-purpose programming. Python has a design philosophy that emphasizes code readability, notably using significant whitespace. It provides constructs that enable clear programming on both small and large scales.

Python features a dynamic type system and automatic memory management. It supports multiple programming paradigms, including object-oriented, imperative, functional and procedural, and has a large and comprehensive standard library.

Some of the libraries being used are:

- Scipy
- OpenCv
- Imutils
- Dlib

VII. BLOCK DIAGRAM

The hardware connections include an input from Raspberry Pi camera and an output at Loudspeaker/Buzzer, LED and GSM Module

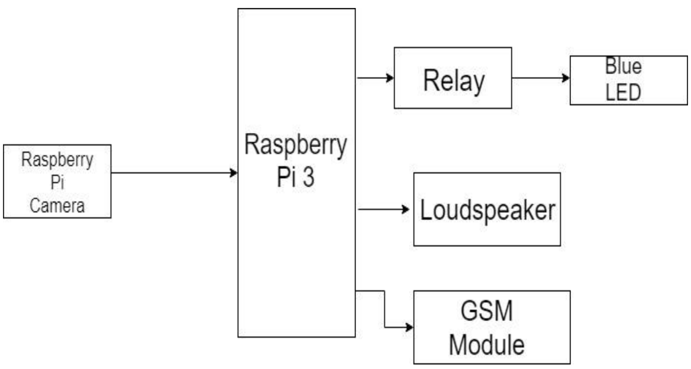

Figure 6: Block Diagram of Hardware Connections

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VIII.DESIGN METHODOLOGY

Step 1: Configure the Raspberry Pi camera and assign the video properties.

Step 2: Obtain the live feed using the start function.

Step 3: Convert the video into individual frames.

Step 4: Detect the face using Haar Cascade Algorithm.

Step 5: Crop frames such that only the face is retained.

Step 6: Compare the face with trained data and recognize the face.

Step 7: Send an SMS to employer if face does not match and exit program. If face matches, continue.

Step 8: Detect the eye region and using edge detection procedure, separate left and right eyes.

Step 9: Perform EAR Algorithm to detect if the eye is *close* or *open*

Step 10: If EAR is below 0.3, wait for 16 more frames and conclude if it's a blink or drowsiness.

Step 11: If the status is found drowsy, initiate an alarm.

Step 12: Send an alert of drowsy driver to concerned authority through SMS and continue monitoring.

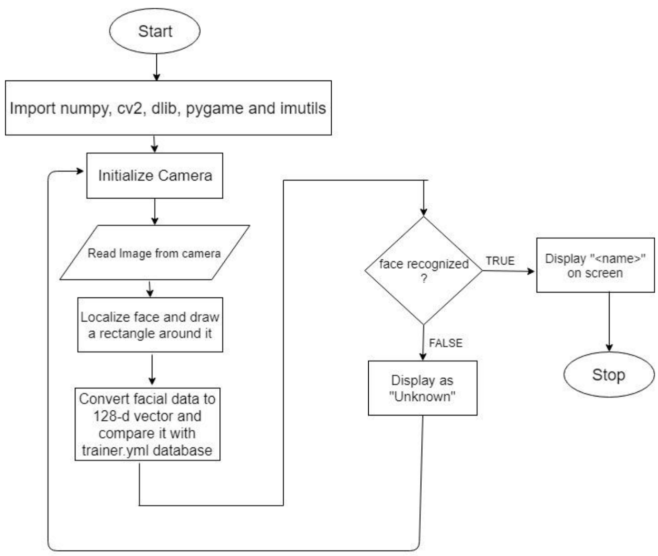

Figure 7: Flowchart of Facial Authentication

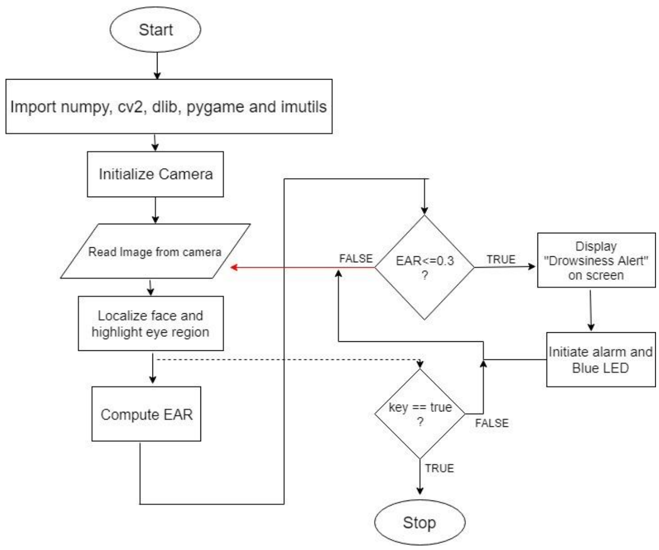

Figure 8: Flowchart of Drowsiness detection

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IX. RESULT

The results obtained were found to be satisfactory and the accuracy was measured up to 92.17%. While the drowsiness monitoring was working fine, the facial recognition would sometimes fail to produce expected results. The GSM Module (SIM 800L) was configured as a serial device with respect to Raspberry Pi, fitted with a Vodafone 3G SIM Card. An SMS was efficiently being sent whenever the face was not matched and the driver was found drowsy.

Here are some of the screenshots of obtained results.

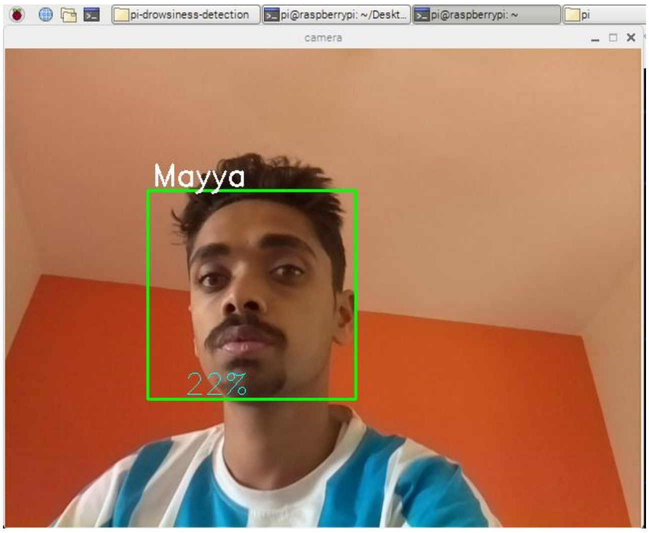

Figure 9: Facial Authentication

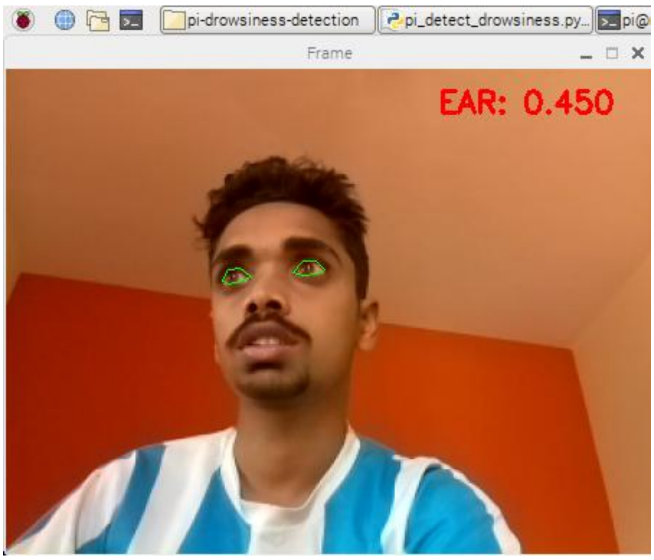

Figure 10: Eye Open (EAR>0.3)

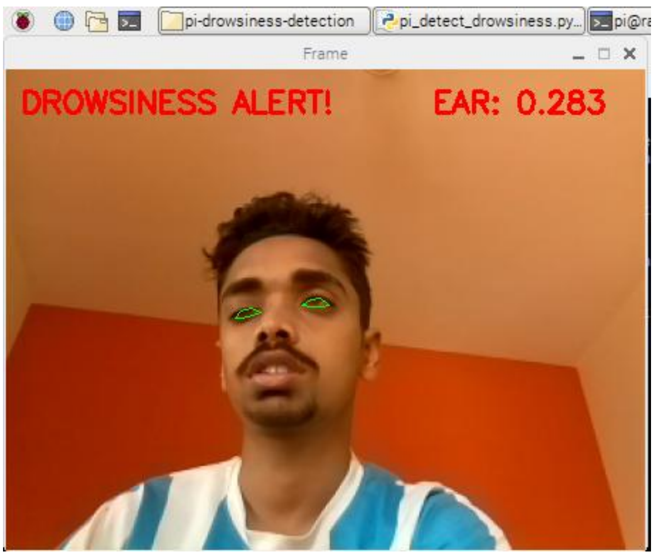

Figure 11: Drowsiness Alert (EAR<0.3 for more than 16 frames)

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X. CONCLUSION

Drowsy driving can be as deadly as drunk driving. Drivers drowsiness not only putting themselves in danger, but they are a risk to everyone else on the road. Drivers who are tiredand sleepy have delayed reactions and make bad decisions.

In this paper, we presented the conception and implementation of a system for detecting driver drowsiness based on vision that aims to warn the driver if he is in drowsy state.

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