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Driver Drowsiness Detection Using OpenCV and Raspberry Pi

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Abstract: ***A countless number of people drive on the highway day and night. People traveling long-distance suffer from lack of sleep. Due to which it becomes very dangerous to drive when feeling sleepy. The majority of accidents happen due to the drowsiness of the driver. According to a thorough investigation, there are over 500,000 accidents in India alone each year. Furthermore, driver fatigue is a factor in almost 60 percent of these accidents. In this paper, we provide a real-time monitoring system that makes use of face / eye identification and image processing algorithm. Driver drowsiness detection is a vehicle safety technology which prevents accidents when the driver is getting drowsy.***
Keywords: Drowsiness, OpenCV, Haar Cascade

I. INTRODUCTION

Drowsiness can be described as a biological state where the body is in transition from awake state to a sleeping state. 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.1 in 4 vehicle accidents are caused by drowsy driving and 1 in 25 adult drivers report that they have fallen asleep at the wheel in the past 30 days. The scariest part is that drowsy driving is not just falling asleep while driving. Drowsy driving can be as small as a brief state of unconsciousness when the driver is not paying full attention to the road. Drowsy driving results in over 71,000 injuries, 1,500 deaths, and $ 12.5 billion in monetary losses per year. Due to the relevance of this problem, we believe it is important to develop a solution for drowsiness detection, especially in the early stages to prevent accidents. Drowsy driving is one of the major causes behind fatal road accidents. Driver fatigue has been the one of the main issue for countless mishaps due to tiredness, tedious, road condition, and unfavorable climate situations. If the drowsiness of the driver can be predicted at initial stages, and if the driver can be alerted of the same, then a number of accidents can be reduced.

There are signs that suggest a driver is drowsy, such as

1) Frequently yawning
2) Inability to keep eyes open
3) Swaying the head forward
4) Face complexion changes.

In real time driver drowsiness system captures drivers eye state using computer vision - based system is done by analyzing the interval of eye closure and developing an algorithm to detect driver's drowsiness in advance and to warn the drivers by in vehicles alarm. The HAAR classifier Cascade files inbuilt on Open CV include different classifiers for face detection and eyes detection. HAAR cascade is a robust feature-based algorithm that can detect the face image efficiently. If the percentage of eye closure (PERCLOS) is defined as the proportion of time for which the eyelid remains closed, more than 70–80% within a predefined time period, then the level of drowsiness will be detected based on the PERCLOS threshold 1 value. The face detection and open eye detection will be carried out on each frame of the driver's facial image acquired from the camera. Thus an alarm is trigerred that wakes the driver, preventing accidents.

II. LITERATURE SURVEY

Anil Kumar Biswal, Debabrata Singh,Binod Kumar Pattanayak and Debabrata Samanta designed a system where system's main components were the Raspberry Pi 3 model and B module. Pi camera module used for persistent recording of face landmarks localized through facial landmark points. System alerts using speech speaker and warning e-mail to the authority.

Jabina M , Neelambika B, Shwetha HR , Supritha JN and Madhavi R P developed a system in which car detects alcohol consumption through Alcohol sensor , it alerts the driver.Owner of the vehicle will get the alert message through GSM. If there is no response from the driver for the alarm then the vehicle turns car from manually to automatic mode.

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R.Rajasekhar Reddy and Dr.Padmaja.Pulicherla project works as visual appearance characteristics are captured by a camera, such as eye aspect, mouth opening ratio and nose width reference. When the data collected have been detected, the person is warned about drowsiness in the vehicle so the person can stop the vehicle.

Badiuzaman Bin Baharu this is a system that will accurately monitor the open or closed state of the driver's eyes and mouth. The method to detect eye closure is PERCLOS(detection method based on the time of eyes closed).

Then alerts drivers when they are in drowsy state. Luminance changes have to be encounter to ensure the detection of the gradient of eyes is sufficient to improve the detection results.

Pratyush Agarwal and Rizul Sharma's project first detects eye region then Pupil center detection,and then the iris boundary localisation. If the person is drowsy then an alarm is sounded and user is warned. Model can be improved incrementally by using other parameters like blink rate, yawning, state of the car.

III. REQUIREMENTS

A. *Hardware Requirements*

Processor – Raspberry Pi 3 Model B+
Camera - Raspberry Pi Camera
SD Card – 32GB
Sound – Buzzer

B. *Software Requirements*

Operating System – Raspberry Pi OS(Raspbian)
Language - Python
Library -OpenCV
Tools - VnC Viewer

IV. PROPOSED SYSTEM

Our proposed system consists of various modules like video acquisition, face detection, eye detection and drowsiness detection. In addition to these it consists of raspberry pi which is a single-board computer, a buzzer which acts as an alarm along with a water pump to sprinkle the water to awake the drowsiness driver soon. First video acquisition is achieved by pi camera placed on raspberry pi and acquired video is converted into a series of image/frames. Next step is detecting the driver's face using OpenCV (Haar algorithm) followed by eye detection using Region Of Interest (ROI). Once eyes have been detected the next step is to detect whether eyes are in a closed or open state. If eyes are detected to open in each frame, no action is taken. But if eyes are detected to be closed and it is above threshold value then it means that the driver is feeling drowsy and a sound alarm along with water sprinkler are triggered.

A. *Flow Diagram*

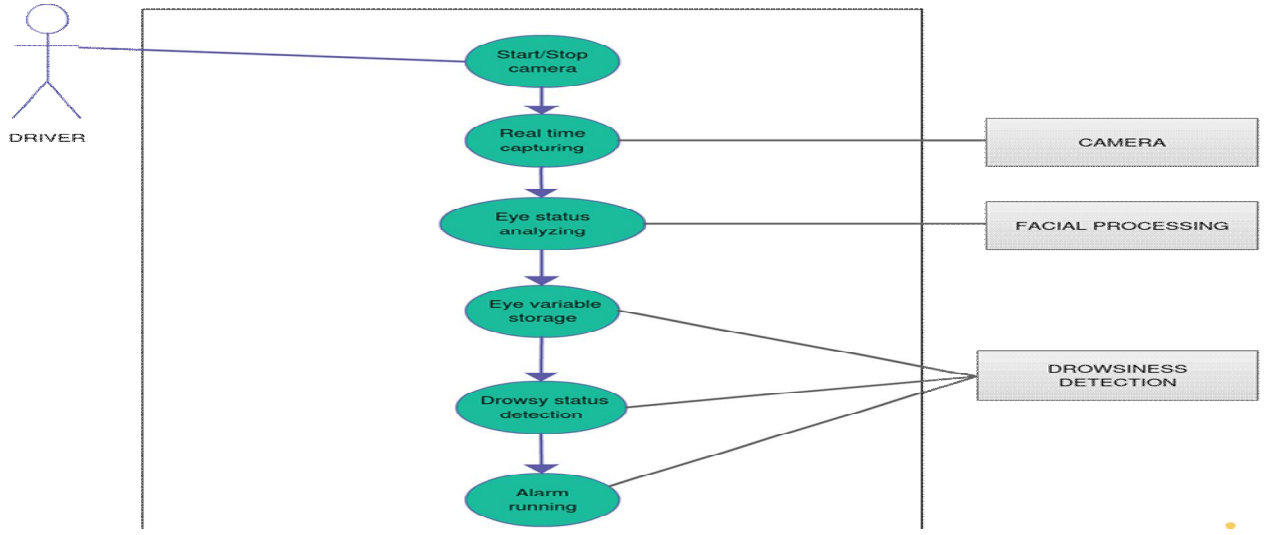

Fig. 1 Flow Diagram

V. ANALYSIS AND DESIGN

1) *Face Detection:* This module takes input from the camera and tries to detect a face in the video input. The detection of the face is achieved through the Haar classifiers mainly, the Frontal face cascade classifier. The face is detected in a rectangle format and converted to grayscale image and stored in the memory which can be used for training the model.
2) *Eye Detection:* Since the model works on building a detection system for drowsiness we need to focus on the eyes to detect drowsiness. The eyes are detected through the video input by implementing a haar classifier namely Haar Cascade Eye Classifier. The eyes are detected in rectangular formats.
3) *Face Tracking:* Due to the real-time nature of the project, we need to track the faces continuously for any form of distraction. Hence the faces are continuously detected during the entire time
4) *Eye Tracking:* The input to this module is taken from the previous module. The eyes state is determined through Perclos algorithm.
5) *Drowsiness detection:*In the previous module the frequency is calculated and if it remains 0 for a longer period then the driver is alerted for the drowsiness through an alert from the system.
6) *Architecture Diagram*

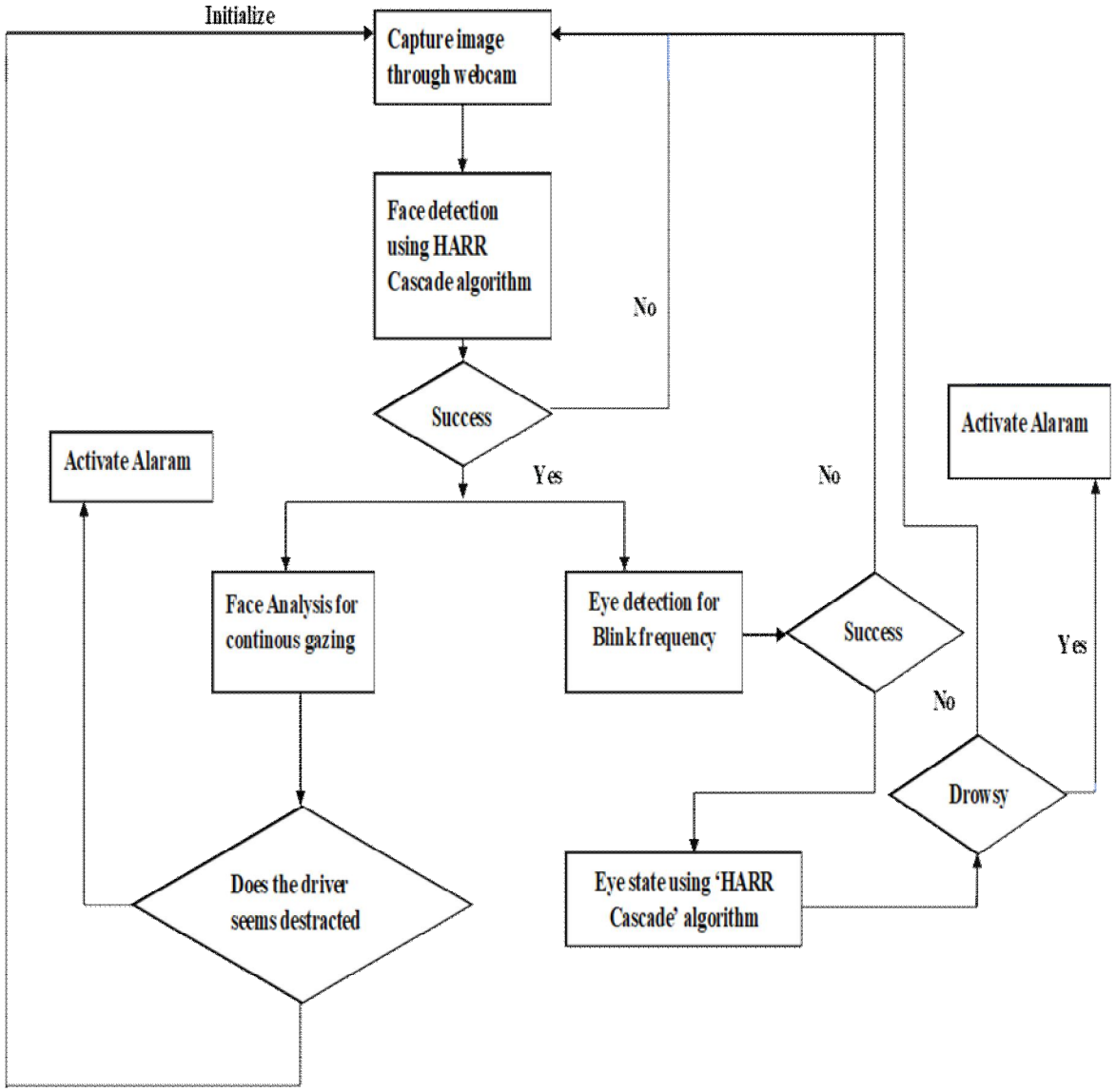

Fig. 2 Architecture Diagram

7) *Haar Cascade*: Haar Cascade is based on the concept of features which are proposed by Paul Viola and Michael Jones in their paper "Rapid Object Detection using a Boosted Cascade of Simple Features" in 2001. It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images. It can be used to detect objects from an image or a video. This algorithm comprises of four stages:

a) Haar Feature Selection
b) Creating Integral Images
c) Adaboost Training
d) Cascading Classifiers

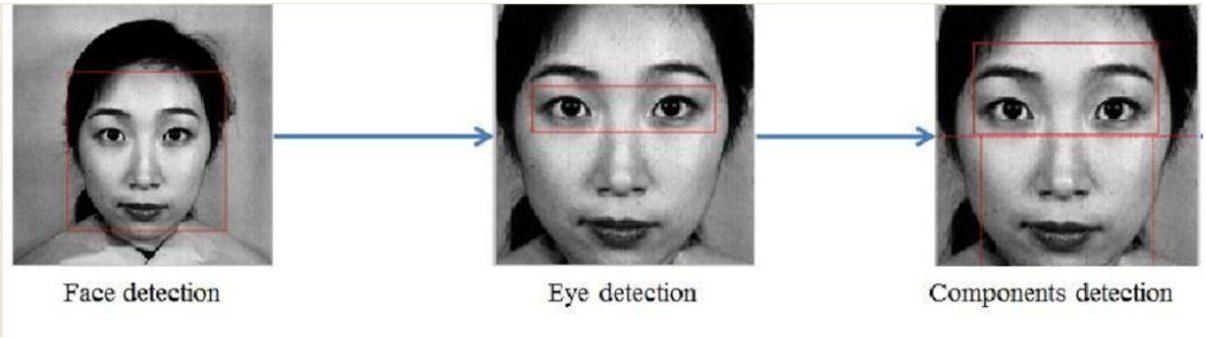

Fig. 3 Haar Cascade Feature Selection

8) *PERCLOS:* Percentage of eye closure (PERCLOS) is defined as the proportion of time for which the eyelid remains closed more than 70-80% within a predefined time period. Level of drowsiness can be judged based on the PERCLOS threshold value. Perclos is a drowsy detection measure used to calculate the percentage of eyelid closure over the pupil over time.

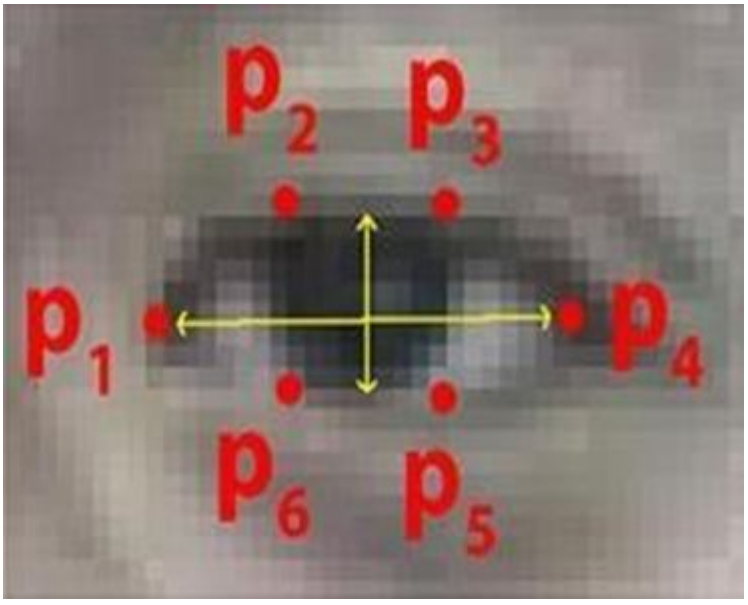

Fig. 4 Perclos Calculation Points

Perclos Calculation Formula:
ear = (A + B) / (2.0 * C)
where
A is the distance between the 2-points (p2 and p6)
B is the distance between the 2-points (p3 and p5)
C is the distance between 2-points (p1 and p4)

VI. RESULTS

Eye Aspect Ratio(EAR) is a tool for measuring driver tiredness. Each individual's eye ratio can be different. Every 0.5 seconds, the rate of eye closure is measured. If the value exceeds a certain threshold, an alarm linked to the GPIO pins of the Raspberry Pi 3 board sends an alert signal to the Raspberry Pi 3. When someone closes their eyes for a longer period of time than a predetermined threshold, an alert signal is generated to bring the driver up from their sleep and water is sprayed to eyes. The system is simple to install in any car.

VII. CONCLUSIONS

The created driver drowsiness system is able to quickly identify drowsy driving behaviours. The drowsiness detection system, which was created based on the driver's eye closure, is able to distinguish between regular eye blinking and drowsiness and can identify drowsiness while driving. The suggested technique can stop accidents brought on by drivers who are drowsy. Several image processing methods are used to gather information about the position of the head and eyes. The monitoring system can determine if the eyes are open or closed. When the eyes have been closed for too long, a warning signal is issued. Processing judges the driver's alertness level on the basis of continuous eye closures.

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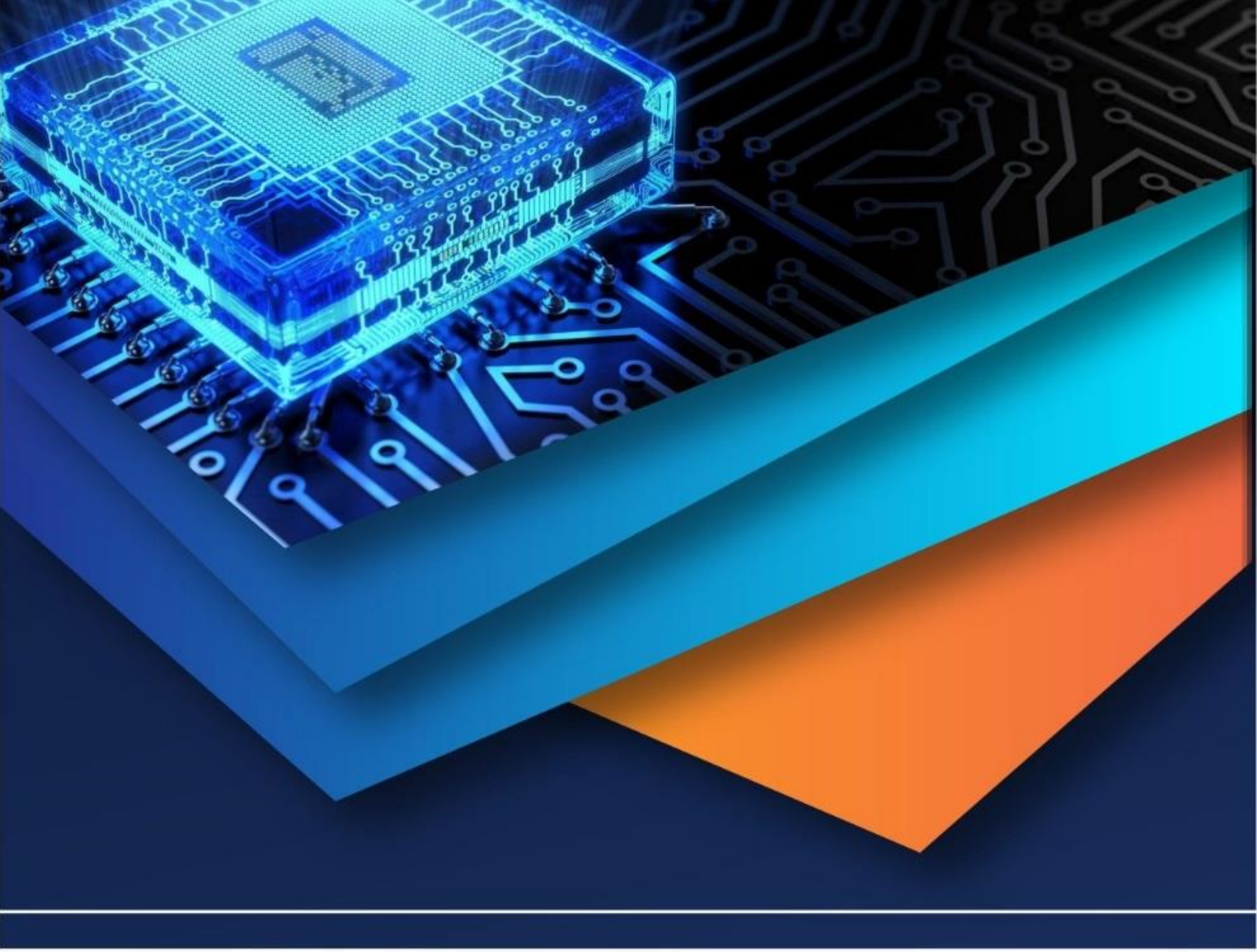

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