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Driver Drowsiness Detection System

Sreelakshmi Kartha[1], Akshaya Mariappan[2], Neha Patil[3], Devika Patil[4], Prof. Mimi Mariam Cherian[5]
[1, 2, 3, 4, 5]*Department of Information Technology, Pillai College of Engineering, Mumbai University*

Abstract: Drowsiness and Fatigue of drivers are the most significant causes of road accidents. Numerous methods have been developed to detect the level of drowsiness, techniques based on image processing. The aim of our project is to use machine learning and image processing techniques to detect the levels of drowsiness of a driver. Images of the Driver's face are captured by the camera, pre-processed and analyzed using image processing techniques, this results in detection of driver's pupil or yawning in case of drowsiness and also when the driver is out of frame for particular seconds conclude as distracted. Regarding the behavior, the system will monitor distraction and notify the driver by setting an alarm and voice command. The results of drivers that have been captured through this system are stored. Through this project, accidents can be prevented to some extent.
Keywords: Face Recognition, Driver Drowsiness, EAR, HOG, OpenCv.

I. INTRODUCTION

Road accidents are normally caused by the driver's carelessness. However, injuries are also caused by drowsiness and exhaustion. The amount of casualties caused by them is rising year by year. It is also important to minimize the number of accidents caused by drowsiness and fatigue. To minimise the number of collisions, researchers around the world are developing several approaches to accurately detect drowsiness on the driver's face. Accidents can be monitored with the aid of this device as it can sense a person's drowsiness and also alert the driver and can control accidents. The system can sense drowsiness within a period of around two or three seconds. The driver is alerted by real-life warnings. Various characteristics, such as visual, non-visual and vehicular, are recommended for identification. Visual characteristics are taken directly from the driver's face and are captured by a camera. Non-visual characteristics are impulses that emerge from the driver's body that are used to obtain certain signals, in which case a special sensor is connected to the driver's body. Vehicle features can be achieved by observing the behavior of the driver as well as the vehicle while driving. But the first suggestion is to create a dataset of facial expression because it can predict drowsiness and exhaustion. The second concept is to merge visual, non-visual and vehicle elements into one for improved identification. And the last one is the development of wearable hardware, such as smart watches for easy-to-use and user-friendly drowsiness detection.

II. LITERATURE SURVEY

A. Behavioral Approach

Susheelamma K H and Smriti Gururaj describe Haar Cascade Algorithm, which is used in this paper. They have also explained how Raspberry Pi is used. OpenCV is also used for face recognition and detection.[1].

J.Rooban Roy **says** the Internet of Things based system which uses Raspberry Pi. ML- Machine Learning is applied for eye detection and region classification [2].

Nora Kamarudin, Nur Anida Jumadil Describes, In this system has four main steps for determining an object namely an integral image, Haar-like feature ,Cascade Classifier and AdaBoost learning. First step is the detection of the face, Haar features are the important part of the Haar Cascade Classifier. The Haar cascade features are mainly used to determine the occurrence of features in the image[4].

According to Sukrit Mehta, Sharad Dadhich, Sahil Gumber, Arpita Jadhav Bhatt EAR (Ear Aspect Ratio) is used to compute the values. Dlib library is used to detect facial landmarks. Based on the value, detection is carried out and alarm buzzes. Eye Closure Ratio to detect driver's drowsiness is based on adaptive thresholding. Machine learning algorithms have been taken on to test the efficacy of the system approach. Algorithms used in this paper effectiveness are Random Forest Classification and SVM[6].

According to J. Rooban Roy, S. Sibi and V. Gowri in An IOT Based Alarm System in Car for Traffic, Alcohol and Drowsiness Detection and Accident Prevention alcohol sensor is used for alcohol detection. IC and Node MCU are also used. If the person did consume alcohol waves are detected and sent to IC. Eye Detection is done using machine learning algorithms. Esp8266 microcontroller performs operation related to detection of the obstacles on the way. A seat belt sensor is also installed. If the sensor doesn't sense the seat belt locked it sends waves to the to the IC thus reminding the driver to wear it [2]

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B. Physiological Approach

According to J. Rooban Roy, S. Sibi and V. Gowri in An IOT Based Alarm System in Car for Traffic, Alcohol and Drowsiness Detection and Accident Prevention alcohol sensor is used for alcohol detection. IC and Node MCU are also used. If the person did consume alcohol waves are detected and sent to IC. Eye Detection is done using machine learning algorithms. Esp8266 microcontroller performs operation related to detection of the obstacles on the way. A seat belt sensor is also installed. If the sensor doesn't sense the seat belt locked it sends waves to the to the IC thus reminding the driver to wear it [2]

In Embedded based drowsiness detection using EEG signals P Kingston Stanley, Jaya prahash T,Sibin Lal S,P Vijay Daniel describes how Hypovigilance is estimated through EEG system using BCI (Brain-computer interface) ,it's a process which prompts an alarm to alert the drowsy driver[3].

T. Edison, K. Ulaga priya says the drowsiness detection method was developed that used a mobile device camera. In order to test a model in proper-time, used wearable EEG mechanism that consists of a bluetooth-enabled EEG headband.[7]

C. Vehicular Approach

In Driver Drowsiness Detection Based on Time Series Analysis of Steering Wheel Angular Velocity Gao Zhenhai, Le DinhDat, Hu Hongyu describes the driving behavior under fatigue is evaluated, followed by the assessment of the time-detection window; and then, the data series Angular velocity of the steering wheel in time detection The window will be selected as the detection function. If it is detected the function meets the constraint of magnitude and uncertainty. Constraint in the time window.[8]

D. Hybrid Approach

In Prediction of drowsy driver detection by using soft computing technique, T. Edison, K. Ulaga priya, A. Saritha provides the application of multifaceted convolution networks. Softmax Layer classifier is used and trained. Here after image acquisition meaningful information is collected using mathematical operations. A hybrid technique is used for detection. A neutral based system is used for determining the amount of fatigue. Deep learning is used to detect driver drowsiness.[7]

1) Summary of Related Work

The summary of methods, advantages and accuracy used in literature is given in Table.

Papers	Methods	Advantages	Limitation
Drowsiness detection of drivers using iot image processing and machine learning techniques.[1]	Opencv picture handling Raspberry Pi	Recognize Mishaps, Alerts Medical Clinics	light falling on the camera fails system
An IOT Based Alarm System in Car for Traffic, Alcohol and Drowsiness Detection and Accident Prevention.[2]	mySQL JSP CSS Raspberry Pi	Non- Meddlesome And prompts Warning On time	It is implemented only in very expensive vehicles.
Embedded based drowsiness detection using EEG.[3]	EEG Signal BCI(brain- Computer interface)	Drivers Safety is Assured Through EEG headband	Inability to Detect driver Eye closure
Implementation of Haar Cascade Classifier and Eye Aspect Ratio for Driver Drowsiness Detection Using Raspberry Pi.[4]	Image Processing and Machine Learning	Less complex as compared to others.	Face & eyes won't be detected In glasses or shades
Drowsy Driver Warning System Using Image Processing.[5]	Image Processing	It can be non-intrusive by using optical sensors of video cameras to monitor changes.	In summer it may lead to perspiration on sensors.

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Real-Time Driver Drowsiness Detection System Using Eye Aspect Ratio and Eye Closure Ratio, Amity University.[6]	Image Proce -ssing and Machine Learning	it operates under all lighting conditions.	Invasive and may distract drivers, need costly sensors.
Prediction of Drowsy Driver Detection by using Soft Computing Technique.[7]	Soft Computing	Feasible for practical drow siness detecti on system.	MATLAB, the software consumes a lot of time to Process videos.
Driver Drowsiness Detection Based on Time Series Analysis of Steering Wheel Angular Velocity, Jilin University.[8]	Calculating angular velocity using steering wheel.	Reflects the Driver's Movements immediately enhances the accuracy.	Affected by external factors such as the geo-metric Condition

Table 1 Summary of literature survey

III. ALGORITHM

The histogram of oriented gradients (HOG) is an algorithm used in computer vision as well as in image processing for object detection. This technique counts occurrences of gradient orientation in localized portions of an image. This method is similar to edge orientation histograms, scale-invariant feature transform descriptors, and shape contexts, but differs in that it is computed on a dense grid of uniformly spaced cells and uses overlapping local contrast normalization for improved accuracy.

A. SVM Hypothesis

$h_\Theta(x)=\begin{cases}1 & if\ \Theta^T\ x>=0\\ 0 & otherwise\end{cases}$

B. Loss function

$$\frac{1}{1+e^z}=\frac{e^{-z}}{1+e^{-z}}$$

C. Optimization

$$\frac{\delta l}{\delta w}=\begin{cases}-t.x & if\ \ t.y<1\\ 0 & otherwise\end{cases}$$

IV. IMPLEMENTATION

1) Web Camera to capture images: the web camera would be capturing on stills live from moving vehicle

2) OpenCV and Dlib in a python environment:OpenCV-Python(library) bindings designed to solve computer vision problems and dlib is used for face detection and facial landmark detection. OpenCV, and dlib code to (1) perform facial landmark detection and (2) detect blinks in video streams.

3) HOG algorithm and linear SVM architecture: all the face sample images of a person are fed to the feature descriptor extraction algorithm; i.e., a HOG. The descriptors are gradient vectors generated per pixel of the image. Linear SVM is a fast machine learning (data mining) algorithm for solving multiclass classification problems from ultra large data sets. He algorithm creates a line or a hyperplane which separates the data into classes.

4) Eye Aspect Ratio/Mouth Aspect Ratio for detecting drowsiness: Eye Aspect Ratio is used to detect the eye blinks (eyes open and close) using the ratio formula based on the eyes width and height. the same formula is used to detect when the driver is yawning.

$$EAR=\frac{||p2-p6||+||p3-p5||}{2||p1-p4||}$$

$$MAR=\frac{||p2-p6||+||p3-p5||}{2||p1-p4||}$$

5) The buzzer to alert the driver: the buzzer goes off as soon as the image in classifier crosses the threshold value, that is if the driver has been sleepy or drowsy or distracted and was yawning constantly and thus the driver is alerted.

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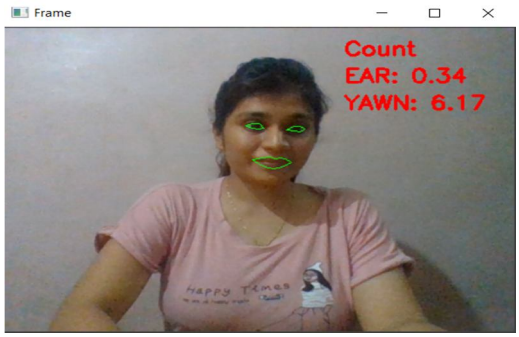

Fig.1 .Implementation of eyes and mouth detection

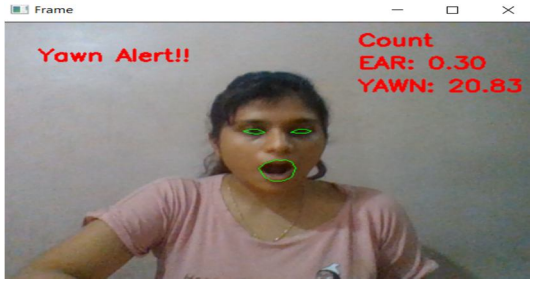

Fig.2 Implementation of Yawn detection

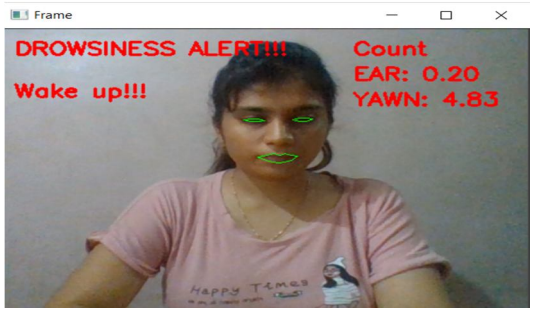

Fig.3 .Implementation of Drowsiness detection

Fig.4 .Implementation of driver distraction.

Fig.5.Drowsiness detection in low light

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V. CONCLUSION

The primary goal of this project is to develop a real time drowsiness monitoring system in automobiles. Driver Drowsiness Detection was worked to enable a driver to remain alert while driving so as to decrease vehicle mishaps brought about by tiredness. Here HOG algorithm is used for image processing which will calculate the EAR. Eye Aspect Ratio for detecting eye blinks that indicates drowsiness. The calculations are coded using OpenCV and Dlib libraries in a python environment. From the facial data,the eye and mouth is extracted which will help to analyse yawning, eye blink and eye closure. Also,when the driver is out of frame for a certain second it will be termed as distraction. So, when these factors are detected an voice command and alarm is induced for alerting the driver.

VI. FUTURE SCOPE

The system can be interfaced with vehicle airbag systems that alert vehicle occupants from getting injured.This can also be improved by adding a camera to the controller module that captures the accident spot and shares its location which makes the tracking easier. By analyzing the collected data we are going to find why accidents occur and provide ways to reduce the road accidents in future.In future, this model can be reached out to give alert before dozing by computing the heart beat measure without physical unsettling influence i.e., non nosy technique utilizing changed ECG strategies.

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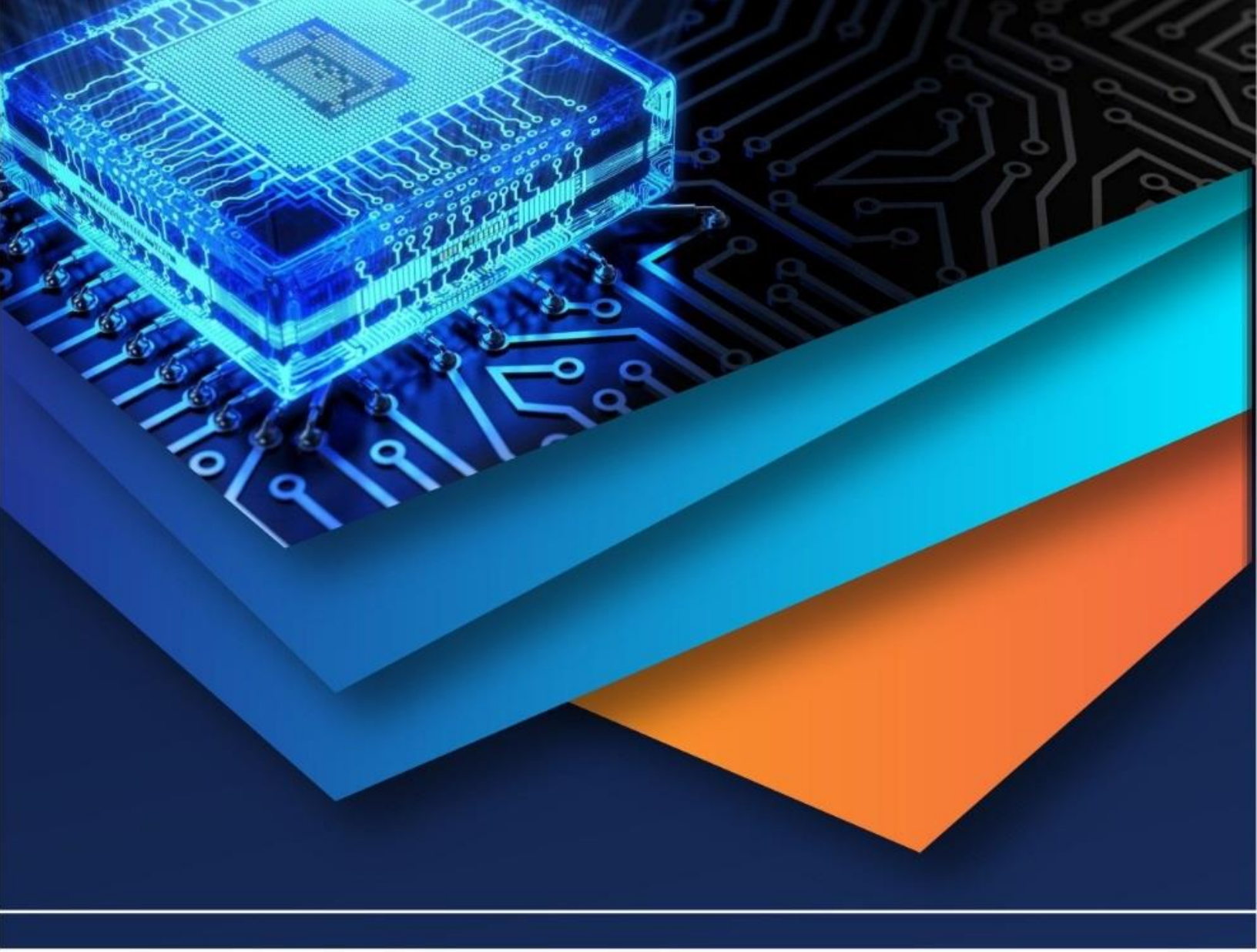

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