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Drowsy Driver Detection and Alert System

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Abstract: Drivers who do not take regular breaks when driving long distances run a high risk of becoming drowsy and cause accidents. The growth of technology supports the society to protect from accidents which happens by human mistakes by building advance accident prevention systems. Drowsy Driver Detection System is developed, using a machine learning and image processing concepts. Proposed system is ready to use for car because of compact hardware which consumes less power and provide much faster processing speed and also can be operated in low light conditions. This system detects the eye landmarks from camera frames for monitoring the drowsiness of driver. The system detects the eye landmark and distance formula is applied to find out that eyes of the driver is open or closed. In case the driver feels drowsy i.e. driver closes eyes for some fraction of time then alert system of car gets activated to prevent accident.

Keywords: Drowsy, machine learning, image processing, eye landmarks.

I. INTRODUCTION

India is a very big country with 1.326 billion populations. Road accidents is a serious problem at the social level because Death from traffic accidents rose three points over two decades. Road accidents rose by 3.1% in one year, from 4,50,898 in 2014 to 4,64,674 in 2015 – with deaths going up by 5.1%, from 1,41,526 to 1,48,707 during the same period, [7] there are many reasons due to which this accident occurs like:

1. Due to Driver (77%)
2. Weather Condition (1%)
3. Vehicle Condition (2%)
4. Pedestrian's fault (2%)
5. Cyclist's Fault (1%)
6. Road Condition (2%)
7. Other (14%) [2]

From the above data the 77% of accidents are happens due to driver and the drowsiness is a big problem found in many accidents. To determine the drowsiness different measures can be useful like heart beat rate, brain signals and eye blinking. While eye blinking is found robust parameter, which can detect drowsiness of driver. [2]

II. LITERATURE REVIEW

The Author Jayasenan J. S and Mrs. Smitha P. S in their paper explained four methods to detect drowsiness: (1) sensing of physiological characteristics, (2) sensing of driver operation, (3) sensing of vehicle response, (4) monitoring the response of driver.[1] Out of this, the first two methods are accurate but expensive and need many sensors like brainwave sensor which cannot be used. Whereas, methods like sensing vehicle responses and monitoring the driver responses is a good method and implementable.

Author Mrs.S. Dhanalakshmi, J.Jasmine Rosepet, G.Leema Rosy, M.Philominal said in their paper that machine is an important part to detect the face and localize the eyes, but it is more important to train the machine efficiently to work effectively to detect the eyes and drowsiness.

Non-intrusive machine vision based drowsy driver detection system in which images are used to detect eye position and eye blinking and eye blink frequency to calculate drowsiness detection [4] can work perfectly and can save the lives of many people. Various papers show that using SVM can make the system robust but increases complexity of the system.

III. PROPOSED SYSTEM

In existing systems, most of the drowsiness detection systems are implemented using laptop which may not be used in real time, so we propose a real time, compact embedded system which use machine learning techniques along with python to detect the drowsiness so that it can be used in vehicles. To make the system compact we use a powerful

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micro-processing system which is capable to handle the video streams provide by camera as an input to the program. To avoid the low light scenario, we used the night vision camera and an alert system to alert the driver about the drowsiness.

What is a machine learning?

While defining machine learning, author Tom M. Mitchelli states: "The field of machine learning is concerned with the question of how to construct computer programs that automatically improve with experience" [6]. Machine learning is closely related to computational statistics, which also focuses on prediction-making through use of computers. If machine learning model uses labelled data for predication, then this is known as supervised learning. In our system, we have used supervised learning technique to create a pre-trained dataset which is used to detect facial landmarks.

Detection of Facial Landmarks

Support vector machine classifier is used in machine learning to divides its input spaces into regions, separated by a linear boundary. Support vector machines are supervised learning models with associated learning algorithms that analyses used for classification and regression.

In this paper we used Support vector machine for creating the pre-train model. we provide labelled images with (x, y) co-ordinates of facial landmarks to SVM algorithm. Given this training data, ensemble of regression trees is trained to estimate the facial landmark positions directly from the pixel intensities. [5] This pre-train model is used in system to detect the facial landmarks. Facial landmark detection algorithm extracts local regions of face such as eyes, nose. With this, we are left with various points defining each local part on the face.

Drowsiness Detection System

As the facial landmarks are detected then we are able to extract the points surrounding various facial region:

Mouth
Right eyebrow
Left eyebrow
Right eye
Left eye
Nose
Jaw

Out of all these, we require points of right and left eye for further calculations. These points are used to calculate the eyes aspect ratio of the driver using the formula given below:

$$x = \sqrt{(px2 - px6)^2 + (py2 - py6)^2}$$

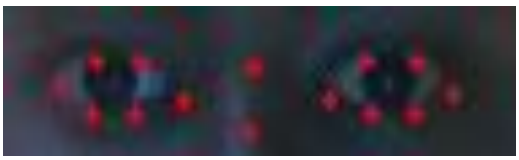

Fig 1: Eye landmark while eye is open

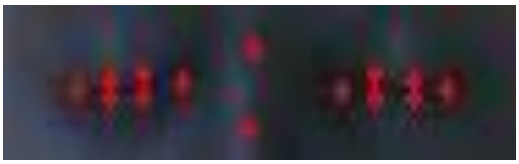

Fig 2: Eye landmark while eye is close

Fig 3: Eye landmark while Driver is wearing glasses

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It is observed that whenever a person's eyes are open, EAR is found to be positive and reaches zero as the person closes his/her eyes. Using this observation, we decide a threshold value and check the real time calculated EAR value against it to decide whether driver is awake or not.

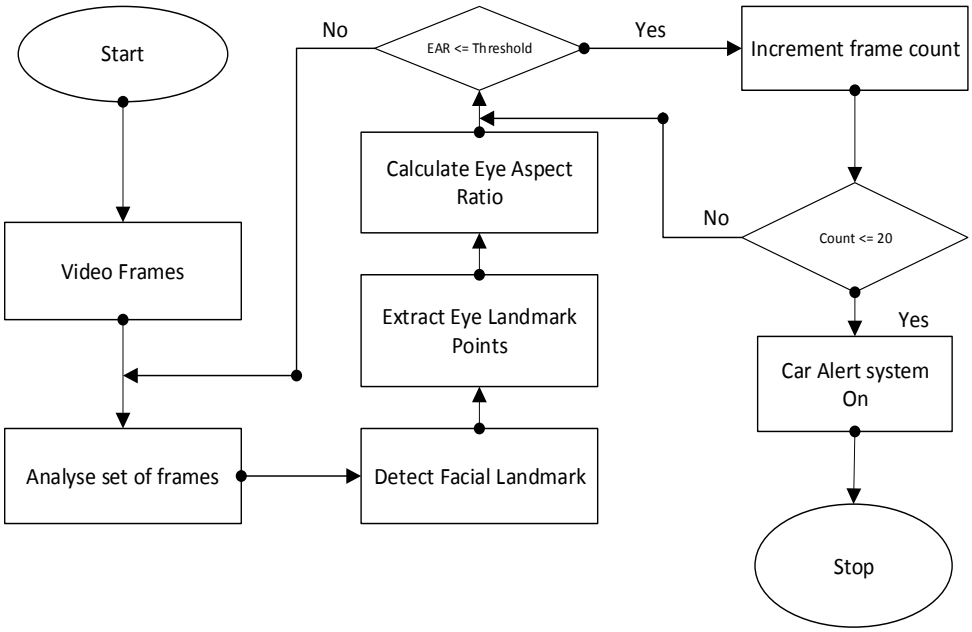

Fig 4: Flow chart showing step by step working of the system

Fig 4. explains flow of the system. The system starts with booting of raspberry pi. The supply from the vehicle battery is used to power raspberry pi. After booting, the program automatically starts executing and camera is initialized within 12 seconds of booting. The camera starts capturing video stream which is converted into grayscale frame by frame and analyzed for facial landmarks. Once the facial landmarks are detected, the eye coordinates extracted are used to calculated EAR value which is then checked against the default threshold value. If it is found to be less than that of threshold, counter is increased. if we found counter to be more than 15, it is deduced that the driver is drowsy and alert system is triggered.

The system takes 15 to 20 seconds when starts to train itself according to the driver's face and starts the alert system after getting accustomed to the driver's face. This system works at the maximum range of 1 meter.

Testing and Result

TABLE I
TASTING RESULTS

Test No.	**Testing Conditions**			
	Ideal Conditions	**Driver With Specs**	**In Low/No Light Conditions**	**Driver With Mask On Face**
Test 1	✓	X	✓	X
Test 2	✓	X	X	X
Test 3	✓	✓	✓	X
Test 4	✓	✓	✓	X
Test 5	X	X	✓	X
Test 6	✓	✓	X	X
Test 7	✓	X	✓	X
Success Rate%	85.71	42.85	71.43	00.00

Ideal conditions give highest success rate because it is performed in ideal light conditions and without any obstacles between eyes and camera. With specs success rate reduced because of the light reflection. Our system works fine in low light conditions because of night vision camera.

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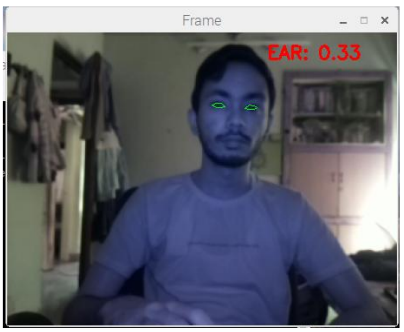

Fig. 5 EAR when eye is open

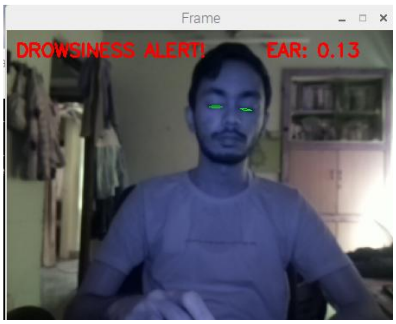

Fig. 6 EAR when eye is closed

IV. Conclusion and Future Scope

A system that is compact and provides fast processing in real time is proposed in this paper. The system uses traditional as well as new and advanced methods such as machine learning to provide better results than previous systems. Non-intrusive concepts are used as it doesn't make driver uncomfortable as intrusive methods do. Using this system, many lives that are lost every day due to micro sleep caused accidents can be saved. There are number of improvements that can be made such as controlling car along with alerting the driver, making the system intelligent enough to work with driver using goggles and face mask as well.

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