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Drowsy State Detection & Warning Using EAR and Shape Predictor_68_Facial Landmark

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Abstract:- Drowsy driving is a major problem in our society. Because of this road accidents are increasing at a tremendous rate and it leads to the loss of human life and many other problems. So that the drowsiness detection system is the perfect solution for this problem. In this system, we consider the parameters like the face detection, position of the head and most importantly the blinking of the eye. Image processing algorithms are used to ensure proper detection of drowsiness in order to avoid road accidents. In the proposed method, the USB camera that captures drivers face and eye. After processing these images, it will be sent to the drowsiness detection system. When the drowsiness is detected, the system gives awareness to the driver through an alarm and also an alert message is sent to the concerned person's mobile. Haar Cascade Classifiers are used to detect the eye blink duration of the driver and then the Eye Aspect Ratio (EAR) value is calculated. The drowsiness detection is based on this calculation.

Keywords:- *Image Processing Algorithms, EAR, Haar Cascade Classifier.*

I. INTRODUCTION

The main objective of our project is to reduce the accident ratio occurring due to drowsy driving. Major accidents occur due to the driver's fault which leads to several other problems, hence to reduce the chance of falling asleep we are making this project. Nowadays, the traffic is increasing at a tremendous rate. Because of the heavy traffic emergency vehicles like ambulances can't arrive on time, thus leading to more deaths caused due to road accidents.

The Driver drowsiness detection techniques can minimize the risk of accidents by alerting the driver on fatigue conditions. To prevent drowsiness of the driver while driving, it requires a method that constantly detects whether there is a fall in the driver alertness. Microsleeps are short periods of sleep that last for 2 to 4 seconds and these are the best sign for the drowsiness condition. By continuously monitoring the eye and mouth movement of the driver's drowsy state can be easily detected.

This project uses EAR and Shape predictor_68_facial landmark for the drowsiness detection, SMS alert is done by Nexmo API and the location of the driver is located by using a GPS module.

II. EXISTING SOLUTION

There are several techniques for analysing driver's drowsiness. These techniques include the image processing-base techniques[1], the electroencephalogram based techniques [2] and artificial neural network-based techniques[3],[4]. In the image processing-based techniques it is divided into three categories such as template matching[7], eye blinking and Yawning based technique.[5],[6]. These techniques are based on computer vision which uses the image processing technique. In the computer vision technique, the facial gestures such as the eye blinking, the head movement of the driever are used to identify drivers' drowsy state.

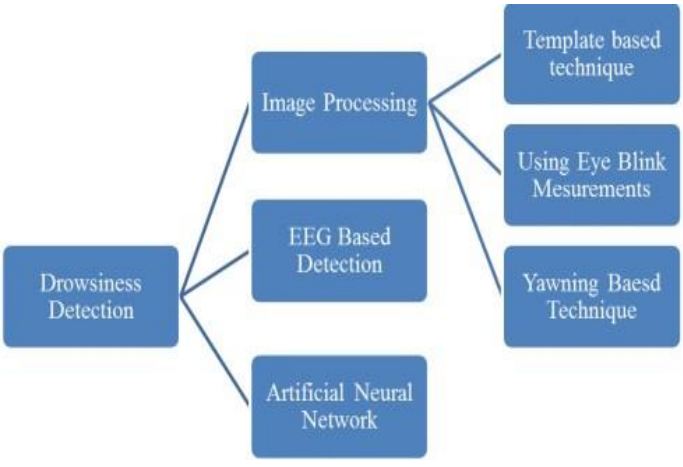

Fig 1

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III. PROPOSED METHODOLOGY

Drowsy driving warning system will be implemented on a computer system using a webcam with the help of image processing algorithms like facial landmark detection algorithm which is used to ensure the proper detection of drowsy state and to prevent road accidents. Driver's face fatigues such as eye blinking, mouth position will regularly monitor by USB camera. If the driver face expressions match with drowsy parameters then the system will alert the driver. For a certain interval of time, if drowsiness is detected for several number of times then the system will send an SMS to the nearby police station or close relatives.

This project uses EAR and Shape predictor_68_facial landmark for the drowsiness detection, SMS alert is done by Nexmo API and the location of the driver is located by using a GPS module.

IV. HARDWARE IMPLEMENTATION

- *Raspberry Pi:*

The Raspberry Pi is a Linux based programmable computer that does all the normal operations in PC. Raspberry Pi 4 Model B has a 1.5 GHz 64-bit quad core ARM Cortex-A72 processor which is used in this system. There is a total of four ports, two USB 2.0 ports and two USB 3.0 ports. The Pi 4 is also powered via USB-C port. The model comes with a standard 40 pin GPIO header. The board is operated in such a way that the code starts to execute as the power is turned ON. The output is obtained through the audio jack.

- *USB Camera:*

The cameras which use USB ports to transfer data such as images are known as USB Cameras. These Cameras help to interface with the computer systems by using the same USB technology that is present in almost every computer. USB cameras are ideal for many imaging applications due to the accessibility of USB technology in computer systems and also provides 480 Mb/s transfer rate of USB port 2.0. An increasing selection of USB port 3.0 Cameras has a data transfer rate of 5Gb/s. The proposed method will use a camera that captures drivers face and eyes, then processes the image to detect the driver's fatigue.

- *Buzzer:*

Buzzer is known as an audio signalling device which produces sound. The applications of the buzzer include alarm on devices, timers, and user input confirmation such as click on the mouse etc.

- *GPS:*

The Global Positioning System (GPS) is used as a radio navigation system which is based on satellites. The Global Navigation Satellite Systems (GNSS) provides the geolocation and the time information to a GPS receiver anywhere on the earth. The GPS does not require the user to transmit any data and operates independently of any internet reception, though these technologies can enhance the usefulness of the GPS positioning information. The GPS applications includes providing critical positioning capabilities to military, civil, and commercial users across the world.

V. SOFTWARE IMPLEMENTATION

- *OpenCV Library:*

An OpenCV (Open Source Computer Vision) is a library of python functions developed to solve the computer vision problems.The OpenCV-Python uses Numpy, which is a highly optimized library for numerical operations. All the OpenCV array structures are transformed to and from the Numpy arrays. So whatever operations performed in Numpy, can be combined with OpenCV. The OpenCV supports many algorithms associated with computer vision and machine learning etc.. and it is growing day-by-day. As of now, the OpenCV is being supported by a huge variety of programming languages such as Java,Python,C++ etc and is out there on different platforms such as iOS, Linux, Windows, OS X, Android etc. Hence, OpenCV- Python is an appropriate tool for fast prototyping of computer vision problems.

- *Haar Cascade Classifier:*

Harr feature-based cascade classifiers are an efficient object detection method[8]. Object detection from other images is done by cascade function which is trained from tons of positive and negative images. That means images of faces and images without faces respectively.

Initially, the algorithm needs the cascade function to train the classifier. Then extract features from it. Haar features are used for this. Each feature is a single value obtained by subtracting the sum of pixels under the white rectangle from the sum of pixels under the black rectangle.

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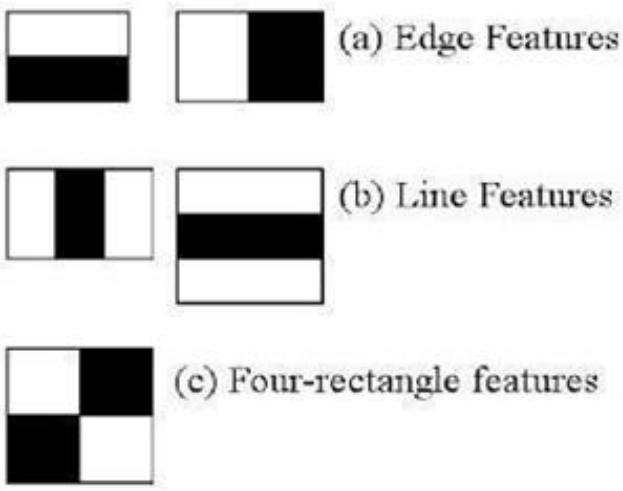

Fig 2

For each feature calculation, all possible sizes and locations of every kernel are used and we need to obtain the sum of the pixels under white and black rectangles.

But, most of the features calculated are irrelevant. For instance, consider the image below. The top row shows two good features. The first feature selected focuses on the property that the region of the eyes is often darker than the region of the nose and cheeks. The second feature selected depends on the property that the eyes are darker than the bridge of the nose. But the same windows applied to the cheek or any other place is irrelevant. It is achieved by Adaboost.

Fig 3

Using Adaboost we select the features with the lowest error rate, which means they are the features that most accurately classify the face and non-face images.

In a picture, most of the image is non-face region. Therefore, the focus will be on the regions where there can be a face. For this, the concept of Cascade of Classifiers is used.

- *Shape Predictor_68_Facial Landmark Detection:*

A single annotation consists of the face region, and the labelled points. The face region can be easily obtained by any face detection algorithm. Instead the points have to be detected by already-available landmark detectors and models (SP68). Training options are a set of parameters. Shape Predictor can be generated from a set of images, annotations and training options that defines characteristics of the trained model.

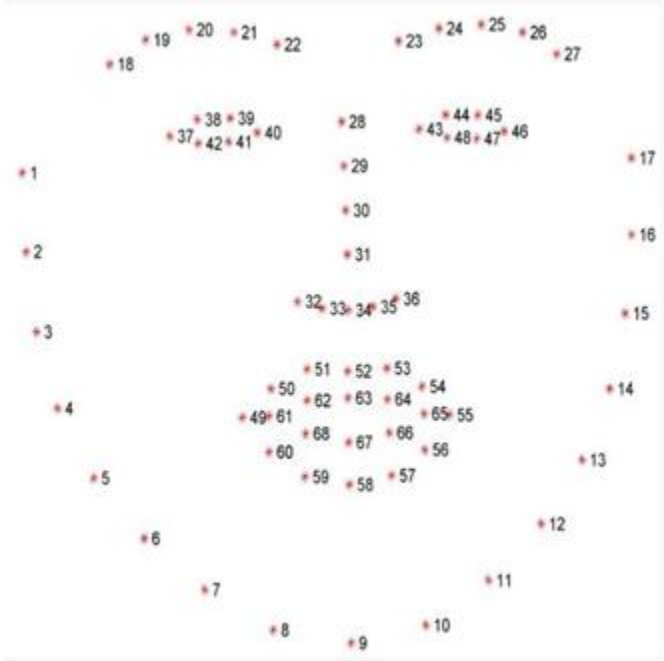

Fig 4

➢ *Eye Aspect Ratio (EAR):*

The eye blink is a fast closing and reopening of a person's eye. Everyone has a different pattern of blinking. The pattern will differ based on the speed of closing and opening, then the degree in which the eye's are kept closed and the time taken to blink the eyes. The eye blink will happen for approximately 100-400 Ms. In this system the facial landmark detectors are used to isolate the eyes and eyelid shapes. From the landmarks that are located , the eye aspect ratio (EAR) value is derived, that is used as an estimate of the eye-opening state.

Each eye is represented by a 6-(x,y)-coordinates. The width and the height of these coordinates are related to each other. The Eye Aspect Ratio (EAR) value is determined by the following equation:

➢ *Nexmo SMS:*

Nexmo is a tool within the Voice and SMS category of a tech stack. The Nexmo SMS API allows the app developers to merge their product with the Nexmo SMS services,thus allowing their users to send and receive messages from Nexmo directly.The Nexmo will attach your applications directly to carriers around the world. It integrates SMS and Voice messages using one simple API.

VI. CONCLUSION

The proposed system helps to reduce traffic accidents. The system will monitor the driver's facial cues and it will alert the driver of fatigue. Also, the system will send an SMS alert to the responsible one.

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