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Driver Drowsiness Detection and Warning System

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Abstract: Driver drowsiness and fatigue has become a major problem all over the world. This has increased the number of accidents and has contributed to a hike in the death rate. Considering this as a serious problem, the need for driver drowsiness detection system is highly necessary. It can be detected using various methods which includes IoT, various sensors for monitoring health conditions, real-time detection using camera to keep tracking the physical conditions of driver etc. Also it should be made cheap so that it is accessible to everyone. The cost of the system depends on the idea of implementation and the method being used.

Keywords: Drowsiness, IoT, Eye blinking rate, Yawning rate, Eye Closure.

I. INTRODUCTION

Even though technology and development has improved the human life style of living, it has also put a lot of adverse effects on them. Every technology that we bring up has brought some side effects in one or the other way. The development of transport system has played an important role in our life such that we are in a state where we can't live without it. But this has affected our health and the environment in a really bad way. Humans who used to be healthy in the olden days has now become weak due to lack of exercise. If transport system wasn't there, then we would have depended on walking even for miles of distances. Apart from this, human death rate has increased just because of road accidents. The nature as a whole started getting polluted. Infact humans are being affected in many ways. As humans, one thing we could do is to avoid accidents that causes human death. Major causes of accidents are due to drowsiness and fatigue which can be due to doing over time work or lack of sleep. Driving after consuming alcohol makes the person tipsy and loses the mental state stability. This also is one of the major causes of accidents and death. To avoid all these problems, a Drowsiness detection system has to be implemented in all vehicles that could detect and warn the driver when he/she falls asleep. The use of Driver Drowsiness Detection System in a car becomes highly helpful when people travel alone. At this condition, the alarming system wakes up the driver and helps to avoid from getting into accidents.

Drowsiness detection systems can be developed using different methods. This paper includes a review of different methods used in drowsiness detection and how when different methods combined together produces a better output. Also the paper gives some information about the proposed system.

II. LITERATURE REVIEW

Dr. K.S. Tiwari et al. [13] introduces a basic and simple drowsiness detection system specially meant for people who drive cars alone and at odd time. It has the necessary elements to identify how tired the driver is so that the system could warn him/her from falling asleep. The system that consists of camera keeps monitoring the eye blinking frequency, a buzzer to alarm the driver and a GPS system to keep tracking the driver's location. The author also adds an extra element as alcohol sensor that helps to sense the content of alcohol and in turn slows down the car to reduce the chance of getting into an accident.

Chao Zhang et al. [14] proposes a method for driver drowsiness which uses Multi-Channel Second Order Blind Identifications abbreviated as "SOBI". It is detected based on Blood Volume Pulse abbreviated as "BVP", yawning and eye blinking frequency. The intensity of drowsiness can be obtained by analysing each of the three signals parallely.

Maganti Manasa et al. [11] in their paper have used the parameters such as blinking of eye and number of yawning within a span of time. Using PERCLOS method and Histogram of Orientation Gradients (HOG) we could detect eye from the upper half of a human face and yawning from the lower half respectively. The system is designed by power spectrum analysis based on EEG value thus obtaining an accuracy of 91-96% and the execution of the system consumes reduced amount of time and less codes, also the alarm in this system is made to work when the binary value becomes lower than the threshold.

Manankumar Patel et al. [10] deals with an IoT based model which deals with detection of drowsiness and the presence of alcohol content in driver's body. The use of MQ-3 sensor helps to detect the presence of alcohol, which sends out alert to the family members by the use of GPRS and GPS module, by making the ignition off as it detects the presence of alcohol in the driver's breath. This paper uses eye blinking as a parameter to detect the drowsiness thus providing buzzer inside the vehicle to wake the driver up. All the parameters were tested and found to be 80% accurate.

Wanghua Deng et al. [8] utilises the frequency of blinking of eyelids and yawning at the time of sleepiness rather than at normal times, along with 68 key points for facial detection, which increases the accuracy of the system to 92%. This model uses DriCare for fatigue detection utilising the in-built camera of the vehicle for video capturing in order to detect eye closure and opening of mouth. Incorporation of CNN and MTCNN for improving the KCF algorithm, thus proposed a new algorithm names as MC-KCF help in detecting the facial expression to its maximum.

Rateb Jabbar et al. [12] uses multiple layers of perceptron for the classification of the images which is used in the detection of drowsiness among drivers during driving. The main advantage of this paper is that it can be used in android mobile applications with a very small size for the model, which gives us an accuracy of 81%. This system model uses characteristic features such as yawning, dizziness, also conventional driving mode which are detected using machine learning with deep leaning techniques, which can be installed as an operating system inside the cars.

Sadegh Arefnezhad et al. [6] have taken different features from steering wheel in which four different filter indexes are applied and from which certain features are selected using adaptive neuro-fuzzy inference system (ANFIS). These extracted features are, then given to Support Vector Machine (SVM) which divides the output to drowsy state or wake state, which is given to Particle Swarm Optimization (PSO) algorithm in order to exploit accuracy of the model.

Mkhuseli Ngxande et al. [7] in their paper, have used facial features such as frequent closing of eyes, blinking of eyes per period, rate of yawning and minute expressions of face. All these features determined by capturing video of the driver, which does face detection using viola and jones algorithm then extracted using Histogram of Oriented Gradients (HOG) and Local Binary Patterns (LBP). This output is given to Support Vector Machine (SVM) and to hidden Markov model (HMM) for making prediction on the hidden states.

Abdelmgeid et al. [15] uses Local Binary Patterns (LBP) for face recognition from the video recorded inside the vehicle, taken for short period of time. This uses the detection of eye movements, nose and skin, which is taken as the physiological parameters for the drowsiness analysis. Since they use the video recording, segmentation algorithm is used in image detection. The method of Haar cascading is used for the project, thus got an accuracy of 96.5% and the rate of error became 3.5%. Through this paper they could prove that their proposed system is better than techniques such as Eigen face and LBPH.

Koichi Fujiwara et al. [5] takes the heart rate variability analysis (HRV) for this drowsiness detection model and compares it with sleep parameters based on Electroencephalography (EEG). This paper focuses on extraction of physiological features other than face detection. If the driver allows to get connected to a measuring device to check EEG, then there is no need of connecting the system to a vehicle. Any abnormalities in HRV will be detected using Multivariate Statistical Process Control (MSPC), then feature extraction using a moving window takes place and thus can control drowsiness to an extent.

Dian Artanto et al. [3] have found out that closure of eye is the most efficient feature to be extracted to find out drowsy condition of the driver, so used Electro-oculo-graphy (EOG). This eye movement can be measured from a video but lighting is a disadvantage for normal videos, thus making the usage of IR sensors will solve the problem but would damage the eye so they have used Electro-myo-graphy (EMG) which tests the eyelid muscles. Also the use of ESP8266 helps in getting the data online, thus can record the health issues causing drowsiness.

R Sasikala et al. [4] has placed a camera in the vehicle's dashboard along with the presence of PIC microcontroller, which gives the software and hardware of the product. They have developed a system to detect the opening or closing of eye. If found closed for a period of time, buzzer would start buzzing and if the driver did not respond then the vehicle would stop and thus make them safe. It uses embedded C for the software part and two-axis robot is used for the easiness of the system's working. Image processing is one technique to detect face from the captured video.

Zhuoni Jie et al. [2] took yawning as a human parameter for the detection of drowsiness in drivers, proving that it is the most important feature that shouldn't be avoided from a driver drowsiness detection system. Along with this, they also extract features from regions around driver's mouth and eye, and they found that bringing hands near to the face or to mouth is a good indicator of sleepiness. This paper uses Local Binary Patterns (LBP) along with Histogram of Orientation Gradients (HOG) for feature extraction whose output is given to Support Vector Machine (SVM) thus provides an output with 94.63% accuracy.

Venkata Rami Reddy Chirra et al. [1] in their model have used deep learning method for the drowsiness detection in drivers. The use of viola-jones algorithm for the process of detection of face specifically the region of eye is noticeable, along with staked deep convolution neural network (CNN), which use instead of tradition CNN because of decrease in accuracy. Thus provides a new model with an accuracy of 96.42%. Linear discriminant analysis (LDA) and discrete cosine transform (DCT) is implemented in order to extract the human features for the drowsiness detection model.

H.M. Chandrasena et al. [9] in his fuzzy based model proposed in the research he did implied that it assured high accuracy in detecting drowsiness. The paper produced a hybrid method, integrating different other methods like eye retina detection and pulse pattern detection. The result obtained was that most of the drowsy people showed an LF/HF ratio between 0.3 and 0.5.

III. PROPOSED MODEL

A. Objective

1) To implement an alerting system and to provide instructions.
2) Detect drowsiness level with the help of eye blinking frequency, yawning and duration of eye closure.
3) Detect the amount of luminance on the driver's face and control the sun visor automatically.
4) Real time vibration alerting using vibrators.

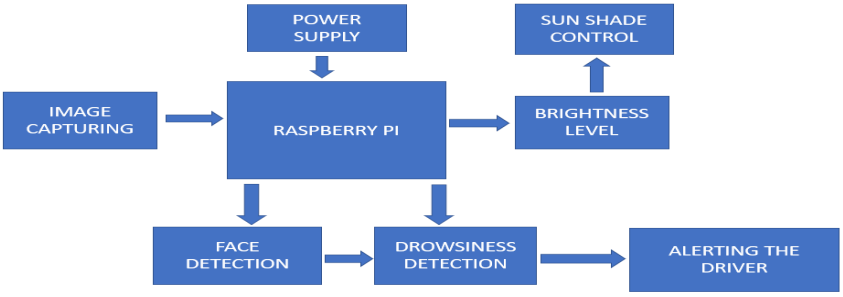
B. System Modelling

The hardware components mainly used are Raspberry Pi 4, Pi Cam, Servo motor and a Mini Vibrator. The Raspberry Pi 4 is the main component which helps to run the software required for face detection and recognition. Pi Cam is used to capture the face of the driver and the main facial features such as the movement of eye and mouth. The Eye blinking frequency, Yawning frequency and duration of eye closure have to be detected inorder to identify whether the driver is feeling sleepy or not. Pi Cam helps to capture all these data and is given for further processing to the Raspberry Pi module which has a 1.5 GHz 64-bit quad core ARM Cortex-A72 processor.

The Servo motor is used to put the sun visor down whenever a high intensity of light is being detected on the driver's face. High intensity light, which can either be sunlight or the bright light of the car coming opposite can force the driver to either close his eye or to take too much of strain and continue driving. This may cause accidents and lose of live. To avoid such situations automatic sun visors would help to some extent. A Mini Vibrator can be attached to the driver's seat inorder to provide a low amount of vibration which helps to keep the driver awake. Warning and alerting systems can be help a driver from falling asleep. Along with this the application of vibration can keep him/her be more alert and vigilant.

The software part of the system is mainly for the driver drowsiness detection. In order to do that, first the 68 key points must be detected by the open source software called Dlib. Now from the facial key points of the eye and mouth it the angle of eye is detected and if it is less than the threshold value, it is considered to be closed eye. Also the height-width ratio of eye and mouth is calculated and if it is less than the threshold value, it is considered to be closed. By combining the results, the system determines whether the person is sleepy or not and alert the driver if he/she gets sleepy. The most of the programming part is done using Open CV with help of python.

C. Block Diagram



IV. CONCLUSIONS

This paper focus to provide an insight to the readers on various methods and types of driver drowsiness detection. From the literature survey it is understood that each and every method gives a required output but these might also have a lot of other limitations due to which many other methods are developed. Also we found out that on incorporating different methods a better result could be produced. For example, two methods among the many methods in face detection are LBP (Local Binary Pattern) method and HOG (Histogram of Oriented Gradients) method. Before, on using the former method alone we used to get the desired outputs. Later when the HOG method was developed it was found to be more efficient than the former. And then on further research, it was understood that combining these two methods would produce a more accurate result than when these methods are used separately.

The proposed system Introduces a novel system for evaluating the driver's level of fatigue based on face tracking and facial key point detection. The facial regions of detection is based on 68 facial key points for the driver drowsiness detection which is done using the eye and mouth status and then alerts the driver by giving certain instructions and helps to awake the driver from getting sleepier. By measuring the amount of brightness level on the face it automatically controls the sun visor.

The paper also introduces a new evaluation method for drowsiness based on the states of the eyes and mouth. They are done using Python 3.6, OpenCV, TensorFlow to build software environment required for the experiment. The drowsiness is detected using the status of eye, frequency of blinking and by the status of mouth, and by combining all these features, the system can conclude whether the driver is fatigue or not and alert the driver accordingly.

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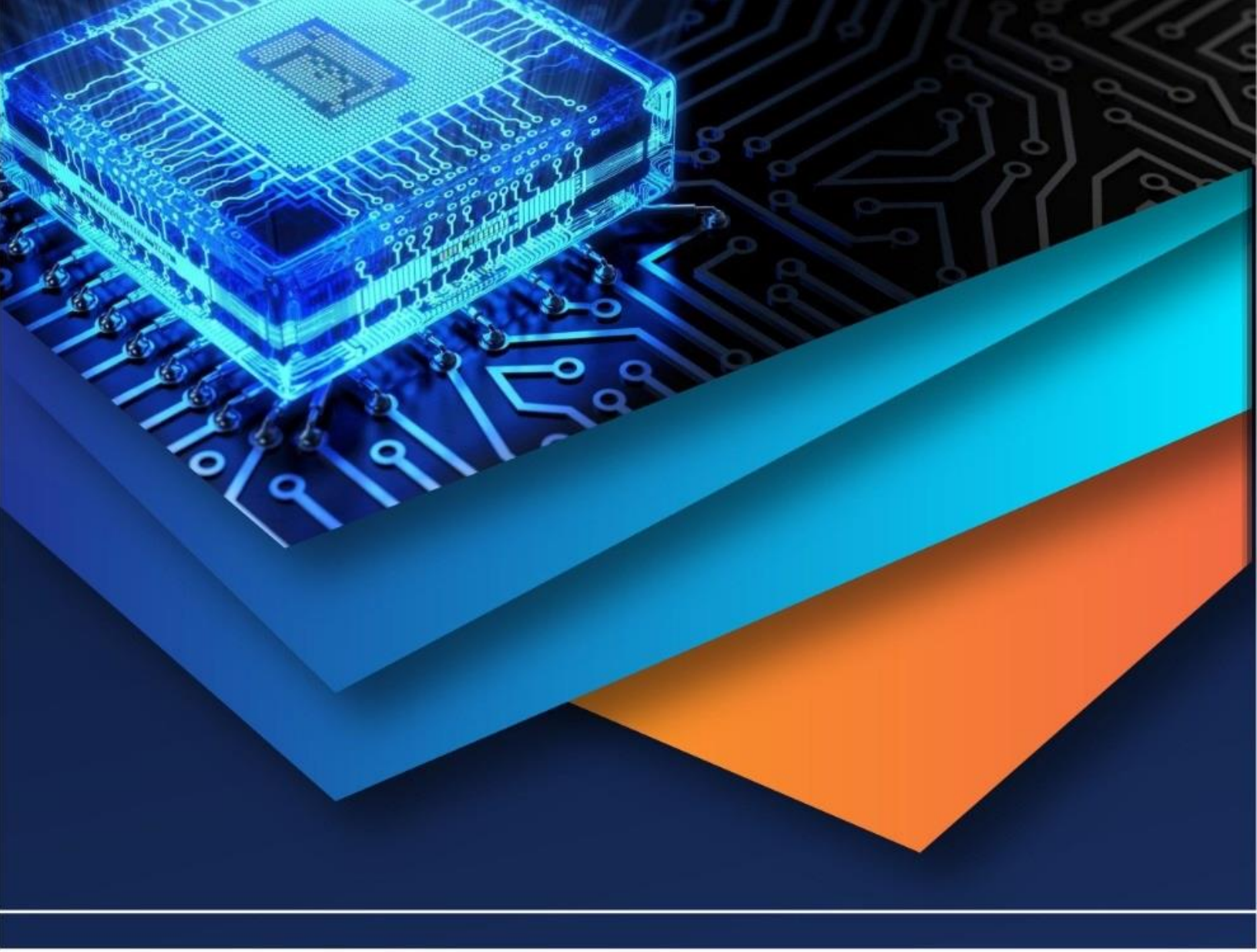

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