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IoT BASED DRIVER DOZINESS SYSTEM

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Abstract: This paper describes a system for detecting driver doziness, which is induced by extreme exhaustion as a result of physical activity or sickness. Road accidents have become more common as the population has grown. According to a recent survey, over half a million fatalities occur in India each year. 60% of these accidents are caused by driver's drowsiness. Drivers must keep a careful eye on the road so that they can react quickly to unexpected incidents. Driver drowsiness is frequently cited as a direct cause of numerous traffic accidents. As a result, systems that identify and inform a driver of her/his poor psychological condition are needed, which might dramatically reduce the incidence of fatigue-related car accidents. This review paper will look at the many strategies used for drowsiness detection.

***Index Terms* - Drowsiness Detection, Face Detection, Raspberry pi, Eye Aspect Ratio (EAR).**

I. Introduction

Driver drowsiness detection is an automobile safety device that detects drowsiness in the driver and prevents accidents. Automobile fatigue-related crashes have increased dramatically in recent years. Various studies have revealed that driver drowsiness is a significant component in a huge number of vehicle accidents, with up to 50% of all road accidents being fatigue-related on particular highways. According to recent figures, fatigue-related crashes cause 1,200 deaths and 76,000 injuries per year. The development of devices for detecting or preventing drowsiness while driving is a significant challenge in the field of accident-avoidance systems. Because drowsiness is a hazard on the road, measures to counteract its effects must be devised. Driver drowsiness is a major contributing factor in a huge number of car accidents. Drowsiness detection is one of the common issues that must be addressed in order to prevent traffic accidents. Automobile fatigue-related crashes have increased dramatically in recent years.

II. Literature Review

A. In 2011, Assari, M. A. et al. [1] **"Driver drowsiness detection using face expression recognition."** They suggested a system for detecting the driver's drowsiness by detecting the face using horizontal projection on the image and tracking the facial components via a template matching technique, which included eyebrows, eyes, and lips. The proposed method has been applied in the MATLAB simulation environment (Simulink). The addition of IR illumination as a light source aided in the recognition of faces in this system.

B. In 2007, Tianyi Hong et al. [2] **"An Improved Real Time Eye State Identification System in Driver Drowsiness Detection."** They demonstrated a system that used a face-detection algorithm based on a cascade of classifiers trained using the Adaboost technique. In this system, optimization is accomplished by using the integral image of the original image to create a canny filter for cascade processing and improve performance. For better and faster computational results, Integrated Performance Primitives (IPP) have been applied. This system has been tested on the GENE-8310 embedded platform.

C. In 2015, B. Warwick et al. [3] **"Detecting Driver Drowsiness Using Wireless Wearables."** They developed a physiologically based system in which the driver wears a wireless biosensor called BioHarness, a wearable device capable of collecting physiological data and transferring it to a smartphone. This data is then analysed using the Fast Fourier Transform (FFT) and Power Spectral Density (PSD), which yield the appropriate vectored inputs for feeding into a neural network. The researchers operated this method on a drowsiness-detecting smartphone app.

Fig. 1. BioHarness

D. In 2014, K. Dwivedi et al. [4] **"Drowsy driver detection using representation learning."** Using representational learning, they created a system that detects the driver's drowsiness. A Haar-like face detector feeds images to a 2-layer convolutional neural network for extracted features, which are then used to train a SoftMax layer classifier to determine whether or not a driver is drowsy. This technology achieved a respectable 78 percent accuracy in detecting fatigue and alerting the driver.

E. In 2016, J.J. Yan et al. [5] **"Real-Time Driver Drowsiness Detection System Based on PERCLOS and Grayscale Image Processing."** They suggested a method in which the collected pictures are transformed to grayscale and edge detection is performed using the Sobel operator. Template matching is used to compute the location of the eyes. Binarization and rapid sort algorithms are utilised to detect the states of the eyes as well as to check the distribution of black pixels in the grayscale image. P80 is used as an essential criteria of the driver's physical condition in this investigation. A threshold value is used to compare pixel values. If the number of black pixels is less than this threshold, the driver is said to be in a sleepy condition.

F. In 2015, Omkar Dharmadhikari et al. [6] "**Survey on Driver's Drowsiness Detection System.**" They proposed a method for detecting driving drowsiness based on yawning measurements and the driver's head posture. The real-time detection and tracking of the driver's face, the detection and tracking of the mouth contour, the identification of yawning based on detecting both the rate and the number of changes in the mouth contour region, and head movement monitoring are all part of this process.

G. In 2018, T. Petkar et al. [7] **"Automatic Driver Drowsiness Alert and Health Monitoring System."** They demonstrated the system by employing several sensors and a microcontroller. These sensors are used to detect sleepy driving and to keep track of the driver's health. The buzzer is meant to notify the driver if he or she becomes asleep. The motor comes to a halt whenever the sensor data fall outside the range of the threshold value. The GPS module detects the position in the event of an emergency, and this information is relayed through GSM to the appropriate person or in charge ward. The microcontroller is in charge of all of these sensor functions.

III. Methodologies

Different methodologies have been developed for detecting a driver's drowsiness. They may be divided into three primary categories:

3.1 Behavioural Parameters Based

This category includes determining the driver's drowsiness without the use of non-invasive devices. Analyzing the driver's behaviour by looking at his or her eye closure ratio, blink frequency, yawning, head posture, and facial expressions. The current parameter in this system is the driver's eye-closure ratio.

3.2 Vehicle Parameters Based

This category includes determining the driver's drowsiness level through vehicle driving behaviours. Lane change patterns, steering wheel angle, steering wheel grip force, vehicle speed variations, and many more characteristics are among them.

3.3 Psychological Parameters Based

This category includes determining the driver's drowsiness based on the driver's physical state. Respiration rate, heart rate, body temperature, and a variety of other parameters are examples of such metrics. These physiological characteristics, among other ways, produce the most reliable findings since they are based on the biological characteristics of the driver.

Each of the options listed above has its own set of benefits and drawbacks. Any strategy can be employed depending on the desired outcome and accuracy.

Wearing the device on the driver's body is part of the physiological approach. Electrodes that detect the driver's pulse rate are included in this equipment, which may make the driver feel uneasy while driving. This also doesn't guarantee that the driver is constantly wearing such gear when driving, which might lead to ineffective outcomes. As a result, employing the physiological method presents a challenge.

The efficiency of the driver and his condition are constantly at the forefront of a vehicle-based strategy. There are further limits, such as the state of the road and the type of vehicle, both of which might vary on a frequent basis.

As a result, it is better to use a behaviour-based method that involves a visual evaluation of the driver using a camera. The driver is not allowed to have any device attached to him. As a result, this method is always the best option and can be used in any vehicle without requiring any adjustments.

The following are some methods for Drowsiness Detection,

3.3.1 Drowsiness Detection Through Region of Interest

A driver's face can be detected using a region of interest (ROI). The region of interest is shown by the blue rectangle. The first step is to get the green rectangle region from the Haar Cascade Classifier in the first frame, which contains height and breadth. The rectangle is then enlarged to form a region of interest. The ROI area is calculated in numerous phases, and we must compute ROI for each and every region of interest.

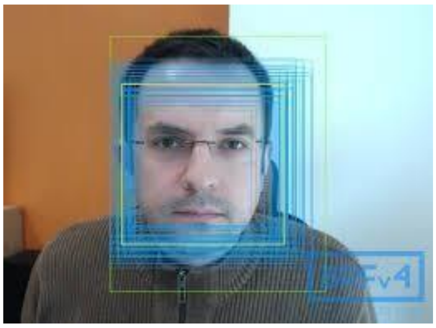

Fig. 2. Region of interest (ROI)

Disadvantages:
1. It detects faces by using extra frames or squares.
2. It is difficult to find in low light.
3. Why use the region of interest again when the Haar-cascade classifier can perform the same task?

4. It is difficult to detect while driving while wearing glasses.

3.3.2 Eye Tracking and Dynamic Template Matching

A real-time driver drowsiness detection system based on eyesight is presented to prevent road accidents. Using the HSI colour model, the algorithm first recognises the driver's face from the input photos. Second, the Sobel edge operator is used to find the locations of the eyes and to obtain pictures of the eyeballs as a dynamic template for eye tracking. The collected pictures are then transformed into an HSI colour model to determine whether the eyes are closed or open, allowing the driver's drowsiness to be assessed. Four test movies are used in the tests to follow the eyes and recognise faces. The suggested system is compared to expert-annotated data that has been labelled. The accuracy of the suggested system is 88.90 percent, and the average accurate rate is 99.01 percent.

3.3.3 Mouth and Yawning Analysis

To begin, the system uses a cascade of classifier training and mouth detection from the input photos to find and track a driver's mouth. SVM is then used to train the pictures of the mouth and yawn. Finally, SVM is used to identify the mouth areas in order to detect yawning and drowsiness. The authors gathered various movies for the experiment and chose 20 yawning photos and more than 100 regular clips as the dataset. The findings reveal that the suggested system outperforms the system that relies on geometric characteristics. The suggested technology detects yawning, notifies the driver of exhaustion sooner, and assists in keeping the driver safe.

3.3.4 EEG- Based Driver Fatigue Detection

An EEG is a method of determining the electrical activity produced by nerve cells in the human brain, i.e., cortical movement. The EEG-action is available at all times, and recordings indicate both ad hoc and regular behaviour. The EEG's primary origin is neuronal action in the cerebral cortex; however, some action also originates in the thalamus and other subcritical areas of the brain. In nerve cells, the EEG represents the sum of excitatory and inhibitory postsynaptic possibilities. The synchronised activation of the nerve cells causes the melodic movement. The use of electroencephalogram (EEG) signals to identify driver fatigue is advocated as a way to avoid road accidents that are frequently caused by fatigued drivers. The suggested technique begins by determining the index associated with various levels of drowsiness. The system uses an EEG signal that is computed using a low-cost single-electrode neuro signal collection device as an input. A data set for a simulated automobile driver under various levels of drowsiness is gathered locally to assess the suggested strategy. And the results suggest that the proposed method is capable of detecting all types of fatigue.

Disadvantages:
1. High cost
2. Sensors Required
3. Can’t see behind objects
4. Takes longer time

3.3.5 Eye Closeness Detection Method

The Raspberry Pi camera and Raspberry Pi 3 model B are used to calculate the driver's drowsiness level. First, the Pi camera records video, and then the Haar cascade classifier from the Viola-Jones technique is used to recognise facial areas in the pictures. Several photos are taken under various lighting conditions. Based on a case study with ten participants, an average percentage of 83.09 percent was attained. The facial region of interest (ROI) is represented by a blue rectangle. The final retrieved frame is subjected to the Haar cascade classifier once again, resulting in a smaller ROI. The eye blink rate is used to calculate the drowsiness level after face identification. The authors employ three templates to examine the eye blink and aye area after detecting the eye region using template matching on the face. CV_TM_CCOEFF_NORMED from OpenCV is used because it produces better results than other template matching algorithms. The combination of eye and face detection allows for the measurement of eye blinking and proximity. If the eyes are closed, the closed eye value is greater than the open eye value, and vice versa if the eyes are open. The authors anticipated that if the face is pointing forward, the Haar cascade classifier will function. That is why the method of rotating the tilted face back to the front-facing position was proposed by the authors. It determines whether or not the head is tilted before calculating the degrees of rotation (angle). The amount of drowsiness of the driver is measured after precise detection of the face and eyes. If the driver blinks his eyes too often, the system detects drowsiness. A loud sound will be made to inform the driver when the level exceeds one hundred.

The suggested approach is compared to the Haar cascade, and the findings demonstrate that the proposed method is 99.59 percent accurate. It operates in all lighting settings and can detect the presence of glasses on the face.

Fig. 3 Facial Landmark Detection Using dlib

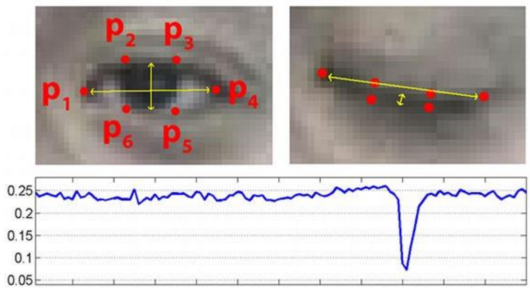

Fig. 4 Top-left: A visualization of eye landmarks when then the eye is open. Top-right: Eye landmarks when the eye is closed. Bottom: Plotting the eye aspect ratio over time. The dip in the eye aspect ratio indicates a blink

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

Equation 1. Eye Aspect Ratio (EAR)

CONCLUSION

This review provides an overview of a system that detects whether a person is drowsy while driving and if so, alerts him by using voice messages in real-time. This system streams real-time using both web cam.

The goal of this research is to find a solution to one of the leading causes of road accidents: driver drowsiness. The proposed solution tracks the driver's eyes and alerts him when they close, preventing the driver from losing control of the vehicle and causing traffic accidents.

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