Survey on Ai-Based Driver Drowsiness Detection and Alert System

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Abstract: ***In recent years driver fatigue is one of the major causes of road accidents in the world. A through way of measuring driver fatigue is measuring the state of the driver drowsiness. So it is very important to detect the fatigue of the driver to save life and property. This prototype is a real time system which captures image continuously and measures the state of the eye according to the specified algorithm and gives warning. This system works by means of monitoring the driver's eyes and sounding an alarm if he or she will become drowsy. The system designed in this way is a non-intrusive real-time monitoring system. The priority is to enhance motive force safety without being intrusive. When the driver's eyes are closed for an extended period of time, an alert sound is generated to notify him in order to certify that the driver is taking certain steps to avoid falling asleep. The output of the system proposed in the paper on Deep learning technology of Dlib which uses CNN (Convolutional Neural Network) as its base algorithm for accurate detection, OpenCV, and Raspberry Pi environments with a mounted camera for the same, show that system achieves good result when it comes to drowsiness detection, reducing the overall number of accidents on the streets. It fully complies with the system's needs and objectives. The structure has reached an unwavering state in which every bug has been eliminated.***

Keywords— Driver fatigue, fatigue detection, eye blink, drowsiness, Raspberry pi, open cv, Face detection, Driver monitoring system, Alarm.

INTRODUCTION

Driver drowsiness and distraction are now widely recognized as important contributors to deadly road accidents around the world. This typically occurs when a driver has not slept enough, but it can also occur as a result of untreated sleep problems, drugs, alcohol consumption, or shift employment. As a result, driver monitoring and identification are becoming increasingly important features of car safety systems. Head position, gaze direction, yawning, and eye state analysis are among the essential aspects. Driver drowsiness detection is a vehicle safety technology that facilitates saving you from injuries prompted by using drowsy driving. In line with various studies, fatigue is answerable for about 20% of all road accidents, and up to 50% on certain roads. Drowsiness may be detected quickly by way of the drowsiness detection machine. The driver's conduct is observed in many situations along with wearing spectacles and also within the circumstance inside the vehicle. The system is able to detect the drowsiness inside the period of more than seconds. After the detection of abnormal behavior, it's far alerted to the driving force through alarms and the parking lighting fixtures will be on so as to stop the car which reduces the accidents because of drowsiness of the driver. It is crucial that we keep looking into the things that lead to car accidents in order to come up with effective defenses against collisions, injuries, and fatalities. However, there is little objective scientific knowledge regarding the circumstances causing teen driver crashes because to the major limits in available crash data [2].Eyelid movement, pupil movement, head A person's degree of attention while driving may be judged by their movement and facial expression. Important information is included in one's eye health, and if visual activity can be assessed, it is feasible to predict a driver's degree of alertness, vigilance, or fatigue. Drowsiness detection methods based on ocular state analysis are numerous. Some of these systems employed a four-step process that included face recognition, eye detection, eye state analysis (open or closed).This research provides deep learning strategy for observing driver drowsiness based on computer vision. This strategy adopts the input stream from driver's face and divides drowsiness into three categories (normal, yawn, and drowsy). This model's major benefit is that it is compact enough to be implemented on an handheld microcontroller with camera embedded on it while maintaining decent

accuracy. A compressed model is important for integrating a driver's tiredness detection system into a normal car. Whereas a person who can fall asleep at any moment, having a real-time classifier for sleepiness detection that consumes little to no electricity and can be effortlessly installed on a car.

A typical driving behavior is a sign of behavioral symptoms, which are represented with the assistance of: • A delayed reaction,

• Not paying attention to what is going on around them, including obstructions, symptoms.

• Errors in coordination, pedestrians, and street

• The inability to keep a rigid, quick pace or trajectory.

• The physiological indicators appeared as unusual expressions, especially at the driving force's face, and showed up as:

• Squinting,

• A sore neck or ache again,

• Frequently yawning,

• Having trouble keeping the top in a frontal position and the eyes open.

• The lengths of micro sleep

LITERATURE SURVEY

Analysis of Physiological Signals EEG (Electroencephalogram) [4, 5], ECG (electrocardiogram) [5], and EoG (electrooculogram) are among the specialized sensors used by physiological sign primarily based sleepiness detection structures to monitor the alteration of warnings like brain hobby or coronary heart rate. 1) EEG, or electroencephalogram Multiple electrodes are used in the EEG (electroencephalogram) to evaluate neuronal electrical activity. Within the EEG, brain activity ranges from 1 Hz 30 Hz. Based on these frequency bands, brain activity may be classified into four types: delta (δ) (0–4Hz), theta (θ) (4–8Hz),. ECG, or electrocardiogram The electrocardiogram (ECG), which measures the cardiac muscle's electric activity, can be used to identify sleepiness. The level of heart rate variability can be used to gauge a driver's level of attentiveness; a more concentrated individual may have a more regular pulse than a less concentrated one. The electric impulses that generate coronary heart contractions, such as low frequency (LF), very low frequency (VFH), excessive frequency (HF), and the low frequency/excessive frequency ratio, are statistically recorded by the ECG sensor. Yuvraj Suryawanshi et al. [7] With effective brightness directed at the face, they can detect fatigue in real time during daytime hours. Their technology's main objective was to detect driver fatigue while they were on the road in order to prevent accidents. The LBP approach identified the facial region, the Haar algorithm identified the eye region, and the AdaBoost algorithm in conjunction with the Haar cascade, which was designed for the purpose of detecting eye blinking, identified the eye region. The outcome is immediate and in real-time since the system recognizes the face, the area around the eyes, and the blinking of the eyes. When there is a lack of brightness, insufficient light, or night vision, the device cannot identify the driver's fatigue. In the future, it is possible to enhance every area of their system's operating conditions.

Maurício Pamplona Segundo et al. [8] developed methods for frontally posed range photos with merely depth information as input for automatic face segmentation and landmark recognition. They recover the entire face region by fusing edge detection, region grouping, and shape analysis. They use facial photo relief curves and surface curvature categorization to identify the nose tip, nose corners, and inner eye corners. Their results highlight the benefits of a face recognition system that combines landmark and face detection, as well as how much this improves verification rates.

Sami Romdhani et al. [9] Pattern detection techniques are frequently used to scan large pictures. From their result, when building systems for real-world applications, decreasing computational complexity is the most challenging issue. In their study, they demonstrated computational reductions in classification utilizing a sequential reduced support vector analysis.

Swapnali Babasaheb Karvekar et al. [10] Physically demanding, repetitive labour can make people tired, which can lead to poor performance and musculoskeletal disorders that are connected to their jobs (WMSD).

METHODOLOGY

Driver sleepiness detection systems continually scan for different characteristics/features of the vehicle, the driver, or the surrounding environment to find anomalies in driving behaviour. The Driver Drowsiness Detection is categorized as illustrated in Fig. 1 based on the object being observed. The actual

number of cars and other vehicles on the road is steadily rising in modern nations. The issue with growing use of cars and other vehicles is that it results in more traffic collisions. These traffic accidents are brought on by excessive speeding, using a cell phone while driving, intoxicated drivers, and sleepy drivers [7]. A state that exists in between awake and sleep is known as drowsiness.

Web cam detection

Face and eye detection

Drowsiness and yawn detection

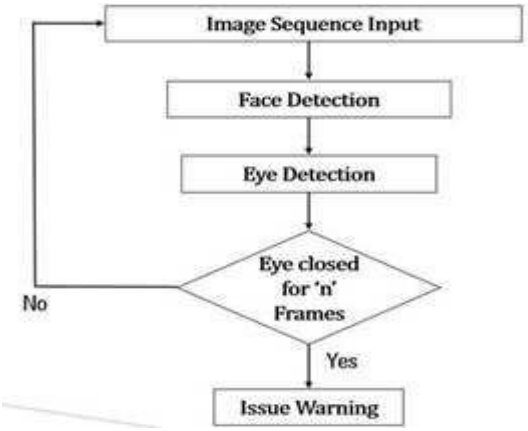

Fig 4.1: Flow chart

Capturing:

Camera appears and begins to capture the picture for further process.

Fig 4.2: capturing the image

Face and eye detection:

The eyelids, pupils, head movement, and facial expression of a driver reveal their level of concentration. If visual activity can be measured, it may be possible to anticipate a driver's degree of attention, attentiveness, or exhaustion. Eye health contains important information. There are several drowsiness detection techniques based on ocular state analysis. Some of these systems used a four-step procedure to identify exhaustion based on eye state analysis, which comprised face recognition, eye detection, eye state analysis (open or closed eye), and drowsy conclusion. These systems used regular cameras and didn't require training data

Drowsiness detection:

The device uses a web camera that is focused directly at the driver's face and records the driver's eye movements in order to detect weariness [11]. A warning signal is created to alert the driver when weariness is detected.

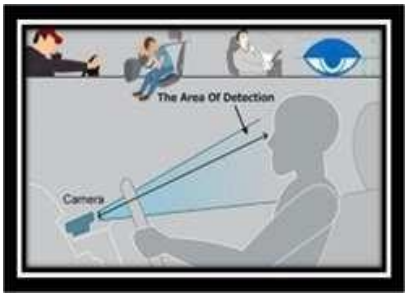

Fig 4.3: drowsiness detection

The block diagram of proposed system for detecting fatigue and sleepiness utilizing Deep learning and IoT technologies is shown in the Fig 2. In Fig 2, a driver can activate the system simply by turning on the power. When the system is turned on, the camera's input is transmitted to the CNN algorithm in Python file. Where the person's face is processed by the corresponding libraries, and every facial feature in the diagram is compared to its threshold value and a prediction of tiredness is made using a series of if else statements and the counter variable count. Based on the counter value, an email is sent to the concerned person or organisation who is linked to the driver for alertness. The key components of the proposed system are as follows:

Raspberry Pi 4 Model B: A Raspberry Pi is single-board based computer that functions as the micro-computer which has Raspbian operating system built in.

Speaker: To produce sound to alarm the driver.

Web Camera: A webcam is a little digital recording device that connects to the Raspberry Pi. It captures high-definition videos with static photos at 720p 30fps.

GPS Module: The GPS (Global Positioning System) is satellite-based system that uses satellites and ground control station to accurately measure and track its geographical position on earth surface.

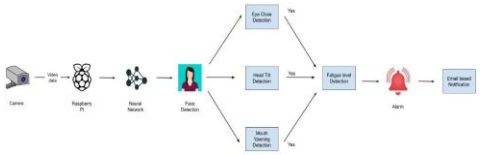

Fig 4.4 Block diagram of Drowsiness detection using Raspberrypi

Proposed system is basically divided into four major parts:

EYE Ratio= Distance between eyelids Distance between eye corner

• Detection of yawning: The trained model recognizes the driver's mouth, marks points while the mouth is closed, and calculates the person's tiredness based on the points and mouth open ratio. The approach helps in calculating clear prediction as the value obtained could be directly compared against the threshold value.

YAWN Ratio= upper-lower lips distance and distance between mouth corners.

Detection of head position: The Trained Model recognizes the drivers headbased position through length of nose and compares with average length of nose for detection.

Alarming System: Dependent on the driver's level of exhaustion, the sound system uses a microcontroller to alert the driver to take specific actions based on the amount of fatigue. In the event of an accident, an e-mail is sent to the appropriate employees as part of the alarming procedure.

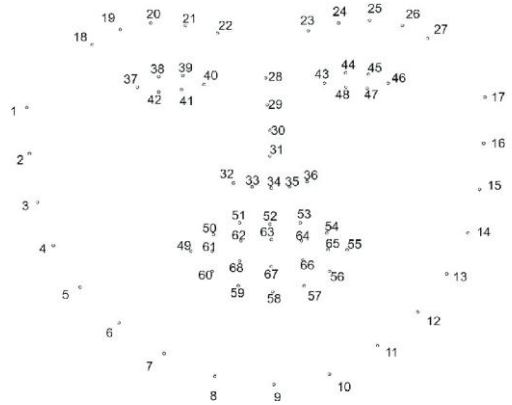

Fig 4.5: Facial landmark points

Drowsiness and tiredness are detected using pre-existing features for face landmark recognition. We utilized the open- source Python library dlib to recognize 68 facial landmarks. These predetermined annotations assist in form of prediction- based recognition of numerous face region parts such as eyes, nose, eyebrows, mouth and others shown in above Fig. 3. The person's numerous expressions are represented by variations in the set parameters of these separate points.

Table 1: Various facial region coordinates

Sr. no.	Facial Points	Landmark Coordinates
1)	Left Eye Region	[37, 42]
2)	Right Eye Region	[43, 48]
3)	Nose Region	[28, 36]
4)	Mouth Region	[49, 68]

The procedure for recognizing a facial landmark is as follows:

High-resolution cameras are used to monitor and capture images in process of extracting frames and then generate alerts. Each captured frame is evaluated to examine the pattern of features of the face, and EAR (Eye Aspect Ratio) and MAR (Mouth Aspect Ratio) at each frame is calculated using Haar Cascade Classifier. A blink and a yawn are considered when the Eye ratio and Mouth ratio values reach at their specific threshold levels. If eye gaze and yawns are detected for particular frames in a sequence, then system informs the driver via playing an alarm. The alarm is set off to get attention of driver and will continue to ring until driver gets wakes up.

A video is captured with a webcam and the frames are retrieved on a laptop. Following that, we have used image processing techniques such as open CV and dlib to extract the image. The video is recorded as soon as the driver sits in front of the web cam. Then eye closure, blinking, head tilt, and yawning are detected.

Eye Detection:

6 coordinates are marked on the eyes using the dlib landmarks predictor function, starting from the left corner and moving clockwise. The formula to obtain EAR (Eye Aspect Ratio), which is the height-to-width ratio of the eye.

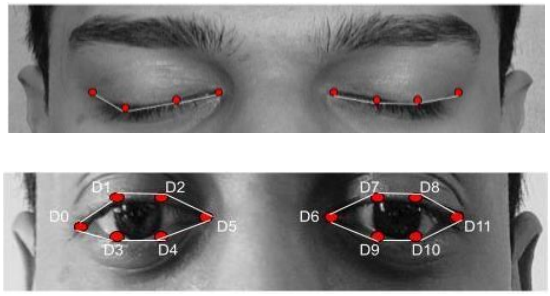

Fig 4.6: eyes open and closed coordinates

Mouth Detection:

The MAR (Mouth Aspect Ratio) is metric that determines the of wide your mouth. The mouth is represented by an 8- coordinate pair. The face landmarks are designated in clockwise manner, beginning at the left corner of your mouth. The MAR is obtained by taking the vertical distance between lower and upper lips by the horizontal distance between the lip corners.

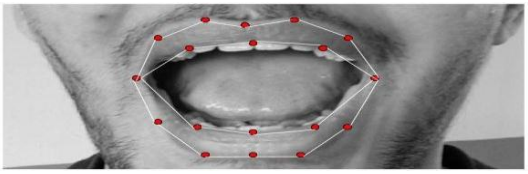

Fig 4.7: open mouth coordinates

RESULTS AND DISCUSSION

We used Python which provides the opencv and dlib packages, for facial recognition. Python is an interpreted general-purpose programming language. It is easy to understand.

Fig 4.8: System indicating drowsiness and yawning alert signal.

A system is built with a single camera and microcontroller and alarm which is compact as some of the methods previously in use were able to cause distraction to the driver, where the drivers were vulnerable to an accident.

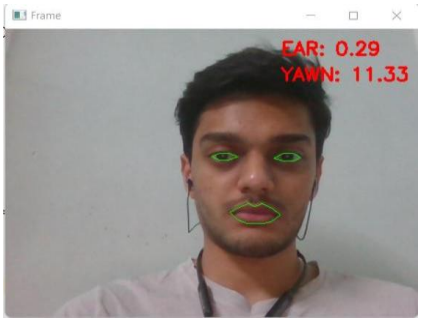

Fig 4.8: Score when eyes are open and subject is not yawning

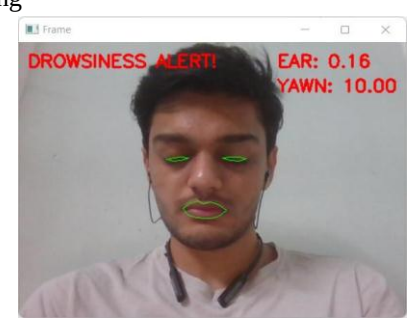

Fig 4.9: Score when eyes are closed (Alarming situation)

Driver	Frame	False Rate
D1	420	0.70
D2	420	2
D3	200	1
D4	200	3.4

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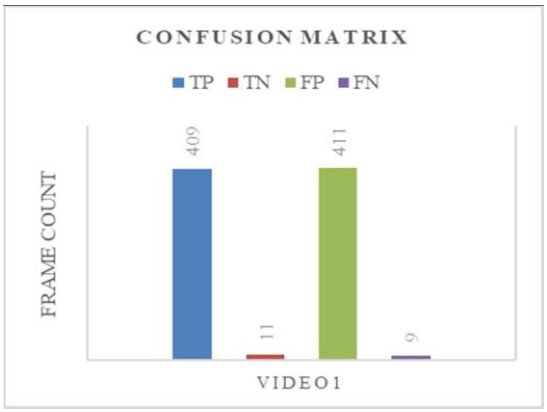
D1	420	0.70
D2	420	2
D3	200	1
D4	200	3.4



CONCLUSION

This model is capable of detecting drowsiness by monitoring the eyes. Shape prediction methods are used to detect face and then eyes. The inputs given to these methods are facial landmarks which are obtained from facial landmark detection.

The ability to prevent accidents and save lives makes this technology highly desirable across many fields, including transportation and healthcare. With ongoing advancements, drowsiness detection systems will become more intricate, reliable, and efficient. This will lead to safer environments on the road and at work. Many accidents will be avoided as a result, as will the drivers and vehicle's safety. Driver security and safety can be implemented in a regular car using eye detection. The main aim is to enhance the road safety and reduces the accidents due to drowsiness of driver.

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