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Driver drowsiness detection system using image processing

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Abstract
Driving a vehicle in a state of drowsiness is one of the problems that is increasing rapidly. People's lifestyles are the main reason behind this. Not getting proper sleep, eating an unhealthy diet, following an improper routine, experiencing work stress, etc. Drowsiness is not dangerous if a person is at home or even sitting in the back seat of a car, but if the person's brain is approaching this state, it may result in a disastrous accident. To deal with this problem, research and development are happening every second. In this paper, an image processing-based technique has been analysed to detect the state of drowsiness by analysing the facial behaviour and trigger an alarm to prevent any mishappening.

Keywords: Drowsiness detection, sleep detection, blink pattern, image recognition

1. Introduction
The rapid growth in automobiles in our country is the main reason behind the exponential growth of road accidents. Several studies suggest that 20 to 50 million people are injured or killed in road accidents all over the world. There are many factors responsible for the road accidents like speeding, drunken driving, unsafe road infrastructure, and many more, out of which 30% of accidents are caused by drivers falling asleep on wheels. Driver drowsiness accidents may occur in various situations like long-distance driving without taking proper rest, early morning or late-night rides, and sleep deprivation. The consequences of driver drowsiness accidents are very devastating and affect not only the driver but also the other vehicles around and the pedestrians which may lead to severe injuries and casualties.
To address this problem, we are developing a Driver Drowsiness Detection System (DDDS)-advanced technology to detect drowsiness and an alert system to prevent accidents. The system mainly monitors the driver's physical behaviour such as eye movement, and head position. For example, if the driver's eyes remain closed for a few seconds or eyes are getting closed very frequently then the system will send an alert to the driver and reduce the vehicle's speed which will give more time to take any required action. An eye-tracking-based drowsiness detection system has been done by analysing the duration of eye closure by using a camera and developing an algorithm. This system can be used in industry transportation, and public use as well as the airplane security system.

2. Literature Review
Existing Research
One common approach to developing a system for detecting the drowsiness state of driver is by using EEG signals. In this method, eyelid closure percentage (PERCLOS) is calculated and examined to detect the state of the driver, whether they are feeling drowsy or not. EEG signals are comprised of different bands that are classified into two parts: low-frequency bands (delta, theta, and alpha) and high-frequency bands (beta, gamma). During the drowsy state compared to the normal state, the low- frequency bands, mainly the alpha band, display a growth in band power at the same time high-frequency bands, mainly the beta band, show a decrease in band power in the state of drowsiness.
Another way to deal with this problem is by using image processing. In this technique, the driver's blink pattern is observed, and based on that, it is decided whether the driver is in a state of drowsiness or not.

Developed Technologies

Mercedes-Benz: Mercedes-Benz introduced a system called Attention Assist in 2009, which monitors levels of driver fatigue and drowsiness. It provides visual and audible alerts to alert the driver if they are too sleepy to continue driving. It is connected to the car's navigation system and uses that data to determine the locations where fuel and coffee is available.

Bosch: Drowsy driver detection takes into account steering angle sensors, the front lane assist camera, vehicle speed, and turn signals. The Bosch system not only recognises dangers and warns the driver, but also intervenes in a targeted manner. If the driver's eyelids become heavy or the driver is distracted, the camera will record. In addition to drowsiness and distraction detection, NCAP also requires the detection of children left in the vehicle.

Hi-tech Robotic Systems Ltd. (THRSL) is a Gurgaon-based IT company, has developed an indigenous drowsiness alert system that will helps reduce the risk of road accidents caused by drivers falling asleep while driving. The security device, named Novus Aware, was designed and manufactured locally and presented at the Components Show in the Innovation Pavilion at Auto Expo 2016. It was shortlisted by the ACMA in the category of innovative technological products.

Challenges and Limitations

There are several pieces of work happening simultaneously to make a system for detecting drivers' drowsiness, but there are several challenges and limitations that need to be addressed.

- **Variability in Facial and Eye Features**

Facial and eye features can vary across individuals due to various factors such as age, ethnicity, and gender. This can cause a variation in the appearance of facial and eye features, making it challenging to develop a universal model that can accurately detect drowsiness in all individuals.

- **Dynamic Driving Conditions**

Driving conditions can differ for every individual, including factors such as lighting conditions, weather conditions, and driving speed. These variations affect the reliability of the images or videos captured for drowsiness detection, and there is a strong possibility that they can lead to false detections or missed detections. It can be a great challenge to address while creating a model for drowsiness detection that is robust to all these variations.

3. Methodology

The approach used to design a drowsiness detection system is an iterative cycle of research and analysis. In the research phase, concepts are generated, and in the analysis, concepts are selected and in this phase needs and constraints are analysed. The cycle is then repeated to generate finer concepts, which are then analysed.

The proposed methodology is based on image recognition system that detects the state of driver if they are normal or drowsy. If the state is detected as drowsy then the system is triggering an alarm.

This is developed in some steps that is described further in this paper.

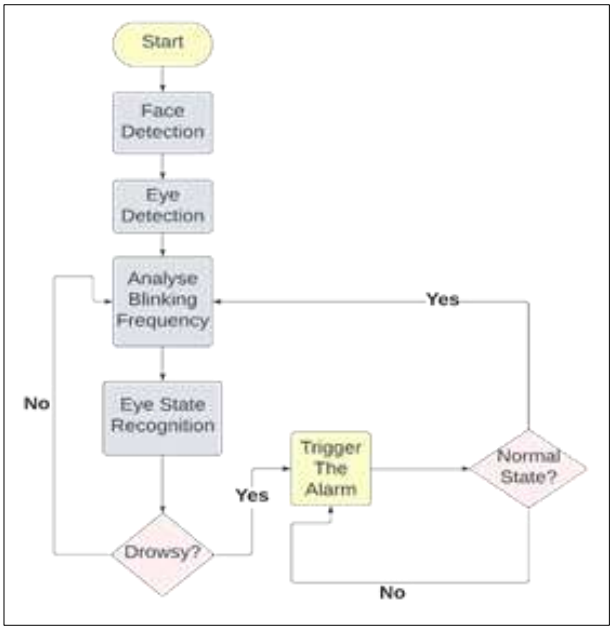

Fig 1: Working flowchart of proposed system

Figure 1 shows the working flow of proposed system. At each step some process is going on that is briefly described further.

At the very first step figure 1 shows, face detection algorithm is used to detect the face of driver. To use this algorithm a pre trained face detector module from dlib library is used. It is based on the Histogram of Oriented Gradients (HOG) in combination with a linear Support Vector Machine (SVM) for classification. This pre trained module to detect the facial landmark used to estimate the location of 68 (x, y)- coordinates that map to facial structures on the face. The 68 landmark outputs are shown in the figure 2.

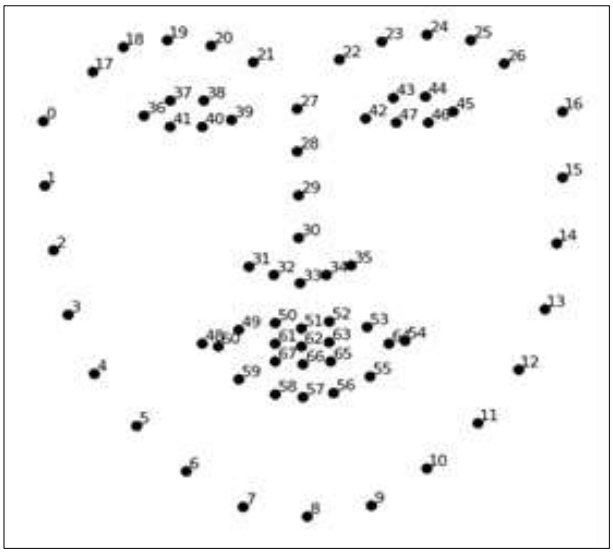

Fig 2: 68 Face landmarks of HOG in dlib

At the **second step** in figure 1, the eyes are detected using their indexes, and then the aspect ratio is calculated to classify the status of eyes whether they are opened or

closed. The determination condition of opened eye is "The eye-aspect ratio should be greater than threshold" (Around 0.3).

At the **third step**, the determination of drowsy blinks is done. A blink is supposed to last 200–300 milliseconds, but a drowsy blink would last for 800-900ms.

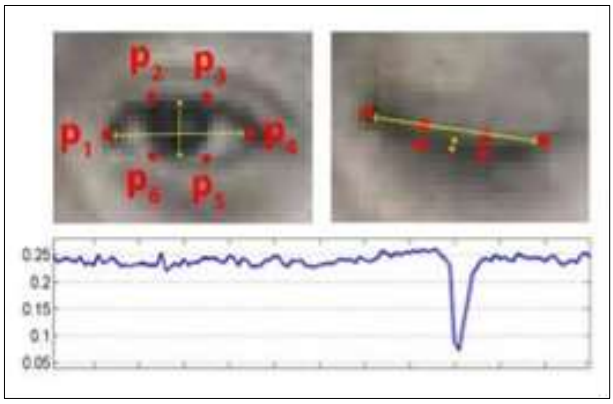

Fig 3: Detecting the state of eye

Figure 3 shows the detection of eye blink based on plotting some indexes.

```
def checkBlinkStatus(eyeStatus):
    global state, blinkCount, drowsy
    if(state >= 0 and state <= falseBlinkLimit):
        if(eyeStatus):
            state = 0

        else:
            state += 1

    elif(state >= falseBlinkLimit and state < drowsyLimit):
        if(eyeStatus):
            blinkCount += 1
            state = 0

        else:
            state += 1


    else:
        if(eyeStatus):
            state = 0
            drowsy = 1
            blinkCount += 1

        else:
            drowsy = 1
```

Fig 4: Code to check the blink status of eyes

Figure 4 shows the code to check the blink status of eye based on the features and values received by observing the driver's blink frequency and current eye status.

At last step in figure 1, if the state is detected as drowsy then the system will play an alarm until the state is normal again.

```
def soundAlert(alarmPath, drowsyStatus):

    while drowsyStatus == 1 :
        playsound.playsound(alarmPath)
```

Fig 5: Code to play alarm

Figure 5 shows the code to trigger an alarm if the state of driver is detected as drowsy.

5. Experimental setup

To check the workings of this technique, there are some requirements for hardware as well as software.

- **Hardware Specification**

The hardware specification that is required to test this proposed system contains:
PC/Laptop, Webcam, Ram (>= 4GB),
Speaker.

- **Software Specification**

The software specification that is required to test this proposed system contains:
Python interpreter, OpenCV, Dlib.
Driver Drowsiness Detection System provides a safety measure to drivers so that it needs to fulfil some safety criteria to deal with any mishappening.

Features Required

- Reliability: The solution must be able to reliably detect the state of drowsiness in order to fulfil its purpose as a driver safety promotion system.
- Real-Time Response: Vehicle operation may involve high speeds, and it is necessary for the system to detect the states in a real-time without any delay. If the system fails to do so, serious consequences may result.
- Economical: There are few existing solutions to this problem are available and widely used, but sometimes it may not be economical.
- Flexible: To be effective, a solution must be designed to physically accommodate all types of users.
- To develop a method to detect driver drowsiness using image recognition, certain algorithms and libraries will be utilised.

Libraries Used

There are some important libraries that are used to implement this particular approach.

- Dlib- It is an open-source, cross-platform library written in the C++ language. It is mainly used in face recognition tasks.
- OpenCV- It is a Python library that performs tasks related to image processing and computer vision.
- Playsound- This library allows to play any kind of sounds/alarm. When the system will detect the state as drowsy then this particular library is used in order to play the alarm system.

Algorithms Used

Face Detection Algorithm- This algorithm will detect the face of the driver, and only if it returns true can further algorithms work. It works by detecting the facial features of an image or video using machine learning techniques.

```
detector = dlib.get_frontal_face_detector()
predictor = dlib.shape_predictor(modelPath)
modelPath = "models/shape_predictor_68_face_landmarks.dat"
```

Fig 6: Code to load in built dlib module

Figure 6 shows, how to load in built module of dlib for face detection. This dlib method uses 68 face landmarks to get the facial features.

Eye Detection Algorithm- The true value of the face detection algorithm signifies that the driver's face is properly visible, and then the eye detection algorithm detects the eye of the driver by analysing the landmarks of the eye. The particular landmarks of the eye are based on some indexes, that is shows in figure 7.

```
leftEyeIndex = [36, 37, 38, 39, 40, 41]
rightEyeIndex = [42, 43, 44, 45, 46, 47]
```

Fig 7: Eye landmarks index

Fig 8: Experimental setup test proposed system

Figure 8 shows the setup that is required to test this proposed methodology. A camera is installed such that driver's face is clearly capturable by it. The algorithm will run continously and if its detect drowsiness state then the speaker will produce an alarm.

6. Result and Outcomes

The successful execution of this proposed methodology produces an outcome that handles three different cases.

Case 1

Figure 9 shows the first case where the driver is in normal state and it is determined by the system as it is calculating the blink status in the background.

Fig 9: Driver status is normal

Case 2

The second case is shown by Figure 10 that if the blinking status matched the condition of drowsiness, then system will detect this condition and trigger an alarm.

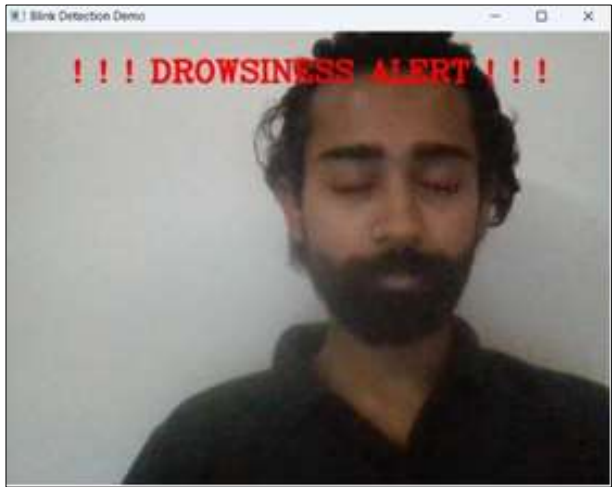

Fig 10: Driver is in the state of drowsiness

Case 3

In the third case, if driver's face is not clearly detectable by the system, then it will produce and warning. As we can see in Figure 11 face detection is interrupted as the hand of the driver covers the face.

Fig 11: Driver face is not detectable

7. Conclusion

There are different techniques that are being discovered and enhanced to detect the drowsiness state of the driver and trigger an alarm so that any mishaps can be prevented. This paper aims to analyse and develop a system based on image recognition to build an alarm system in order to handle the problem associated with drowsiness. Currently, few automobile manufacturing companies are providing these safety features in their vehicles, but they are not effective in every circumstance, and vital research and development are still in their infancy.

8. References

1. Poursadeghiyan M, Mazloumi A, Saraji GN, Baneshi MM, Khammar A, Ebrahim MH. Using image processing in the proposed drowsiness detection system design. Iran Journal of Public Health. 2018 Sep;47(9).

2. Yan JJ, Kuo HH, Lin YF, Liao TL. Real-Time Driver Drowsiness Detection System Based on PERCLOS and Grayscale Image Processing. In: 2016 International Symposium on Computer, Consumer and Control (IS3C).
3. Babu A, Nair S, Sreekumar K. Driver Drowsiness Detection System Using Dlib HOG. In: Smart Innovation and Systems and Technologies Book Series (SIST, Vol. 243).
4. Kaavya RM, Ramya V, Franklin RG. Alert System for Driver's Drowsiness Using Image Processing. In: 2019 International Conference on Vision Towards Emerging Trends in Communication and Networking (ViTECoN).
5. Picot A, Charbonnier S. On-Line Detection of Drowsiness Using Brain and Visual Information. IEEE Transactions on Systems, Man, and Cybernetics Part A: Systems and Humans. 2012;42(3).
6. Gupta AD, George A. A Vision-Based System for Monitoring Loss of Attention in Automotive Drivers. IEEE Transactions. 2013;14(4).
7. Mbouna RO, Kong SG. Visual Analysis of Eye State and Head Pose for Driver Alertness Monitoring. IEEE Transactions. 2013;14.
8. Saini V, Saini R. Driver Drowsiness Detection System and Techniques. IEEE. 2017;5.
9. Suryaprasad J, Sandesh D, Saraswathi V, Swathi D, Manjunath S. Real-Time Drowsy Driver Detection using Haar Cascade Samples. 2013.
10. Hariri B, Abtahi S, Shirmohammadi S, Martel L. A Yawning Measurement Method to Detect Driver Drowsiness.
11. Danisman T, Bilasco IM, Djerba C, Ihaddadene N. Drowsy Driver Detection System using Eye Blink Patterns. In: 2010 International Conference on Machine and Web Intelligence (IEEE).
12. Kaushik P, Yadav R. Reliability design protocol and blockchain locating technique for mobile agent. Journal of Advances in Science and Technology (JAST). 2017;14(1):136–141. https://doi.org/10.29070/JAST.