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Drowsiness Detection of Drivers Using MachineLearning

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***Abstract*-Drowsy driving is a major cause of road accidents, leading to severe injuries and fatalities. This study presents a machine learning-based approach to detect driver drowsiness in real time. The system utilizes various input modalities, including facial features, eye closure duration, yawning frequency, and head position, captured through a camera. Advanced image processing techniques are employed to analyse facial expressions and eye movement patterns. Additionally, physiological signals such as heart rate and EAR for facial landmarks. The programming for this is done in OpenCv using haar cascade library for facial detection other machine learning libraries for detection facial features.The system detects if a driver is feeling drowsy or not in generates alarm which helps the drivers a lot. This research contributes to enhancing road safety by offering an intelligent, non-intrusive, and real-time drowsiness detection solution.**

***Keywords*-Drowsiness detection, eye closure detection, openCv, haar cascade library, facial future analysis, real time monitoring.**

I.INTRODUCTION

Driver fatigue plays a crucial role in a significant number of vehicle accidents, contributing to both fatalities and injuries. Recent data suggests that approximately 1,200 deaths and 76,000 injuries occur each year due to fatigue-related crashes. Addressing this issue is a major priority in the field of road safety, prompting researchers and engineers to explore innovative solutions. Developing technologies capable of detecting or preventing drowsiness in drivers remains a critical challenge in the advancement of accident-prevention systems.Due to the dangers that drowsiness poses on the road; it is essential to develop effective methods to mitigate its impact. This project aims to create a prototype drowsiness detection system, with a primary focus on designing a system capable of accurately monitoring the driver's eye state in real-time to determine whether their eyes are open or closed.Monitoring eye movements and behaviour is considered an effective method for detecting early signs of driver fatigue. By analysing indicators such as blinking patterns, eyelid closure, and gaze direction, it is possible to identify drowsiness before it leads to a potential accident. This approach plays a crucial role in enhancing road safety by providing timely warnings or triggering corrective measures to prevent collisions.

Throughout history, humans have developed machines and innovative techniques to enhance their daily lives, whether for routine tasks like commuting or more complex endeavours such as air travel. As technology has progressed, transportation methods have continually evolved, leading to a significant rise in our reliance on them. This rapid advancement has transformed the way people move, making travel more efficient and accessible while also shaping modern society. It has affected our lives as we know it. Now, we can travel to places at a pace that even our grandparents would not have thought possible. In modern times, everyone in this world uses some sort of transportation every day. Some people are rich enough to have their own vehicles while other use public transportation.Regardless of social status, every driver must adhere to specific rules and codes of conduct. One of the most fundamental responsibilities is remaining alert and attentive while driving. Failing to uphold these safety measures has contributed to countless tragedies each year, turning a remarkable invention into a source of danger. While some may overlook the importance of traffic regulations, abiding by them is essential for ensuring road safety. When in motion, a vehicle holds significant power, and in the hands of a reckless driver, it can become a serious threat—not only to those inside but also to pedestrians and others on the road.One form of negligence is failing to acknowledge when we are too fatigued to drive. Monitor and prevent a destructive outcome from such negligence, many researchers have authored research papers on driver drowsiness detection systems. However, there are instances where the system's assessments and observations may lack complete accuracy. Certain factors, such as environmental conditions or individual differences among drivers, can lead to misinterpretations. As a result, the effectiveness of these technologies may vary, highlighting the need for continuous improvements and refinements to enhance their reliability.Hence, to provide data and another perspective on the problem at hand, to improve their implementations and to further optimize the solution, this project has been done.

Recent statistics indicate that in 2015 alone, India recorded 148,707 fatalities caused by car-related accidents.Among these incidents, at least 21 percent were the result of driver fatigue, leading to errors behind the wheel. Drowsiness impairs reaction time, decision-making, and overall control, significantly increasing the risk of accidents on the road. This can be a smaller number still, as among the multiple causes that can lead to an accident, the involvement of fatigue as a cause is grossly underestimated. Fatigue, when coupled with poor infrastructure in developing nations such as India, creates a highly dangerous situation. Inadequate road conditions, lack of proper signage, and insufficient lighting further amplify the risks associated with drowsy driving, making accidents more likely and severe. Fatigue, in general, is exceedingly difficult to measure or observe unlike alcohol and drugs, which have clear key indicators and tests that are available easily. The most effective ways to address this issue include raising awareness about fatigue-related accidents and encouraging drivers to acknowledge when they are too tired to drive. However, spreading awareness can be both challenging and costly. Additionally, without proper awareness, drivers may be reluctant to take breaks, especially since long hours on the road are often financially rewarding. When there is an increased need for a job, the wages associated with it increases leading to more people adopting it. This is particularly true for nighttime transport vehicle drivers, where financial incentives push them to make risky choices, such as driving through the night despite exhaustion. A major reason for this behaviour is the lack of awareness about the severe dangers of fatigued driving. While some countries have implemented regulations limiting the number of consecutive driving hours, these measures remain insufficient. Fatigue remains a significant safety concern that no country has fully addressed, largely due to the complex nature of the issue.

Fatigue, in general, is exceedingly difficult to measure or observe unlike alcohol and drugs, which have clear key indicators and tests that areavailable easily. The most effective approaches to tackling this issue involve increasing awareness of fatigue-related accidents and encouraging drivers to recognize and admit when they are too tired to drive. However, raising awareness is both challenging and costly. Moreover, without proper understanding of the risks, drivers may be unwilling to acknowledge fatigue, especially when extended driving hours offer significant financial incentives.

The Project is being developed using OpenCV's pre-trained Haar Cascade classifier which is extremely fast for Face detection and the facial features are extracted using the Dlib Shape predictor. The metrics Eye Aspect Ratio and Mouth Aspect Ratio are used to monitor eyes and mouth.

II.LITERATURE **S**URVEY

World Bank survey injuries and deaths put a significant financial burden on the victims' families, pushing the destitute into poverty and debt. Road accidents have a considerable influence on the country's human resources.
According to the experts it has been observed that when drivers do not take a break, they tend to run an elevated risk of becoming drowsy. Studies have indicated that driver drowsiness contributes to approximately 20% of all road accidents, surpassing the incidence of accidents caused by alcohol impairment. To address this issue, technologies such as Attention Assist have been developed to monitor driver attentiveness across a wide range of speeds. These systems alert drivers when signs of fatigue or inattentiveness are detected, provide information on the duration of continuous driving since the last rest, and offer adjustable sensitivity settings. Additionally, upon issuing a warning, they can suggest nearby service areas through integrated navigation systems like COMAND, encouraging drivers to take necessary breaks and thereby enhancing road safety.

This is about making cars more intelligent and interactive which may notify or resist user under unacceptable conditions, they may provide critical information of real-time situations to rescue or police or owner himself. Driver fatigue resulting from sleep disorders is a principal factor in the increasing number of accidents on today's roads.This paper presents a real-time safety prototype designed to regulate vehicle speed in response to driver fatigue.

Researchers have attempted to determine driver drowsiness using the following measures: vehicle-based measures, behavioural measures, physiological measures.
A comprehensive review of these measures will offer valuable insights into existing systems, the challenges they face, and the improvements required to develop a more effective solution. This paper examines three key approaches based on the sensors utilized, highlighting their benefits and limitations. Additionally, it explores various experimental methods used to induce drowsiness for research purposes. The study concludes that integrating a hybrid drowsiness detection system, which combines non-intrusive physiological monitoring with other techniques, can enhance accuracy in detecting driver fatigue. Implementing such a system could help prevent numerous road accidents by issuing timely alerts to drowsy drivers

This project focuses on developing an interface for detecting driver drowsiness by continuously monitoring eye movements using image processing and DIP algorithms. Micro-sleeps, which last for about 2 to 3 seconds, serve as a strong indicator of fatigue. By using a camera to track the driver's eyes in real-time, the system can identify signs of drowsiness and issue timely warnings. The goal is to create advanced hardware that enhances road safety through a combination of controllers and image processing technology. The system not only detects drowsiness and alerts the driver with an alarm but also reduces the vehicle's speed as a precautionary measure. Additionally, an ultrasonic sensor is integrated for continuous distance monitoring, further improving overall safety.The ultrasonic sensor detects the obstacle and accordingly warns the driver as well as decreases the speed of vehicle.

III.PROPOSED METHODOLOGY

Driver's Drowsiness is detected using different machine learning libraries like OpenCV and Dlib. Here the face recognition is being done along with detecting weather the eyes are open or closed. If the eyes have seemed to be closed for a significant amount of time. An alarm is triggered to make the driver Alert.

3.1 DROWSINESS DETECTION DESIGN

A camera is setup that looks for faces in the input video stream and monitors frames of faces. If a face is identified, facial milestone identification is connected, and the eye district is removed from the edges of the video stream.

3.2 Technology Used

Python:Python is a high-level, interpreted programming language developed by Guido Van Rossum and introduced in 1991. Designed with an emphasis on readability, it utilizes significant whitespace to enhance code clarity. With a focus on simplicity and efficiency, Python supports an object-oriented approach that enables developers to write clean and logical code suitable for both small and large-scale applications. It includes dynamic typing and manages memory automatically using garbage collection.Additionally, Python accommodates various programming paradigms, including procedural, object-oriented, and functional programming, making it a versatile choice for developers.

PyCharm:PyCharm is an Integrated Development Environment (IDE) designed for Python programming. Developed by the Czech company JetBrains, it offers features such as code analysis, a graphical debugger, an integrated unit tester, and seamless integration with version control systems (VCS). Additionally, it supports web development with Django and data science workflows with Anaconda. PyCharm is a cross-platform IDE, compatible with Windows, macOS, and Linux. It is available in two editions: the Community Edition, which is open source under the Apache License, and the Professional Edition, which includes additional features and is distributed under a proprietary license.

OpenCV:OpenCV (Open-Source Computer Vision) is a library consisting of programming functions designed for real-time computer vision applications. Initially developed by Intel, it later received support from Willow Garage and Itseez before Intel reacquired it. This cross-platform library is available under the open-source BSD license, making it free to use. OpenCV is compatible with various deep learning frameworks, including TensorFlow, Torch, and Caffe, and it also supports PyTorch models after conversion to the ONNX format. Additionally, it promotes Open Vision Capsules, a portable format designed for compatibility across different platforms.

SciPy: The SciPy library relies on NumPy, which offers efficient and convenient manipulation of N-dimensional arrays. The SciPy library is designed to operate with NumPy arrays and offers a range of efficient and user-friendly numerical methods, including functions for numerical integration and optimization. Both libraries are compatible with major operating systems, easy to install, and available for free. NumPy and SciPy are easy to u the basic data structure used by SciPy is a multidimensional array provided by the NumPy module. NumPy provides some functions for Linear Algebra, Fourier Transforms a Random Number Generation.

NumPy: NumPy is a Python library that provides support for large, multi-dimensional arrays and matrices, along with a wide range of high-level mathematical functions for performing operations on these arrays. The ancestor of NumPy, Numeric, was originally created by Jim with contributions fromseveral other developers. In 2005, Travis created NumPy by incorporating features of the competing Num array into Numeric, with extensive modifications. NumPy is an open-source project with contributions from a large community of developers.

Dlib: Dlib is a contemporary C++ toolkit that includes machine learning algorithms and various tools for developing complex software solutions in C++. It is widely utilized in both industry and academia across multiple fields, such as robotics, embedded systems, mobile devices, and high-performance computing environments. As an open-source library, Dlib is freely available for use in any application.

• Functions for loading and saving images in commonly used formats.

• Automatic colour space conversion between various pixel types

• Basic image processing tasks, including edge detection and morphological transformations.

IV.SYSTEM ARCHITECTURE

The architecture described in the image represents a drowsiness detection system for drivers. It follows a structured workflow to detect and alert drowsy driving behaviour. The system consists of the following steps:

1. **Camera Input:** The system captures real-time video using a camera focused on the driver's face.
2. **Dividing into Frames:** The video feed is split into individual frames for further processing.
3. **Face Detection:** The system detects the driver's face in each frame using a face detection algorithm.
4. **Filter for Face Detection:** A filtering mechanism ensures that only relevant facial data is processed.
5. **Eye and Mouth Landmark Plotting:** The system identifies and maps facial landmarks, particularly around the eyes and mouth.
6. **FaceLandmarkPredictor:** A specialized model predicts the positioning of facial features to analyse expressions.
7. **Drowsiness Detection:** The system assesses whether the driver exhibits signs of drowsiness (e.g., closed eyes, yawning).
8. **Alert Mechanism:** If drowsiness is detected, the system triggers an alert (such as a sound or vibration) to wake the driver.

This architecture ensures real-time monitoring and alerts to prevent accidents due to driver fatigue.

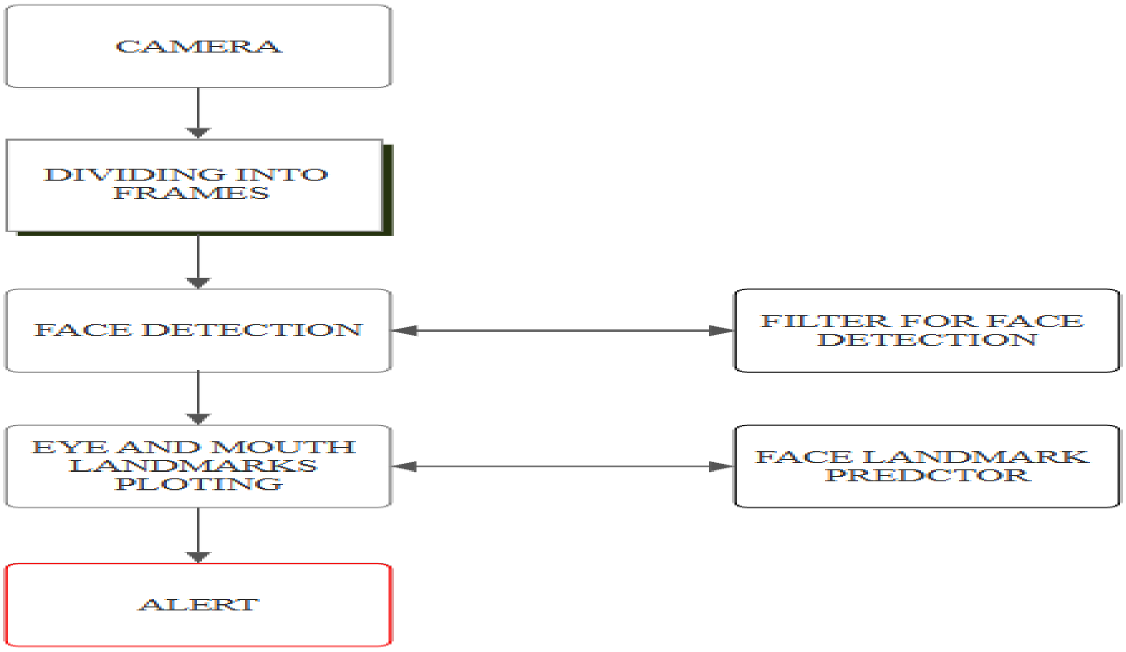


Figure 1: System Architecture

V. METHODOLOGY

The methodology for implementing a drowsiness detection system involves a structured approach, including data acquisition, preprocessing, feature extraction, drowsiness detection, and alert mechanisms. Below is a detailed breakdown of the methodology:

5.1 Data Collection

The first step involves collecting relevant data for training and testing the system.

5.1.1 Video recording and processing

A camera is mounted inside the vehicle, focusing on the driver's face.
The system captures video frames in real-time.
The dataset consists of both drowsy and alert driver facial expressions.

5.1.2 Dataset Preparation

If using machine learning, a labelled dataset is required with images of:
EyesOpen (Alert)
EyesClosed (Drowsy)
Yawning (Drowsy)

5.2Preprocessing

Preprocessing enhances the images for accurate feature extraction.

5.2.1 Frame Extraction

Convert the video feed into individual frames for processing.

5.2.2 Image Enhancement

Convert images to grayscaleto minimize computational load.
Apply Gaussian blur to eliminate noise.
Resize images to ensure uniform dimensions.

5.2.3 Face Detection

Detect the driver's face using a face detection algorithm:
Haar Cascade Classifier (lightweight but less accurate).
Dlib's-based detector (high accuracy but computationally expensive).

5.2.4 Facial Landmark Detection

Detect facial landmarks, specifically focusing on eyes and mouth using:
Dlib's facial landmark detector with 68 key points.

5.3 Feature Extraction

The system extracts feature related to drowsiness, focusing on eye and mouth movements.

5.3.1 Eye Aspect Ratio (EAR) Calculation

EAR is used to determine if the driver's eyes are open or closed.
Formula:

$$EAR = \frac{(d_2 + d_3)}{2 \times d_1}$$

If EAR drops below a threshold (e.g., 0.2) for a certain duration (e.g., 3 seconds), the driver is considereddrowsy.

5.3.2 Mouth Aspect Ratio (MAR) Calculation

MAR detects yawning behaviour.
Formula:

$$MAR = \frac{(d_2 + d_3 + d_4)}{3 \times d_1}$$

If MAR exceeds a threshold (e.g., 0.6), it indicates a yawn.

5.4Drowsiness Detection Model

The system classifies the driver's state based on extracted features.

5.4.1 Rule-Based Detection (Simple Approach)

If EAR < 0.2 for more than 3 seconds → Drowsy Alert.
If MAR > 0.6 (Yawning detected) → Drowsy Alert.

5.5 Alert System

If signs of drowsiness are detected, the system activates an alert.

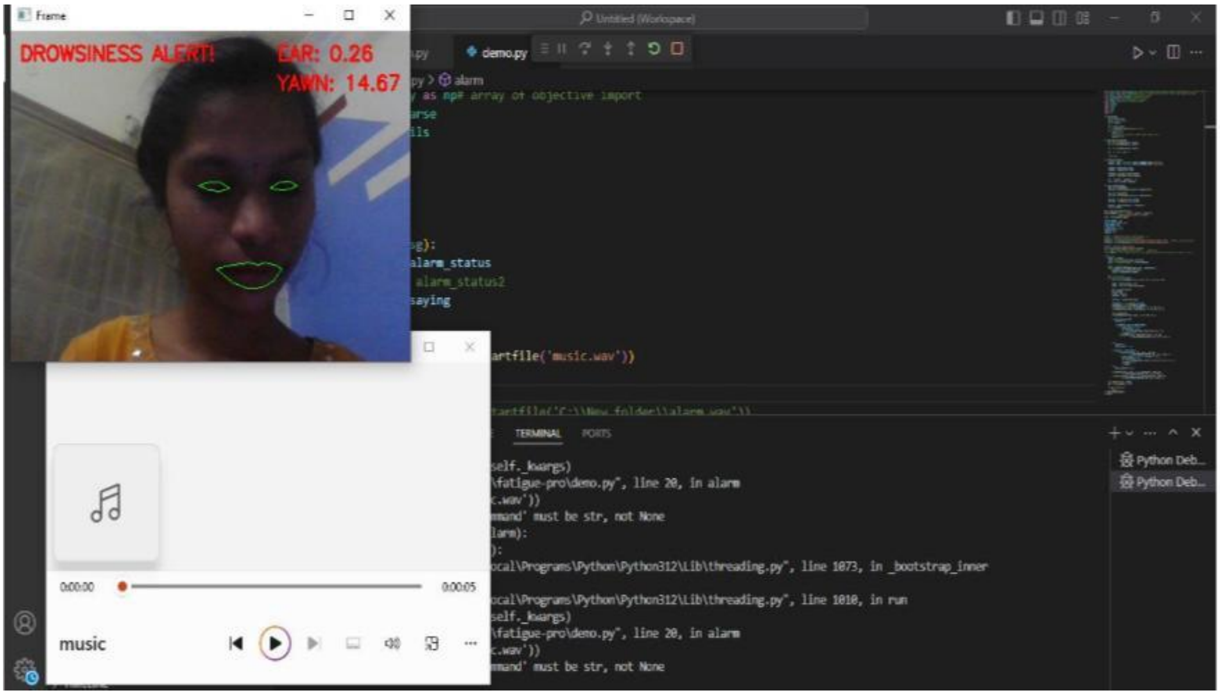
5.5.1 Types of Alerts

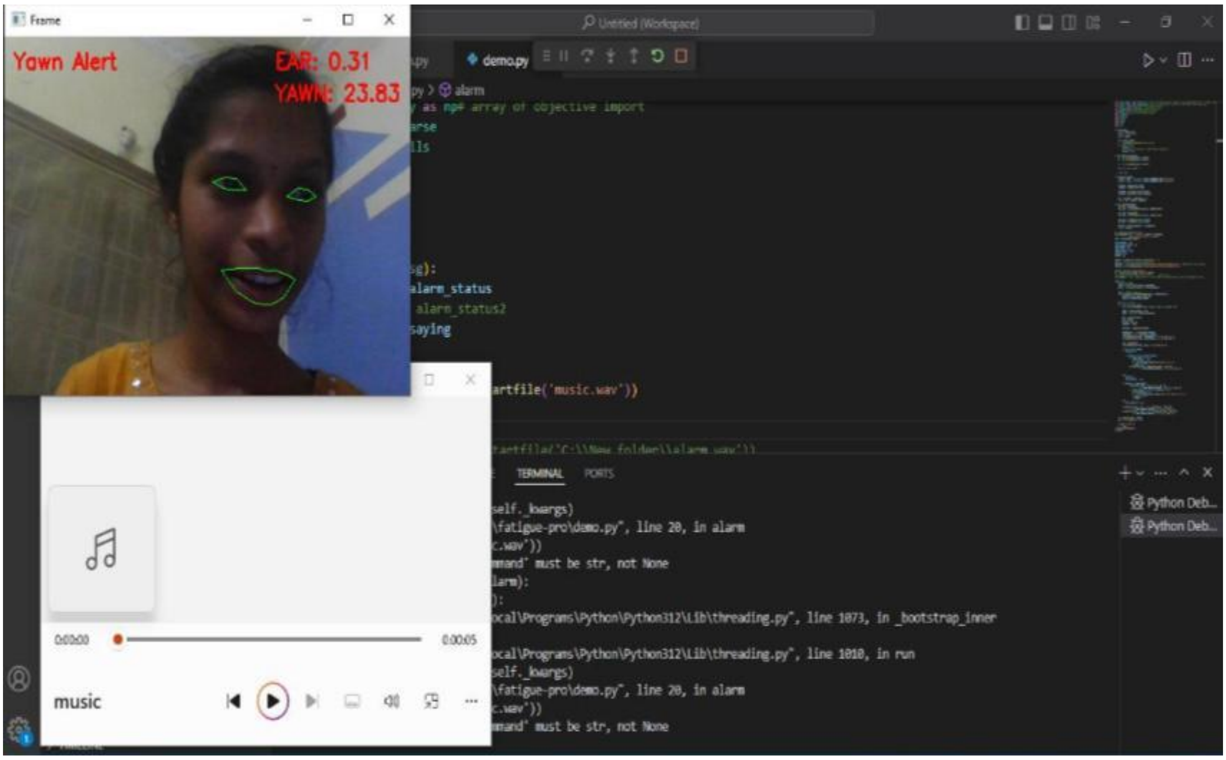
Audio Alert: A buzzer or voice command warns the driver.

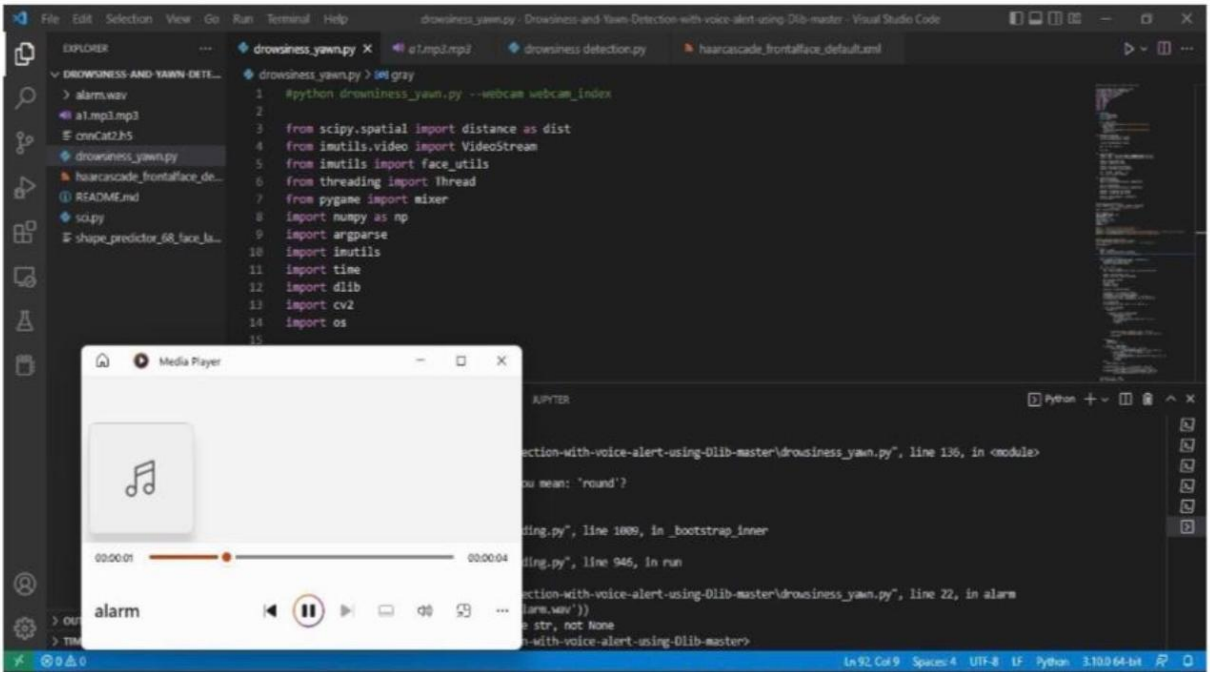
Visual Alert: A flashing light or warning on the car dashboard.

Haptic Alert: Vibrations on the steering wheel or seat.

RESULT







VI.CONCLUSION

This study designed an automated system to detect driver drowsiness. The continuous video stream is read from the system and is used for detecting the drowsiness. It is detected by using haar cascadealgorithm. The haar cascade algorithm uses haar features to detect face andeyes. Haar features are predefined are used for detecting different things. The haar features are applied on the image and blink frequency iscalculated using parclos algorithm. If the value remains zero for some amountof time, then it detects as sleepy and alerts driver by activating an alarm. Ifthe value remains constant for longer periods, then the driver issaid to be distracted then also an alarm is activated.

REFERENCES

[1.]Assari, M. A., &Rahmati, M. (2011). Driver drowsiness detection based on facial expression recognition. 2011 IEEE International Conference on Signal and Image Processing Applications (ICSIPA).

[2.]Tianyi Hong, Huabiao Qin, &Qianshu Sun. (2007). An Improved Real Time Eye State Identificationsystem in Driver Drowsiness Detection. 2007 IEEE International Conference on Control and Automation.

[3.]Warwick, B., Symons, N., Chen, X., & Xiong, K. (2015). Detecting Driver Drowsiness Using WirelessWearables. 2015 IEEE 12th International Conference on Mobile Ad Hoc and Sensor Systems (MASS).

[4.]Dwivedi, K., Biswa Ranjan, K., & Sethi, A. (2014). Drowsy driver detection using representation learning.2014 IEEE International Advanced Computing Conference (IACC).

[5.]Yan, J.-J., Kuo, H.-H., Lin, Y.-F., & Liao, T.-L. (2016). Real-Time Driver Drowsiness Detection System Based on PERCLOS and Grayscale Image Processing. 2016 International Symposium on Computer, Consumer and Control (IS3C).

[6.]Alshaqaqi, B., Baquhaizel, A. S., Amine Ouis, M. E., Boumehed, M., Ouamri, A., &Keche, M. (2013).Driver fatigue monitoring system.20138th International Workshop on Systems, Signal Processing and Their Applications (WoSSPA).

[7.]Tripathi, D.P., Rath, N.P. (2009).A new method to address the drowsy driver issue through eye localization using the CHT technique.International Journal of Recent Trends in Engineering.

[8.] Subbarao, A., Sahithya, K.(2019) Driver Fatigue DetectionSystem for Vehicle Safety, International Journal of Innovative Technology and Exploring Engineering (IJITEE).

[9.]Sukrit Mehta, Sharad Dadhich, Sahil Gumber, Arpita Jadhav Bhatt (2019). Real Time Driver Drowsiness Detection System Utilizing Eye Aspect Ratio and Eye Closure Ratio, International Conference on Sustainable Computing in Science, Technology, and Management.

[10.]Tayab Khan, M., Anwar, H., Ullah, F., Ur Rehman, A., Ullah, R., Iqbal, A., ... Kwak, K. S. (2019). Smart Real-Time Video Surveillance Platform for Drowsiness Detection Based on Eyelid Closure. Wireless Communications and Mobile Computing, 2019.

[11.] RamalathaMarimuthu, A. Suresh, M. Alamelu and S. Kanagaraj, "Driver Fatigue Detection Using Image Processing andAccident Prevention," International Journal of Pure and Applied Mathematics, Vol. 116, 2017.

[12.]Omkar, RevatiBhor, Pranjal Mahajan, H.V. Kumbhar “Survey on Driver’sDrowsiness Detection System,”vol.132, 2015.
[13.]Rajasekar, Vivek Bharat Pattni, S.Vanangamudi “Drowsy driver sleeping device and driver alertsystem”, IJSR, Vol.3 Issue4,2014.
[14.] S. Podder and S. Roy, “Driver’s drowsiness detection using eye status to improve the road safety,” International Journal of Innovative Research in Computer and Communication Engineering, Vol. 1, No. 7, 2013.
[15.] I. García, S. Bronte, L. M. Bergasa, J. Almazán, and J. Yebes, (2012). “Vision based drowsiness detector for real driving conditions,” IEEE Intelligent Vehicles.