Drowsiness Detection System

A PROJECT REPORT

Submitted by

NAME	***UID***
NIKHIL KUMAR	***21BCS2374***
RAJARAPU SIVANARAYANA	***21BCS3596***
RITIK KUMAR	***21BCS8651***
SAUGAT DUTTA	***21BCS2415***

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BONAFIDE CERTIFICATE

Certified that this project report **"DROWSINESS DETECTION SYSTEM"** is the bonafide work of "**Nikhil Kumar, Rajarapu Sivanarayana, Ritik Kumar and Saugat Dutta**" who carried out the project work under my/our supervision.

SIGNATURE	**SIGNATURE**
Dr. Sandeep Singh Kang	Er. Himanshu Sharma
HEAD OF THE DEPARTMENT	**SUPERVISOR**

Submitted for the project viva voce examination held on

INTERNAL EXAMINER **EXTERNAL EXAMINER**

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List of Standards (Mandatory for Engineering Programs)

Standard	Publishing Agency	About the standard	Page no
IEEE 802.11	IEEE	IEEE 802.11 is part of the IEEE 802 set of local area network (LAN) technical standards and specifies the set of media access control (MAC) and physical layer(PHY) protocols for implementing wireless local area network (WLAN) computer communication.	Mention page nowhere standardis used

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ABSTRACT

The major goal of this research is to create a non-intrusive technology that can quickly alert users whenever a human exhibits signs of weariness. Drowsiness and fatigue are one of the main causes leading to road accidents. They can be prevented by taking effort to get enough sleep before driving, drink coffee or energy drink, or have a rest when the signs of drowsiness occur. Long-distance drivers who do not take frequent rests have a greater risk of becoming sleepy, a condition they frequently fail to identify in time. Studies conducted by experts indicate that tired drivers in need of a break are at blame for about 25% of all serious motorway accidents, making them more common than drunk driving. The popular drowsiness detection method uses complex methods, such as EEG and ECG. This method has high accuracy for its measurement but it needs to use contact measurement and it has many limitations on driver fatigue and drowsiness monitor. Thus, it is not comfortable to be used in real time driving. This paper proposes a way to detect thedrowsiness signs among drivers by measuring the eye closing rate and yawning. This system will use a camera to track the driver's eyes, and by creating an algorithm, we can identify signs of driver fatigue early enough to prevent the individual from falling asleep. So, this initiative will help in identifying driver weariness beforehand and will give warning output in form of alarm and pop –ups. A participant will operate the driving simulation system while a webcam is set up in front of it for the video. Using the webcam, a video of the transition from waking will be captured.

KEYWORDS = Drowsiness, Supervised Learning, UnsupervisedLearning, Machine Learning

CHAPTER 1

INTRODUCTION

Humans have always created tools and developed methods to make life easier and safer, whether for routine tasks like getting to and from work or for more intriguing ones like flying. As technology advanced, modes of transportation also advanced, and our dependence on them began to grow rapidly. It has had a significant impact on how we live presently. Nearly everyone in the modern world commutes daily using a method of transportation. While some people are wealthy enough to buy cars, others go by public transportation. Yet, regardless of socioeconomic standing, there are some laws and standards of behavior for drivers. One of them is driving while being attentive and active. Drowsiness is a state of near sleep, where the personhas an ardent desire for sleep. It has two distinct meanings, referring both to the usual state preceding falling asleep and the chronic condition referring to being in that state independent of a daily rhythm. Sleepiness can be dangerous when performing tasks that require constant concentration, such as driving a vehicle. When a person is sufficiently fatigue while driving, they will experience drowsiness and this leads to increase the factor of road accident. A few days one of the India's promising young cricketers Rishabh Pant met with a fatal accident while travelling from Delhi to Dehradun. According to reports, he fell asleep while driving. Real- Time Sluggishness Eye closure, head nodding, and increased brain activity are all signs of exhaustion. Hence, to monitor drowsiness, we can either evaluate changes in physiological signals like brain waves, heart rate, and eye blinking or take into account bodily alterations like slumped posture, a tilted head, and open or closed eyelids. While being more accurate, the earlier method is unrealistic because of highlysensitive electrodes.

Moreover, prolonged work would cause perspiration on the sensors, which would reduce their ability to monitor precisely. The second technique is particularly suited for measuring physical changes, such as open/closed eyes to determine exhaustion. Current systems for detecting intoxication, such as Electroencephalography (EEG) and Electrocardiography (ECG), which separately measure heart rate and brain activity, require complicated calculations and pricey clothing that is uncomfortableto wear while driving and inappropriate for road conditions.

The physical signals that indicate sleepiness must first be linked in order to create a reliable and accurate drowsiness detection algorithm, but a system that uses a camera in front of the driver is more suited for use. Issues arise while examining the area around the eyes and mouth because of the brightness of the lighting and when the driver tilts their head to the left or right. So, the purpose of this design is to examine all previous research and style, as well as to propose a method for spotting intoxication utilizing a webcam or videotape. It analyses the recorded videotape pictures and creates a system that can look at each frame of the tape.

Fig 1.1= Drowsy Driver

Fig 1.2 = Fatigue Driver

1.1 Identification of client/ need/ relevant issue

Exhausted drivers who doze off at the wheel are responsible for about

40% of road accidents, says a study by the Central Road Research Institute (CRRI) on the 300-km Agra-Lucknow Expressway. The finding rings the alarm bell on how Indian highway motorists ignore the importance of taking adequate rest and end up endangering lives. (3). In USA, Drowsy driving fatalities were 1.9 percent of total driving fatalities in 2019. Between 2013 and 2017, there were 4,111 fatalities involving drowsy driving. (4). 1 In 25 Fall Asleep at the Wheel According to CDC Report. The number of crashes that involve drowsy drivers, NHTSA reported that 2.5% of fatal crashes in 2009 involved drowsy driving. According to the CDC, somemodeling studies have estimated that the number is 15% to 33% of fatal crashes. (5). According to our most recent data, 148,707 persons died in car- related incidents in India alone in 2015. At least 21% of these accidents involved fatigued drivers who made mistakes. This number may even be lower because, among the many factors that may contribute to an accident, weariness is sometimes severely underrated as a factor. In developing nations like India, a terrible combination of infrastructure and fatigue can lead to calamity. Unlike to alcohol and drugs, which have obvious key signs and tests that are simple to obtain, fatigue is generally quite difficult to measureor detect. The best ways to address this issue are probably to raise awareness of incidents linked to driver drowsiness and to encourage drivers to admit it when necessary.

Identification of client: -

There are several ways to identify a client on a Drowsiness Detection System, including:

User Login: The Drowsiness Detection System can require the user to login using a username and password. This method ensures that only authorized users can access the system.

Facial Recognition: The system can use facial recognition technology to identify the client. The client's face is captured by the system's camera, and the system compares it to a database of known faces.

Biometric Identification: The system can also use other biometric identification methods, such as fingerprint or iris recognition, to identify the client.

RFID Technology: The system can use RFID technology to identify the client. The client wears an RFID tag, and the system reads the tag when the client enters the monitoring area.

Voice Recognition: The system can use voice recognition technology to identify the client. The client speaks a passphrase or answer a question, and the system matches the voice to a pre-recorded sample.

Need: -

A drowsiness detection system can be beneficial in various situations where human alertness is critical for safety, such as:

1. Transportation: Drowsy driving is a significant cause of accidents on the road, which can be prevented with a drowsiness detection system that alerts the driver when they are showing signs of fatigue.
2. Industrial and Manufacturing Settings: Heavy machinery and equipment operation require alertness and can pose serious safety hazards if an operator is drowsy or fatigued.
3. Healthcare: Doctors, nurses, and other healthcare professionals often work long hours, and their alertness is essential to ensure patient safety.
4. Military and Defense: Military personnel and defense operators often work in high-stress environments and long hours, which can lead to drowsiness and reduce their ability to make quick andaccurate decisions.

Relevant issue: -

Drowsiness detection systems are an important technology used in the field of transportation safety. These systems are designed to detect signs of driver fatigue and alert the driver to take a break or stop driving altogether.

One relevant issue in the development and implementation of drowsiness detection systems is their accuracy and reliability. While these systems are meant to prevent accidents caused by driver fatigue, they may not always accurately detect drowsiness. False positives can be triggered by certain driving conditions or enviro]nmental factors, while false negatives can occur if the system fails to detect drowsiness in a driver.

Another issue is the ethical considerations surrounding the use of these systems. Some people may feel uncomfortable with a system monitoringtheir driving behavior and alerting them to take a break. There is also the concern that these systems could be used for surveillance or tracking purposes, potentially infringing on individual privacy rights.

Additionally, the cost and accessibility of these systems could be a barrier to their widespread adoption. While they are becoming increasingly common in newer vehicles, retrofitting older vehicles with drowsiness detection technology can be expensive, and not all drivers may have access to these systems.

1.2 Identification of Problem

More and more vocations today demand long-term focus. Individuals who work in the transportation industry (such as automobile and truck drivers, steersmen, and pilots) must pay great attention to the road so they can respond quickly to any unexpected incidents (such as road accidents, animals on the road, etc.). Extended hours behind the wheel make the driver tired, which slows down their reaction time. Thirty percent of traffic accidents are caused by fatigued drivers, per study findings given at the International Symposium on Sleep Disorders. The results of an experiment using a driving simulator were published in the British magazine "What Car?" They came to the conclusion that a sleepy driver is far riskier than someone whose blood alcohol content is 25% above the legal limit. There are more business accident cases in India than ever before involving buses and regular exchanges of heavy vehicles including motorcars, lorries, and trucks.

Dozing off and being exhausted are two of the main factors that contribute to workplace accidents. Being in this situation while driving might have disastrous results because it clouds the driver's judgement and attention. If drivers take precautions like getting adequate sleep before driving, drinking coffee, or stopping for a break if drowsy, they can prevent falling asleep at the wheel. However, when drivers suspect they are tired, they consistently fail to follow one of these practices and continue driving. Thus, detecting doziness is important as one of the ways to reduce road accidents.

1.3 Identification of Task

To guarantee that the project is correctly planned and carried out, it can be helpful to identify the activities involved in creating a drowsiness detection system.

1. **Previous Data Gathering and Analysis:** In this stage, it was discovered that using an algorithm is one of the best ways to identify eyes and yawning.

To aid in the project's development, certain recent algorithms that are relevant to it are studied.

2. **Algorithm Design and Development:** A few algorithms and technique has been used in the process of detecting face, eyes and mouth. The primary behavioral

indicators used in the suggested technique are the driver's yawning and eye blinking. The purpose of this project is to alert the driver by detecting yawning via closed eyesor an opened mouth. This is accomplished by mounting a camera or other recording device in front of the driver and using OpenCV and dlib to continuously capture real-time video. The program is run in Python, and the laptop's camera is used for processing.

The work is mostly divided into three steps:

- Face, eye and mouth detection
- Eye closure detection
- Open Mouth detection

3. **Analysis and Testing =** In order to detect eye and mouth area, the face area need to be detected first. However, this step will reduce the performance and the speed of the system due to a large area of detection. The project objective is the detection of the drowsiness signs which is

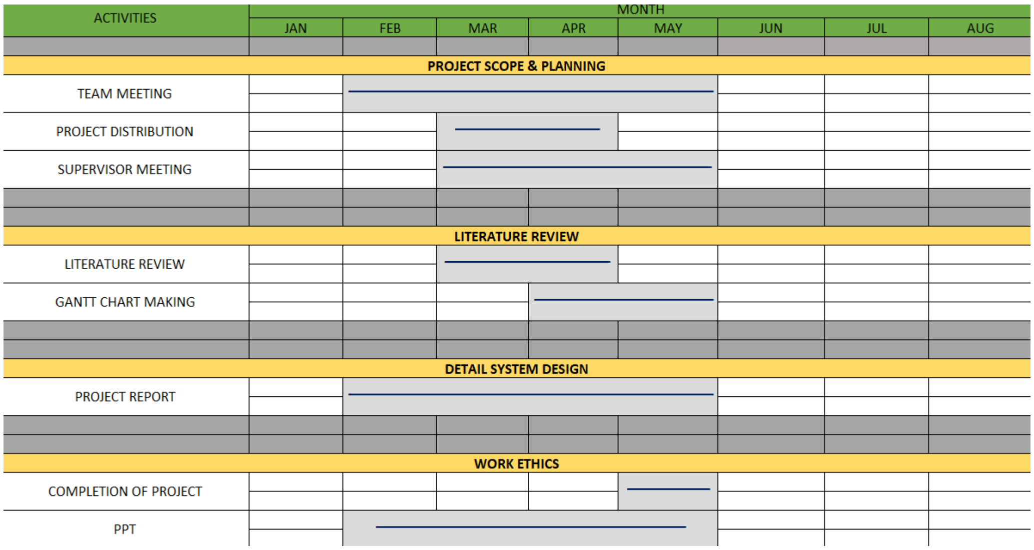
eyes and mouth area. Therefore, this project limited the area of detection to eye and mouth. This will enhance the performance of the system.

Tools going to be used in the project = Python, Cmake, Dlib and Microsoft Visual Studio.

4. **Deployment and maintenance:** Upon testing and approval, the system can be made available to users. It will be necessary to perform regular checkups maintenance to make sure the

system keeps working properly and to address any potential problems.

1.4 Timeline



Sixth Semester Project I Milestones:

. Completion of title selection: Week 1

. Completion of preliminary research & literature review: Week 2

. Completion of methods identification: Week 4

. Completion of understanding the techniques and methods: Week 8

. Analyzing video experiment: Week 8

Sixth Semester Project II Key Milestones:

. Data Collection & Measurement: Week 1

. Integrations Of Methods Chosen: Week 2

. Coding Development and Simulation: Week 4

. Complete Simulation & Improvement: Week 7

. Testing And Modification: Week 7

1.5 Organization of the report

I. Introduction

- Provide a brief background on the importance of driver alertness whiledriving.
- Introduce the problem of drowsy driving and its potential risks for drivers andpassengers.

- Explain the purpose of the report and the Drowsiness Detection Systemproject.

CHAPTER: 2

LITERATURE REVIEW/BACKGROUND STUDY

2.1. Timeline of the reported problem

The danger of tiredness is higher for long-distance drivers who seldom stop, and they commonly fail to recognize it in time. Studies show that fatigued drivers who need to rest account for around 25% of severe highway collisions, making them riskier than drunk drivers. The four key factors that contribute to driver weariness are physical activity, job, sleep, and the time of day. People occasionally try to do a lot in a day, which prevents them from getting enough sleep. Caffeine and other stimulants are widely consumed by people to stay alert. The lack of sleep becomes worse over a few days until the body finally gives up and the person nods off. The time of day can frequently have an effect on the body. The human brain has been trained to think that the body occasionally needs to sleep. They often include observing the sunrise and sunset. The body is instructed to sleep by the brain between the hours of 2 AM and 6 AM. If the period of time spent awake is extended, the body will ultimately crash. The final factor is physical wellness. Drugs that cause certain bodily states, such as tiredness, are occasionally used by people. You will feel exhausted if you are physically unfit, whether you are underweight or overweight. Additionally, while under emotional stress, the body will tire more quickly.

According to Antoine Picot et al., drowsiness is a condition when a person is halfway between awake and sleepy. This situation causes the driver to be less attentive when driving. The car can no longer be managed since the driver is only half aware. A person's ability to perform is hampered by mental tiredness, according to Gianluca Borghini et al., since it reduces the brain's ability to respond to unexpected occurrences.

Drowsiness, according to Antoine Picot et al., is a state where a person is somewhere between awake and tired. The motorist is less attentive when driving as a result of this circumstance. Since the driver is only partially awake, the automobile can no longer be controlled. According to Gianluca Borghini et al., mental fatigue impairs performance because it makes it harder for the brain to react to unanticipated events.

The most common times for crashes involving fatigued drivers to occur are during long trips on monotonous roads, such as highways, between 2 and 6 in the morning, between 2 and 4 in the afternoon (especially after eating or having even one alcoholic beverage), after getting less sleep than usual, after drinking alcohol, if taking drowsiness-inducing medications, after long working hours, or on trips home following long shifts, particularly night shifts.

The chance of a collision was compared to the quantity of sleep a motorist had in research done by a traffic safety foundation in the US. The most important conclusion was that drivers who slept for 4 hours or fewer had an accident rate that was 11.5 times higher than those who slept for more than 4 hours.

Shift workers, truck drivers, young male drivers, and business vehicle drivers are the most prone to nodding off behind the wheel. Professional drivers, especially HGV drivers, report abnormally high levels of drowsiness and are involved in accidents linked to exhaustion, with commercial drivers making up roughly 40% of such instances. However, two-thirds of people who fall asleep at the wheel are automobile drivers. Males make about 85% of those driving when fatigued and account for more than one-third of crashes.

2.2. Existing solutions

Drowsiness detection systems have been the subject of several investigations, and they may be generally divided into two groups: physiological and behavioral systems. Electroencephalography (EEG), electrooculography (EOG), electromyography (EMG), and heart rate variability (HRV) are examples of physiological measurements. The use of the steering wheel, lane departure, and eye closure are examples of behavioral measures.

In 1968, a man by the name of J. Broughton did one of the early experiments on sleepiness detection systems. He utilized EEG to assess the main waves of sleepy people. Since then, several research has examined the use of EEG, EOG, EMG, and HRV to identify sleepiness. For instance, Kaida et al. (2006) employed EOG to identify patterns of eye blinking and categorize them as awake or sleepy.

Research in recent years has concentrated on applying machine learning strategies to create more precise sleepiness detection systems. For instance, Xia et al. (2018) created a deep-learning model that can recognize sleepiness using both physiological and behavioral indicators. On a dataset with 30 individuals, their model had an accuracy of 92.67%.

Although sleepiness detection research has advanced, there are still a number of issues that need to be resolved. The absence of standardized datasets for assessing the efficacy of sleepiness detection systems is a significant restriction. The majority of research make use of modest datasets, which could not accurately reflect actual driving conditions. The lack of real-time sleepiness monitoring devices that can alert the driver in time is another drawback. The majority of existing solutions need data post-processing, which may not be practical in actual driving situations.

Depending on the precise implementation and technology employed, the essential characteristics and functions of a sleepiness detection system may differ, however the following are some typical ones:

- **Monitoring Driver Behavior:** The technology monitors the driver's behavior, including head and eye movements, facial expressions, and body posture, to look for indicators of exhaustion or sleepiness.

- **Real-time Alerts:** The system warns the driver with an aural or visual signal, such as a loud beep or a flashing light, when it notices that the driver is starting to get sleepy or distracted to assist the driver stay awake and focused.
- **Machine Learning:** Some cutting-edge drowsiness monitoring systems study the driver's behavior patterns and forecast when the driver is most likely to become distracted or drowsy depending on variables including the time of day, road conditions, and other environmental factors.
- **Sensitivity Adjustment:** The system could offer a function that lets the user alter the sensitivity of the system to suit their driving preferences and style.
- **Integration with Other Systems:** To give a complete safety package, the sleepiness detection system may be combined with other driver aid systems, such as lane departure warning, adaptive cruise control, and collision avoidance.

Drowsiness may be detected using a variety of techniques, each of which has advantages and drawbacks. Here are some of the most popular techniques compared.

- **Eye Tracking:** This technique employs cameras to monitor eye movements and blink rates in order to ascertain whether the driver is about to nod off. Although it is extremely precise and non-intrusive, external elements like glasses, sunglasses, or contact lenses may have an impact**.**
- **Electroencephalography (EEG):** With the use of this technique, it is possible to identify variations in brainwaves that happen when a driver starts to get sleepy. Although it needs specialized equipment and might be obtrusive and uncomfortable for the driver, it is extremely precise and dependable.
- **Heart Rate Variability (HRV):** In order to identify changes in the driver's autonomic nervous system, which may be an indication of sleepiness, this approach examines the variability of heart rate. Although it is non-intrusive and real-time, it could not be as accurate as other approaches and may be impacted by outside variables like stress or physical activity**.**
- **Steering Wheel Movement:** In order to identify changes in driving behavior, such as drifting or swerving, this approach tracks variations in steering wheel motion. Although it is non-intrusive and real-time, it could not be as accurate as other approaches and is susceptible to outside influences like wind or road conditions.
- **Facial Expression Analysis:** This technique makes use of cameras to examine facial expressions and spot sleepiness indicators like drooping eyelids or a slack jaw. Although it is non-intrusive and real-time, it might not be as precise as previous approaches and may be impacted by outside factors like lighting or facial hair.

Overall, each approach has its advantages and disadvantages, and the most effective approach may vary depending on the application and environment.

2.3. Bibliometric analysis

Table 1. Karolinska sleepiness scale (KSS)

Rating	Verbal Descriptions
1	Extremely alert
2	Very Alert
3	Alert

4	Fairly Alert
5	Neither Alert nor Sleepy
6	Some Signs of Sleepiness
7	Sleepy, but no effort to keep alert
8	Sleepy, some effort to keep alert
9	Very sleepy, great effort to keep alert, fighting sleep

Table 2. List of previous works on driver drowsiness detection using behavioral measures

Ref	Sensor Used	Drowsiness Measure	Detection Techniques	Feature Extraction	Classification	Positive Detection Rate
[55]	CCD micro camera with Infra-Red Illuminator	Pupil	Ada-boost	Red-eye effect, Texture detection method	The rationale height eye width	92%
[43]	Camera and Infra-Red Illuminator	PERCLOS, eye closure duration, blink frequency, and 3 others	Two Kalman filters for pupil detection	Modification of the algebraic distance algorithm for conics Approximation & Finite State Machine	Fuzzy Classifier	Close to 100%
[7]	CCD camera	Yawning	Gravity-center template and grey projection	Gabor wavelets	LDA	91.97%
[42]	Digital Video camera	Facial Action	Gabor filter	Wavelet Decomposition	SVM	96%
[44]	Firewire camera and webcam	Eye Closure Duration & Freq of eye closure	Hough Transform	Discrete Wavelet Transform	Neural Classifier	95%
[9]	Camera	Multi-Scale dynamic features	Gabor filter	Local Binary Pattern	Ada boost	98.33%
[56]	IR Camera	Eye State	Gabor filter	Condensation algorithm	SVM	93%

[45]	Simple Camera	Eye Blink	Cascaded Classifiers The algorithm detects face and Diamond searching algorithm to trace the face	Duration of eyelid closure, No. of continuous blinks, Frequency of eye blink	Region Mark Algorithm	98%
[8]	Camera with IR Illuminator	PERCLOS	Haar Algorithm to detect face	Unscented Kalman filter algorithm	SVM	99%

Table 3. List of previous works on driver drowsiness detection using physiological signals

Ref	Sensors	Preprocessing	Feature Extraction	Classification	Classification Accuracy (%)
[12]	EEG, ECG, EoG	Optimal Wavelet Packet, Fuzzy Wavelet Packet	The Fuzzy MI based WaveletPacket Algorithm	LDA, LIBLINEAR, KNN, SVM	95–97% (31 drivers)
[58]	ECG	Band Pass Filter	Fast Fourier Transform (FFT)	Neural Network	90% (12 drivers)
[59]	EEG	Independent Component Analysis Decomposition	Fast Fourier Transform	Self-organizing Neural Fuzzy Inference Network	96.7% (6 drivers)
[10]	EEG, EMG	Band Pass Filter & Visual Inspection	Discrete Wavelet Transform (DWT)	Artificial Neural Network (ANN) Back Propagation Algorithm (Awake, Drowsy, Sleep)	98–99% (30 subjects)
[60]	EEG	Low pass filter 32 Hz	512 point Fast Fourier Transform with 448-point overlap	Mahalanobis distance	88.7% (10 subjects)
[28]	Eog, EMG	Filtering & Thresholding	Neighborhood search	SVM	88.7% (10 subjects)

[61]	EEG, EoG, EMG	Low pass pre Filter and Visual Inspection	Discrete Wavelet Transform	ANN	97–98% (10 subjects)
[62]	EEG	Least mean square algorithm and Visual Inspection	Wavelet packet analysis with Daubechies 10 as the mother wavelet	Hidden Markov Model	84% (50 subjects)

Table 4. Advantages and limitations of various measures

Refs.	Measures	Parameters	Advantages	Limitations
[26,35]	Subjective measures	Questionnaire	Subjective	Not possible in real time
[5,72]	Vehicle-based measures	Deviation from the lane position Loss of control over the steering wheel movements	Nonintrusive	Unreliable
[15,54]	Behavioral Measures	Yawning Eye closure Eye blink Head pose	Non-intrusive; Ease of use	Lighting condition Background
[67,69]	Physiological measures	Statistical & energy features derived from ECG EoG EEG	Reliable; Accurate	Intrusive

Electrocardiogram (ECG) and Electroencephalography (EEG)

The electrocardiogram (ECG) and electroencephalogram (EEG) have been proposed by several studies as physiological indicators of fatigue. The heart rate (HR) varies significantly depending on the degree of awareness, level of fatigue, and various phases of sleepiness. As a result, heart rate, which the ECG signal makes simple to compute, may also be used to diagnose fatigue. Others have utilized heart rate variability (HRV), whose low (LF) and high (HF) frequencies range from 0.14 to 0.4 Hz and 0.04-0.15 Hz, to assess tiredness. The electroencephalogram (EEG) is the physiological signal that is most commonly utilized to assess tiredness. The EEG signal has a number of frequency bands, such as the theta band (4–8 Hz), which is linked to sleep, the alpha band (8–13 Hz), which represents relaxation and creativity, and the beta band (13–25 Hz), which is linked to alertness. The delta band (0.5–4 Hz) represents activity during sleep. Increases in the theta frequency band and decreases in the power changes in the alpha frequency band are indicators of drowsiness.

Drowsiness detection using face detection system

Using facial area detection, drowsiness may be identified. Different strategies are utilized to diagnose drowsiness there since the indications are more visible and simpler to recognize there. Based on eye detection, the position of the eyes may be identified from the facial region. There are four main types of eyelid movement that may be used to identify fatigue, according to authors D. Liu, P. Sun, Y. Xiao, and Y. Yin. The eyes alternate between being totally open and closed and are fully open, fully closed, and in the middle. Use the computer vision toolbox system's method for detecting faces, which is Eye Movement Detector. By employing the Viola-Jones approach, it develops a system object detector. The algorithm converts the color from the photos into black and white after processing them using the grey-scale approach. Because there are just two characteristics to assess when working with black and white photos, the process is simpler.

The value of the eyelid area is then computed after performing edge detection on the edges of the eyes. The disadvantage of this strategy is that individual eye regions may vary in size. Some people may look sleepy and have small eyes, although they are not. Other than that, if someone is wearing glasses, it is challenging to distinguish the area around the eyes. Since images get hazy at longer distances, photos must be taken within a certain range of the camera.

PERCLOS (Percentage of Eye Closure)

The percentage of eye closure (PERCLOS) and eye blinks can both be used to measure drowsiness.

D. Liu, P. Sun, Y. Xiao, and Y. Yin provide a technique that learns the pattern of time of eyelid closure for eye blink recognition. "This proposed method measures the time for a person to close their eyes, and if they are closed longer than the normal eye blink time, it is possible that the person is falling asleep," claim T. Danisman, I. M. Bilasco, C. Djeraba, and N. Ihaddadene. The authors said that "the average normal person eye blink" lasts around 310.3 milliseconds. The PERCLOS technique states that the proportion of 'droops' in the eyelids may be used to quantify how fatigued a person is.To distinguish between eyes that are fully open and those that are closed for the eyelid, the software library provides sets of eyes open and closed that may be utilised as a parameter. As they go off to sleep, the individual droops much more gradually. Thus, the development of the driver's sleepiness may be seen. As a result, the PERCLOS technique established a proportionate value where it was assumed that the driver was asleep at 80% closure, or virtually complete closure. By measuring PERCLOS, we may ascertain the status of the driver. It is considered sleepy if the driver closed his eyes for at least five consecutive frames several times during a period of up to five seconds.

Yawning Detection Method

M. Sarada Devi and P. Bajaj assert that a person's level of sleepiness may be determined by observing their face and behavior. The author suggests a technique in which sleepiness may be identified by mouth position and the photos are processed using a cascade of classifiers for faces developed by Viola-Jones. The photos and the set of image data for the mouth and yawning were compared. Some people yawn while covering their mouths with their hands. Although yawning is an indication of tiredness and exhaustion, it makes it difficult to capture clear photos if a person is doing it.

2.4. Review Summary

Driver fatigue may be detected using a variety of methods, as was mentioned throughout the study. This article examines contemporary technologies and pinpoints the best tactics. to stop the main cause of fatal auto accidents. The best-selling product on the market right now is a simple reed switch that gauges head tilt. This product is useless and has a very limited market. Although the high-end BMW automobiles include a built-in system for identifying driver tiredness behaviors, it is only slightly more successful at detection and provides insufficient warning to alarm a driver.

Today's market and technology are continually being developed. New technologies are constantly being developed using various techniques. This study suggested using the eyes and yawning detection method after reading the research publications and the already employed techniques. Eye blink frequency indicates that a person will be seen as drowsier the longer they close their eyes. The reason for this is that tired people's eyes will stay closed longer than they would normally blink. In addition, yawning is a common human reaction when it indicates drowsiness or exhaustion. It is one of the signs of drowsiness.

2.5. Problem Definition

Electrocardiography (ECG) and electroencephalography (EEG) are two examples of modern drowsiness detection equipment that track the state of the driver, however they are inconvenient to wear while driving and are not suitable for driving situations. (ECG), which monitors heart rhythm and detects brain frequency, respectively. However, it is first necessary to identify the physical cues that would signal tiredness in order to create a sleepiness detection algorithm that is reliable and accurate. The employment of a camera placed in front of the driver as a sleepiness detection device is more appropriate. Lighting intensity and the driver's face tilting to the left or right cause problems when identifying the area around the driver's eyes and lips. In order to provide a way for detecting sleepiness using video or a webcam, this study's objective is to assess all previous research and approaches. After analyzing the captured video pictures, it develops a system that is capable of looking at every frame of the video.

2.6. Goals/Objectives

The project is concentrated on these goals, which are

- Suggested methods for spotting weariness and sleepiness when driving.
- To examine participant video footage of their mouths and eyes to look for signs of tiredness and exhaustion in the driving simulation experiment.
- To research how sleepiness and exhaustion affect the body.

To create a system that can recognize sleepiness and weariness using the eyes closing and yawning motions.

CHAPTER: 3

DESIGN FLOW/PROCESS

3.1. Evaluation & Selection of Specifications/Features

Alarming data, such as the 2013 World Health Organisation report, which stated that 1.24 million people die on the road each year, that drivers are responsible for about 6% of accidents, and that the majority of these accidents result in fatalities, have sparked interest in the installation of driver drowsiness detection systems in cars. Drowsiness (sometimes called sleepiness) is defined as "the need to fall asleep". This mechanism is influenced by the regular human biological rhythm and its sleep-wake cycles. The longer the duration of alertness, the more pressure there is to sleep, and the harder it is to resist. The goal of the sleepiness detection project is to create a system that can recognise human weariness and send out an alert in a timely manner. The device uses an algorithm and a camera to track the driver's eyes in order to identify signs of driving weariness before the individual falls asleep. The project will provide warning output in the form of an alert and pop-ups and may be useful in anticipating driver weariness. However, employing this gadget won't guarantee that the driver is awake and alert or that there won't be an accident. It only serves as a tool to improve driver safety, with a focus on long-distance truck drivers, night drivers, lone travelers, and those who are sleep-deprived. This study describes the development and implementation of a driver tiredness detection system based on visual information (driver's face and head). It creates a novel technique by combining easily accessible software components for face identification, determining the colour of human skin, and distinguishing eye state (open vs. closed).
Preliminary results show that the system is reliable and resistant to a variety of real-world constraints.

1. **Sensors:** The sensors used in a sleepiness detection system must be able to detect physiological changes or drowsy-like behavioural patterns. Depending on the application, these sensors might be cameras, accelerometers, or EEG sensors.

2. **Data Processing and Machine Learning Model:** It is necessary to interpret and analyse the sensor data in order to correctly identify sleepiness. The most common method for doing this is to employ a machine learning model that has been trained on a collection containing

samples of both drowsiness and non-drowsiness. The model must be able to identify certain patterns and traits that indicate fatigue, such as slow head movements or closed eyes.

3. Reliability: As a system for enhancing driving safety, the solution must be able to accurately identify tiredness.

4. Alert Mechanism: The system must feature a trustworthy alarm system that can alert the user when they start to nod off. The alert mechanism might be a visible, audible, or tactile cue, such as blinking lights, alarms, or vibrations.

5. Integration and testing: The target application should be integrated with the drowsiness detection system, and various testing scenarios should be run through it to ensure that it functions as planned. Testing should be done with a range of users to ensure that the system functions effectively for different users and conditions.

6. Rehability: The solution must be capable of accurately identifying tiredness in order to perform its function as a system for boosting driver safety.

7. Real-time response: Use of a drowsiness detection system when driving at relatively high speeds might be necessary, and failing to do so could have disastrous consequences.

8. Unobtrusive: The solution must be as apparent to the driver as feasible.

9. Flexible: The problem must be solved in a way that can accommodate people of all physical kinds if we want it to work.

10. Economical: There are currently existing solutions to this issue, but the best ones are typically too expensive for mainstream use.

A drowsiness detection system can reliably identify tiredness and send out timely notifications to reduce accidents and increase safety by integrating these components.

3.2. Design Constraints

The following are a few projected restrictions and limits for the planned system:

- **Lighting Conditions:** The frequent and sudden changes in brightness or darkness of a scene (or portion of it), which may happen even during the shortest driving intervals, have been demonstrated to constitute a significant difficulty for many computer vision algorithms.

- **Camera Motion:** A picture in motion. Bad road conditions, aggressive driving, and otherfactors can greatly increase vibrations and discomfort when driving.

The camera may receive these vibrations and experience picture distortion, which can drastically skew the results and reduce the system's overall performance.

- **Device placement in relation:** The camera must be positioned with respect to the driver at a certain distance and viewing angle. There is a "comfort zone" for each computer vision algorithm where it performs most reliably and successfully. If you step outside of your comfort zone, your performance may decrease significantly.
- **Limitations of the hardware and software:** Common mobile devices have one or two processor cores, less working memory, and a propensity to run at lower clock rates than their desktop equivalents. All of this reduces energy use, but it makes building this sort of system very challenging.
- **Cooperative driving:** Last but not least, all driver drowsiness detection systems depend on an attentive driver who is willing to assist with setup, constantly keep the monitoring system on, and act correctly when the system warns them of potential hazards brought on by detected fatigue.

- **Space:** A space-efficient implementation of the solution is required. It must not tamper with the vehicle's current controls.
- **Power:** The solution must be built to function effectively with a finite power source because there will only be one available.

3.3. Analysis of Features and finalization subject to constraints

The sleepiness detection system may require some elements to be changed, eliminated, or added in order to comply with the aforementioned design limitations. Here are some potential changes:

Remove:

Video recording: Although video recording raises privacy problems and may not be sufficient to accomplish precise detection, it can give extra information for identifying tiredness.

Facial recognition: For accurate sleepiness detection, facial recognition technology may not be essential and can be pricey.

Heart rate monitoring: Although it can expand the knowledge base for identifying tiredness, it can be expensive and may not be necessary to arrive at an accurate conclusion. Other sensors, like those mentioned above, can provide accurate detection without heart rate monitoring.

Modify:

Robustness: The system must be capable of handling slight changes in lighting, relative camera motion (caused, for instance, by poor road conditions), changes in the driver's visual appearance (even during a session, such as when they don or take off hats or sunglasses), camera resolution and frame rates, and a variety of computational capabilities of the device's process.

Computationally lightweight: Because (near) real-time performance is required, algorithms must be optimised to provide continual monitoring of the driver's condition without unnecessarily stressing the device's primary CPU. Furthermore, battery usage is reduced.

Alert system: The driver's attention shouldn't be diverted by the alarm system, which should be easy to use. The car can vibrate or another quiet signal can be used by technology to alert the driver without an alarm or a loud sound.

Machine learning algorithms: The technology can use machine learning techniques to improve accuracy and response time by determining each driver's distinct driving patterns.

Add:

Easily portable to different platforms: The software must be installed on a mobile device that is affixed to the dashboard of the car, such as an Android smartphone. It should ideally be easily transferable to other mobile devices with equivalent size and computing capabilities (such as iOS-based ones).

Real-time monitoring: The device needs to continually give the motorist feedback on their driving style while keeping track of them in real-time.

Integration with other safety features: For a more complete safety system, the system can be integrated with other safety features including emergency braking, adaptive cruise control, and lane-keeping assistance**.**

System calibration will allow sensors and machine learning algorithms to adapt to different driving styles and provide more accurate detection.

A drowsiness detection system can reliably identify tiredness and send out timely notifications to reduce accidents and increase safety by integrating these components.

3.4. Design Flow

Three major criteria can be used to categorize drowsiness detection: (1) vehicle-based (2) behavioral (3) physiological.

Vehicle-based measures: Any change in these measurements that exceeds a certain threshold denotes a greatly increased likelihood that the driver is sleepy. These metrics include deviations from lane position, movement of the steering wheel, pressure on the accelerator pedal, etc.

Behavioral-based measures: A camera records the driver's actions, such as yawning, eye closing, eye blinking, head posture, etc. The driver is informed if any of these signs of sleepiness are seen.

Physiological-based measures: ECG (Electrocardiogram) and EOG (Electrooculogram) physiological signals are correlated. Brain activity, heartbeat, and pulse rate data are used to identify drowsiness.

Studies show that a variety of technology can detect driver fatigue. The first one is the custom of viewing someone else's behaviour on camera. This involves watching their eyes, lips to see whether they're yawning, head position, and several other features. The next of these technologies is voice recognition. A person's speech tone typically conveys their level of fatigue..

The underlying drowsiness detection methods that are widely used for purposes of detection are explained in detail below:

- ECG, EEG, the steering wheel movement (SWM), and optical detection, along with the local binary pattern (LBP).

EEG and ECG:

The electrocardiogram (ECG) and electroencephalogram (EEG) are two physiological signals that have attracted the attention of many researchers as potential sleepiness indicators. Additionally, there are substantial differences in heart rate (HR) between alertness and weariness and other phases of sleepiness. As a result, tiredness may also be detected using heart rate, which the ECG signal makes it easy to calculate. The EEG signal has several frequency bands, including the delta band (0.5–4 Hz), which is associated with sleep activity, the theta band (>4 Hz), which is associated with drowsiness, the alpha band (>8 Hz), which is associated with relaxation and creativity, and the beta band (>13–25 Hz), which is associated with alertness. Drowsiness is indicated by a rise in the theta frequency band and a reduction in the power changes in the alpha frequency band.

Steering Wheel Method:

The degree of driver sleepiness is evaluated using a steering angle sensor and is a commonly used vehicle-based statistic. The driver's steering behaviour is gauged using an angle sensor positioned on the steering column. Fewer micro-corrections are made to the steering wheel while driving while fatigued than while driving normally. According to study by Furlough and Graham, sleep-deprived drivers turn the steering wheel less frequently than regular drivers. To prevent the impact of lane changes, the researchers only took into account very small steering wheel motions (between 0.5° and 5°), which are necessary to modify the lateral position inside the lane.The qualities of the driving task (like speed, curvature, and lane width), the driver's traits (like driving experience), and the driver's states (like laziness, attention, or weariness) all affect steering behaviour. In order to compensate for minor road irregularities and crosswinds, drivers continuously examine the situation in front of them and turn the steering wheel in very small increments. Therefore, based on minor SWMs, it is feasible to assess the driver's level of sleepiness and, if necessary, issue a warning.

Eye Blinking-Based Technique:

The frequency of eye blinking and the duration of ocular closure are measured to determine whether a driver is fatigued. Drivers who are drowsy can be easily spotted since their eye blinking and interocular gazing are different from what they usually do when they are tired. To calculate the frequency and duration of blinking, this system tracks the location of the irises and the health of the eyes over time. This type of technology also uses computer vision algorithms once footage is taken by a remote camera. to determine the locations of the face, eyes, and eyelids in order to measure the ratio of closure. By observing a driver's closed eyes and blink rate, one can determine whether they are sleepy. This type of sensor, concealed within the car, might look out for any signs of simultaneous head tilting, drooping eyelids, and mouth yawning.

Yawning Based Technique:

yawning measurement-based sleepiness detection in drivers. This comprises a number of processes, including the live detection and tracking of the driver's face as well as the detection, tracking, and detection of the shape of the lips. A video camera that is mounted inside the automobile under the front mirror continually records the driver's face. In order to accurately evaluate changes in facial motions that suggest tiredness, there are two essential processes in the detection of drowsiness. The driver's face is first recognized and tracked in the camera's series of frame images. The next stage is to find the driver's face and then find and track the driver's mouth After the mouth has been located, the yawning condition is determined by gauging the pace of changes in the region around the mouth and its aspect ratio.

3.5. Design selection

The four primary steps of the driver drowsiness detection system are discussed in this research study:

(1) Detection Stage: Right now, the system is at the startup stage. Every time the system is initiated, it must be customised and optimised for the current user and situation. The critical step at this moment is the successful head detection. After precisely locating the driver's head, we may proceed to extract the characteristics needed for system setup. In the initial setup, samples of the driver's eyes open and closed as well as their regular head position are collected. Additionally, the driver's skin tone is extracted and used to create a unique skin colour model. To help with the accomplishment of these aims, user involvement may be required. The system may ask the driver to sit comfortably in their usual driving position in order to identify the top and lower levels necessary for detecting probable nodding.

The system may advise the driver to sit comfortably in their usual driving stance if it notices any possible nodding. The driver can also be instructed to close their eyes for a brief period of time before opening them once more. Just this can be used to launch the system. Over time, the picture dataset for the system will increase and become more robust and error-resistant.

(2) Tracking Stage: Once the driver's head and eyes are precisely located and all pertinent characteristics have been retrieved, the system enters the usual tracking (monitoring) phase.

An essential element in this phase is the continuous observation of the driver's eyes inside a tracking region that is dynamically assigned. To cut down on processing time, the system will decide the size of the tracking zone based on previous eye movements. For instance, it is plausible to assume that the tendency will persist throughout the frame if the eyes have been moving leftward for a number of frames. The tracking area should be expanded in the direction in which the eyes are most likely to gaze while being shrunk in the other three directions. At this step, the system must evaluate the state of the eyes.All of these processes must be carried out in real-time, however occasionally it can be necessary to miss a few frames without jeopardising algorithmic accuracy, depending on the workload and the processor's capabilities.

(3) Warning Stage: If the driver's eyes are closed for a lengthy period of time or if he starts to nod, he has to be more attentive. At this point, paying close attention to the driver's eyes is essential. The system must recognise if the eyes are still closed and how far away from previously established thresholds they are. We can't afford to miss frames right now. Tracking of the eyes is done in practice in a way that is quite similar to that employed in the tracking stage with the inclusion of the following procedures: determining the eye's speed and trajectory for threshold monitoring. Several more computations are required to improve the system's capacity to determine whether the driver is fatigued or not.

(4) Alert Stage: Once it is determined that the driver looks to be driving abnormally, the system must be proactive and notify the driver of potential threats. Both audio and visual cues are utilised to draw the driver's attention and increase their level of attentiveness. Using alerts must prevent the undesired result of shocking the motorist into having an accident.

3.6. Implementation plan/methodology

DIAGRAMS

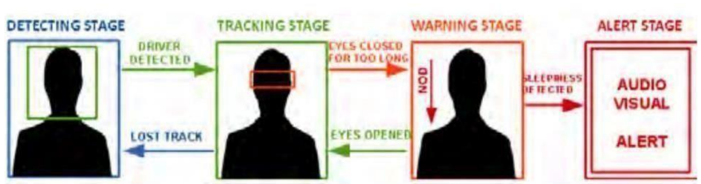


Fig. 3.1: Four Stages of Drowsiness Detection System

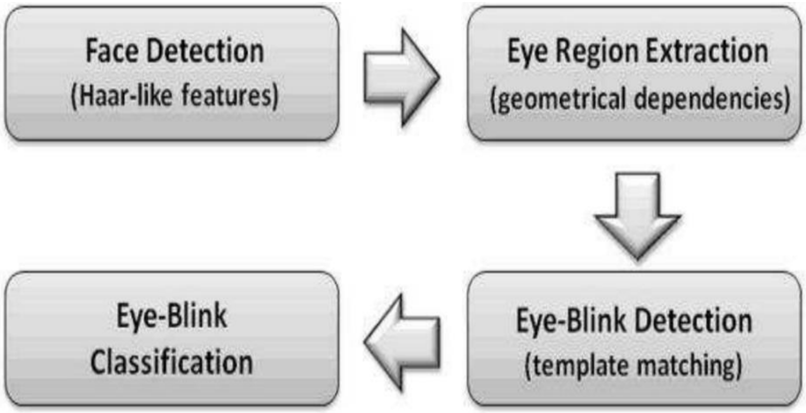


Fig. 3.2: Scheme of the proposed Algorithm for Eye-Blink Detection.

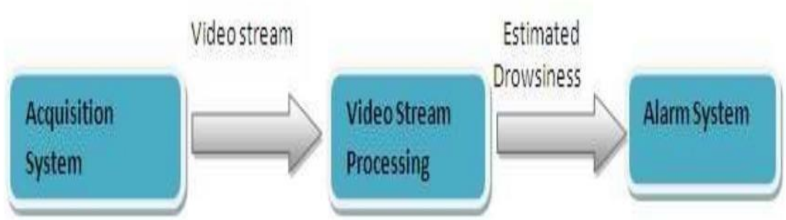
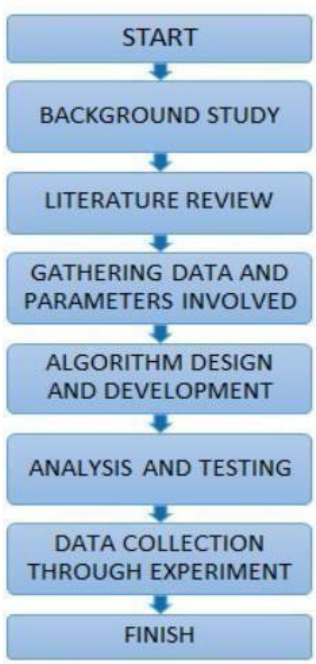
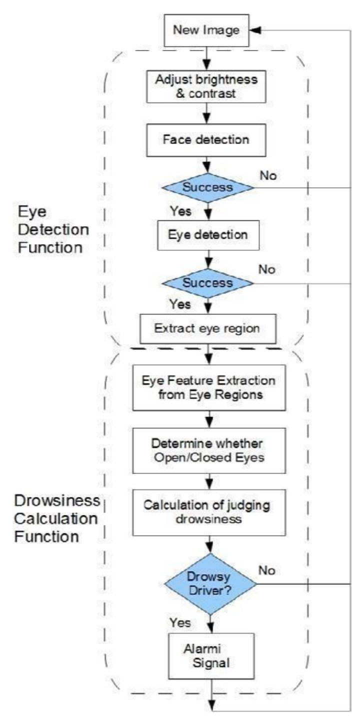


Fig. 3.3: Block Diagram of Overall System

FLOWCHART





Selected algorithms for feature detection and image classification:

The three primary characteristics of a driver used by the proposed system are face, eyes, and skin. For baseline face identification, we have used the well-known Viola-Jones method because to its widespread availability and general simplicity. Utilising data on skin tone, we improved the face detection method. Human skin colour has distinctive characteristics. The easiest way to express and define these characteristics is to dissect a given colour into its primary chroma components (red, green, and blue) and specify the ranges of each component. The great majority of threshold skin colour types have been found to have red chroma components that fall between 133 and 173 and blue chroma components that fall between 77 and 127. The adoption of a red chroma range that is individual to the user is one of this work's contributions. The difference between using a bespoke, user-specific range and a generalised range is illustrated in the figure below. When a driver's face is identified during system setup, the region around the face is utilised to analyse the precise red chroma range that the driver's skin falls in. Between 0 and 255 is the range for chroma values. To provide us with that precise range, a list of the red chroma components of the region enclosing the driver's face is constructed. The generalised range is substantially wider than this particular range. The top and lower border of the histogram can be extracted and used in the subsequent phases of the when the. Therefore, when the system tracks a driver's face in the next frames, we can verify that the tracked object is indeed a pair of eyes by examining the red chroma component histogram. Our detection system concentrates on figuring out whether the eyes are open or closed after detecting a face and, subsequently, the eyes. The recommended approach monitors if the driver closes their eyes for a prolonged amount of time. If that's the case, we can draw the conclusion that the driver might be drowsy. In order to distinguish between open and closed eyes, the classification method employed in our system uses a 2-class Support Vector Machine (SVM) classifier using training data from the most recent setup step. We have used a categorization strategy that considers both head position and eye condition in order to improve the system's overall resilience. The following tenets form the foundation of our strategy:

- When completely awake, the driver's head posture does not significantly vary.
- The posture of the head is dramatically altered when tired.

Our method employs a dynamic two-threshold approach to recognise anomalous head behaviour in drivers in a timely and accurate manner. Just below the eyes is where the lower threshold is located. As long as the eyes are above this threshold, the system considers the driver's state as awake, attentive, and looking ahead in the direction of the road. As the eyes start to sink vertically and reach the upper barrier, the system starts to get ready for possible nodding. If the head leans forward and the eyes eventually touch the lower threshold, the motorist is most obviously not paying attention to the road. The very specific motion of a human nod entails the head falling gradually and then swiftly returning to its original position. Our system takes this into account. The rate of each nodding stage is measured to remove any false positives, such as a driver nodding in agreement with something.

As long as the eyes are maintained above the upper threshold, the system is considered to be in a normal state. The nodding sequence is said to begin when the head bends downward vertically and crosses the top barrier. From this point on, if the head recovers and travels back up, the nodding pattern ends; but, if the head keeps moving downward and hits the lower threshold, we may be certain the driver is no longer paying attention to the road. The device not only tracks where the eyes are in respect to the thresholds but also keeps an eye on their health. In the event that the driver ever closes his eyes while nodding, the action is reversed. In order to distinguish between a genuine drowsy nod and other possibly comparable head motions that are not produced by nodding, the system additionally tracks the nod's velocity.

CHAPTER: 4

RESULTS ANALYSIS AND VALIDATION

4.1. Implementation of solution

Software Requirements Specification:

Python:

- Python 3

Libraries:

- Scipy
- Numpy
- Dlib

- Imutils

- Opencv, etc.

Operating System

- Windows or Ubuntu

Hardware Requirements Specification:

- Laptop with basic features
- Webcam

Requirement Analysis

- **Python:** Python is the basis of the program that we wrote. It utilizes many of the python libraries.

Libraries used:

- **Imutils :** Imutils is a collection of image processing tools built on top of OpenCV, a well-known Python computer vision library. The imutils package offers several useful methods that simplify standard image processing operations including resizing, rotating, and cropping. Convenient functions written for OpenCV.
- **Dlib :** Dlib is a cutting-edge C++ library that includes machine learning algorithms and tools for building sophisticated software. It is particularly well-known for its extremely precise face recognition, object detection, and facial landmark detection capabilities. The library is quick and effective and made to be used in practical applications. Additionally, Dlib has a Python API, making it simple for programmers to include the library into Python-based applications. The machine learning tools and algorithms in Dlib may be used with ease and clarity thanks to the Python API, which is built on top of the C++ library. Using 68 face markers, this programme locates the frontal human face and estimates its pose.
- **OpenCV:** For applications involving the processing of images and videos, OpenCV offers a wide range of algorithms and functions, including:
- capture of images and videos
- video and image editing
- examination of images and videos
- tracking and identification of objects

- Deep learning and machine learning

- **Operating System:** Windows 10
- **Laptop:** Used to run code
- **Webcam:** Used for video feed

Algorithm used:

The Drowsiness Detection System uses computer vision and image processing algorithms, specifically the facial landmark detection algorithm provided by the Dlib library, to analyze the position and movement of the eyes and determine whether the individual is showing signs of drowsiness.

Each eye is represented by 6 (x, y)-coordinates, starting at the left-corner of the eye (as if you were looking at the person), and then working clockwise around the eye.It checks 20 consecutive frames and if the Eye Aspect ratio is less than 0.25, Alert is generated.

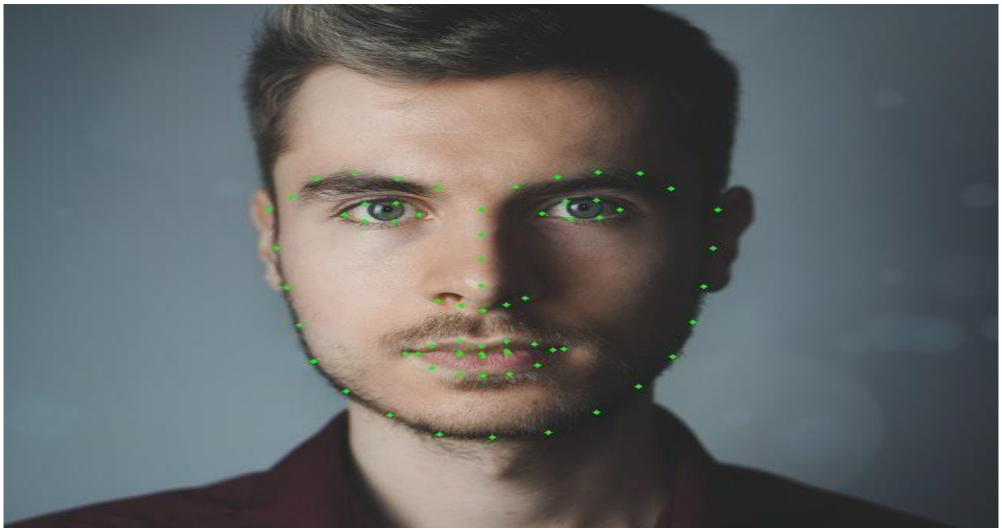
- **SciPy Spatial import distance:** Functions for computing distances between points in a variety of ways are available in the scipy.spatial.distance module. You can utilize it by importing it in your Python code as shown here.

from scipy.spatial import distance

Once imported, We used the module's functions to determine the separations between points. The distance. euclidean() function, for instance, can be used to determine the Euclidean separation between two points. The Euclidean () function takes two tuples representing the coordinates of two points, and returns the Euclidean distance between them.

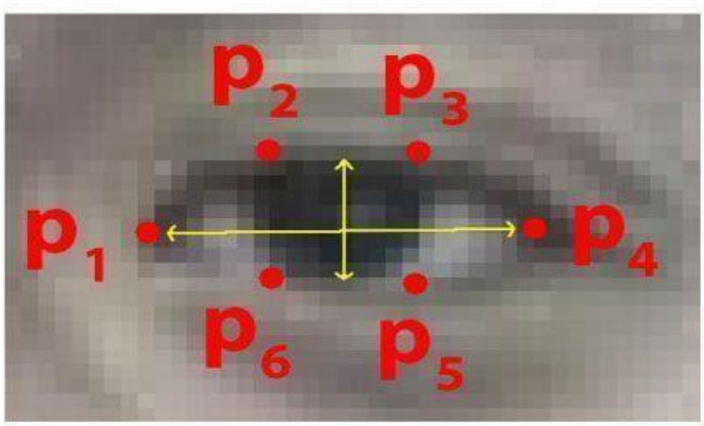
Implementation:

- In our program we used Dlib, a pre-trained program trained on the Helen dataset to detect human faces using the pre-defined 68 landmarks.



Landmarked image of a person by Dlib

- We were successful in identifying the left eye and right eye features of the face after sending our video stream to the dlib frame by frame.
- Now, we drew contours around it using OpenCV.
- Using Scipy's Euclidean function, we calculated the sum of both eyes' aspect ratio which is the sum of 2 distinct vertical distances between the eyelids divided by its horizontal distance.



Eyes with horizontal and vertical distance marked for Eye Aspect Ratio calculation

- The aspect ratio number is now checked to see if it is less than 0.25 (0.25 was selected as the base case after several tests). An alarm sounds and the user is warned if it is less.

Source Code:

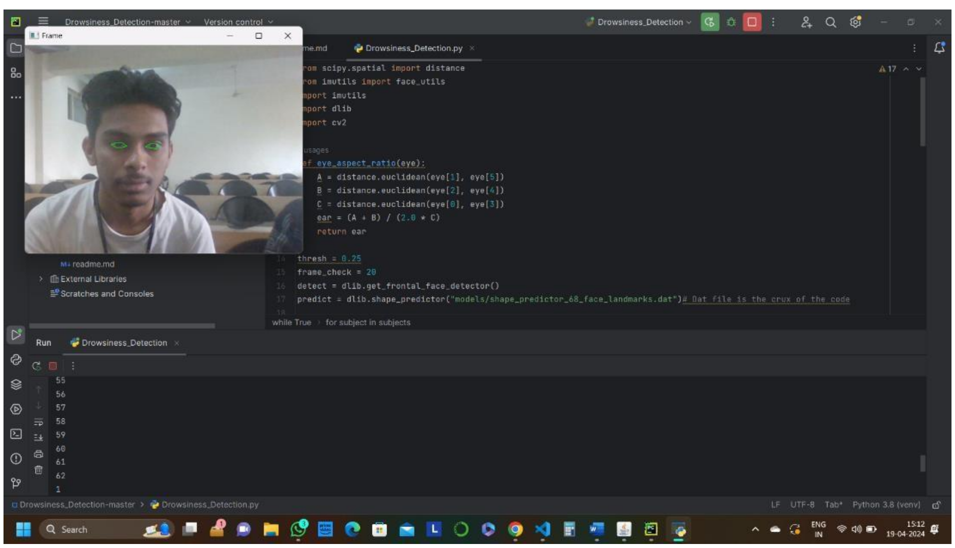
```
from scipy.spatial import distancefrom imutils
import face_utils import imutils
import dlibimport cv2

defeye_aspect_ratio(eye):
    A = distance.euclidean(eye[1], eye[5]) B =
    distance.euclidean(eye[2], eye[4]) C =
    distance.euclidean(eye[0], eye[3])ear = (A + B) / (2.0 *
    C)
    return ear

thresh = 0.25
frame_check = 20
detect=dlib.get_frontal_face_detector()predict =
dlib.shape_predictor("models/shape_predictor_68_face_landmarks.dat")# Dat fileis the crux of the code

(lStart, lEnd) = face_utils.FACIAL_LANDMARKS_68_IDXS["left_eye"](rStart, rEnd) =
face_utils.FACIAL_LANDMARKS_68_IDXS["right_eye"]cap=cv2.VideoCapture(0)
flag=0 while
True:
    ret, frame=cap.read()
    frame = imutils.resize(frame, width=450)
    gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)subjects =
    detect(gray, 0)
    for subject in subjects:
        shape = predict(gray, subject)
        shape = face_utils.shape_to_np(shape)#converting to NumPy ArrayleftEye = shape[lStart:lEnd]
        rightEye = shape[rStart:rEnd] leftEAR =
        eye_aspect_ratio(leftEye) rightEAR =
        eye_aspect_ratio(rightEye)ear = (leftEAR + rightEAR)
        / 2.0 leftEyeHull = cv2.convexHull(leftEye)
        rightEyeHull = cv2.convexHull(rightEye) cv2.drawContours(frame, [leftEyeHull], -1, (0,
        255, 0), 1)
        cv2.drawContours(frame, [rightEyeHull], -1, (0, 255, 0), 1)
        if ear < thresh:flag += 1
            print (flag)
            if flag >= frame_check:
                cv2.putText(frame, "****************ALERT!****************", (10,
30),
                    cv2.FONT_HERSHEY_SIMPLEX, 0.7, (0, 0, 255), 2)
                cv2.putText(frame,"************You are Drowsy****************",
(10,325),
                    cv2.FONT_HERSHEY_SIMPLEX, 0.7, (0, 0, 255), 2)
                # print ("Drowsy")
          else:
```

```
            flag = 0 cv2.imshow("Frame",
    frame)key = cv2.waitKey(1) & 0xFFif
    key == ord("q"):
        break
cv2.destroyAllWindows()
cap.release()
```

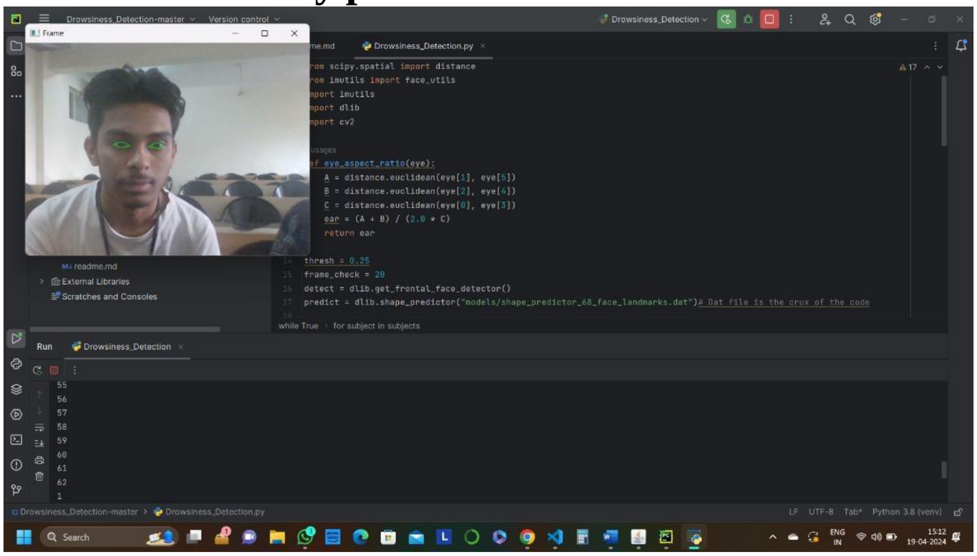
Test Cases and Test Results:

Test ID	Test Case Title	Test Condition	System Behavior	Expected Result
T01	NSGY	Straight Face, Good Light, With Glasses	Non Drowsy	Non Drowsy
T02	YTGN	Tilted Face, Good Light, No Glasses	Drowsy	Drowsy
T03	YTGY	Tilted Face, Good Light, With Glasses	Drowsy	Drowsy

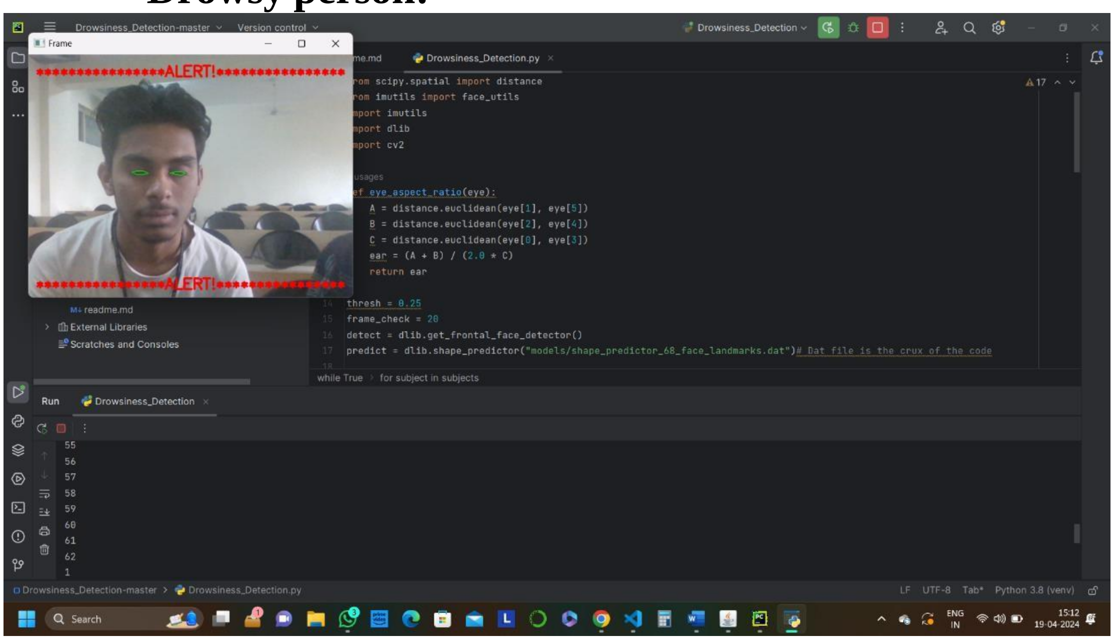
Screenshot of Project:



Non Drowsy person:



Drowsy person:



CHAPTER: 5

CONCLUSION AND FUTURE WORK

5.1. Conclusion

Drowsiness Road accidents have historically been seen as a required concern on regular roads, highways, or any other vehicle area, so to avoid those types of road accidents that can be entirely automated with an effective software program. The advantages of using this technology would assist in reaching a condition without hesitation where all issues or bugs have been fixed. Numerous technologies are available to identify driver weariness, as was discussed throughout the report. To find the best strategies for preventing the leading cause of fatal automobile crashes, this report examines emerging technology. The system aids in process implementation and retrieves hidden insights from data. This system can be improved and developed further.

5.2. Future work

Future research and advancement in Python-based sleepiness detection systems have a number of promising directions. The following are some things to think about:

1. Enhanced Feature Extraction: Examine cutting-edge methods for extracting features from the face and eyes. To do this, it could be necessary to use deep learning-based feature extraction techniques or add more sensors, such infrared cameras or depth sensors, to get a more comprehensive picture of the driver's face and eyes.

2. Real-Time Fatigue Level Estimation: Create methods that determine the driver's state of exhaustion on a continuous scale rather than relying on binary drowsiness detection. As a result, preventative actions may be taken and more detailed information on the driver's awareness can be provided.

3. Fusion of Multiple Modalities: To increase the precision and dependability of sleepiness detection, combine data from several modalities, such as eye movement, head posture, heart rate, and brain activity. Look at strategies for successfully combining the information from these many sources.

4. Context-Aware Systems: Consider include contextual data in the sleepiness detection system, such as the time of day, weather, and road conditions. This might facilitate the development of a more reliable and flexible system that considers external variables impacting driver weariness.

5. Long-Term Monitoring and Prediction: Create algorithms that can analyse long-term patterns and trends in driver sleepiness, enabling the early identification and forecasting of episodes related to tiredness. In order to anticipate future sleepiness levels, this may include analysing previous data and adding machine learning algorithms.

6. Personalized Drowsiness Models: Examine methods for creating individualised models that can adjust to different drivers according to their special traits, behavioural patterns, and physiological reactions. This may result in sleepiness detection that is more precise and specifically catered to the requirements of each driver.

7. Edge Computing and IoT Integration: To allow real-time analysis and reaction at the edge, look into integrating sleepiness detection systems with edge computing platforms or IoT devices. This can lessen latency and enhance the system's responsiveness in general.

8. Online Learning and Adaptation: Create algorithms that can continually learn from and adjust to alterations in the driver's behaviour and patterns of tiredness. The system's performance can be enhanced by using online learning techniques to dynamically update the model depending on fresh data.

9. Robustness to Environmental Factors: Improve the sleepiness detection systems' resistance to adverse environmental factors as dim illumination, occlusions, and drivers wearing masks or glasses. Investigating alternate imaging methods, image-enhancing algorithms, or sensor fusion strategies might be part of this.

10. Real-World Validation and Deployment: Extensive field tests and validation studies of the sleepiness detection system should be carried out in actual driving situations. This will assist gauge how well the system is working, determine how well it prevents accidents, and gather user input for potential future enhancements.

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APPENDIX

1. Plagiarism Report

2. Design Checklist

USER MANUAL

1. Login Module - This module allows the user to log in and start the drowsiness system, which in turn activates the camera and begins monitoring the driver. The user must enter their login information, including their username and password, in this module**.**

Fig 1. = Login Page

2. Registration Module - This module allows users to enter their contact information, including phone number and email, as well as information about their family members, including phone numbers and emails, in order to warn them by email and SMS when they are about to nod off.

Fig 2. = Registration Page

3. Eye Extraction Module - This module uses algorithms to analyse images to determine if a driver is tired or not by identifying the eyes and other facial landmarks from a live webcam feed.

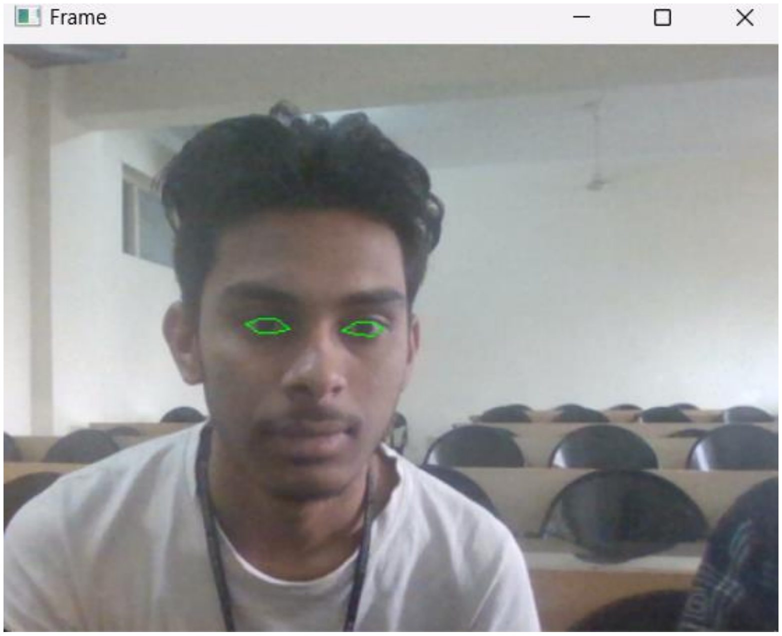

Fig 3. = Eye Extraction

4. Drowsiness Detector Module - This module uses algorithms to analyse images to determine if a driver is tired or not by detecting the eyes from a live webcam feed.

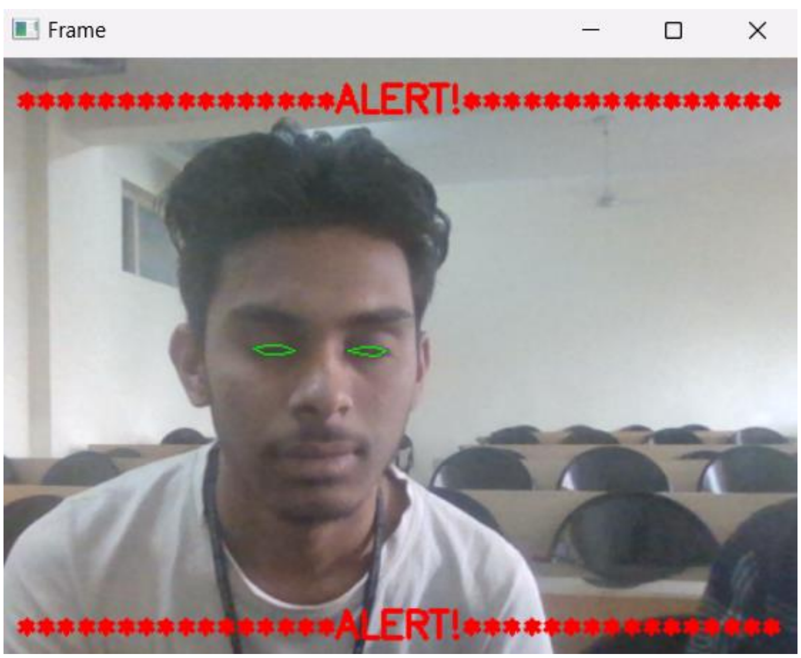

Fig 4. = Drowsiness Detection

5. facial Recognition Module: This module uses facial recognition technology to identify drivers. After completing the authentication process, it retrieves the driver's family information from the database and sends an alarm message.

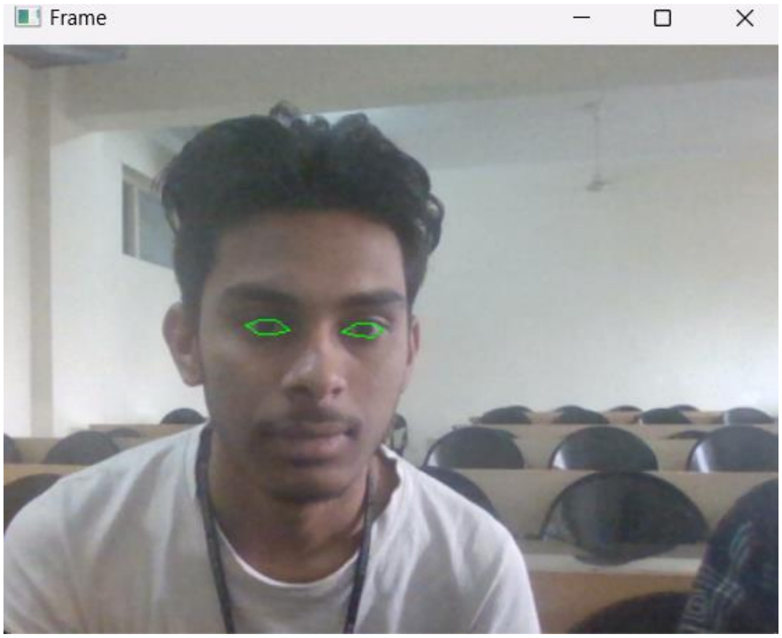

Fig 5. = Face Identification

6. The Alert Module - notifies the user's family members through SMS and email that you are sleepy and provides them with your current location and photo if the driver does not awaken after 50 notifications of alarm music.

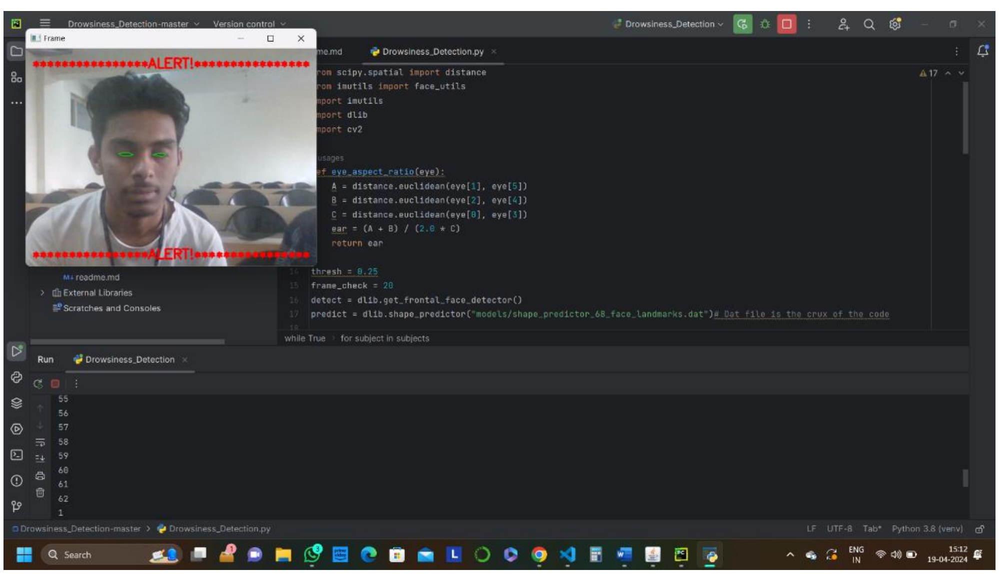

Fig 6. = Alert Message