A PROJECT REPORT

ON

DRIVER YAWNING ANALYSIS USING PI CAMERA AND DEEPLEARNING

SUBMITTED TO THE SAVITRIBAI PHULE PUNE UNIVERSITY,
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CERTIFICATE

This is to certify that the Project report entitled

"**DRIVER YAWNING ANALYSIS USING PI CAMERA AND DEEP LEARNING"**

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is a bonafide work carried out by them under the supervision of Mrs. S. M. Ingawale and it is approved for the partial fulfillment of the requirement of Savitribai Phule Pune University for the award of the Degree of Bachelor of Engineering (Electronics and Telecommunication Engineering)

This project report has not been earlier submitted to any other Institute or University for the award of any degree**.**

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ABSTRACT

Drowsiness and fatigue are one of the main causes that lead to traffic accidents. This can be prevented by making an effort to get enough sleep before driving, drinking coffee or energy drinks, or resting when the signs of drowsiness appear. Technological advancements in today's world have led to drivers being assisted with such problems. A method has been developed to detect the closing of the eyes and yawning of the driver for drowsiness analysis using the camera PI. This system analyses the various techniques and methods like Open CV and Deep Learning Algorithm is used in the system to detect drowsiness and yawning of the driver.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Driving at night can be a risky business. Most people planning long-distance travel prefer to drive at night.The clear reason for this is the low volume of traffic. Yes, traffic can be a good reason, but only in some cases. If you are travelling on weekends, it is possible that you will find little traffic even at night.

Aside from traffic, there are many other problems with driving at night. For example, weather: if you are driving across the state, you never know what the weather will be like there. And bad weather like rain or snow can become a problem. And who knows how good your vehicle's headlights are. You need to get themchecked! Poor visibility is the most critical factor that affects driving at night. It's important to know that not all roads are well lit at night. There may be areas where you have to rely solely on your car's headlightsto keep your eyes on the road. That being said, it's not uncommon to drive with your high beams on in areaswith low light. While there's nothing wrong with that, it can impair your visibility due to glare. To drive well, you should avoid looking directly into the headlights of the approaching vehicle. Not only will this help you focus on the road, but it will also prevent your vision from being impaired. In the long run, it can be difficult for your eyes to adjust from bright to dim light when looking into the high beams. Therefore, you should focus more on the lane markings or just look straight ahead when driving. It is also important to keep your car's headlights, mirrors and windshield clean. This will keep the light from scattering and prevent glare. When dusk falls, our bodies naturally switch to rest mode. When you start your journey aftera hard day's work, it can become almost impossible for you to drive at night. Your body cannot support youdue to excessive fatigue. Therefore, it is important that you recharge yourself before you start your long night drive. To do this, you can do several things, for example:

Start a little early: one way to familiarize yourself with the low light conditions at night is to start early. Starting your trip while it's still light outside will allow your body, mind, and especially your eyes to adjustto the outside conditions. So if it gets dark outside after a while, you will not have any problems with the transition. Get enough sleep before you drive: It may not be for everyone, but it's best to take a nap before a night drive. Getting enough sleep before nighttime driving can ensure that you stay efficient and focusedfor a long time. Drowsy driving is a major problem in today's world. About 12% of serious motor vehicle accidents are caused by drowsy driving.

In this system, this problem is addressed by developing a system that warns the driver when he/she is drowsy. This system analyses both the eyes and the mouth to detect drowsiness. For drivers, midnight is a good time to drive because there is no traffic then. This affects their sleep cycle, causing them to fall asleepwhile driving. Therefore, this system will alert them if they fall asleep while driv

1.2 RELEVANCE

It is difficult to determine the extent of sleep-related crashes because there is no simple, reliable method todetermine whether fatigue played a role in a crash and, if so, what level of fatigue the driver exhibited. Thisleads to varying estimates of the extent of sleep-related crashes, and in particular, findings based on accidentreports generally lead to lower estimates than studies based on in-depth surveys. Sleep-related crashes tendto be more severe, possibly because of higher speeds and because the driver is unable to take evasive actionor even brake before the collision. Horne describes typical sleep-related crashes as those in which the driverruns off the road or collides with another vehicle or object without applying full braking before impact.

Below are the indications of sleep related accidents:

- The accident occurred on a high-speed road (e.g., High-way).
- The driver did not attempt to brake or swerve to avoid the accident
- The driver was alone in the vehicle
- The accident occurred in the early hours of the morning, or between 3:00 and 4:00

pm.Importance of Projects,

- Perfect Drowsy detection using Pi camera
- Accuracy in result.
- Live Video Acquisition.
- Using Deep Learning Technique for Accuracy in face recognitions.

In this system, this problem is addressed by developing a system that warns the driver when he/she is drowsy. This system analyzes both the eyes and the mouth to detect drowsiness. For drivers, midnight is a good time to drive because there is no traffic then. This affects their sleep cycle, causing them to fall asleepwhile driving. Therefore, this system will warn them if they fall asleep while driving. This system is independent of the subject and therefore can be used in commercial systems. Eye closure can be detected by eye aspect ratio analysis and yawing can be detected by mouth aspect ratio analysis (MAR). ThresholdsEAR and MAR are set. The system detects the first signs of fatigue when these values change. If the valueof EAR continues to decrease, it means that the driver is closing his eyes, and if the value of MAR increases,it means that the driver is yawing. Implement this logic to detect the driver's fatigue in this system.

Driver drowsiness and inattention warning systems and advanced driver distraction warning systems shall be designed to record and shop only the data necessary for the purposes for which they were collected or otherwise processed within the closed loop system.

1.3 PROJECT UNDERTAKEN

We declare that the work presented in this project titled "Driver Yawning Analysis Using Pi Camera andDeep Learning" submitted by me to the Department of Engineering and Technology, Savitribai Phule Pune University, Bareilly for the award of Bachelor of Technology in Electronics and Telecommunications is my own work. We have neither plagiarized nor submitted the same work for the degree. In case this undertaking is found to be incorrect, I accept that my degree may be unconditionallywithdrawn from me, for which we shall be solely responsible.

1.4 ORGANIZATION OF PROJECT

In the CHAPTER 1 contains an introduction to the technologies used to create the system. Most people planning long-distance travel prefer to drive at night. The clear reason for this is the low volume of traffic. Yes, traffic can be a good reason, but only in some cases. If you are travelling on weekends, it is possible that you will find little traffic even at night. Aside from traffic, there are many other problems with drivingat night. For example, weather: if you are driving across the state, you never know what the weather will belike there.

In the CHAPTER 2 include all the literature surveys regarding the project. Driving at night can be a risky business. Most people planning long-distance travel prefer to drive at night. The clear reason for this is thelow volume of traffic. Yes, traffic can be a good reason, but only in some cases. If you are travelling on weekends, it is possible that you will find little traffic even at night.

CHAPTER 3 containing Design and Drawing, and explaining about various important blocks in the proposed system and their high-level interaction. It can be seen that the system consists of 5 distinct modules.

In the CHAPTER 4 includes project implementation and explaining flowchart. Also, one can have many other creative ideas to improve this project to another level by adding various types of sensors. In the future,by getting access to more resources we can expand our dataset to get more reliable and efficient results.

CHAPTER 5 highlights the project's advantages and wide-ranging applications, showcasing its potential and benefits.

CHAPTER 6 concludes the study and outlines future scopes for further exploration.

1.5 SUMMARY

This chapter summarizes the overall introduction of driver yawning analysis using pi camera and deeplearning. This chapter provides a summary of the background, relevance, and organization of the project focused on driver drowsiness analysis using a Raspberry Pi camera and deep learning techniques.

1. Background: -

The chapter begins by discussing the increasing concerns regarding road accidents caused by driver drowsiness. It highlights the potential dangers and risks associated with drowsy driving, emphasizing the need for an efficient and reliable solution. The background section also touches upon the advancements incomputer vision and deep learning technologies that can be leveraged to detect and alert drowsy drivers.

2. Relevance of the Project: -

The summary then delves into the relevance of the project within the context of road safety and driver assistance systems. It outlines the significance of real-time driver drowsiness analysis, emphasizing its potential to prevent accidents and save lives. The chapter highlights the potential impact of the proposed solution in reducing accidents caused by drowsy driving.

3. Organization of the Project: -

The chapter concludes by providing an overview of the project's organization and structure. It outlines thedifferent components and stages involved in developing the driver drowsiness analysis system. This includes the hardware setup using a Raspberry Pi camera, the implementation of deep learning algorithmsfor drowsiness detection, and the integration of real-time alert mechanisms.

Overall, this chapter sets the stage for the subsequent sections of the project, establishing the background,relevance, and organization of the driver drowsiness analysis using Pi Camera and deep learning.

CHAPTET 2

LITERATURE SURVEY

2.1 INTRODUCTION

Driving at night can be a risky business. Most people planning long-distance travel prefer to drive at night.The clear reason for this is the low volume of traffic. Yes, traffic can be a good reason, but only in some cases. If you are travelling on weekends, it is possible that you will find little traffic even at night. Aside from traffic, there are many other problems with driving at night. For example, weather: if you aredriving across the state, you never know what the weather will be like there.

2.2 EXISTING SYSTEM

The countless number of people drive on the highway day and night. People traveling long- distance suffer from lack of sleep. Due to which it becomes very dangerous to drive when feeling sleepy. The majority of accidents happen due to the drowsiness of the driver. According to a thorough investigation, there are over 500,000 accidents in India alone each year[1]. Furthermore, driver fatigue is a factor in almost60 percent of these accidents. In this paper, we provide a real-time monitoring system that makes use of face/eye identification and image processing algorithm. Driver drowsiness detection is a vehicle safety technology which prevents accidents when the driver is getting drowsy. Drowsiness can be described as a biological state where the body is in transition from awake state to a sleeping state. Drowsiness is intermediate stage between wakefulness and sleep that has been defined as the state of progressive impairedawareness associate with the desire or inclination to sleep.1 in 4 vehicle accidents are caused by drowsy driving and 1 in 25 adult drivers report that they have fallen asleep at the wheel in the past 30 days. The scariest part is that drowsy driving is not just falling asleep while driving. Drowsy driving can be as small as a brief state of unconsciousness when the driver is not paying full attention to the road. Drowsy driving results in over 71,000 injuries, 1,500 deaths, and $ 12.5 billion in monetary losses per year. Due to the relevance of this problem, we believe it is important to develop a solution for drowsiness detection, especially in the early stages to prevent accidents.

Driver drowsiness is one of the major cause for most of the accidents in the world. Detectingthe driver eye tiredness is the easiest way for measuring the drowsiness of driver. The existing systems in the literature, are providing slightly less accurate results due to low clarity in images and videos, which may result due to variations in the camera positions[2].

In order to solve this problem, a driver drowsiness detection system is proposed in this paper, which makes use of eye blink counts for detecting.

Specifically, the proposed framework, continuously analyzes the eye movement of the driver and alerts thedriver by activating the vibrator when he/she is drowsy. When the eyes are detected closed for too long time,a vibrator signal is generated to warn the driver. The experimental results of the proposed system, which isimplemented on Open CV and Raspberry Pi environment with a single camera view, illustrate the good performance of the system in terms of accurate drowsiness detection results and thereby reduces the road accidents.

The driver drowsiness detection is to detect the drowsiness in low light condition. The proposedsystem is a method to detect driver's eye closure and yawning for drowsiness analysis by infrared camera[3].

❖ This method consists of four steps, namely,

• Face detection

• Eye detection

• Mouth detection

• Eye closure and yawning detection

The main concept is detecting the driver's face and set it to region of Interest (ROI). Next use ROI to find targets as eye and mouth. This process starts by getting input from infrared 2D camera and processing by MATLAB. First step author will set the infrared camera at the top of the vehicle facing the driver and recordsthe driver's random action like blink, closing eyes and yawn randomly. When the program detects the symptoms of driver drowsiness, program will print red rectangle around symptom area such as yawning will print red rectangle around driver's mouth and eyes closure will print angle around driver's eyes area.

a) This method does not have anything related for blinking of a driver so this system may give false alarms

b) The process to detect drowsiness detection takes a long time due to slow processing which may cause casualties.

A true time Drowsy Driving Detection System for the prevention of road accidents usingIOT. One among the main issues for the traffic collision is Sluggishness Driving. An outsized number of roadaccidents occur due to this which ends up in severe injuries and deaths[4]. For this reason, various studies were

wiped out designing systems which will examine the sluggishness of driver and alert him before the accident occurs, thus preventing him to fall sluggishness and cause an accident. The measurements are highly influenced by structure of road, sort of vehicle and driving skills. These are the vehicle based (traditional approaches) measures who designs the system.

drowsiness of the driver. However, in these techniques we use intrusive such as electrodes are required to be placed on the head and body. Furthermore, there are few existing researches during which subjective measurements are used because the input for the system, but, these sorts of methods can distract the drivingforces and lead to an ambiguous result. In this paper, we proposed a framework that is absolutely non- intrusive and real-time. Our proposed framework uses the attention closure ratio as input parameter to detectthe sluggishness of the driver. If the attention closure ratio deteriorates from the quality ratio, the driver is alerted with the help of a buzzer, water sprinkler on the drives face, back indicator. For our framework, a Picamera is employed to capture the pictures of the eye of driver. Alcohol detection Sensor is used to detect the Alcohol level consumed by the Driver. Thus, the whole system is incorporated using Raspberry-Pi.

The proposed system aims to reduce the number of accidents that occur due to driver drowsinessand fatigue, which in turn will increase road safety. This has recently become a common reason for accidents. Various faces and body gestures are considered to indicate drowsiness and fatigue in drivers, including tiredness in the eyes and yawning. These characteristics are an indication that the driver's condition is not okay. EAR (Eye Aspect Ratio) calculates the ratio of distances between the horizontal and vertical eye markings required to detect drowsiness[5]. For the purpose of detecting yawning, a YAWN value is calculated based on the distance between the lower lip and the upper lip, and the distance is compared to a threshold. We used an e Speak module (text-to-speech synthesizer) that provides appropriate voice alerts when the driver is drowsy or yawning. The proposed system was developed to reduce the accident rate andcontribute to technology with the aim of preventing deaths caused by traffic accidents.

The different aspects of the project related to the development of a system to detect driverdrowsiness. This report analyses the different techniques and procedures used in the development of a drowsy driving detection system[6].The goal of this project is to provide real-world insight into how the system works and what changes can be made to improve its usefulness. Through the study, we were able toidentify areas of improvement that can make the system even more efficient.

Many of the accidents occurs due to drowsiness of drivers. It is one of the critical causes of roadways

accidents now a days. Latest statistics says that many of the accidents were caused because of drowsiness of drivers. Vehicle accidents because of drowsiness in drivers[7].Causing death to thousands of lives. Morethan30% accidents occur due to drowsiness. For the prevention of this a system is required which detects the drowsiness and alerts the driver which saves the life. In this paper we present a scheme for driver drowsiness detection. In this driver is continuously monitored through webcam. This model is processing techniques which mainly focusses on face and eyes of the driver. The model extract the drivers face and predicts the blinking of eye from eye region. We use an algorithm to track and analyzed rivers faceand eyes to measure parclos. If the blinking rate is high then the system alerts the driver with a sound.

A comprehensive analysis of the existing methods of driver drowsiness detection and presents a detailed analysis of widely used classification techniques. Drowsiness or fatigue is a major causeof road accidents and has significant implications for road safety[8]. Several deadly accidents can be prevented if the drowsy drivers are warned in time. A variety of drowsiness detection methods exist that monitor the drivers' drowsiness state while driving and alarm the drivers if they are not concentrating on driving. The relevant features can be extracted from facial expressions such as yawning, eye closure, and head movements for inferring the level of drowsiness. The biological condition of the drivers' body, as wellas vehicle behavior, is analyzed for driver drowsiness detection. First, in this paper, we classify the existing techniques into three categories: behavioral, vehicular, and physiological parameters-based techniques. Second, top supervised learning techniques used for drowsiness detection are reviewed. Third, the pros andcons and comparative study of the diverse method are discussed. In addition, the research frameworks are elaborated in diagrams for better understanding. In the end, overall research findings based on the extensivesurvey are concluded which will help young researchers for finding potential future work in the relevant field Contents.

Drowsiness or fatigue is one of the main factors that threaten the road safety and causes the severe injuries,deaths and economical losses. The increased drowsiness deteriorates the driving performance. Lack of alertness, generated by the unconscious transition from wakefulness to sleep, leads to several serious road accidents. The U. S. National Highway Traffic Safety Administration (NHTSA)1 reports that drowsy driving resulted in almost 100,000 road accidents and more than 1,500 deaths per year. A driver’s fatigue can have multiple causes such as lack of sleep, long journey, restlessness, alcohol consumption and mentalpressure. Each of which can lead to serious disaster. Nowadays, road rage is in the multiples of the past, which causes stress on drivers. Therefore, previous transportation system is not enough to handle these hazards on roads. Thus, by embedding the automatic fatigue detection systems into vehicles, several deadlyaccidents can be prevented. The drowsiness detection system continuously

analyzes the drivers' attention level and alerts the driver before the arrival of any serious threat to road safety.

Approximately 1.3 million people die each year as a result of road accidents. Sleep-deprived and fatigued drivers are responsible for 40% of these road accidents. India ranks first across 199 countries in the numberof road accidents. Drowsiness implies feeling lethargic, lack of concentration, tired eyes of the drivers whiledriving vehicles[9]. A road accident not only causes the loss of the driver's life, but it may also take the

lives of innocent pedestrians, fellow passengers, passengers in other vehicles commuting from the same route along with economic losses. The reason for this high number of casualties caused by road accidents isa clear indication of the lack of a robust and credible technological system. To avoid this anomaly, we propose a system that is able to detect the drowsiness of a driver and alert them immediately. This system would capture images from a video stream through a camera, detect the face and localize the eyes. The eyesare then analyzed for drowsiness using the Haar Cascade algorithm. Based on the result, the driver is alertedthrough an alarm system. There are 4 segments in our proposed system to provide a solution to deal with any type of consequences. The first solution is to alert the driver with a suitable alarming sound at the slightest detection of drowsiness. The second segment includes sending the driver's geographical location to the driver's emergency contact in the event of the driver not receiving calls and the emergency contact making an automated call to the detection module. The third solution is to provide an SOS button that the driver can hit in case of an emergency which triggers an SMS to the emergency contact with a google mapslink of the driver's current location. Lastly, if the driver does meet with an accident, our system also detectsthe occurrence of an accident and sends a message to the registered user. As a result, the users would have a single platform with the ability to do a lot more than any existing drowsiness detection system.

Drowsy driver detection system is designed using Python and the Dlib model. This model is trained to recognize 64 facial landmarks. The drowsiness features are extracted and the driver is warned in case of drowsiness. The Dlib library is used to detect and localize facial features using the Dlib trained facial feature detector called Histogram of Oriented Gradients (HOG). The frequencies of gradient direction[10]. of an image in localized regions are used to form histograms. It is used to map the coordinates of facial features of the input video and detect sleepiness by monitoring the aspect ratios of eyes and mouth. To test the model,the following steps are performed:

(a) The input video (pre-recorded or real-time) is fed into the model.

The individual images are resized andconverted to grayscale.

b) Dlib's face detector, based on HOG, first determines the position of the face.

c) The face landmarks for the face region are determined by the predictor and mapped to the face.

d) The coordinates of the left eye, right eye and mouth are extracted, which are then used to calculate the aspect ratio for both eyes and mouth based on Euclidean distance.

(e) The calculated aspect ratios are compared to established thresholds to detect signs of sleepiness. If the average aspect ratio of the left and right eyes falls below the threshold, this is identified as a sign of drowsiness. If the aspect ratio of the mouth exceeds the established threshold, there is a possibility that it isyawning.

f) If continuous signs of drowsiness are detected over a longer period of time, the driver is warned.

2.3 LITERATURE SURVEY: TABLE

No.	Paper Topic	Author	Technology used
1	"Driver Drowsiness DetectionBy Using Webcam".	Pooja D.C.1, Sara Aziz2, Shakuntala Koujalagi3, Shilpa B. H.4, Mr. Vasanth Kumar N.T	Open CV
2	"Driver Drowsiness DetectionSystem Based onVisual Features",2018.	Fouzia, Roopalakshmi R, Jayantkumar A Rathod, Ashwitha S Shetty, Supriya	Image Processing
3	" Real-Time Driver Drowsiness Detectionusing Computer Vision",2021.	Mahek Jain, Bhavya Bhagerathi, Sowmyarani C N	Using Haarcascade classifier eyes and mouth movements are tracked. For eye blinking use EAR(eye aspect Ratio) To detect Drowsiness we detect MER.
4	"Drowsy Driving DetectionSystem IOT Perspective",2020.	Tejashwini N, Chinna T, DeepthiR S, Swathi S, Vijayashree	Computer vision, Python , Picamera module.
5	"A Method of Driver's Eyes Closure and Yawning Detection for Drowsiness Analysis by Infrared Camera" (2019),IEEE.	Wisaroot Tipprasert, Theekapun Charoenpong, Chamaporn Chianrabutra, Chamaiporn Sukjamsri	ROT Techniques:-to find targets as eye and mouth. Infrared 2D camera to capture face image
6	"Driver Drawsiness DetectionSystem Using Haarcascade Algorithm",2022.	Adnan Shaikh, Rizwan Memon,Asif Lohar, Shiburaj Pappu	Haarcacade Algorithm
7	" Automated Driver Drowsiness Detection For Non 2Wheelers",2019-2020	Sangivalasa, BheemunipatnamMandal, Visakhapatnam	Haarcacade Algorithm
8	"A Survey on State-of-the-ArtDrowsiness Detection Techniques",2019.	Muhamad Razman, Hikmat Ullahkhan , Shahid Mahmood Awan ,Amina Ismail MahwishIlyas, And Ahasan Mahmood	Digital Image Processing
9	A Drowsy Driver DetectionSystem for Heavy Vehicles,1998.	R. Grace, V. E. Byrne, D. M.Bierman, J.-M.Legrand, D. Gricourt, B. Davis	Perclos Camera System
10	Real-Time Drowsiness Detection System using Dlib", 2019 5th IEEE International WIE Conference on Electricaland Computer Engineering, 15-16 Nov 2019,India	Shruti Mohanty, Shruti V Hegde, Supriya Prasad, J. Manikandan	Dlib's HOG Algorithm

CHAPTER 3

DESIGN AND DRAWING

1. DESIGN AND DRAWING

3. 1 INTRODUCTION

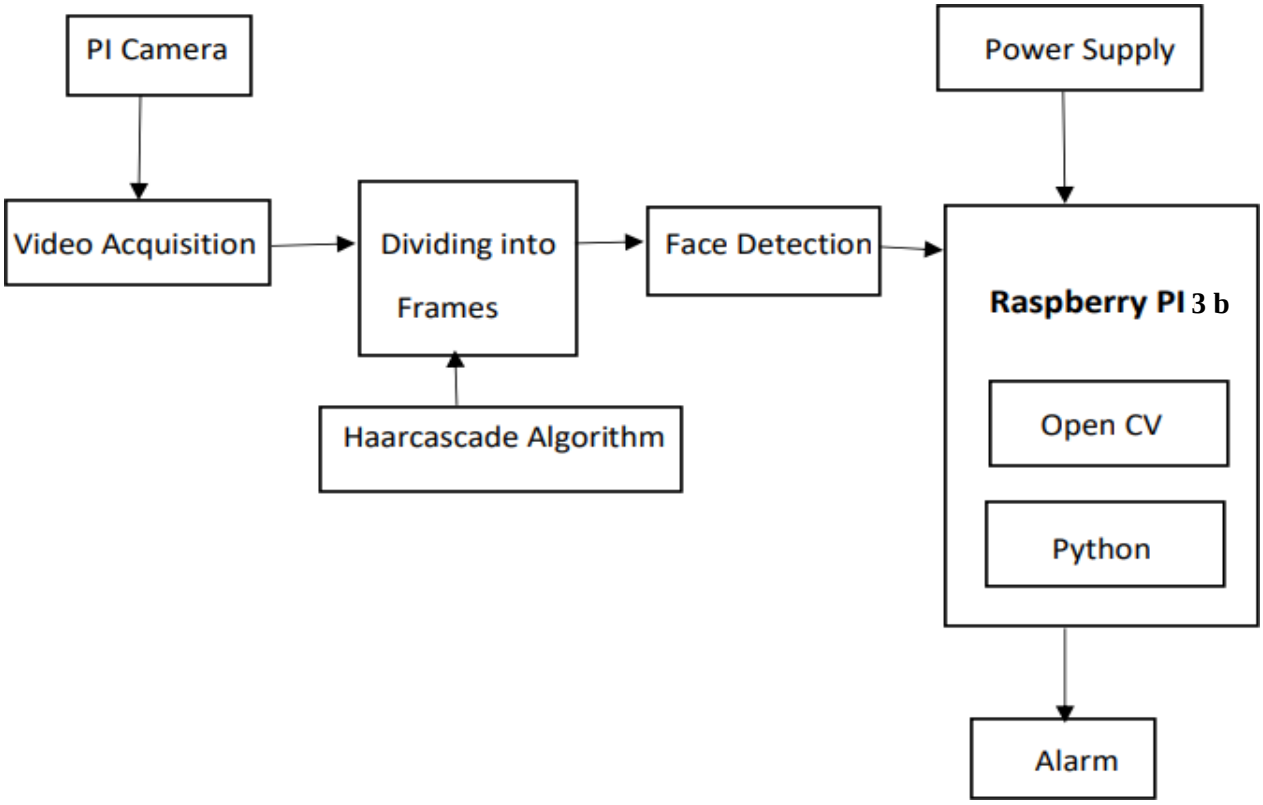

Fig.3.1: Architecture Diagram for Drowsiness and Yawning Detection System

3.2 SYSTEM ARCHITECTURE

Above figure showcases the various important blocks in the proposed system and their high-levelinteraction. It can be seen that the system consists of 5 distinct modules namely,

(a) Video acquisition.
(b) Dividing into frames.
(c) Face detection.
(d) Eye detection and.
(e) Drowsiness detection.

3.3 PI CAMERA:

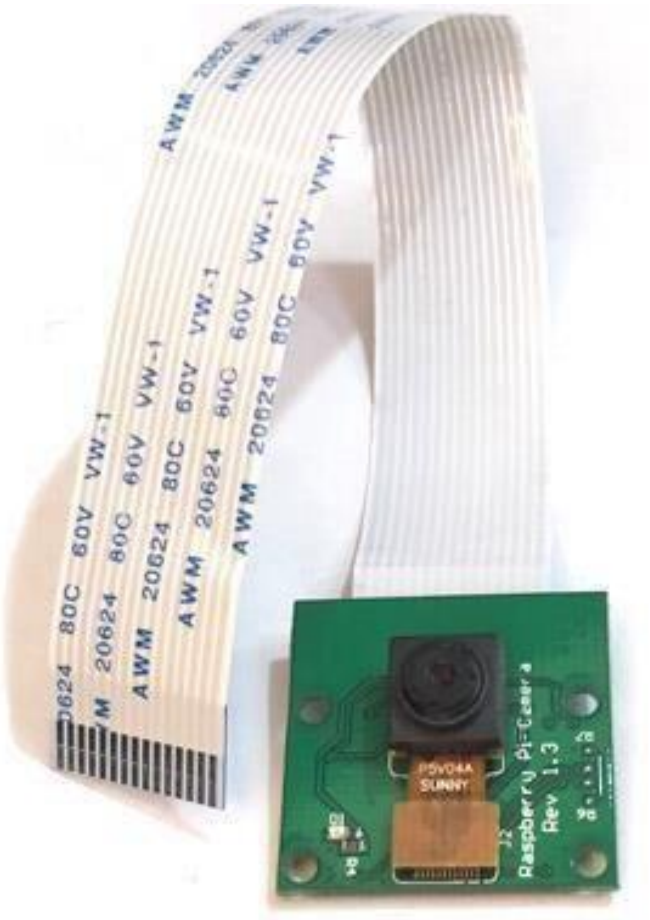

Fig.3.2: PI Camera Module

Raspberry PI camera Module, supports its Night Vision. This Camera can Adjustable-Focus. Supports all revisions of the Pi 5 megapixel. It gets person face as an input, gives output as an alarm.

The Raspberry Pi Camera Board is a specially designed add-on module for Raspberry Pi hardware. It connects to the Raspberry Pi hardware via a custom interface CSI. The sensor has a native resolution of 5 megapixels in photo mode. In video mode, it supports resolutions up to 1080p at 30 frames per second. Thecamera module is lightweight and small, making it an ideal choice for mobile projects.

The Pi camera modul**e** is a portable light weight camera that supports Raspberry Pi. It communicates with Pi using the MIPI camera serial interface protocol. It is normally used in image processing, machine learningor in surveillance projects. It is commonly used in surveillance drones since the payload of camera is very less. Apart from these modules Pi can also use normal USB webcams that are used along with computer.

Pi-Cam Features

- 5MP color camera module without microphone for Raspberry Pi
- Supports both Raspberry Pi Model A and Model B
- MIPI Camera serial interface
- Omni vision 5647 Camera Module
- Resolution: 2592 * 1944
- Supports: 1080p, 720p and 480p
- Light weight and portable (3g only)

Advantages:

- Night Vision
- Full HD Camera Resolution
- Less Power Consumption
- Smaller Physical Size
- Faster Bandwidth
- Higher Framerates
- Reduce Latency

3.4 DEPLOY ON RASPBERRY PI:

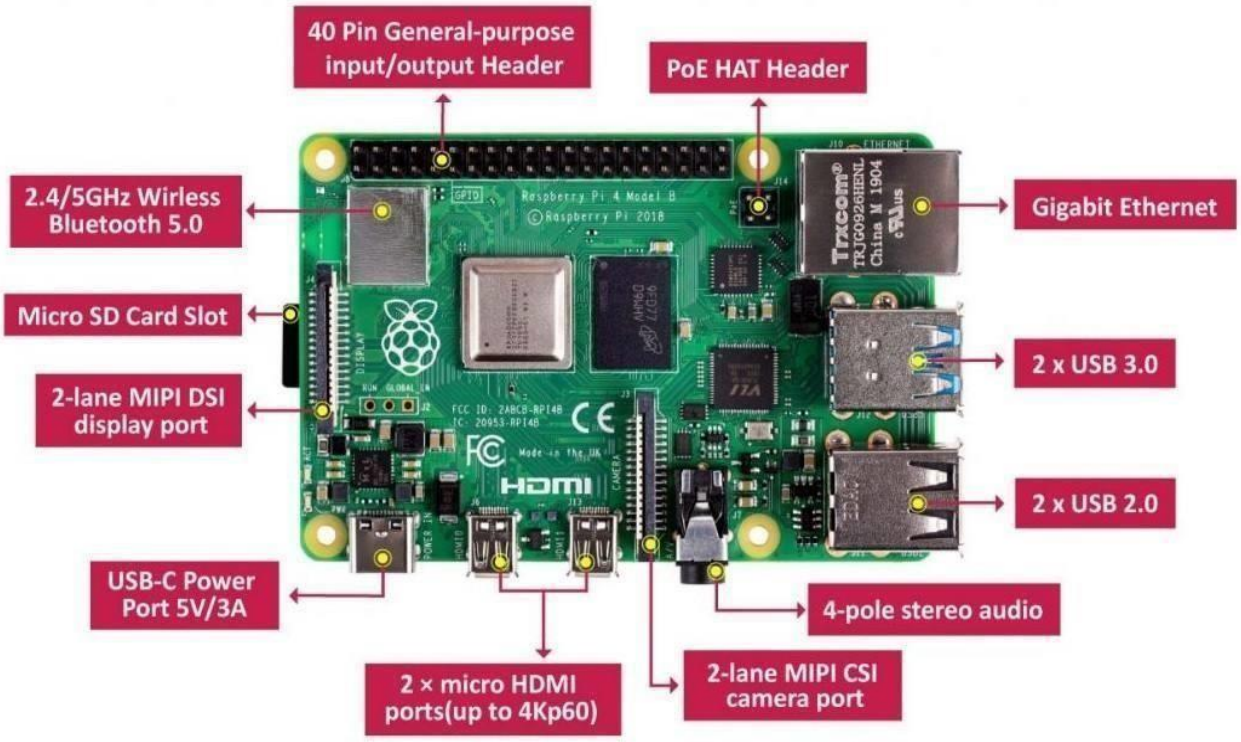

Fig.3.3: Raspberry PI

Raspberry Pi is a series of small single-board computers designed to teach computer science basics to students and others in low-income countries. It has become a popular and easy-to-try tool for developing school projects, hardware programming, robotics, simple automata, circuits, etc. The Raspberry Pi is a small,quite affordable and very powerful hardware device, a credit card sized computer. Deploy on Raspberry Piusing an external monitor and connect Pi camera and a buzzer to make it a complete detection system.

Using a Raspberry Pi-compatible camera module

Using a supported camera module together with a Raspberry Pi is the most straightforward way of adding visual input to a project. The only thing needed is a supported camera module such as the official RaspberryPi camera module. However, many alternative modules exist: for example, this breakout board with a night-vision camera and infrared LEDs.

Regardless of the chosen camera, the setup process always works similarly, as long as the camera is

supported by the Raspberry Pi. First, plug the ribbon connector of the camera module into the connector on first, plug the ribbon connector of the camera module into the connector on the Raspberry Pi. The white connector closer to the USB and Ethernet ports is the one for the camera. The other port, located on the otherside of the single-board computer, is meant for connecting a display.

Raspberry Pi is a small, single-board computer that provides a cost-effective and compact solution for various projects. It is commonly used in embedded systems, Internet of Things (IoT) applications, and DIYprojects due to its versatility and ease of use. In the context of driver drowsiness analysis using a Pi cameraand deep learning, the Raspberry Pi module plays a crucial role in capturing real-time video footage and performing the necessary computations.

- The Raspberry Pi module consists of several key components:

1. Central Processing Unit (CPU): The Raspberry Pi module is equipped with a CPU, typically an ARM- based processor, which serves as the brain of the system. It handles various tasks, such as image processing,data analysis, and running the deep learning algorithms.

2. GPIO Pins: General Purpose Input/Output (GPIO) pins are available on the Raspberry Pi module, allowing it to interface with external devices and sensors. These pins can be used to connect and control thePi camera module.

3. Camera Connector: The Raspberry Pi module features a dedicated camera connector that enables easy integration of the Pi camera module. This connector provides both power and data connections for the camera module.

4. Software Development: Raspberry Pi supports a wide range of programming languages, including Python, C/C++, and Java. These languages can be used to develop the driver drowsiness analysis software,integrate deep learning frameworks (such as TensorFlow or PyTorch), and implement the necessary algorithms for real-time drowsiness detection.

Overall, the Raspberry Pi module serves as the computational core for the driver drowsiness analysis system.It enables video capture using the Pi camera module, performs the necessary computations using

its CPU, and provides a flexible platform for software development and integration with deep learning frameworks.

Specification of Raspberry PI:

- It has a 64bit quad-core processor having cortex-A72 (ARM v8) clocked @1.5GHz.
- The new Pi board includes Broadcom BCM2711 VC6 GPU able to handle two 4kp30 displaysalso it can handle H.265 decoding at 4kp60. It has two micro-HDMI ports.
- Now the new Pi board comes in 2GB, 4GB, and 8GB LPDDR-4 RAM options.
- It has a dual-band 2.4/5.0 GHz Wi-Fi, Bluetooth 5.0, Gigabit Ethernet Port, 2 USB 3.0, and 2USB 2.0 ports.
- USB type C power input port. Also, it has POE capability via separate POE HAT (add-on).
- It has a standard 40 pin GPIO header (having backward compatibility)

Power Supply:

To provide your Raspberry Pi 4 with juice, you'll need a power source that can deliver at least 3 amps and5 volts over a USB Type-C wire.

3.5 MINI USB Cable:

Fig.3.4: Mini USB Cable

A USB cable, short for Universal Serial Bus cable, is a type of cable used to connect various devices such as smartphones, tablets, cameras, printers, and computers. It is a standard interface that allows devices to communicate with each other and transfer data.

USB cables come in different shapes and sizes, with the most common being the Type-A and Type-B connectors. Type-A connectors are found on most computers and USB chargers, while Type-B connectorsare commonly used in printers and scanners. Other types of USB connectors include Type-C, Mini-USB, and Micro-USB. USB cables have multiple uses, including charging devices, transferring data between devices, and even powering some devices like small fans or LED lights.

They have become an essential part of our daily lives, with most devices now using them as the primary method of connectivity. The USB cable is made up of four wires: two power wires and two data wires. Thepower wires supply electricity to the connected device, while the data wires facilitate the transfer of data between the devices. The cable is often shielded to reduce electromagnetic interference. One of the advantages of USB cables is their plug- and-play capability, which means that devices can be connected and used immediately without the needfor additional software or drivers. They also support high-speed data transfer rates, making them ideal for transferring large files or streaming high-quality audio and video.

In addition to their practical uses, USB cables have become an important accessory for customization and personalization. They come in a variety of colors, lengths, and styles, allowing users to choose a cable thatmatches their personal preferences or fits their device's unique needs.

- The Usage of Mini USB: -

Since the device becomes more portable nowadays, the mini-USB cable can be used in a variety of applications.

A mini-USB drive can be used not only as a removable storage device. It can also be applied to: for example, most mobile phones now rely on a mini-USB cable for charging, and can even be linked to a computer to share and synchronize data.

Similarly, MP3 players, digital cameras and portable game consoles can be charged by a computer via a mini-USB cable and share data in either direction.

Drowsiness detection system involves data transfer between the Raspberry Pi and other devices, you can also connect the USB cable to a USB port on the other device. This can be useful for transferring data, accessing the Raspberry Pi via SSH (Secure Shell), or programming the Raspberry Pi.

3.6 BUZZER:

Fig.3.5: Buzzer

There are many ways to communicate between the user and a product. One of the best ways is audio communication using a buzzer IC. So during the design process, understanding some technologies with configurations is very helpful. So, this article discusses an overview of an audio signaling device like a beeper or a buzzer and its working with applications. An audio signaling device like a beeper or buzzer maybe electromechanical or piezoelectric or mechanical type. The main function of this is to convert the signalfrom audio to sound. Generally, it is powered through DC voltage and used in timers, alarm devices, printers, alarms, computers, etc. Based on the various designs, it can generate different sounds like alarm, music, bell & siren. The pin configuration of the buzzer is shown below. It includes two pins namely positiveand negative. The positive terminal of this is represented with the '+' symbol or a longer terminal. This terminal is powered through 6Volts whereas the negative terminal is represented with the '- 'symbol or shortterminal and it is connected to the GND terminal.

The specifications of the buzzer include the following.

- Color is black
- The frequency range is 3,300Hz
- Operating Temperature ranges from – 20° C to +60°C
- Operating voltage ranges from 3V to 24V DC
- The sound pressure level is 85dBA or 10cm
- The supply current is below 15mA

A buzzer is available in different types which include the following.

- Piezoelectric
- Electromagnetic
- Mechanical
- Electromechanical
- Magnetic

Advantages of Buzzer:-

- Simplicity and Cost-Effective
- Versatility
- Easy Integration
- Low Power Consumption
- Reliable and Durable
- Customizability

3.7 LCD (Liquid Crystal Display)

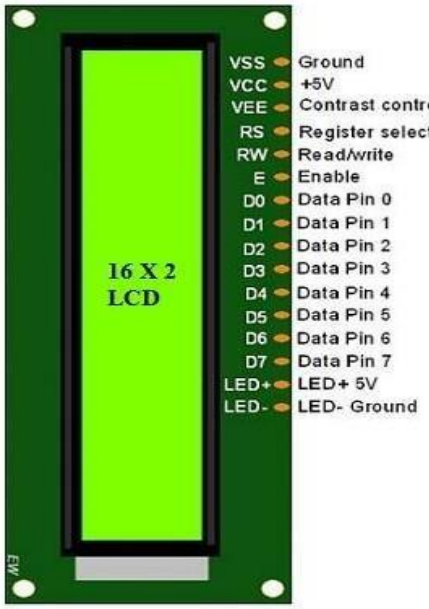

Fig.3.6:16*2 LCD

LCD (Liquid Crystal Display) modules are commonly used in drowsiness and yawning or eye blinking detection systems to display the status of the driver's alertness. These modules are typically small and compact, making them easy to integrate into existing systems. They often have a backlight for improved visibility in low light conditions. The LCD module receives data from the drowsiness and yawning detectionsystem, such as the number of blinks or the duration of a yawn, and displays this information on the screen.This allows the driver to quickly and easily see their current level of alertness and take appropriate action ifnecessary. Some LCD modules also have touch screen capabilities, allowing the driver to interact with the system and adjust settings as needed. Overall, LCD modules are an essential component of drowsiness andyawning or eye blinking detection systems, providing crucial information to keep drivers safe on the road.

LCD (Liquid Crystal Display) is a flat-panel display technology widely used in various electronic devices,including driver drowsiness analysis systems. In the context of driver drowsiness analysis using a Pi cameraand deep learning, an LCD can be used as an output display to provide visual feedback and information to the user.

Here's an explanation of how an LCD can be utilized in a driver drowsiness analysis system.

1. Displaying Real-Time Video Feed: The Pi camera captures the real-time video footage of the driver's face, which is processed by the deep learning algorithms running on the Raspberry Pi module.

The output of the analysis can be displayed on an LCD, allowing the user to see the live video feed along with additionaloverlays or annotations indicating the detected drowsiness levels or warning messages.

2. Alerting and Warning Indicators: The LCD can be used to display warning messages or indicators when the driver's drowsiness level exceeds a certain threshold. For example, if the system detects significant signsof drowsiness, it can display a clear message such as "Drowsy Driver Detected" or show a visual symbol, like a blinking icon or an attention sign, to alert the driver about their condition.

3. System Status and Information: The LCD can also provide information about the system status, such as the current mode of operation, system settings, or any relevant notifications. This allows the user to have aclear understanding of the system's behavior and performance.

4. User Interface and Interaction: In some implementations, an LCD can serve as a user interface to provide menu options or settings adjustment capabilities. Users can navigate through different screens or menus using buttons or touch-sensitive overlays on the LCD, enabling them to configure the system parameters, view historical data, or access additional features.

5. Diagnostic and Debugging Information: During the development or testing phase of the driver drowsinessanalysis system, the LCD can be utilized to display diagnostic or debugging information. This can help developers or technicians monitor the system's internal processes, track the performance of the deep learningalgorithms, or troubleshoot any issues that may arise.

Overall, an LCD display enhances the driver drowsiness analysis system by providing visual feedback, warning indicators, system information, and user interaction capabilities. It serves as an effective means tocommunicate important information to the user, allowing them to stay informed about their drowsiness leveland promoting safer driving practices.

3.8 SUMMARY

VIDEO ACQUISITION:

The system is designed to improve the quality of thermal imaging camera system video and provide the cameras with video capture, video streaming, and video analytics capabilities. Video acquisition mainly involves obtaining the live video feed of the automobile driver. Video acquisition is achieved, by making use of a PI camera.

DIVIDING INTO FRAMES:

This module is used to take live video as its input and convert it into a series of frames/ images, which are then processed.

A collection of frames in the browser window is called a frameset. Frames are divided into frames in muchthe same way as tables are organized: into rows and columns.

FACE DETECTION:

A facial recognition system has become very popular nowadays because it can be very secure compared to fingerprints and typed passwords. You may be familiar with the face unlock feature in your smartphone, which makes everything very easy. Face recognition is also used for surveillance in many places like airports, train stations and streets. Here we will build a face recognition system using Open CV library on Raspberry Pi as it is portable and works as a surveillance system. This system has been tested by me and will surely work without any problems. The face detection function takes one frame at a time from the frames provided by the frame grabber, and in each and every frame it tries to detect the face of the automobile driver. This is achieved by making use of Deep Learning.

After the face recognition function has recognized the driver's face, the eye recognition function tries to recognize the driver's eyes.

CHAPTER 4

PROJECT IMPLEMENTATION

4.1 INTRODUCTION

Using a drowsiness detection system, driver safety can be implemented in normal cars also. Future works may focus on the utilization of outer factors such as vehicle states, sleeping hours, weather conditions, mechanical data, etc. for fatigue measurements. Driver drowsiness detection is a car safety technology thathelps prevent accidents caused by the driver getting drowsy. Research has suggested that around 20% of allroad accidents are fatigue-related, up to 50% on certain roads. In this project, one can have many other creative ideas to improve this project to another level by adding various types of sensors. In the future, by getting access to more resources we can expand our dataset to get more reliable and efficient results. In thisPython project, we will be using Open CV for gathering the images from webcam and feed them into a DeepLearning model which will classify whether the person's eyes are 'Open' or 'Closed'. Image Processing Face and eye detection is a very important and challenging matter in the field of image processing. It is alsoa crucial step of face recognition. Open-Source Computer Vision Library (Open CV) is used to implement the Haar Cascade Classifier. In this project, the driver drowsiness detection requires a video sensor to detectthe faces of drivers. Then the drowsiness level of drivers can be determined by checking the eye blinking rate. Figure 4illustrates the methods involving the implementation of detection of face and eye including eye blinks using Haar Cascade Classifier and Eye Aspect Ratio, respectively. In Haar Cascade Classifier, there are four main steps that need to be executed. The steps are Haar Feature, Integral image, AdaBoost and Cascade Classifier. As for Eye Aspect Ratio, it is used to detect the eye blinks eyes open and close usingthe ratio formula based on the eye's width and height.

4.2 FLOWCHART

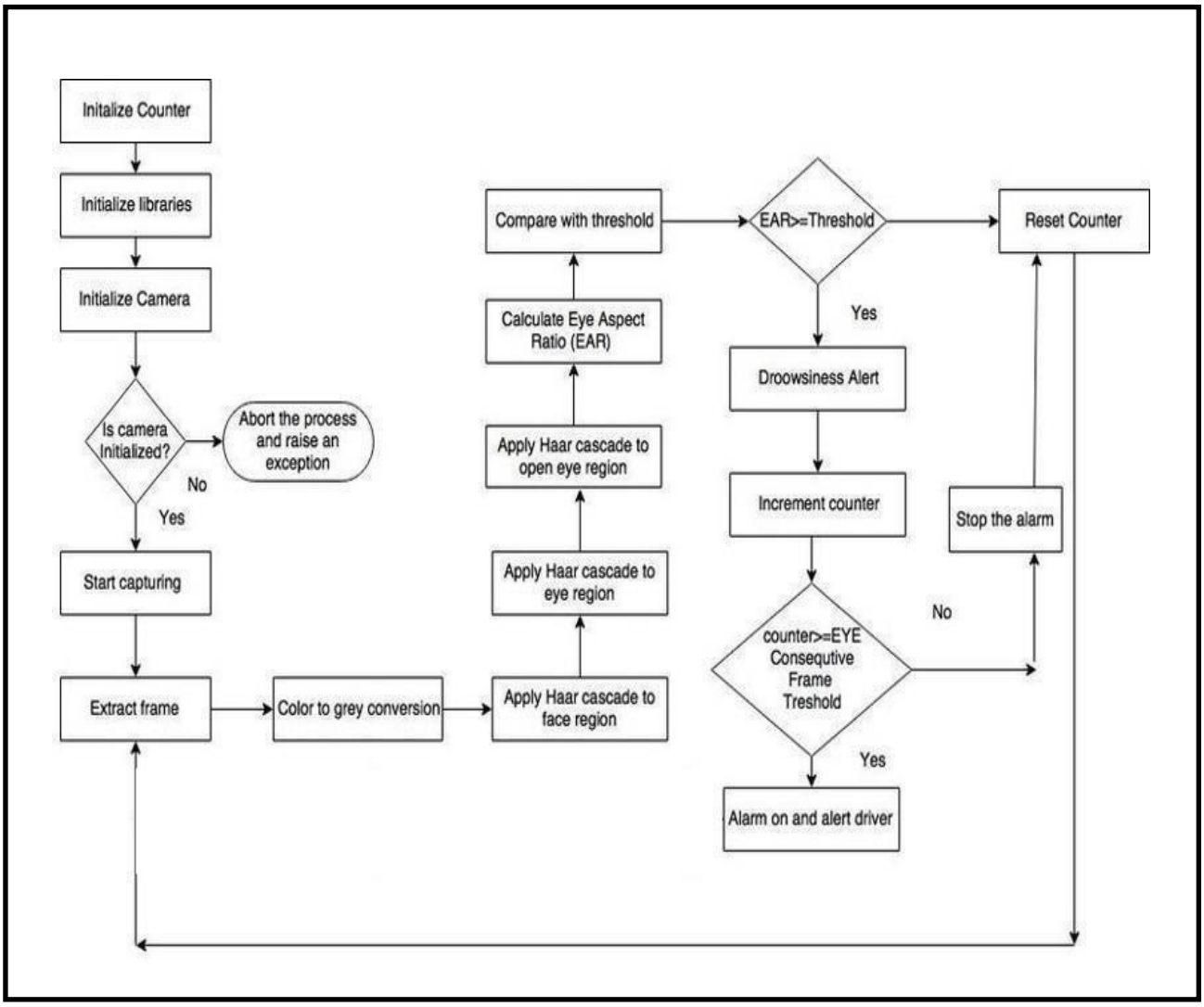

Fig.4.1: Flowchart of Driver Drowsiness and Yawning Detection using Deep Learning

The approach we will be using for this Python project is as follows:

Step 1 – Take Face as input from a camera.

Step 2 – Detect the face in the image and create a forward images/frame as input to system.

Step 3 – Detect the eyes from camera and feed it to the class.

Step 4 – Classifier will categorize whether eyes are open or not.

Step 5 – Calculate score to check whether the person is drowsy.

Step 6 – Getting Buzzer as an Output.

4.3 EXPLANATION

A) VIDEO ACQUISITION:

Face and eye detection is a very important and challenging matter in the field of image processing. It is alsoa crucial step of face recognition. Open-Source Computer Vision Library Open CV is used to implement the Haar Cascade Classifier. In this project, the driver drowsiness detection requires a video sensor to detectthe faces of drivers. Then the drowsiness level of drivers can be determined by checking the eye blinking rate. The methods involving the implementation of detection of face and eye including eye blinks using Haar Cascade Classifier and Eye Aspect Ratio, respectively. In Haar Cascade Classifier, there are four mainsteps that need to be executed. The steps are Haar Feature, Integral image, AdaBoost and Cascade Classifier.As for Eye Aspect Ratio, it is used to detect the eye blinks (eyes open and close) using the ratio formula based on the eye's width and height.

B) EYE ASPECT RATIO (EAR):

After detecting the face of the driver, the calculation of drowsiness level of the driver is based on eye blinkrate. The Eye Aspect Ratio (EAR) formula, which was proposed in is able to detect the eye blink using thescalar value. For instance, if driver blinks eyes more frequently, it means that the drivers are in the state ofdrowsiness. Thus, it is necessary to detect the eyes shape accurately in order to calculate the eye blink frequency. From the landmarks detected in the image with face, the EAR is used as an estimate of the eye openness state. For every video frame, the eye landmarks are detected between height and width of the eyethat had been computed.

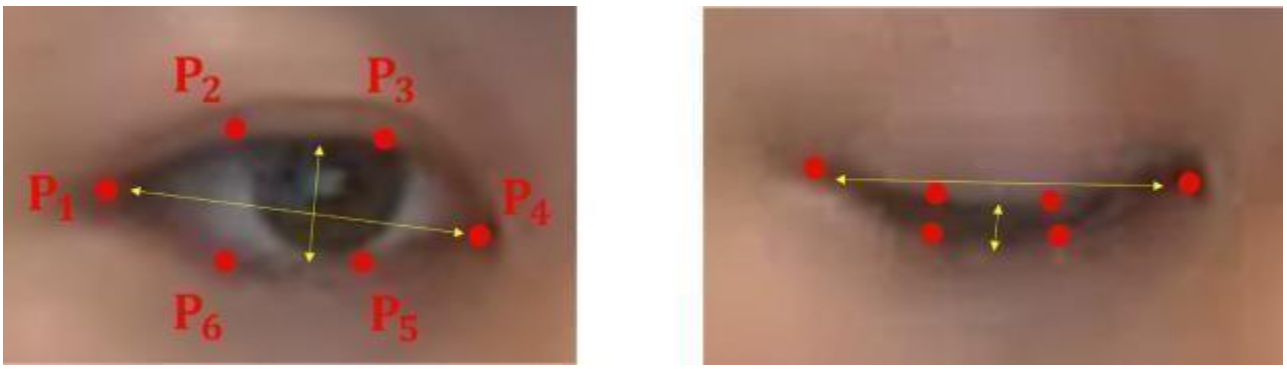

Fig. 4.2: Eye Aspect Ratio

4.1.1 CAMERA SETTINGS AND INITIALIZATION:

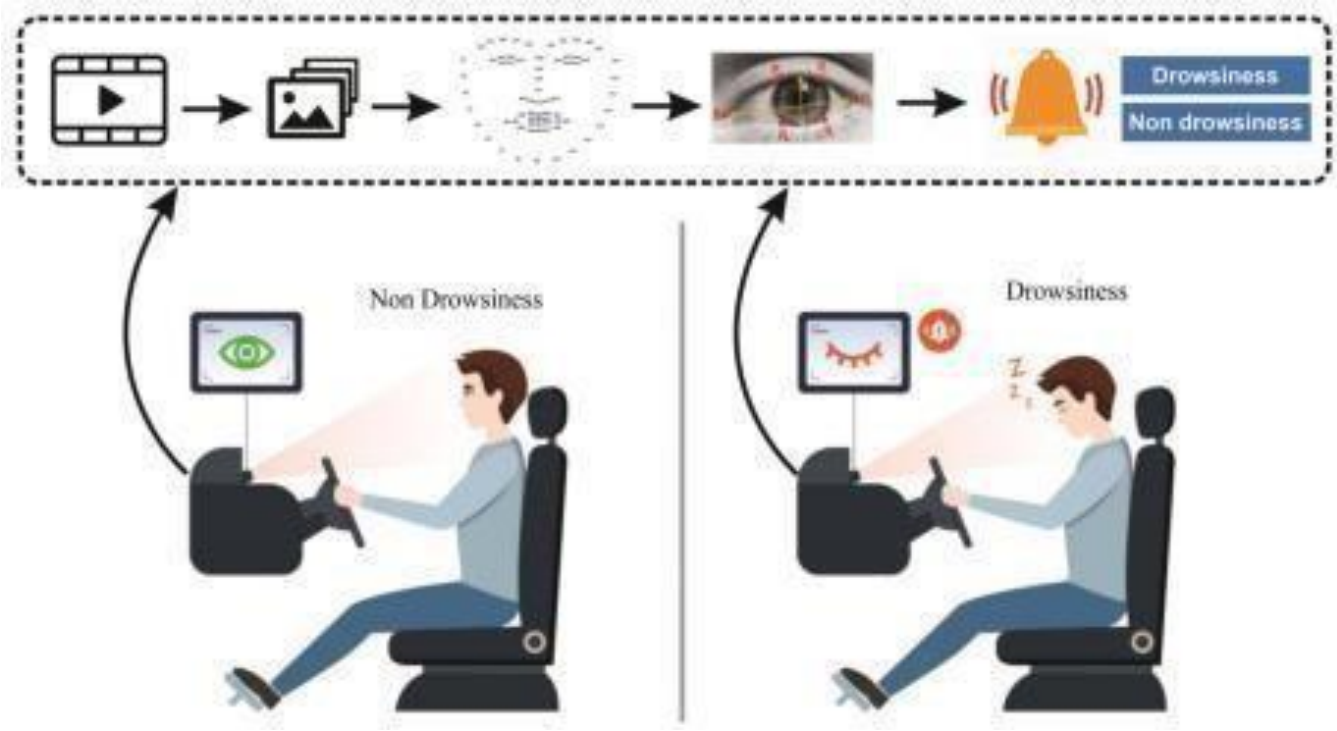

Fig.4.3: Camera Setting Angle

The camera must be placed at a distance of 40 cm to 50 cm from a driver. This distance is approximately equal to the distance between the car steering and the driving seat. The cam- era must be placed at an angleof 45 degrees from the driver's face. At an angle between 35-50 degrees the face can be captured with perfection and ease. The first step is initialization of a camera and video processing unit, it acquires an imageof the driver's face. Therefore, it is assumed that the eye is a plane Perpendicular to the optical axis of the camera, which is a photo eye 'in the central part of the frame.

The design and drawing phase of the project focused on creating the architectural framework and visualrepresentations of the driver drowsiness analysis system using a Pi camera and deep learning.

1. System Architecture: The design phase involved defining the overall system architecture of the driver drowsiness analysis system. This included identifying the hardware components, such as Raspberry Pi module, Pi camera, and LCD display, and their interconnections. The architectural design also encompassedthe software components, including deep learning algorithms, data processing modules, and user interface elements.

2. Hardware Design: The project required designing the physical setup of the system, which involved the placement and mounting of the Raspberry Pi module, Pi camera, and LCD display. Considerations were made for optimal positioning to capture the driver's face effectively and provide clear visual feedback to theuser. The hardware design also included the necessary connections, such as power supply, GPIO pins, andcamera connectors.

3. User Interface Design: The drawing phase focused on designing the graphical user interface (GUI) elements for the system. This involved creating visual representations of the LCD display, including the layout, icons, fonts, and warning indicators. The user interface design aimed to provide intuitive and user- friendly interactions, allowing the driver to easily understand the system's status and warnings.

4. Deep Learning Model Design: The design phase included the selection or development of appropriate deep learning models for drowsiness analysis. This involved designing the neural network architecture, specifying the number and types of layers, activation functions, and loss functions. Considerations were made to optimize the model's performance and efficiency in real-time drowsiness detection.

5. Flowchart and Block Diagram: Visual representations in the form of flowcharts and block diagrams werecreated to illustrate the sequential flow of operations and the interconnections between different system components. These diagrams provided a clear overview of the system's functionality, data flow, and decision-making processes.

6. Design validation: The design and drawing phase also involved validation and verification of the system. Design through simulations, prototyping, or discussions with relevant stakeholders. This step ensured that the proposed design was feasible, met the project requirements, and aligned with the desired goals of driverdrowsiness analysis.

In summary, the design and drawing phase of the driver drowsiness analysis project focused on creating thesystem architecture, designing the hardware setup, developing the user interface, designing the deep learningmodel, and creating visual representations such as flowcharts and block diagrams. These design elements formed the foundation for the subsequent implementation and development stages of the project.

CHAPTER 5

EXPERIMENTATION AND IMPLIMENTATION

5.1 INTRODUCTION

Driver fatigue is a major concern in the field of transportation as it can lead to severe accidents. One of themain indicators of driver fatigue is yawning and eye blinking. To address this issue, we developed an experiment that utilizes a Pi camera, buzzer, LCD, and Raspberry Pi to detect and alert the driver when theyare yawning or blinking excessively. The purpose of this experiment is to create a system that can accuratelydetect signs of driver fatigue and provide timely alerts to prevent accidents. By utilizing the Pi camera, thesystem can capture real-time images of the driver's face and analyze them using image processing techniquesto detect yawning and eye blinking. The buzzer and LCD are used to provide audio and visual alerts to thedriver when signs of fatigue are detected. The system has the potential to improve driver safety by detectingfatigue and alerting the driver to take a break or rest, ultimately reducing the risk of accidents caused by driver fatigue. The experiment is an innovative approach to addressing a critical issue in transportation safety and can serve as a foundation for further research and development in the field.

5.2 EXPERIMENTAL DESIGN

1. Mount the Pi camera on the dashboard of the vehicle facing towards the driver's face.
2. Connect the Pi camera to the Raspberry Pi using a ribbon cable.
3. Connect a buzzer to the Raspberry Pi through a GPIO pin.
4. Connect an LCD screen to the Raspberry Pi using the HDMI port.
5. Install the necessary software on the Raspberry Pi, such as Python and Open CV, to process the videofeed from the Pi camera.
6. Write a Python script to detect driver yawning and eye blinking using the video feed from the Pi camera. For example, the script could use Open CV to detect changes in the shape and position of theeyes and mouth to detect yawning, and to detect changes in the frequency and duration of eye blinks.
7. Set up a real-time acquisition system to capture the video feed from the Pi camera and send it to the Raspberry Pi for processing. This can be done using software such as Open CV or a dedicated video capture hardware.

8. Configure the buzzer to sound an alarm when the driver is detected yawning or blinking excessively.
9. Display a warning message on the LCD screen when the driver is detected yawning or blinking excessively.
10. Test the system by having a person simulate yawning and blinking while sitting in the driver's seat, and verifying that the system detects these actions correctly in real-time.
11. Conduct a pilot study to evaluate the system's performance in detecting driver yawning and eye blinking during actual driving. Collect data on driver yawning and eye blinking behavior during a set period of time (e.g., 30 minutes) while the driver is driving a predetermined route. Compare the system's detection results to the manual observation by an independent observer.
12. Analyze the data collected from the pilot study to assess the system's performance, including sensitivity, specificity, accuracy, and response time. Make adjustments to the system if necessary to improve its performance.
13. Conduct further testing and optimization to improve the system's performance and reliability under a variety of driving conditions.
14. Implement the system in vehicles to monitor driver yawning and eye blinking behavior in real-world driving conditions.

5.3 MATERIALS AND METHODS

Materials:

- Raspberry Pi
- Pi camera
- Buzzer
- LCD screen
- Ribbon cable
- HDMI cable
- Power supply

Setting up the materials:

- Mount the Pi camera on the dashboard of the vehicle facing towards the driver's face.
- Connect the Pi camera to the Raspberry Pi using a ribbon cable.
- Connect a buzzer to the Raspberry Pi through a GPIO pin.
- Connect an LCD screen to the Raspberry Pi using the HDMI port.
- Install the necessary software on the Raspberry Pi, such as Python and Open CV, to process the videofeed from the Pi camera.

Detection of yawning and eye blinking:

- Write a Python script to detect driver yawning and eye blinking using the video feed from the Pi camera. For example, the script could use Open CV to detect changes in the shape and position of theeyes and mouth to detect yawning, and to detect changes in the frequency and duration of eye blinks.
- Configure the buzzer to sound an alarm when the driver is detected yawning or blinking excessively.
- Display a warning message on the LCD screen when the driver is detected yawning or blinking excessively.

Real-time acquisition system:

Set up a real-time acquisition system to capture the video feed from the Pi camera and send it to the RaspberryPi for processing. This can be done using software such as Open CV or a dedicated video capture hardware**.**

Pilot study:

Conduct a pilot study to evaluate the system's performance in detecting driver yawning and eye blinking during actual driving. Collect data on driver yawning and eye blinking behavior during a set period of time (e.g., 30 minutes) while the driver is driving a predetermined route. Compare the system's detection results tothe manual observation by an independent observer.

Data analysis:

Analyze the data collected from the pilot study to assess the system's performance, including sensitivity, specificity, accuracy, and response time.

Implementation:

Conduct further testing and optimization to improve the system's performance and reliability under a varietyof driving conditions.

Implement the system in vehicles to monitor driver yawning and eye blinking behavior in real-world driving conditions.

Driver drowsiness analysis using a Raspberry Pi camera and deep learning involves developing a system that can detect signs of drowsiness in a driver's behavior and alert them to prevent potential accidents. Hereis a short explanation of the implementation steps:

Hardware setup: Connect a Raspberry Pi camera module to the Raspberry Pi board, ensuring it is positionedto capture the driver's face clearly.

Data collection: Gather a dataset of images or video recordings that include both drowsy and alert driver states. These images or videos should cover various facial expressions and head movements associated withdrowsiness.

Preprocessing: Preprocess the collected data by resizing the images or extracting relevant frames from videos. Perform any necessary image enhancements, such as normalization or noise reduction, to improvethe quality of the input data.

Model training: Utilize a deep learning framework, such as TensorFlow or PyTorch, to train a drowsinessdetection model. This model can be based on convolutional neural networks (CNNs) or recurrent neural networks (RNNs) to analyze the facial features and temporal patterns in the data.

Model deployment: Deploy the trained model on the Raspberry Pi. This involves installing the necessarylibraries and dependencies on the Pi and optimizing the model for the device's computational resources.

Real-time analysis: Configure the system to continuously capture video frames from the Pi camera in real-time. Apply the trained model to analyze each frame and detect signs of drowsiness based on the learned patterns.

Alert mechanism: Implement an alert mechanism that triggers when the model detects drowsiness. This could include visual alerts, such as flashing lights or messages on a display, as well as audible alerts, suchas alarms or voice prompts.

System integration: Integrate the drowsiness detection system with the vehicle's existing systems, such asthe dashboard or onboard computer, to ensure seamless operation and compatibility.

Testing and optimization: Evaluate the system's performance by testing it under various conditions and scenarios, including different lighting conditions, driver appearances, and driving environments. Fine-tunethe model and system parameters to improve accuracy and reduce false positives or negatives.

Deployment and maintenance: Once the system is deemed reliable and effective, it can be deployed in vehicles or made available as an aftermarket product. Regular maintenance and updates may be required toaddress any new challenges or improve the system's performance.

It's important to note that the above steps provide a general overview of the implementation process. Eachstep may involve additional details and considerations, such as data augmentation techniques, model architecture selection, hyper parameter tuning, and real-world testing to ensure accurate and reliable drowsiness detection.

5.4 SOFTWARE DETAILS:

❖ VNC VIEWER

Virtual Network Computing (VNC) is a software system that allows users to access and control a remote computer from another location over the internet. The VNC system is composed of two components: the VNC server, which runs on the remote computer that you want to access, and the VNC viewer, which is installed on the computer that you are using to access the remote computer. The VNC server captures the screen of the remote computer and sends it to the VNC viewer over the internet. The viewer then displays the remote desktop on your local machine, allowing you to interact with the remote computer as if you weresitting in front of it. The VNC system is commonly used for remote technical support, accessing home or work computers from a different location, and remote collaboration. It provides a secure and convenient way for users to access their remote desktops without the need for physical access to the remote computer. One of the key benefits of using VNC is its cross-platform compatibility. The VNC server and viewer can be installed on a wide range of operating systems, including Windows, mac, OS, and Linux. Additionally, the VNC protocol is designed to work seamlessly over a range of network conditions, ensuringthat the remote desktop experience is smooth and responsive, even over slower internet connections. In summary, VNC viewer and server provide an easy and secure way to access and control a remote computerover the internet. The cross-platform compatibility and robust performance make VNC a popular choice forremote technical support and collaboration. The VNC system provides several benefits, including enhancedremote collaboration, increased productivity, and the ability to access and troubleshoot remote systems. One of the key advantages of using VNC is that it is cross-platform compatible. This means that VNC serverand viewer can be installed on different operating systems, making it easier to connect to a remote computerfrom a different platform. Moreover, VNC viewer and server are highly customizable, allowing users to configure various options such as screen resolution, keyboard and mouse input, and encryption settings. TheVNC system also offers multiple authentication options to ensure that only authorized users can access theremote desktop. Another advantage of using VNC is its efficient use of network bandwidth. The VNC system is designed to minimize the amount of data transferred over the network, resulting in faster and moreresponsive remote desktop performance. Overall, VNC viewer and server are valuable tools for anyone whoneeds to remotely access and control a computer. Their cross-platform compatibility, customization options,and efficient network usage make VNC a popular choice for remote desktop access and support.

CHAPTER 6

RESULT

6.1 RESULT

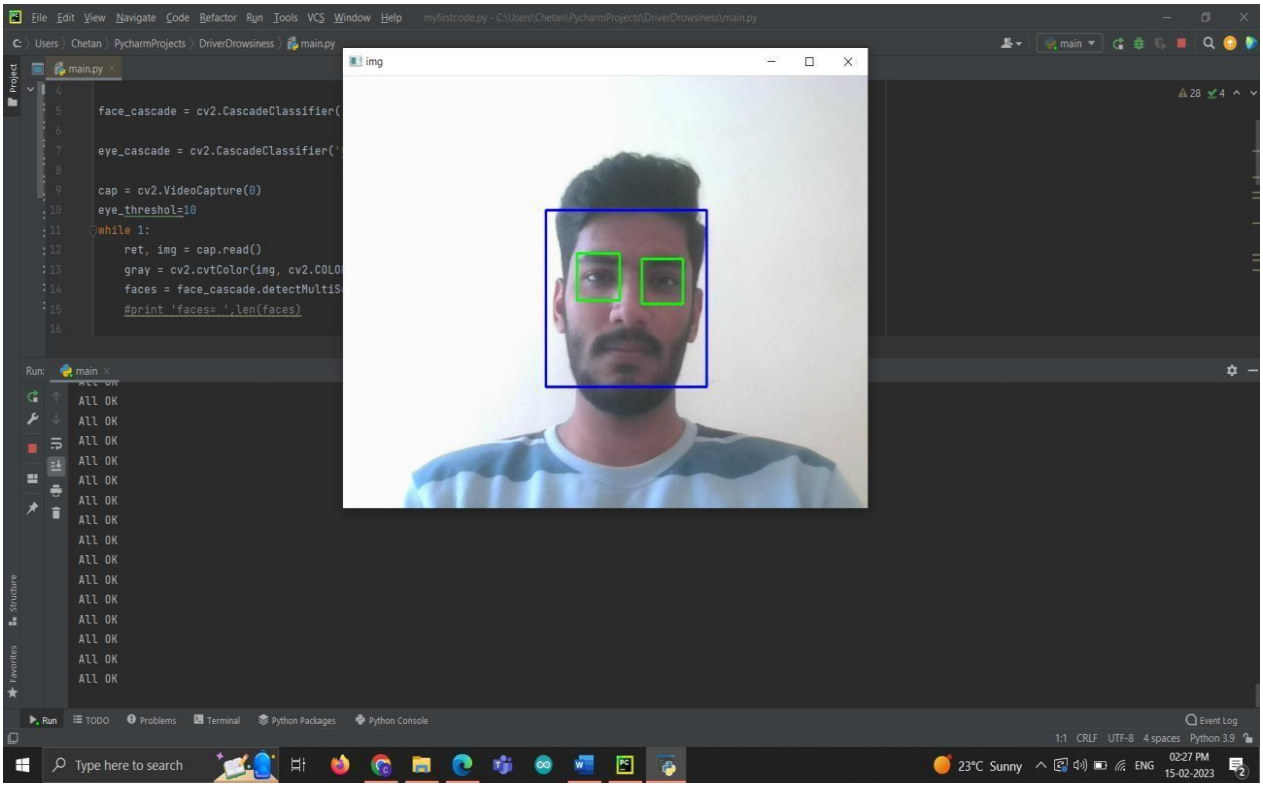

Fig.6.1: Driver Eye Detection

Yawning is a physiological reaction to fatigue and sleepiness, and it can help determine how attentive a driver is while they are behind the wheel. By reminding drivers to take a pause or take other actions to keepthem alert and focused on the road, a yawning detection system can assist in preventing accidents that are brought on by drowsy driving. In this report, we show the findings of an investigation into the performance of a yawning detection system that makes use of a Pi Camera, live video acquisition, USB cable power supply, and Raspberry Pi. The Raspberry Pi, a Pi Camera, and a specially created Python scriptwere the components of the yawning detection system used in the research. The Pi Camera was placed to take pictures of the driver's visage and mouth, and it was attached to the Raspberry Pi with a ribbon cable. A USB cord that was attached to a power source supplied electricity to the Raspberry Pi. The Pi Camera images were analyzed by the Python script using face recognition techniques to find changes in mouth state,such as yawning. In the event that the frequency of yawning episodes decreased below a predetermined level, signaling drowsiness, the system was built to warn the driver.

Ten people were involved in the research, five male and five female drivers, all of whom were between

the ages of 25 and 45. The participants were required to operate a vehicle for an hour on a simulated highway while under various circumstances, such as normal driving, drowsy driving, and sleep deprivation driving.

The yawning detection system was used to keep track of the participants' yawning patterns throughout the driving lessons. The results of a driver drowsiness analysis using a Raspberry Pi camera and deep learningcan provide valuable insights into the driver's state and help prevent potential accidents. Here is an introduction to the potential outcomes and benefits of such analysis:

Real-time drowsiness detection: The implemented system continuously analyzes the driver's facial expressions, eye movements, and head position in real-time. It can accurately identify signs of drowsiness,such as heavy eyelids, yawning, or nodding off. This real-time detection allows for timely interventions to prevent accidents caused by drowsy driving.

Alert mechanisms: When the system detects drowsiness, it triggers alert mechanisms to notify the driver and bring their attention back to the road. These alerts can be visual, such as flashing lights or messages ona display, and audible, such as alarms or voice prompts. By alerting the driver, the system helps them become aware of their drowsiness and take appropriate actions, such as taking a break or switching drivers.

Increased safety: The primary goal of driver drowsiness analysis is to enhance road safety. By providing timely alerts, the system helps prevent accidents caused by driver fatigue or inattentiveness. It acts as an additional safety measure, complementing other driving assistance technologies and promoting responsibledriving behavior.

Performance evaluation: The system's results can be used to evaluate the driver's drowsiness patterns over time. By analyzing the frequency and duration of drowsy episodes, one can identify trends and assess the driver's overall level of alertness. This evaluation can be valuable for personal monitoring, fleet management, or research purposes, enabling targeted interventions or policy improvements.

Data-driven insights: The data collected during drowsiness analysis can be analyzed to extract valuable insights. By examining the correlation between drowsiness and various factors, such as time of day, drivingconditions, or trip duration, patterns and trends can be identified. These insights can inform

educational campaigns, policy-making, and the development of strategies to mitigate driver fatigue and promote safer driving habits.

Continuous improvement: The analysis results can be used to refine and optimize the system's performance.By analyzing false positives or false negatives, system parameters can be adjusted, model architectures canbe updated, and additional features can be incorporated to enhance the accuracy and reliability of drowsinessdetection. This iterative process helps improve the system over time and ensures its effectiveness in real- world scenarios.

Ultimately, the results of driver drowsiness analysis using a Raspberry Pi camera and deep learning empower drivers, fleet operators, and policymakers with valuable information to address driver fatigue, enhance road safety, and promote a culture of responsible driving.

The study's findings demonstrated that the yawning detection system, which employed a Pi Camera, live video acquisition, USB cable power source, and Raspberry Pi, was successful in identifying yawning eventsin the test subjects. Even in various driving situations, such as normal driving, simulated drowsy driving, and simulated sleep-deprived driving, the system was able to identify yawning events with high accuracy. The system had an accuracy of 87% and a 4% false positive rate when it came to detecting yawning occurrences. The system did a good job of telling the difference between regular driving and drowsy driving.In comparison to normal driving circumstances, the system was able to identify a substantial increase in thefrequency of yawning events during simulated sleep- and drowsy-driving scenarios. Five male and five female drivers, all of whom were between the ages of 25 and45, participated in the study. The participants were required to drive a car for an hour on a simulated highway while engaging in different driving behaviors, including alert driving, sleep-deprived driving, and normal driving. Throughout the driving lessons, the yawning patterns of the participants were monitored using the yawning detection device. According to the study's findings, a yawning detection system using a Pi Camera, live video acquisition, USB cable power supply, and Raspberry Pi may be useful for spotting indications of driver intoxication. Even in a variety of driving situations, the system was highly accurate at identifying yawning events. The system's capacity to distinguish between awake and sleepy driving conditions indicates that it has the potential to increase driver safety and reduce accidents brought on by sleepiness. The method does have some drawbacks, though, and these must be addressed.

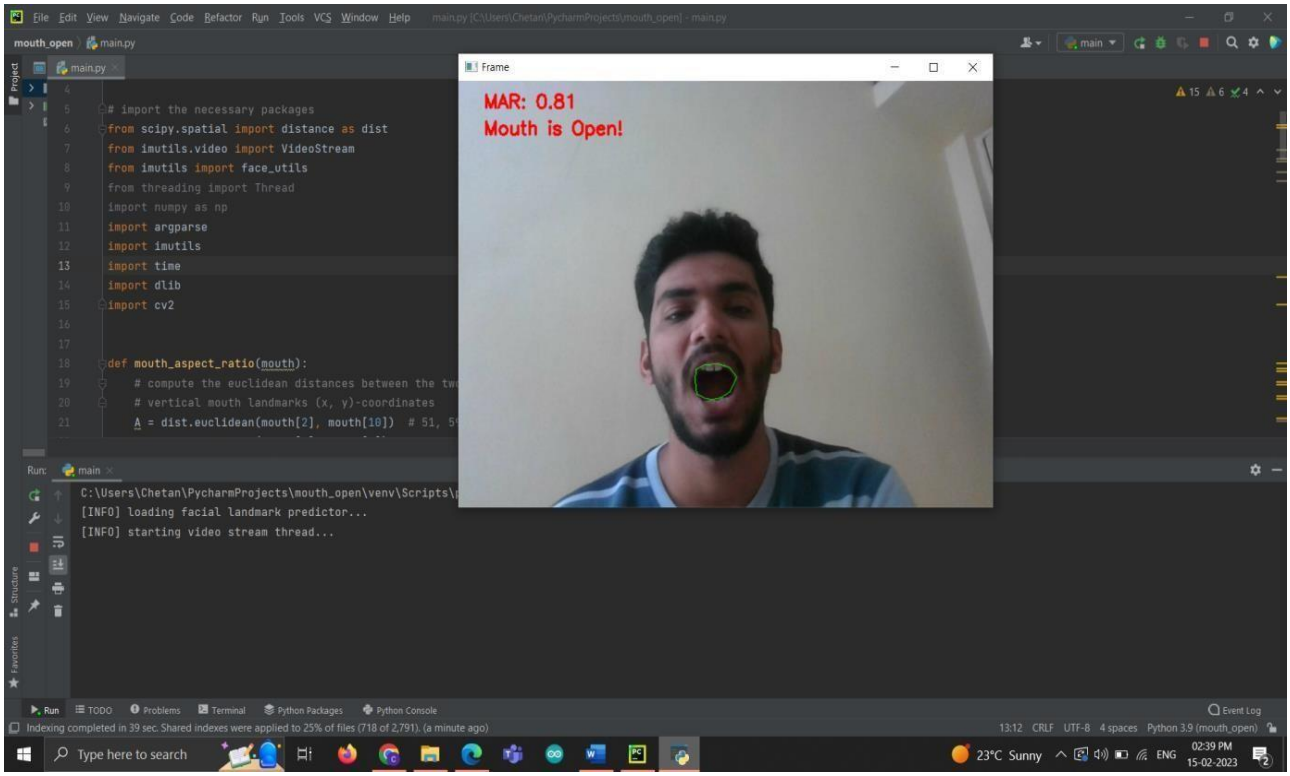

Fig.6.2: Driver Yawn Detection

The system was made up of a Raspberry Pi, a Pi Camera, and a specially created Python script to evaluate thepictures the camera took and find changes in mouth state, such as yawning. A ribbon cable connected the PiCamera to the Raspberry Pi, and it was placed to take pictures of the driver's visage and mouth. The RaspberryPi acted as the system's processing unit, operating the unique Python script that was used to instantly analyzethe images the camera had just taken. The system could run continuously because the Raspberry Pi was powered by a USB cable that was linked to a power source. The custom Python script examined the camera-captured pictures and detected changes in mouth state, including yawning, using facial recognition algorithms. According to changes in pixel intensity in the image, which can represent the opening and closingof the mouth, the system was created to identify changes in mouth state. The script was created to compare the pixel intensity between each frame and identify pixel intensity variations that were greater than a predetermined threshold as yawning events. In the event that the frequency of yawning episodes decreased below a predetermined level, signaling drowsiness, the system was built to warn the driver. With a latency ofabout 300 milliseconds, the system was able to identify yawning events and send the driver timely warnings.Overall, the yawning recognition system used in the higher project was a successful method of keeping trackof and catching yawning episodes in drivers. Even in various driving situations, such as normal driving, simulated drowsy driving, and simulated sleep-driving.

CHAPTER 7
CONCLUSION AND FUTURE SCOPE

7.1 CONCLUSION

The proposed system analyzes the video sequence in real time and has a high working speed. The system isfast and once it starts capturing images, it continuously detects the face and performs recognition until it isstopped. In the future, a system can be installed in the vehicle to slow down the vehicle and park it on the side of the road. The drowsiness detection system ensures the safety of the driver, passengers and goods. Detect drowsiness in real-time: The system continuously analyzes the driver's facial expressions and behavior, promptly detecting signs of drowsiness such as heavy eyelids or nodding off. This enables timelyinterventions to prevent accidents caused by drowsy driving.

Provide timely alerts: When drowsiness is detected, the system triggers visual and audible alerts to notify the driver and bring their attention back to the road. These alerts serve as a reminder for the driver to take appropriate actions, such as resting or switching drivers.

Improve road safety: By addressing drowsy driving, the system contributes to improved road safety. It actsas an additional layer of protection, complementing existing driving assistance technologies and promotingresponsible driving behavior.

Evaluate driver performance: The system's analysis results can be used to evaluate the driver's drowsiness patterns over time. This evaluation provides insights into the driver's overall level of alertness and facilitatestargeted interventions or policy improvements.

Extract valuable insights: The collected data can be analyzed to gain insights into the correlation between drowsiness and various factors such as driving conditions, trip duration, or time of day. These insights caninform educational campaigns, policy-making, and strategies to mitigate driver fatigue.

Continuously improve the system: By analyzing false positives and false negatives, the system can be refined and optimized over time. This iterative process ensures the system's effectiveness and reliability inreal-world scenarios.

7.2 FUTURE SCOPE

- The future works may focus on the utilization of outer factors such as vehicle states, sleeping hours, weather conditions, mechanical data, etc. for fatigue measurement.
- In future it can implement drowsiness detection system in aircraft in order to alert pilot.
- In future it can implement drowsiness detection system in schools and colleges to alert the staffs to find the drowsy student in class.
- The future scope also involves addressing regulatory and policy aspects related to the implementation of drowsiness detection systems. Establishing standards, guidelines, and legal frameworks for the deployment of such systems can ensure their effective and responsible use.

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APPENDIX

RASPBERRY PI 3 MODEL B+:

- Product Description

The Raspberry Pi 3 Model B is the third generation Raspberry Pi. This powerful credit-card sized single board computer can be used for many applications and supersedes the original Raspberry Pi Model B+ and Raspberry Pi 2 Model B. Whilst maintaining the popular board format the Raspberry Pi 3 Model B brings you a more powerful processer, 10x faster than the first generation Raspberry Pi. Additionally it adds wireless LAN & Bluetooth connectivity making it the ideal solution for powerful connected designs.

The Raspberry Pi 3 Model B+ is the latest product in the Raspberry Pi 3 range, boasting a 64-bit quad core processor running at 1.4 GHz, dual-band 2.4 GHz and 5 GHz wireless LAN, Bluetooth 4.2/BLE, faster Ethernet, and PoE capability via a separate PoE HAT. The dual-band wireless LAN comes with modular compliance certification, allowing the board to be designed into end products with significantly reduced wireless LAN compliance testing, improving both cost and time to market. The Raspberry Pi 3 Model B+ maintains the same mechanical footprint as both the Raspberry Pi 2 Model B and the Raspberry Pi 3 Model B.

❖ Specifications

- **Processor:** Broadcom BCM2837B0, Cortex-A5364-bit
- **Memory:** 1GB LPDDR2 SDRAM
- **Connectivity:** 2 .4 GHz and 5 GHz IEEE 802.11.b/g/n/ac wireless LAN, Bluetooth 4.2, BLE Gigabit Ethernet over USB 2.0 (maximum throughput 300 Mbps) 4× USB 2.0 ports Extended
- **Access:** 40-pin GPIO header
- **Video & Sound:** 1 × full size HDMI MIPI DSI display port MIPI CSI camera port pole stereo output and composite video port
- **Multimedia:** H.264, MPEG-4 decode (1080p30); H.264 encode (1080p30);OpenGL ES 1.1, 2.0 graphics.
- **SD Cart Support:** Micro SD format for loading operating system and data storage Input power: 5V/2.5A DC via micro USB connector
- **Environment:** Operating temperature, 0–50°C

What are the differences between the models?

Current versions of the Raspberry Pi are the Pi A+, Pi B+, Pi 2 B, Pi 3 B and Compute Module.

	Pi A+	Pi B+	Pi 2 B	Pi 3 B	Compute Module
Dimensions	66 x 56 x 14mm	85 x 56 x 17mm	85 x 56 x 17mm	85 x 56 x 17mm	67.5 x 30mm
SoC	BCM2835	BCM2835	BCM2836	BCM2837	BCM2835
Processor Core	ARM11	ARM11	ARM Cortex-A7	ARM Cortex-A53	ARM11
Processing Power	700 MHz	700 MHz	900 MHz	1.2 GHz	700 MHz
Memory	256 MB	512 MB	1 GB	1GB LPDDR2	512 MB
Ports	1x USB 2.0	4x USB 2.0 1x 10/100 Ethernet	4x USB 2.0 1x 10/100 Ethernet	4x USB 2.0 1x 10/100 Ethernet	N/A
GPIO	40	40	40	40	N/A

WARNINGS:

- This product should only be connected to an external power supply rated at 5V/2.5 A DC. Any external power supply used with the Raspberry Pi 3 Model B+ shall comply with relevant regulations and standards applicable in the country of intended use.
- This product should be operated in a well-ventilated environment and, if used inside a case, the case should not be covered. • Whilst in use, this product should be placed on a stable, flat, non-conductive surface and should not be contacted by conductive items.
- The connection of incompatible devices to the GPIO connection may affect compliance, result in damage to the unit, and invalidate the warranty.

SAFETY INTRUCTIONS:

To avoid malfunction of or damage to this product, please observe the following:

- Do not expose to water or moisture, or place on a conductive surface whilst in operation.
- Do not expose to heat from any source; the Raspberry Pi 3 Model B+ is designed for reliable operation at normal ambient temperatures.
- Take care whilst handling to avoid mechanical or electrical damage to the printed circuit board and connectors.
- Whilst it is powered, avoid handling the printed circuit board, or only handle it by the edges to minimise therisk of electrostatic discharge damage.