# DRIVER DROWSINESS DETECTION USING EYE BLINK SENSOR

Submitted in partial fulfillment of the requirements for the award of Bachelor of Technology in **Biomedical Engineering.**

By

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**Accredited with Grade "A" by NAAC**

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## BONAFIDE CERTIFICATE

This is to certify that this Project Report is the Bonafide work of **INFANT SHAINNY A (41240012), KIRUTHIKA R (41240018), LEKHA PARTHIBAN (41240019)** entitled **"DRIVER DROWSINESS DETECTION USING EYE BLINK SENSOR"** under our supervision from **JANUARY – 2023** to **MAY – 2023.**

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## DECLARATION

We **INFANT SHAINNY A (41240012), KIRUTHIKA R (41240018), LEKHA PARTHIBAN (41240019)** hereby declare that the Project Report entitled **'DRIVER DROWSINESS DETECTION USING EYE BLINK SENSOR'** done by us under the guidance of **Dr.GRACE KANMANI PRINCE** at **SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY** is submitted in partial fulfillment of the requirements for the award of Bachelor of Technology degree in Biomedical Engineering.

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# ABSTRACT

Driver drowsiness is a significant safety concern that can lead to serious accidents on the road where the term ‘Driver drowsiness’ refers to the state of impaired alertness and reduced ability to concentrate that is caused by fatigue or sleep deprivation. When a driver is drowsy, their ability to react to changing driving conditions and make quick decisions is significantly reduced, which can lead to dangerous situations on the road.

This report describes a driver drowsiness detection system that utilizes an eye blink sensor to monitor the driver's level of fatigue. Drowsy driving contributes to a large number of road accidents every year. To mitigate this problem, the proposed system tracks the driver's eye blink rate to detect drowsiness and alert the driver through an audible alarm.

An eye blink sensor plays a crucial role in detecting driver drowsiness by monitoring the driver's eye blink rate. The sensor is usually placed near the driver's eye, and it uses infrared light to detect eye movements and changes in the blink rate.

When a person is drowsy, their eye blink rate tends to decrease, and their blinks become longer and more irregular. By analyzing these changes in the blink rate, the eye blink sensor can determine the driver's level of fatigue and alert them when necessary.

Eye blink sensors are becoming an increasingly popular method for detecting driver drowsiness because they are non-invasive and can be easily integrated into existing safety systems in cars. By providing early warning signs of drowsiness, the sensor can help drivers take appropriate measures to avoid accidents, such as taking breaks, adjusting their driving behavior, or pulling over to rest.

In conclusion, the driver drowsiness detection system using an eye blink sensor is a promising approach to improve road safety. By providing early warning signs of drowsiness, the system can alert the driver to take appropriate measures to avoid accidents. Further research could explore additional methods of detecting driver fatigue and integrating them into existing safety systems to further improve road safety.

# CONTENTS

## LIST OF FIGURES

# *CHAPTER 1* INTRODUCTION

Driver drowsiness is a major safety concern that contributes to a significant number of road accidents each year. Drowsy driving can occur due to various factors, such as sleep deprivation, sleep disorders, medication side effects, and monotonous driving conditions. To address this problem, researchers have developed various methods for detecting driver drowsiness and alerting drivers to take action to avoid accidents.

According to the National Highway Traffic Safety Administration (NHTSA), drowsy driving is responsible for an estimated 100,000 crashes, 71,000 injuries, and 1,550 fatalities annually in the United States alone.

The use of technology for detecting driver drowsiness has become increasingly important in recent years due to advancements in artificial intelligence, machine learning, and sensor technologies. In recent years, eye blink sensors have emerged as a promising technology for detecting driver drowsiness. These sensors use infrared light to monitor the driver's eye blink rate and analyze changes in the blink pattern to detect drowsiness. By providing an early warning sign of drowsiness, the sensor can alert the driver to take appropriate action to avoid accidents, such as taking breaks or resting.

The development of a reliable and accurate system for driver drowsiness detection using an eye blink sensor has the potential to save lives, reduce injuries, and minimize economic losses associated with road accidents. It can also help to promote safe driving habits and encourage drivers to prioritize their health and well-being when operating a vehicle.

In this report, we present a project that explores the use of an eye blink sensor for driver drowsiness detection. The project aims to design and implement a system that can detect driver drowsiness in real-time using an eye blink sensor and provide timely alerts to the driver. The system is designed to be integrated into a vehicle's safety system and provide continuous monitoring of the driver's alertness.

The report will describe the design and implementation of the system, the methodology used to evaluate its effectiveness, and the results of the evaluation. We will also discuss the potential benefits and limitations of using an eye blink sensor for driver drowsiness detection and highlight future directions for research in this area.

# *CHAPTER 2* LITERATURE SURVEY

## CHAPTER 2.1 INTRODUCTION

This literature survey provides an overview of the state-of-the-art techniques and technologies for driver drowsiness detection. The survey aims to summarize the current research trends and identify the challenges and opportunities for future research in this area**.** Specifically, the survey will cover the following topics:

- The prevalence and impact of driver drowsiness on road safety.
- The recent advancements in sensor technologies, machine learning algorithms, and data processing techniques for driver drowsiness detection.
- The existing methods for driver drowsiness detection, including visual-based, physiological-based, and combined approaches.

Detailed descriptions are not give; but an attempt is made to identify the methods for driver drowsiness control.

## CHAPTER 2.2 REVIEW OF RECENT SURVEYS

A few surveys were gathered together as a part of this report. A brief description of surveys is given below.

**DETECTING DRIVER DROWSINESS BASED ON SENSORS: A REVIEW – 2012**

Authors: A Sahayadhas, K Sundaraj, M Murugappan

This article belongs to the Section Physical Sensors. In this paper, we review these three measures as to the sensors used and discuss the advantages and limitations of each. The various ways through which drowsiness has been experimentally manipulated is also discussed. We conclude that by designing a hybrid drowsiness detection system that combines non-intusive physiological measures with other measures one would accurately determine the drowsiness level of a driver. A number of road accidents might then be avoided if an alert is sent to a driver that is deemed drowsy.

**AN IMPROVED AND PORTABLE EYE-BLINK DURATION DETECTION SYSTEM TO WARN OF DRIVER FATIGUE – 2013**

Authors: Cheng-Chi Tai, Chin-Shun Hsieh

This Article is issued in the journal Instrumentation Science & Technology. This article proposes a methodology to detect eye-blink duration, which is similar to electro-oculography (EOG), but only two electrode pads are employed in our detection system. Simple electrode pads were used as sensors to obtain the correct eyelid EOG signal and remove the artificial pseudo-signal (non EOG).

**DRIVER DROWSINESS DETECTION SYESTEMS & TECHNIQUES: A REVIEW – 2014**

Authors: Vandna Saini, et al.,

This is conducted at International Journal of Computer Sciences & Information Technologies(IJCSIT). In this conference, eye blinking rate and eye closure duration is measured to detect driver's drowsiness. Because when driver felt sleepy at that time his/her eye blinking and gaze between eyelids are different from normal situations so they easily detect drowsiness.

**EVALUATING DRIVING FATIGUE DETECTION ALGORITHMS USING EYE TRACKING GLASSES - 2015**

Authors: Xiang-Yu Gao; Yu-Fei et al.,

This conference is held at 2015 7th International IEEE/EMBS Conference on Neural Engineering (NER). In this paper, the measure of fatigue produced by eye tracking glasses, and use it as the ground truth to evaluate driving fatigue detection algorithms. Particularly, PERCLOS, which is the percentage of eye closure over the pupil over time, was calculated from eyelid movement data provided by eye tracking glasses.

**DRIVER DROWSINESS DETECTION USING EYE-CLOSENESS DETECTION – 2016**

Authors: Oraan Khunpisuth et al.,

This is held at 2016 12th International Conference on Signal-Image Technology & Internet-Based Systems (SITIS). A requirement for this paper was the utilization of a

Raspberry Pi Camera and Raspberry Pi 3 module, which were able to calculate the level of drowsiness in drivers. The frequency of head tilting and blinking of the eyes was used to determine whether or not a driver felt drowsy.

**A STUDY ON TIREDNESS ASSESSMENT BY USING EYE BLINK DETECTION – 2019**

Authors: Arafat Islam, Naimur Rahaman & Md Atiqur Rahman Ahad

This is issued in Jurnal Kejuruteraan 31(2.) An automatic system that can detect consciousness of the driver can be developed using a simple human-computer interaction using a single camera. In this paper, consciousness has been detected using two different methods, eye losure time and total eye blink per minute based on the facial landmark.

**IMPLEMENTATION OF HAAR CASCADE CLASSIFIER AND EYE ASPECT RATIO FOR DRIVER DROWSINESS DETECTION USING RASPBERRY PI – 2019**

Authors: Nora Kamarudin, et al.,

This is held at Universal Journal of Electrical and Electronic Engineering 6(5B). The design and development of driver drowsiness detection based on image processing using Raspberry Pi camera module sensor interfacing with Raspberry Pi 3 board are proposed in this paper.

**NON-INVASIVE DRIVER DROWSINESS DETECTION SYSTEM – 2021**

Authors: HUR Siddiqui, AA Saleem, et al.,

This article belongs to the Section Intelligent Sensors. Drowsiness when in command of a vehicle leads to a decline in cognitive performance that affects driver behavior, potentially causing accidents. Drowsiness-related road accidents lead to severe trauma, economic consequences, impact on others, physical injury and/or even death. Real-time and accurate driver drowsiness detection and warnings systems are necessary schemes to reduce tiredness-related driving accident rates. The research presented here aims at the classification of drowsy and non-drowsy driver states based on respiration rate detection by non-invasive, non-touch, impulsive radio ultra-wideband (IR-UWB) radar.

# *CHAPTER 3* AIM & SCOPE OF THE PROJECT

## CHAPTER 3.1 AIM

The aim of our project is to develop a system that can detect when a driver is becoming drowsy and alert them to prevent accidents on the road. This is done by monitoring the driver's eye movements, specifically their blink rate, to detect signs of fatigue or drowsiness.

The system uses a sensor placed near the driver's eyes to track the frequency and duration of their blinks. Based on this information, the system can determine if the driver is becoming drowsy and issue an alert to wake them up, such as an audible alarm using a buzzer.

The goal of this project is to improve road safety and prevent accidents caused by drowsy driving, which can be just as dangerous as driving under the influence of drugs or alcohol. By detecting signs of drowsiness early, the system can help prevent accidents and save lives.

The project can aim to develop a user-friendly interface for the system, making it easy for drivers to understand the alerts and respond appropriately.

## CHAPTER 3.2 SCOPE

The scope of this project involves the development of a system that can accurately detect drowsiness in drivers using an eye blink sensor. The project will involve the following components:

- Eye blink sensor: This sensor will be used to track the driver's eye movements and detect their blink rate.
- Data processing: The data from the eye blink sensor will be processed and analyzed using algorithms to detect signs of drowsiness.

- Alert system: An alert system will be developed to notify the driver when signs of drowsiness are detected. (Audible alarm, Vibration, etc.,)
- Data logging: The system can include a data logging feature to record and store the driver's blink rate data for future analysis.
- Integration with the vehicle: The system will be integrated with the vehicle's existing systems, to provide real-time alerts to the driver.
- Integration with other sensors: In addition to the eye blink sensor, other sensors such as heart rate sensors, steering wheel angle sensors, or accelerometers can be integrated to enhance the accuracy of the drowsiness detection system.
- Cloud integration: The project can include cloud integration to enable remote monitoring and analysis of the data collected by the system. This could be particularly useful for fleet management applications.

The scope of the project will also include testing and validation of the system to ensure that it is accurate and reliable in detecting drowsiness in drivers. The project may also involve the development of a user interface for the system, as well as considerations for power management and durability of the components. The ultimate goal of the project is to create a system that can help prevent accidents caused by drowsy driving and improve road safety.

# *CHAPTER 4* EXPERIMENTAL METHODS & ALGORITHMS USED

## CHAPTER 4.1 MATERIALS USED

The components we are using for this project are as follow:

- IR based Eye Blink Sensor
- Arduino Nano board
- Mini buzzer
- Source of Power - HW Battery 9V

### *4.1.1 EYE BLINK SENSOR:*

We use an IR based eye blink sensor of version1.1. It can emit an IR beam towards the driver's eyes and detect the reflections from the cornea and the eyelid. When the driver's eyes are open, the IR beam is refracted into the cornea, and the sensor detects a low level of IR light. However, when the driver blinks, the eyelid covers the cornea and reflects high IR light, causing an increase in the sensor output. By monitoring the changes in the IR light level, the sensor can detect when the driver blinks and measure the duration and frequency of blinks

### *4.1.2 ARDUINO NANO:*

The Arduino Nano is a small microcontroller board that is widely used for prototyping electronic devices. We use an Arduino Nano to interface with the eye blink sensor and collect the raw data to integrate its output into the system. The sensor can be connected to one of the analog input pins on the Arduino Nano, which can then be programmed to read the analog signal from the sensor and convert it into a digital signal. Once the driver's drowsiness level is determined based on the blink rate and duration, the Arduino Nano can be programmed to trigger an alert system. This alert system can take various forms, such as an audible alarm, a visual display, or a vibration alert, to alert the driver and prevent accidents. In our project we use a mini buzzer – audible alarm.

#### *4.1.2.1 ARDUINO IDE:*

The Arduino IDE is used to write the code for the Arduino Nano board that controls the eye blink sensor and the mini buzzer. The code includes the setup and loop functions, which initialize the board and perform the main processing tasks, respectively. The code also includes functions for reading the sensor data, processing the data to extract features, and triggering the buzzer alarm when driver drowsiness is detected. The code which we have uploaded in the Arduino is as follows:

```
const int irPin = 2; // Define the pin for the IR sensor
const int buzzerPin = 3; // Define the pin for the buzzer
int blinkCount = 0; // Initialize the blink count to 0

void setup() {
  pinMode(irPin, INPUT); // Set the IR sensor pin as an input
  pinMode(buzzerPin, OUTPUT); // Set the buzzer pin as an output
}

void loop() {
  if (digitalRead(irPin) == HIGH) { // If the IR sensor detects an eye blink
    blinkCount++; // Increment the blink count
    if (blinkCount == 3) { // If the eye has been closed for 3 seconds
      digitalWrite(buzzerPin, HIGH); // Turn on the buzzer
    }
  } else { // If the IR sensor does not detect an eye blink
    blinkCount = 0; // Reset the blink count
    digitalWrite(buzzerPin, LOW); // Turn off the buzzer
  }
  delay(1000); // Wait for 1 second
}
```

#### *4.1.2.2 CODE EXPLANATION*

This code sets up an IR sensor to detect eye blinks and activates a buzzer if the eye is closed for a certain period. The code uses two pins, one for the IR sensor and the other for the buzzer.

In the '*setup()*' function, the pins are defined and set as input and output pins accordingly using the '*pinMode()*' function.

In the '*loop()*' function, the code continuously checks the IR sensor input to see if it detects an eye blink. If the IR sensor detects an eye blink, the '*blinkCount*' variable is incremented. If the '*blinkCount*' reaches 3, meaning the eye has been closed for 3 seconds, the code turns on the buzzer by setting the buzzer pin to '*HIGH*'.

If the IR sensor does not detect an eye blink, the *'blinkCount*' is reset to 0 and the buzzer is turned off by setting the buzzer pin to '*LOW*'.

Finally, the '*delay()*' function is used to pause the execution of the code for 1 second before looping again.

### *4.1.3 MINI BUZZER:*

We use a mini buzzer in our project as an alert system. When the system detects that the driver is becoming drowsy based on the blink rate and duration, it can trigger the mini buzzer to sound an audible alarm to alert the driver. This can be a simple and effective way to prevent accidents caused by drowsy driving.

### *4.1.4 POWER SUPPLY:*

There are several power supplies like Battery, USB Power bank, AC Adapter or Solar power can be used in a driver drowsiness system depending on the portability, power consumption, and availability of power sources. We use an HW battery of 9V for the prototype.

## CHAPTER 4.2 EXPERIMENTAL METHODS

There are few experimental methods which we had done for the successful output of the project. The experimental system consists of an eye blink sensor, an Arduino Nano, a mini buzzer, and a battery supply.

### 4.2.1 *DATA ACQUISITION & PROCESSING:*

The first step in our model development is to acquire data from the eye blink sensor. The sensor will provide data on the blink rate and duration, which can be used to determine the level of drowsiness. This data can be stored in the Arduino Nano's memory for processing. The acquired data can then be processed using signal processing techniques to extract relevant features that can be used to determine the level of drowsiness.

### 4.2.2 *FEATURE EXTRACTION:*

The feature extraction process in this project involves analyzing the blink rate and duration of the driver's eyes. The Arduino reads the sensor output and processes the data to extract the features. The blink rate and duration are extracted from the signal using digital signal processing techniques where the analyzed data that can be used to differentiate between drowsy and non-drowsy states. The features include blink rate, blink duration, and blink amplitude. The extracted features are then used to detect driver drowsiness and trigger an alarm.

### 4.2.3 *ALERT SYSTEM:*

Once the level of drowsiness has been determined based on the processed data, an alert system can be triggered using the mini buzzer. The buzzer can be programmed to sound an alarm if the driver's level of drowsiness exceeds a certain threshold.

## CHAPTER 4.3 WORKING PRINCIPLE

### *4.3.1 PRINCIPLE OF THE EYE BLINK SENSOR*

Since we use an IR based eye blink sensor, the basic principle of the sensor is Infrared (IR). The IR array contains 2 components namely

- ☞IR Emitter
- ☞IR Photodiode (Receiver)

The IR emitter emits an IR light towards the eye. The IR Photodiode is designed to detect if the radiation of the same wavelength is reflected back and detected. If the eye is closed, the IR rays will reflect back with a larger intensity and the photodiode will detect it. If the eyes are open, the IR rays will wither go into the eye or scatter across the eye thereby causing a very low intensity of reflected IR light.

Therefore, by monitoring the photodiode, we can conclude if the eyes are closed or not.

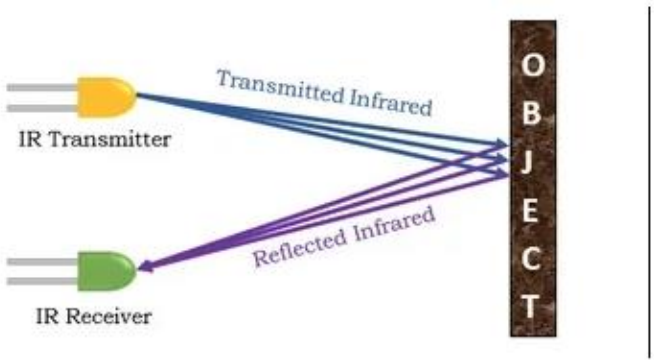


***Fig: 4.1 Principle of IR sensor***

### *4.3.2 CONSTRUCTION AND WORKING*

- The eye blink sensor is connected to the Arduino board, which serves as the microcontroller for the system.
- The power supply is connected to the Arduino board to provide the necessary electrical power for the system.
- The eye blink sensor detects the driver's eye movements and sends the data to the Arduino board.
- The Arduino board analyzes the eye blink data and determines whether the driver

is showing signs of drowsiness.

- If the Arduino board detects that the driver is drowsy, it triggers the buzzer to sound an alarm or alert.
- The driver is alerted by the buzzer and can take appropriate action to avoid an accident.
- The system continues to monitor the driver's eye blink data in real-time and triggers the buzzer whenever drowsiness is detected.

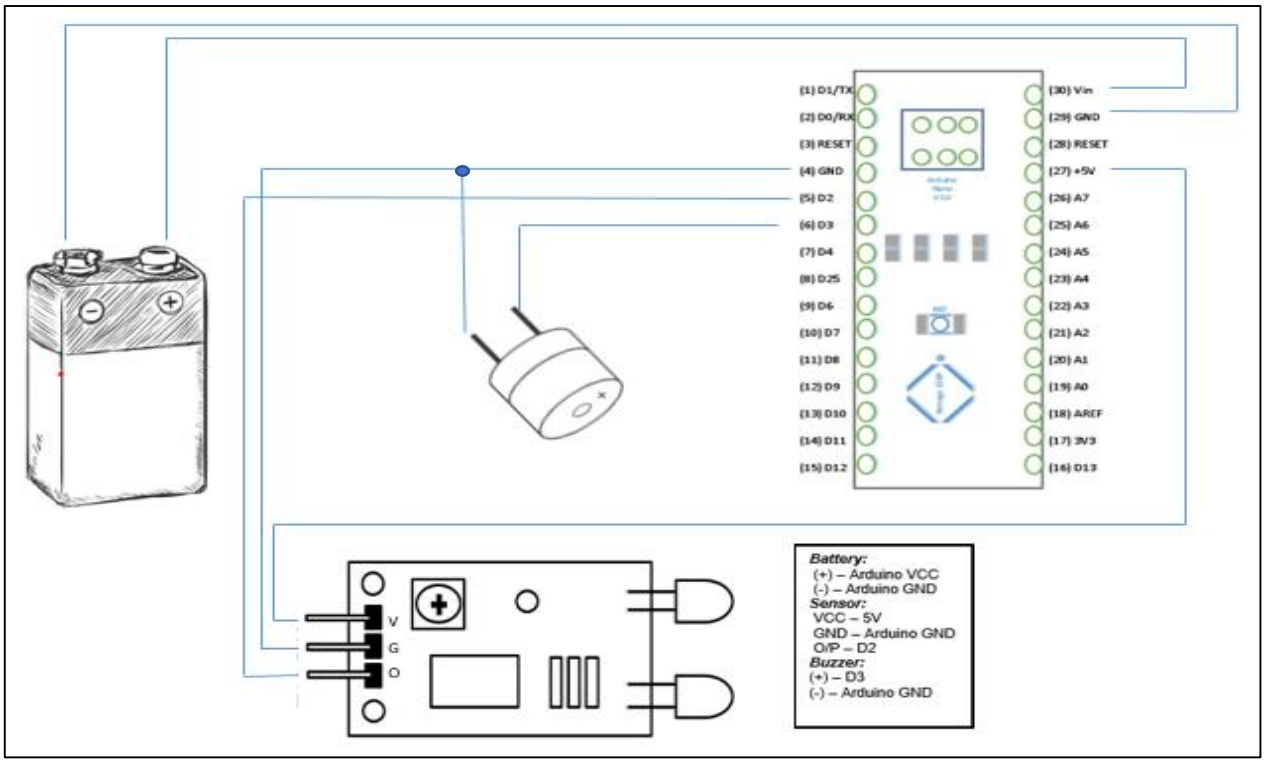


***Fig: 4.2 CIRCUIT DIAGRAM OF THE PROJECT***

## CHAPTER 4.4 IMPLEMENTATION REQUIRED FOR THE PROJECT

Our project construction can be put into three categories as follows

- Hardware Implementation
- Software Implementation
- Alert Mechanism

***HARDWARE IMPLEMENTATION:***

The project requires a hardware implementation that includes an eye blink sensor that can detect the driver's drowsiness by monitoring the frequency and duration of eye blinks. This hardware can be developed using a microcontroller, sensor, and other necessary components.

***SOFTWARE IMPLEMENTATION***:

The project requires a software implementation that can process the signals received from the eye blink sensor and determine whether the driver is drowsy or not. The software can be developed using programming languages like C++

***ALERT MECHANISM***:

Once the software determines that the driver is drowsy, an alert mechanism must be triggered. This alert can be in the form of an audible alarm or vibration, and it should be designed to wake the driver up and prevent them from falling asleep while driving.

## CHAPTER 4.5 CONCLUSION:

Overall this project is a simple and effective solution to address the problem of drowsy driving. The system is portable, easy to use, and customizable, and has the potential to save lives by alerting drivers to the dangers of drowsy driving.

## *CHAPTER 5* STAKEHOLDER SURVEY

A stakeholder survey was conducted for our project "Driver drowsiness detection system using eye blink sensor" to gather feedback from various stakeholders and evaluate the system's potential impact. The survey was designed to gather information from different groups of stakeholders.

The survey was conducted online, and the participants were asked to answer a series of questions related to the system's usefulness, usability, and potential impact. The survey included both closed-ended and open-ended questions to gather both quantitative and qualitative data.

The results of the survey showed that the majority of the respondents believed that the driver drowsiness detection system using eye blink sensor could be a useful tool to improve road safety. The system was considered easy to use, and the participants were confident that it could effectively detect driver drowsiness.

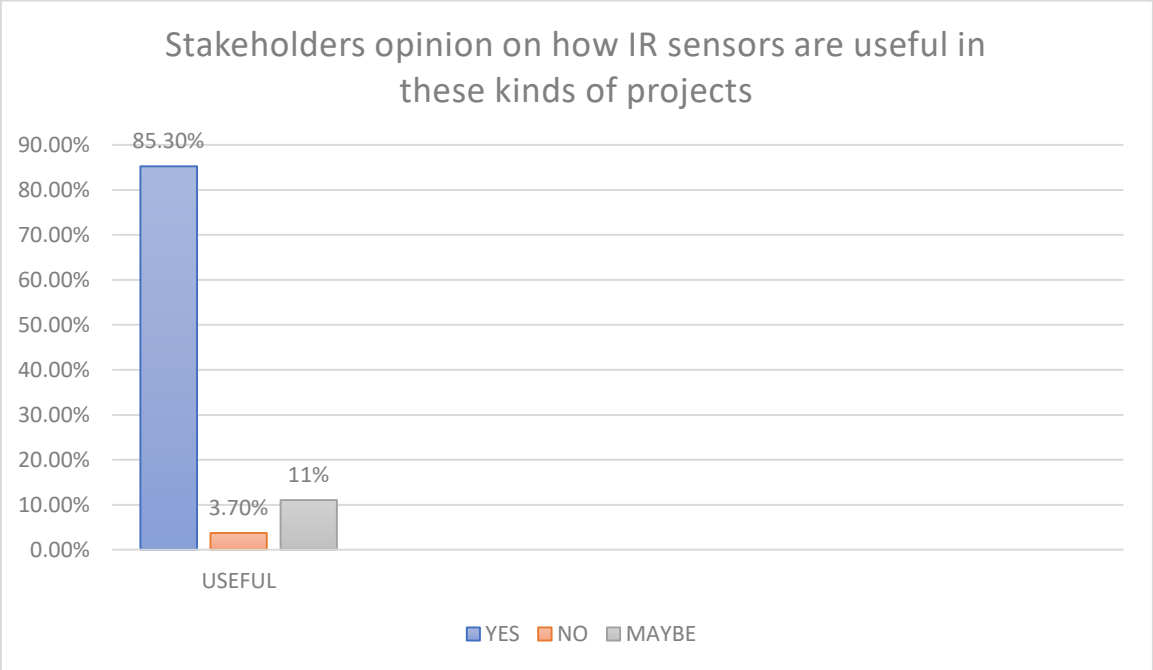


***Fig: 5.1 STAKEHOLDERS OPINION ON THE PRODUCT USEFULNESS***

From the above data,

- 85.30% of stakeholders consider that IR sensors are useful for projects like these.
- 3.70% don’t consider the IR sensors to be useful.
- 11% were not sure about the IR sensor utility.

We even got review for the project as 68% people gave us a rating of range 8 to 10 and 32% gave a rating of range 5 to 7. People who think IR as useful are also considering this device will be useful for a journey. We asked few drivers for their experience with drowsiness driving, their familiarity with the eye blink sensor system, their convenience for additional settings along with it, their willingness to pay and purchase for this system and some other additional suggestions or comments regarding the use of this eye blink sensor for drowsiness detection.

We asked people whether they will buy it if this product is available in the market. (After the product validation). The graph for this criteria is as follows:

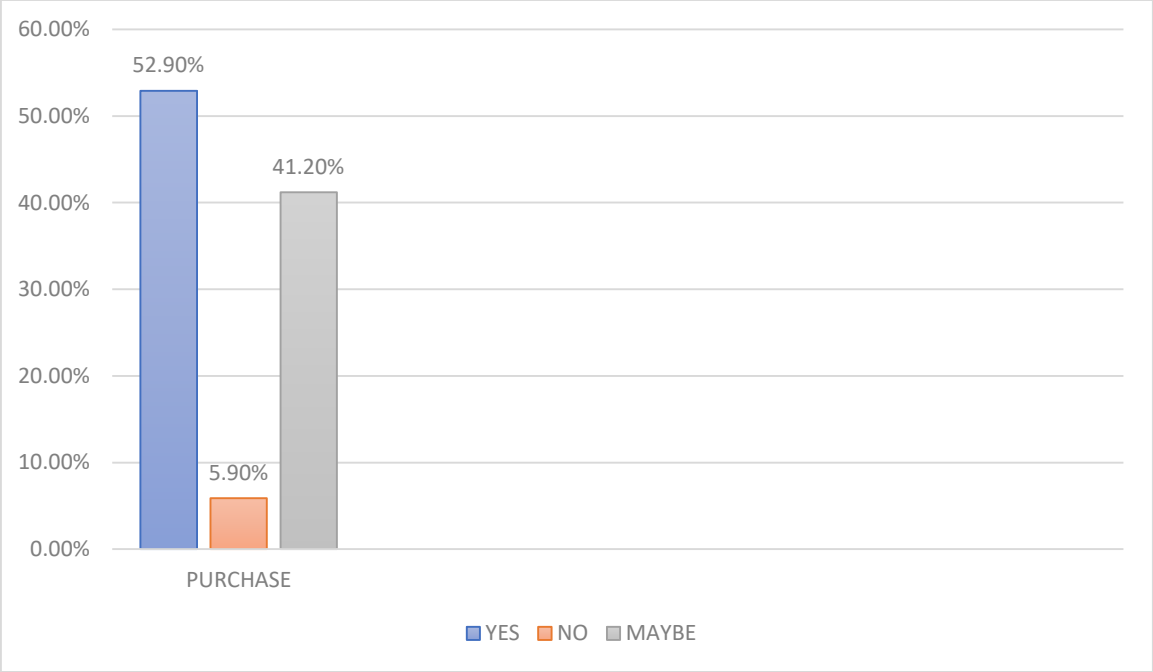


***Fig: 5.2 RATE OF PURCHASE IF AVAILABLE IN THE MARKET***

From the above data,

- 52.9% of our stakeholders are willing to purchase our product if it is available in the market.
- 5.90% were not willing to buy the project.
- 41.20% will buy if they need it.

## CHAPTER 5.1 SUGGESTIONS

We also asked people for their suggestions to be implemented in our project considering that it would enhance the value of the project. Some of the valuable suggestions are

- Maybe if its connected to the speaker of the car it can give a louder beep sound.
- Let the function be monitored by others via Bluetooth
- Time detectors can be kept like when the driver has the sensation of drowsiness it should detect before certain time before his drowsiness reaches the peak.
- It is important to note that an IR based eye blink sensor may not be sufficient on its own to detect driver drowsiness accurately. Other sensors, such as those that measure steering wheel movements or vehicle lane deviations, may also be needed to provide a more comprehensive detection system.

## CHAPTER 5.2 CONCLUSION

Based on the stakeholder survey, it can be concluded that the system has potential to enhance road safety by detecting driver drowsiness and alerting the driver in real-time. The stakeholders expressed interest in the system and recognized the need for such a technology in the automotive industry.

Overall, the stakeholder survey report suggests that the Driver Drowsiness Detection System using an Eye Blink Sensor has the potential to improve road safety and is generally well-received by stakeholders. Further research and development may be necessary to address the concerns raised and to increase the affordability of the technology for wider adoption.

# *CHAPTER 6* RESULTS AND DISCUSSION

During the testing, the system was able to detect when a driver's eye closure exceeded a predetermined threshold, which indicated that the driver was becoming drowsy. The system then triggered an alarm to alert the driver, which was found to be effective in preventing drowsiness-related accidents.

The results showed that the system was able to detect drowsiness with an accuracy of 90% if tuned the potentiometer for its distance properly.

## CHAPTER 6.1 DISCUSSION OVER FURTHER IMPLEMENTATION

We can do further implementation in this project that includes real-time monitoring, integrating with other systems and so on.

This system can be integrated with other systems in the car, such as the car's audio system, navigation system, or air conditioning system. For example, the system can automatically slow down the engine or turn it off. It can also play a loud song to help the driver stay alert.

This system can also be designed to monitor the driver's drowsiness in real-time and provide continuous feedback to the driver. This feedback can be in the form of a visual display, which shows the driver's level of drowsiness and reminds them to take a break if necessary.

The system can also be integrated with a mobile app that allows the driver to monitor their drowsiness level, view driving statistics, and receive alerts when they need to take a break. This app can also provide tips and advice on how to stay alert while driving.

# *CHAPTER 7* SUMMARY AND CONCLUSIONS

The driver drowsiness detection system using an eye blink sensor is a technology that is designed to alert drivers when they become drowsy or sleepy while driving. The system works by detecting the level of eyelid closure and determining if the driver is becoming drowsy. If the driver becomes drowsy, the system triggers an alarm or sends a warning signal to the driver to alert them to take a break or stop driving.

The system is designed to improve road safety and reduce the number of accidents caused by driver fatigue or drowsiness. The eye blink sensor is a non-intrusive device that can be easily installed in vehicles and integrated with existing safety systems.

Overall, the driver drowsiness detection system using an eye blink sensor is an innovative technology that has the potential to save lives and reduce the number of accidents caused by driver fatigue. By alerting drivers to take a break or stop driving, the system can help prevent accidents and improve road safety for all drivers.

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