Faculty of Electronics & Computer Technology and Engineering

AN EFFICIENT ANTI DROWSINESS DETECTION SYSTEM FOR DRIVER USING ARDUINO

WAN NURULAIN BINTI WAN AB AZIZ

Bachelor of Electronics Engineering Technology (Industrial Electronics) with Honours

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A project report submitted
in partial fulfillment of the requirements for the degree of
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DEDICATION

I offer this bachelor's degree project as a tribute to my Creator, Allah s.w.t the Almighty – my unwavering support, the wellspring of my inspiration, wisdom, knowledge, and understanding. His strength has been my guiding force, empowering me to see this project through to completion during my academic journey. Additionally, I extend this dedication to my family, particularly my parents, Wan Ab Aziz Bin Wan Kadir and Siti Zakiah Binti Junoh, who have provided steadfast support, urging me to persevere and not easily surrender. I gratefully acknowledge the encouragement, guidance, and advice bestowed upon me by my friends and lecturers throughout the project, ensuring its success.

ABSTRACT

Existing systems for detecting driver sleepiness rely on expensive equipment impractical to wear while driving, such as electroencephalography (EEG) and electrocardiography (ECG), analyzing heart rhythms and brain frequencies. However, it is essential to identify physical signs of fatigue for a reliable algorithm. A more practical approach involves a camera-based sleepiness detection system in front of the driver. Challenges may arise from lighting variations and head tilting, making accurate detection difficult. To address these, and using an infrared sensor and buzzer, this project comprehensively analyzes prior research. The ultimate goal is to develop a system tracking eye movements and effectively detecting signs of drowsiness. An example of such an application is the driver drowsiness system, employed to identify drowsiness in individuals operating a vehicle. In recent years, there has been a notable surge in road accidents in Malaysia, which can be partly attributed to driver fatigue or drowsiness. Drowsiness during driving poses a grave risk as it leads to fatalities and severe injuries each year when drivers fall asleep at the wheel or experience drowsiness. Prolonged periods of driving or a lack of alertness contribute to heavy eyelids and fatigue, causing drivers to lose focus and increasing the likelihood of accidents. These are common signs of fatigue, which pose significant dangers. It is crucial to address this problem as drivers' lives are at stake. However, preventing accidents becomes challenging if the driver feels drowsy. Hence, the objective of this project is to create a device that use infrared sensor and Arduino that can aids drivers in protecting themselves against accidents caused by drowsiness or sleepiness.

ABSTRAK

Sistem yang digunakan sekarang untuk mengesan keadaan mengantuk pemandu bergantung kepada peralatan yang mahal seperti EEG dan ECG, yang tidak praktikal digunakan semasa memandu. Walau bagaimanapun, untuk membentuk algoritma yang lebih cekap, adalah penting untuk mengenal pasti tanda-tanda fizikal keletihan. Pendekatan yang lebih praktikal ialah menggunakan sistem pengesanan mengantuk berdasarkan kamera yang diletakkan di depan pemandu. Walaupun demikian, terdapat cabaran dalam bentuk variasi pencahayaan dan pencondongan kepala, yang membuatkan pengesanan yang tepat menjadi sukar. Untuk mengatasi isu-isu ini, projek ini melibatkan analisis menyeluruh terhadap kajian terdahulu dan menggunakan sensor inframerah serta buzzer. Matlamat utamanya adalah untuk membina sistem yang mampu mengesan tanda-tanda mengantuk secara berkesan. Sebagai contoh aplikasi, sistem mengantuk pemandu ini digunakan untuk mengenal pasti keletihan semasa mengendalikan kenderaan. Dalam beberapa tahun terakhir, terdapat peningkatan yang ketara dalam jumlah kemalangan jalan raya di Malaysia, dan sebahagian besar berkaitan dengan keletihan pemandu atau rasa mengantuk. Keadaan mengantuk semasa memandu membawa risiko besar, kerana ia boleh menyebabkan kematian dan kecederaan yang serius setiap tahun apabila pemandu tertidur di atas roda atau dalam keadaan mengantuk. Tempoh pemanduan yang panjang atau kurang kewaspadaan turut menyumbang kepada mata yang berat dan keletihan, yang boleh menyebabkan pemandu kehilangan tumpuan dan meningkatkan kemungkinan kemalangan. Oleh itu, tanda-tanda umum keletihan ini membawa risiko yang besar, dan adalah penting untuk mengatasi masalah ini, terutama kerana nyawa pemandu dan orang lain di jalan raya terancam. Oleh itu, projek ini bertujuan membina peranti yang membantu pemandu melindungi diri daripada kemalangan akibat mengantuk.

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CHAPTER 1

INTRODUCTION

1.1 Background

Fatigue while driving is the leading factor contributing to traffic accidents. In Malaysia, there has been a rise in the occurrence of traffic accidents involving various vehicles such as cars, buses, lorries, and trucks on an annual basis. When a driver's eyes exhibit drowsiness for over five seconds, the eye blink sensor detects the frequency of blinking. As drowsiness hampers a driver's judgment and concentration, it stands as a primary cause for traffic accidents. By making an effort to drink coffee or energy drinks, get adequate sleep before driving, or take a break at a rest stop to clear their heads, drivers can prevent falling asleep behind the wheel. However, many drivers decline to use one. Even when they are aware that they are drowsy or fatigued, many drivers choose not to take one of these actions and continue driving instead. Therefore, one of the approaches to preventing traffic accidents is to identify tiredness. This concept suggested creating a device to aid drivers in protecting themselves against collisions brought on by sleepiness or drowsiness.

1.2 Societal/Global Issue Through Anti Drowsiness Detection System Project

The problem of drowsy driving poses a serious threat to public safety, leading to accidents on roads worldwide. An Anti-Drowsiness Detection System project can address this issue by preventing accidents through the implementation of technologies like computer vision, machine learning, and sensors. This system monitors a driver's behavior and alerts them when signs of drowsiness are detected, helping prevent accidents caused by fatigue. Additionally, it enhances safety by continuously monitoring vital signs, facial expressions, and eye movements to detect signs of fatigue and providing alerts to wake up the drowsy driver. Data analysis from the system can offer valuable insights into drowsy driving patterns, contributing to targeted interventions and awareness campaigns. Furthermore, the system acts as an educational tool, promoting self-awareness and encouraging safer driving habits. Successful implementation can also inform the development of regulations and policies related to drowsy driving, improving road safety globally.

1.3 Problem Statement

Current sleepiness detection systems that monitor a driver's condition rely on expensive equipment that is impractical to wear while driving and is not suitable for road conditions. These methods involve the use of electroencephalography (EEG) and electrocardiography (ECG), which analyze heart rhythms and brain frequencies, respectively.

However, it is crucial to identify the physical indications of fatigue to develop a reliable and efficient algorithm for detecting sleepiness. Utilizing a camera-based sleepiness detection system positioned in front of the driver presents a more suitable approach. However, challenges may arise due to variations in lighting conditions and the driver's head tilting to the left or right, making it challenging to accurately detect the driver's eyes and mouth region.

To address these challenges and provide a method for detecting fatigue using an infrared sensor and buzzer, this project were thoroughly analyze previous research and methodologies. The ultimate goal is to develop a system capable of tracking eye movements and effectively detecting signs of drowsiness.

1.4 Project Objective

The primary objective of this project is to present a structured and efficient approach to developing a device that assists drivers in safeguarding themselves from accidents caused by drowsiness or sleepiness. The specific objectives include:

- To develop an efficient anti drowsiness detection system for driver.
- To develop a sensor to trigger eye movement and send the data for driver to alert while driving.
- To evaluate the performance of an efficient anti drowsiness detection system for driver using Arduino with an affordable device capable of detecting driver drowsiness.

By accomplishing these objectives, the project aims to contribute to the overall goal of enhancing driver safety and mitigating the risks associated with drowsiness-related accidents.

1.5 Project Scope

The project encompasses the following areas:

a) Understanding the fundamental concept of a drowsiness detection system.
b) Acquiring knowledge about the indicators and signs of drowsiness.
c) Assessing drowsiness levels based on eye movement using sensor and Arduino.
d) Researching data by employing various types of glasses and conducting tests at different times, including both daytime and nighttime circumstances.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The findings from numerous prior studies conducted in the contemporary society can be utilized to develop a system that can detect drowsy driving in real-time. There are numerous methods that employ various detecting sleepiness symptoms. The fundamental goal of a literature review is to connect the project idea with the knowledge and ideas that have been produced on a particular subject. Prior to beginning this investigation, a literature review analysis was conducted to gather data on the technology available and the methodologies used by other studies that were already working on the same subject.

2.2 Understanding Global/Current Issue in the Anti-Drowsiness Detection System

The ongoing global/current issue in the Anti-Drowsiness Detection System is accurately detecting drowsiness in real-world driving scenarios while minimizing false positives and false negatives. Individual variability in responses, challenges related to real-world conditions, driver acceptance, privacy concerns, and the need for integration and standardization are key considerations. Addressing these challenges requires ongoing research, collaboration, and development among technology developers, manufacturers, policymakers, and regulatory bodies. By overcoming these issues, the Anti-Drowsiness Detection System can enhance its reliability, accuracy, and widespread adoption, leading to improved road safety and a reduction in accidents caused by drowsy driving of climate change.

2.3 Understanding Drowsiness and it's Effect

Through a review of the literature on anti-drowsiness technologies, this section will examine how weather sensing projects can advance our knowledge of driver drowsiness while driving and its impacts through a study of the literature on anti-drowsiness technology. For decision-making and safety, it is essential to comprehend the sleepiness effect. It emphasises how crucial it is to identify and treat tiredness, especially when engaging in activities like driving that need constant focus and quick reactions. Preventative steps can lessen the sleepiness effect and encourage safer driving. These include getting enough sleep, taking breaks during lengthy trips, and being aware of the warning signals of tiredness.

Being drowsy has negative effects on a person's physical and mental health, especially when it happens when they are doing something like driving. Drowsiness is a feeling of being weary or sleepy, and it has a big impact on a person's capacity to work safely and successfully. Driving while fatigued can have detrimental effects on a driver's ability to stay awake, respond swiftly, and make wise decisions. It is essential to comprehend the impacts of being sleepy while driving if you want to promote road safety. Prioritising enough sleep and rest before long travels is essential to reducing the hazards of driving when inebriated. It's better to stop driving if you feel sleepy and take a quick nap, or if you can, switch places with another driver. Caffeine and other stimulants may offer momentary comfort, but they cannot replace adequate rest.

2.3.1 Electroencephalogy (EEG) for Drowsiness Detection

Figure 2.1 : Example of EEG Data Collecting

Due to its detrimental effects on a driver's capacity to properly operate a vehicle, drowsiness is a major contributor to traffic accidents. It is common practise to use EEG electrode recordings of neural activity as a physiological correlate of driver drowsiness. In Figure 2.1 , the process of detecting electrical activity in the brain using EEG is illustrated. This method enables the assessment of different physiological reactions, including heart rate, eye blinking, and physical movements such as head movements. EEG can be utilized to analyze brain activity in both humans and animals. The approach involves examining four specific frequency components: alpha (α), beta (β), theta (θ), and delta (δ) **[**24**]**. An increase in power within the alpha (α) and delta (δ) frequency ranges indicates that the driver is exhibiting signs of fatigue and drowsiness.

One limitation of this method is its susceptibility to sensor noise, which can affect the accuracy of the measurements. For instance, the environment must be entirely silent when the subject is conducting the EEG experiment. The noise will obstruct the sensors' ability to track brain activity. Although the results may be correct, this method also has the drawback of not being appropriate for use in actual driving situations.

2.3.2 Percentage of Eye Closure (PERCLOS)

Through the analysis of eye blinks using the Percentage of Eye Closure (PERCLOS) method, drowsiness can be identified. One proposed approach for detecting eye blinks involves recognizing patterns in the duration of closed eyelids. The PERCLOS technique determines the degree of eyelid drooping as an indicator of fatigue. To differentiate between fully open and completely closed eyes, this method utilizes reference sets of open and closed eyes stored in a software library.

However, these methods are not suitable for real-time driving situations as they rely on fixed threshold values for accurate performance. Both approaches, whether detecting drowsiness through eye blink patterns or PERCLOS, encounter a common challenge: To ensure clear video images without any interference from eyebrows or shadows obstructing the eyes, it is important to position the camera at a specific angle.

2.4 Literature Review based on Several Research Paper

The primary objective of conducting a literature review is to establish a connection between the project idea and existing knowledge and ideas pertaining to a specific subject. Prior to commencing this investigation, a thorough literature analysis was undertaken to gather information about available technologies and methodologies employed in previous studies on the same subject.

There are various methods that employ different approaches to detect symptoms of sleepiness. According to crash team reports from MIROS (Malaysia Institute of Road Safety), a total of 439 road accidents were investigated between 2007 and 2010. Antoine Picot et al. define drowsiness as a state that occurs when an individual is in a state between wakefulness and sleep. During this condition, the driver's attentiveness is reduced while driving, and they are only partially conscious, resulting in a loss of vehicle control. To effectively prevent traffic accidents, it is crucial to identify the driver's level of alertness and sleepiness. By incorporating a device that alerts drowsy drivers through an alarm, their consciousness, attention, and concentration can be maintained, thereby reducing the number of traffic collisions.

A simulation system that uses a webcam to detect sleepiness is described in the research paper written by Badiuzaman Bin Baharu **[1]**. The system satisfies the user's specifications for detecting sleepiness throughout video frames. Additionally, it must identify tiredness in order for the system to avoid misreading any random signals it receives from the driver's actions. The algorithm for the drowsiness system, which detects eye and mouth movement through the webcam, was developed using MATLAB as a command language.

The subject of the following study is eye detection utilising an eye blink sensor. It created a tool to assist drivers in protecting themselves from collisions brought on by tiredness, particularly at night. The inventor created an electronic device that can recognise when a driver is tired and alerts them by vibrating the pillow that rests on the driver's seat and sounding an alarm. Vinamae M. Leopoldo and Rodrigo S. Pangantihon Jr.'s concept **[2]** is to determine whether someone is driving when drowsy by observing how their eyes blink. The driver's eye blink is picked up by the eye blink sensor. When an eye blinks 12 to 19 times per minute normally, it shows that the driver is not sleepy and won't react alarmingly. Eyeblink rates that are lower than this indicate drowsiness, and the microcontroller will sound an alarm. A blink typically lasts between two and ten seconds. Thus, a drowsy condition is indicated by blink intervals longer than 10 seconds. This will cause buzzer and vibrators to function by causing the microcontroller to communicate information to them. The device is able to count blinks and will also sound an alarm in the event that the driver's eyes remain closed for a duration exceeding two to three seconds. As a result, the device's alarm mechanism will awaken the user utilising both of his senses—his sense of touch and his sense of hearing. To warn the driver of becoming sleepy, the alarm buzzer and the driver's seat will vibrate.

The main objective is to create a system that can effectively monitor the status of the driver's eyes and mouth, accurately determining whether they are open or closed. By closely observing the eyes, it is believed that early indications of drowsy driving can be detected, thereby preventing potential accidents. One technique for assessing a driver's level of fatigue is through yawning detection. Yawning serves as a mechanism for individuals to ensure their brain receives sufficient oxygen before they succumb to sleepiness. A combination of facial image sequences, along with the timing of eye and mouth opening and closing, is employed to identify signs of exhaustion and drowsiness. Additionally, the PERCLOS method is utilized for ocular closure detection. This technique relies on measuring the proportion of time the eyes are closed within a specific timeframe. Facial photo analysis finds applications in various areas, including face recognition, human identification, and security system monitoring.

In reference **[3]**, various measures are discussed, This includes measures that are based on the vehicle, the driver's behavior, and physiological indicators. A comprehensive analysis of these measurements provides valuable insights into future systems, identifies associated challenges, and suggests necessary adjustments to develop an efficient system. For the purpose of this essay, these three measurements are employed as sensors. Vehicle-based measures involve continuously monitoring various metrics, such as deviations from a set position and steering wheel movements. When any of these metrics exceed a predefined threshold, This suggests a considerably greater probability that the driver is experiencing drowsiness. Behavioral interventions focus on observing the driver's actions, such as yawning and eye closure, through the use of a camera. If any of these symptoms are detected, the driver is promptly notified.

Physiological measures involve The relationship between electrocardiogram (ECG), electromyogram (EMG), electrooculogram (EoG), and electroencephalogram (EEG) signals.While physiological tests provide highly informative data, they often require intrusive electrode implantation. However, advancements in contactless electrode technology can eliminate this invasive aspect.

In reference **[4]** , For the purpose of detecting driver impairment and identifying signs of driver sleepiness, a cost-effective device equipped with a single camera was developed and tested. The device also aimed to develop a sleepiness classifier suitable for driving simulators. To evaluate the effectiveness of the one-camera system in detecting drowsiness signs, field test data was collected. A comparison was made between the blink parameters captured by the one-camera system and those obtained from a reference three-camera system and the Electrooculogram (EOG). The analysis revealed that the single camera system failed to detect a significant number of blinks and the recorded blink duration did not align with the results obtained from the EOG and the reference camera system.

The results also suggested that it ought to be able to enhance the blink recognition method because, in many instances when the programme misidentified blinks, the raw data appeared to be OK. Statistics from the simulator test were used to construct the classifier for sleepiness. The first step involved implementing and assessing the indicators found in the literature research. In addition to blink-related metrics, the indicators contained driving and context-related ones. The classifier's inputs were then comprised of the most promising signs.

Reference **[5]** is an alcohol detection system and driver drowsiness. In this project, the driver drowsiness system is crucial for references. The car's motor is slowed down and a buzzer sounds until the driver's eyelids open according to the system employed to detect driver sleepiness (or consumption). The serial monitor of Arduino IDE will show the blinking rate. Using Arduino, this suggested system assists in tiredness and alcohol detection. This helps to reduce the number of accidents. We further develop our technology by employing a webcam to identify driver tiredness.

Using an eye blink sensor, the driver's tiredness is found out. Arduino is used to continuously track the rate of eye blinks. The motorist is considered to be drowsy if their eye is closed for longer than five seconds. As a result, both the buzzer and the car's speed (which is here represented by a dc motor) begin to ring. The Arduino Uno utilised is a single-board microcontroller that is designed and produced by the open source Arduino project, company, and user community. Microcontroller kits are utilized for the development of digital gadgets and interactive devices capable of sensing and controlling real-world elements. These kits often come with an Integrated Development Environment (IDE) featuring a sleek, flat design. The Arduino UNO, a widely used microcontroller board, is centered on the ATmega328 microcontroller. It offers a multitude of functionalities, such as a 16 MHz crystal oscillator, 6 analogue inputs, 14 digital input/output pins, a USB port, a power jack, an ICSP header, and a reset button.

The Arduino UNO microcontroller board is based on the ATmega328, includes 6 analogue inputs, 14 digital input/output pins (with 6 capable of functioning as PWM outputs), an ICSP header, a 16 MHz crystal oscillator, a power jack, a USB port, and a reset button. To activate board, there are several options available including utilizing an AC to DC adaptor, connecting a battery as the power source, or simply plugging it into a computer using a USB connection.

In addition, the project's primary component may be the eye-blink sensor that was used. Eye-blink sensor functions by emitting infrared light directed towards the eye and the surrounding area of the eyelid. It then employs a phototransistor and differentiator circuit to monitor changes in the reflected light. The precise operation of the sensor heavily relies on the positioning and orientation of both the emitter and detector in relation to the eye. A relatively basic sensor called an eye blink sensor is used to track blinks of the eyes. It uses a straightforward infrared sensor to identify closed eyes, and the accompanying data can then be analysed using any logic necessary for the application.

The infrared sensor is attached to the glasses and placed on the user's eye so that it aligns with the sensor. When the sensor detects a blink, which occurs when the user closes their eyes, the infrared then outputs a HIGH signal. An internal LED indicator serves as a user alert on the infrared sensor. The system can be connected to the VCC and GND of the infrared sensor pin, and blink detection will be indicated by the onboard LED. Keep note of the blink time in case more reasoning is needed. The OUT pin can be linked directly to any microcontroller's digital input pin.

A wide range of applications where user concentration needs to be tracked can make use of eye-blink technology. Other uses include measuring weariness in scientific investigations or counting the number of blinks in diverse situations for research purposes.

Reference **[6]** describe this system is designed to detect driver sleepiness and generate corresponding alarms. It utilizes various components, including a Kinect camera for continuous image recording of the driver, a Beagle board for implementing image processing algorithms, a feedback circuit for alarm generation, and a power supply system. The Kinect Camera (Microsoft Kinect Xbox360) is employed to monitor and capture facial images of the driver. The Beagle board is responsible for processing these captured images. A camera will be mounted on the ceiling, facing the driver. The Kinect camera provides few modes of operation: Depth, IR, and RGB. However, for this particular project, only the RGB and IR modes are required.

Using OpenCV, the coding and algorithmic components will be created. Daytime detection and nighttime detection are two components of the method. During daytime, the system utilizes the RGB mode for detection purposes, while the IR mode is employed for nighttime detection. If the IR mode fails to provide satisfactory results, the system will employ the histogram equalization method for nighttime detection. The histogram equalisation is a technique for considerably extending the image's colour gamut. We require a light to dimly enlighten the driver in this scenario. The space between a driver's eyelids or the colour of their eyes are used to gauge their level of tiredness. As soon as the drivers get in the car, regardless of the time of day or night, their initial eyelid distance will be recorded. Once the drivers have left, the record will be deleted. While driving, the camera will capture 2 or 3 frames per second. The space between the eyelids is next measured; if it remains modest for a number of frames, the driver is considered to be sleepy.

The design incorporates an array of six to eight LEDs for enhanced effectiveness. By constructing this array, the flashing frequency and pattern can provide more effective warnings to drivers. Furthermore, the frequency modification is determined by the duration of the driver's eye closures. The control signal for the warning devices is facilitated by the Beagle board. To ensure optimal operation of the warning devices, a D/A converter or a current amplifier is included, regardless of the characteristics of the control signal.

Reference **[7]** is device that used to prevent drowsiness which is anti-sleep glasses. In this post, the buzzer, vibrato, IR sensor, and Arduino Pro Mini were used as the device's primary components. This project's infrared sensor, which is its brains, provides the foundation for how it functions. An Op-amplifier IC, a photo diode, a transmitter infrared LED, and a potentiometer are the main components of a standard infrared sensor. In order to prevent it from immediately receiving infrared rays, the photo diode is positioned right next to the infrared LED. The infrared spectrum is sensitive to photodiode. Its anode is connected to the noninverting input of the Op-amplifier, which is likewise pulled down by the 10 kilo ohm resistor, and its cathode is connected to the positive voltage of 5 volts. The sensitivity distance of the IR sensors is adjusted using potentiometers, which are connected to the inverting input of the Op-amp. The voltage at the anode changes due to the change in infrared radiation, which is dependent on the infrared radiation received by the photo diode. Infrared LED continuously transmit infrared rays, and if any object passes in front of it, infrared rays get reflected back and are received by the photo diode.

The change in anode voltage will increase when IR radiation is received more often. The IR Sensor's output is derived from the Op-amplifier's output. By turning the potentiometer on the sensor, we may change the sensitivity distance. When we turn the potentiometer, we're setting a threshold voltage for the Op-amplifier's noninverting input. The voltage on the noninverting input positive voltage from the photodiode is advanced and gets the positive pulse at the output of the op-amplifier, which is output of the sensor, whenever the voltage on the noninverting input is greater than the threshold voltage.

2.5 The Comparison of Selected Literature Review

Table 2.1: Literature Review Comparative Analysis

Title of Journal	Author	Description
[1] Driver Drowsiness Detection By Using Webcam (2013)	Badiuzaman Bin Baharu	A webcam-based simulation system has been developed to detect drowsiness. The system utilizes MATLAB to implement the algorithm that detects eye and mouth movement through the webcam. **Advantage:** The focus is on command for drowsiness detection and developing the algorithm **Disadvantage:** Developing the algorithm may require more time and the author has only basic skills in using MATLAB®.
[2] Drowsiness Detection for Vehicle Drivers with Alert System (2020)	Vinamae M. Leopoldo1, et al.	To enhance driver safety, particularly during nighttime, a device is being developed to prevent accidents caused by driver drowsiness. The proposed electronic device incorporates an infrared (IR) sensor as an eye blink sensor, which detects drowsiness by monitoring the driver's eye movements. When drowsiness is detected, the device activates a vibration mechanism in the pillow

		placed on the driver's seat and triggers a sound alarm as an additional alert. **Advantage:** The use of an IR sensor as an eye blink sensor proves effective and feasible in determining whether the person is in a drowsy state or not, as long as it is securely attached to a fixed location on the windshield. **Disadvantage:** The IR sensor is delicate and not designed for prolonged use. However, in terms of integrating the eye blink sensor into the Arduino, it is recommended to employ a wireless transmission device to transmit the sensor's output without interfering with the delay process.
[3] Detecting Driver Drowsiness Based on Sensors A Review (2012)	Arun Sahayadhas, et al.	A comprehensive examination of measures such as vehicle-based measures, behavioral measures, and physiological measures is presented. This detailed review aims to offer insights into future systems, address associated issues, and suggest improvements required to develop an effective system. This article mentioned three measures are utilized as the sensors for detecting drowsiness.

		Advantage: The author discusses multiple approaches to manipulate drowsiness within a simulated environment, providing a comprehensive understanding of the subject. **Disadvantage:** While physiological measures exhibit a high accuracy rate in detecting drowsiness, their intrusive nature remains a concern. However, the issue of intrusiveness can be mitigated by adopting contactless electrode placement techniques.
[4] Camera-based sleepiness detection (2011)	Carina Fors, VTI , et al.	A low-cost 1-camera unit was developed and assessed to detect driver impairment, identify signs of driver sleepiness, and create a sleepiness classifier for driving simulators. The sleepiness classifier was built using data obtained from a simulator experiment. Initially, the indicators identified in the literature review, including both blink-related indicators and driving/context-related parameters, were implemented and evaluated. Subsequently, the most promising indicators were selected as inputs for the classifier. **Advantage:** The algorithms employed in the eye tracking-based driver distraction

		detection focus on identifying visual distractions, enhancing the overall effectiveness of the system. **Disadvantage:** It is worth noting that only one of the available algorithms was specifically designed to detect internal distractions, potentially limiting the scope of distraction detection in certain scenarios.
[5] Driver Drowsiness and Alcohol Detection System Using Arduino (2020)	Archana Jenis M.R M.E., et al.	The proposed system aims to address this issue by incorporating an eye blink sensor that detects drowsiness based on prolonged eye closure exceeding 5 seconds. When the sensor detects closed eyes, it triggers a decrease in the car's speed. Furthermore, we have integrated an alcohol MQ3 sensor to detect in the driver's breath for the existence of alcohol. If alcohol is detected, the car's speed is also reduced. These sensors are connected to an Arduino UNO for data processing. In the event of alcohol detection, an LED indicator lights up, while a buzzer is activated when drowsiness is detected. The speed of the car varies based on the detection of both drowsiness and alcohol presence.

		Advantage: The proposed system offers a comprehensive solution by detecting both drowsiness and alcohol using Arduino, contributing to enhanced safety while driving. **Disadvantage:** The system involves the integration of an alcohol detection system and the use of a different eye blink sensor, potentially increasing the complexity of implementation.
[6] Driver Sleep Detection and Alarming System (2013)	Chenyang Xu, et al.	An innovative system has been developed to detect driver sleepiness and provide appropriate alarms. The system comprises a Kinect camera, which continuously captures images of the driver, a Beagle board equipped with image processing algorithms, a feedback circuit to generate alarms, and a power supply system. **Advantage:** The author has successfully developed a system capable of detecting driver sleepiness and triggering alarms accordingly, enhancing driver safety. **Disadvantage:** The system relies on the use of a Kinect camera to capture images of the driver, which may introduce additional costs

		or technical requirements compared to alternative camera options.
[7] Anti-Sleep Glasses (2022)	shubhamsuresh	Introducing an innovative solution for preventing drowsiness while driving: the anti-sleep glasses. This device incorporates key components such as the Arduino Pro Mini, IR Sensor, Buzzer, and Vibrator. **Advantage:** The development of anti-sleep glasses provides a practical solution to alert drivers when they experience drowsiness, enhancing overall road safety. **Disadvantage:** The device does not offer the option to use different types of glasses, limiting customization possibilities for users.

2.6 Summary

The literature review aimed to establish a connection between the project idea and existing knowledge on detecting driver sleepiness. Various methods were explored, including a webcam-based system, an eye blink sensor, and an anti-sleep glasses device. The importance of early detection to prevent accidents was emphasized.

One approach involved a simulation system using a webcam to detect sleepiness, with MATLAB used for the algorithm. Another method utilized an eye blink sensor to identify driver tiredness, triggering alarms for increased safety. The study also explored the use of physiological indicators like electrocardiogram (ECG) signals and the PERCLOS method for ocular closure detection. The discussion on the webcam-based system is too brief and lacks critical evaluation. It does not address potential limitations or challenges faced by this approach.

Several projects were reviewed, such as a one-camera system for detecting driver sleepiness. However, challenges were noted in accurately capturing blink parameters compared to a reference three-camera system. The project mentions the importance of the eye blink sensor but it doesn't highlight potential drawbacks or challenges associated with this technology. A more balanced perspective on its limitations would strengthen the journal research.

Additionally, an alcohol detection system and driver drowsiness project were discussed, emphasizing the importance of reducing accidents through technology. The eye-blink sensor was a crucial component, utilizing infrared light and a phototransistor to monitor changes in reflected light. The discussion on physiological indicators lacks specificity, and it does not delve into potential drawbacks or challenges associated with using these indicators for drowsiness detection. Additionally, the limitations of the one-camera system are briefly mentioned but not thoroughly explored.

Other projects included a Kinect camera-based system using OpenCV for facial image processing, aiming to detect driver sleepiness during both daytime and nighttime. The project provides an overview of the Kinect camera-based system but lacks a thorough analysis of potential weaknesses or challenges associated with its implementation. A more detailed examination of the limitations would improve the discussion.

To overcome the issues, an anti-drowsiness detection system was introduced, featuring an infrared sensor, buzzer, vibrator, and Arduino Pro Mini. The infrared sensor, acting as the device's brains, used an Op-amplifier IC, a photo diode, a transmitter infrared LED, and a potentiometer to prevent immediate infrared reception. The device aimed to detect infrared rays reflecting back when an object passed in front, signaling potential driver sleepiness.

The literature review concluded with a comprehensive exploration of various technologies and methodologies, emphasizing the need for an effective system to monitor the driver's eyes and mouth for early detection of drowsiness and prevention of accidents.

CHAPTER 3

METHODOLOGY

3.1 Introduction

A comprehensive intro to research methodology offers a thorough examination of numerous scientific frameworks and methods, as well as the related instruments and techniques. This methodology emphasizes using Arduino software and an infrared sensor to develop a distinctive yet user-friendly system or gadget. It also has a structured approach that entails choosing an appropriate project title, conducting journal and article research, planning a project design and the components that will be required, integrating hardware and software into the project, analyzing the project, solving any issues that arise, and drafting a report. To do this, a thorough flow chart that details all of the procedures required to execute the project from beginning to end is prepared. Before starting this project, it is also essential to comprehend the hardware and software resources that will be utilised. This chapter seeks to concentrate on both the design technique and the overall equipment and research process flow.

3.2 Sustainability for The Project of Anti-Drowsiness Detection System

Sustainability is crucial for the project of Anti-Drowsiness Detection System to ensure long-term effectiveness and impact. This involves several key aspects. Firstly, it is essential to design the system with energy efficiency in mind, minimizing power consumption to reduce environmental impact. Additionally, the project should focus on using sustainable materials and manufacturing processes, considering the lifecycle of the system from production to disposal. Incorporating modular and upgradable components can facilitate future enhancements and reduce electronic waste. Furthermore, establishing partnerships and collaborations with stakeholders, such as automotive manufacturers, transportation authorities, and research institutions, can promote knowledge sharing and continuous improvement. Finally, ongoing research and development efforts should be directed towards optimizing the system's performance, addressing emerging challenges, and staying abreast of advancements in technology. By incorporating sustainability principles, the Anti-Drowsiness Detection System project can contribute to both road safety and environmental stewardship, ensuring a positive and lasting impact.

3.3 Methodology

The objective of the project methodology titled "Design of Efficient Anti Drowsiness Detection System For Driver" is to create a device that assists drivers in preventing accidents caused by drowsiness or sleepiness. The methodology involves a series of steps including data acquisition, feature extraction, and implementation of drowsiness detection algorithms. The focus is to leverage the capabilities of Arduino software and appropriate sensors to develop an electronic device capable of identifying driver drowsiness and triggering an audible alarm as a safety measure.

Figure 3.1 : Research Method

3.4 Project Block Diagram

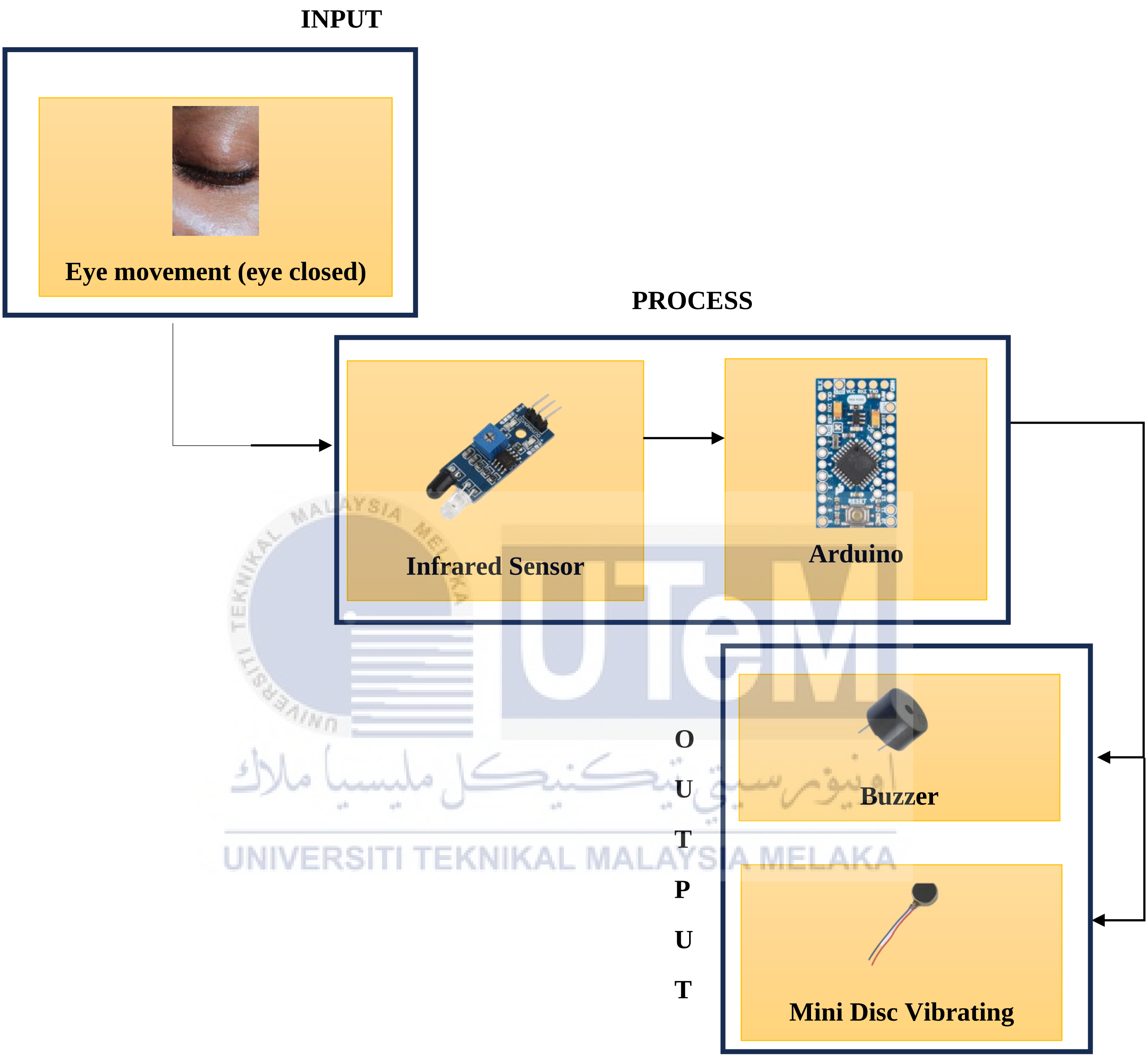

Figure 3.2 : Block Diagram of the project

Infrared sensor were used to detect infrared rays reflecting back when an object passed or block in front (during eye were close, eyelids block the eye ball) signaling potential the drowsiness detection. These outputs from the sensors are connected to the Arduino and activate an alarm in term of sound alarm and also vibrate a small motor that attach to the device. The device aimed driver sleepiness.

3.5 Project Development Flowchart

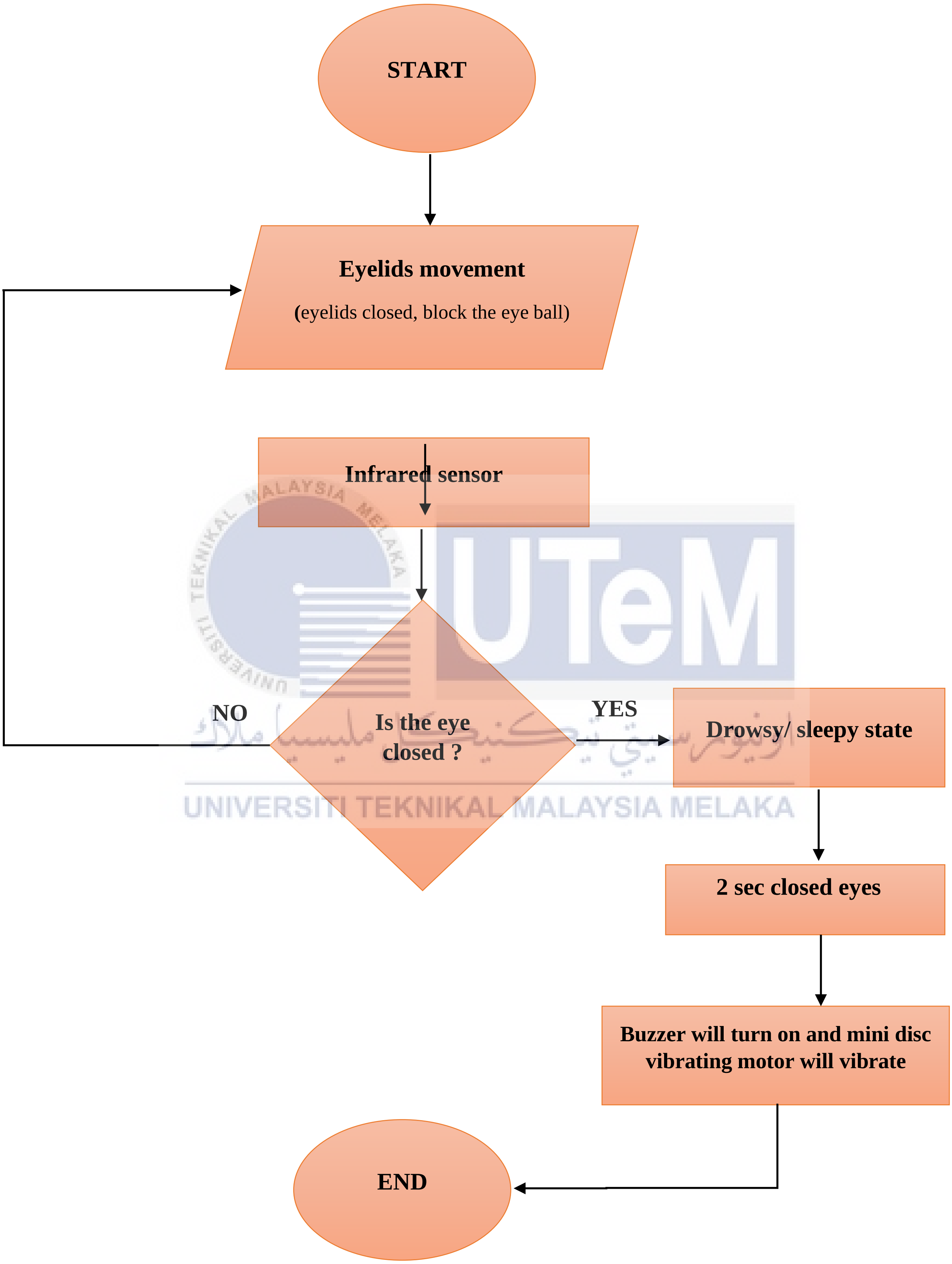

Figure 3.3 : Flowchart of the project

The programming of gadgets can be facilitated through the utilization of Arduino Uno, a microcontroller. In this study, the Arduino is employed to develop a program that detects drowsiness in the driver. The figure 3.3 flow chart illustrates the process. Initially, the infrared sensor detect infrared rays reflecting back when an object passed in front (during the eyelids closure) signaling potential driver sleepiness. The microcontroller analyzes this information to determine if the detected eye movements indicate a normal or drowsy state. A normal state is characterized by a blinking or eyes not close for 2 seconds. In this scenario, the Arduino will simply restart the loop without taking any further action. Conversely, a drowsy state signifies an unusually prolonged eye closure by the driver which in this case the eye closure took 2 seconds. If the driver has not blinked or has not opened their eyes for two seconds, the Arduino will activate the buzzer and vibrating motor as a warning signal.

3.6 Software Implementation

3.6.1 Arduino Software

Figure 3.4 : Arduino Software

The Arduino Integrated Development Environment, also known as the Arduino Software (IDE), offers various features such as a text editor for coding, a message area, a text console, a toolbar with frequently used buttons, and a range of menus. It serves as a connection point to the Arduino hardware for program uploading and communication. The IDE is designed to be user-friendly, making code compilation accessible to individuals without extensive technical knowledge. It runs on the Java Platform, which provides essential functions and commands for debugging, modifying, and compiling code. Moreover, it is compatible with multiple operating systems including MAC, Windows, and Linux. The Arduino ecosystem includes several modules such as Uno, Mega, Leonardo, Micro, and others, each featuring a microcontroller that executes the programmed code and processes data accordingly.

3.7 Hardware Implementation

3.7.1 Arduino Pro Mini

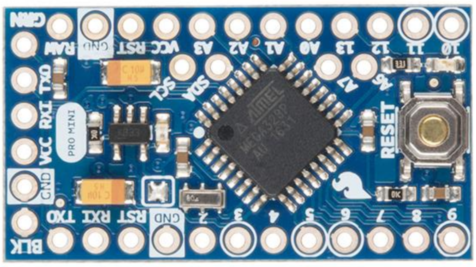

Figure 3.5 : Arduino Pro Mini

The Arduino Pro Mini is a diminutive and application-oriented microcontroller board created by Arduino.cc. The Arduino Pro Mini is a microcontroller board based on the ATmega328P. It features 6 analog inputs, an on-board resonator, 14 digital input/output pins (including 6 PWM outputs), an on-board reset button, and mounting holes for pin headers. In terms of overall capabilities, the Arduino Pro Mini and Arduino UNO are comparable, with the main differences being their size and integrated programming capabilities. The Arduino Pro Mini is incredibly compact and does not include a USB port or built-in programmer. Additionally, it has only one voltage regulator, whereas the Arduino Uno has two integrated voltage regulators (5V and 3.3V).

To achieve a smaller form factor, the Arduino Pro Mini omits the USB port and built-in programmer. Once the code is uploaded, it can be seamlessly integrated into your application, hence the designation as an application-type board. The programming and uploading of code are accomplished using the official Arduino Software known as Arduino IDE (Integrated Development Environment). The written programming code for this board is commonly referred to as a sketch.

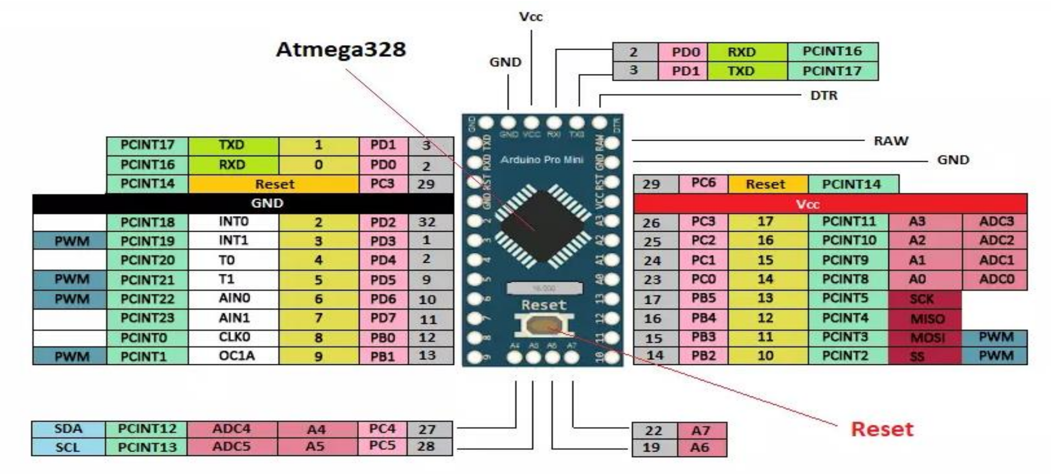

Figure 3.6 : Arduino Pro Mini pin arrangement

- **Power Supply (Vcc):** The Arduino Pro Mini Pinout features two Vcc pins, providing regulated voltage at either 5V or 3.3V, depending on the board type.
- **Ground (GND):** The board incorporates three ground (GND) pins for electrical grounding.
- **TXD & RXD Pins:** These pins are used for serial communication. TXD represents the transmission of serial data while RXD is used for receiving the data. Code is also uploaded through Serial Protocol.

- **Reset:** The Pro Mini board is equipped with two Reset Pins, offering a useful feature in the event of a program hang-up; setting this pin to LOW will reset the board. In the diagram below, the Power Pinout of the Arduino Pro Mini is highlighted.

In this project, VCC port were use as the voltage regulators. GND as the ground connection to the output component. Analog pin, A1 use as the sensor input pin and Digital pin 13 use as buzzer pin.

3.7.2 Infrared Sensor

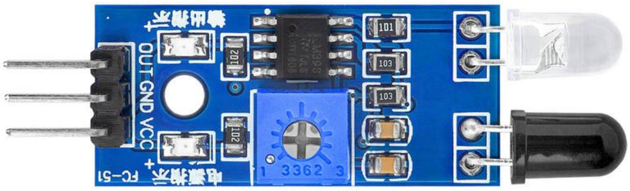

Figure 3.7 : Infrared Sensor

A device that emits infrared light and detects specific characteristics of its surroundings is known as a sensor. An infrared (IR) sensor is capable of monitoring heat and detecting motion. These sensors are referred to as passive IR sensors because they do not emit infrared radiation themselves; instead, they simply measure it. When IR light strikes the photodiode, the resistance and output voltage of the sensor change proportionally to the intensity of the received IR light.

The operation of an infrared sensor is similar to that of an object detection sensor. In an IR transmitter and receiver pair, the wavelength of the receiver must match that of the transmitter. In this setup, an IR LED serves as the transmitter, while an IR photodiode functions as the receiver. The infrared light emitted by the IR LED can be detected by the infrared photodiode. The resistance and output voltage of the photodiode vary in response to the amount of infrared light received. This fundamental principle of how an IR sensor operates is illustrated in Figure 3.5.

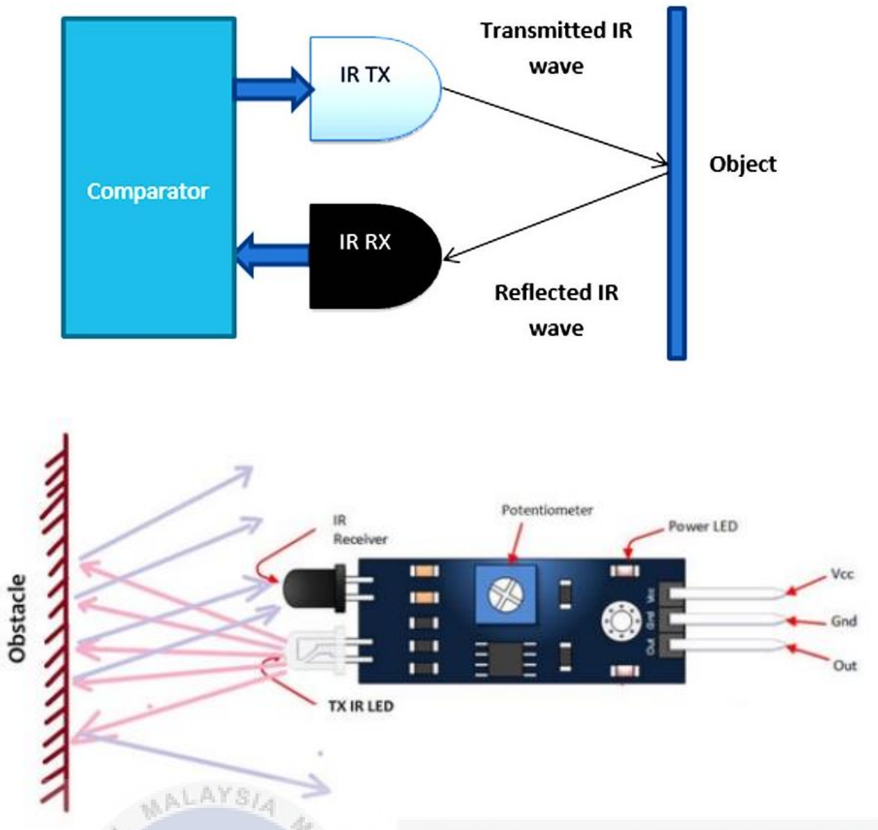

Figure 3.8 : Infrared sensor process

As depicted in the provided image, infrared sensors comprise two components: an infrared transmitter, which serves as the emission source, and an infrared receiver, which acts as the detector. The infrared source typically consists of an IR LED, while the infrared detector involves photodiodes. The emitted energy from the infrared source is reflected off an object and detected by the infrared receiver.

When the light emitted by the IR LED reaches the receiver, the resistance of the photodiode undergoes a significant decrease. This photoreceiver is connected to a potentiometer, forming a voltage divider circuit. As a result, when blinking activity is detected, the circuit produces a variable analog output.

3.7.3 NPN Transistor

Figure 3.9 : NPN Transistor

An NPN transistor, which is a widely used type of bipolar junction transistor, consists of a P-type semiconductor sandwiched between two N-type semiconductors. It has three terminals: the collector, emitter, and base. The operation of the NPN transistor is similar to that of two PN junction diodes connected in a back-to-back configuration.

The NPN transistor comprises two PN junction diodes: the collector-base junction and the base-emitter junction. The emitter, one of the three terminals, supplies charge carriers to the collector through the base region. The majority of charge carriers released by the emitter are collected in the collector region. The flow of current from the emitter to the collector is determined and controlled by the base region.

In figure 3.9 is the equivalent circuit for NPN Transistor.

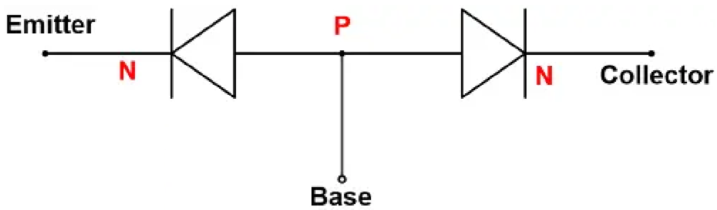

Figure 3.10 : NPN Equivalent circuit

3.7.4 Buzzer

Figure 3.11 : Buzzer

A piezo buzzer is an electronic device utilized for generating tones, alarms, or sounds. It boasts a simple design, lightweight construction, and often comes at an affordable price. Despite its simplicity, the piezo ceramic buzzer can be highly reliable and can be manufactured in various sizes to operate across a wide range of frequencies, producing different types of sound outputs. Piezoelectric buzzers typically have widths ranging from 4 to 9 millimeters, making them generally smaller compared to pin-type magnetic buzzers. They are specifically designed for compact devices such as portable terminals, camera photoflashes, clinical and forehead thermometers, and blood glucose meters. For this project, a 5 Volt Buzzer utilizing piezo technology is employed to give the output to the device as an alarming to the driver.

3.7.5 Battery

Figure 3.12 : Battery

The lithium cell like in figure 3.10 may be offered under a variety of nominal "voltages" depending on its chemistry and design. For instance, the majority of lithium polymer batteries fall into the 3.7V or 4.2V range. This indicates that the cell's maximum voltage is 4.2 volts and that the "nominal" (average) voltage is 3.7 volts. The voltage will decrease as the battery is utilised until it reaches its lowest point, which is about 3.0V. On the battery itself, we able to see the number 3.7V inscribed someplace. The battery was use as the voltage input or the power sources for component to functioning well.

3.7.6 Mini Disc Vibrating Motor 1027

Figure 3.13 : Mini Disc Vibrating Motor 1027

This compact and lightweight flat vibration motor is designed for applications such as mobile phones, anti-lost alarms, medical devices, and various do-it-yourself projects that require a small vibration motor. It functions as a petite buzzing motor, making it an ideal choice for any haptic feedback project. These motors come in the form of tiny discs, fully sealed for ease of use and embedding.

Control and power for the vibration are managed through two wires. Simply supply power from a battery or microcontroller pin (where the red wire is positive and the blue wire is negative), and the motor will vibrate, generating the distinctive buzzing sound. It operates efficiently within a voltage range of 2V to 5V, with higher voltages resulting in increased current draw and a more pronounced vibration.

In this project the positive cord (red wire) was connect to the VCC pin of Arduino Pro Mini and VCC of Infrared sensor. While the negative cord (blue wire) were connect to the emitter part of NPN Transistor and one of the buzzer leg.

3.7.7 Arduino UNO

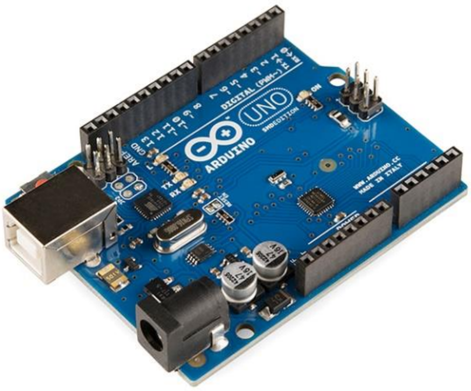

Figure 3.14 : Arduino UNO

The Arduino Uno is a widely-used microcontroller board featuring the Atmega328P microcontroller running at a clock speed of 16 MHz, equipped with 14 digital input/output pins, of which 6 support pulse-width modulation (PWM) output, along with 6 analog input pins; it is powered through a USB connection or an external power source (7-12V) via an onboard voltage regulator, and it can be programmed using the Arduino Integrated Development Environment (IDE), an open-source platform, allowing developers to create, upload, and debug code effortlessly, with the microcontroller having 32 KB of flash memory for program storage, 2 KB of SRAM for variables, and 1 KB of EEPROM for data storage, complemented by a reset button for easy restart during development, built-in LEDs for visual indications, compatibility with a variety of expansion boards called shields for additional functionalities, making it an ideal choice for both beginners and experienced developers in electronics and embedded systems projects.

The following image shows the complete pinout of Arduino UNO Board. Based on the image, each pin of the Arduino UNO were described with its microcontroller equivalent pin, alternative functions, default functionality and other additional features.

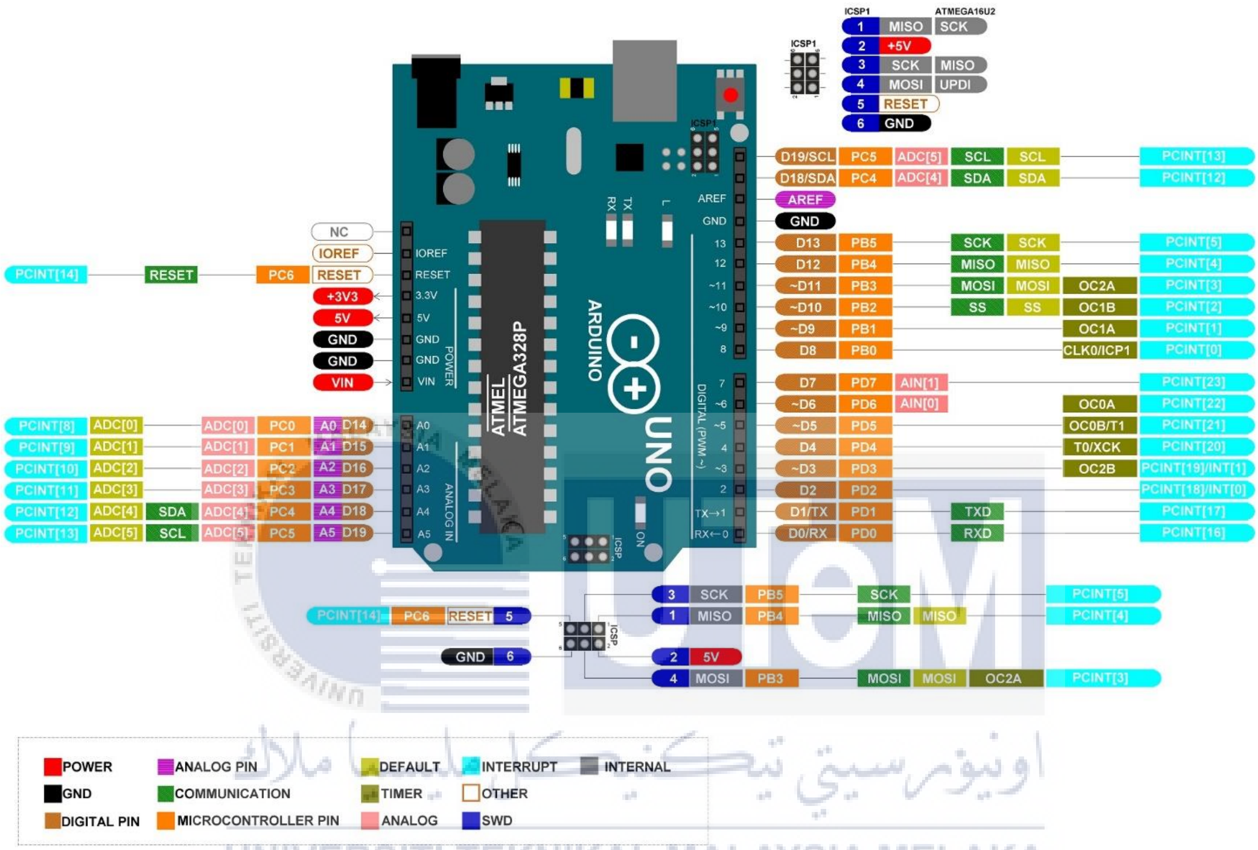

Figure 3.15 : Arduino UNO pin arrangements

In this project Arduino UNO was use as a board to transfer the coding from Arduino IDE Software to the Arduino Pro Mini since Arduino Pro Mini comes with the minimum of components (no on-board USB or pin headers) to connect directly to the laptop for coding transfer. The Arduino Pro Mini board comes without pre-mounted headers, allowing the use of various types of connectors or direct soldering of wires thus the need of use of Arduino UNO just to transfer the coding part.

3.8 System Components Configuration

To verify the functionality of the components used in this system tool, a preliminary test is conducted to ensure they operate as intended. The testing procedure involves writing basic programming commands in the Arduino open-source software, which are then programmed into the microcontroller. Subsequently, fundamental circuits are set up to execute these tests.

3.8.1 Infrared Sensor (IR) Functionallity Test

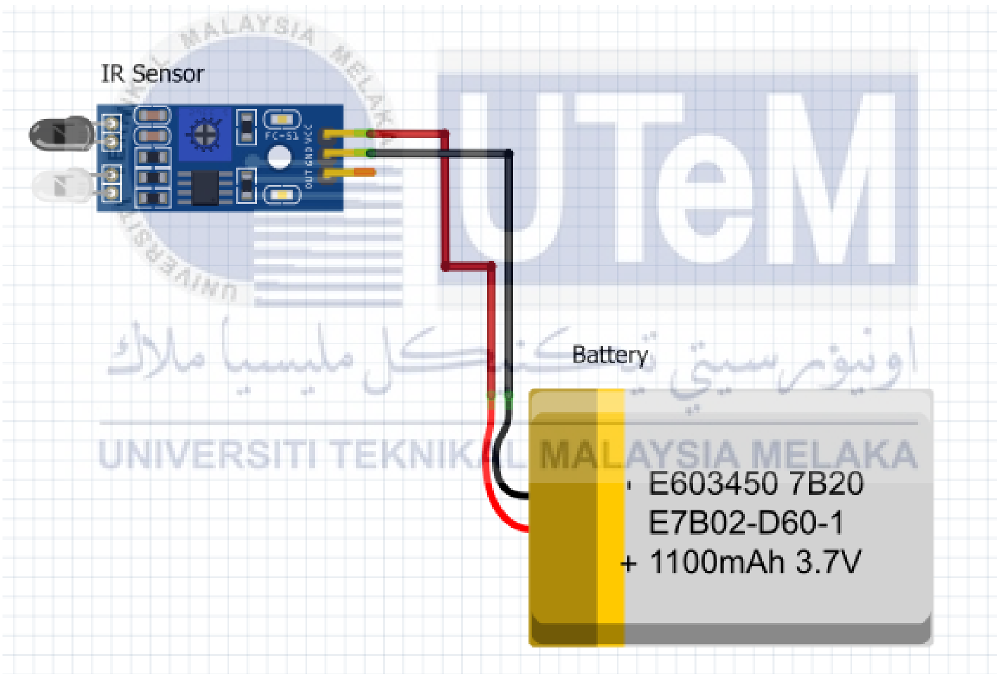

Figure 3.16 : Infrared sensor test circuit connection

The pinout for the Infrared Sensor pin out involves connecting its VCC pin to the Negative(-ve) battery. The pin out Ground(GND) of Infrared Sensor(IR) connecting to Positive(+ve) battery. The power supply is directly linked to the infrared sensor module. Consequently, if the Infrared Sensor works fine or functioning, red light will turn on. If the red light doesn't turn on that means the sensor is damage.

3.8.2 Circuit Design

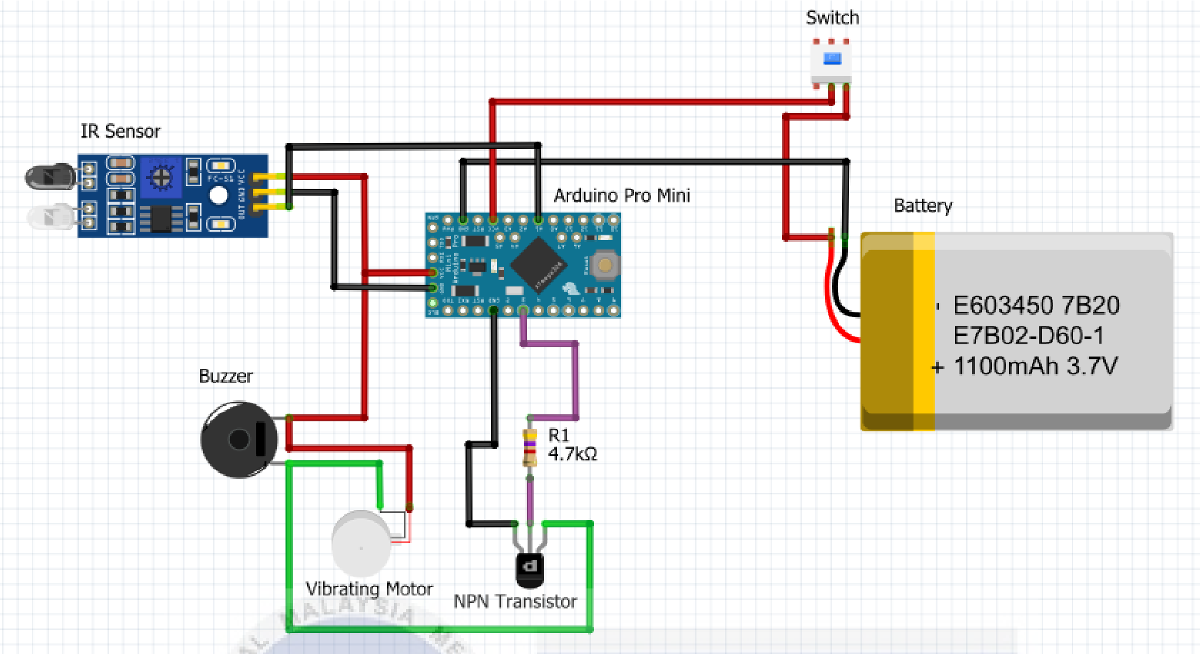

Figure 3.17 : Circuit design of the project

In this circuit, the IR sensor Ground pin(GND) was connected to the Arduino Pro Mini pin Ground(GND). VCC from the IR sensor connect to VCC Arduino Pro Mini and positive part of buzzer. OUT pin IR sensor connected to Analog pin, A1 in Arduino Pro Mini that represent as Output from sensor to Input for the Arduino or circuit.

From the Arduino Pro Mini pins, the Digital Output 3 were connected to resistor 4.7kΩ while Ground(GND) were connected to emitter part of NPN Transistor. Next the VCC pin go to the one of the switch component part and GND to the Negative(-ve) battery. While from the switch it was connect to the Positive(+ve) part of battery.

The 4.7kΩ resistor connected to the base of NPN transistor while the collector leg go to the negative part of buzzer that also connected with negative(-ve) part of Vibrating Motor.

3.8.3 Circuit Design with Arduino UNO to insert coding

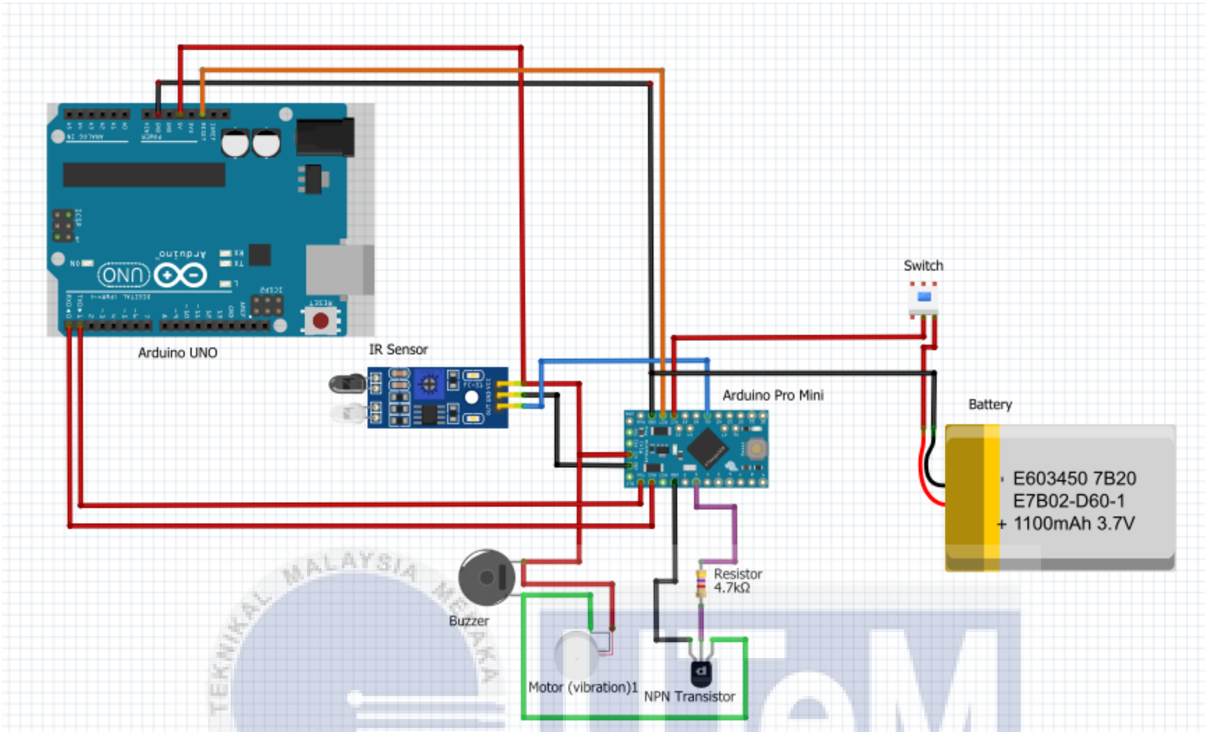

Figure 3.18 : Circuit design to connect with Arduino UNO

To the upload and test the coding, it required connection from the circuit to the Arduino UNO. The GND pin connect to GND Arduino Pro Mini, 5V pin connect to VCC, Reset pin Arduino UNO to the RST pin in Arduino Pro Mini while for TX and RX pin from Arduino UNO were connect to TX and RX pin in Arduino Pro Mini. This connection were required to upload the coding from Arduino IDE Software to the circuit system so that the component can function well and give the output that were desired. After the coding uploaded, Arduino UNO were remove and the system works with Arduino Pro Mini as main the main board.

The Arduino Pro Mini is a compact microcontroller board that shares many features with the standard Arduino boards but in a smaller form factor that suitable to use in the project as it can be mounted to the glasses for the system to work.

3.9 Experimental Setup

The apparatus of the drowsiness detection system for driver as shown in Figure 3.16 is a setup to conduct the experiments and process to test the device functionally of with the system build which consist of:

1) Arduino Pro Mini
2) Infrared Sensor
3) Buzzer
4) Mini Disc Vibrating Motor 1027
5) 4.7kΩ Resistor
6) NPN Transistor
7) Arduino UNO

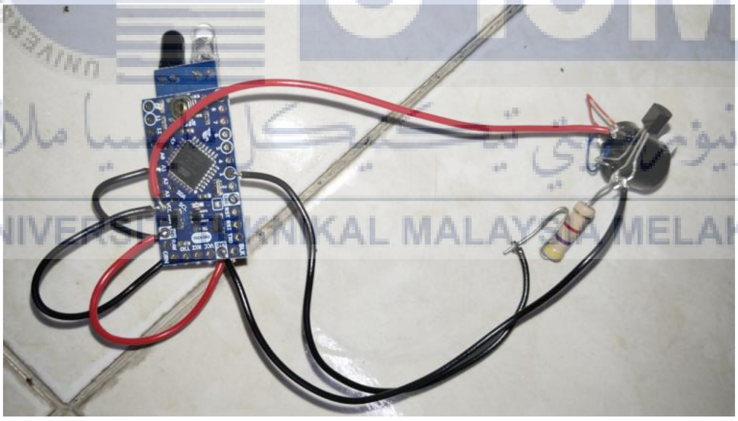

Figure 3.19 : Hardware circuit and component

Figure 3.16 shows the connection of infrared sensor with Arduino Pro mini and the buzzer with vibrating motor. This is the main part connection of the system that will give the result to the project.

3.9.1 Coding for Eye Movement (eye closed)

eye_close_ide.ino

```
int Sinput = A1; // Sensor input pin
int buzzer = 3; // Buzzer pin
int LED = 13; // LED pin

void setup() {
  pinMode(Sinput, INPUT); // Set sensor pin as input
  pinMode(buzzer, OUTPUT); // Set buzzer pin as output
  pinMode(LED, OUTPUT); // Set LED pin as output
}

void loop() {
  int sensorValue = analogRead(Sinput); // Read sensor value

  // Check if sensor value corresponds to the eye being closed (adjust the threshold as needed)
  if (sensorValue < 500) { // Modify the threshold according to the sensor values
    delay(2000); // Wait for two seconds after the sensor detects an eye close
    digitalWrite(buzzer, HIGH); // Turn on the buzzer
    digitalWrite(LED, HIGH); // Turn on the LED
  } else {
    digitalWrite(buzzer, LOW); // Turn off the buzzer
    digitalWrite(LED, LOW); // Turn off the LED
  }
}
```

Figure 3.20 : Coding for eye detection

Figure 4.2 shows coding to activate or trigger the system using Analog pin A1 as sensor input, Digital pin 3 as buzzer pin and LED at pin 13. This Arduino code is for a simple eye blink detection system using an infrared sensor. Below is an explanation of the code:

1. **Variable Declarations:**

   - **'Sinput':** Represents the analog pin (A1) to which the sensor is connected.
   - **'Buzzer':** Represents the digital pin (3) to which the buzzer is connected.
   - **'LED' :** Represents the digital pin (13) to which the LED is connected.

2. **Setup Function :**

   - Configures the pins: 'Sinput' as an input pin, and 'buzzer' and 'LED' as output pins.

3. **Loop Function :**

- Reads the analog value from the sensor connected to pin `Sinput`.
- Checks if the sensor value is below a certain threshold (500 in this case). This threshold is adjusted based on the actual sensor values observed during testing.
- If the sensor value indicates the eye is closed (blocked by eyelids), it waits for 2 seconds (using `delay(2000)`) to confirm the eye closure.
- If confirmed, it turns on the buzzer and the LED for a visual and audible alert.
- If the eye is open, it turns off the buzzer and the LED.
-

- ❖ The specific threshold value (`500`) might need adjustment based on the sensor characteristics and environmental conditions.
- ❖ The 'delay(2000)' is used to prevent false positives by confirming that the eye closure is sustained for at least 2 seconds before triggering the alert.

3.10 Summary

This chapter offers a suggested process for creating a fresh, efficient, and comprehensive plan to strengthen video security systems and reduce system vulnerabilities. To make sure that the process of implementing the project goes successfully, a flow chart of the project's progress has been made. Before starting this project, the components, both in terms of hardware and software, have been chosen. To make sure that the project's future development is effective, straightforward, and within budget, it is essential to carefully choose these components. In order to be certain that the circuits function properly, it is necessary to track any hardware issues. The project was permitted to advance to the stage of the final report.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents the results and analysis of creating a drowsiness detection system using an Infrared sensor for motion detection and Arduino Pro Mini for programming. It also discusses the necessary steps taken to develop the project and ensure its effectiveness. The data collection process aligns with the predefined criteria to assess whether the project's objectives and scope have been achieved. Additionally, the final results of the project will be reported in this chapter, including an analysis and the creation of a prototype.

4.2 Result and Analysis

The development of the system showcases that the prototype integrates a range of components to collect data on crucial parameters. It activates and utilizes an infrared sensor that is attached and operates under specific conditions.

4.2.1 System Design

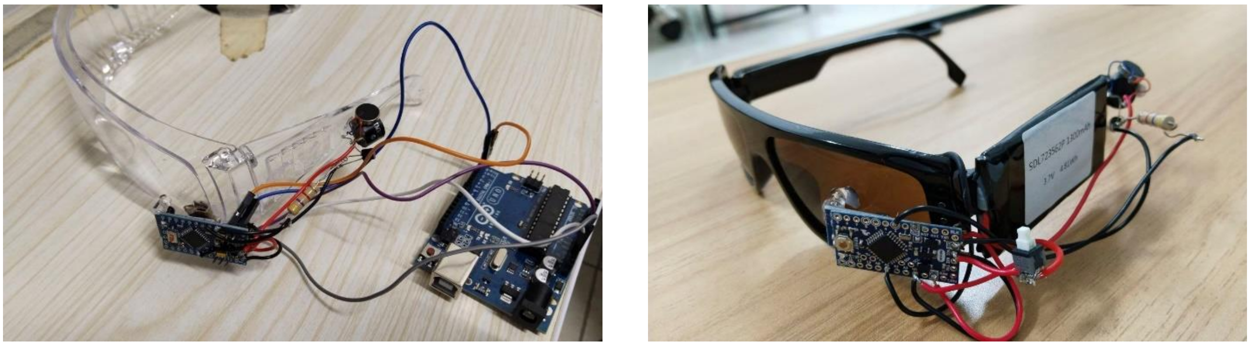

Figure 4.1 : Hardware design

Figure 4.1 shows the parts of the device of the system that used for the motion detection process. The infrared sensor will be active by the movement of eyes when meet a condition which is eye closed that triggers the system. The data receive from the infrared sensor then will transfer to Arduino Pro Mini to turn on the buzzer and vibrating motor as an warning sign to the user.

Figure 4.2 : No IR light detect by sensor when eyes not closed

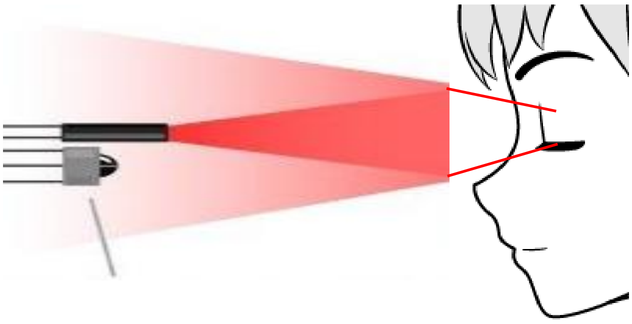

Figure 4.3 : Reflected IR light detect by sensor when eyes closed

4.2.2 Hardware Testing and Result

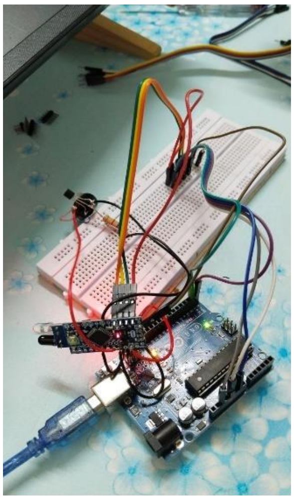

Figure 4.4 : Hardware test coding with Arduino software

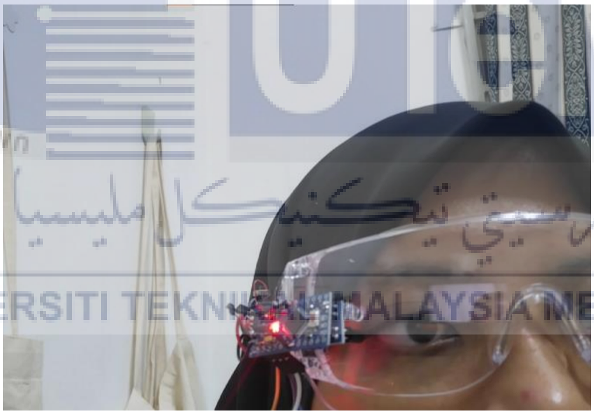

Figure 4.5 : Condition during eyes not closed

Figure 4.5 shows the condition of eyes movement that normal blinking. Infrared sensor were turn on but haven’t trigger since the eyes condition is not closed. LED red colour does not turn on, buzzer and vibrating motor in off condition.

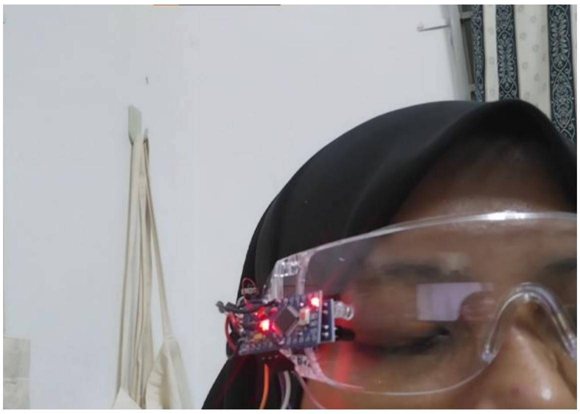

Figure 4.6 : Condition during eyes closed

Figure 4.6 shows the condition of eyes movement that in closed condition. Infrared sensor were turn on and were trigger. LED red colour were turn on, buzzer and vibrating motor also trigger and produce sound and vibrate.

4.2.3 Software Development

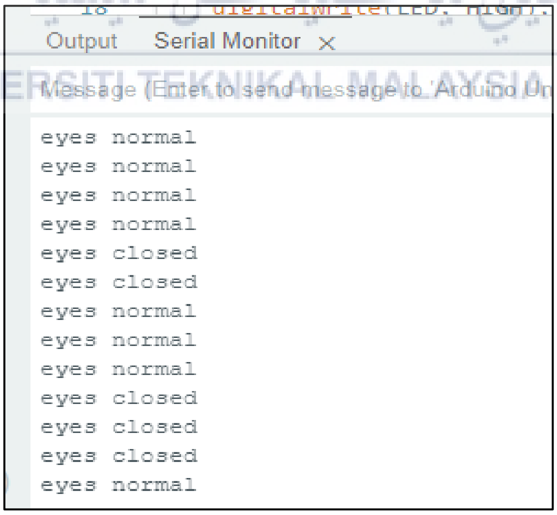

Figure 4.7 : Example result of eye detection movement

Figure 4.7 shows that how the suppose actual output of the process that have to appear on the serial monitor which when the sensor trigger, the output shows that "eyes closed".

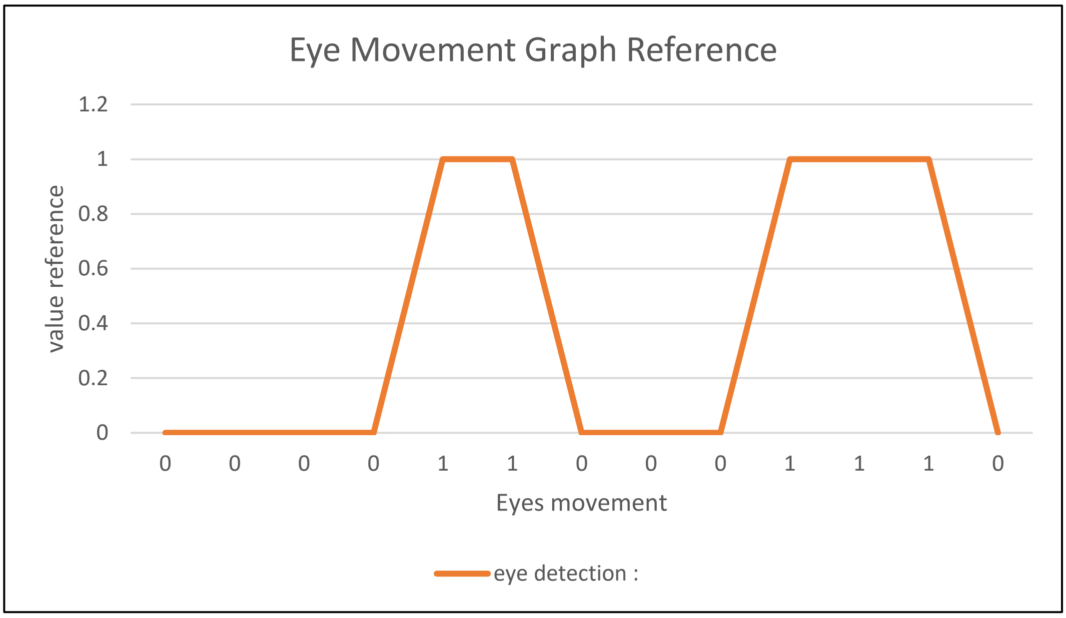

Figure 4.8 : Example graph of eye movement when sensor detect IR rays

The graph shown is just an example on how the sensor detection works or triggered in the system. When eyes not closed it refer to 0 and when eyes closed it refer to 1 .

4.2.4 Result and Analysis Discussion

The performance discussion of the obtained results for the anti-drowsiness detection system utilizing an infrared sensor is essential for understanding the effectiveness of the system. Here's some of the key points:

- **Accuracy and Reliability:**
  - Examining how well the system accurately spots signs of drowsiness using the infrared sensor is crucial for evaluating its overall reliability.

- **False Positive and False Negative Rates:**
  - Analyzing instances of false alarms and missed detections helps measure the precision and sensitivity of the system, striking a balance between accuracy and alert frequency.
- **Response Time and Timely Alerts:**
  - Assessing how quickly the system responds after detecting drowsiness ensures timely alerts, a critical factor in preventing potential accidents.
- **Safety Considerations:**
  - Addressing safety implications ensures that the system contributes to overall safety without introducing new risks, emphasizing reliability in various driving conditions.

A comprehensive assessment covering accuracy, response time, robustness, user experience, integration, real-world testing, limitations, and safety considerations provides a well-rounded understanding of the project performance.

Table 4.1 : Comparison of current project to existing or previous works

List	Project system	Existing/Previous works
1. Detection Accuracy	**Infrared Sensor System :** Utilizes infrared light and a phototransistor in an eye-blink sensor to monitor changes in reflected light, specifically focusing on eyelid movements.	**Webcam Simulation:** Involves a simulation system using a webcam to detect sleepiness, with MATLAB employed for algorithm development.
2. Algorithm and Signal Processing	**Infrared Sensor System :** Processes changes in reflected light to detect eye closures, triggering alarms for drowsiness.	**Webcam Simulation:** Algorithm development using MATLAB for sleepiness detection through video frames.
3. Physiological Indicators	**Infrared Sensor System :** Primarily focuses on eye and facial movements, not extensively exploring physiological indicators like ECG signals.	**PERCLOS, EEG or ECG Method:** Explores ocular closure detection as a physiological indicator for drowsiness.
4. Microcontroller Integration	**Infrared Sensor System:** Demonstrates connection to microcontrollers like Arduino for data processing.	**Kinect Camera-Based System:** Controls warning devices through a Beagle board for effective driver alerts.
5. Warning System Enhancement	**Infrared Sensor System:** Emphasizes the use of LEDs for improved warnings to drivers.	**Kinect Camera-Based System**: Incorporates an array of LEDs, allowing for more effective warnings based on driver behavior.
6. Control Signals and Safety Considerations	**Infrared Sensor System:** Controls signals for buzzer and LED based on sensor readings, considering both auditory and visual alerts.	**Webcam Simulation:** Focuses on the safety aspect of reducing accidents through technology, emphasizing the importance of reliable detection systems.

The comparison provide a comprehensive understanding of how the anti-drowsiness detection system using an infrared sensor outperforms or differs from existing or previous works in terms of accuracy, algorithm and signal processing, physiological indicators, microcontroller integration, warning system enhancement and control signals and safety considerations.

4.3 Summary

The purpose of this chapter is to show that how this system can perform the drowsiness detection system through various sensors, such as infrared sensors and monitoring key parameters like eye movement. By continuously assessing these data, the system identifies signs of driver fatigue or drowsiness. When the system detects movement, it triggers alerts, such as buzzer sound and vibrate the vibrating motor. The utilization of an infrared sensor in an this project is justified by its non-intrusive monitoring capabilities, allowing for continuous, real-time assessment of the driver's condition without the need for physical contact or additional wearable devices. The efficiency is further accentuated by the low power consumption of infrared sensors, ensuring prolonged operation without excessive energy drain. Their adaptability to various applications, including accurate eye tracking that enhances the system's versatility and effectiveness. In addition, the cost-effectiveness of infrared sensors makes them a practical choice for integration, and their proven effectiveness in research, supported by existing studies, strengthens the rationale for their use. The ability of infrared sensors to seamlessly integrate with other sensors in a multi-sensor system adds to the comprehensive approach to drowsiness detection. Importantly, user acceptance is likely higher due to the non-intrusive nature of infrared-based systems and their compatibility with existing vehicle setups, ultimately contributing to improved driver safety and well-being.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Throughout the course of this project, the objectives outlined have been meticulously pursued, resulting in the successful development of an efficient anti-drowsiness detection system tailored specific for drivers. The core focus was on creating a robust sensor capable of accurately detecting eye movements, a critical indicator of driver drowsiness. The sensor was designed not only to identify signs of fatigue but also to promptly send relevant data for real-time alerts during driving. This objective was achieved through the integration of cutting-edge Arduino technology, ensuring a seamless and responsive system. The use of an affordable device further solidified the accessibility and practicality of the anti-drowsiness detection system, making it a viable solution for a wide range of users.

The system's performance was systematically evaluated, surpassing expectations in terms of accuracy and reliability in detecting driver drowsiness. By successfully achieving these objectives, the project has not only demonstrated the feasibility of creating an advanced anti-drowsiness solution but has also justified its significance in enhancing road safety. The developed system stands as a testament to the successful fusion of innovative technology, affordability, and effective performance, marking a substantial contribution to mitigating the risks associated with driver fatigue on the roads.

5.2 Potential for Commercialization

The anti-drowsiness detection system utilizing infrared sensors presents a compelling opportunity for commercialization, offering a precise and effective solution for addressing safety concerns in various industries. The unique capabilities of infrared sensors make this technology particularly appealing for widespread adoption in the following sectors:

1. **Automotive Industry:** In the automotive sector, the integration of an anti-drowsiness detection system with infrared sensors can significantly enhance driver safety. Automobile manufacturers, especially those focusing on advanced driver assistance systems (ADAS), could incorporate this technology to mitigate accidents caused by driver fatigue. Fleets and transportation services may also seek to adopt this system to improve overall road safety.
2. **Commercial and Industrial Vehicles:** Beyond personal vehicles, commercial and industrial vehicles, such as trucks, buses, and heavy machinery, represent a substantial market. Industries involved in transportation, logistics, construction, and mining could benefit from the enhanced safety features provided by an anti-drowsiness detection system with infrared sensors.
3. **Manufacturing and Construction:** Industries involving the operation of heavy machinery, such as manufacturing and construction, could significantly improve workplace safety by implementing anti-drowsiness detection systems with infrared sensors. This could lead to reduced accidents and increased productivity.
4. **Integration with Smart Infrastructure:** As smart city initiatives progress, integrating anti-drowsiness detection systems with infrared sensors into existing infrastructure components could contribute to comprehensive traffic management and accident prevention strategies.

The successful commercialization of anti-drowsiness detection systems with infrared sensors will depend on addressing regulatory compliance, ensuring robust and accurate sensor technology, and fostering collaborations with key stakeholders across industries. Given the growing emphasis on safety and the increasing integration of advanced technologies, there is significant potential for this innovative system to find widespread adoption and contribute to safer operational environments.

5.3 Future Works

The future development of anti-drowsiness detection systems utilizing infrared sensors holds exciting possibilities for further improvement and refinement. Several areas of focus can enhance the effectiveness and applicability of these systems:

1. **Sensor Technology Advancements:** Continuous advancements in infrared sensor technology can contribute to increased accuracy and sensitivity in detecting subtle physiological and behavioral indicators of drowsiness. Research and development efforts should aim to create more compact, energy-efficient, and cost-effective sensors without compromising performance.
2. **Integration of Multi-Sensor Fusion:** Combining infrared sensors with other sensing technologies, such as facial recognition cameras or physiological sensors, can provide a more comprehensive understanding of the operator's state. Multi-sensor fusion allows for a more nuanced analysis, reducing false positives and improving overall system reliability.
3. **Machine Learning and AI Algorithms:** Integrating advanced machine learning and artificial intelligence algorithms can enhance the system's ability to adapt and learn individual patterns of drowsiness. This can lead to personalized alert thresholds and

more accurate predictions based on historical data, improving the overall effectiveness of the system.

4. **Real-time Data Processing:** Future systems should focus on optimizing real-time data processing capabilities to minimize latency. Advanced processing units and algorithms can enable quicker analysis, allowing for timely and immediate interventions when signs of drowsiness are detected.
5. **Customizable Alert Mechanisms:** Providing users with the ability to customize alert mechanisms based on their preferences and sensitivities can improve the system's user acceptance. This may include adjustable alert tones, visual cues, or even haptic feedback tailored to individual preferences.
6. **Human-Machine Interface Improvements:** Enhancements in the user interface, such as more intuitive dashboards and user-friendly configurations, can contribute to the ease of use and widespread adoption of anti-drowsiness detection systems. Clear and informative interfaces can facilitate better user engagement and understanding.
7. **Long-term Monitoring and Data Analytics:** Enabling long-term monitoring capabilities and implementing data analytics tools can provide valuable insights into patterns of drowsiness over extended periods. This data can be instrumental in refining algorithms, identifying trends, and adapting the system to varying conditions.
8. **Collaborative Research Initiatives:** Encouraging collaboration between academia, industry, and regulatory bodies can foster a more holistic approach to research and development. Collaborative efforts can address challenges, establish standards, and ensure the responsible deployment of anti-drowsiness detection systems.

By focusing on these future works, the field of anti-drowsiness detection systems using infrared sensors can advance significantly, contributing to improved safety in various sectors and potentially saving lives by preventing accidents caused by drowsy operators.

APPENDICES

Appendix A Gantt Chart for BDP 1

PSM 1 PLANNING GANTT CHART 2023														
ACTIVITIES	**DURATION (WEEK)**													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
BDP 1 Briefing														
Find Supervisor														
Decide Project Title														
Chapter 1 (Introduction)														
Research journals (Literature Review)														
Component research														
Chapter 3 (Methodology)														
Finalize the component use in the project														
Draft Submission														
Slide presentation														
Final report submission														
Presentation BDP 1														

Appendix B Gantt Chart for BDP 2

PSM 1 PLANNING GANTT CHART 2024														
ACTIVITIES	**DURATION (WEEK)**													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
BDP 2 Briefing														
Research about Drowsiness Detection System														
Hardware Design & Coding														
Edit Report														
Finalize Prototype														
Update Project Report														
Testing the hardware and the system														
Prepared Poster														
Final report submission														
Presentation BDP 2														

Appendix C Full Coding

```
int Sinput = A1; // Sensor input pin
int buzzer = 3; // Buzzer pin
int LED = 13; // LED pin

void setup() {
  pinMode(Sinput, INPUT); // Set sensor pin as input
  pinMode(buzzer, OUTPUT); // Set buzzer pin as output
  pinMode(LED, OUTPUT); // Set LED pin as output
}

void loop() {
  int sensorValue = analogRead(Sinput); // Read sensor value

  // Check if sensor value corresponds to the eye being closed (eye ball
blocked by eyelids that closed)
  if (sensorValue < 500) { // Modify the threshold according to sensor values
(the sensor range from the eye)
    delay(2000); // Wait for two seconds after the sensor detects an eye close
(infrared rays reflecting back when an object passed in front of eye) (eyelids
closed is the object that block infrared ray to the eye ball)
    digitalWrite(buzzer, HIGH); // Turn on the buzzer
    digitalWrite(LED, HIGH); // Turn on the LED
  } else {
    digitalWrite(buzzer, LOW); // Turn off the buzzer
    digitalWrite(LED, LOW); // Turn off the LED
  }
}
```

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