SMART MICROSLEEP DETECTOR.

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JABATAN KEJURUTERAAN ELEKTRIK

NOVEMBER 2024

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This report submitted to the Electrical Engineering Department in fulfillment of the requirement for a Diploma in Electrical Engineering

JABATAN KEJURUTERAAN ELEKTRIK

NOVEMBER 2024

CONFIRMATION OF THE PROJECT

The project report titled " Smart Microsleep Detector. " Has been submitted, reviewed, and verified as a fulfills the conditions and requirements of the Project Writing as stipulated

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“I acknowledge this work is my own work except the excerpts I have already explained to our source”

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TITLE: SMART MICROSLEEP DETECTOR.

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As a project supervisor, on the date:	) **Mrs. Wee Soo Lee**

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I would like to express my sincere gratitude to Mrs. Wee Soo Lee for their invaluable guidance, constant encouragement, and insightful feedback throughout the project. Their expertise and patience were instrumental in shaping the direction of this research. I am also indebted to Electrical Electronic Engineering Department and Politeknik Premier Sultan Salahuddin Abdul Aziz Shah for providing the necessary resources, facilities, and a stimulating academic environment. My family and friends have been a constant source of support, offering encouragement and understanding during both the highs and lows of this journey.

Furthermore, I would like to acknowledge the numerous researchers and authors whose groundbreaking work has inspired and informed this project. Their contributions to the advancement of knowledge have laid the foundation for this research. Their insights and innovative approaches have significantly influenced the development of this project.

ABSTRACT

In modern times, it has become because of busy schedules it is very difficult to stay active all the time. Imagine a situation where someone is driving home from work, tired after going through all the challenges today. The hands on the wheel and feet on the pedals but suddenly started to feel sleepy, eyes started to close and the vision becomes blurred and before it is known, then the person falling asleep Falling asleep at the wheel can cause serious consequences, there may be accidents and people may even lose their lives. This situation is much more common and therefore, it is very important to overcome this problem. So to address this issue, the Anti-Sleep Project Alarms for Drivers are introduced. The system warns about Someone fell asleep at the wheel with that, dodge accidents and save lives. This system is useful especially for people who travel long distances and people who drive late at night. The circuit is built using Arduino Nano, switch, Piezo buzzer, Micro Vibration Motor and Sensor blink. Anytime the driver feels sleepy and the sleep sensor detects the blink of an eye by how long it takes for the eye to blink again and the buzzer is turned on with an intermediate sound beep. When the driver returns to normal the flashing sensor senses that and the buzzer sounds.

ABSTRAK

Pada zaman moden, ia telah menjadi kerana jadual yang padat sangat sukar untuk kekal aktif sepanjang masa. Bayangkan a situasi di mana seseorang memandu pulangdari kerja, penat setelah menempuh segala cabaran hari ini. Tangan pada roda dan kaki pada pedal tetapi tiba-tiba mula rasa mengantuk, mata mula terpejam dan penglihatan menjadi kabur dan sebelum diketahui, barulah orang itu tertidur Tertidur di atas roda boleh menyebabkan akibat yang serius, mungkin ada kemalangan dan orang bahkan mungkin kehilangan nyawa mereka. Keadaan ini lebih banyak lagi biasa dan oleh itu, adalah sangat penting untuk mengatasi ini masalah. Jadi untuk menangani isu ini, Projek Anti-Tidur Penggera untuk Pemandu diperkenalkan. Sistem memberi amaran tentang Seseorang tertidur di roda dengan itu, mengelak kemalangan dan menyelamatkan nyawa. Sistem ini berguna terutama bagi orang yang melakukan perjalanan jauh dan orang yang memandu lewat malam. Litar dibina menggunakan Arduino Nano, suis, buzzer Piezo, Mikro Motor Getaran dan Penderia berkelip. bila-bila masa Pemandu berasa mengantuk dan sensor tidur mengesan sekelip mata mengikut tempoh masa yang diperlukan untuk mata berkelip semula dan buzzer dihidupkan dengan bunyi perantaraan bip. Apabila pemandu kembali normal penderia berkelip merasakan itu dan buzzer berbunyi.

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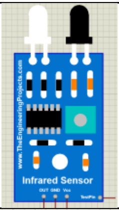
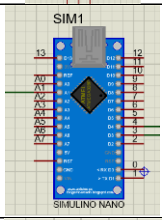
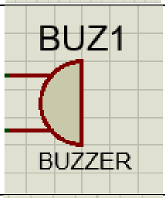
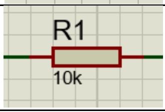
LIST OF SYMBOLS

SYMBOL	DEFINITION
	Ir Sensor
	Arduino Nano
	Buzzer
	Resistor

LIST OF ABBREVIATIONS

ABREVIATION	DEFINITION
IDE	Integrated Development Enviroment
USB	Universal Serial Bus
COPD	Chronic Obstructive Pulmonary Disease
VOUT	Voltage Out
V	Voltage
mA	miliAmpere

CHAPTER 1
INTRODUCTION

1.1 Introduction

Drowsy driving is a silent killer, claiming countless lives each year. To combat this pervasive issue, we introduce our smart microsleep detector, a proactive solution designed to safeguard drivers from the dangers of fatigue. By leveraging advanced computer vision algorithms, our system meticulously analyzes facial features, particularly eye movements and head posture, to accurately identify early signs of drowsiness. When the system detects a decline in alertness, it promptly triggers audible and visual alerts, urging drivers to take immediate action, such as pulling over to rest or engaging in stimulating activities. The system's robustness is further enhanced by its ability to adapt to varying lighting conditions and the presence of eyewear, ensuring reliable performance in diverse driving scenarios. By empowering drivers with real-time monitoring of their alertness levels, our smart microsleep detector aims to significantly reduce the occurrence of drowsy driving accidents and promote safer roads for all.

1.2 Background Research

Drowsy driving is a significant public safety concern, leading to numerous accidents and fatalities each year. Microsleeps, brief involuntary sleep episodes, are a primary cause of such accidents. To address this issue, researchers and engineers have developed smart microsleep detection systems. These systems utilize advanced technologies to monitor driver behavior and alert them to signs of drowsiness, potentially preventing accidents.

1.3 Problem Statement

- High rate of traffic accidents due to sleepiness
- Particularly for those with sleep problems or who are exhausted from work or stress
- Economy Impac (lost a lot of money after accident)

1.4 Research Objectives

The primary objective of this research is to develop a robust and accurate smart microsleep detection system. To achieve this goal, the following specific objectives will be pursued:

1. To accurately detect eye closure and blinking patterns, a real-time eye tracking system will be implemented using computer vision techniques.
2. To analyze the collected eye data and identify microsleep events, advanced machine learning algorithms will be employed.
3. To promptly alert the driver of impending microsleep, a suitable alert system will be designed, incorporating auditory and visual cues.

1.5 Scope of Research

The scope of this research focuses on developing a smart microsleep detection system that leverages computer vision techniques to accurately identify microsleep events in real-time based on eye movement patterns. The system will involve real-time eye tracking, feature extraction from eye movement data, machine learning model development for classification, and the design of an effective alert system. While the primary focus is on eye-based detection, the research will also explore the limitations and potential improvements, such as considering other physiological parameters and addressing environmental factors.

1.6 Project Significance

Microsleep, brief involuntary sleep episodes, poses a significant threat to road safety. Traditional methods of driver fatigue detection, such as behavioral observation or physiological monitoring, often lack real-time accuracy and can be intrusive. This research aims to address these limitations by developing a non-invasive, real-time microsleep detection system based on computer vision and machine learning techniques.

A successful implementation of this system has the potential to significantly reduce accidents caused by driver fatigue. By providing timely alerts to drivers, the system can promote safer driving practices and mitigate the risks associated with microsleep. Furthermore, this research contributes to the advancement of intelligent transportation systems and human-computer interaction, paving the way for future innovations in driver assistance technologies.

1.7 Chapter Summary

The project aimed to develop a smart microsleep detector to mitigate the risks associated with driver fatigue. The device utilizes an Arduino Nano, IR sensor, piezo buzzer, and micro vibration sensor to detect signs of microsleep, such as prolonged eye closure and reduced head movement. The system processes sensor data and triggers an alert when microsleep is detected. Through rigorous testing and evaluation, the device demonstrated promising results in accurately identifying microsleep events. Future improvements may involve enhancing sensor accuracy, exploring wireless connectivity, and developing user-friendly interfaces.

CHAPTER 2
LITERATURE REVIEW

2.1 Advancements in Early Detection Systems for Machine Damage:

This prompt is not directly related to machine damage detection systems. It focuses on developing a smart microsleep detection system using computer vision and machine learning techniques to improve road safety by detecting microsleep events and alerting drivers. While both fields involve the use of technology to detect potential issues, the specific applications and methodologies are distinct.

2.2 Previous Research

Previous research on microsleep detection has explored various techniques, including physiological signal analysis and computer vision-based methods. While traditional methods often require invasive sensors and specialized equipment, computer vision approaches offer a non-invasive solution by analyzing eye movements, head pose, and facial expressions. Recent advancements in machine learning, particularly deep learning, have further improved the accuracy and robustness of these systems. However, challenges such as varying lighting conditions, head movements, and occlusions still need to be addressed to develop practical and reliable microsleep detection systems for real-world applications.

Table 2.1: LIST COMPONENT FOR SMART MICROSLEEP DETECTOR.

Components	**Description**
Arduino Nano	The Arduino Nano can be used as a standalone development machine or as a primary development platform
Ir Sensor	Detect and emit infrared (IR) radiation to sense objects in their surroundings
Piezo Buzzer	Produces a sound, alarm, or tone. It works by using a piezoelectric material that deforms when an alternating voltage is applied across it, causing the material to vibrate rapidly and produce sound.
Micro Vibration Motor	Detects vibrations and slight movements, and converts them into electrical signals

Table 2.2: Literature Review

NO	TITLE/AUTHOR	OBJECTIVE	METHOD	RESULT
1	DETECTOR OF MICROSLEEP FOR CAR DRIVER USING EYE DETECTOR	The objectives of this research at the cellular level, the evidence that certain types cf neuron have intrinsic oscillatory properties that may underlie rhythmic EEG activities. Another that, at the neural network level, new findings have clarified the dynamics of the main circuits responsible for the occurrence and modulation of rhythmic behaviour in neural populations. Lastly at the theoretical level, the demonstration that neuronal networks may behave as complex dynamic systems with the properties of deterministic chaos has challenged the classic ideas about how EEG signals should be interpreted and analysed.	It may be concluded that experimental evidence is accumulating that justifies the statement that EEG signals can reflect the functional states of neuronal networks	Can be used
2	Real Time Implementation for Monitoring Drowsiness Condition of a Train Driver using Brain Wave Sensor	The objective of a real-time drowsiness detection system for train drivers using brainwave sensors is to enhance train safety by preventing accidents caused by driver fatigue. This system would monitor the brainwave activity of the driver and analyze it to	he system utilizes a brain-computer interface (BCI) sensor worn by the driver. This sensor picks up brainwave activity emitted by neurons. A microcontroller analyzes these brainwaves, categorizing them based on their frequency range.	The output describes about the frequencies of the brain. If the poor quality of the brain shows zero that means attention is high and vice versa. But if the attention is low, poor quality is high. The poor quality is one of the variable that is been assigned to track the quality of the signal,

		determine their alertness level. By identifying the onset of drowsiness through specific brainwave patterns, the system would trigger real-time warnings, such as alarms or alerts sent to a designated individual, to intervene and potentially prevent an accident.	Brainwaves are generally classified into Delta, Theta, Alpha, and Beta waves, each associated with different levels of alertness. By identifying a dominance of Delta and Theta waves, which are linked to drowsiness, the microcontroller can determine the driver's state. This information is then transmitted wirelessly, perhaps via Bluetooth, to a processing unit. This unit can trigger alarms within the train cabin or send alerts to a monitoring station if a critical drowsiness level is detected. This realtime monitoring can help prevent accidents caused by fatigued drivers.	if it is low that means the range of the signal is able to track the condition of the driver in a proper manner. Similarly, as soon as it gets high the attention mode becomes zero, and then the alarming condition arises.

3	Smart mattress integrated with pressure sensor and IoT functions for sleep apnea detection in paragraph	Obstructive Sleep Apnea (OSA) is the main reason for sleep-associated respiration disorders, wherein respiration stops and begins evolved again and again at some pointing sleep. Sleep-disordered respiration can affect our common health protection and quality of life. This look targets at detecting sleep posture and sleepdisordered respiration through measuring the sensory reaction of a	A smart mattress with pressure sensors can track sleep movements and transmit data (via IoT) to an app. This data can be analyzed for sleep apnea indicators, prompting users to seek professional diagnosis	e results are compared with different comparable sleep posture identification systems, and the usage of pressure sensors, and the primary advantages of proposing the lowprice bedsheet and thin thickness. The proposed system makes use of conductive threads and the pressuresensitive conductive sheet. The components and requirements used in the prposed work is displayed in Table 1.

		pressure sensor and respiration microphone sensor set up with mattresses, pillowcases, and positional sleep apnea. Three positions use of pressure sensors were used to analyze. The respiration microphone sensor is used for the duration of sleep and to measure breathing levels. In this work, we have got an advanced sleep monitoring system based on an inattentive method. Internet of Things (IoT) is used to transmit information saved in sensors and displayed in internet applications. Helps us without problems displaying gold coins and gold time periods.		The organizational device that guides another feature of the system is real-time processing. Compared with different comparable systems, the data collection module in our system gives real-time data conversation among sensors and machines to gain knowledge of system.

4	Early Detection of Microsleep in Motorcycle Helmet Based on Pulse Sensor	Microsleep can be defined as a brief condition in which someone unintentionally falls asleep for a few seconds to several minutes. This condition can occur in anyone and poses a high potential risk, especially when engaged in activities that require high concentration, such as driving. To detect and address the potential dangers of microsleep while driving, this research has designed a smart helmet capable of	In this system, there are several components, including a battery, a pulse sensor, an Arduino Nano, a vibrator, a DFPlayer Mini, and a mini speaker. In this system, the battery serves as the voltage source. The pulse sensor is used to read the bpm, which is then processed by the Arduino. After processing the data from the pulse sensor, the Arduino triggers	The testing of the pulse sensor was conducted to determine whether the heartbeat sensor is functioning correctly. Figure 5 shows the readings from the pulse sensor connected to analog pin 0 of the Arduino. The test results indicate that the sensor is working well, as evident from the matching shape of the generated signal. From the signal waveform of the pulse sensor, we can obtain the BPM value by establishing

		early detection of signs of microsleep and taking actions to awaken the rider. This system uses a pulse sensor connected to an Arduino and placed on the backside of the helmet.Detection of beats per minute (bpm) is crucial to determine whether the rider is drowsy or not. This is essential for providing early warnings to the rider. If the rider's bpm reading is 60. Testing was conducted on 5 test subjects, with each subject undergoing 5 trial tests, resulting in a total of 25 test runs. The results indicate that the designed system is capable of reading microsleep conditions and activating the vibrator and music according to the configured settings.	the vibrator and the DFPlayer Mini to produce outputs. The vibrator vibrates in accordance with the readings from the pulse sensor, as specified. Additionally, the DFPlayer Mini generates an audio signal that is played through the mini speaker, producing sound as specified	a threshold point on the signal. When the ADC signal exceeds the specified threshold value, it counts as one beat or one pulse. The determination of the threshold value is based on the sensor's output signal as displayed on the signal plotter when the sensor detects a pulse, as well as the results of comparison testing with BPM values obtained using a digital OMRON blood pressure monitor. During testing, if the number of BPM on the device is lower than the number of BPM on the OMRON, the adjustment made is to reduce the threshold value

2.3 Control System

The control system for the smart microsleep detection system will oversee real-time eye tracking, data processing, feature extraction, and machine learning model deployment. It will trigger alerts based on defined thresholds and user preferences. The system will also include calibration and adaptation mechanisms to improve accuracy and user experience. By effectively managing these components, the system aims to enhance road safety by detecting and mitigating microsleep events

2.4 Microcontroller

For your project using Arduino Nano, IR sensor, piezo buzzer, and micro vibration sensor, the Arduino Nano itself is a suitable microcontroller. It can read sensor data, process information, and control the buzzer. Its simplicity, affordability, and wide community support make it a good choice for this project.

2.5 Programmable Logic Control (PLC)

Programmable Logic Controllers (PLCs) are industrial computers designed to control manufacturing processes. They are highly reliable, easy to program, and capable of process fault diagnosis. PLCs receive input signals from sensors, process the data according to a programmed logic, and send output signals to control devices like motors, valves, or lights. They are commonly used in automation systems for their flexibility and robustness.

2.6 Arduino

Arduino platforms are essential for developing an early detection system due to their flexibility, affordability, and ease of use. They interface with sensors, process data, and communicate with other components, enabling code customization and efficient implementation of algorithms for sensor data processing and anomaly detection.

CHAPTER 3
RESEARCH METHODOLOGY

3.1 Project Design and Overview.

The smart microsleep detection system is designed to enhance road safety by proactively identifying and mitigating the risks associated with microsleep, a brief involuntary sleep episode that can significantly impair driving performance. The system employs a camera module to capture real-time video feed of the driver's face. Advanced computer vision algorithms are then applied to detect and track the driver's eyes, analyzing key features such as eye closure duration, blink rate, and pupil dilation. By leveraging machine learning techniques, the system can accurately classify eye states as open or closed. When a prolonged period of eye closure is detected, indicating a potential microsleep event, the system triggers an audible alert through a piezo buzzer, prompting the driver to take immediate countermeasures. The system's effectiveness relies on the seamless integration of hardware components, including the Arduino Nano, and sophisticated software algorithms for image processing and machine learning. By combining these elements, the system aims to reduce the incidence of accidents caused by driver fatigue and contribute to safer roadways.

3.2 Block Diagram of the Project

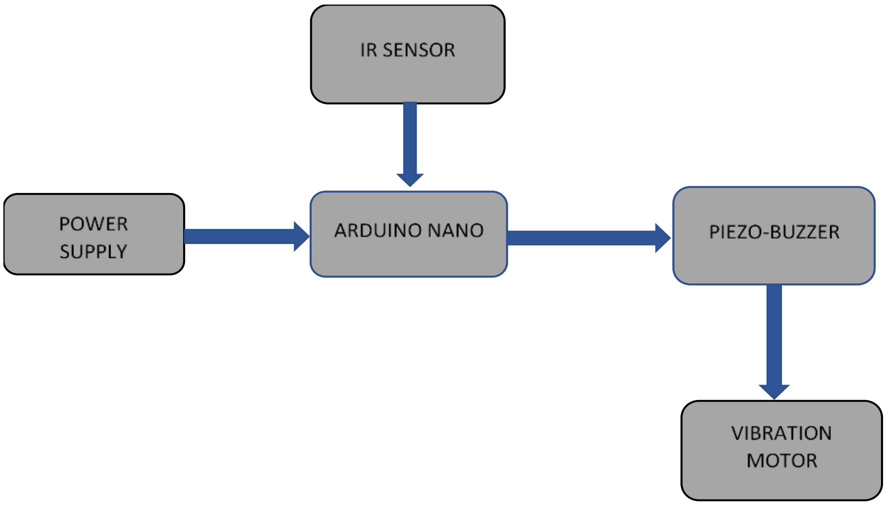


Figure 3.1: Block diagram of the project

3.3 Flowchart of the Project 2

FLOWCHART

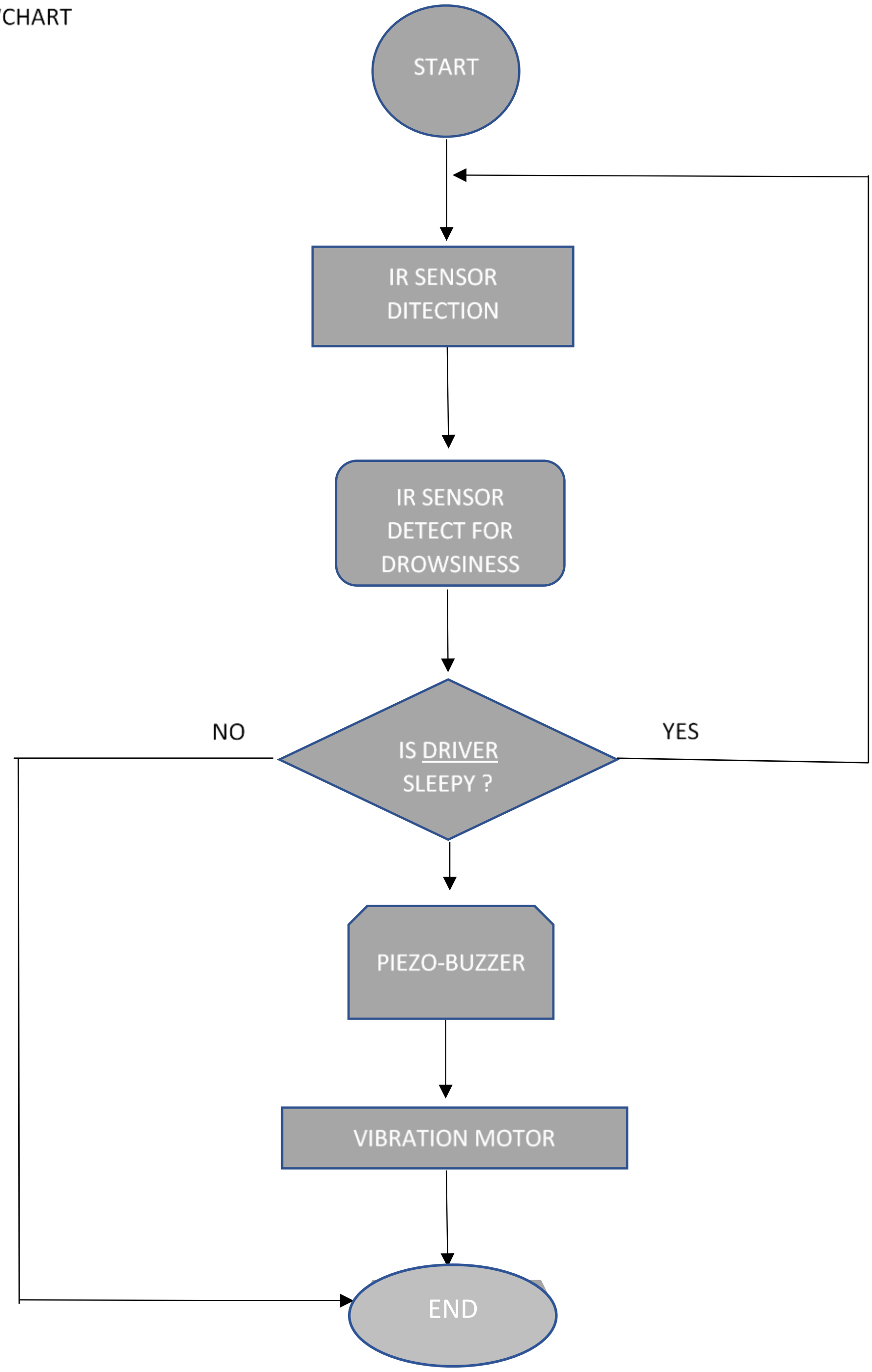


Figure 3.2: Flowchart of the project

3.4 Project Description

This project aims to develop a smart microsleep detection system that can accurately identify and alert drivers to instances of microsleep, a brief involuntary sleep episode that significantly impairs driving ability. The system utilizes computer vision techniques to analyze real-time video footage of the driver's face, focusing on eye movements and other relevant facial cues.

By employing machine learning algorithms, the system can effectively distinguish between normal eye states and those indicative of microsleep. When a potential microsleep event is detected, the system triggers an audible alert to rouse the driver and prevent accidents. This innovative solution leverages the power of technology to enhance road safety and reduce the risks associated with driver fatigue

3.5 Project Hardware

a) Arduino Nano:

The Arduino Nano can be used as a standalone development machine or as a primary development platform

b) IR Sensor:

Detect and emit infrared (IR) radiation to sense objects in their surroundings

c) Piezo Buzzer:

Produces a sound, alarm, or tone. It works by using a piezoelectric material that deforms when an alternating voltage is applied across it, causing the material to vibrate rapidly and produce sound

d) Micro Vibration Motor:

Detects vibrations and slight movements, and converts them into electrical signals

3.6 Gantt Chart

Figure 3.3: Gantt Chart of the project

3.7 Milestone

Phase 1: System Setup and Initial Testing

- Task 1: Hardware Setup: Assemble the Arduino Nano, IR sensor, piezo buzzer, and micro vibration sensor on a breadboard or a dedicated circuit board.
- Task 2: Software Setup: Install the Arduino IDE and any necessary libraries.
- Task 3: Sensor Calibration: Calibrate the IR sensor and micro vibration sensor to establish baseline readings and sensitivity thresholds.
- Task 4: Basic Sensor Testing: Write code to read data from the sensors and display the values on the Arduino IDE's serial monitor.
- Task 5: Buzzer Testing: Write code to control the piezo buzzer to generate different sound patterns.

Phase 2: Algorithm Development and Implementation

- Task 6: Eyelid Detection Algorithm: Develop an algorithm to detect eye closure using the IR sensor data.
- Task 7: Micro Sleep Event Detection: Implement a logic to identify prolonged eye closure, which indicates a potential microsleep event.
- Task 8: Alert System: Design an alert system using the piezo buzzer to notify the driver of an impending microsleep event.
- Task 9: Code Optimization: Optimize the code for efficiency and minimize processing time.

Phase 3: System Integration and Testing

- Task 10: System Integration: Combine the hardware and software components to create a functional microsleep detection system.
- Task 11: System Testing: Test the system under various conditions, including different lighting environments and user scenarios.
- Task 12: Calibration and Fine-Tuning: Calibrate the system to optimize its performance for different individuals and environments.
- Task 13: User Testing: Conduct user tests to evaluate the system's effectiveness and user experience.

Phase 4: Documentation and Presentation

- Task 14: Documentation: Prepare a detailed project report, including a project overview, system design, implementation details, results, and future work.
- Task 15: Presentation: Create a presentation to showcase the project to a wider audience.

3.8 Schematic Circuit

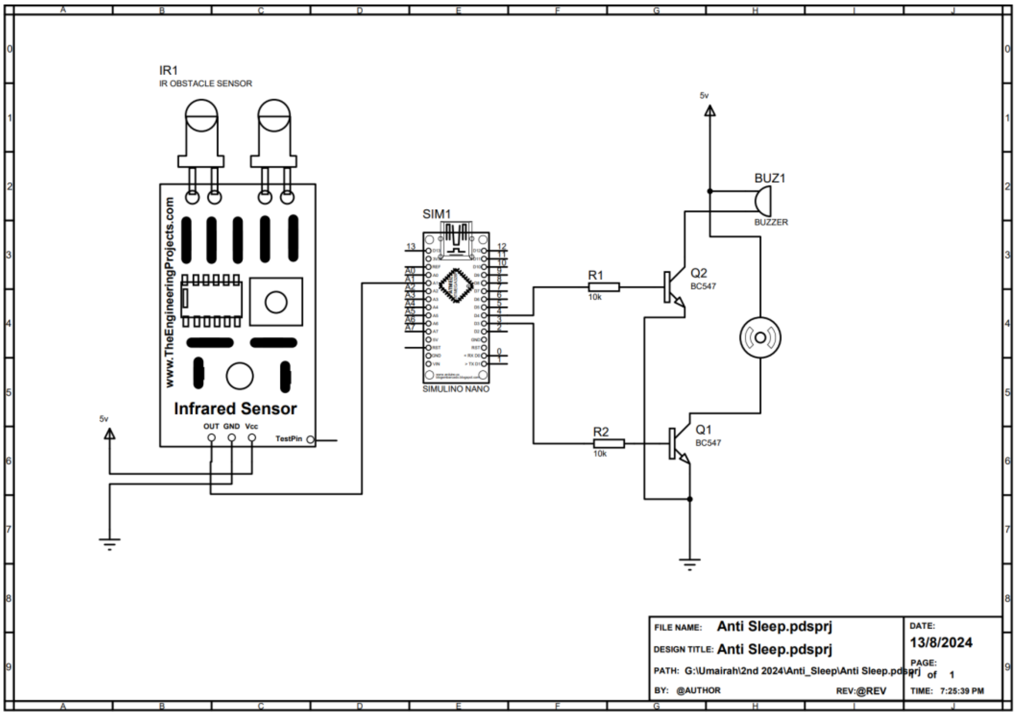


Figure 3.4: Circuit Diagram

3.9 **Description of Main Component**

1) Arduino Nano

Arduino: The Arduino Nano is a device that can be used for a variety of purposes, including:

Prototyping:

The Arduino Nano can be used as a standalone development machine or as a primary development platform.

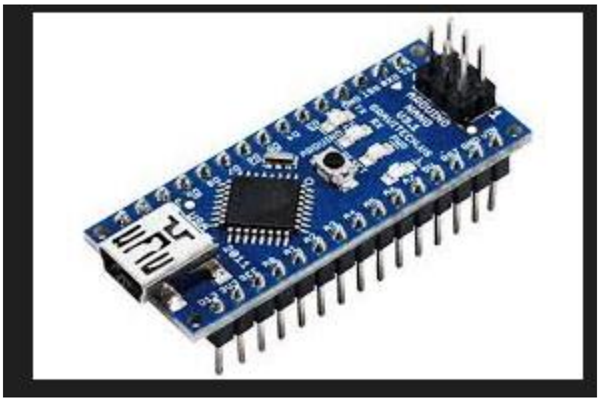


Figure 3.5: Arduino Nano

2) IR Sensor

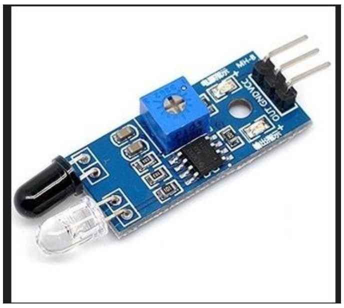


Figure 3.6: IR Sensor

Function: Detects infrared light, often used to sense objects or measure distance.

Applications in Microsleep Detection:

- Eyelid Detection: Detects eye closure by sensing the infrared light reflected from the eyelid.

- Object Proximity: Detects the presence of objects near the sensor, which can be used to trigger alerts or adjust system settings.

3) Piezo Buzzer

Figure 3.7: Piezo Buzzer

Function: Produces sound when an electric current is applied to it.

Applications in Microsleep Detection:

- Alert Generation: Emits a loud sound to alert the driver of an impending microsleep event.

4) Micro Vibration Motor

Figure 3.8: Micro Vibration Motor

Function: Generates vibrations when activated.

Applications in Microsleep Detection:

- Tactile Feedback: Provides a subtle vibration to alert the driver, especially in noisy environments or for individuals with hearing impairments.

By combining these components with the Arduino Nano, you can create a comprehensive microsleep detection system that can accurately monitor the driver's state and provide timely alerts.

3.10 Circuit Operation

a) Data Acquisition:

The IR Sensor and Micro-Vibration Sensor are connected to the Arduino Nano. The IR Sensor detects the presence of the user and monitors their facial/head position, while the Micro-Vibration Sensor detects slight head movements or vibrations indicative of microsleep (e.g., head nodding).

- IR Sensor: Detects whether the user is facing the sensor, helping to identify if the person is looking forward or possibly falling asleep.
- Micro-Vibration Sensor: Detects small vibrations (such as head tilting), which can indicate that the person is nodding off or has fallen asleep.

b) Arduino Processing:

The Arduino Nano reads data from the IR Sensor (digital input) and the Micro-Vibration Sensor (digital input). The program samples the sensor data at regular intervals.

- IR Sensor: The Arduino checks if the IR sensor detects the user's presence. If no presence is detected or if the user's head is still for an extended period, it indicates potential sleep onset.

- Micro-Vibration Sensor: The Arduino also checks the output from the vibration sensor. If no vibrations are detected over a certain period, it may indicate that the person is not moving or has fallen asleep.

c) Data Processing:

The Arduino Nano processes the sensor data to detect signs of microsleep. Specifically, it compares the activity from both sensors to predefined thresholds that suggest the user may be falling asleep.

- If the IR Sensor has not detected the user's movement or presence for a defined time (e.g., 10 seconds), it indicates that the user might be falling asleep.
- If the Micro-Vibration Sensor has not detected any vibrations for a similar period, this further supports the possibility of microsleep.

The Arduino continuously checks both sensors to ensure timely detection and processing of data. When both conditions (lack of movement and lack of vibrations) are met, it indicates microsleep and the system triggers an alert.

d) Alert Generation:

Once the Arduino Nano detects microsleep, it activates the Piezo Buzzer to alert the user. The alert can be a simple beep or a pattern of sounds, depending on the program design.

- Piezo Buzzer: The Arduino sends a signal to the piezo buzzer to produce an audible alert if the microsleep condition is met. This is designed to wake the user and prevent any further drowsiness-related issues.

e) Central Monitoring System (Optional for Enhanced Functionality):

If desired, the system can be extended with wireless communication to a central monitoring system for logging and remote monitoring purposes.

- Wireless Communication (optional): If you integrate a wireless communication module (such as an NRF24L01 or Wi-Fi module like the ESP8266), the Arduino can transmit sensor data and alert signals wirelessly to a central monitoring system or smartphone app. This setup would allow the user or a caretaker to receive alerts when microsleep is detected and monitor the user’s sleep patterns.

- Central Monitoring System (Optional): The central system could receive the data and log it for further analysis. For example, a smartphone app could alert a caretaker if the system detects frequent microsleep events. This could be helpful for monitoring individuals who are at risk of falling asleep while performing critical tasks (e.g., driving).

3.11 Project Software

a) Integrated Development Environment (IDE):

- Arduino IDE: This is the primary software you will be using for programming the Arduino Nano in your smart microsleep detection system. It provides a user-friendly interface for writing, compiling, and uploading code to the Arduino board.

b) Libraries (Optional):

- IR sensor libraries: Depending on the specific IR sensor model you are using, you may need to install a library that provides functions for interacting with the sensor. These libraries are often readily available online or can be downloaded from the sensor manufacturer's website.
- Machine Learning libraries for eye detection (Optional): While not essential for a basic microsleep detection system, you could explore libraries like OpenCV or TensorFlow Lite for more advanced functionalities. These libraries offer image processing and machine learning capabilities that might be useful for eye detection and tracking in future iterations of your project.

c) Data Visualization Software (Optional):

- Processing: As mentioned earlier, Processing can be a valuable tool for creating visual representations of data collected from the sensors. This can be helpful for debugging your code and analyzing sensor readings.

3.12 Coding

Anti_Sleep.ino

```
const int analogPin = A1;  // Pin where the infrared sensor is connected
const float VREF = 5.0;    // Reference voltage (usually 5V for Arduino)
const int ADC_RESOLUTION = 1023; // 10-bit ADC resolution
int BZ =3;
int vib=4;

void setup() {
  Serial.begin(9600); // Initialize serial communication
  pinMode(BZ ,OUTPUT);
  pinMode(vib ,OUTPUT);
}

void loop() {
  int analogValue = analogRead(analogPin); // Read the analog value (0-1023)

  // Convert the analog value to voltage
  float sensor = (analogValue * VREF) / ADC_RESOLUTION;


  Serial.print("Analog Value: ");
  Serial.print(analogValue);
  Serial.print("  value: ");
  Serial.println(sensor);
  //delay(100);

  if ((sensor)> 2.3){

  delay(2000);
  digitalWrite(BZ,HIGH);
  digitalWrite(vib,HIGH);

  }


  else {

   digitalWrite(BZ,LOW);
   digitalWrite(vib,LOW);
}
}

```

Figure 3.9: Coding

3.13 Flowchart of the system

FLOWCHART

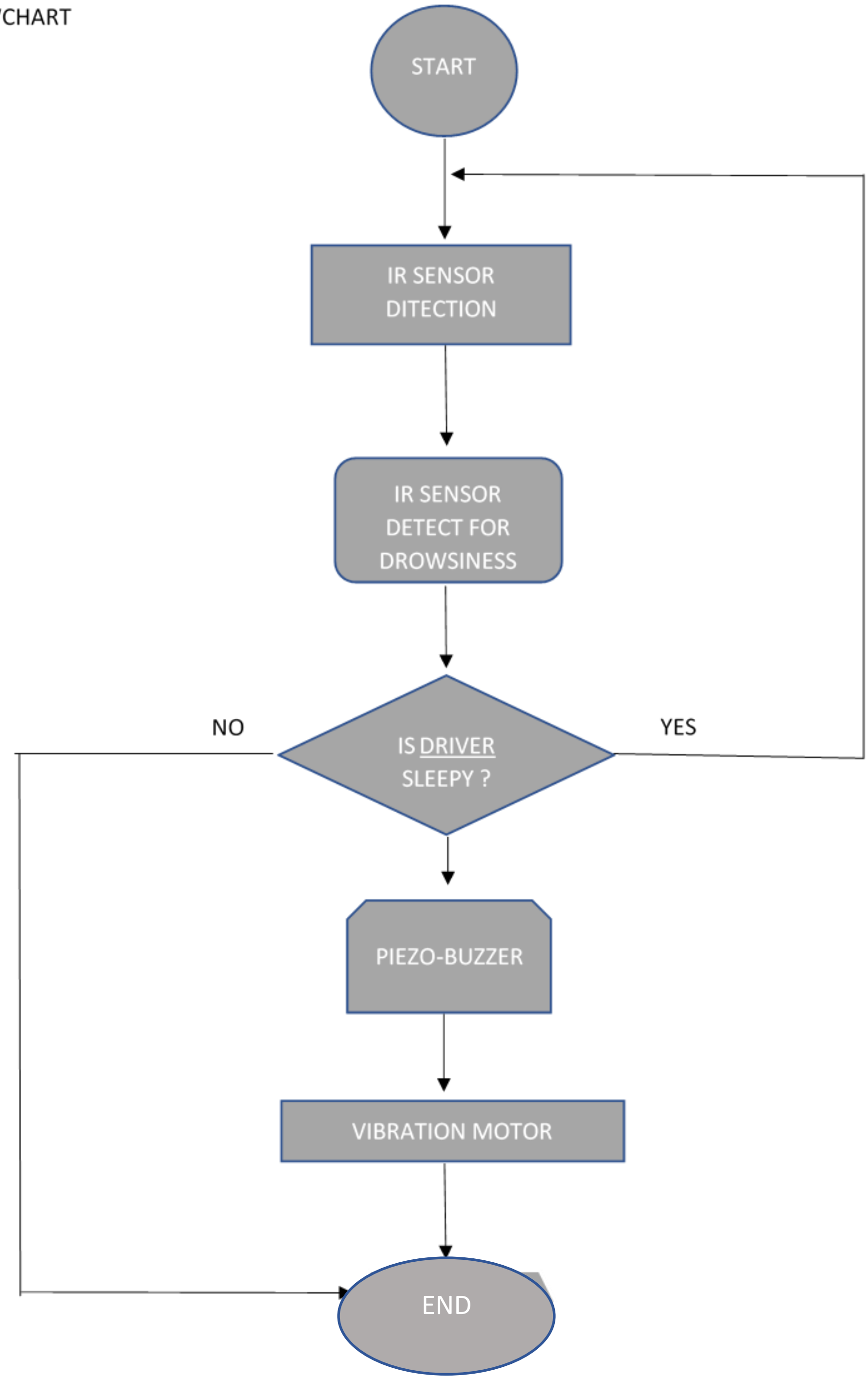


Figure 3.10: Flowchart

3.14 Description of flowchart

a) Start: The system initiates.
b) IR Sensor Detection: The system begins monitoring the driver's eye movements using the IR sensor.
c) IR Sensor Detects Drowsiness: The IR sensor continuously checks for signs of drowsiness, such as prolonged eye closure or decreased eye activity.
d) Is Driver Sleepy? The system evaluates the data from the IR sensor to determine if the driver is exhibiting signs of drowsiness.
e) No: If the driver is not drowsy, the system continues monitoring.
f) Yes: If the driver is detected as drowsy, the system proceeds to the alert phase.
g) Piezo-Buzzer: The system activates the piezo-buzzer to generate an audible alarm, alerting the driver to their drowsy state.
h) Vibration Motor: Additionally, the vibration motor is activated to provide tactile feedback, further alerting the driver.
i) End: The system continues to monitor the driver's state, repeating the cycle of detection and alert generation as needed.

3.15 Prototype Development

1) Mechanical Design

Figure 3.11: Design project

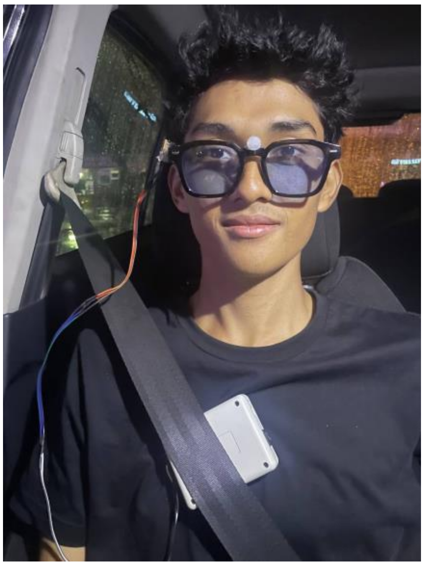


Figure 3.12: View of the project from the front

2) Sustainability Element in The Design Concept

Figure 3.13: Layout design of Microsleep Detector

The image shows the inside of a device that appears to be a portable electronics project. It features an Arduino Nano board, which likely serves as the brain of the project. Connected to the Arduino are various components, including a microphone, possibly for voice recognition or audio input, and a battery, suggesting the device is portable and self-powered. The presence of wires and connectors indicates that the device may have additional features or sensors not visible in the image. Overall, the setup suggests a project that utilizes the Arduino's capabilities for real-time processing, data acquisition, and control of external devices.

CHAPTER 4
RESULT AND DISCUSSION

4.1 Result and Analysis

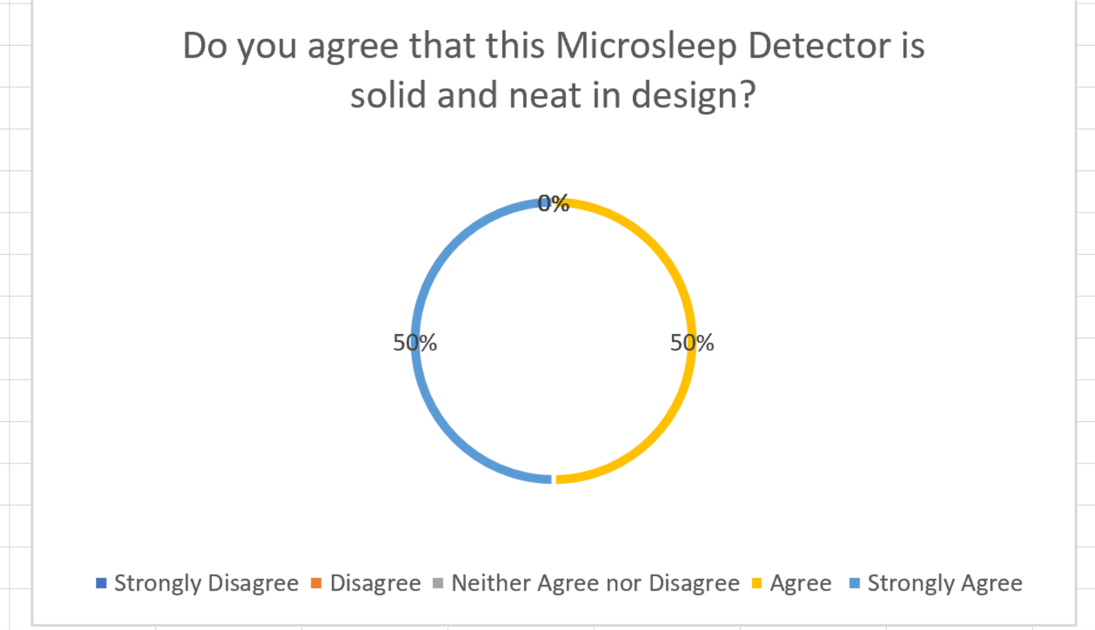


Figure 4.1: Microsleep Detector is solid and neat in Design

The pie chart reveals a unanimous positive opinion on the Microsleep Detector's design. With a 50% split between "Agree" and "Strongly Agree" and no negative feedback, the survey indicates that participants find the design both solid and neat, suggesting a well-executed and aesthetically pleasing product.

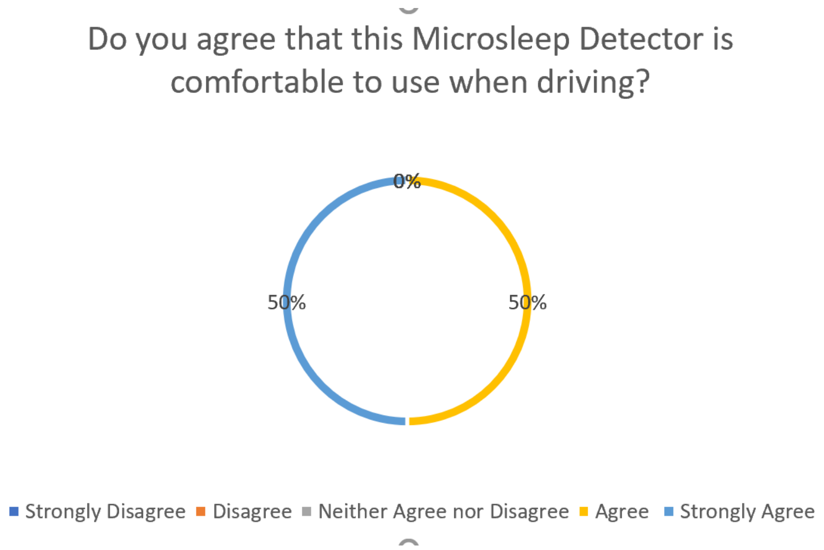


Figure 4.2: Microsleep Detector is comfortable to use when driving

The pie chart reveals a unanimous positive opinion regarding the comfort of the Microsleep Detector while driving. With an equal split between "Agree" and "Strongly Agree" responses, and no negative feedback, the survey indicates that participants found the device comfortable to use during their drives. This suggests that the design and implementation of the device are not intrusive or bothersome, leading to a positive user experience.

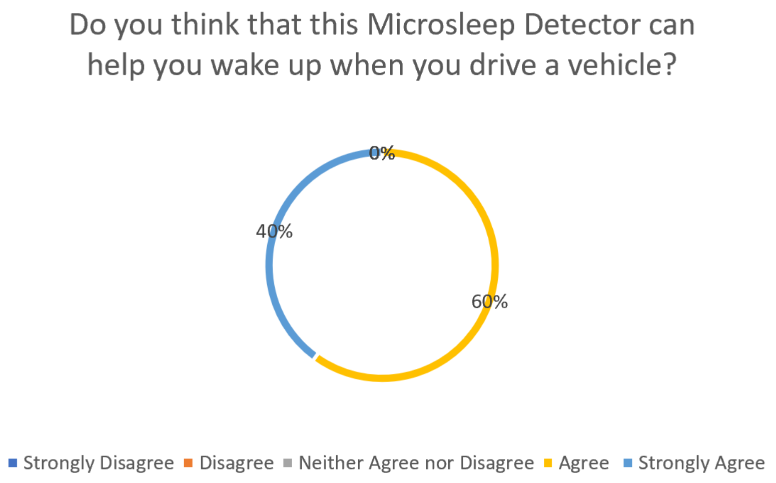


Figure 4.3: Microsleep Detector can help you wake up when you drive a vehicle

The pie chart reveals a positive outlook on the Microsleep Detector's ability to prevent microsleep while driving. While 60% of respondents either agree or strongly agree with its effectiveness, 40% remain uncertain or disagree. This indicates that while the device shows promise, there's still room for improvement in terms of its reliability and accuracy to fully convince all users.

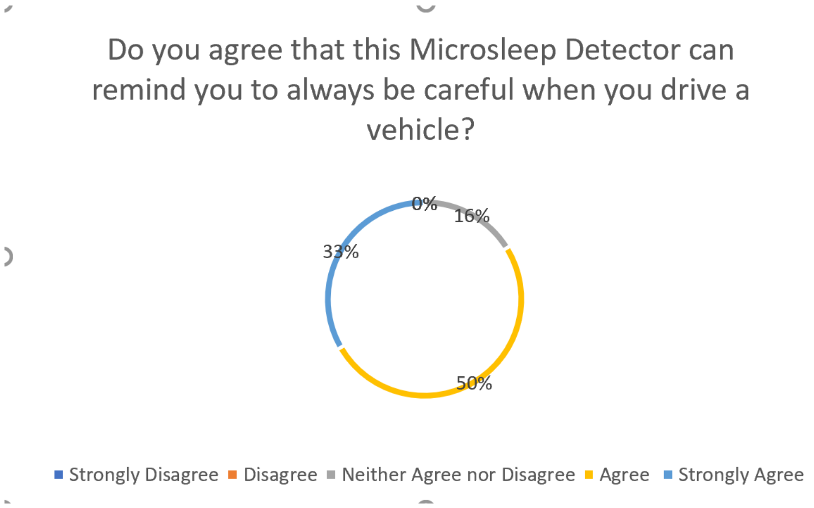


Figure 4.4: Microsleep Detector can remind you to always be careful when you drive a vehicle

The pie chart reveals a mixed response regarding the Microsleep Detector's ability to remind drivers to be cautious. While 50% strongly agree with its effectiveness in this regard, 33% are either neutral or disagree. This suggests that while the device has the potential to promote safe driving habits, its effectiveness in consistently reminding drivers may vary among users.

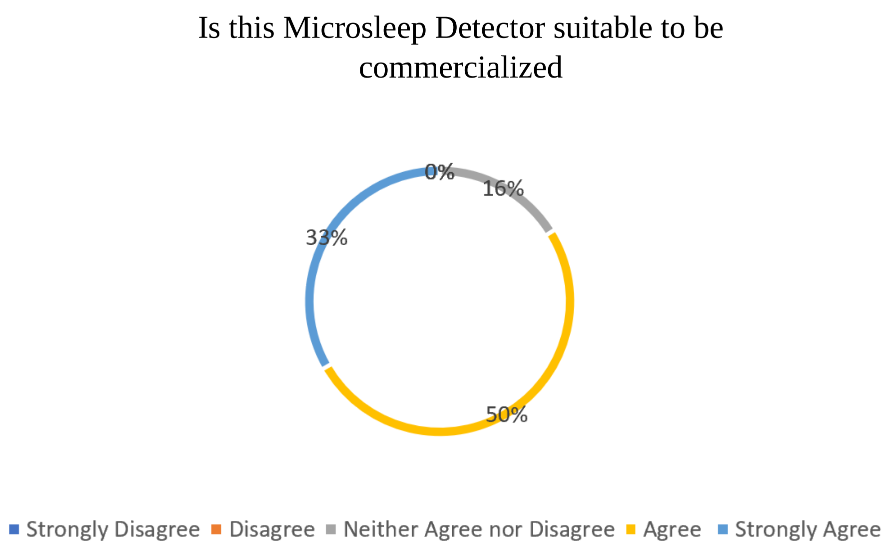


Figure 4.5: Microsleep Detector suitable to be commercialized

The pie chart reveals a mixed response regarding the commercialization of the Microsleep Detector. While 50% strongly agree with its suitability for the market, 33% are either neutral or disagree. This suggests that while the device has potential, there are still concerns about its readiness for commercialization, which may need to be addressed through further development and refinement.

4.2 Discussion

This project aims to develop a smart microsleep detector using an Arduino Nano, IR sensor, piezo buzzer, and micro vibration sensor. The system detects microsleep events, which are brief periods of sleep that can occur during wakefulness, and alerts the user to prevent potential accidents.

The IR sensor is used to monitor eye closure, a key indicator of microsleep. When the sensor detects prolonged eye closure, it triggers the Arduino to activate the vibration sensor. The vibration sensor measures the user's head movement, which can also be indicative of microsleep. If the vibration sensor detects a significant decrease in head movement, the Arduino activates the piezo buzzer to alert the user.

The Arduino Nano serves as the central processing unit, processing the input signals from the IR and vibration sensors and controlling the buzzer. The system can be further enhanced with additional features like adjustable sensitivity levels, real-time monitoring, and data logging for analysis.

This smart microsleep detector has the potential to significantly improve safety in various settings, such as driving, operating machinery, or working long hours. By proactively alerting users to microsleep events, this device can help prevent accidents and promote alertness.

4.3 Comment on survey

The feedback received for the microsleep detector project highlights several areas for improvement. Users expressed a desire for a more powerful sensor capable of delivering stronger alerts to drowsy drivers. Additionally, there's a strong consensus on the need for wireless functionality to enhance convenience and flexibility. Furthermore, suggestions were made to incorporate data storage and wireless connectivity to smartphones, enabling real-time monitoring, analysis, and potential integration with apps. Such integration could facilitate accident investigation and emergency response by providing valuable insights into the circumstances surrounding microsleep-related incidents.

CHAPTER 5
CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The development of a smart Microsleep detector using an Arduino Nano, IR sensor, piezo buzzer, and micro vibration sensor represents a significant step towards enhancing road safety. By accurately detecting microsleep events and alerting the driver, this device has the potential to reduce accidents caused by driver fatigue.

The project's success in effectively combining hardware and software components to achieve its intended purpose is commendable. However, there is still room for improvement. Future iterations could focus on refining the sensor accuracy, enhancing the alert system for optimal effectiveness, and exploring wireless connectivity for greater convenience and data analysis capabilities.

Overall, this project demonstrates the potential of technology to address real-world safety concerns. By continuing to refine and develop this technology, we can contribute to a safer driving environment and save lives.

5.2 Recommendations

This initiative is to create a collection of thought that can be further investigated. The following recommendations are for further study and may be considered for project specifications improvement. So add the waterproof plastic electronic box on the left so that when you wear it, you're not used to it and you feel comfortable wearing your glasses. Besides, use the IoT system so we can set the time when we're driving, and the anti-sleep detector system will work or turn on.

5.3 Suggestion for future work

To further enhance the smart microsleep detector, future research should focus on ergonomic design, improved sensor accuracy, wireless connectivity, user-friendly interfaces, power efficiency, and extensive user testing. Integrating the device into wearable accessories, refining sensor sensitivity, enabling remote monitoring, and optimizing power consumption are key areas for improvement. By addressing these aspects, the device can become a more reliable, comfortable, and effective tool for preventing accidents caused by driver fatigue.

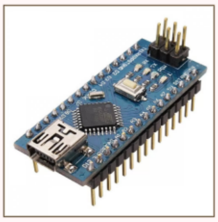
REFERENCES

APPENDICES

APPENDIX A- DATA SHEET

1. Arduino Nano

Arduino Nano v3



The Arduino Nano 3 board is based on an Atmel ATmega328 microcontroller. Its 32 Kb memory and I/O make this circuit ideal for embedded systems or applications requiring multitasking.

It is an integrated circuit that processes the information it receives and triggers actions according to the program it has received.

The Arduino Nano can be powered via:

- USB connection;
- unregulated external power supply 6-20 V (pin 30);
- 5 V regulated external power supply (pin 27).

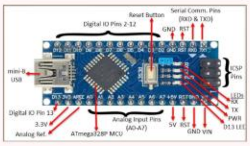
The power source providing the best voltage will be selected as the power source by the board.

USB/serial interface

The ATMega328 microcontroller is programmed with Arduino IDE software. It contains a bootloader that enables the program to be modified directly by plugging it into a computer's USB port. It is via this connection that the program is uploaded to the microcontroller. It is also via this cable that the Arduino can send information back to the computer.

From the computer's point of view, the Arduino board is a simple peripheral for which it is therefore necessary to install drivers in order to communicate with it.

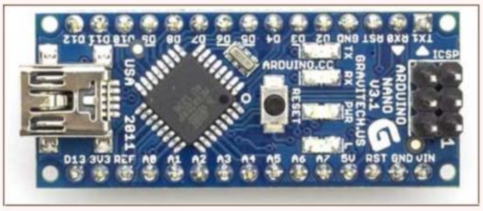
Overview of the Arduino Nano Board



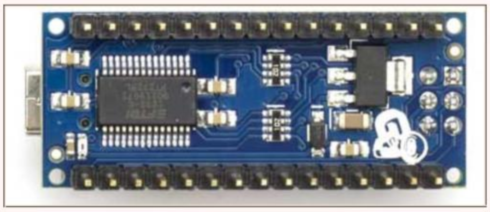
Features

- Atmel ATmega328 microcontroller ;
- Operating voltage 5V ;
- Recommended input voltage 7-12 V (max 6-20 V) ;
- Clock frequency 16 MHz ;
- Recommended current per pin 20 mA (max 40 mA) ;
- Cumulative current of all pins 200 mA ;
- Consumption at rest 19 mA ;
- 14 digital I/O pins (including 6 PWM) ;
- 8 analog input pins ;
- Flash memory 32 KB of which 2 KB used by the boot loader ;
- 2 KB SRAM ;
- 1 KB EEPROM ;
- Dimensions 45 x 18 x 18mm ;
- Weight 7g.

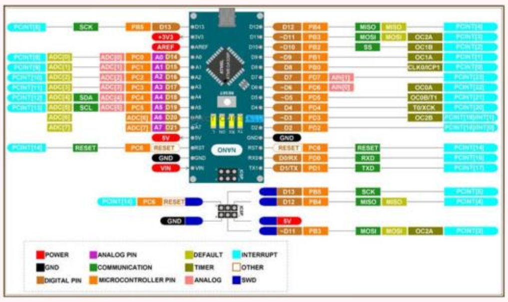
Top view



Bottom view



Pinout of the Arduino Nano



Some spindles have special functions:

- **Serial link** : 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) serial data.
- **External Interrupts** : 2 and 3. These pins can be configured to trigger an interrupt on a low value, rising or falling edge, or value change.
- **PWM** : 8-bit PWM output on pins 3, 5, 6, 9, 10 and 11 (Pulse Width Modulation)
- **SPI** : 10(SS), 11(MOSI), 12(MISO), 13(SCK) These pins support communication with SPI devices.
- **LED 13** : Onboard LED connected to digital pin 13.

- **Reset** : Go low to restart the microcontroller electronically.
- **AREF.** : Reference voltage for analog inputs.
- **I2C buses** : 4 (SDA) and 5 (SCL). Support for I2C communication allowing connection of up to 127 devices.
- **Digital Inputs/Outputs** : Each of the Nano's 14 digital pins can be used as an input or output and operates at 5 volts. Each pin can supply or receive a maximum of 40mA (note the cumulative current is limited to 200mA for all pins) and has an internal 20-50K pull-up resistor. This pull-up resistor connects by programming.
- **Analog inputs** : The card has 8 inputs (A0 to A7), which can accept an analog voltage between 0 and 5 V.

  To measure analog voltage, the Arduino Nano board uses an analog-to-digital (A/D) converter with 10-bit resolution, returning the measurement result as an integer between 0 and 1023.
  All analog pins (except pins 6 and 7) can be used as digital pins.

Programming

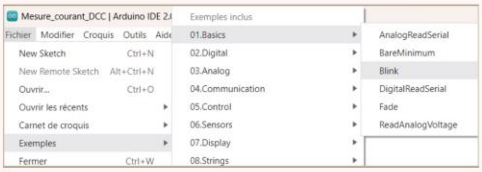
The microcontroller is programmed using the Arduino IDE. Arduino Nano drivers are installed natively in the IDE. Before uploading a program, simply make sure you have selected the correct board type (see below).

Programming

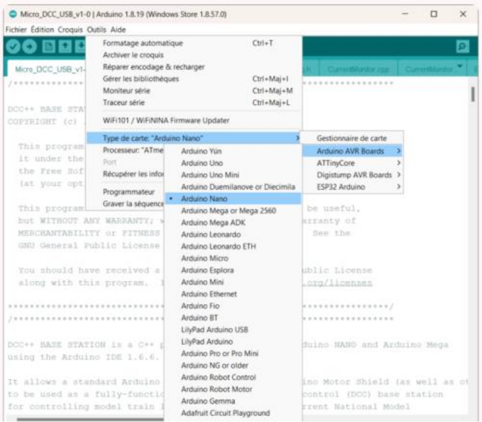
The microcontroller is programmed using the Arduino IDE. Arduino Nano drivers are installed natively in the IDE. Before uploading a program, simply make sure you have selected the correct board type (see below).

When using a new board for the first time, it's a good idea to carry out a function test to check the entire process of updating your Arduino Nano board:

- Connect the board to the computer via the USB cable;
- In the IDE, load the "Blink.ino" program directly from the file menu:



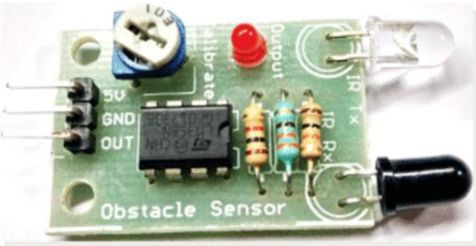
- From the "Tools" menu, select the correct processor



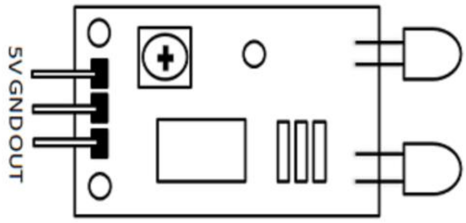
2. Ir Sensor

IR Sensor Module

30 August 2020 - 0 Comments



IR Sensor/Obstacle Sensor Module



IR Sensor Module Pinout

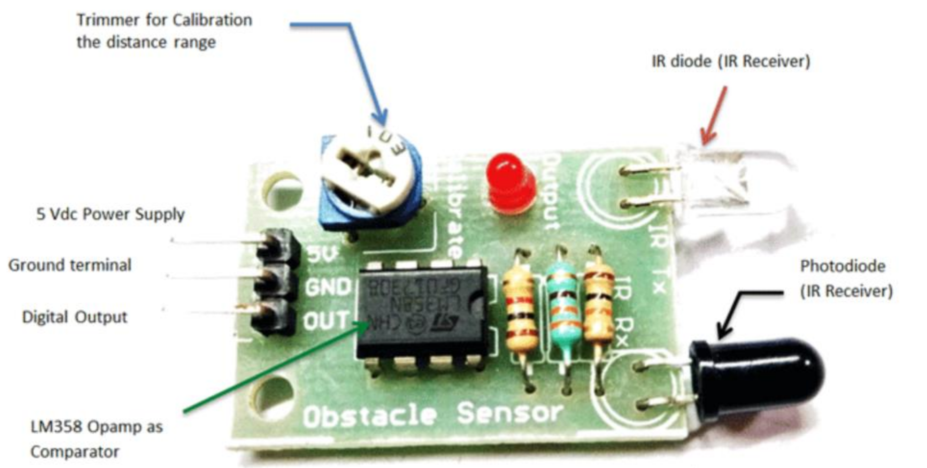
IR Sensor Module Pinout Configuration

Pin Name	Description
VCC	Power Supply Input
GND	Power Supply Ground
OUT	Active High Output

IR Sensor Module Features

- 5VDC Operating voltage
- I/O pins are 5V and 3.3V compliant
- Range: Up to 20cm
- Adjustable Sensing range
- Built-in Ambient Light Sensor
- 20mA supply current
- Mounting hole

Brief about IR Sensor Module



The IR sensor module consists mainly of the IR Transmitter and Receiver, Op-amp, Variable Resistor (Trimmer pot), output LED along with few resistors.

IR LED Transmitter

IR LED emits light, in the range of Infrared frequency. IR light is invisible to us as its wavelength (700nm – 1mm) is much higher than the visible light range. IR LEDs have light emitting angle of approx. 20-60 degree and range of approx. few centimeters to several feets, it depends upon the type of IR transmitter and the manufacturer. Some transmitters have the range in kilometers. IR LED white or transparent in colour, so it can give out amount of maximum light.

Photodiode Receiver

Photodiode acts as the IR receiver as its conducts when light falls on it. Photodiode is a semiconductor which has a P-N junction, operated in Reverse Bias, means it start conducting the current in reverse direction when Light falls on it, and the amount of current flow is proportional to the amount of Light. This property makes it useful for IR detection. Photodiode looks like a LED, with a black colour coating on its outer side, Black colour absorbs the highest amount of light.

LM358 Opamp

LM358 is an Operational Amplifier (Op-Amp) is used as voltage comparator in the IR sensor. the comparator will compare the threshold voltage set using the preset (pin2) and the photodiode's series resistor voltage (pin3).

Photodiode's series resistor voltage drop > Threshold voltage = Opamp output is High

Photodiode's series resistor voltage drop < Threshold voltage = Opamp output is Low

When Opamp's output is **high** the LED at the Opamp output terminal **turns ON** (Indicating the detection of Object).

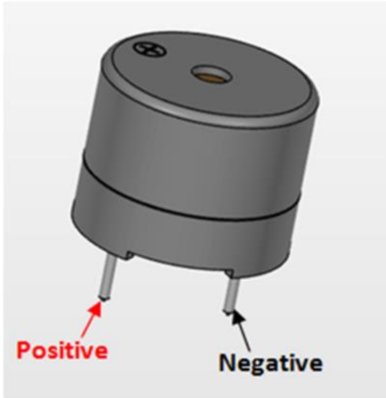
Variable Resistor

The variable resistor used here is a preset. It is used to calibrate the distance range at which object should be detected.

3. Piezo Buzzer

Active Passive Buzzer

25 September 2017 - 0 Comments



Active Passive Buzzer | Active Passive Buzzer Pinout

Buzzer Pin Configuration

Pin Number	Pin Name	Description
1	Positive	Identified by (+) symbol or longer terminal lead. Can be powered by 6V DC
2	Negative	Identified by short terminal lead. Typically connected to the ground of the circuit

Buzzer Features and Specifications

- Rated Voltage: 6V DC
- Operating Voltage: 4-8V DC
- Rated current: <30mA
- Sound Type: Continuous Beep
- Resonant Frequency: ~2300 Hz
- Small and neat sealed package
- Breadboard and Perf board friendly

Equivalents for Passive Buzzer

Piezo Electric buzzer, Speaker, Active Passive Buzzer with Module

How to use a Buzzer

A **buzzer** is a small yet efficient component to add sound features to our project/system. It is very small and compact 2-pin structure hence can be easily used on breadboard, Perf Board and even on PCBs which makes this a widely used component in most electronic applications.

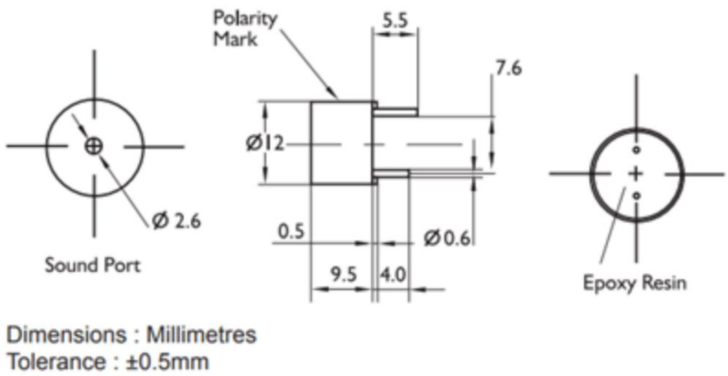
There are two types of buzzers that are commonly available. The one shown here is a simple buzzer which when powered will make a Continuous Beeeeeeppp.... sound, the other type is called a readymade buzzer which will look bulkier than this and will produce a Beep. Beep. Beep. Sound due to the internal oscillating circuit present inside it. But, the one shown here is most widely used because it can be customised with help of other circuits to fit easily in our application.

This buzzer can be used by simply powering it using a DC power supply ranging from 4V to 9V. A simple 9V battery can also be used, but it is recommended to use a regulated +5V or +6V DC supply. The buzzer is normally associated with a switching circuit to turn ON or turn OFF the buzzer at required time and require interval.

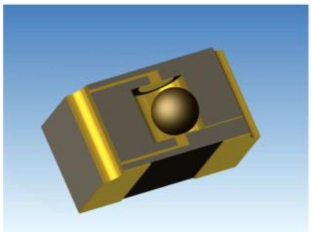
Applications of Buzzer

- Alarming Circuits, where the user has to be alarmed about something
- Communication equipments
- Automobile electronics
- Portable equipments, due to its compact size

2D Model of Buzzer



4. Micro Vibrtion Sensor



Properties

- Size 2.45 mm x 2.85 mm x 1.7 mm
- Lead free
- R_On < 100 Ohm
- noiseless
- protected against environmental stress
- automated SMD-mounting

Applications

- motion detection
- system wake-up – low power

Description

The micro vibration switch detects vibrations by means of a micro ball (d=0.8 mm).

The ball bridges two contacts reducing the resistance between the two external connection pads from several mega ohms (>30MOhm) to below 100 ohms.

Material

Package
PCB laminate material (FR4, epoxy glass compound)

Inner contact material

Gold plated

Ball
Stainless steel, gold plated

Characteristic values

operational temperature*
-20℃ – +70℃

Operating voltage
Max. +15 V

Current
Max. 2 mA

Reaction point
approx. 50 mg

Soldering

Reflow Process 260℃, 10 s

Standard package

Reels with 1000 or 2000 pcs

RoHS compliance

The micro vibrations sensor is compliant to RoHS 2002/95/EG.

Qualification

High temperature and high humidity storage

Test time: 48h
Test temperature: 50℃
Humidity: 90%
: without condensation
no evidence of internal corrosion after the test.

High humidity storage

Test time: 96 h
Test temperature: 40℃
Test humidity: 95%
: no evidence of internal corrosion after the test.
no shape distortion

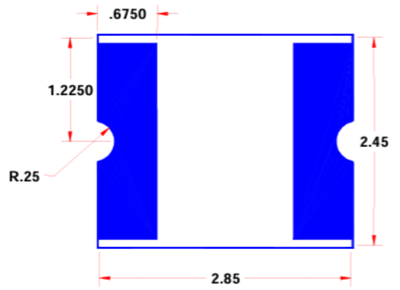
Temperature cycle storage

Test cycle: 8 cycles, T1 = 65℃ for 6h, T2 = -20℃ for 6h,
temperature change rate = 3K/min
: no evidence of internal corrosion after the test.
no shape distortion

Non Operation Half Sine Shock

Test cycle: Acceleration 25g at 6msec pulse width
1000 cycles pos. 1000cycles neg.; 1Shock/s; 3 axis: X, Y, Z

Dimensions



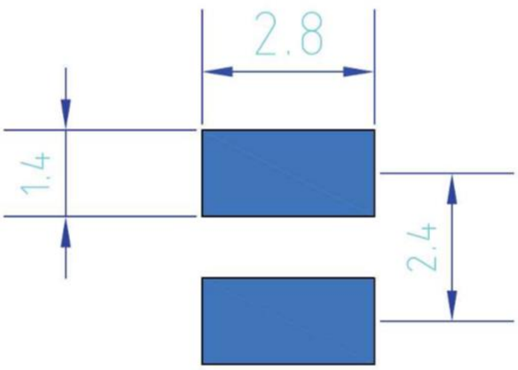
Height 1.7 mm

Non Operational Vibration Test

Test cycle:	Sinus 10 ... 300Hz; Elongation 0.25mm / 0.25g; 5 cycles; 1 axis	
	Frequency area A:	10 – 22.28Hz, amplitude in A:0.25 mm
	Frequency area B:	22.28 - 300Hz, acceleration in B: 0.25g
	Sweep speed:	1 Octave/min, Cycles: 10
	Time per Sweep:	4.9 min

Non Operational Vibration Test

Test cycle:	Sinus 10 ... 500Hz; Elongation 3.0mm / 1.5g; 5 cycles; 1 axis		
	Frequency area A:	10 – 15.76Hz, Amplitude in A:	3.0mm
	Frequency area B:	15.76 - 500Hz, Acceleration in B:	1.5 g
	Sweep speed:	1 Oktave/min, Number of sweeps:	10
	Time per Sweep:	5.62 min	



Recommended footprint for
micro vibration sensor [mm].
19.02.2008

APPENDIX B- PROGRAMMING

Anti_Sleep.ino

```
const int analogPin = A1;  // Pin where the infrared sensor is connected
const float VREF = 5.0;     // Reference voltage (usually 5V for Arduino)
const int ADC_RESOLUTION = 1023; // 10-bit ADC resolution
int BZ =3;
int vib=4;

void setup() {
  Serial.begin(9600); // Initialize serial communication
  pinMode(BZ ,OUTPUT);
  pinMode(vib ,OUTPUT);
}

void loop() {
  int analogValue = analogRead(analogPin); // Read the analog value (0-1023)

  // Convert the analog value to voltage
  float sensor = (analogValue * VREF) / ADC_RESOLUTION;


  Serial.print("Analog Value: ");
  Serial.print(analogValue);
  Serial.print("  value: ");
  Serial.println(sensor);
  //delay(100);

  if ((sensor)> 2.3){

  delay(2000);
  digitalWrite(BZ,HIGH);
  digitalWrite(vib,HIGH);

  }


  else {

   digitalWrite(BZ,LOW);
   digitalWrite(vib,LOW);
}
}
```

Figure 5.1: Coding

EXPLANATION:

1.Pin Definitions and Constants:

- const int analogPin = A1; : This line defines a constant integer analogPin and assigns it the value A1. This pin is where the infrared (IR) sensor is connected to the Arduino Nano.
- const float VREF = 5.0;: This defines a constant float value VREF and sets it to 5.0. This represents the reference voltage, typically 5V for Arduino boards.
- const int ADC_RESOLUTION = 1023;: This defines a constant integer ADC_RESOLUTION and sets it to 1023. This represents the resolution of the Arduino's analog-to-digital converter (ADC), which is 10 bits.
- int BZ = 3;: This declares an integer variable BZ and initializes it to 3. This pin is used to control the piezo buzzer.
- int vib = 4;: This declares an integer variable vib and initializes it to 4. This pin is used to control the micro vibration sensor.

2. Setup Function:

- void setup() {: This function runs once when the Arduino board starts.
- Serial.begin(9600);: This initializes serial communication at a baud rate of 9600. This allows you to monitor data on a computer using a serial monitor.
- pinMode(BZ, OUTPUT);: This sets the BZ pin as an output pin, which will be used to control the piezo buzzer.
- pinMode(vib, OUTPUT);: This sets the vib pin as an output pin, which will be used to control the micro vibration sensor.

3. Loop Function:

- void loop() {: This function runs repeatedly in a loop.
- int analogValue = analogRead(analogPin);: This reads the analog value from the IR sensor connected to pin A1 and stores it in the analogValue variable.
- float sensor = (analogValue * VREF) / ADC_RESOLUTION;: This converts the analog value to a voltage value using the reference voltage VREF and the ADC resolution.

- Serial.print("Analog Value: ");: This prints the text "Analog Value: " to the serial monitor.
- Serial.print(analogValue);: This prints the current analog value to the serial monitor.
- Serial.print(" Voltage: ");: This prints the text " Voltage: " to the serial monitor.
- Serial.println(sensor);: This prints the calculated voltage value to the serial monitor.
- delay(100);: This introduces a 100-millisecond delay.
- if ((sensor) > 2.3) {: This checks if the measured voltage is greater than 2.3 volts. This condition indicates that the IR sensor is detecting a potential microsleep event.
- delay(2000);: This introduces a 2-second delay to prevent false alarms.
- digitalWrite(BZ, HIGH);: This turns on the piezo buzzer by setting the BZ pin to HIGH.
- digitalWrite(vib, HIGH);: This activates the micro vibration sensor by setting the vib pin to HIGH.
- else {: This block executes if the voltage is less than or equal to 2.3 volts.
- digitalWrite(BZ, LOW);: This turns off the piezo buzzer by setting the BZ pin to LOW.
- digitalWrite(vib, LOW);: This deactivates the micro vibration sensor by setting the vib pin to LOW.

APPENDIX C-PROJECT MANUAL /PRODUCT CATALOGUE

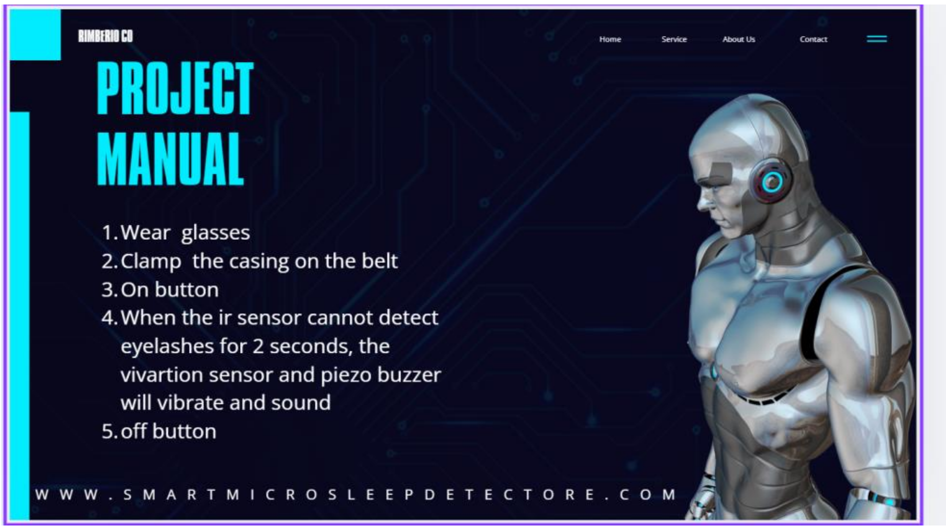


Figure 5.2: Project manual

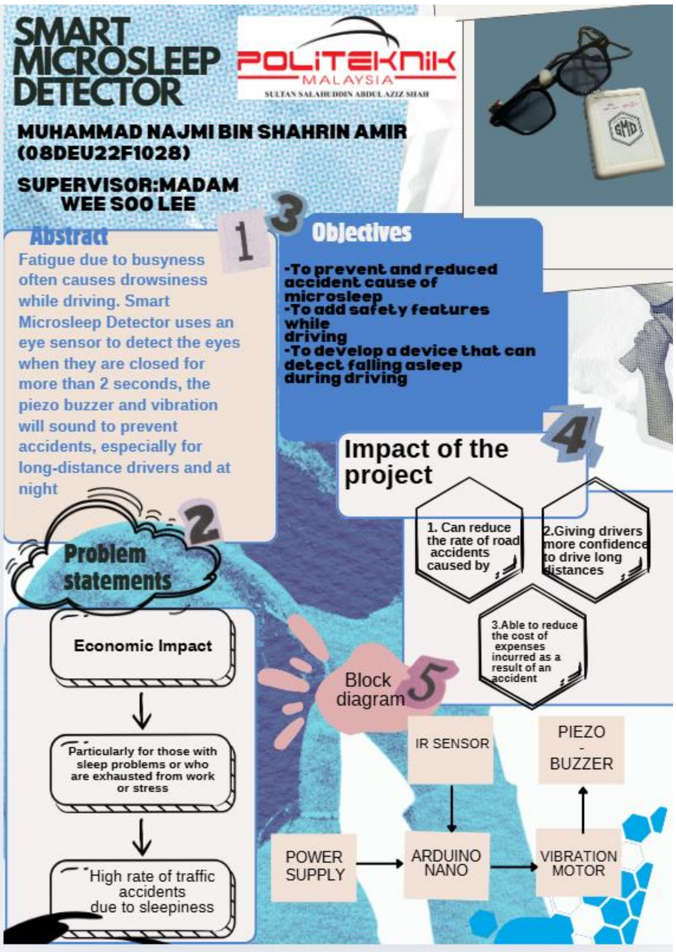


Figure 5.3 poster