A

Major Project Report

on

ANTI-SLEEP ALARM SYSTEM FOR DRIVERS

Submitted in the partial fulfillment of the requirement for the award of the degree

of

Bachelor of Technology

in

Electronics & Instrumentation Engineering

Submitted by

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Abhinav Baghel
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CANDIDATE'S DECLARATION

We, **Abhinav Baghel** S/o Mr. Rajyapal Baghel, **Lokesh** S/o Mr. Nand Kishore and **Shiva Pal** S/o Mr. Raju Pal, students of B.Tech. (EI) 4th year (2023-24) hereby declare that the project entitled **"Anti-Sleep Alarm System for Drivers"** is our authentic work done carried out in partial fulfilment of the requirement for the award of degree of **Bachelor of Technology** in **Electronics and Instrumentation Engineering** under the supervision of **Prof. Rakesh Kumar Maurya**, **Department of Electronics and Instrumentation Engineering, Faculty of Engineering and Technology, M.J.P. Rohilkhand University, Bareilly**.

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CERTIFICATE

This is to certify that ***Mr. Abhinav Baghel (Roll No. 20EI01)***, ***Mr. Lokesh (Roll No. 20EI23)*** and ***Mr. Shiva Pal (Roll No. 20EI38)*** have carried out the major project work, presented in this report entitled **"Anti-Sleep Alarm System for Drivers"** submitted in partial fulfilment of the requirement for the award of the degree of **Bachelor of Technology** in **Electronics and Instrumentation Engineering**, **Faculty of Engineering and Technology**, **M.J.P. Rohilkhand University, Bareilly (U.P)** during the academic year 2023-24.

The project work carried out by them is satisfactory. The report embodies result of the original work and studies carried out by them and the contents of the report do not form the basis for the award of any other degree to the candidates.

(Prof. Rakesh Kumar Maurya)
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ABSTRACT

In modern-times, owing to hectic schedules it becomes very difficult to remain active all the time. Imagine a situation where a person is driving home from work, dead tired after facing all the challenges of the day. The hands are on the wheel and foot on the pedal but suddenly started feeling drowsy, the eyes start shutting and the vision blurs and before it knew, then the person fall asleep. Falling asleep on the wheel can lead to serious consequences, there may be accidents and people may even lose their lives. This situation is much more common and hence, it is very important to counter this problem. So, to address this issue, the Project Anti-Sleep Alarm System for Drivers is introduced. This system alerts the Person falls asleep at the wheel thereby, avoiding accidents and saving lives. This system is useful especially for people who travel long distances and people who are driving late at night. The circuit is built using Arduino UNO, a switch, a Piezo buzzer, and an Eye blink sensor. Whenever the driver feels sleepy and asleep the eye blink sensor detects and the buzzer turn ON with a sound of an intermediate beep. When driver comes back to his normal state eye blink sensor senses that and buzzer turns OFF.

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LIST OF ABBREVIATIONS

ASAS	Anti-Sleep Alarm System
IR	Infrared
LED	Light Emitting Diode
WHO	World Health Organization
ECG	Electrocardiography
EEG	Electroencephalograph
EMG	Electromyograph
EOG	Electrooculogram
SSS	Stanford Sleepiness Scale
KSS	Karolinska Sleepiness Scale
PVT	Psychomotor Vigilance Test
ERD	Entity-Relationship Diagrams
UI	User Interface
UX	User Experience
DC	Direct Current
PWM	Pulse Width Modulation
IDE	Integrated Development Environment
USB	Universal Serial Bus
IoT	Internet of Things
UAT	User Acceptance Testing
CNN	Convolutional Neural Networks
RNN	Recurrent Neural Networks
GPS	Global Positioning System

Chapter 1

Introduction

1.1 Introduction

Driver drowsiness has emerged as one of the key factors in recent times' traffic_accidents, which can result in fatalities, serious physical losses, large monetary losses, and significant property damage. Drowsiness in a driver can be brought on by long hours behind the wheel, drowsiness, fatigue, medicine, difficulty sleeping, and medical illnesses. A dependable technology that can identify driver drowsiness and warn the driver before an accident occurs is needed, according to statistics from several research. Many studies have been conducted in the previous to develop a reliable driver drowsiness detection and prediction system that uses a variety of parameters to gauge the driver's level of drowsiness. Substantial efforts are needed to reduce the consequences of drowsiness since it plays a significant role in road crash fatalities and injuries. [1] Due to the prevalence of drowsy driving accidents on high-speed expressways, they are generally more serious than other accidents. A driver will become tired and obsessed after a long period of driving, which could result in fatal crashes. However, sleepy driving can also be attributed to car drivers who get inadequate sleep on the majority at nights.

Road traffic injuries and deaths have a terrible impact on individuals, communities, and countries. They involve massive amount of costs too often overburdened health care systems occupy more hospital beds consume resources and result in significant losses of productivity, prosperity with deep social and economic losses. According to the 2021 report of WHO, 1.54 lakh road traffic deaths occur in India . This makes it the number one cause of death among those aged 15-29 years. [2] Imagine a situation where a person is driving home from work, dead tired after facing all the challenges of the day. The hands are on the wheel and foot on the pedal but suddenly started feeling drowsy, the eyes start shutting and the vision blurs and before it knew, the person fall asleep. Falling asleep on the wheel can lead to serious consequences, there may be accidents and people may even lose their lives. This situation is much more common and hence, it is very important to counter this problem.

So, to address this issue, the Project Anti-Sleep Alarm System (ASAS) for Drivers is introduced. This system alerts the Person falls asleep at the wheel thereby, avoiding accidents and saving lives. This system is useful especially for people who travel long distances and people who are driving late at night. The circuit is built using Arduino UNO, a switch, a Piezo buzzer, Micro Vibration Motor and an Eye blink sensor. Whenever the driver feels sleepy and asleep the eye blink sensor detects and the buzzer turn ON with a sound of an intermediate beep. [3] When driver comes back to his normal State eye blink sensor senses that and buzzer turns OFF. The system works well irrespective of driver wearing spectacles and under low light conditions also. During the monitoring, the system is able to decide if the eyes are closed or opened. When the eyes have been closed for too long a warning signal is issued.

1.2 Drowsiness Signs and Stages

Although “drowsiness” is the commonly mentioned term, “fatigue” is also used. Despite their difference, fatigue and drowsiness are interchangeably utilized. Fatigue refers to “the reluctance to continue a task as a result of physical or mental exertion or a prolonged period of performing the same task”. However, sleepiness or drowsiness is defined as the urge to fall asleep. Basically, drowsiness is the result of a captivating biological need to sleep. Drowsiness can happen due to many reasons, such as medication, working for long hours, sleep disorders, poor quality (or not having enough) sleep, and being awake for long periods. [4] Thus, their relationship is evident, as fatigue directly contributes to drowsiness. Although they are different concepts, some researchers considered drowsiness and fatigue alike, due to their similar consequences, such as. In our work, we refer to these systems as drowsiness detection systems.

A driver does not become drowsy suddenly, without showing some signs. Examples of such signs include:

1. Difficulty keeping eyes open;
2. Yawning;
3. Frequent blinking;
4. Difficulty concentrating;
5. Swerving out of the lane and delayed reaction to traffic;

6. Nodding;
7. Unjustifiable variations in speed.

These signs gradually become more apparent as drowsiness deepens and, as such, can serve as indicators for the level of driver drowsiness.

1.3 Motivation

India accounts for just 1% of the global vehicular population, but has the highest number of accident-related deaths in the world. The fatalities recorded in 2022 represent an increase of 9.4% on the previous year, a new report by transport ministry said. Road accidents also injured 443,000 people in the country and the number of accidents rose by 11.9% between 2021 and 2022. According to google, worldwide there are 1lakh police reported crashes each year are caused primarily by drowsy driving. It's result in 71,000 injuries annually. Drowsy driving results in more than 6,400 losses annually. [5]

More than half of the victims are pedestrians, cyclists, or motorcyclists and almost 84% of all fatalities are among road users between the working ages of 18-60 years, it said. Falling asleep on the wheel can lead to serious consequences, there may be accidents and people may even lose their lives. This situation is much more common and hence, it is very important to counter this problem. Here is no good mechanism to prevent accidents in our country. We lose many of our close people in road accidents. Sometimes the whole family is torn apart by the death of one person in accident. That's why we want to reduce this via a system.

1.4 Objective

It is appropriate to evaluate how this issue has evolved given the significance of driving while drowsy as a problem for transport safety and the growing interest in continuous surveillance across several transport industries. To evaluate the progress made in predicting sleepiness-related incidents in research investigations and to determine how close researchers have come to being able to measure drowsiness in the field with reliability. The lack of a thorough grasp of behaviour in the field has historically impeded driver behaviour model development. To achieve a solid theoretical foundation, it is essential to develop new techniques and measurements for studying drowsy driving. [6] It is also getting more important to forecast driver behaviours. Governments, international organizations, the research belonging, and automakers have all made several attempts over the years to address the problem of driver drowsiness and its negative impacts. The purpose of this report is to determine if it is possible to accurately detect or forecast drowsiness on roadways using both vehicle-based data and other measurements obtained in-vehicle, given the present state of research. In order to develop and improve technology interventions, it is essential question that researchers have a theoretical understanding of the actions of drowsy drivers and the safety consequences they cause.

The ultimate goal of the system is to check the drowsiness condition of the driver. Based on the eye movements of the driver, the drowsiness is detected and according to eye blink, the alarm will be generated to alert the driver and to reduce the speed of the vehicle along with the indication of parking light. Using eye detection, driver security and safety can be implemented in normal car also. This has the potential to save lives on the road. Long-distance lorry drivers can fall asleep by driving too long hours due to the pressures put on them to get the goods to their destination at certain times. It has the potential to keep them awake or at least to tell them when they are overtired and need to stop driving.

1.5 Expected Outcome

An expected outcome or driver anti-sleep device may be a device or system that's designed to alert a driver after they are in danger of falling asleep at the wheel. These systems will take several forms, as well as wearable devices, in-vehicle alarms, or a mix of each.
One example of associate anti-sleep device may be a wearable device that uses sensors to sight once a driver's head nods or their body becomes inactive for an extended amount of your time. once this happens, the device can emit associate alert, like a loud beep or vibration, to wake the motive force and stop them from falling asleep at the wheel.
Another example is associate in-vehicle system that uses sensors to observe the driver's eye movements and facial expressions. If the system detects that the motive force is exhibiting signs of drowsy driving, like frequent eye blinking or yawning, it'll trigger associate alarm to alert the motive force to require a clear stage or head to rest. [7]

There are several potential advantages to victimization associate anti-sleep device, as well as accumulated safety on the roads, reduced risk of accidents and fatalities, and improved productivity for industrial drivers. However, it's necessary to notice that these systems mustn't be relied upon as a sole suggests that of preventing drowsy driving, and drivers should make sure that they're well unwary and alert once behind the wheel.

1.6 Project Management and Finance

Project management and finance are important considerations when developing an anti-sleep alarm system for drivers. Some specific tasks and considerations that may be relevant to this project include:

1. **Setting project goals and objectives:** Clearly defining the goals and objectives of the project will help guide the development process and ensure that the final product meets the desired requirements.
2. **Budgeting:** Estimating the costs associated with developing and producing the anti-sleep alarm system, including materials, labour, and other expenses, will help inform decisions about the project's scope and resources.
3. **Resource management**: Identifying and securing the resources needed to complete the project, including personnel, equipment, and materials, is crucial for successful project execution.
4. **Risk management:** Identifying and mitigating potential risks that could impact the project's success is an important part of project management. This may include identifying potential sources of delay or failure and implementing contingency plans to address them.
5. **Project scheduling:** Developing a detailed schedule of tasks and milestones will help ensure that the project stays on track and meets its deadlines.
6. **Quality control:** Implementing processes and procedures to ensure that the anti-sleep alarm system meets the required standards for functionality, reliability, and safety is essential for the success of the project.

Managing the finances of the project may also involve tasks such as seeking funding or investment, tracking expenses, and managing budgets to ensure that the project stays within its financial constraints. [8] It is necessary for the project to stay within the financial constraints so that it does not cause any financial burden on the person/student who is making it and to also ensure that the proposed system is cost friendly for the end-user, driver, in this case.

1.7 Report Layout

A project report for an anti-sleep alarm system for drivers can be organized as follows:

1. **Abstract:** This section should provide a brief overview of the project, including its goals, objectives, and main findings.
2. **Introduction:** This section should provide background information on the problem of driver fatigue and the need for an effective solution, such as an anti-sleep alarm system.
3. **Project scope and objectives:** This section should describe the specific goals and objectives of the project, as well as any constraints or limitations that were considered.
4. **Design and Implementation:** This section should describe the approach taken to develop the anti -sleep alarm system, including the tools and techniques used, any testing or validation methods employed, and any challenges or obstacles encountered.
5. **Results:** This section should present the findings of the project, including any data collected or analysis performed. This may include data on the effectiveness of the Anti-sleep alarm system, as well as any insights or recommendations for future work.
6. **Conclusion:** This section should summarize the main findings of the project and provide any recommendations for further work or improvement.

A well-organized project report will help to clearly convey the results and findings of the anti-sleep alarm system development project, and provide a useful reference for future work.

Chapter 2

Literary Survey

2.1 Preliminaries/Terminologies

Here are some common terminologies that may be used in the context of an anti-sleep alarm system for drivers:

1. **Driver fatigue:** A state of physical or mental tiredness that can impair a driver's ability to operate a vehicle safely.
2. **Anti-sleep alarm system:** A device or system that is designed to alert a driver when they show signs of drowsiness or fatigue, in order to help prevent accidents caused by driver fatigue.
3. **Microcontroller:** A small, self-contained computer that can be programmed to perform various tasks, such as monitoring sensors or controlling actuators
4. **Infrared (IR) sensor:** A device that detects and measures infrared radiation, which is a type of electromagnetic radiation with a wavelength longer than visible light. IR sensors are commonly used to detect the presence or absence of objects, as well as to measure temperature and other environmental conditions.
5. **Buzzer:** An alerting device or system that is designed to attract attention or signal the presence of a specific condition, such as a fire, intrusion, or hazard.
6. **Digital input/output (I/O):** A type of I/O that can be used to transfer digital data, such as a binary 1 or 0, between a device and a computer or microcontroller.
7. **Power supply:** A device or system that provides electrical power to an electronic device or system.

2.2 Related Work

Different techniques have been employed by researchers to gauge driver drowsiness. The process of detection can be carried out by using behavioural data, physiological characteristics, subjective measurements, and data collected from the vehicle. In addition to these three, researchers have also employed subjective methods, in which drowsy driving is assessed directly or by completing a questionnaire by the driver. The majority of studies demonstrate that driver drowsiness continues to be a significant safety issue and a leading contributing element in fatal crashes while driving. The process of developing more effective methods to measure it has moved steadily. [9] The various measurements and the associated parameters are discussed in this section. The brief classification of driver drowsiness measures is displayed in the figure 2.2 (a) [2] below:

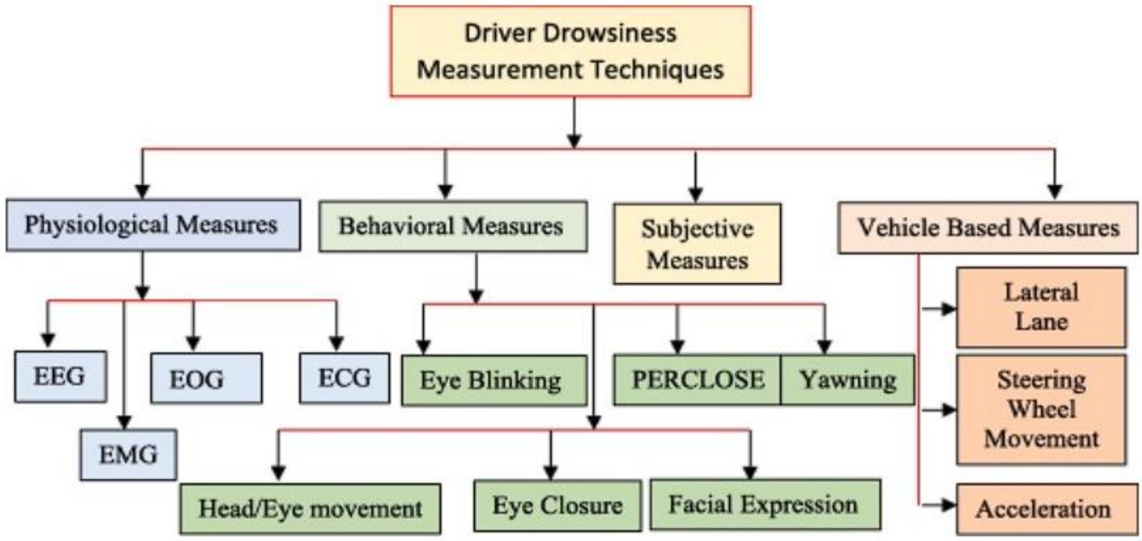

Figure 2.2 (a): Types of Anti-sleep Measures [2]

1. **Physiological measures:** The driver in this category is monitored for drowsiness using sensors and other electronic gadgets that are attached to their bodies. By focusing on the heart rate, pulse rate, brain_activity, body temperature, and other physiological variables, the state of the driver can be evaluated. Three key signals are EEG, EOG, and ECG that are used to identify sleepiness and enhance performance in this area. The EEG technique measures brainwaves that are utilized in several applications, such as the diagnosis of epilepsy and the monitoring of sleep problems, by using the electrical activity of the human brain. The electrical activity of the brain during different states of arousal, such as awakens, drowsiness, and sleep, is also measured using an EEG. Due to its excellent accuracy, objective evaluation, and low chance of fraud, the EEG is the physiological. [10] EOG is a technique for measuring the cornea-retinal standing potential that exists between the front and the back of the human eye and is employed to capture the motion of the eye. Heart rate, which is produced by bioelectric currents traveling through the heart at different stages of blood flow, can be tracked and evaluated using the ECG technique. Physiological measure is shown the following figure 2.2 (b) [3] :

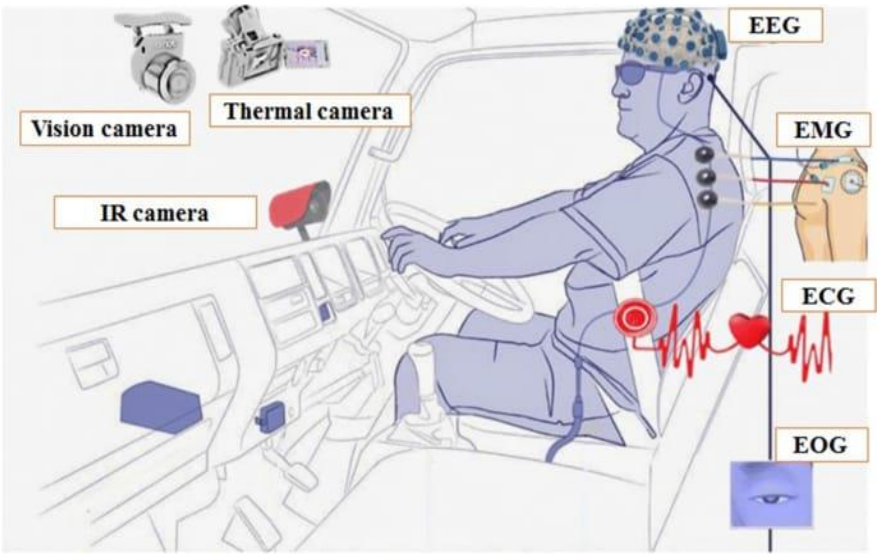

Figure 2.2 (b): Physiological System [3]

The results of a study show that the chosen traits performed better in hybrid techniques than in singular approaches, which may have important implications for future investigations. The findings from another investigation show that it is possible to identify a driver's mild drowsiness early and accurately utilizing a hybrid approach with non-contact sensor. Because driving involves movement, measuring raw physiological information is always subject to noise and distortions. When compared to other technologies, physiological signals-based driver drowsiness detection has a very high consistency and accuracy. All the monitoring of a typical physiological system is shown the table 2.2 (a) below:

Table 2.2 (a): Physiological-based Measures

Physiological Signals	**Description**
Electroencephalography (EEG)	A monitoring technique that records the electrical activity of the brain from the scalp is known as an EEG signal. It is a representation of the surface layer in the brain beneath the scalp's tiny activity. These signals are divided into five categorized based on their frequency ranges (0.1- 100 Hz): delta, theta, alfa, beta and gamma.
Electrocardiography (ECG)	Electrodes positioned on the skin are used to collect ECG data, which indicate the electrical activity of the heart, including heart rate and rhythm.
Electrooculography (EOG)	EOG signals are used to monitor and documents eye movements as well as the cornea-retinal standing potential which exists between the front and back to the human eye.
Electromyography (EMG)	The electric impulses that are generated collectively when muscle moves are known as EMG signal.

2. **Behavioural measures:** There are several facial signals that indicate someone is drowsy, such as rapid and continuous blinking, head movements, and repeated yawning etc. The amount of drowsiness of drivers is frequently assessed using computerized, quasi behavioural procedures by observing their unusual behaviour. The majority of research that have been published on employing behavioural techniques to assess tiredness concentrate on (which is the percentage of eyelid closure over the pupil over time). All of these studies aimed to establish a drowsiness identification model that takes into account the variable possible influence of drowsiness on driving productivity. Multiple facial expressions and ocular scans were employed by several studies to identify signs of drowsiness. [11] However, numerous researchers have also created studies on how to use other behavioural indicators, like yawning and head or eye position orientation to measure amount of drowsiness.

A study used machine learning models (artificial neural networks) to detect a driver's level of drowsiness or to forecast the beginning of a driving impairment. In order to gather information about spontaneous behaviour during actual periods of drowsiness, a study presented a technique for automatically measuring facial expressions. For the purpose of detecting drowsy driving, two-stream networks, multi-facial characteristics, CNN, and gamma_correction was used and this was highly accurate and avoided placing unnecessary equipment on the driver’s body. In order to improve the classification of the alert and drowsy states of drivers, additionally looked into the accuracy of drowsiness detection through algorithm improvement and the use of ensemble machine learning

A highly difficult video collection that simulates actual driving situations was used to evaluate their suggested technique. To deliver precise and timely alerts to the driver, it is crucial to develop an automated, real-time sleepiness detection mechanism. The majority of drowsiness detection techniques currently in use simply employ one facial characteristic to determine drowsiness condition, omitting the intricate relationship between drowsiness characteristics and the information provided by the timing of those features. [12] In order to address these issues, a model was suggested for estimating driver drowsiness based on factorized bilinear feature fusion and a long-short-term recurrent convolutional network.
A typical behaviour measure is shown the figure 2.2(c) [3] .

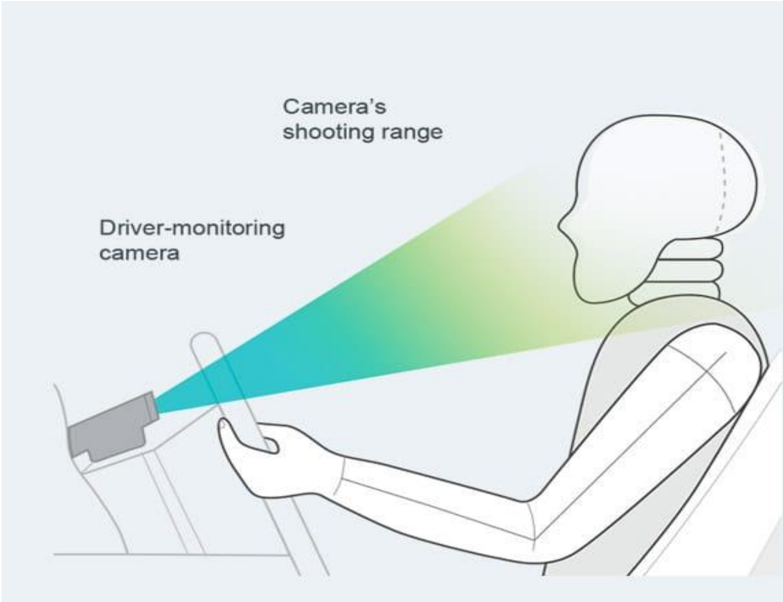

Figure 2.2 (c): Behaviour Monitoring System [3]

3. **Vehicle based measures:** The way a drowsy driver operates a vehicle may differ from the way a regular driver operates a vehicle. Any change in these measurements that exceeds a certain threshold denotes a greatly increased likelihood that the driver is sleepy. These metrics include deviations from lane position, steering wheel movement, pressure on the accelerator, etc.

The lateral lane position and steering wheel movement are the two most often utilized vehicle-based measurements. Steering_angle sensors are used to assess steering wheel movement, which is a popular vehicle-based method of measuring driver drowsiness. The driver's steering behaviour is monitored by an angle sensor that is positioned on the steering column. Another significant indicator of the degree of driver sleepiness is the position of the vehicle in the lateral. When conducting field trials, an external camera is used to track the location of the lane. Numerous studies have shown that drowsiness-related performance error risk is not well predicted by precautions taken while operating a vehicle. Furthermore, drowsiness is not a defined measurement in vehicle-based metrics. [13] A structure was developed to surreptitiously evaluate the driver's level of drowsiness while driving. By leveraging the vehicle generated data in an unobtrusive manner, they succeeded in diagnosing the driver's level of drowsiness using vehicle measurements like as acceleration, braking, and steering. In order to detect drowsiness-related lanes, an author develops and tests a contextual and temporal algorithm. The program lowers the proportion of false positives in rural and highway settings, which are normally troublesome for vehicle-based detection techniques. To increase driving safety, it may be utilized in conjunction with all-encompassing mitigation techniques.

4. **Subjective measures:** Subjective measures that assess the degree of drowsiness are based on the driver's individual assessment. A variety of procedures have been used to convert this evaluation into a measure of driver drowsiness. Most other research used the two most popular drowsiness scales, either the 7-point Stanford Sleepiness Scale (SSS) or the 9-point Karolinska Sleepiness Scale (KSS), where the numerical ratings match to a specific verbal description for the state of drowsiness in question. Examples for the KSS include 1 for extremely alert and 9 for extremely sleepy, requiring significant effort to stay awake. [14] The KSS scale is a commonly used subjective sleepiness scale whose results are connected with physiological measurements and the results of the psychomotor vigilance test (PVT). KSS Scale is shown in the table 2.2 (b) below:

Table 2.2 (b): Karolinska Sleepiness Scale (KSS)

Rating	Verbal Description
1	Extremely Alert
2	Very Alert
3	Alert
4	Fairly Alert
5	Neither Alert nor Sleepy
6	Some Sign of Sleepiness
7	Sleepy, but no Effort to keep Alert
8	Sleepy, some Effort to keep Alert
9	Very Sleepy, great Effort to keep Alert

The subjects of these tests are given brief questionnaires, and they are instructed to rate their current state using the provided scale. A sample's members who slept a lot have been identified using KSS scores. In reality, simulator night driving results in greater KSS scores than on-road night driving. Participants who self-rated as drowsier (KSS > 8) and less sleepy (KSS < 3) were distinguished.

Similarly, SSS is an instrument that contains seven statements through which people rate their current level of alertness (e.g., 1= feeling...wide awake to 7= sleep onset soon.). The scale correlates with standard performance measures, is sensitive to sleep loss and can be administered repeatedly throughout a 24-hour period. Typically, subjects are asked to rate their alertness level every two hours throughout the day by choosing a single number associated with specific alertness description. SS Scale is shown in the table 2.2 (c) below:

Table 2.2 (c): Stanford Sleepiness Scale (SSS)

Value	Description
1	Feeling active, vital, alert or wide awake
2	Functioning at high levels, but not at peak; able to concentrate
3	Relaxed, awake but not fully alert; responsive
4	Little foggy
5	Foggy, beginning to lose track; having difficulty staying awake
6	Sleepy, woozy, fighting sleep; prefer to lie down
7	Cannot stay awake, sleep onset appears imminent

The KSS was categorized into three clusters: KSS 1–5 represents alertness; KSS 6–7 represents the onset of drowsiness; and KSS 8–9 represents extreme drowsiness. Performance variations between people have been observed during insufficient sleep earlier and were predicted. Although drowsiness can be detected using subjective assessments in a controlled environment, other metrics may be more appropriate for application in actual settings.

It has been shown that the amount of sleepiness as measured by the KSS has, in most situations, a curve-linear relationship to lateral location and blink duration when matched to other driver fatigue measurements. Higher subjective drowsiness scores on the KSS scale were associated with slower eye movements and greater visual equivalent drowsiness scores were associated with longer eye blink durations. Several instances show that on-road night driving KSS scores are higher than those for daytime driving. Every five minutes, the KSS ratings of drivers and compared them to the gathered EOG signal. [15] A correlation between the length of the eye blink, the variation in lane position, and the KSS recorded every 5 and 2 min during the driving activity has been found by several researches.

A common model for KSS or SSS data analysis is shown in the figure 2.2 (d) [2] below:

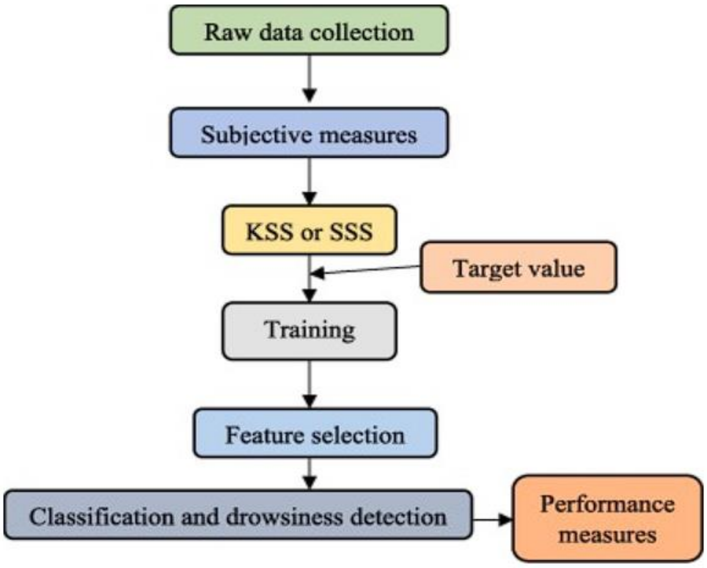

Figure 2.2(d): A typical Model for KSS or SSS Data Analysis [2]

2.3 Comparative Analysis

Driver fatigue is a major safety concern on the road, as it can lead to accidents and injuries. One way to address this issue is through the use of a driver anti-sleep alarm system. This type of system is designed to alert the driver when they show signs of fatigue, such as nodding off or closing their eyes for too long.

There are several different approaches to designing and implementing a driver anti sleep alarm system. Some systems use sensors to monitor the driver's eye movements, while others use facial recognition software to detect changes in the driver's facial expression or head position. [16] Some systems use a combination of these technologies, as well as other factors such as the time of day and the length of the trip, to determine when the driver may be at risk of falling asleep.

A comparative analysis of different driver anti-sleep alarm systems would involve examining the various technologies and approaches used by each system, as well as their effectiveness in detecting and preventing driver fatigue. This could include comparing the accuracy and reliability of different sensors and facial recognition software, as well as the overall cost and complexity of each system. It could also involve evaluating the user experience of each system, including how easy it is for drivers to use and whether it causes any distractions or discomfort.

Overall, the goal of a comparative analysis would be to identify the most effective and practical solution for reducing the risk of driver fatigue and improving road safety. A comparison of different measures is shown in the table 2.3 below:

Table 2.3 Comparison of various Measures

Measures	Parameters	Advantages	Limitations
Subjective Measure	Questionnaire	Subjective	Not Possible in Real-time
Vehicle based Measure	Deviation from the Lane Position Loss of Control over Steering Wheel Movements	Non-intrusive	Unreliable
Behavioural Measure	Eye Closure Eye Blink Head Pose	Non-intrusive Ease of Use	Lighting Condition Background
Physiological Measure	Statistical & Energy features derived from ECG EOG & EEG	Reliable Accurate	Intrusive

2.4 Scope of the Problem

The scope of the problem of driver fatigue can be quite broad, as it can affect drivers of all types of vehicles and in a variety of settings. Some of the key factors that can contribute to driver fatigue include:

1. **Length of time spent driving:** The longer a person drives, the more likely they are to experience fatigue. This is especially true if the trip involves long stretches of monotonous driving or if the driver has been awake for an extended period of time.
2. **Lack of sleep:** Drivers who are sleep deprived are more prone to fatigue, as the body's natural sleep-wake cycle is disrupted. This can be a problem for drivers who work long hours or who have irregular sleep schedules.
3. **Time of day:** Fatigue is more common during the night, when the body's natural sleep wake cycle is primed for sleep. This can be a problem for drivers who work overnight shifts or who travel long distances at night.

4. **Medical conditions:** Certain medical conditions, such as sleep disorders or undiagnosed sleep apnea, can increase the risk of fatigue.
5. **Substance abuse:** Alcohol and certain medications can impair a person's ability to stay awake and alert while driving. Drink and driving can severely affect the performance of the system. Therefore, it should be avoided. [17]

The scope of a driver anti-sleep alarm system project would depend on the specific goals and objectives of the project. The scope of the project could also vary based on the target audience, such as whether it is designed for commercial truck drivers, long-haul drivers, or everyday commuters.

2.5 Challenges

There are several challenges that may arise when developing and implementing a driver anti-sleep alarm system. Some of these challenges include:

1. **Sensing technology:** One of the key challenges in developing an effective driver anti- sleep alarm system is accurately detecting when the driver is at risk of falling asleep. This can be difficult to do using sensors alone, as there are many other factors that can affect a person's eye movements or facial expressions. As a result, it may be necessary to use a combination of sensors and other technologies, such as facial recognition software, to more accurately detect fatigue.
2. **False alarms:** Another challenge is avoiding false alarms, which can be frustrating and distracting for drivers. False alarms can be triggered by a variety of factors, such as changes in lighting or the driver's facial expression. To minimize false alarms, it may be necessary to fine-tune the system's sensitivity and to use multiple sensors and technologies to confirm the presence of fatigue.
3. **User acceptance:** In order for a driver anti-sleep alarm system to be effective, it needs to be used consistently by drivers. However, drivers may be resistant to using the system if it is perceived as intrusive or inconvenient. To increase user acceptance, it may be necessary to design the system to be as unobtrusive and easy to use as possible.
4. **Cost:** Developing and implementing a driver anti-sleep alarm system can be expensive, as it requires the use of specialized sensors and software. This can be a challenge for some organizations, especially if they are trying to implement the system on a large scale.

Chapter 3

Design Specification

3.1 Design Requirement

Design requirements are the specific requirements that must be met in order to design a system that is functional, reliable, and user-friendly. In the context of a driver anti-sleep alarm system project, the design requirements would depend on the specific needs and goals of the project, as well as any relevant regulatory or legal requirements. Some possible design requirements for a driver anti-sleep alarm system might include:

1. **Accuracy:** The system must be able to accurately detect signs of driver fatigue, such as nodding off or closing the eyes for extended periods of time.
2. **Reliability:** The system must be reliable and work consistently over time. It should not be prone to false alarms or other issues that could distract or annoy the driver.
3. **Ease of use:** The system should be easy for drivers to use and understand, with clear instructions and straightforward controls.
4. **Compatibility:** The system should be compatible with a variety of vehicle types and models, as well as different operating systems and hardware configurations.
5. **Safety:** The system should not distract the driver or cause any other safety issues while it is in use.
6. **Compliance:** The system should comply with any relevant safety regulations or standards, such as those governing the use of electronic devices in vehicles.

By defining the design requirements up front, it is possible to ensure that the system is developed and implemented in a way that meets the needs of all stakeholders and addresses any potential risks or concerns.

3.2 Business Process Modeling

Business process modeling is the process of creating a visual representation of the steps and activities involved in a business process. In the context of a driver anti sleep alarm system project, business process modeling could be used to understand and optimize the various processes involved in developing, implementing, and maintaining the system. There are several different approaches to business process modeling, but one common method is to use flowcharts or diagrams to depict the steps in a process. [18] A typical business process model is shown in the figure 3.2 [7]. For example, a business process model for a driver anti-sleep alarm system project might include the following steps:

1. **Identify the problem:** The first step in the process is to identify the problem that the driver anti-sleep alarm system is intended to solve. This may involve analysing data on accidents and injuries caused by driver fatigue, as well as researching the underlying causes of fatigue.
2. **Develop a solution:** Next, the team would develop a solution to the problem, which might involve designing a system that uses sensors and/or facial recognition software to detect signs of driver fatigue.
3. **Test the solution:** The team would then test the solution to ensure that it is accurate and effective at detecting fatigue. This might involve using simulation software or conducting field tests with actual drivers.
4. **Implement the solution:** Once the solution has been tested and proven to be effective, it can be implemented on a wider scale. This might involve installing the system on a fleet of vehicles or making it available to individual drivers.
5. **Monitor and maintain the system:** Finally, the team would need to monitor and maintain the system to ensure that it is working properly and to make any necessary updates or modifications. This might involve troubleshooting any issues that arise, as well as conducting regular maintenance and performance checks.

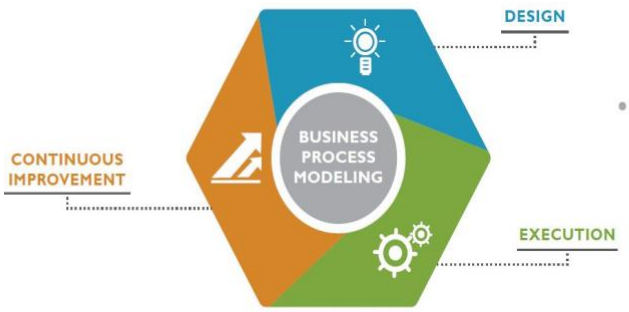

Figure 3.2: Business Process Modeling [7]

By modeling the business process in this way, it is possible to identify any bottlenecks or inefficiencies in the process and to develop strategies for improving the system's performance and effectiveness.

3.3 Requirement Collection and Analysis

Requirement collection and analysis is an important step in the development of any project, including a driver anti-sleep alarm system. This process involves gathering and organizing information about the needs and expectations of stakeholders, as well as any relevant regulatory or legal requirements. There are several different approaches to requirement collection and analysis, but some common methods include:

1. **Interviews:** One way to gather requirements is to conduct interviews with stakeholders, such as drivers, safety managers, and regulatory authorities. These interviews can help to identify the key needs and concerns of stakeholders and to clarify any ambiguities or uncertainties.
2. **Surveys:** Surveys can be a useful tool for gathering data from a large number of stakeholders. Surveys can be conducted online or in person, and can be used to gather a wide range of information, including opinions, preferences, and experiences.
3. **Focus groups:** Focus groups involve bringing a small group of stakeholders together to discuss a particular issue or topic. These sessions can be a useful way to gather more in-depth and qualitative data on stakeholders' needs and expectations.
4. **Observation:** Observing stakeholders in their natural environment, such as while they are driving, can provide valuable insights into their needs and behaviours. This can be done through the use of cameras or other sensors.

Once the requirements have been collected, they can be analysed to identify any common themes or patterns. [19] This can help to prioritize the requirements and to focus on the most important needs and concerns of stakeholders. It can also help to identify any potential conflicts or trade-offs that may need to be addressed in the design of the system.

3.4 Logical Data Model

A logical data model is a conceptual model that represents the data used by a system and the relationships between the data. In the context of a driver anti-sleep alarm system project, a logical data model could be used to organize and structure the data collected by the system, such as information about the driver's eye movements, facial expressions, and driving patterns. There are several different approaches to creating a logical data model, but one common method is to use entity-relationship diagrams (ERDs). An ERD is a graphical representation of the data entities (or "things") in a system and the relationships between them.

To create a logical data model for a driver anti-sleep alarm system, the team would need to identify the data entities that are relevant to the system and the relationships between them. For example, the data model might include entities such as "driver," "trip," and "alarm," as well as relationships such as "drives" and "triggers." The ERD would then depict these entities and relationships in a visual way, using symbols such as boxes and lines to represent the different elements. [20]

The logical data model can be used to understand and organize the data used by the system and to design the database structure and schema that will be used to the data. It can also be used to identify any potential data quality or integrity issues and to develop strategies for addressing them.

3.5 Front-end Design

A driver anti-sleep alarm system is a device that helps prevent drivers from falling asleep while driving. It typically works by detecting when the driver's head nods or the vehicle drifts out of its lane and issuing an alert to wake the driver up. For the front-end design of this project, you will need to consider the user interface (UI) and user experience (UX) of the device. This includes the layout, design, and functionality of the device's display and controls. Here are some things to consider when designing the front-end of a driver anti sleep alarm system:

1. **Ease of use**: The device should be easy to use and understand, with clear and intuitive controls. The driver should not have to spend a lot of time figuring out how to use the device.
2. **Visibility:** The display should be easy to read in a variety of lighting conditions, including at night. The driver should not have to strain to see the display.
3. **Alerts:** The device should have a clear and attention-getting alert system to wake up the driver when necessary. This could be a loud beep or an alarm, or a vibrating seat or steering wheel. The driver should be able to easily understand the alert and know what to do in response.

4. **Customization:** The device should allow the user to customize settings such as sensitivity and alert frequency. The driver should be able to easily adjust these settings to their preference.
5. **Integration:** The device should be easily integrated into the vehicle's existing controls and display system. The driver should not have to spend a lot of time figuring out how to use the device in conjunction with other systems in the vehicle.

3.6 Back-end Design

The back-end design of a driver anti-sleep alarm system refers to the underlying hardware and software that powers the device. Here are some things to consider when designing the back-end of this project:

1. **Sensors:** The device will need sensors to detect when the driver's head nods or the vehicle drifts out of its lane. These could include cameras, accelerometers, gyroscopes, and other types of sensors.
2. **Power source:** The device will need a power source, such as a battery or connection to the vehicle's electrical system. Consider how long the device should be able to operate without needing a charge or replacement.
3. **Connectivity:** The device may need to connect to other systems, such as the vehicle's onboard diagnostic system or a smartphone app. Consider the type of connectivity required and the best way to implement it.
4. **Hardware:** The device will need physical hardware, such as a processor, memory, and other components, to run the software and perform the necessary tasks. Consider the type and size of hardware needed for the device.
5. **Software:** The device will need software to control the hardware and perform the necessary tasks. This could include an operating system, drivers, and other applications.

3.7 Block Diagram and Description

Block diagram is a technique used to capture and organize the requirements for a system. In the context of a driver anti-sleep alarm system project, block diagram could be used to identify the different ways in which the system might be used and to specify the steps and interactions involved in each use case.

A block diagram is a description of a specific scenario or interaction between a user (in this case, the driver) and the system. Each use case typically includes a set of steps, that describe the interactions between the user and the system.

To create a block diagram model for a driver anti-sleep alarm system, we would first identify the different types of users and the tasks that they need to perform with the system. [21] For example, block diagram for a long-haul truck driver might involve detecting and alerting the driver when they show signs of fatigue during a long trip. A block diagram for a commuter might involve detecting and alerting the driver when they show signs of fatigue during a daily commute. A typical block diagram is shown the figure 3.7 below:

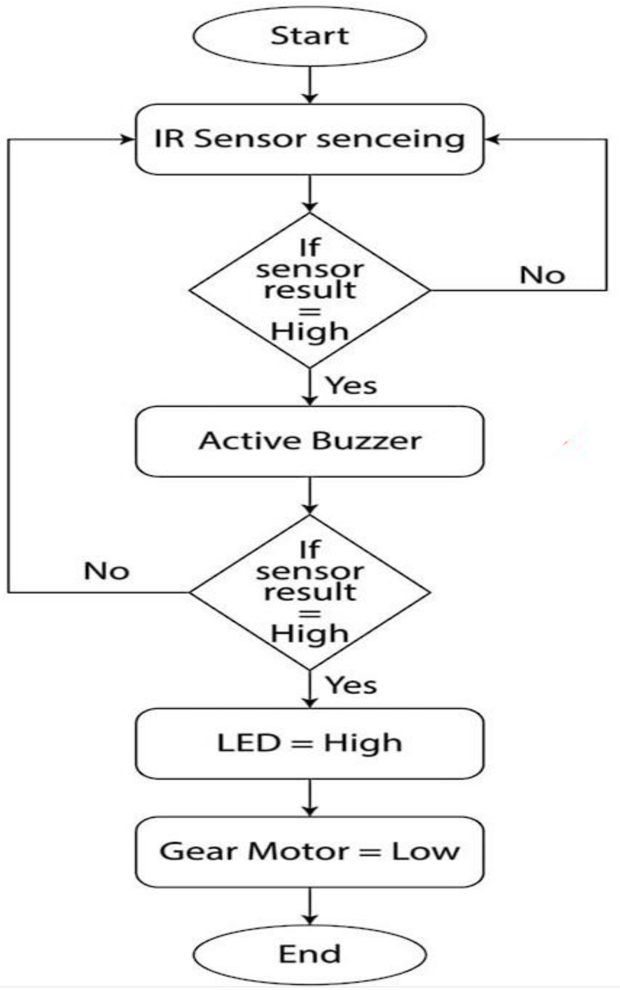

Figure 3.7: Block Diagram of the Proposed System

Once the use cases have been identified, the team can create a detailed description of each use case, including the steps involved and the expected outcomes. For example, a use case for detecting and alerting a driver when they show signs of fatigue might include the following steps:

1. The driver starts the trip
2. The system monitors the driver's eye movements using IR Sensor.
3. If the system detects signs of fatigue, it sounds an alarm.
4. If driver do not open his eye the system automatic stop the engine.
5. The driver responds to the alarm by taking a break or pulling over to rest.
6. By modeling the use cases in this way, it is possible to understand the requirements for the system in more detail and to ensure that the system is designed to meet the needs of all of the different users.

3.8 Implementation Requirements

To implement a driver anti-sleep alarm, you'll have to be compelled to think about variety of necessities. Here are some things to consider:

1. **Hardware:** We will have to be compelled to choose and get the hardware elements for the device, like sensors, piezo-buzzer, Arduino UNO, relays and alternative elements. We will conjointly have to be compelled to think about the way to power the device, either through battery or affiliation to the vehicle's electrical system.
2. **Software:** We have to be compelled to develop or purchase the computer code for the device, together with the package, drivers, and any necessary applications. We will conjointly have to be compelled to think about the way to update the computer code as required.
3. **Connectivity:** If the device has to connect with alternative systems, like the vehicle's onboard diagnostic system or a smartphone app, we will have to be compelled to think about the kind of property needed and therefore the best thanks to implement it.
4. **Testing:** We will have to be compelled to check the device to make sure that it's reliable, accurate, and meets the wants of the user. This could involve testing completely different in several in numerous} environments and with different users.
5. **Certification:** Depending on our location , laws varies and therefore the laws need to be followed, we will have to be compelled to get certifications or approvals for the device from the required authority and this might embrace safety certifications, emissions certifications, or some other alternative styles of approvals.
6. **Manufacturing:** If we're manufacturing the device on an oversized scale, we will have to be compelled to think about the producing method, together with the way

to assemble the device, the way to package it, and the way to distribute it to customers.

3.9 Components Required

There various hardware components that are required for the implementation of Anti-sleep Alarm System are as follows:

1. **Arduino UNO:** The Arduino Uno is a popular microcontroller board renowned for its simplicity, versatility, and robustness. At its core lies the ATmega328P microcontroller, clocked at 16 MHz, providing ample computational power for a wide range of projects. The Uno is powered by the ATmega328P microcontroller, which offers 32KB of flash memory for storing code, 2KB of SRAM for variables, and 1KB of EEPROM for data storage. It features 14 digital input/output pins, of which 6 can be used as PWM (Pulse Width Modulation) outputs, allowing for precise control over motors, LEDs, and other devices. [22] The Uno as shown in the figure 3.9 (a) [5] boasts 6 analog input pins, enabling the connection of sensors and other analog devices to measure variables such as temperature, light, and sound.

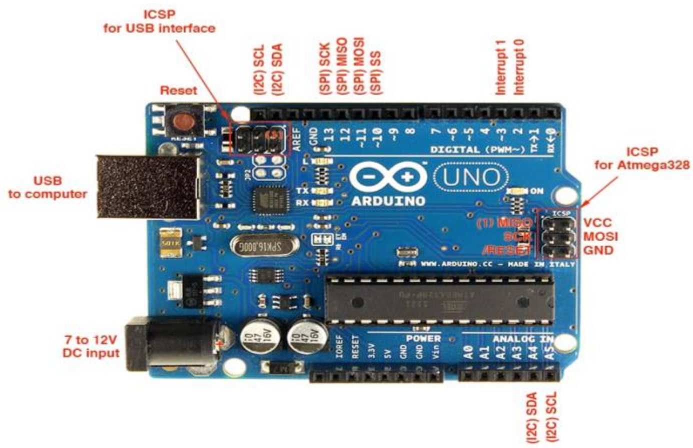

Figure 3.9 (a): Arduino UNO Board [5]

2. **IR Sensor:** IR sensor is an electronic device that emits the light in order to sense some object of the surroundings. An IR Sensor can measure the heat of an object as well as detects the motion. Usually, in the Infrared spectrum all the objects radiate some form of thermal radiation. These types of radiations are invisible to our eyes, but infrared sensor can detect these radiations. The emitter is simply an IR LED and the detector is simply an IR photodiode. Photodiode is sensitive to IR light of the same wavelength which is emitted by the IR LED. [23] When IR light falls on the

photodiode, the resistances and the output voltages will change in proportion to the magnitude of the IR light received. IR Sensor is shown in the figure 3.9 (b) [5]

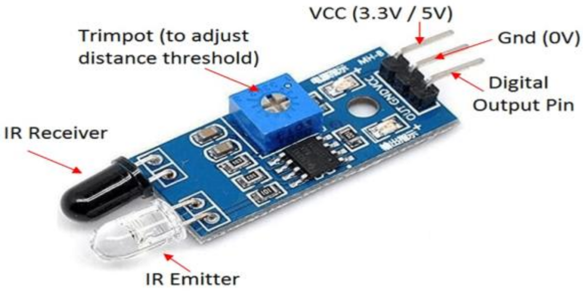

Figure 3.9 (b): IR Sensor [5]

There are five basic elements used in a typical infrared detection system: an infrared source, a transmission medium, optical component, infrared detectors or receivers and signal processing. Infrared lasers and Infrared LEDs of specific wavelength used as infrared sources. The three main types of media used for infrared transmission are vacuum, atmosphere and optical fibre. Optical components are used to focus the infrared radiation or to limit the spectral response.

3. **Relay Module:** A relay module is a fundamental component in electrical and electronic systems, serving as a versatile and reliable switch. Comprising an electromechanical relay and supporting circuitry, it functions as an interface between low-voltage control signals and high-power loads. The relay module operates on the principle of electromagnetism, where the energizing of a coil generates a magnetic field, attracting an armature to make or break electrical contacts. [24] This mechanism enables the isolation of control and load circuits, providing crucial safety and protection against voltage spikes and current surges. A typical relay module is shown in figure 3.9 (c) [5] below:

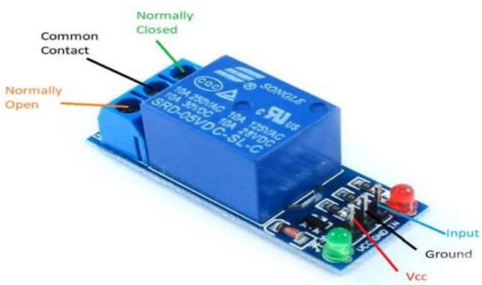

Figure 3.9 (c): A Relay Module [5]

One of the primary advantages of relay modules is their ability to handle high currents and voltages, making them indispensable in applications where direct control by low-power devices is impractical or unsafe. They find extensive use in automation, robotics, industrial control systems, and Internet of Things (IoT) projects, enabling precise control over various electrical appliances such as lights, motors, pumps, heaters, and more.

4. **Piezo Buzzer:** The piezo buzzer produces sound based on reverse of the piezoelectric effect. The generation of pressure variation or strain by the application of electric potential across a piezoelectric material is the underlying principle. These buzzers can be used alert a user of an event corresponding to a switching action, counter signal or sensor input. [25] They are also used in alarm circuits. A piezo buzzer is shown in the figure 3.9 (d) [5]

Figure 3.9 (d): A Piezo Buzzer [5]

The buzzer produces a same noisy sound irrespective of the voltage variation applied to it. It consists of piezo crystals between two conductors. When a potential is applied across these crystals, they push on one conductor and pull on the other. This, push and pull action, results in a sound wave. Most buzzers produce sound in the range of 2 to 4 kHz. The Red lead is connected to the Input and the Black lead is connected to Ground.

5. **Gear Motor 60 RPM:** The BO Series1 60RPM DC Motor Plastic Gear Motor – BO series straight motor gives good torque and rpm at lower operating voltages, which is the biggest advantage of these motors. Small shaft with matching wheels gives an optimized design for your application or robot. Mounting holes on the body & light weight makes it suitable for in-circuit placement. [26] A gear motor with wheel is shown in the figure 3.9 (e) [5] below:

Figure 3.9 (e): Gear Motor with a Wheel [5]

This motor can be used with 69mm Diameter Wheel for Plastic Gear Motors and 87mm Diameter Multipurpose Wheel for Plastic Gear Motors. Low-cost geared DC Motor. It is an alternative to our metal gear DC motors. It comes with an operating voltage of 3-12V and is perfect for building small and medium robots.

6. **Lithium-ion Battery:** When it comes to using lithium-ion batteries with Arduino Uno projects, they offer several advantages. Firstly, their compact size and lightweight make them ideal for portable or wearable projects where space and weight are critical considerations. Secondly, lithium-ion batteries provide a stable voltage output, typically around 3.7 volts when fully charged, which is compatible with the operating voltage of Arduino Uno boards (which operate at around 5 volts with a maximum tolerance of 5.5 volts). Additionally, lithium-ion batteries can be recharged multiple times, making them cost-effective and environmentally friendly compared to single-use batteries.The voltage typically ranges from 3.2 to 4.2 volts per cell, with multiple cells often combined in series to achieve higher voltages. [27] A typical 3.7V Li-ion battery is shown in the figure 3.9 (f) [5] below:

Figure 3.9 (f) : A 3.7V Li-ion Battery [5]

7. **Jumper Wire:** Generally, jumpers are tiny metal connectors used to close or open a circuit part. They have two or more connection points, which regulate an electrical circuit board. Their function is to configure the settings for computer peripherals, like the motherboard. Suppose your motherboard supported intrusion detection. Jumper wires are shown in the figure 3.9 (g) [5] below:

Figure 3.9 (g): Jumper Wire [5]

A jumper can be set to enable or disable it. Jumper wires are electrical wires with connector pins at each end. They are used to connect two points in a circuit without soldering. You can use jumper wires to modify a circuit or diagnose problems in a circuit.[27] Further, they are best used to bypass a part of the circuit that does not contain a resistor and is suspected to be bad. This includes a stretch of wire or a switch.

8. **Eye Glasses:** The eye blink system comes with an IR sensor mounted on glasses which the user can wear like regular glasses, shown in the picture below. Eye blink Sensor is a relatively simple sensor used to detect eye blinks. It uses a simple infrared sensor to detect if the person's eye is closed and the corresponding data received can further be processed by any logic as required for the application. [28] Eye glasses with IR Sensor is shown in the figure 3.9 (g) [5] below:

Figure 3.9 (g): Eyeglass with IR Sensor [5]

3.10 Circuit Diagram

The proposed system is built in four stages and it is applied to the Microcontroller.

1. IR LED focused to the eye.
2. Photodiode senses the reflected ray and sends a corresponding output to the Arduino.
3. The Arduino compares the output with a set threshold and determines eye status.
4. If closed eye status comes in 10 out of last 60 reading to warn the driver or to wake him.

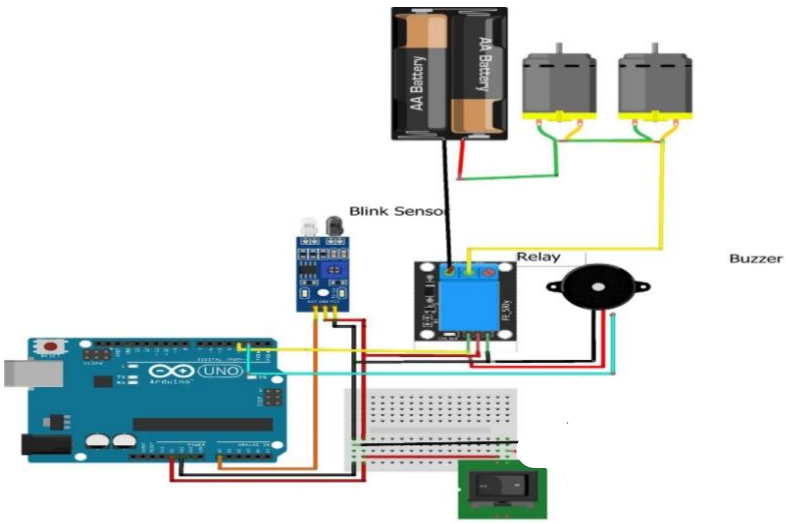

Figure 3.10 : Circuit Diagram of the Proposed System

The circuit diagram of the proposed system is shown in the figure 3.10. The sensor was processed by a microcontroller and transfer to sensor-based system. The IR Led sensor module is focused on the eye with the help of an eyeglass fixed with respect to the eye. It provides the two different level of signal from the sensor which we use to differentiate between a closed eye and open eye. The micro controller considers that the last 60 readings and if 10 of those readings indicate a closed eye then the micro controller decides that the drivers is getting drowsy an alarm is raised to warn the driver attached to the rear of the vehicle. The alarm continues for a minimum of 10 seconds and longer even until the microcontroller.

Procedure:

1) Connected all the Components as Shown in above Circuit Diagram.
2) Required Code is dumped into Arduino UNO using Arduino IDE by Connecting USB Cable to Laptop/ Computer.
3) Now Power supply is given to the Circuit with a help of a 9V Battery.
4) IR Sensor is used to detect the Eye-blink or closing the eyes of a person, if eyes closed for a while an immediate buzzer automatically turns ON.
5) The buzzer automatically turns OFF, when the person come back to his normal state.

Chapter 4

Implementation and Testing

4.1 Implementation of Database

The implementation of a database is the process of designing and building the database to store the data used by a system, such as a driver anti-sleep alarm system. By implementing the database, it is possible to ensure that the data used by the system is organized, structured, and accessible in a way that supports the needs of the system and its users

4.2 Implementation Front end Design

The front-end design of a driver anti-sleep alarm system refers to the user interface (UI) that the driver interacts with while using the system. The front-end design is a key factor in the usability and user experience of the system, as it determines how the driver accesses and interacts with the system's features and functions. To implement the front-end design of a driver anti-sleep alarm system, the team would need to consider a variety of factors, such as the layout and navigation of the UI, the visual design of the UI, and the overall user experience.

The front-end design of a driver anti-sleep alarm system refers to the user interface (UI) that the driver interacts with while using the system. The front-end design is a key factor in the usability and user experience of the system, as it determines how the driver accesses and interacts with the system's features and functions. [29] To implement the front-end design of a driver anti-sleep alarm system, the team would need to consider a variety of factors, such as the layout and navigation of the UI, the visual design of the UI, and the overall user experience. Some specific steps that might be involved in the implementation of the front-end design might include:

1. **Designing the UI layout:** The first step in implementing the front-end design is to determine the layout and navigation of the UI. This might involve creating wireframes or mock-ups of the UI to visualize how the different elements and features will be arranged and accessed.

2. **Developing the visual design:** The next step is to develop the visual design of the UI, which includes the colour scheme, typography, and other aesthetic elements. This should be done in a way that is consistent with the overall brand identity of the system and that is visually appealing and easy to read.
3. **Implementing the UI:** Once the UI design has been developed, it can be implemented using HTML, CSS, and JavaScript or other web development technologies. This might involve creating custom components and widgets or using existing libraries or frameworks.
4. **Testing and debugging:** It is important to test the front-end design to ensure that it is functional and easy to use. This might involve conducting usability testing with real users or using automated testing tools to identify any issues or bugs. By implementing the front-end design in this way, it is possible to create a UI that is intuitive, visually appealing, and easy for drivers to use.

4.3 Test Results and Reports

Test results and reports area very important part of the testing method within the implementation of a driver anti-sleep warning device. Take a look at results which give information on the performance and behaviour of the ASAS throughout the testing, whereas take a look at reports which give an outline of the results and any observations or recommendations.

The anti-sleep alarm system for drivers is shown in the figure 4.3.

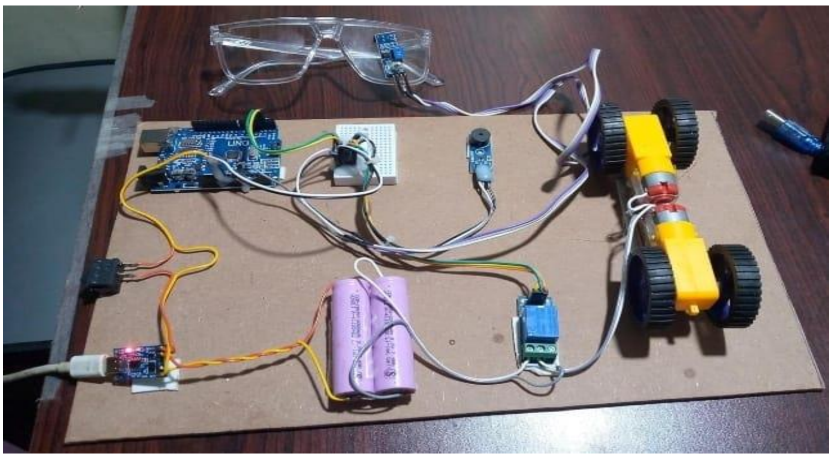

Figure 4.3: Anti-Sleep Alarm System for Drivers

There are many different types of tests, take a look at results and reports which may be generated throughout the implementation of a driver anti-sleep warning device, including:

1. **Test case results:** Test case results give information on the end result of individual cases, as well as whether or not the case passed or unsuccessful, and any error messages or different problems that were encountered. During the testing of ASAS, the system was found performing in the satisfactory manner but with a time delay between the buzzer and the braking mechanism. The microcontroller was re-programmed and the issue was resolved.
2. **Test outline reports:** Test outline reports give an outline of the results of the testing method, as well as the quantity of tests performed, cases that were run, the quantity of test cases that passed, and therefore the variety of cases that unsuccessful. A various number of tests were performed on the ASAS. The tests were performed in day light, dim light and even at night time to review the performance and efficiency of the system to detect the eye-blink. All tests were passed in day light, 90% tests were passed in dim light while 85% tests were passed in night light.
3. **Test execution reports:** Test execution report give elaborate information on the execution of the tests, as well as the steps that were taken, the expected results, and therefore the actual results. In the case of ASAS several tests were executed as mentioned in test outline report with their result. It was found that the system was performing well and is efficient in detecting the drowsiness.
4. **Test incident reports:** Test incident reports document any problems or bugs that were encountered throughout testing, as well as the steps that were taken to breed the difficulty and any recommendations for fixing it. While testing the ASAS, the braking mechanism was not working well along with the piezo buzzer, as it was encountering some delay. The re-programming of the microcontroller solved the interfacing issue of buzzer and braking mechanism.

4.4 Advantages

Anti-sleep alarm systems can help drivers stay alert and improve safety on the road by providing real-time alerts and feedback. They can also help reduce driver fatigue and prevent accidents. Some advantages of drowsiness detection systems include:

1. **Safety:** Drowsiness detection systems can help ensure that drivers keep their eyes on the road, which can increase safety for everyone, including pedestrians and bikers.

2. **Improved driving performance:** Drowsiness detection systems can help drivers promote responsible and proactive behaviour on the road.
3. **Reduced driver fatigue:** Drowsiness detection systems can help reduce driver fatigue by alerting drivers when they need to take a break.
4. **Reduced risk of accidents:** Drowsiness can affect a driver's ability to make decisions, react quickly, and stay focused on the road. Drowsiness detection systems can help prevent accidents and save lives by detecting drowsiness and alerting the driver in time.

4.5 Disadvantages

These are few drawbacks of the proposed system:

1. **False alarms:** Bright lights, sudden movements, or changes in posture can cause false alarms. Yawning repeatedly or rubbing the eyes may get the circuit ON.
2. **Technology:** The technology used in these systems can malfunction or fail. Device may not work when the system circuitry fails.
3. **Sensors:** Sensors attached to the driver's body can age and affect the driver. Prolonged exposure to IR sensor can cause irritation and itching in eyes.
4. **Driver acceptance:** Even the most sensitive system won't be effective if the driver doesn't understand or accept the warning.
5. **Driver compliance:** Drivers might forget to wear the device or be hesitant to do so.

4.6 Applications:

There are various applications of the proposed system, some of them are as follows:

1. Eyelid distance tracking to detect the Sleepiness.
2. Sleepiness detection is Efficient and alarms will generate only when demanded (while in asleep).
3. This can be used in high-end manufacturing cars to prevent accidents.
4. Not only for Drivers but also, the device is used in number of ways like, ATM Guard Security, Military Base Security, bank Security and so on.

Chapter 5

Impact on Society and Environment

5.1 Impact on Society

Driver fatigue is a major cause of accidents on the roads, and an anti-sleep alarm system can help to reduce the risk of such accidents occurring. By alerting drivers when they are becoming drowsy, the system can help to keep them awake and alert at the wheel, reducing the risk of accidents due to fatigue.

The impact of such a system on society could be significant, as it could help to reduce the number of accidents and fatalities on the roads. This could lead to a reduction in the overall cost of car insurance, as well as a reduction in the economic and social costs associated with accidents. In addition, the use of an anti-sleep alarm system could help to improve the overall safety and reliability of the road transportation system, which would be beneficial for both individuals and businesses.

Overall, an anti-sleep alarm system has the potential to have a positive impact on society by improving road safety and reducing the number of accidents and fatalities on the roads.

5.2 Impact on Environment

An anti-sleep alarm system for drivers could potentially have a positive impact on the environment in several ways.

First, by reducing the number of accidents on the roads, the system could help to reduce the amount of pollution and other emissions caused by car accidents. This could be particularly beneficial in urban areas where air quality is often poor due to high levels of vehicle traffic.

In addition, the use of an anti-sleep alarm system could help to improve the efficiency of the road transportation system, as drivers who are well-rested and alert are likely to drive more efficiently and use less fuel. This could lead to a reduction in fuel consumption and greenhouse gas emissions, which would have a positive impact on the environment. [30]

Finally, the use of an anti-sleep alarm system could also help to reduce the number of vehicles on the roads, as drivers who are more rested and alert are likely to be more productive and able to complete their tasks in less time. This could lead to a reduction in the overall amount of time that vehicles are on the roads, which would also have a positive impact on the environment.

Overall, an anti-sleep alarm system has the potential to have a positive impact on the environment by reducing accidents, improving the efficiency of the road transportation system, and reducing the number of vehicles on the roads.

5.3 Ethical Aspects

There are several ethical considerations that should be considered when developing and implementing an anti-sleep alarm system for drivers.

One ethical consideration is the potential impact on individual privacy. Some people may object to the use of an alarm system that monitors their level of alertness and sends alerts when they are becoming drowsy. It is important to ensure that any system that is developed respects the privacy of drivers and that the data collected by the system is used only for the purpose of improving road safety.

Another ethical consideration is the potential for the system to create an expectation that drivers should always be alert and awake while driving. This could lead to a culture of overwork and fatigue, which could have negative impacts on the health and well-being of drivers. It is important to ensure that any system is developed considers the need for drivers to have adequate rest and to ensure that they are not expected to drive while overly tired.

Finally, there may be ethical considerations related to the potential for the system to be used as a tool for monitoring and controlling the behaviour of drivers. It is important to ensure that the system is not used in a way that undermines the autonomy or dignity of drivers. [31] Overall, the ethical aspects of an anti-sleep alarm system for drivers should be carefully considered in order to ensure that the system is developed and implemented in a way that is respectful of the rights and well-being of drivers.

5.4 Sustainability Plan

A sustainability plan for an anti-sleep alarm system for drivers should consider the environmental, social, and economic impacts of the system.

From an environmental perspective, the sustainability plan should consider the potential impact of the system on greenhouse gas emissions, air quality, and other environmental factors. This might involve designing the system to be as energy efficient as possible, using materials that are environmentally friendly and sustainable, and implementing measures to minimize the system's impact on the environment.

From a social perspective, the sustainability plan should consider the impact of the system on the well-being and safety of drivers. This might involve designing the system to be as non-intrusive as possible, and ensuring that it does not create an expectation that drivers should always be alert and awake while driving. [32]

From an economic perspective, the sustainability plan should consider the long-term financial viability of the system. This might involve identifying potential funding sources, developing a business model that is financially sustainable, and ensuring that the system is cost-effective over the long term.

Overall, a sustainability plan for an anti-sleep alarm system for drivers should consider the environmental, social, and economic impacts of the system, and implement measures to ensure that the system is sustainable over the long term.

Chapter 6

Conclusion and Future Scope

6.1 Discussion

A driver loses control of the vehicle if they fall asleep at the wheel, which frequently leads to a collision with some other car or an immovable object. The level of drowsiness of the driver needs to be kept an eye on in order to avoid these fatal collisions. In various research, the link between driver drowsiness and accident probability has been thoroughly examined with the aim of finding and measuring the elevated risk. If a driver who is considered to be drowsy receives an alarm, many accidents on the road may be prevented. The impact of different data sets on adaptation was generally found to vary. Using only behavioural data, the majority of the model performs best at prediction. When a lack of alertness impairs vehicle control or deviates from the path planned, vehicle-based metrics are helpful in assessing drowsiness. The genuine internal state of the driver is revealed by physiological measurements, which are trustworthy and accurate. When employing the entire dataset, including behavioural, physiological, vehicle, personal, and driving time information, the best detection performance is also attained. However, there is no discernible difference between the various dataset combinations in the latter scenario.

On different days, people don't respond and react in precisely the same way, and they don't all have the same propensity to nod off while driving. Forcing a sleepy driver to operate a motor vehicle is not recommended. Understanding the connection between simulated driving behaviour and actual driving was one issue raised. As a result, numerous studies have been carried out in simulated circumstances, with the results then undergoing extensive research. In order to design a system that promotes safety and warning features, real-time data collecting and preprocessing are essential. To get this information in actual driving situations without seriously deterring the driver from their main objective is not practical. The accuracy of simulated driving situations has been investigated by several researchers through experiments. [33] The simulated environment should be as accurate a representation of the real environment as feasible when creating a drowsiness detection method. But a hybrid system that combines the advantages of the various techniques would be necessary to create a reliable drowsiness detection system.

The road and weather conditions, the driver's skill level, and the type of vehicle can all have an impact on the accuracy of the majority of approaches. Some researchers suggested deep learning techniques for multi-level classification of drowsiness to increase the accuracy by using a hybrid approach that combines different physiological, behavioural, and driving performance characteristics. In order to identify driver drowsiness with high accuracy, convolutional neural networks (CNNs) and recurrent neural networks (RNNs) have been used.

6.2 Conclusion

An anti-sleep alarm system for drivers is a technology that has the potential to improve road safety and reduce the number of accidents and fatalities on the roads. By alerting drivers when they are becoming drowsy, the system can help to keep them awake and alert at the wheel, reducing the risk of accidents due to fatigue. The ultimate goal of this system is to prevent the road accident, where the values measured in life. This system detects the drowsiness in quickly. This system which can differentiate normal eye blink and drowsiness can prevent the driver from entering the state of sleepiness while driving and create a safer driving environment.

There are several potential ethical considerations that should be considered when developing and implementing an anti-sleep alarm system for drivers, including the potential impact on individual privacy, the potential for the system to create an expectation that drivers should always be alert and awake while driving, and the potential for the system to be used as a tool for monitoring and controlling the behaviour of drivers. [34]

The majority of research share the same flaw that there weren't enough participants. Finding a generalized model that can be learned is really difficult. Because to inter-individual variability, with a select group of drivers before being applied to more drivers. Numerous studies noted a wide range in how drowsiness impacts general physiological indicators and function. The research demonstrates that initiatives by businesses, academic institutions, and governmental organizations have begun to produce significant advancements in the development of driver drowsiness detection systems.

There are indeed a number of limitations to studying the detection and prediction of driver drowsiness. Most of the studies that have been done so far don't perform well in low light conditions. Since the investigation is also depending on street conditions, light effects, and traffic instances, more trial observations are needed for many countries. The most important thing to remember is that it has become increasingly challenging to be precise as well as comprehensive.

A sustainability plan is also important for ensuring that the system is developed and implemented in a way that is environmentally, socially, and economically sustainable over the long term. This might involve designing the system to be as energy efficient and environmentally friendly as possible, considering the impact of the system on the wellbeing and safety of drivers, and identifying long-term funding sources and a financially sustainable business model.

In conclusion, an anti-sleep alarm system for drivers has the potential to have a positive impact on society by improving road safety and reducing the number of accidents and fatalities on the roads. However, it is important to carefully consider the ethical and sustainability aspects of the system in order to ensure that it is developed and implemented in a responsible and sustainable manner. [35] We conclude by emphasizing that ASAS technology has enormous market potential. Many car manufacturers, such as Toyota and Nissan, have recently installed or upgraded driver assistance devices in their products. The artificial intelligence and deep learning fields are developing tremendously. Soon, the ASAS systems will most likely evolve, enabling the formation of smart cities.

6.3 Scope for Further Developments

There are several areas where an anti-sleep alarm system for drivers could be further developed in order to improve its effectiveness and usability.

One area for further development is in the accuracy and reliability of the system. Currently, many anti-sleep alarm systems rely on indicators such as eye movement and head position to detect drowsiness, but these indicators are not always accurate and can be affected by factors such as eyeglasses or headwear. Developing more accurate and reliable methods for detecting drowsiness, such as using brainwave or physiological data, could improve the effectiveness of the system. Another area for further development is in the user interface and usability of the system. Many anti-sleep alarm systems require drivers to manually activate the alarm or to manually reset it when they become alert again. Developing more intuitive and user-friendly interfaces, such as voice-activated systems or systems that automatically adjust the alarm frequency based on the driver's level of alertness, could make the system more convenient and easier to use for drivers.

Nowadays, mobile phones are equipped with at least two cameras and multiple sensors. Additionally, they can connect with a wide range of sensors through Bluetooth or other wireless technologies. When attached to the driver’s dashboard, a mobile phone’s front camera can collect various visual parameters, including eye features, mouth features, and head movements. Furthermore, the rear camera is capable of detecting vehicle-based features, such as lane departure and change in orientation, among others. Most mobile phones are also equipped with GPS sensors, an accelerometer, a gyroscope, and a magnetometer, which also could describe the car’s direction and orientation, leading to a better understanding of the driving experience. [36] The phone’s microphone can also be used to collect data about the driver. The possibility of connecting sensors to a mobile phone using various wireless technologies allows the use of various biological sensors to collect the driver’s data seamlessly. For example, ECG, EEG or EMG, sensors can be attached to the driver’s body or embedded within the seat or steering wheel for more convenience.

The data collected by the phone are analysed using pre-trained machine learning models to infer the driver’s drowsiness status. While the use of machine learning algorithms on a mobile phone is possible, the use of deep learning is challenging and could lead to delayed inference times. Therefore, it is proposed to equip new mobile phones with chips, optimized for artificial intelligence, that facilitate the use of deep learning for drowsiness detection on mobile platforms in real-time.

This study overviews and summarizes the techniques, participants, performance metrics, and datasets for the physiological, driving-based, subjective, and behavioural drowsiness measures. It is suggested to summarize and analyse all available data regarding driver behaviour, psychology, and road conditions in future research, including more feature extraction, preprocessing, and detection algorithms. In addition to considering how future driving conditions with semi-automated and ultimately completely automated driving can affect how driver behaviours like drowsiness will really be represented, it is important to think about new indications that can forecast drowsiness. The development of an appropriate dataset that includes a diverse variety of racial groups will also be a focus of future work in order to make drowsiness assessments more accurate. Any driver sleepiness detection system must take into account practical considerations including pervasiveness, aesthetics, economic viability, and user acceptance. Future research could focus on the significant application of deep learning techniques for more accurate drowsiness detection.

In future, small micro camera will replace the eye sensor and will incorporate GPS module in the device to track the location of the driver. It can be added to every high-end manufacturing car to prevent accidents. Sleepiness detection is Efficient and alarms will generate only when demanded (while in asleep). Due to portable size, it can be used in different applications. Finally, there is also potential for further development in the integration of the system with other technologies and systems, such as navigation systems or driver assistance systems. Integrating the anti-sleep alarm system with these other technologies could allow for a more seamless and integrated experience for drivers, as well as enabling the system to make use of additional data sources to improve its accuracy and effectiveness.

In coming days 5G networks will play a prominent role in enhancing ASAS systems. With 5G connectivity, future ASAS systems will be based on real driving scenarios. The data will be obtained from various drivers in actual vehicles, where factors such as ambient light, road surface vibrations, and individual differences among drivers are considered. The use of 5G connectivity will also enable the use of multi-access edge computing power for deep learning, resulting in highly accurate real-time decisions. Vehicles are expected to operate as members of Internet of vehicle networks, enabling the network to warn the drowsy driver, take control of the car (if needed), and contact neighbouring vehicles in the network to alert them about the weary driver. These technologies will lead to safer roads and pave the way towards realizing smart cities. Overall, there are many opportunities for further development of an anti-sleep alarm system for drivers, which could lead to improved effectiveness and usability of the system and ultimately help to reduce the number of accidents and fatalities on the roads.

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Appendix A

Programming Arduino Code

The programming code for the interfacing of the microcontroller is as follows:

```
int IRSensor = 7;
int buzzer = 5;
int led = 12;
int motor=6;
int b=3000;
int m=1500;
int l=1500;
void setup()
{
 pinMode (IRSensor, INPUT);
        pinMode (buzzer, OUTPUT);
        pinMode (led, OUTPUT);
        pinMode (motor, OUTPUT);
}
void loop()
{
 int statusSensor = digitalRead (IRSensor);
        If (statusSensor == 1)
        {       digitalWrite(buzzer, LOW);
                digitalWrite(led, LOW);
                digitalWrite(motor, HIGH);
                delay(b);
}   Else
        {        digitalWrite(buzzer, HIGH);
                 delay(l);
                 digitalWrite(led, HIGH);
                 delay(m);
                 digitalWrite(motor, LOW);        }
```