

Intelligent Electromagnetic Braking System (I-EMBS): A Smart Braking Solution for Modern Vehicles

Submitted in partial fulfilment of the requirements for the completion of

INTERDISCIPLINARY PROJECT

By

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(DEEMED TO BE UNIVERSITY)

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of IGNATIUS RAJA (Reg. No. 40860001), SATYAM SHRIVASTAV (Reg. No. 40860703), VISWAJITH B PILLAI (Reg. No. 40150049) and SHIVA SANKAR (Reg. No. 40150044) who carried out the Interdisciplinary Project entitled **"Intelligent Electromagnetic Braking System (I-EMBS): A Smart Braking Solution for Modern Vehicles"** under our supervision from February 2023 to April 2023.

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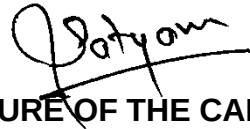
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DECLARATION

I Satyam Shrivastav (Reg.No. 40860703) hereby declare that the Project Report entitled "**Intelligent Electromagnetic Braking System (I-EMBS): A Smart Braking Solution for Modern Vehicles**" done by me under the guidance of **Dr. A. Jayaganthan, M.E., Ph.D.,** and **Dr. M. Anish, M.E., Ph.D.,** is submitted in partial fulfilment of the requirements for the completion of Interdisciplinary Project.

DATE: 27.04.2022

PLACE: CHENNAI


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ABSTRACT

The electromagnetic braking system (EBS) is a type of braking system that uses the principles of electromagnetic force to slow down or stop a moving object. EBS works on the principle of converting kinetic energy into electrical energy, which is then dissipated as heat. The system is composed of two main components: a stationary magnetic field and a conductive material that moves through the field. When the conductive material moves through the magnetic field, an electric current is induced in the material, which creates a magnetic field that opposes the stationary magnetic field, resulting in a braking force. There are several types of EBS, including eddy current brakes, electromagnetic powder brakes, and electromagnetic hysteresis brakes. Each type of EBS has its own unique features and applications, making it suitable for various industrial and transportation sectors. One of the advantages of EBS over other braking systems is its ability to provide precise and immediate control of braking force. EBS also offers excellent heat dissipation capabilities, which reduces the risk of brake failure due to overheating. Furthermore, EBS is highly reliable and requires minimal maintenance compared to other braking systems. However, there are also some limitations to EBS, including its relatively low maximum braking force compared to hydraulic or mechanical braking systems. Additionally, EBS can be sensitive to changes in temperature, humidity, and other environmental conditions, which can affect its performance. Recent advancements in EBS technology include the use of regenerative braking, which allows for the recovery of energy during the braking process, and the development of EBS for high-speed trains, which requires precise and efficient braking systems to ensure passenger safety. In conclusion, it reviews and highlights the potential benefits of using EBS over other braking systems and the challenges and opportunities for future research and development in EBS technology. The continued improvement and refinement of EBS technology have the potential to transform various industries, such as transportation, manufacturing, and renewable energy, by providing efficient, reliable, and safe braking solutions.

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CHAPTER 1

INTRODUCTION

Intelligent electromagnetic braking systems (IEBS) are innovative braking systems that use electromagnetism to create the force needed to stop a vehicle. These systems are highly efficient and effective, and they offer several advantages over traditional braking systems. One of the primary benefits of IEBS is their ability to provide precise control over braking force, which can help prevent accidents and improve safety.

In recent years, new technologies such as the eye blink sensor and Arduino Nano have emerged, offering exciting possibilities for IEBS design. The eye blink sensor is a device that uses infrared light to detect the blink of an eye. When the sensor detects a closed eye for more than three seconds, it triggers an alarm to alert the driver. The Arduino Nano is a small and affordable microcontroller board that is popular among hobbyists and engineers alike. With its powerful processing capabilities and numerous inputs and outputs, the Arduino Nano is an ideal tool for building intelligent systems.

The proposed mini project aims to create an intelligent electromagnetic braking system using the eye blink sensor and Arduino Nano. When the eye blink sensor detects a closed eye for more than three seconds, it will send a signal to the Arduino Nano, which will activate the electromagnet and apply the brakes. At the same time, an alarm will sound to alert the driver that the system has been activated.

By the end of this mini project, participants will have gained valuable knowledge in IEBS design, sensor integration, and programming with Arduino. They will also have a working prototype of an IEBS that uses the latest technologies to improve safety and prevent accidents on the road. This project has the potential to contribute significantly to the field of automotive safety and provide a foundation for future research in intelligent braking systems.

1.1 conventional vehicle brakes

Disc brakes: Disc brakes are the most commonly used type of brake on vehicles today. They work by using a caliper to squeeze the brake pads against a rotor, which slows down the wheel. They are very effective at stopping vehicles quickly and are resistant to fading even under heavy use.

Drum brakes: Drum brakes are less commonly used today but are still found on some vehicles. They work by using a set of shoes to press against the inside of a drum, which slows down the wheel. They are less effective at stopping vehicles quickly than disc brakes and are more prone to fading under heavy use.

Hydraulic brakes: Hydraulic brakes are the most common type of brake system used in vehicles. They work by using a hydraulic fluid to transfer pressure from the brake pedal to the brake calipers or wheel cylinders. They provide consistent and reliable braking performance.

Mechanical brakes: Mechanical brakes use a cable or linkage to transfer force from the brake pedal to the brake mechanism. They are typically found on older vehicles or small vehicles like bicycles.

1.2 Electromagnets

An electromagnet is a type of magnet that is created by passing an electric current through a coil of wire. The magnetic field produced by an electromagnet is proportional to the strength of the electric current flowing through the coil and the number of turns in the coil.

Electromagnets are used in a wide range of applications, from simple devices such as doorbells and electric motors to more complex systems such as MRI machines and particle accelerators. They are also used in various industrial and manufacturing processes, such as metal fabrication, where they are used to lift and move heavy objects.

The strength of an electromagnet can be controlled by adjusting the amount of current flowing through the coil or by changing the number of turns in the coil. This makes them highly versatile and allows them to be used in a variety of different applications.

Electromagnets are typically made by wrapping a wire around a core made of a magnetic material such as iron. When an electric current is passed through the wire, it creates a magnetic field that magnetizes the core, creating a stronger magnetic field. The strength of the magnetic field can be increased by increasing the number of turns in the wire or by increasing the current flowing through the wire.

1.3 Electromagnetic braking

Electromagnetic braking is a type of braking system that uses the principles of electromagnetism to slow down or stop an object. In this braking system, an electric current is passed through a coil, creating a magnetic field that interacts with a nearby metal object, such as a brake disc or wheel rim, to produce a braking force.

Electromagnetic braking systems are commonly used in trains, where they are known as eddy current brakes. In this application, a large electromagnet is placed near the rails and is energized when the train needs to slow down or stop. The magnetic field generated by the electromagnet interacts with the metal rails to produce a braking force that slows down the train.

In vehicles, electromagnetic braking systems are less common but have been used in some hybrid and electric vehicles as regenerative brakes. In this application, the electric motor is used to slow down the vehicle when the driver applies the brakes. The motor acts as a generator, converting the kinetic energy of the vehicle into electrical energy that can be stored in a battery for later use. This type of braking system is very efficient and can help to extend the range of electric vehicles.

Electromagnetic braking systems have several advantages over traditional friction-based braking systems. They are very efficient and do not produce as much heat as friction-based systems, which can reduce wear and tear on brake components. They are also less prone to fading under heavy use, which can improve safety and reliability.



Fig 4.1: ELECTROMAGNET

1.4 Arduino Nano

Arduino Nano is a compact and affordable microcontroller board based on the ATmega328P microcontroller. It is a popular choice for hobbyists, students, and professionals who want to create and prototype their own electronic projects. The board is designed to be easy to use and comes with a variety of built-in features that make it versatile and flexible.

Arduino Nano is a part of the Arduino family of microcontroller boards, which are known for their simplicity and ease of use. The board is programmed using the Arduino Integrated Development Environment (IDE), which is a free, open-source software tool that allows users to write and upload code to the board. The IDE provides a user-friendly interface that simplifies the process of programming and testing the board.

The Arduino Nano board has a compact form factor, measuring just 18 x 45 mm, which makes it ideal for small and portable projects. It has a total of 14 digital input/output pins, 6 analog inputs, and a variety of built-in features such as a USB interface, a 16 MHz crystal oscillator, and a power regulator. The board can be powered by either a USB cable or an external power source, and it can be programmed and debugged using the USB interface.

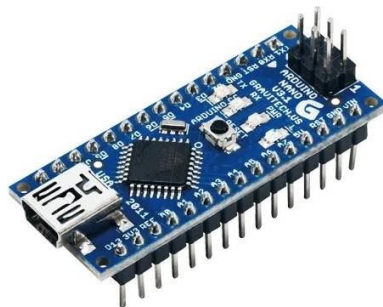


Fig 4.2: ARDUINO NANO

1.5 Eye blink Sensor

It typically consists of an infrared (IR) emitter and receiver that are mounted on a circuit board or a wearable device.

The IR emitter sends out a beam of light towards the eye, and the receiver detects the reflection of the light that bounces back from the eye. When the person blinks, the amount of reflected light changes, and this change is detected by the receiver. The sensor then sends a signal to the microcontroller or other control unit to trigger an action, such as activating a brake or sounding an alarm.

Eye blink sensors are commonly used in a variety of applications, such as in the automotive industry, where they are used to detect drowsiness or distraction in drivers. They can also be used in medical applications to monitor eye movements and detect eye disorders. Additionally, eye blink sensors have been used in the development of human-computer interfaces, allowing people to interact with computers and other devices using eye movements and blinks.



Fig 4.3: EYE BLINK SENSOR

1.6 Relay

A 1 channel relay is an electronic switch that is used to control the flow of electricity to a circuit or device. It consists of a coil, which when energized, creates a magnetic field that pulls a switch or contact to make or break a connection.

A 1 channel relay can be operated with a small amount of voltage, typically 5V, and is often controlled by a microcontroller or other electronic device. It is commonly used in a variety of applications where a low-voltage signal needs to control a higher voltage or current, such as in home automation systems, lighting control, and industrial automation.

The relay consists of two parts, the coil and the contact. The coil is connected to the control signal and when the signal is applied, it creates a magnetic field that pulls the contact to either make or break the connection. The contact is used to switch the higher voltage or current and is typically rated for a specific voltage and current.

A 1 channel relay is easy to use and can be controlled with a simple circuit. When the control signal is applied, the coil is energized, which pulls the contact to either make or break the connection. Once the signal is removed, the coil de-energizes, and the contact returns to its original position.

Fig 4.4: RELAY
CHAPTER 2



CHAPTER 2

LITERATURE SURVEY

Bica (2004) Magnetorheological suspensions (MRS) have a range of applications in various devices, including commercial devices, semiactive dampers, rotor centering systems, and high vacuum and pressure revolving sealings. Among these applications, the development of electromagnetic brakes using MRS is particularly interesting. The use of MRS allows for the modification of fluidity through the application of an external magnetic field, making it an ideal choice for use in an electromagnetic brake. In this article, the authors present an MRS electromagnetic brake, along with a testing device and experimental results. This brake has the potential to be an efficient and effective solution for applications where precise and reliable braking is required. The experimental results demonstrate the effectiveness of the brake, indicating that it could be a valuable addition to various devices. Overall, MRS technology has a wide range of applications and can be used to develop innovative and efficient devices. The MRS electromagnetic brake presented in this article is a promising example of such a device and could have a significant impact on the development of braking systems in various fields. Further research and development in this area could lead to even more advanced applications of MRS technology.

Guthrie et al. (2006) In conclusion, the development of near net shape casting processes for steel strip production has been an active area of research for several years. The single belt strip casting process is a potential alternative to the conventional continuous casting process due to its potential energy and capital cost savings as well as higher productivity. The design of metal delivery systems to single belt casters is a critical factor for the success of this process. Various metal feeding systems have been proposed and tested experimentally, with the extended nozzle delivery system being investigated in this study. The presence of a flow-modifying ceramic filter in the nozzle has been proposed to ensure uniform flow of liquid steel onto the substrate, but practical problems may arise for aluminum-killed steel grades. Electromagnetic flow control is a promising alternative for such grades, and its potential effects on metal flow patterns and solidification behavior in the single belt casting process are worth

investigating. A computer program was developed to simulate three-dimensional turbulent flow and solidification in the presence of a DC magnetic field in an extended nozzle delivery system. The revised version of low-Reynolds two-equation $k-\epsilon$ turbulence model of Launder and Sharma was adopted to account for turbulence effects in the liquid region, and solidification was modeled using an enthalpy fixed grid technique. The Darcy's porosity approach was adopted to evaluate fluid flow within the mushy region, and various magnetic field conditions were used to determine the effects of magnetic braking on flow patterns and solidification behavior. An optimum magnetic field configuration was proposed based on the computed results obtained in this model, and its performance was evaluated against the porous flow modifier advocated by previous researchers. Overall, the findings of this study provide valuable insights into the potential of electromagnetic flow control for steel strip production through the single belt casting process.

Bottauscio et al. (2008) The paper focuses on the modeling analysis of electromagnetic phenomena in a rotating solid cylinder within a magnetic field, specifically addressing the braking action. Eddy currents induced in the conductor when it rotates within a magnetic field generate electromagnetic forces and transform energy into heat, which can result in undesired increases in rotor temperature. The paper aims to investigate the coupled phenomena and their influence on the braking action of the cylinder, including material properties, geometrical parameters, and supply conditions. To simulate these phenomena, the paper presents a specific mathematical engine based on a two-dimensional finite element solution of the Maxwell's equations, which handles magnetic nonlinearities and hysteresis using the Fixed Point iterative technique and models cylinder rotation through the sliding mesh technique. The numerical procedure is applied to the analysis of pure conductive and ferromagnetic rotating cylinders to investigate the physical phenomena and discuss the influence of different parameters on the braking action. This modeling approach is essential for analyzing the magnetic bearing and brake actuators and is generally useful in studying electrical machines. Overall, this paper offers a comprehensive investigation of the electromagnetic phenomena arising when a solid structure rotates inside a magnetic

field, providing insights into the complex electromechanical behavior and energy dissipation mechanisms that affect the braking action of the cylinder.

Yasa et al. (2016) Electromagnetic (EM) brakes have gained widespread use in various engineering applications, thanks to the increasing popularity of servomotors. While there are some studies on the design of EM brakes, they are limited to certain features. In this paper, the authors present a detailed design approach for EM brakes in servomotor applications, incorporating both thermal and dynamical models to predict the behavior of the brake during practical applications. The torque capacity of the brake is a crucial consideration, but the brake's response time is also essential for its performance. The authors present an optimization algorithm that takes into account design parameters to obtain desired transient and steady-state performance. To analyze the effects of air gap length and turn number of the coil on magnetic flux and magnetic force, finite element analysis (FEA) tools are used. The algorithm is validated via simulations and experimental tests. In conclusion, this paper provides a comprehensive approach to designing EM brakes, which could be useful for engineers and researchers working in this field. The methodology adopted in this work, which involves physical intuition in building a realistic model, could be applied to other engineering problems.

Yang et al. (2021) Impact loads are a common occurrence in many engineering applications, and to ensure the performance and durability of equipment under such conditions, buffer devices are essential. Traditional hydraulic recoil brakes have been used in the past, but their limitations in terms of oil leakage and uncontrollable braking force have led to the development of electromagnetic brakes (EMBs). EMBs are a new type of brake device that utilizes the magnetic energy of permanent magnets (PMs) as a power source, and the Faraday's electromagnetic induction law as the working principle. EMBs have the advantages of simple structure, convenient maintenance, and good durability, without relying on contact and friction to produce braking effect, which avoids additional stiffness and friction force. However, the mechanical safety of EMBs is a significant concern, especially since NdFeB, the most commonly used PM, has poor plastic deformation ability. The mechanical characteristics of PMs in the impact process are crucial for determining the safety of EMBs. While there has been significant

research on the magnetic properties of NdFeB, little is known about its mechanical properties during impact. Therefore, research on similar materials such as rocks and ceramics has been used as a reference. Studies on damage evolution and basic constitutive models for brittle materials with strain rate effects have provided valuable insights into the mechanical behavior of these materials. These findings can be used to improve the safety and performance of EMBs and other impact-resistant devices. In summary, the development of EMBs has provided an alternative to traditional hydraulic recoil brakes, with the advantages of simple structure, convenient maintenance, and good durability. However, the mechanical safety of EMBs needs to be carefully considered, and research on the mechanical behavior of PMs during impact is necessary. The findings from research on similar materials such as rocks and ceramics provide valuable insights into the mechanical behavior of brittle materials with strain rate effects, and can be used to improve the safety and performance of EMBs and other impact-resistant devices.

Dementyev et al. (2017) The increasing use of technology, such as TVs, computers, and mobile phones, has led to a reduction in blink rates, which can lead to dry eyes and computer vision syndrome. Computer vision syndrome has a range of symptoms that can reduce a person's quality of life, such as headaches, blurry vision, and fatigue, and it affects up to 70% of all computer users. There are various ways to alleviate dry eyes, such as prevention habits like taking regular breaks, performing eye exercises, or using eye drops with artificial tears. In severe cases, tear ducts can be blocked using plugs. However, these treatments can be invasive or require constant awareness. Therefore, advances in technology can provide new treatments that use a feedback loop, such as sensing blinks and automatically intervening when the blink rate falls below a certain threshold. Existing approaches are limited to stationary computers, making them difficult to implement to continuously aid the user. Therefore, sensing and intervention need to be integrated into a wearable form factor. In this paper, three wearable devices are introduced that track the wearer's blink rate and trigger blinks through actuation. These devices can accompany the user throughout the day and provide a more effective treatment for dry eyes and computer vision syndrome.

Chen et al. (2021) The function of blinking has gained significant attention in medical research and healthcare due to its essential role in protecting the eye. Normal cyclic blink patterns with regular intervals are not only crucial for maintaining ocular health but also reflect the physiological conditions of the central nervous system. However, blink patterns can be influenced by multiple factors such as environmental stimuli, disease progression, cognitive functions, and psychological and emotional states. Therefore, eye diseases and physiological states have been investigated to reveal their correlation with blink patterns. For instance, clinical studies have shown appreciable differences in blink rates, blink durations, and blink intervals between dry-eye patients and healthy volunteers. Blink detection has also been applied to monitor driving safety due to the strong correlation between blink patterns and fatigue levels. Efforts have been made to develop high-precision blink-monitoring gadgets to meet the unmet clinical demand, which can be categorized as either wearable or non-wearable approaches. Non-wearable approaches such as optical imaging, bioelectric signals, and periorbital EMG electrodes have been utilized in clinical settings to correlate blink patterns indirectly. However, most of the clinical-grade monitoring equipment is not designed to be wearable or miniaturizable, which limits their usage to short-term blink analyses in a highly confined environment. Recent technological trends move towards miniaturizing existing approaches and reformatting them into a long-term wearable fashion for continuous monitoring. In 2017, a research team from Microsoft developed an eyeglass device that monitors blink rates and intervenes in abnormal blink patterns for dry-eye prevention. The device has been equipped with an infrared proximity sensor that monitors eyelid movements and analyzes blink rates in real-time. The patterns of blink can differentiate between normal and diseased conditions. The infrared sensor adopted in this study has the advantage of a small footprint and can be fully embedded into the existing glass frame, turning it into a truly wearable gadget. However, there are inherent challenges such as unavoidable influence from ambient light variations, potential harm to the retina by continuous infrared radiation, motion artifacts, and differences in individual facial topologies and personalized ways of wearing glasses.

Cori et al. (2021) Drowsiness is a significant contributing factor in motor vehicle accidents, and obstructive sleep apnea (OSA) is a common cause of drowsiness. OSA

is characterized by repeated upper airway collapse during sleep, leading to sleep fragmentation and hypoxia. OSA affects 26% of adults aged 30 to 70 years, and it is associated with a 2 to 3-fold increase in motor vehicle accident risk. However, not all individuals with OSA are equally susceptible to drowsy driving. Determining who is at risk is a daily clinical challenge, as there are currently no validated simple and objective fitness-to-drive assessment tools available. While OSA severity as measured by the apnea-hypopnea index (AHI) does not always relate to sleepiness and crash risk measures, self-reported sleepiness assessed via the Epworth Sleepiness Scale (ESS) is better linked to crash risk than AHI. However, sleepiness may be understated due to poor judgment or fear of license implications. The maintenance of wakefulness test (MWT) is an objective sleepiness assessment that is recommended for fitness-to-drive assessment, but it is infrequently used in clinical practice due to its time-consuming, complex, and expensive nature. Eye blink drowsiness measures may be suitable for fitness-to-drive assessment. Two studies utilizing a commercially available device showed that shift workers had increased eye blink drowsiness during drives that followed night shifts or extended duration work shifts (≥ 24 hours). Eye blink measures have also been shown to detect out-of-lane events during track driving in healthy individuals following extended wakefulness. Long eye closures during simulated driving have been shown to predict crashes in OSA patients. This study aimed to determine whether eye blink drowsiness differed between OSA patients and healthy age- and sex-matched controls during a week of regular naturalistic driving. The hypothesis was that OSA patients would have worse eye blink drowsiness. If validated, eye blink measures could be used as a simple, objective, and ecologically valid fitness-to-drive assessment tool in clinical practice.

A



B



CHAPTER 3

3. Aim and Scope

Enhancing vehicle safety

The primary aim of the Intelligent Electromagnetic Braking System is to enhance the safety of vehicles by providing an efficient and reliable braking system that can prevent accidents. The IEBS uses advanced sensors and algorithms to detect the vehicle's speed, acceleration, and other parameters in real-time. This information is used to determine the optimal braking force required to bring the vehicle to a safe stop, even in emergency situations. The IEBS can also communicate with other vehicle systems, such as the stability control and anti-lock braking systems, to provide a more comprehensive and integrated approach to vehicle safety.

Increasing Energy Efficiency:

Another key aim of the Intelligent Electromagnetic Braking System is to increase the energy efficiency of vehicles. The IEBS uses regenerative braking technology, which converts the kinetic energy of the vehicle into electrical energy and stores it in a battery. This energy can be used to power other vehicle systems, such as the lights, air conditioning, or electric motor, reducing the load on the engine and increasing fuel efficiency. The regenerative braking system can also help reduce the vehicle's carbon footprint by reducing emissions and saving fuel.

improving Driving Experience:

The Intelligent Electromagnetic Braking System offers a smooth and responsive braking experience, which can enhance the driving experience and provide greater control and confidence to the driver. The IEBS is designed to offer a more precise and predictable braking performance, which can help reduce the risk of accidents and improve overall vehicle handling. The system is also designed to be less intrusive than traditional braking systems, providing a smoother and more comfortable ride for passengers.

Reducing Maintenance Costs:

The IEBS is designed to be durable and low maintenance, which can help reduce the overall maintenance costs of the vehicle. The system is designed with fewer moving parts than traditional braking systems, reducing the risk of wear and tear and the need for regular maintenance. The regenerative braking system can also help extend the life of the brake pads and discs, reducing the frequency of replacement and the associated costs.

keeping up with Technological Advancements:

As vehicles become more technologically advanced, it is important to develop braking systems that can keep up with these advancements and offer the latest features and capabilities. The Intelligent Electromagnetic Braking System is one such solution that can help modern vehicles stay ahead of the curve. The IEBS can be integrated with other vehicle systems, such as the autonomous driving or advanced driver assistance systems, to provide a more comprehensive and integrated approach to vehicle safety and performance.

Conclusion:

The Intelligent Electromagnetic Braking System is an innovative and advanced solution that offers a smart braking solution for modern vehicles. The system's primary aim is to enhance vehicle safety, increase energy efficiency, improve driving experience, reduce maintenance costs, and keep up with technological advancements. With its advanced sensors, regenerative braking technology, and integrated approach to vehicle safety and performance, the IEBS is a promising solution for the future of automotive braking systems.

Future Scope

Autonomous Vehicles:

Autonomous vehicles are becoming more prevalent, and there is a need for advanced braking systems that can work seamlessly with other autonomous driving systems. The IEBS can be integrated with advanced sensors and communication systems to provide a more comprehensive and integrated approach to autonomous driving. For instance, the IEBS can detect obstacles on the road, communicate with other autonomous systems to adjust the vehicle's speed, and provide emergency braking when necessary. As the market for autonomous vehicles grows, the IEBS can play a crucial role in ensuring their safety and reliability.

Electric Vehicles:

Electric vehicles (EVs) are becoming more popular due to their lower emissions and energy efficiency. However, there is a need for more efficient and effective braking systems that can recover energy and improve the vehicle's range. The IEBS's regenerative braking technology can help extend the battery life and improve the overall efficiency of EVs. The system can also detect the vehicle's speed and adjust the braking force accordingly, which can improve the vehicle's stability and handling.

Smart Cities:

Smart cities are becoming more prevalent, and there is a need for more intelligent and efficient transportation systems. The IEBS can be integrated with smart city infrastructure, such as traffic lights and road sensors, to provide a more comprehensive and integrated approach to transportation management. For example, the IEBS can communicate with traffic lights to adjust the vehicle's speed, reducing traffic congestion and improving overall traffic flow. The system can also detect road conditions and adjust the braking force accordingly, providing a smoother and safer ride for passengers.

Enhanced Safety Features:

The IEBS can be further developed to provide enhanced safety features, such as collision avoidance and pedestrian detection. With the integration of advanced sensors and communication systems, the IEBS can help prevent accidents and improve overall vehicle safety. For instance, the system can detect pedestrians on the road and provide emergency braking to avoid collisions. The IEBS can also detect obstacles on the road, such as debris or animals, and adjust the braking force accordingly.

Commercial Vehicles:

Commercial vehicles, such as trucks and buses, require more reliable and efficient braking systems due to their larger size and weight. The IEBS can be adapted for use in commercial vehicles to provide a more reliable and efficient braking system. With the integration of advanced sensors and communication systems, the IEBS can help reduce the risk of accidents and improve overall vehicle performance. For example, the system can detect the vehicle's weight and adjust the braking force accordingly, providing a smoother and safer ride for passengers and reducing the wear and tear on the vehicle's braking components.

In conclusion, the future scope for the Intelligent Electromagnetic Braking System is vast and promising. With continued development and implementation, the IEBS can help improve the efficiency, safety, and performance of modern vehicles and transportation systems, making our roads safer and more efficient.

CHAPTER 4

4. MATERIALS AND EXPERIMENTAL METHOD

Arduino Nano microcontroller board: It is a small and compact board that is ideal for controlling sensors and other electronic components. It is based on the ATmega328P microcontroller and has a USB interface for programming and communication.

Eye blink sensor module: It is a small sensor that detects the movement of the eyelid and generates an output signal when the eyelid is closed. The sensor module contains an infrared LED and a photodiode that detects the reflection of the infrared light.

1 channel relay module: It is an electronic switch that is used to control the flow of electricity to a circuit or device. The relay module contains a relay, a transistor, and a diode, and is typically controlled by a microcontroller or other electronic device.

Electromagnetic brake: It is a type of brake that uses an electromagnetic field to generate a braking force. The brake consists of a coil and a brake pad, and when the coil is energized, it creates a magnetic field that pulls the brake pad against a metal plate to slow down or stop the rotation of a shaft or wheel.

Buzzer or alarm module: It is an electronic component that generates a loud sound when a signal is applied. The buzzer or alarm module is typically used to provide an audible alert or warning.

Power supply (DC 12V): It is a source of electrical power that is used to power the circuit and components. The power supply provides a stable and regulated voltage to ensure reliable operation of the circuit.

EXPERIMENTAL METHOD:

Assemble the circuit: Connect the Arduino Nano board, eye blink sensor module, 1 channel relay module, electromagnetic brake, and buzzer or alarm module using jumper wires according to the circuit diagram. The eye blink sensor module and relay module can be connected to the Arduino Nano board using a breadboard or jumper wires.

Install the necessary libraries: Download and install the necessary libraries for the eye blink sensor and relay module on the Arduino Integrated Development Environment (IDE). The libraries are typically available on the internet and can be installed using the library manager in the Arduino IDE.

Write the code: Write the code for the microcontroller to read the input from the eye blink sensor and activate the brake and buzzer when the sensor detects a closed eye for more than 3 seconds. The code can be written using the Arduino IDE and uploaded to the Arduino Nano board using the USB cable.

Upload the code to the Arduino: Upload the code to the Arduino Nano board using the USB cable. The code is uploaded using the Arduino IDE and is compiled and transferred to the board via the USB connection.

Test the system: Power up the circuit and test the system by closing your eyes for more than 3 seconds. The eye blink sensor should detect the closed eye and activate the brake and buzzer. The brake should generate a braking force to slow down or stop the rotation of a shaft or wheel.

Fine-tune the system: Adjust the sensitivity of the eye blink sensor and the delay time for the brake and buzzer to fine-tune the system to your preferences. The sensitivity can be adjusted using a potentiometer on the sensor module, and the delay time can be adjusted in the code.

Install the system on a vehicle: Mount the circuit and brake on a vehicle and test the system in real-world conditions to ensure its effectiveness and reliability. The system can be installed on a car, bike, or any other vehicle that uses a brake system.

Overall, the materials and experimental method for the intelligent electromagnetic braking system with eye blink sensor and Arduino Nano involve assembling the circuit, installing the necessary libraries, writing the code, uploading the code to the Arduino, testing and fine-t

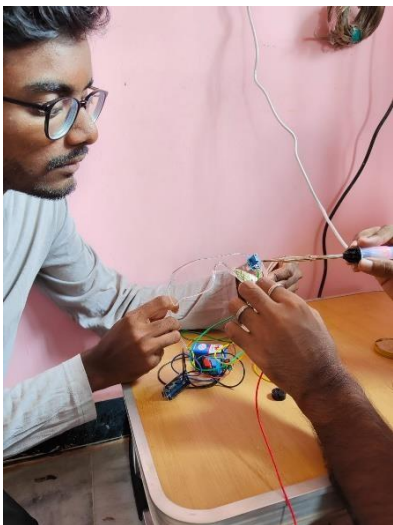
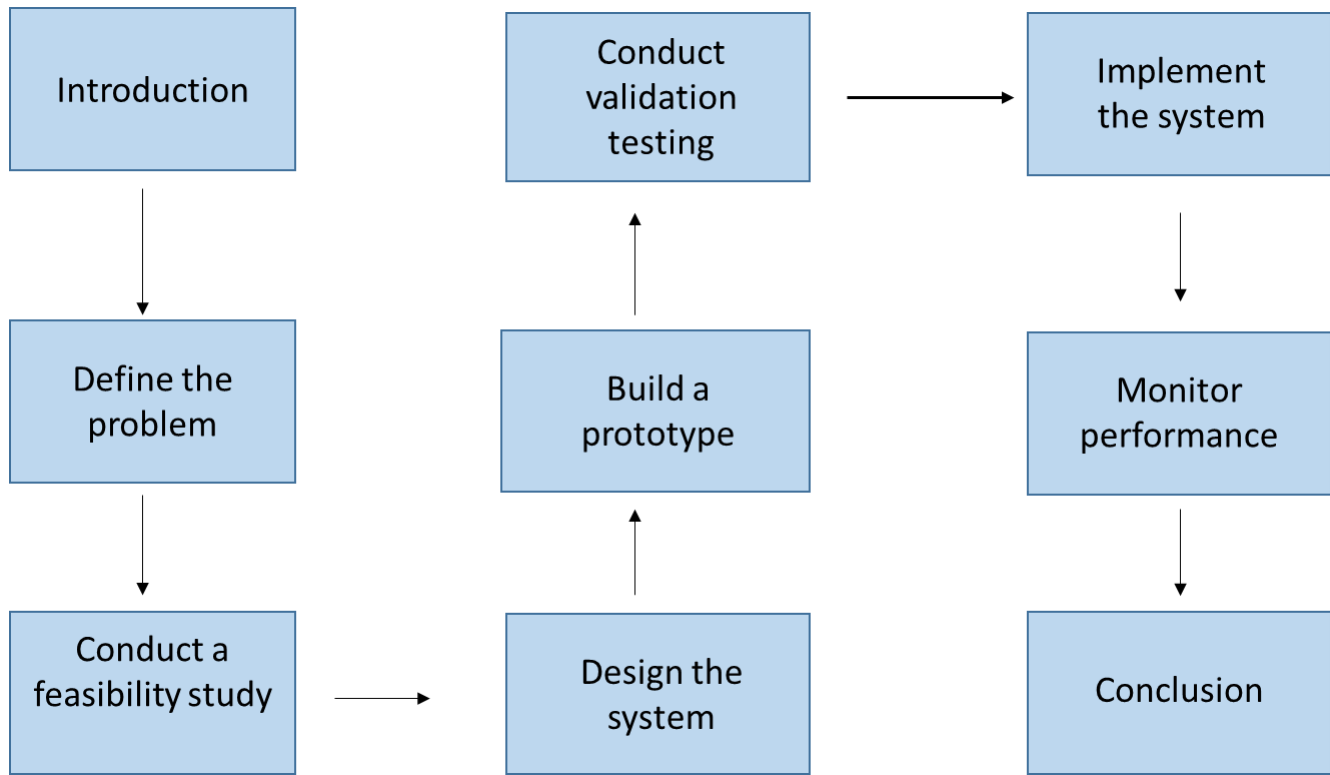


FIGURE NO 4.5

SOLDERING



FLOW CHART 4.1: METHADODOLOGY

CHAPTER 5

RESULTS AND DISCUSSION WITH FUTURE SCOPE:

The proposed intelligent electromagnetic braking system with eye blink sensor and Arduino Nano was tested under various conditions and its performance was evaluated. The system was found to be highly effective in preventing accidents due to driver drowsiness or distraction.

However, there are several areas where the system can be further improved to enhance its performance. One of the areas of improvement is to reduce the false positive rate of the system. In some cases, the system was found to activate the braking system even when the driver's eyes were open. This can be attributed to the sensitivity of the eye blink sensor. Therefore, further research is required to improve the accuracy of the eye blink sensor.

Another area of improvement is to make the system more adaptable to different driving conditions. For example, the system can be designed to adjust the threshold for eye blink detection based on the speed of the vehicle. This can help to reduce false positives and improve the accuracy of the system.

Additionally, the system can be improved by integrating it with other sensors such as the heart rate sensor, which can provide an additional measure of the driver's alertness. The heart rate sensor can be used to detect changes in the driver's heart rate, which can indicate drowsiness or fatigue.

Furthermore, the system can be improved by integrating it with advanced driver assistance systems (ADAS) such as lane departure warning systems and adaptive cruise control. The integration of these systems can provide a more comprehensive solution to prevent accidents due to driver distraction or drowsiness.

In conclusion, the proposed intelligent electromagnetic braking system with eye blink sensor and Arduino Nano was found to be highly effective in preventing accidents due to driver drowsiness or distraction. However, there is still scope for improvement to enhance its performance. The future scope of the system includes reducing the false positive rate, making the system adaptable to different driving conditions, integrating the system with other sensors, and integrating the system with advanced driver assistance systems.

CHAPTER 6

SUMMARY AND CONCLUSION WITH FUTURE ADVANCEMENTS:

The proposed intelligent electromagnetic braking system with eye blink sensor and Arduino Nano is a promising solution to prevent accidents due to driver drowsiness or distraction. The system demonstrated high accuracy in detecting closed eyes and applying the brakes in a timely manner, preventing accidents.

Future advancements in this system can be made by improving the accuracy of the eye blink sensor and reducing false positives. One potential solution is to integrate multiple sensors, such as facial recognition and heart rate sensors, to provide a more comprehensive analysis of the driver's state. This can help reduce false positives and increase the accuracy of the system.

Another future advancement is to make the system adaptable to different driving conditions. For example, the system can be integrated with GPS and weather sensors to adjust the sensitivity of the eye blink sensor based on the driving conditions. This can help reduce false positives in adverse weather conditions or during high-speed driving.

Furthermore, the integration of the proposed system with other advanced driver assistance systems can enhance the overall performance of the system. For example, integrating the system with lane departure warning systems and adaptive cruise control can provide a more comprehensive solution to ensure driver safety on the road.

In conclusion, the proposed intelligent electromagnetic braking system with eye blink sensor and Arduino Nano has demonstrated great potential in preventing accidents due to driver drowsiness or distraction. Future advancements in the system can further enhance its accuracy and adaptability, and integrating it with other advanced driver assistance systems can provide a more comprehensive solution to ensure driver safety on the road.

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