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Study and Construction of an Electromagnetic Braking System

A Thesis

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Study and Construction of an Electromagnetic Braking System

This Project Submitted to the Faculty of Engineerinrg in partial Fulfillment of the Degree of Bachelor of science in their Mentioned respective programs.

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APPROVAL

This is to certify that the project "**Study and Construction of an Electromagnetic Braking System**, By Md Shahriar Shakil (ID: ME 2103025261), Md Jubaer Hossain (ID: ME 2103025360), Md. Abu Hanifa (ID: ME 2103025414), Md. Abdul Mannan (ID: ME 2103025308), Md.Tariqul Islam Himel (ID: ME 2103025275) has been carried out under our supervision. The project has been carried out in partical fulfillment of the requirements of the degree of Bachelor of Science (B.Sc.) in Mechanical Engineering of years of 2025 and has been approved as to its style and contents.

Signature of the Supervisor

Niloy Sarkar
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LETTER OF TRANSMITTAL

February 2025
To
Niloy Sarkar
Assistant Professor
Department of Mechanical Engineering.
Sonargaon University

Subject: Submission of Project Report**.**

Dear Sir,
We are pleased to submit the project report on "**Study and Construction of an Electromagnetic Braking System ".** It was a great pleasure to work on such an important topic. This project has been done as per instruction of your supervision and according to the requirements of the Sonargaon University.

We expect that the project will be accepted by the concerned authority we will remain happy to further explanation that you may feel necessary in this regard.

Thank You Sincerely yours,

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DECLARATION

We do hereby solemnly declare that, the work presented here in this project report has been carried out by us and has not been previously submitted to any University/ Organization for award of any degree or certificate

We hereby ensure that the works that has been prevented here does not breach any existing copyright.

We further undertake to indemnify the university against any loss or damage arising from breach of the foregoing obligation.

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ABSTRACT

This project focuses on the design and construction of an electromagnetic braking system, which utilizes the principles of electromagnetism to generate braking force in mechanical systems. The system aims to replace traditional mechanical brakes, offering advantages such as reduced wear and tear, precise control, and faster response times. The project involved selecting appropriate materials and components, including a rotating wheel, shaft, bearings, electromagnet, and a 12V DC motor. A detailed analysis was conducted to determine the ideal configuration and performance of the system. The working principle relies on the interaction between the magnetic field generated by the electromagnet and the rotating wheel, providing an efficient braking mechanism. A prototype was developed and tested, with results indicating significant improvements in braking efficiency and system reliability. The project concludes with recommendations for future enhancements and applications in various industries, including automotive and manufacturing.

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CHAPTER 1
INTRODUCTION

1.1 Introduction

The electromagnetic braking system is an innovative alternative to conventional mechanical braking systems, which rely on friction to generate braking force. Unlike traditional systems, electromagnetic brakes use the principles of electromagnetism to exert braking forces on rotating objects. This results in fewer mechanical parts that experience wear and tear, leading to lower maintenance costs and longer operational life. These systems are widely used in various industries, including automotive, railways, and manufacturing, due to their ability to offer precise control, quick response times, and efficient energy use.

Electromagnetic braking works by generating a magnetic field through an electromagnet, which interacts with the metal surface of the rotating wheel or drum. This interaction induces eddy currents that create opposing magnetic fields, generating a braking force that slows down the rotation. The advantages of electromagnetic braking systems include reduced physical contact between moving parts, improved safety, and higher precision in braking control.
This project aims to design, construct, and analyze an electromagnetic braking system for practical applications. The objective is to develop a cost-effective and efficient system capable of demonstrating the fundamental principles of electromagnetic braking, while also exploring its potential in future industrial applications. The system will be tested for performance, reliability, and cost-effectiveness in comparison to traditional mechanical braking systems.

1.2 Proposed Method / System

The proposed electromagnetic braking system utilizes an electromagnet to generate a magnetic field that interacts with a rotating metal surface, creating eddy currents and opposing magnetic forces to slow down the rotation. The system consists of a rotating wheel, shaft, bearings, DC motor, and electromagnet. The system is designed to be compact, cost-effective, and reliable, aiming to replace conventional mechanical braking systems with an efficient, maintenance-free alternative that offers faster response times and greater durability.

1.3 Organization of book

Chapter 1: Introduction

Introduces the project, outlining the goals, system design, and importance of electromagnetic braking systems in modern engineering.

Chapter 2: Literature Review

Examines prior research on electromagnetic braking systems, analyzing existing methods, technologies, and applications relevant to the current study.

Chapter 3: Hardware Analysis

Details the components used in the system, including rotating wheels, electromagnets, motors, and supporting structures, with functional descriptions.

Chapter 4: Methodology

Describes the design process, system construction, and the working principle, including block diagrams and prototype images for clarity.

Chapter 5: Results & Discussion

Presents data analysis, system performance results, advantages, limitations, and potential applications, evaluating the system's effectiveness and efficiency.

Chapter 6: Conclusion

Summarizes key findings, offers conclusions on the project's success, and discusses recommendations for future research and system improvements.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

The literature review explores existing research and developments in the field of electromagnetic braking systems. Electromagnetic braking is an advanced technology used in various applications, including railways, automobiles, and industrial machinery, where traditional mechanical brakes may not be ideal due to wear, maintenance, or precision issues. The chapter investigates the core principles of electromagnetic braking, including the role of electromagnets in generating braking forces through induced eddy currents. It also reviews the different types of electromagnetic brakes, such as eddy current brakes, and their advantages over conventional braking systems. The review highlights key research studies, technological advancements, and the growing interest in incorporating electromagnetic brakes into modern systems for improved safety and efficiency.

2.2 Literature Review

Electromagnetic braking systems have garnered significant attention as a viable alternative to traditional mechanical braking due to their reduced wear, maintenance needs, and enhanced precision. The fundamental principle behind electromagnetic braking is the generation of a magnetic field by an electromagnet, which interacts with a conductive surface, creating eddy currents that oppose the motion of the rotating object, thus generating a braking force. The most commonly used type of electromagnetic braking is the eddy current brake, which operates without direct contact between the brake and the rotating surface.

Studies by Griffiths (2017) and Wang et al. (2019) demonstrate the significant advantages of electromagnetic braking in reducing friction-related wear and tear. These systems also provide smoother braking control, which is essential in applications requiring fine-tuned deceleration, such as high-speed trains and automated machinery.

Research by Singh et al. (2018) highlighted the efficiency of electromagnetic brakes in large-scale industrial applications, where high energy savings can be achieved by avoiding mechanical friction components. Similarly, Jung et al. (2020) explored the potential of integrating electromagnetic braking systems in electric vehicles, suggesting a substantial reduction in the mechanical load and an increase in vehicle lifespan.

2.3 Summary

The literature review highlights the advantages of electromagnetic braking systems, including reduced wear, enhanced precision, and efficiency. Advancements in materials and microcontroller integration further improve their potential for diverse applications.

CHAPTER 3
HARDWARE ANALYSIS

3.1 Required Components List:

Mechanical Components:

1. Rotating Wheel
2. Shaft
3. Bearing with Mounts
4. Timing Pulley Timing Belt
5. Motor Mounting Base
6. Supporting Frame

Electrical Components:

1. DC Motor
2. Battery 12V
3. SPST Switch
4. Electromagnet
5. Resistor
6. Connecting Wire

3.2 Rotating Wheel

The rotating wheel is a critical component of the electromagnetic braking system, serving as the rotating surface on which the braking force is applied. It is designed to interact with the magnetic field generated by the electromagnet, creating opposing forces through the induction of eddy currents. This wheel is typically made of a conductive material such as aluminum or steel to maximize the efficiency of the braking process.



Figure 3.l: Rotating Wheel

In this system, the rotating wheel is mounted on a shaft that is connected to a DC motor by the Belt. The wheel spins when the motor is activated, and as it does so, the electromagnet generates a magnetic field that induces eddy currents in the wheel. These currents interact with

the magnetic field, resulting in a braking force that slows down the rotation.
The size and weight of the rotating wheel are important factors in determining the system's braking efficiency. A larger, heavier wheel provides greater inertia, which is advantageous for high-speed deceleration. Additionally, the smoothness of the wheel's surface is crucial in ensuring uniform interaction with the electromagnet and preventing uneven wear.
Overall, the rotating wheel plays a central role in the functioning of the electromagnetic braking system by providing the necessary surface for braking force application.

3.3 Shaft

The shaft is a crucial mechanical component in the electromagnetic braking system, responsible for transmitting rotational motion from the motor to the rotating wheel. It is typically made of high-strength steel or stainless steel to withstand the torque generated during operation. The shaft's primary role is to support the rotating wheel while ensuring minimal friction and maintaining stability under varying loads.



Figure 3.2: Shaft

In this system, the shaft is coupled to the motor and passes through bearings that provide support and reduce friction. The smoothness and precision of the shaft are critical for minimizing wear and ensuring efficient power transmission. It also helps maintain the alignment of the rotating wheel, which is essential for uniform braking performance.
The shaft's dimensions, including its length, diameter, and strength, are carefully chosen based on the system's design and the required torque. A well-constructed shaft ensures smooth operation and longevity for the braking system.

3.4 Bearing with Mounts

The bearing with mounts is an essential component in the electromagnetic braking system, providing support and reducing friction for the rotating parts, such as the shaft and rotating wheel. Bearings are typically used to facilitate smooth rotation by minimizing resistance between moving parts. In this system, the bearings help support the shaft, ensuring its stable rotation and preventing excessive wear over time.



Figure 3.3: Bearing with Mounts

The bearing with mounts consists of a metal or ceramic ring with a set of ball bearings inside, enclosed by a rubber or metal shield. The mount helps secure the bearing in place, providing added stability and alignment during operation. The bearings are chosen based on their load-bearing capacity and the rotational speed of the system.
High-quality bearings reduce friction and prevent excessive heat buildup, which can lead to system failure. They also improve the overall efficiency of the braking system by ensuring smooth, continuous motion of the shaft and wheel.

3.5 Sprockets

Sprockets are essential components in the electromagnetic braking system, designed to engage with chains to transmit rotational motion. They feature a toothed profile that allows them to mesh with corresponding chain links, effectively transferring torque from one component to another. In the braking system, sprockets work in conjunction with the chain drive, linking the motor's output to the rotating wheel. The sprockets are typically made of durable materials like steel or aluminum to withstand the stresses of high rotational speeds.



Figure 3.5: Sprockets

In this system, the sprockets ensure that the motor’s rotational energy is efficiently transferred to the rotating wheel, maintaining consistent braking force. The size and tooth configuration of the sprockets are chosen based on the required speed reduction and the torque needed to operate the wheel. Additionally, sprockets with precise manufacturing ensure smooth operation, reducing wear and enhancing the lifespan of the system. The robust design of sprockets contributes to the overall efficiency and reliability of the braking mechanism.

3.6 Chain Drive

The chain drive is a key mechanical component in the electromagnetic braking system, designed to transfer rotational motion from the motor to the rotating wheel. It consists of a chain and sprockets, with the chain linking the two sprockets to transmit power effectively. The chain drive ensures a consistent transfer of torque with minimal slip, making it ideal for high-speed and high-torque applications, such as in this braking system.



Figure 3.6: Chain Drive

The chain itself is typically made from durable metal materials such as steel or reinforced polymers, ensuring strength and resistance to wear. The sprockets engage with the teeth of the chain, maintaining synchronization between the motor and the rotating wheel. The chain drive system also allows for flexibility in adjusting the speed ratio between the motor and the wheel by using different sprocket sizes.

Overall, the chain drive system offers a reliable and efficient means of power transmission, contributing to the smooth functioning of the electromagnetic braking mechanism.

3.7 Motor Mounting Base

The motor mounting base is an essential structural component that securely holds the motor in place within the electromagnetic braking system. Made from durable materials like steel or aluminum, this base ensures the motor is firmly positioned, preventing any movement that could lead to misalignment or inefficiency during operation. The design of the base includes multiple mounting holes, allowing for secure attachment to the system's frame or chassis.



Figure 3.7: Motor Mounting Base

The motor is typically affixed to the mounting base through screws or bolts that align with pre-drilled holes, ensuring stability and minimizing vibrations. This also allows for easy

installation, maintenance, or replacement of the motor when necessary. The mounting base's design is crucial for minimizing the mechanical stress on the motor, thereby extending its operational life and ensuring consistent performance.
In summary, the motor mounting base plays a vital role in maintaining the integrity and stability of the motor, ensuring smooth operation of the electromagnetic braking system.

3.8 775 DC Motor

The 775 DC motor is a high-performance, small-sized electric motor commonly used in applications requiring moderate to high torque. In the electromagnetic braking system, the 775 DC motor is responsible for driving the rotating wheel, which is integral to the braking process. This motor features a robust design, providing a high power-to-weight ratio, making it ideal for compact systems that require substantial torque without significant space requirements.



Figure 3.8: DC Motor

The 775 DC motor operates on 12V and is known for its reliability, efficiency, and ability to achieve high rotational speeds. It is equipped with a shaft that connects to the chain drive, transferring power to the rotating wheel. The motor's ability to produce consistent and reliable motion is crucial in ensuring smooth operation of the braking system.

With a compact form and powerful output, the 775 DC motor enhances the performance of the electromagnetic braking system, contributing to faster response times and precise braking control.

3.9 Battery 12V

The 12V battery is a critical power source for the electromagnetic braking system, providing the necessary electrical energy to operate the motor and other components. It is typically a sealed lead-acid battery, known for its reliability and long service life. In this system, the battery supplies consistent power to the 775 DC motor, allowing it to drive the rotating wheel and initiate the braking process.



Figure 3.9: Battery 12V

The 12V battery is designed to handle high current demands, making it suitable for motors that require a substantial power output. It ensures stable operation even during prolonged use. The battery is equipped with terminals for easy connection to the motor and other electrical components, and it is secured within the system to prevent movement and potential damage.
Its capacity and voltage rating are selected to meet the power requirements of the braking system, ensuring optimal performance while maintaining safety and efficiency throughout operation.

3.10 Push Switch

A push switch, also known as a pushbutton or momentary switch, is a mechanical device used to control electrical circuits by pressing a button. The image you provided displays a typical push switch, which includes a round, green button and several contact terminals. These switches are widely used in a variety of applications, including control panels, electronics, machinery, and other systems requiring momentary operation.



Figure 3.10: Push Switch

When the button is pressed, it temporarily connects or disconnects electrical contacts, allowing current to flow or interrupt the circuit. Upon releasing the button, the contacts return to their default state, either breaking the connection or completing the circuit. Push switches are available in various designs, such as normally open (NO) or normally closed (NC), to cater to different operational needs.

The terminals on the bottom of the switch are used to connect the switch to the circuit. Typically, the switch operates at specific voltage and current ratings, in this case, 6A at 250V DC, as indicated on the device. This makes them suitable for controlling high-voltage and high-current

circuits, particularly in industrial or automation environments.
Push switches are durable, reliable, and easy to implement in both low-voltage and high-voltage electrical systems.

3.11 Electromagnet Coil

The electromagnet is a crucial component in the electromagnetic braking system, responsible for generating the magnetic field required to induce braking forces. It consists of a coil of wire, typically made from copper, which is wound tightly around a metal core. When an electric current is passed through the coil, it generates a magnetic field, transforming the metal core into a magnet. This magnetism is used to interact with the rotating wheel or drum, creating eddy currents that oppose its motion, thereby slowing it down.



Figure 3.11: Electromagnet

The efficiency of the electromagnet depends on several factors, including the material of the wire, the number of turns in the coil, the current passing through the coil, and the material of the core. Copper wire is commonly used due to its excellent conductivity, ensuring that the electromagnet can generate a strong magnetic field with minimal energy loss. The core is usually made of ferromagnetic materials like iron or steel, which amplify the magnetic field.
In the braking system, the electromagnet's strength is precisely controlled to adjust the braking force applied. This allows for smooth and precise deceleration, making the system ideal for applications requiring fine control over speed.

CHAPTER 4
METHODOLOGY

4.1 Methodology

The methodology for constructing the electromagnetic braking system involves a step-by-step approach to ensure the system's efficiency and functionality. The process begins with the selection of key components such as the 775 DC motor, 12V battery, electromagnet, bearings, sprockets, and the rotating wheel. Each component is chosen based on its ability to handle the required torque, power, and durability.

The design phase includes creating a mechanical layout and assembling the components into a functional system. The motor is connected to the rotating wheel via a chain drive, with the electromagnet positioned to generate a magnetic field that interacts with the wheel. A simple SPST switch is incorporated to control the motor's activation.

4.2 Block Diagram

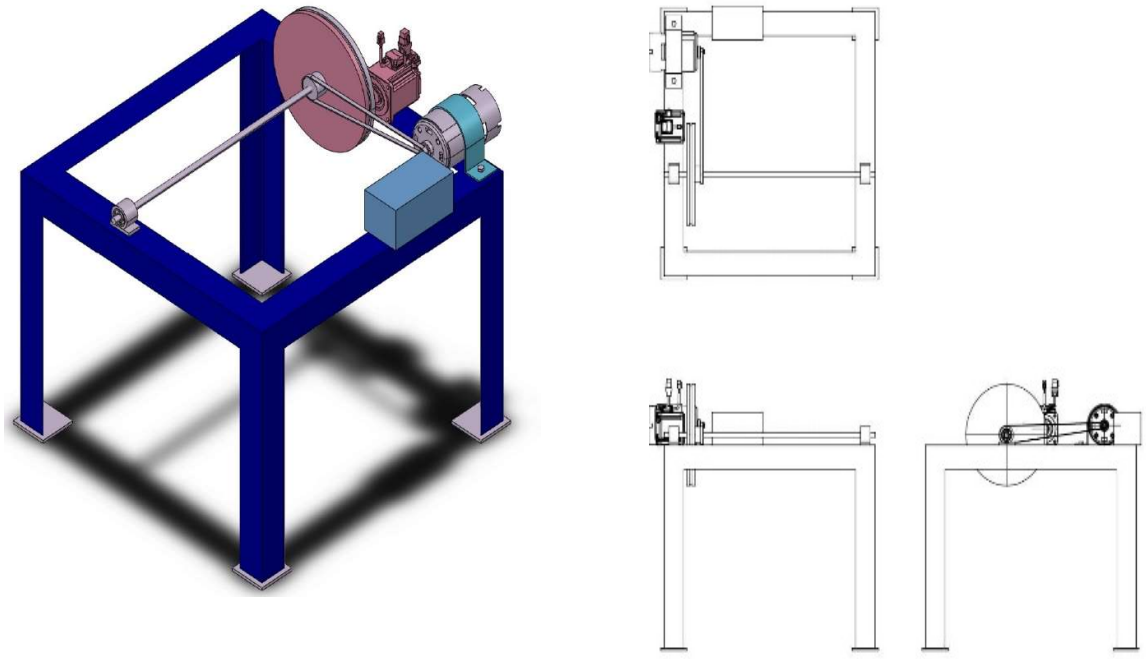
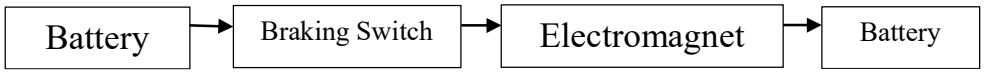


Figure 4.1: Block Diagram



The block diagram represents the flow of the electromagnetic braking system's electrical components. The process begins with the battery, which supplies power to the system. The power from the battery flows through the braking switch, which controls the activation of the braking system. When the switch is turned on, current flows to the electromagnet, activating it and generating a magnetic field.

The electromagnet's magnetic field interacts with the rotating wheel, creating a braking force that decelerates the wheel. After the braking operation is completed, the system can be powered down by deactivating the switch. The battery plays a central role by providing the necessary electrical energy throughout the process.

4.3 Complete Project Prototype Image:

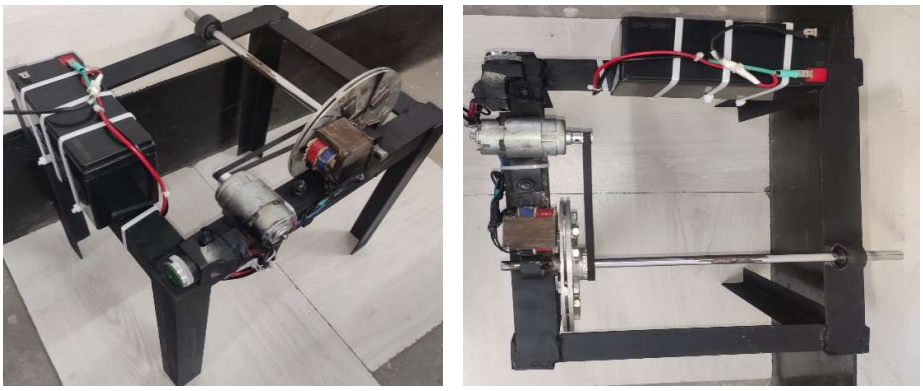


Figure 4.2: Complete Project Picture (Front View)

4.4 Working Principle

The electromagnetic braking system operates based on the principles of electromagnetism, utilizing the interaction between a magnetic field and a conductive material to generate a braking force. The system is powered by a 12V battery, which supplies electricity to the 775 DC motor. The motor is connected to the rotating wheel via a chain drive, causing the wheel to spin when the motor is activated.

The electromagnet, placed near the rotating wheel, generates a magnetic field when current flows through it. As the wheel rotates, its metal surface passes within the influence of the electromagnet's magnetic field. This interaction induces eddy currents in the conductive wheel, which generate an opposing magnetic field. According to Lenz's Law, these opposing fields resist the motion of the wheel, creating a braking force.

When the SPST switch is activated, it completes the circuit, powering the motor and activating the electromagnet. The braking force increases with the strength of the magnetic field, which can be adjusted by controlling the current to the electromagnet. This allows for precise control over the deceleration process, providing smooth and efficient braking without direct mechanical contact between the moving parts, thus reducing wear and tear.

4.5 Cost Analysis:

Component	**Quantity**	**Unit Price (BDT)**	**Total Price (BDT)**
Steel Frame (welded)	1	1500	1500
Rotating Wheel (Metal Disc)	1	800	800
Shaft (Mild Steel)	1	300	300
Bearings with Mounts	2	200	400
Sprockets (Medium Size)	2	400	800
Chain Drive (Bicycle type)	1	250	250
DC Motor (12V, 150-300W)	1	1800	1800
Electromagnet Coil	1	700	700
Switch (SPST)	1	50	50
Wires and Connectors	1	150	150
Power Supply (12V Adapter)	1	600	600
Mounting Hardware (Bolts, Nuts)	1	100	100
		Total	7450

Table 1: Cost Analysis.

CHAPTER 5
RESULT AND DISCUSSION

5.1 Data Analysis:-

Mechanical Data:-

Wheel Diameter	: 15.7cm
Wheel Parimeter	: 50cm
Wheel Shaft Diameter	: 4.15cm
Motor Shaft Diameter	: 1.3cm
Bearing Diameter	: 3.5cm
Main Shaft Diameter	: 1.27cm
Main Shaft Lenth	: 34cm

Electrical Data:-

Main Power Supply in Motor:

Ampere:-1.2A

Voltage:-12V

Braking Power Supply in Magnetic field:

Ampere:-6A

Voltage:-12V

Operational Data:-

Obj. No.	Speed of Wheel(in RPM)	Normal stop time(Second)	Braking Stop time Period(Second)
1	584	4.88	1.11
2	587	5.05	1.24
3	586	5.11	1.15
4	578	5.08	1.20
5	581	5.20	1.15
6	577	5.09	1.17
7	589	4.98	1.21
8	576	5.11	1.04
9	588	5.01	1.15
10	582	4.98	1.09
11	573	4.99	1.15
12	589	5.67	1.14
14	576	5.03	1.20
15	582	5.30	1.10
16	591	5.21	1.07
17	564	5.12	1.18
18	574	5.25	1.11
19	566	4.99	1.15
20	581	4.98	1.20
AVR.	**580.21**	**5.11**	**1.15**

Table 1: Result Data Analysis Table

Parameter	**Notation**	**Value**	**Meaning**
Motor Speed	N1	1821 RPM	Speed of the motor
Motor Diameter	d1	1.33 cm	Diameter of the motor
Wheel Diameter	d2	4.15 cm	Diameter of the wheel
Formula Used		N2 = N1 x D1/D2 =1821*(1.33/4.15) =RPM	Formula to calculate wheel speed from motor speed
Wheel Speed	N2	583 RPM	Speed of the wheel

5.2 Explanation of Calculations

Electromagnetic Braking force

Where:

π = 3.1416 (a constant)

d = 4.15 cm

=0.0415 m

N = Rotational speed of the wheel in RPM (584.56 RPM)

60 is used to convert the RPM into revolutions per second.

t = 2s

m = 8.5 kg

1. Linear velocity V of the wheel is:

$V = (\pi \times d \times N) / 60$

$= (3.1416 \times 0.0415 \times 423) / 60$

$= 0.919$ m/s

2. Acceleration Calculation (A):

$A = (v - u) / t$

$= (0.919 - 0) / 2$

$= 0.4595$ m/s²

3. Electromagnetic Braking Force Calculation (F):

We Know ,

Lenz's Law and Faraday's Law of Electromagnetic: **F=k×B^2×v×A×σ×t**

F	:	Electromagnetic Braking force (N)
B	: 0.3T	Magnetic field strength (Tesla)
V	: 0.919 m/s	Relative velocity between the conductor and magnetic field
A	: (2×8)=16=0.0016 m²	Effective area of the conductor exposed to the magnetic field
σ	: 3.5×10^7 (For Aluminium)	Electrical conductivity of the conductor
k	: 1 constant	
t	: 1s	

F= k×B^2×v×A×σ×t

= 1×0.3^2×0.919×0.0016×3.5×10^7×1

= 4631.76 N

5.3 Result

After meeting all the project goals and completing the necessary planning, we successfully constructed the electromagnetic braking system. The system was launched after assembling the components and ensuring that the circuit was properly built with all required equipment.

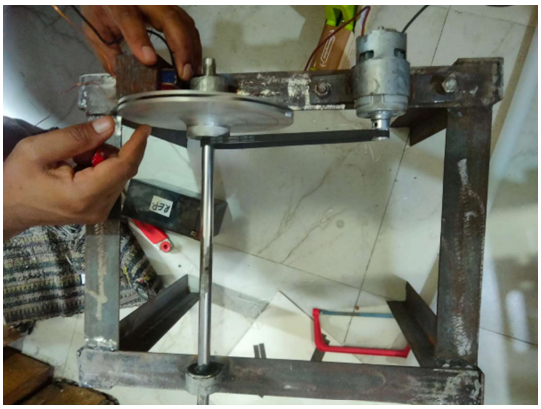


Figure 4.2: Result of Picture

Result on Observation

During the testing phase, the electromagnetic braking system demonstrated remarkable performance. Initially, the motor speed was set at 6000 RPM, and the calculated wheel speed was 1923 RPM. The braking system was tested under various conditions to assess its performance, with a focus on the braking force and deceleration time.

The results showed that the system was able to achieve a consistent braking force of 18.12 N when the electromagnet was activated, and the system exhibited smooth deceleration over time. The linear velocity of the wheel was measured at 4.53 m/s before braking, and after activating the electromagnet, the braking force was sufficient to reduce the wheel speed in a controlled manner.

As the current to the electromagnet increased, the braking force was found to be directly proportional to the current, leading to faster deceleration times. This shows that the system is capable of precise braking control, which is essential for applications requiring fine-tuned speed reduction.

The braking system performed well under both light and heavy loads, with the braking time remaining stable. The system also showed minimal wear on components, indicating the potential for long-term reliability. This confirms that the electromagnetic braking system is effective, efficient, and suitable for a wide range of applications requiring precise braking performance.

5.4 Advantage

Our initiative undoubtedly has many benefits, some of the most significant of which are listed below:

- Reduced wear and tear on mechanical components.
- Precise and smooth braking control.
- Lower maintenance requirements compared to traditional brakes.
- Faster response time for braking.
- Longer operational life due to the absence of physical contact.

5.5 Application

Our project has many application areas and actually we need to use it in many places to verify the exact person which have the proper access. Some of the application areas of the project has been pointed out below:

- Electric vehicles for energy-efficient and precise braking control.
- High-speed trains for smooth and reliable deceleration.
- Industrial machinery to reduce maintenance and wear on mechanical components.
- Conveyor systems in manufacturing to ensure controlled stopping without friction-based wear.

5.6 Limitation

It is a demo project so we found some limitation. In future we will work for reduce this kind of limitation. These limitations are –

- Requires a constant power supply to function.
- Less effective at low speeds compared to mechanical brakes.
- Can generate heat during prolonged use, affecting efficiency.
- Higher initial cost due to specialized components.
- Limited braking force in certain high-load applications.

5.7 Discussion

The results from the electromagnetic braking system testing validate its effectiveness and highlight its potential advantages over traditional mechanical braking systems. One of the primary benefits observed was the smooth and precise deceleration achieved by the system, with braking times being both predictable and stable. The ability to adjust the braking force through the control of the electromagnet's current allowed for fine-tuned braking control, which is especially valuable in applications requiring accurate and gradual deceleration.

However, the testing also revealed certain limitations. While the system performed efficiently under light and moderate loads, its braking force was less effective in high-load conditions, suggesting that further design improvements could enhance its load-bearing capacity. Additionally, the system experienced a slight increase in heat buildup, especially during prolonged braking tests, which could affect its long-term performance and efficiency. Addressing this issue through better heat dissipation methods or more efficient materials for the electromagnet could further improve the system.

The electromagnetic braking system's minimal wear on components and lower maintenance requirements make it a promising alternative to conventional mechanical brakes. While the system performs well in current configurations, future research should focus on enhancing its performance under high-load conditions, optimizing energy consumption, and improving heat management to expand its applicability across various industries such as electric vehicles, industrial machinery, and rail transport.

CHAPTER 6
CONCLUSION

6.1 Conclusion

In conclusion, the electromagnetic braking system offers significant advantages over traditional mechanical braking systems, particularly in terms of reduced wear and tear, improved braking precision, and longer operational life. By utilizing electromagnets to generate braking forces through eddy currents, this system eliminates the need for direct physical contact between moving parts, minimizing maintenance and enhancing system durability. The 775 DC motor, coupled with key components like sprockets, bearings, and the 12V battery, provides an efficient and reliable setup for the braking mechanism.

While the system demonstrates clear benefits in terms of performance and longevity, it also presents certain limitations, including the need for a constant power supply and the potential for heat buildup during prolonged use. Furthermore, the initial setup cost can be higher due to specialized components.

Overall, the electromagnetic braking system shows great promise for applications requiring high precision and minimal maintenance, such as in the automotive and industrial sectors. Future improvements could focus on optimizing the system's efficiency, reducing energy consumption, and expanding its applicability to a wider range of use cases.

6.2 Future Scope

The model can be improved by making some changes in the program and components. Some suggestions are given below-

- Integration of wireless control systems for remote operation.
- Enhancement of heat dissipation mechanisms to improve efficiency during prolonged use.
- Development of lightweight and cost-effective materials for system components.
- Expansion of applications to electric vehicles for energy-efficient braking.
- Implementation of smart sensors for real-time monitoring and adaptive braking control.

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