CONSTRUCTION AND PERFORMANCE TEST OF AUTOMATIC WINDING MACHINE

A Thesis
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SEPTEMBER, 2023

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Submitted to the
DEPARTMENT OF MECHANICAL ENGINEERING
SONARGAON UNIVERSITY (SU)
In partial fulfillment of the requirements for the award of the degree
of
Bachelor of Science in Mechanical Engineering

SEPTEMBER, 2023

Acknowledgment

We would like to express our sincere gratitude to all those who have contributed to the successful completion of this thesis.

First and foremost, we would like to thank our supervisor, Shahinur Rahman, Lecturer of Department of Mechanical Engineering, for his guidance, support, and encouragement throughout the project. We are deeply grateful for their valuable insights and expertise, which have greatly enhanced the quality and depth of our research.

And we would also like to thank our Prof. Md. Mostofa Hossain, Head, Department of Mechanical Engineering and Brig. Gen. (Retd) Prof. Habibur Rahman Kamal, ndc, psc, DEAN of Science & Engineering for their encouragements.

Finally, we would like to extend our appreciation to our friends and colleagues who have provided encouragement and support throughout the project. Their help and encouragement has been invaluable and has greatly contributed to our success.

Abstract

The automatic winding machine is an advanced electromechanical device designed for efficiently winding various types of materials onto spools, coils, or bobbins. This technology finds applications in a wide range of industries, such as textiles, electronics, automotive, and more. The primary purpose of the automatic winding machine is to streamline and automate the winding process, increasing production efficiency, reducing labor costs, and improving overall product quality.

The design and functionality of the automatic winding machine are centered around precise control, versatility, and user-friendliness. The machine consists of several key components, including a spool or bobbin holder, a tension control system, a material feed mechanism, a winding spindle, and a programmable control unit. These components work together to ensure smooth and accurate winding of various materials, such as wires, threads, yarns, tapes, and even delicate fabrics.

We measured the system's detection accuracy, response time, false alarm rate, and robustness under different operating conditions such as varying levels number of turn intensity. We also compared the performance of our system to existing systems in the literature to assess its effectiveness and identify areas for improvement.

According to the performance evaluation, it is satisfactory that we can use this device to accurately and confidently to any building or platform for a simple implementation of Automatic winding machine.

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List of Symbols

α	Alpha
β	Beta
θ	Theta
γ	Gamma
ρ	Rho (Density)
π	Pi (3.1416)

List of Acronyms

GSM	Global System for Mobile communication
LCD	Liquid Crystal Display
IOT	Internet of Things
IDE	Integrated Development Environment
USB	Universal Series Bus
HVAC	Heating, Ventilation, and Air Condtioning
CDS	Cadmium Sulfide
ICSP	In-Circuit Serial Programming
DC	Direct Current.

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Chapter 1

Introduction

1.1 Introduction

The automatic winding machine project aims to design and develop a sophisticated industrial device capable of automating the process of winding various materials onto spools, bobbins, reels, or cores. This project is driven by the need for increased efficiency, precision, and consistency in industries that rely on the winding process, such as textiles, electronics, wire manufacturing, and more.

The primary objective of this project is to create a versatile and adaptable automatic winding machine that can effectively handle different types of materials while maintaining uniform winding quality. By automating the winding process, the project seeks to reduce manual labor requirements, minimize human errors, and enhance overall production efficiency.

Key Features and Components:

Material Handling System: The proposed automatic winding machine will incorporate an advanced material handling system capable of efficiently feeding various materials to the winding mechanism.

Precision Winding Mechanism: The core of the machine will be its precision winding mechanism, designed to wind materials onto spools or reels in a controlled and uniform manner. The mechanism will incorporate adjustable tension control to accommodate different material properties.

Tension Control System: To ensure the quality of the wound product, the project will integrate a sophisticated tension control system. This system will dynamically adjust the tension based on the material being wound, preventing overstretching or slackening during the winding process. [1]

1.2. Purpose of the study

The purpose of a study related to an automatic winding machine is to comprehensively investigate & understand various aspects of the machine's design, functionality, benefits, and potential applications. This study serves as a foundation for decision-making, development, and implementation within industrial and manufacturing contexts.

1.3 Objectives

- Study of automatic winding machine system.
- Construction how to make a automatic winding machine.
- Understand the operation of the project.
- Construction to make it at low cost.

1.4 Statement of the Problem

The study on automatic winding machines aims to address several critical challenges and concerns related to the implementation, operation, and impact of these machines in industrial and manufacturing settings. The following statement of the problem outlines the key issues that this study seeks to explore and resolve.[2]

In various industries that require the precise winding of materials onto spools, bobbins, reels, or cores, there exists a need for increased efficiency, consistency, and quality in the winding process. However, traditional manual winding processes often result in labor-intensive operations, inconsistent winding quality, higher production costs, and increased risk of human errors. As industries strive to optimize production processes and enhance product quality, there is a demand for a solution that addresses these challenges.[1]

1.5 State-of-the-art Solutions

In recent years, advancements in technology have led to significant improvements in automatic winding machines, addressing various challenges associated with traditional manual winding processes. State-of-the-art solutions have emerged that enhance efficiency, precision, and versatility. Here are some cutting-edge solutions in the field of automatic winding machines. In the paper "Automated winding machine and Controlling System," the authors propose a low-cost of any winding system and control system based. The system is comprised of a combination of electrical and electronic components, including sensors, a microcontroller, and a display unit. The sensors are used to detect the presence of smoke and heat, and when a indicate number of turn is detected, the system sends a signal to the microcontroller, which in turn activates an alarm and initiates any necessary emergency response procedures. The system also includes a display unit, which provides visual feedback to the user about the status of the system and any detected of sensor. Overall, this system is designed to help prevent sensor from spreading and causing serious damage or loss by detecting winding early and activating appropriate response measures. [2]

1.6 Design Goals

Designing an automatic wire winding machine involves specific goals and considerations tailored to efficiently and accurately wind wires onto spools or coils. Here are design goals for such a machine:

High Precision and Accuracy: Precision is critical in wire winding to ensure uniformity and consistency. The machine should be capable of winding wire with tight tolerances.

Consistent Tension Control: Maintain consistent tension throughout the winding process to prevent wire breakage or slack. Implement a tension control system with sensors and feedback mechanisms.

Wire Handling: Ensure the machine can handle wires of various gauges and materials, accommodating differences in flexibility and thickness.

Adaptability: Design the machine to handle different wire types and sizes by allowing for quick and easy changeovers or adjustments.

1.7 Thesis Outline

Give a brief outline of your paper. For example:

1.7.1 **Chapter 1: Introduction** provides a transitory synopsis of basic info, the problem statement, objectives, scope, thesis contribution, and organization of the thesis.

1.7.2 **Chapter 2: Background and Motivation** present the in-progress state of exploration in AFDP system. And discussed the benefits and methods of and the justification of thesis work.

1.7.3 **Chapter 3: The Design Methods and Procedures** dives deeper into the system architecture with complete description of the methodology along with block and circuit diagram and hardware component lists.

1.7.4 **Chapter 4: Performance** Evaluation analysis of the project outcome and hardware setup, the performance metrics, and the result analysis and discussion of this project are presented.

1.7.5 **Chapter 5: Conclusion** concludes the book discussing limitations and further scopes of research work.

Chapter 2

Background and Motivation

2.1 Introduction

The development of automatic wire winding machines is driven by several key factors, including the increasing demand for precision winding in various industries. Here's some background and motivation behind the creation and evolution of automatic wire winding machines.

Industrial Automation: Automation has become a fundamental aspect of modern manufacturing processes. It offers several advantages, including increased efficiency, reduced labor costs, and improved product consistency. Automatic wire winding machines fit into this trend by automating the wire winding process, which is traditionally a labor-intensive and repetitive task.

Consistency and Precision: Many industries, such as electronic, electrical engineering, telecommunications, & automotive, require precise winding of wires onto spools, coils, or bobbins. In these applications, maintaining consistent winding tension, spacing, and layering is crucial for product quality and performance. Automatic winding machines are designed to achieve this level of precision consistently.

Increased Production Efficiency: Manual wire winding is time-consuming and can be prone to errors. Automatic wire winding machines can significantly increase production efficiency by winding wire more quickly and accurately, leading to higher throughput and reduced production costs.

Complex Geometries: Some applications require wires to be wound in complex geometries, such as toroid’s or bobbins with specific patterns. Automatic winding machines can be programmed to handle these intricate winding requirements with ease, providing capabilities that are challenging or impossible to achieve manually.

Material Conservation: Automatic winding machines can optimize material usage by minimizing waste. They can precisely control wire tension and winding patterns to ensure that minimal material is wasted during the winding process.

Safety and Ergonomics: By automating the wire winding process, companies can reduce the risk of workplace injuries associated with repetitive tasks. This promotes a safer working environment for employees while also improving overall job satisfaction.

Quality Control: Automatic wire winding machines often incorporate quality control features such as sensors and monitoring systems. These features allow real-time quality checks during the winding process, helping to identify and rectify defects or inconsistencies quickly.

Customization and Adaptability: The versatility of automatic winding machines enables manufacturers to adapt to changing product requirements easily. These machines can be programmed to accommodate different wire types, sizes, and winding configurations, making them suitable for a wide range of applications.

Competitive Advantage: Companies that invest in automatic wire winding technology gain a competitive edge by offering faster turnaround times, higher product quality, and lower production costs, ultimately increasing their market competitiveness.

Industry-Specific Needs: Different industries have specific requirements for wire winding, and automatic winding machines can be customized to meet those needs. For example, the aerospace industry may require precision winding for electrical components, while the automotive industry may need high-speed winding for wire harnesses.

In summary, the motivation behind the development of automatic wire winding machines is to improve production efficiency, enhance product quality, reduce labor costs, and meet the growing demand for precision winding in various industries. As technology continues to advance, these machines will likely become even more versatile and capable of meeting evolving industry requirements.

2.2 Literature Review

A literature review on automatic wire winding machines reveals a wealth of research and development efforts in various industries, with a focus on improving automation, precision, and efficiency in wire winding processes. Below are some key points and findings from the literature numerous studies and articles highlight the increasing trend toward automation in wire winding processes across industries.[4]

Technical Understanding: To provide a detailed technical analysis of the automatic winding machine, including its components, mechanisms, control systems, and automation features. This understanding is crucial for engineers, designers, and manufacturers who are involved in the development and operation of the machine.[4]

Functionality and Operation: To explain how the automatic winding machine operates, including its material handling, tension control, winding mechanisms, guiding systems, speed adjustments, and other relevant functions. This understanding helps operators and technicians efficiently operate and maintain the machine.[4]

Advantages and Benefits: To highlight the benefits of using an automatic winding machine in various industries. This includes improved efficiency, reduced labor costs, higher production quality, increased safety, and overall enhanced productivity.[4]

Applicability and Versatility: To explore the diverse industries and applications where automatic winding machines can be employed. This may include textile manufacturing, electronics production, wire and cable industries, paper processing, and more. Understanding the versatility of the machine helps potential users identify its relevance to their specific needs.[3]

Customization Potential: To discuss the potential for customizing the automatic winding machine to accommodate different materials, winding patterns, and production requirements. This addresses the adaptability of the machine to cater to various scenarios.[3]

Automation minimizes human error, enhances precision, and boosts production efficiency. Research in wire winding technology often discusses the importance of selecting the appropriate wire material and size based on the application. Different materials, such as copper, aluminum, and superconducting wires, have unique winding requirements. Research explores various wire guiding systems, including mechanical guides and laser-guided systems, to ensure that wires are accurately positioned during winding. Laser-guided systems are gaining popularity for their high precision. [4]

The practical implementation of the Automatic winding machine System is highly significant in ensuring safety and minimizing time in industrial settings. The system is designed to turn and through various sensors. Once the sensors detect a potential number of turn the system immediately triggers an alarm to alert workers and initiates the ventilation system to expel. In practical terms, the system can be installed in various industrial settings, including factories, warehouses, and manufacturing plants, to prevent catastrophic protect workers. The system's ability to detect and respond quickly to potential can help prevent the loss of valuable property and equipment, minimize downtime, and reduce overall costs. Furthermore, the system's practical implementation can also help businesses comply with safety regulations and standards set by various regulatory bodies. The Automatic winding machine System offers an efficient, cost-effective, and reliable solution to ensure workplace safety, protect workers, and safeguard businesses from catastrophic losses.[3]

2.3 Summary

Based on the literature review, we found that the state-of-the-art solutions for IR detection and winding systems often rely on Internet of Things (IOT) and machine learning technologies. However, our proposed system will not include IOT and will instead use fire and smoke sensors, temperature sensors. We discussed the potential benefits of our system, including its low cost and ease of implementation, compared to other systems that rely on more complex technologies. Overall, this chapter provides an overview of the background and motivation for our project, as well as a comprehensive literature review of related works. It serves as a foundation for the rest of our thesis, which will focus on the design, development, and evaluation of our proposed Automatic winding machine.

Chapter 3

The Design Methods and Procedures

3.1 Introduction

The design methodology for the Automatic wire winding machine System involves the use of several hardware components, including an Arduino Uno microcontroller board, IR sensors, motor controller, and an Display. In this section, we will describe the design process and the components used in our system.

Firstly, the Arduino Uno board is the primary component used in our system. It is a widely used microcontroller board that allows us to control and monitor various components in our system. We can program the board using the Arduino Integrated Development Environment (IDE) and upload the code to the board to control its behavior.

Next, the IR sensor, Motor controller, Resistor, Transistor, Diode are used to the project. These sensors are connected to the Arduino Uno board, which can read their output values and trigger an alarm or activate a any fault in the system in case . Finally, an IR sensor is used to measure the number of turns. The IR can be used to trigger the system to activate a winding system in case of project.

In this section, we have outlined the hardware components used in our Automatic winding machine System. The next section will focus on the software design and programming of the system.

The input devices used in this system are keypad and proximity sensor, keypad is used for feeding the machine number of slots, number of turns, width of the slot, and also for start, stop and reset of the operation. Proximity sensor is used to count the number of turns the arm rotated.

3.2 Hardware description

The items that we have used in this project are given below:

- Arduino Uno
- Motor controller
- DC Motor
- IR sensor
- Transistor
- LCD display
- LCD display adapter
- Relay
- Switch
- Diode
- Resistor
- Basic circuit component

3.2.1 Arduino Uno

Arduino Uno is a microcontroller board based on the ATmega328 microcontroller. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It is the first model of the Arduino board and the reference model for the Arduino platform. The Arduino Uno can be powered through the USB connection or with an external power supply. The power source is selected automatically. [5]

Figure 3.1: Arduino Uno

The Arduino Uno has several features that make it a useful platform for a wide variety of applications. It is easy to use and has a large user community, which means that there is a wealth of online resources and support available. The Arduino Integrated Development Environment (IDE) is a free, open-source software tool that allows you to write and upload code to the board. It supports C and C++ programming languages and has a simple, easy-to-use interface.

The Arduino Uno is widely used in a variety of projects, including robotics, home automation, and Internet of Things (IOT) applications. It is a versatile and reliable platform that can be used by beginners and experts alike. [5]

3.2.2 IR sensor

The LM393 is not an IR (Infrared) sensor itself but rather an integrated circuit (IC) that is commonly used in various electronic applications, including those involving IR sensors. The LM393 is a dual comparator IC manufactured by various semiconductor companies, such as Texas Instruments and National Semiconductor (now part of Texas Instruments).[5]
It is widely used for its versatility and ease of use in analog signal processing and comparison tasks. [4]
Here's how the LM393 can be used in conjunction with an IR sensor or other sensors.[4]
An IR (Infrared) sensor is a device that detects infrared radiation in its surrounding environment. Infrared radiation is a type of electromagnetic radiation that has longer wavelengths than visible light, making it invisible to the human eye. IR sensors are commonly used for various applications, including:
Proximity Sensing: IR sensors can detect the presence or proximity of objects by emitting infrared light and measuring the reflection or interruption of that light. These sensors are often used in applications such as automatic hand sanitizers, automatic faucets, and proximity switches in electronics.
Motion Detection: Infrared motion detectors, often referred to as passive infrared (PIR) sensors, detect changes in the heat signature in their field of view. When a warm object, such as a person or animal, moves within the

sensor's range, it triggers an output signal. PIR sensors are widely used in security systems and automatic lighting.[6]

Temperature Measurement: Some IR sensors are designed to measure the temperature of objects by detecting the infrared radiation they emit. These sensors are known as infrared thermometers or pyrometers and are used in industrial applications, medical devices, and consumer products like forehead thermometers.[6]

Remote Control: IR sensors are commonly. [5]

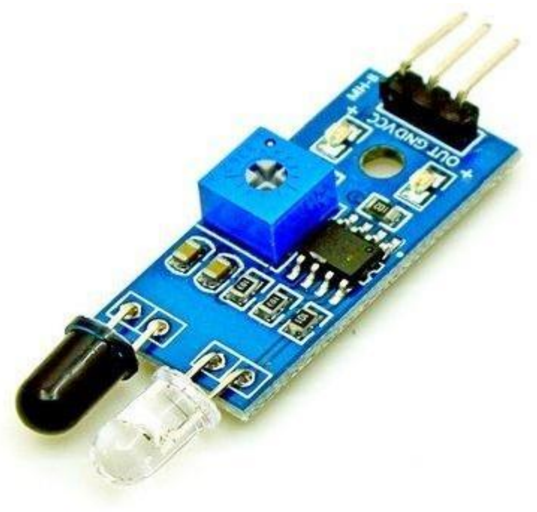

Figure 3.2: IR Sensor

3.2.3 DC motor

A DC motor is an electric motor that runs on direct current electricity. It consists of a rotor and stator, with the rotor being the moving part and the stator being the stationary part. The stator includes a series of windings, or coils, which are connected to a power source. When a current is applied to the windings, it creates a magnetic field which interacts with the rotor, causing it to rotate.[6]

Figure 3.3: DC Motor

DC motors are used in a wide range of applications, including power tools, robotics, and electric vehicles. They are known for their simple design, high efficiency, and ability to be easily controlled by varying the strength of the current applied to the windings. DC motors can also be easily reversed by reversing the direction of the current flow. However, we have used it with the gear mechanism to control the speed with the torque. [6]

3.2.4 LCD display

An LCD display is a type of electronic display that uses liquid crystals to produce a visual image. The 1602 model is a specific type of LCD display that is commonly used in a variety of applications, such as in handheld devices, appliances, and industrial equipment.[7]

The 1602 LCD display has a screen size of 16 characters by 2 lines, which means it can display a maximum of 16 characters per line and a total of 2 lines. It is commonly used in applications where a small, compact display is needed to display text or numerical data. [7]

Figure 3.4: LCD Display

The 1602 LCD display uses a backlight to illuminate the screen, which makes it easy to read in a variety of lighting conditions. It also has an adjustable contrast control, which allows the user to adjust the contrast of the display to suit their preference.[7]

The 1602 LCD display is easy to use and is compatible with a wide range of microcontrollers and control systems. It is also relatively inexpensive and widely available, making it a popular choice for a variety of applications. [7]

3.2.5 LCD display adapter

An LCD display adapter is a device that is used to connect an LCD display to a host system, such as a microcontroller or a computer. The I2C model is a specific type of LCD display adapter that uses the I2C communication protocol to send data between the host system and the LCD display.[7]

The I2C LCD display adapter is a compact and easy-to-use device that allows an LCD display to be easily connected to a host system. It typically consists of a small circuit board with an I2C interface on one side and a connector for the LCD display on the other side. [7]

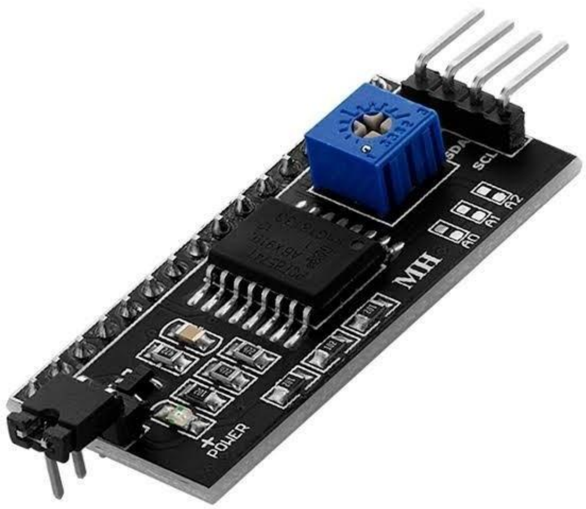

Figure 3.5: LCD Display Adapter

To use the I2C LCD display adapter, the host system sends data to the adapter over the I2C bus. The adapter then translates the data into a format that can be understood by the LCD display and sends it to the display. The LCD display then displays the data on its screen.[8]

The I2C LCD display adapter is a convenient and cost-effective solution for connecting an LCD display to a host system. It is easy to use and allows the host system to control display without the need for a dedicated interface.[8]

A relay is an electrically operated switch that is used to control a circuit by an external device. It is commonly used in electronic projects to switch electrical loads on and off, such as motors, lights, and other electrical device.[8]

Relays are typically used in situations where it is necessary to control a circuit using a low-power control signal, such as a signal from a microcontroller or a switch. The relay acts as a switch that is controlled by the low-power control signal and is able to switch a higher-power load on and off. [8]

3.2.6 Relay

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Figure 3.6: Relay

There are many different types of relays available, each with its own unique features and characteristics. Some relays are designed to switch high-voltage or high-current loads, while others are designed to switch low-voltage or low-current loads. Some relays are also designed to operate at high speeds, while others are designed for slower switching speeds.[5]

Overall, relays are a useful and versatile component that is often used in electronic projects. They allow a low-power control signal to control a high-power load, making them an essential component in many electronic systems.

A pushbutton switch is a type of electrical switch that is activated by pressing a button. These switches are commonly used in a variety of applications, such as household appliances, office equipment, and electronic devices. Pushbutton switches come in a range of sizes and styles, including single pole and double pole, momentary and latching, and illuminated and non-illuminated.[5]

Single pole pushbutton switches have a single set of contacts that are controlled by the switch. Double pole pushbutton switches have two sets of contacts that are controlled by the switch, which can be used to control two separate circuits. [5]

Figure 3.7: Pushbutton

Momentary pushbutton switches are designed to be pressed and held down to activate the switch, while latching pushbutton switches remain in the on or off position until they are pressed again.[5]

Illuminated pushbutton switches have a built-in light that is activated when the switch is in the on position. This can be helpful in low light environments or as a visual indicator of the switch's status. [5]

Pushbutton switches are commonly used in a variety of applications, such as controlling electrical appliances, turning on and off electronic devices, and activating machinery. They are often used in conjunction with other electrical components, such as relays, to control larger loads or to switch between multiple circuits. [5]

3.2.7 DC Motor Controller

A 12V DC motor controller is a device that allows you to control the speed and direction of a 12-volt Direct Current (DC) motor. DC motors are commonly used in a wide range of applications, from robotics and hobby projects to automotive systems and industrial machinery. A motor controller is essential for regulating the motor's speed and direction of rotation. [6]

Here are some key features and components typically found in a 12V DC motor controller:

Voltage Rating: The controller is designed to work with 12 volts DC power supply, so it should be compatible with a 12V power source.[6]

Motor Current Rating: Ensure that the controller can handle the current requirements of your DC motor. Different motors have different current ratings, so choose a controller that matches or exceeds the motor's specifications.[6]

Control Interface: Most DC motor controllers provide various ways to control the motor, such as:

PWM (Pulse Width Modulation): This is a common method for controlling motor speed by varying the duty cycle of a square wave signal. [8]

Direction Control: Some controllers have pins or settings to control the motor's direction (clockwise or counterclockwise). [8]

Analog Voltage Input: Some controllers accept an analog voltage signal to control the motor's speed. [8]

Protection Features: Look for controllers with built-in protection features, such as over-current protection and thermal shutdown, to prevent damage to the motor and controller. [8]

User Interface: Some motor controllers come with user-friendly interfaces like knobs, buttons, or displays for manual control and monitoring. [8]

Feedback: Advanced controllers may have feedback mechanisms like encoders or Hall effect sensors for precise motor control and position feedback. [8]

Communication Interfaces: In some applications, you may need to control the motor remotely or integrate it into a larger system. Controllers with communication interfaces like UART, I2C, or SPI can be useful. [8]

Mounting and Form Factor: Consider the physical size and mounting options of the controller to ensure it fits your application. [8]

Cooling and Heat Dissipation: Depending on the motor's load and the controller's current handling capabilities, you may need to consider cooling solutions such as heatsinks or fans. [8]

Power Supply Compatibility: Ensure that the controller's power requirements match the available power supply you have.[8]

Popular types of 12V DC motor controllers include H-bridge motor drivers, motor driver ICs, and microcontroller-based motor control boards. The choice of controller will depend on your specific application requirements and whether you need simple speed control or more advanced features like precise positioning or closed-loop control.[8]

Always consult the datasheets and documentation for the specific motor controller you plan to use to ensure proper installation and operation. [6]

Figure 3.8: Motor controller

3.3 Block Diagram

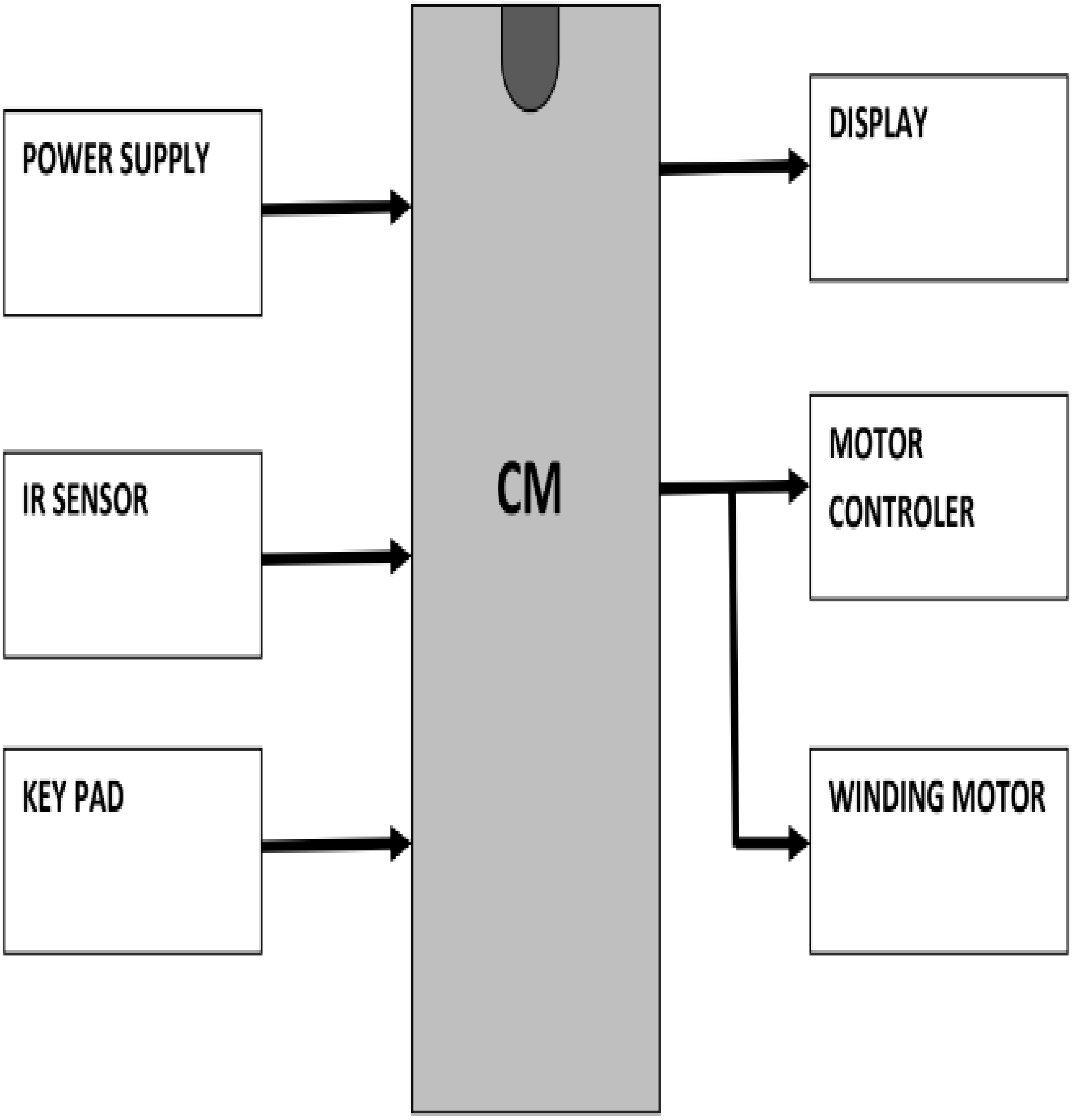

Figure 3.9: Block Diagram

3.4 Flow Chart

Flow chart is a great way to understand the procedure or the methodology perfectly. Here, the flow chart is given below for the project.

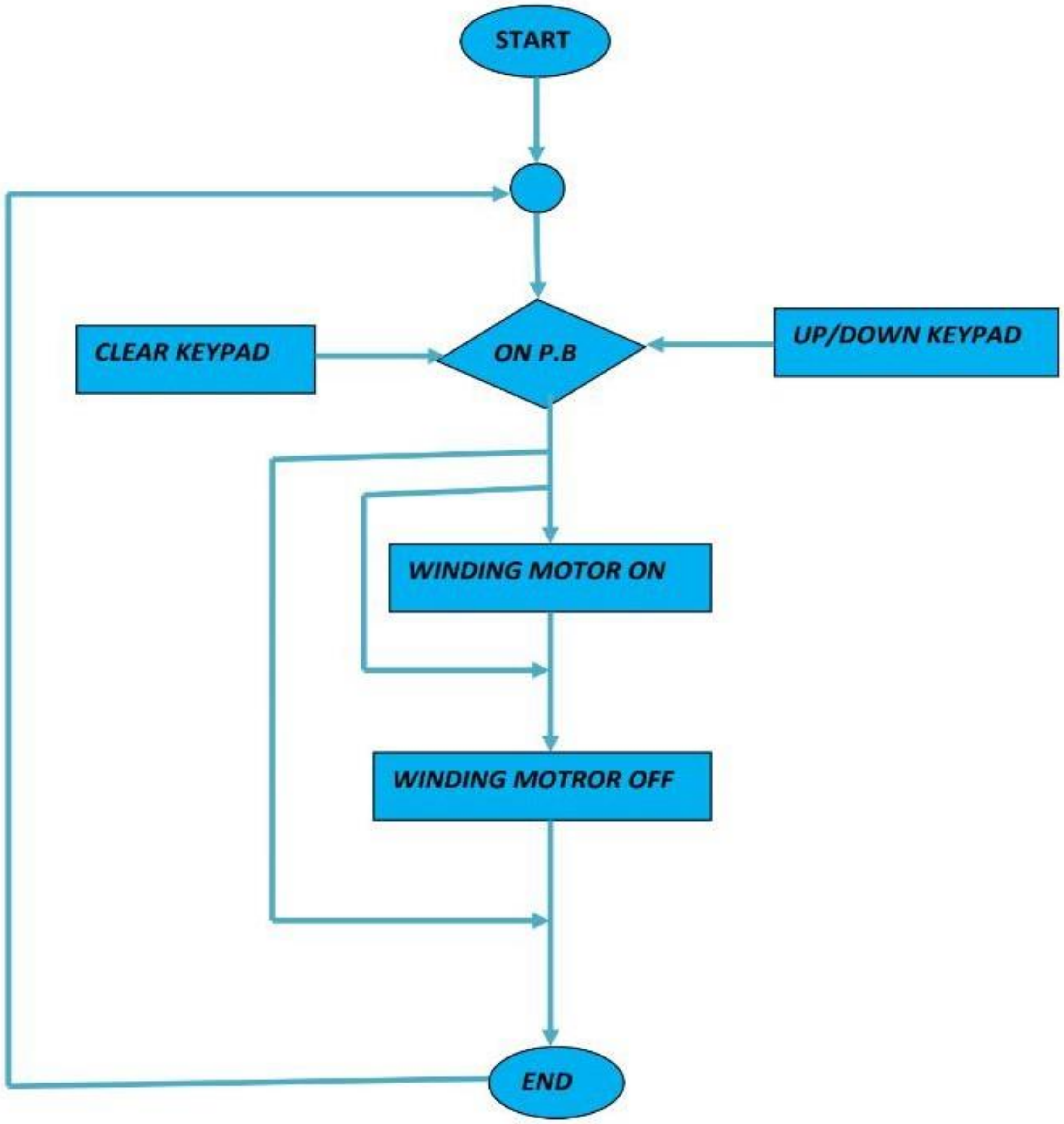

Figure 3.10: The flow chart

3.5 Circuit Diagram

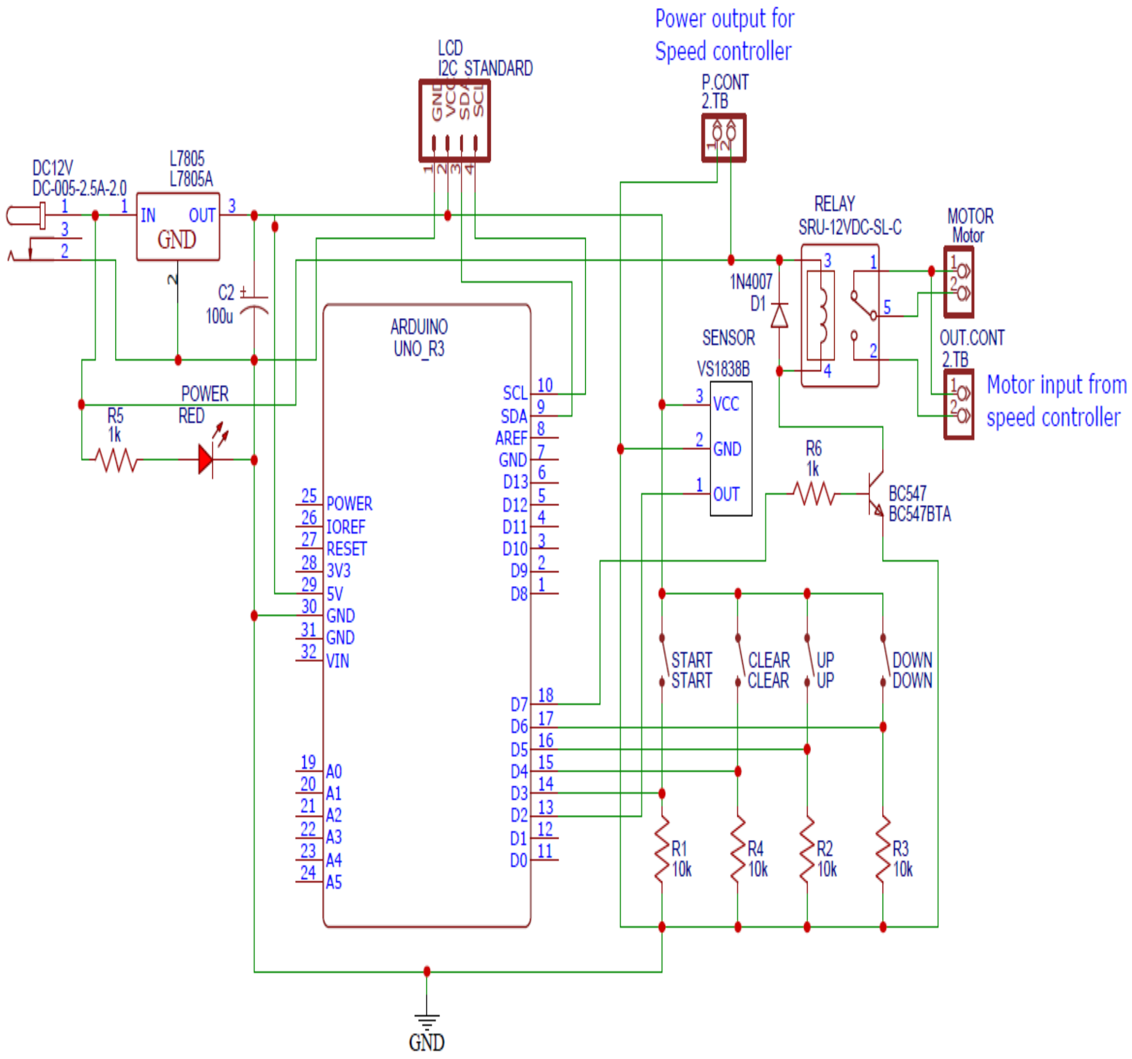

Fig 3.11: Circuit Diagram

3.6 Microcontroller

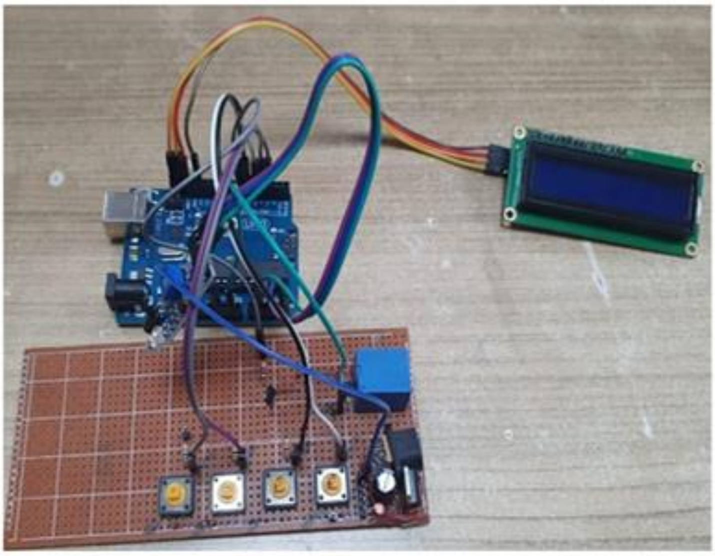

Fig 3.12: Microcontroller

3.7 Summary

In this chapter, we have presented the design methodology for the Automatic winding machine System. The chapter started with an introduction to the project and the motivation behind it. Then, a literature review was presented that discussed the state-of-the-art solutions and related works in the field of winding systems.

Next, the design methodology was introduced, which included the components used in the system such as the Arduino Uno board, IR sensor, and other necessary hardware components. We also introduced a flowchart that visualizes the system architecture and data flow between components.

The design methodology section also discussed the programming of the Arduino Uno board and how it reads sensor data and triggers appropriate actions based on the detected number of turn. Additionally, we discussed how the system communicates with the user through the use of an LCD display and alert system.

Overall, this chapter provides a detailed overview of the design methodology for the Automatic winding machine System. The next chapter will present the implementation details of the system, including the hardware setup and software programming.

Chapter 4

Performance Evaluation

4.1 Introduction

Automatic winding machine systems play a crucial role in protecting life and property from the devastating effects of this projecct. These systems utilize a combination of sensors, algorithms, and control mechanisms to detect fires, provide timely warnings, and activate appropriate protection measures. One important aspect of these systems is their performance, which refers to their ability to accurately detect fires and minimize damage .Performance evaluation is essential to ensure that the system is functioning properly and can provide timely warnings and appropriate protection measures in the event of this project.

In this project, we aim to design and implement an automatic winding machine system that incorporates advanced sensing technologies. We will evaluate the performance of the system under different operating conditions, such as varying number of turn, intensity. We will also compare the performance of our system with existing systems in the literature to assess its effectiveness. The performance evaluation of our system will be conducted in a laboratory setting using simulated number of turn. We will measure the system's detection accuracy, response time, false alarm rate, and other performance metrics to assess its overall effectiveness. The results of this performance evaluation will be critical in determining the practicality and reliability of our system and will provide insights for future improvements.

4.2 Performance Evaluation

In this section, we will discuss the performance evaluation of our automatic winding machine system. Performance evaluation is an essential aspect of ensuring the reliability and effectiveness of the system in protecting life and property from the devastating effects of this project.[1]

To evaluate the performance of our system, we conducted laboratory tests using simulated number of turn scenarios. We measured the system's detection accuracy, response time, false alarm rate, and robustness under different operating conditions such as varying levels number of turn intensity. We also compared the performance of our system to existing systems in the literature to assess its effectiveness and identify areas for improvement.[1]

In terms of robustness, our system was able to function properly under different operating conditions, such as varying levels of smoke and temperature. However, we also identified some areas for improvement, such as enhancing the system's ability to detect turn with high push switch indicate. [2]

Overall, our performance evaluation demonstrated the effectiveness and reliability of our automatic winding machine system in protecting life and property from the devastating effects of our project. These results provide valuable insights for future improvements and innovations in the field of fire safety engineering.[2]

Detection Accuracy:

Sensors Name	**Detection accuracy**
IR Sensor	100 %
Push switch	97%
Motor controller	100%

Table 4.1: The detection accuracy of the sensor

Response time:

Sensor Name	**Delay**
IR Sensor	0 seconds
Push Switch	2 seconds
Motor Controller	0 seconds

Table 4.2: The Response time

False alarm rate: By optimizing the sensors, we have tried to make the false alarm rate as low as possible. In some case delay time is added to make it more accurate response.[5]

4.3 Performance Metrics

Here are metrics of the project performance:

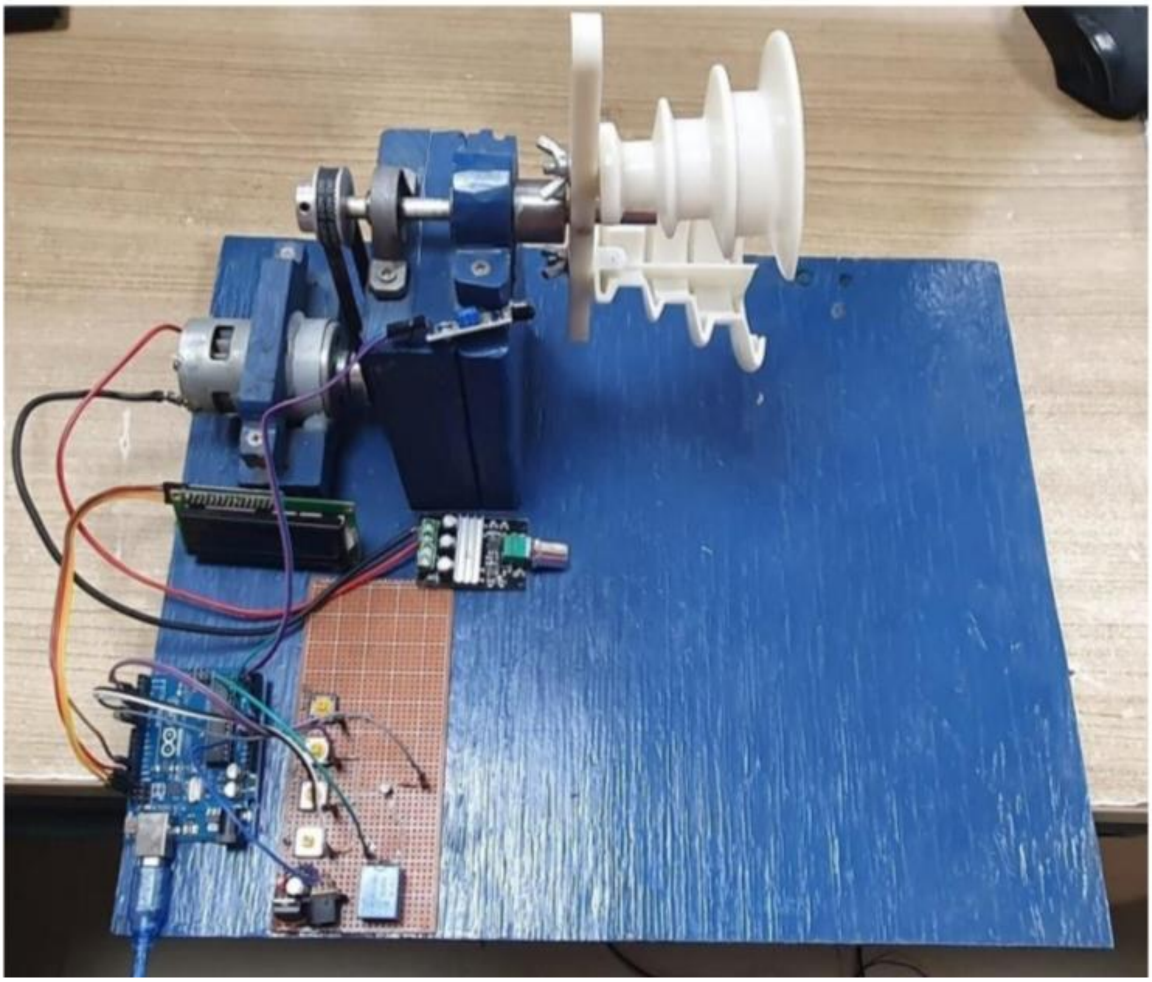

Fig 4.1 : Winding Machine

4.4 Results and Discussions

According to the performance evaluation, it is satisfactory that we can use this device to accurately and confidently to any building or platform for a simple implementation of Automatic winding machine. In our life, every sector is trying to use automation. But with the use of automation, the cost is becoming also more and more. To implement using just these sensors we can at least detect the IR sensor automatically and protect our life or any instances.

4.5 Summary

In this chapter, we have been introduced with the performance metrics of the AFDP. Before that, we have seen the practical application. Later we have checked the response time and detection accuracy for the sensor so that we can be sure about the project success rate.

Chapter 5

Conclusion

The main objective of this machine is to replace the manual labour and optimize the process. The inference is that, this automated system has increased the production and also provided solution for lack of human labour for such hectic jobs is compensated. In general we need one worker for one machine but by implementing this automation we need one worker for four machines. The labour requirement is reduced in the ratio of 1:4. It was found that the machine can wind coils of 110 turns per minute at 120 rpm.

5.1 Discussion

The present study aimed to design and implement an automatic winding machine system using various sensors and a microcontroller. The system was designed to detect number of turn, and trigger an alarm along with the activation of a system to mitigate the effects of the project.

The results of the study indicate that the system was successful in detecting turn number, in real-time. Along with the microcontroller, enabled accurate and timely detection of potential fire hazards.

The system is also cost-effective and easy to install, making it accessible to a wide range of users.

In conclusion, the automatic winding machine system designed and implemented in this study can be an effective solution for safety in various settings, . Further research can be conducted to improve the system's accuracy and efficiency and to explore its potential for integration with other technologies for enhanced.

5.2 Scope of Future Works

Based on the work done in this project, there are several potential directions for future research. One possible avenue is to explore the integration of IOT technologies into the system. This would allow for remote monitoring and control of the system, as well as the potential for data analytics and predictive maintenance.

Another potential area for future research is the optimization of the cooling system. This could involve experimenting with different types of coolers, such as air or liquid cooling, or exploring the use of more efficient cooling materials.

Additionally, there is a need for further testing and validation of the system in real-world scenarios. This could involve collaborating with industry partners to implement the system in a factory or warehouse setting and collecting data on its performance.

Overall, the prospect of this work is promising as it addresses a critical safety issue in the industry. The system can potentially prevent fire incidents and minimize damage, leading to a safer and more efficient workplace.

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