DESIGN AND FABRICATION OF AN AUTOMATIC WHITEBOARD CLEANER

A thesis report submitted to the department of mechanical engineering for the partial fulfillment of the degree of Bachelor of Science in Mechanical Engineering

A Thesis by

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LETTER OF TRANSMITTAL

September, 2023

To

Md. Minhaz Uddin

Assistant Professor

Department of Mechanical Engineering.

Sonargaon University

Subject: Submission of Project Report**.**

Dear Sir,

We are pleased to submit the project report on **"Design and Fabrication of an Automatic Whiteboard Cleaner".** 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.

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ACKNOWLEDGEMENT

First, we started in the name of almighty Allah. This thesis is accomplished under the supervision of Md. Minhaz Uddin, Assistant Professor, Department of Mechanical, Sonargaon University. It is a great pleasure to acknowledge our profound gratitude and respect to our supervisor for this consistent guidance, encouragement, helpful suggestion, constructive criticism and endless patience through the progress of this work. The successful completion of this thesis would not have been possible without his persistent motivation and continuous guidance.

The authors are also grateful to Md. Mostofa Hossain, Head of the Department of Mechanical Engineering and all respect teachers of the Mechanical Engineering Department for their co-operation and significant help for completing the thesis work successfully.

ABSTARCT

Now-a-days white boards are widely used in almost every educational institute. About 70-80% educational institute around the world uses white board as the writing medium in their class room. They are large in size, for that reason it is very time-consuming process to erase the writings from the board with duster. Using duster also reduce the visual quality of the board. If a class continue about one hour then about 8-10% time become waste because of cleaning the board using duster. Considering this “The board wiper”, an automatic system can solve these problems. The board wiper will shorten the time and also the effort. It takes around 8 sec to clear the board without destroying the quality. The wiper has horizontal movements and it wipes the board twice at a short time. The wiper consists of electric motor, supports, a wiper bar and a micro-controller to give that an-automation figure. It is possible to control the wiper by a remote-control system and this allows the controller to wipe the board from a reasonable distance. And it has an advantage to remove the wiper if it’s necessary to clean and the whole wiper system can be established at a very low cost. So, “The Automatic board wiper” is a spectacular replacement of “duster” and it can be suggested to use this to reduce the effort of the board user as well as to introduce the classroom with an automation system.

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CHAPTER 1
INTRODUCTION

1.1 Introduction

When we said teaching and learning process we will focus on teacher and student, who are person that delivering and receiving information and knowledge. How do they deliver their knowledge to student? Nowadays, there are many methods which are used by teachers to deliver their knowledge such as computer, note given by teacher and at last but not the least whiteboard or blackboard as medium to deliver the information to student. The invention of black boards was a revolutionary change in the history of mankind which led to the development of the society. One of the problems we are experiencing in our classroom is erasing the blackboard. Chalk dust scatter causing extreme nuisance especially for people who have asthma.

Also, chalk dust causes skin irritation and serious health problems. [1] Blackboards require lot of time to get rubbed which increase the demand of whiteboards. The first whiteboards were very expensive and was made of enameled steel but seeing the growing demand in the market cheaper whiteboards made of steel with polyester or acrylic coating of white color omit were launched. Innovations in the field of whiteboards were done since a long time. Different types of whiteboards like laminated chipboard, high pressure laminated boards and porcelain boards were launched in the market for cheaper alternatives. [2] Modifications were also done in cleaning and rubbing methods of whiteboards. Remote control motorized cleaners were innovated to reduce the human efforts required for cleaning. This type of cleaner is operated by motors and is controlled by switch or remote.

For teaching purpose generally, boards are used. For effective learning board is the basic thing in classroom. The powder obtained from the chalk piece while erasing the blackboard causes problem to the respiratory organ when inhaled by human. Those who are allergic to dust cannot sit near the blackboard. Other than this there are more problems related to the dust or chalk powder like hair loss, burning of eyes etc. For cleaning the board manual work has to be done by the teacher which is time consuming while taking classes.
Moreover, chalk dust not only harm the human but also the machines such as projectors when exposed to chalk dust there could be heat production in it.

1.2 Background Study

In the very past cave man used the wall of the cave as the writing medium. There they used the board to capture various memories or the story of their own culture and daily activities. As the time goes on and a civilized society was being formed the scenario begun to change. In the middle age people began to use a big slice of the wood piece as the board, and coal as the pen medium. [3] But it was not so comfortable and it became nasty. Then the black board had been introduced. It's nothing but a black canvas where a chalk is used as the pen medium. Chalk is a composite of calcium carbonate and it look s like a stick. It was comfortable but it creates dust during wiping the board using the duster. A duster is device which is used to wipe the writings from the board. Though the black board has not lost its popularity as in present time and it's being used widely across the world. But a white board is the modified version of the blackboard. Here a marker pen is used as pen medium and as duster a piece of cloth or a foam duster. As the whiteboard has the advantage of not creating the dust as it only makes the duster dirty and it is very much comfortable using marker pen as it comes in different colors. Across the world now white board is the best writing medium during teaching. Now almost everything is automated. And the automation system has the capacity to reduce the human effort and to make any arrangement easier. And those became possible for micro-controlling system. The Arduino micro-controller is an open-source hard ware controller which is designed to ease any mechanism by using electronic commands.

1.3 Problem Statement

In educational and office environments, whiteboards are commonly used for presentations and lectures. However, over time, whiteboards accumulate markings and become increasingly difficult to read, affecting the quality of presentations and the overall learning or communication experience. Manual erasing is time-consuming and can disrupt the flow of a presentation. Therefore, there is a need for an automated solution that can efficiently and autonomously clean whiteboards, ensuring they remain clear and ready for use without human intervention.

1.4 Objective

We have some specific objectives for this project and they are pointed below:

- To design & construction **of Design and Fabrication of an Automatic Whiteboard Cleaner**.
- To implementation of Automatic Whiteboard Cleaner.
- To take some output for future modification in our work.
- To study the system performance for future reference and improvement purposes.

1.5 Structure of the Project

This Project is Organized as Follows:

Chapter 1 Introduction: The first chapter contains the statement of the introduction, our background study for the project, problem statement, objectives of the study and the project outline.

Chapter 2 Literature Review: The chapter two contains our introduction, literature review part.

Chapter 3 Hardware and Software Analysis: Chapter three describes the theoretical model. Here we mainly discuss about proposed system Hardware and software development of our project etc.

Chapter 4 Methodology: Chapter three describes the theoretical model. Here we mainly discuss about proposed system architecture in details with having block diagram, circuit diagram, structural diagram, project working principle, complete project image etc.

Chapter 5 Calculation and Data Table

: Chapter five deals with the Calculation and Data Table about our project

Chapter 6 Result and Discussion: Chapter six deals with the result and discussion and discuss about our project advantages and application.

Chapter 7 Conclusion: Chapter Seven all about our project conclusion and future scope.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

In this section topics related to Automatic Whiteboard Cleaner are included. These provide a sampling of problems appropriate for application of Automatic Whiteboard Cleaner. The references are summarized below.

2.2 Literature Review

This section encompasses a review of various systems for cleaning whiteboards and blackboards, drawing insights from different research papers and their mechanisms.

S. Joshibaamali and K. Geetha Priya (2015) introduced a machine capable of three selectable operating modes: cleaning the left side, the right side, or the entire board. It utilized two stepper motors for horizontal and vertical movement and a linear motor for up and down motion. Infrared transceivers detected horizontal direction, and limit switches were used to detect board boundaries. A dsPIC30F401 microcontroller in C language served as the main controller. [1]

Mr. Sunil R. Kewate, Mr. Inzamam T. Mujawar, Mr. Akash D. Kewate, Mr. Hitesh R. Pant (Year not mentioned) designed a sliding-type wipe mechanism capable of automatically detecting chalk stains on blackboards. Their system employed two motors, three guide rails, and three sliders. Mechanical components included sliders connected by cross guide rails, allowing parallel movement, and motors A and B driving horizontal and vertical slider movement, respectively, for efficient cleaning. [2]

Sonia Akhter, Anindo Saha ,Md.Rayhan Parvez koushik,Md. Asaduzzaman, Razoana Isla m Shorna, Md. Moudud Ahmed explained that when the teacher switch on the supply, current is passed to the 18V adapter and then it passes through Arduino. To sense the distance and time specified by ARDUINO , a sonar sensor is used, hence the motor rotates in both clock-wise & anti-clockwise direction [3].

Dhananjay N. Jadhav, Aditi H. Manajan , Mayuri B. Surve& Pramod R. Sona wane explained that to implement this approach we have used Arduino UNO as a controller to control the motor operation during the whole process. We have used IR receiver to move duster and curtains in reverse and forward direction. A motor driver is used to supply 12v power supply to run the motor when it receives high at input through the remote button press. When any button is pressed by the user from remote it transmits a particulate button which is then received by IR sensor TSOP1738 connected to an Arduino [4].

Amit (2015) discussed a board erasing machine that relied on belt drive mechanisms and manual switches, requiring the teacher to be physically present at the board to initiate the erasing process. This approach was found to be inconvenient.[5]

Vivek et al. (2015) emphasized the wasted time during manual board erasing and suggested that this time could be better utilized for teaching or attendance. They proposed a system that would automate the erasing process by interfacing the mechanical erasing system with microcontrollers.[6]

Sathosh et al. (2016) introduced a duster with a track design that allowed it to move along the side of the board. A chain connected to the duster was driven by a motor to facilitate its movement. This innovation aimed to simplify and improve the board cleaning process.

Gaurav (2016) presented a device for automatic blackboard erasing, incorporating a duster mounted for longitudinal movement on the board. An engine connected to a drive assembly enabled the duster's movement, utilizing a rack and pinion system to convert motor rotation into linear motion. [7]

The electric board cleaner and the automatic whiteboard cleaner make use of belts. Most belts have low wear and tear resistance and with the frequent operation of the duster (i.e. the cleaning process), the belt is likely to cut and hence makes the device or the cleaner-less useful. In the process of trying to change the belt, the whole components may have to be loosened which is time-consuming. However, as for the case of the electric board cleaner, the idea of applying manual effort still comes in. The difference being that effort applied is less since it is powered electrically.

This project is aimed at modifying the automatic whiteboard cleaner by replacing the belts with chains which will improve the efficiency and effectiveness of the cleaner. The objective of this project is to reduce the stress of cleaning the board by using an automated duster. This objective would be achieved through the following specific objectives

i) Conceptualization of an automated whiteboard cleaner

ii) Preliminary and detailed design of new mechanism

III) Fabrication of the preliminary design of an automated white board cleaner automated whiteboard cleaner.

IV) Performance testing of the automated whiteboard cleaner.

CHAPTER 3
HARDWARE AND SOFTWARE ANALYSIS

3.1 Arduino Pro Mini

The Arduino Pro Mini is a micro-controller board based on the ATmega168. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, an on-board resonator, a reset button, and holes for mounting pin headers. A six pin header can be connected to an FTDI cable to provide USB power and communication to the board.

Specification

- Micro-controller ATmega168
- Operating Voltage: 3.3V or 5V (depending on model)
- Input Voltage: 3.35 -12 V (3.3V model) or 5 - 12 V (5V model)
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 6
- DC Current per I/O Pin: 40 mA
- Flash Memory: 16 KB (of which 2 KB used by boot loader)
- SRAM: 1 KB
- EEPROM: 512 bytes
- Clock Speed: 8 MHz (3.3V model) or 16 MHz (5V model)

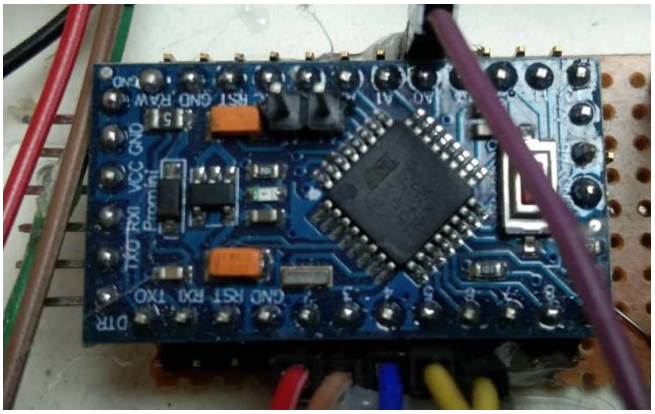

Figure 3.1: Arduino Pro Mini

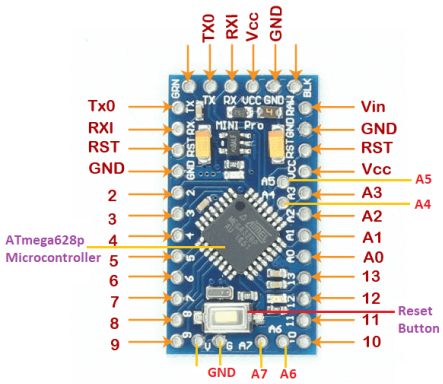

Figure 3.2: Arduino Pro Mini Pin Out

3.2 SMPS

A switched-mode power supply (SMPS) is an electronic power source that uses a switching regulator to efficiently convert electrical power. It transforms power from a DC or AC source (often mains power) into DC for devices like computers. Unlike linear supplies, SMPS frequently switches between low-dissipation states, minimizing energy waste. It achieves voltage regulation by adjusting on-to-off time ratios, while linear supplies dissipate power in the pass transistor. SMPS offers greater efficiency, smaller size, and reduced weight due to smaller transformers.

Figure 3.3: SMPS

Switching regulators are used as replacements for linear regulators when higher efficiency, smaller size or lighter weight are required. They are, however, more complicated; their

switching currents can cause electrical noise problems if not carefully suppressed, and simple designs may have a poor power factor.

Switched-mode power supplies are classified according to the type of input and output voltages. The four major categories are:

- AC to DC
- DC to DC
- DC to AC
- AC to AC

A basic isolated AC to DC switched-mode power supply consists of:

- Input rectifier and filter
- Inverter consisting of switching devices such as MOSFETs
- Transformer
- Output rectifier and filter
- Feedback and control circuit

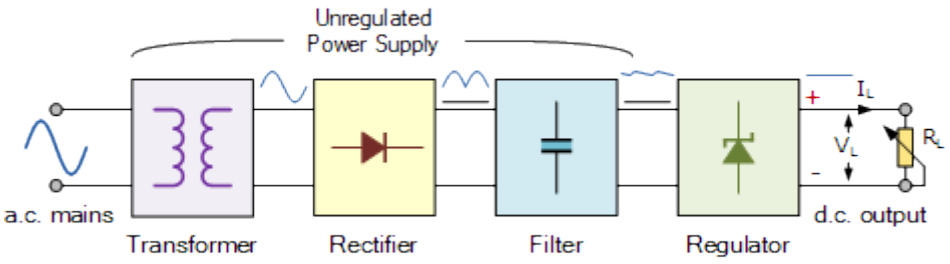

Figure 3.4: DC Power supply way

These typical power supply designs contain a large mains transformer (which also provides isolation between the input and output) and a dissipative series regulator circuit. The regulator circuit could consist of a single zener diode or a three-terminal linear series regulator to produce the required output voltage. The advantage of a linear regulator is that the power supply circuit only needs an input capacitor, output capacitor and some feedback resistors to set the output voltage.

3.3 Motor Driver

The **L293D** is a popular 16-Pin **Motor Driver** IC. As the name suggests it is mainly used to drive **motors**. A single **L293D** IC is capable of running two DC **motors** at the same time; also the direction of these two **motors** can be controlled independently.

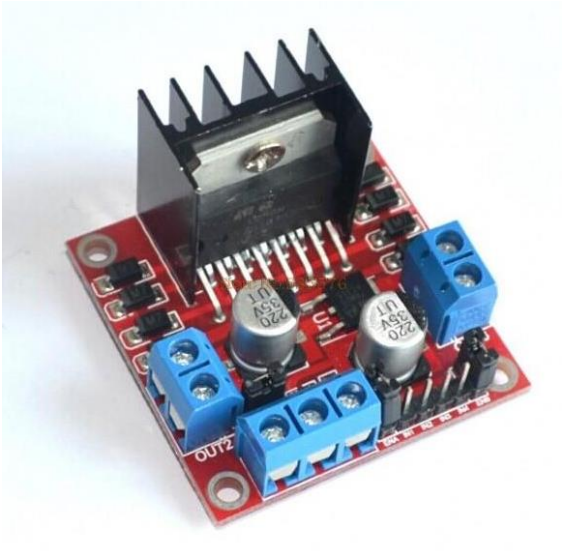

Figure 3.5: Motor driver IC L293D

Working Process:

L293D IC is a typical **Motor Driver** IC which allows the DC **motor** to drive on any direction. This IC consists of 16-pins which are used to control a set of two DC **motors** instantaneously in any direction. It means, by using a **L293D** IC we can control two DC **motors**.

Features

- Can be used to run Two DC motors with the same IC.
- Speed and Direction control is possible
- Motor voltage Vcc2 (Vs): 4.5V to 36V
- Maximum Peak motor current: 1.2A

- Maximum Continuous Motor Current: 600mA
- Supply Voltage to Vcc1(vss): 4.5V to 7V
- Transition time: 300ns (at 5Vand 24V)
- Automatic Thermal shutdown is available

Use of a L293D Motor Driver IC:

Using this L293D motor driver IC is very simple. The IC works on the principle of **Half H-Bridge**, let us not go too deep into what H-Bridge means, but for now just know that H bridge is a setup which is used to run motors both in clock wise and anti-clockwise direction. As said earlier this IC is capable of running two motors at the any direction at the same time, the circuit to achieve the same is shown below.

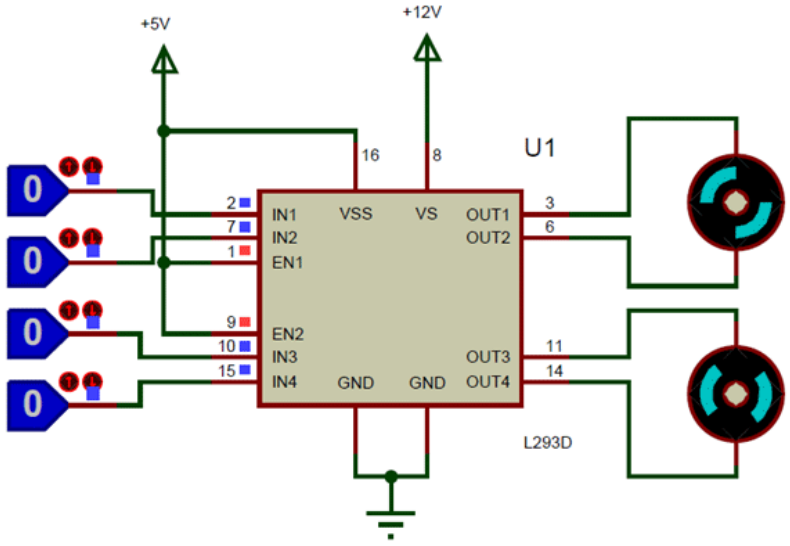

Figure 3.6: L293D circuit Diagram

To summarize, in this setup, ensure all ground pins are grounded. There are two power pins: Vss (Vcc1) should be connected to +5V for the IC to operate, and Vs (Vcc2) can be connected to +12V or a range of 4.5V to 36V, depending on motor specifications. Enable pins (Enable 1,2 and Enable 3,4) are kept high at +5V for both motors. Input pins (Input 1,2 for Motor 1, and Input 3,4 for Motor 2) interface with a digital circuit or microcontroller for motor speed and direction control.

Applications

- Used to drive high current Motors using Digital Circuits
- Can be used to drive Stepper motors
- High current LED’s can be driven

3.4 DC Gear Motor

A DC motor is any motor within a class of electrical machines whereby direct current electrical power is converted into mechanical power. A 12v DC motor is small and inexpensive, yet powerful enough to be used for many applications.

Specification:

- Voltage: 12V DC
- Gear ratio: 1/31
- No-load speed: 200 RPM
- Rated Speed: 140 RPM
- Rated torque: 10 kg.cm
- Rated current: 2.5 Amp
- Length of Motor (including spindle): 106 mm/4.17″
- Shaft diameter: 6 mm/0.24″

Figure 3.7: DC Gear Motor

3.5 Wireless Remote

An RF module, or radio-frequency module, is a compact electronic device used for wireless transmission and reception of radio signals between devices. In embedded systems, wireless communication is often essential. RF communication is preferred for its non-line-of-sight capability. RF modules come in various types and ranges, with some capable of transmitting up to 500 feet. They are typically manufactured using RF CMOS technology. RF modules are widely utilized in electronic design due to the complexity of designing radio circuits. Designing reliable RF circuits requires precision, careful manufacturing monitoring, and adherence to regulatory emission limits. Engineers often opt for pre-made RF modules to save development time and costs.

Figure 3.8: RF 315MHZ 4 Channel Wireless Remote

3.6 Capacitor

A capacitor is an essential electronic component designed to store electrical energy temporarily in an electrostatic field. Its fundamental structure comprises two conductive plates, typically made of metal, separated by an insulating material known as a dielectric. When a voltage is applied across these plates, electrons accumulate on one plate, creating a negative charge, while the other plate becomes positively charged. This charge separation allows the capacitor to store electrical energy, which can later be discharged as needed. Capacitors serve various crucial functions in electronic circuits, including smoothing voltage fluctuations, filtering signals, and storing energy in applications such as power supplies, timing circuits, and noise reduction. They exist in multiple types, such as

electrolytic, ceramic, and tantalum capacitors, each tailored for specific electronic applications due to their distinct characteristics and capabilities.

Figure 3.9: Capacitor

An ideal capacitor is characterized by a single constant value for its capacitance. Capacitance is expressed as the ratio of the electric charge (Q) on each conductor to the potential Difference (V). The SI unit of capacitance is the farad (F), which is equal to one coulomb per volt (1 C/V). Typical capacitance values range from about 1 pF (10−12 F) to about 1 mF (10−3 F).

3.7 Resistor

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. Resistors act to reduce current flow, and, at the sometime, act to lower voltage levels within circuits. Resistors may have fixed resistances or variable resistances, such as those founding thermostats, visitors, trimmers, photo resistors, hamsters and potentiometer. The current through a resistor is in direct proportion to the voltage across the resistor's terminals. This relationship is represented by Ohm's law.

Figure 3.10: Resistor

3.8 EasyEDA Software

EasyEDA is a web-based suite of tools for hardware engineers to design, simulate, and share schematics, simulations, and printed circuit boards. It offers features like bill of materials creation, Gerber files generation, and output in various formats. Users can create schematics, perform SPICE simulations, and design PCB layouts. Free membership covers public and limited private projects, with options to increase private projects through contributions or paid subscriptions. Users can download Gerber files for free, and EasyEDA provides a PCB fabrication service for a fee, accepting Gerber files from third-party tools.

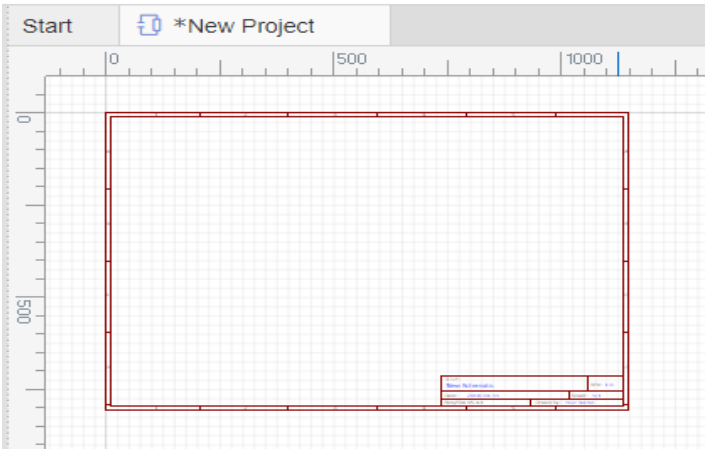

Figure 3.11: EasyEDA

CHAPTER 4
METHODOLOGY

4.1 Our methodologies for the project

Our methodologies for the project:

- Creating an idea for **Automatic Whiteboard Cleaner**.
- And designing a block diagram & circuit diagram to know which components need to construct it.
- Collecting the all components and programming for the micro controller to controlled the system.
- Setting all components in a PCB board & soldering. Then assembling the all block in a board and finally run the system & checking.

4.2 Block Diagram

Block diagram is a diagram where all equipment's are organized by block . This is a primary diagram of our system. Here we use Arduino Pro Mini, SMPS, DC Gear Motor, Motor Driver, Wireless remote. Here we also use various instrument which is visible in this block diagram-

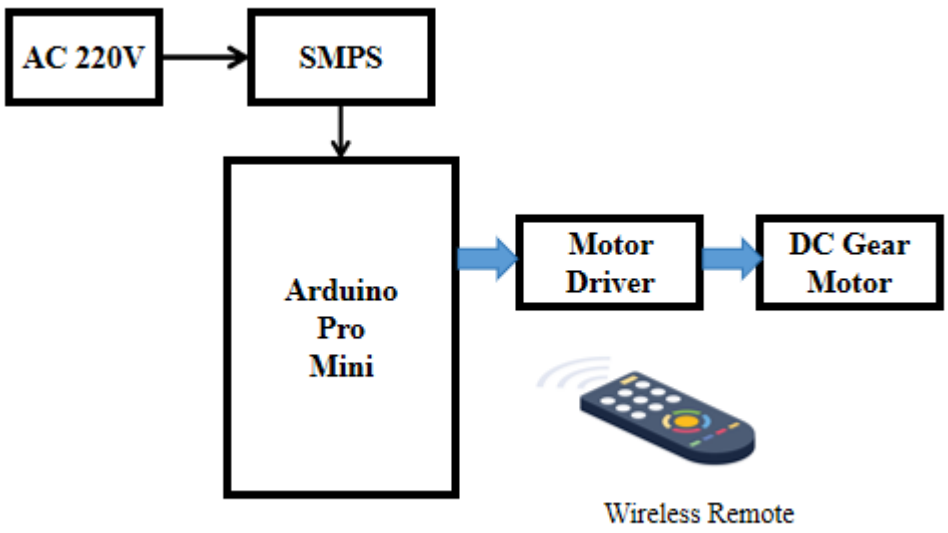

Figure 4.1: Block Diagram of Our System

4.3 Schematic Diagram

The schematic diagram here is representing the electrical circuit and the components of the project. Here we have used standardized symbols and lines.

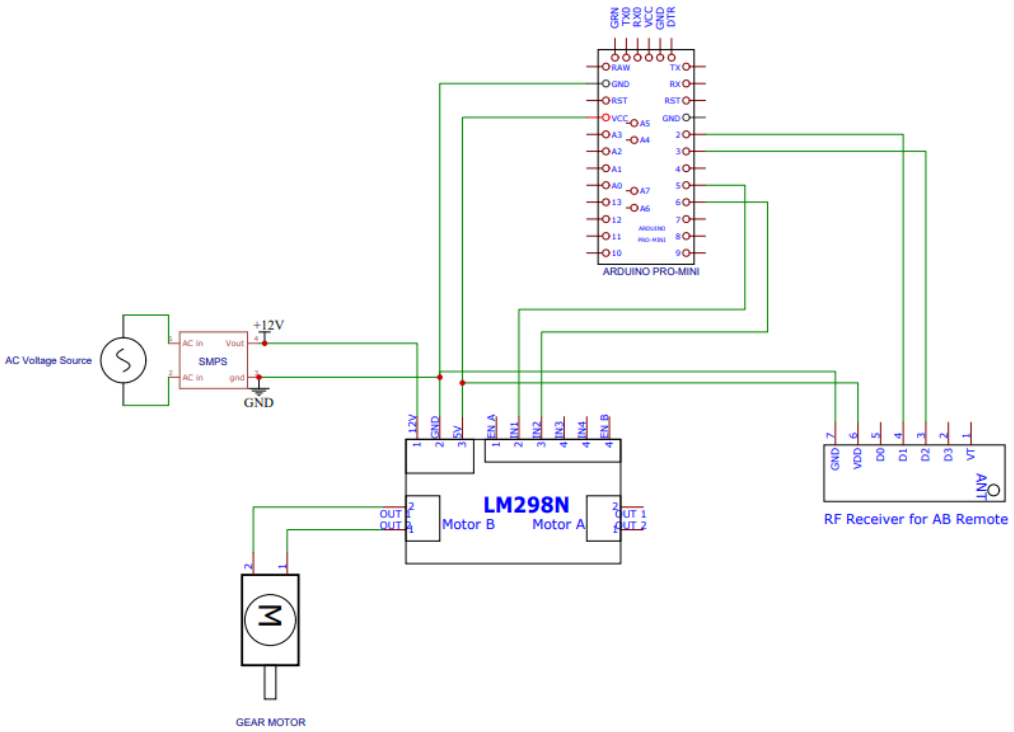

Figure 4.2: Schematic Diagram of the Project

4.4 Working Principle

The core of our system is the Arduino Pro Mini, functioning as the central controller. We begin by taking 220V AC power from the source and use an SMPS module to convert it into a stable 5V DC supply. This power source runs the Arduino and other components. The Arduino manages the motor driver, receives wireless remote commands, and controls the cleaning process. The motor driver precisely regulates the DC Gear Motor's speed and direction, driving the cleaning mechanism based on required torque and speed. The wireless remote control enables wireless start and stop of the cleaning operation, a key feature of our system.

4.5 Our Final System View

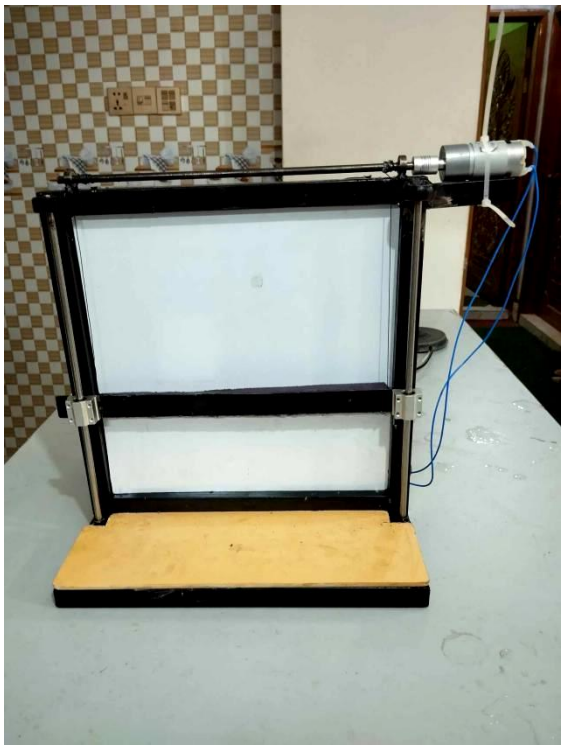

Figure 4.3: Our Final System of Front View

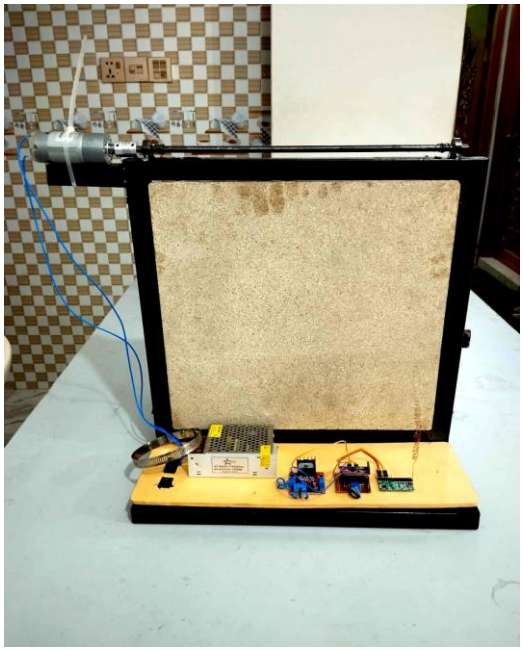

Figure 4.4: Our Final System of Side View

CHAPTER 5
CALCULATION AND DATA TABLE

5.1 CALCULATION

For the purpose of design, the following calculations has been carried out. Which is not exactly matching with the actual performance

DC geared motor: Voltage=12 V, Load current(I)=2.5 Amp, Speed(N)=100 RPM, Torque=10 kg-cm(98.1 N-cm), Power=30 Watt . Mass of duster (m)= 1.2 kg, Radius of pully = .01m

$$Forces\ acting: \frac{Power}{Velocity}$$

i) Tangential force (Ft):

$$Velocity = \frac{Angular\ velocity}{Radius}$$

$$Angular\ velocity\ (\omega) = \frac{2\pi N}{60} = \frac{2\pi \times 100}{60} = 10.47\ rad/s$$

$$Velocity = \omega r = 10.47 \times .01 = 0.1047\ m/s$$

$$Ft = \frac{30}{0.1047} = 286.47\ N$$

ii) Radial force (Fr):

$$Fr = m\frac{v^2}{r} = 1.2\frac{0.1047^2}{.01} = 12.90\ N$$

iii) Resultant force (F):

$$Ft^2 + Fr^2 = 286.76\ N$$

iv) Actual force with friction: $\mu \times F = 0.3 \times 286.76 = 86.02$
($\mu = 0.3$)

v) Time required to clean the board:

$$t = \frac{length\ of\ board}{velocity} = \frac{.5}{.1047} = 4.77\ second \approx 5\ second$$

5.2 Data Table

Table 5.1. Time required using different speed by Automatic white board cleaner

Sl. No	Speed (RPM)	Velocity (m/s)	Length (m)	Time required to Clean (Second)
1	60	0.0628	.5	7.94
2	80	0.0502	.5	5.96
2	100	0.1047	.5	4.77

CHAPTER 6
RESULT AND DISCUSSION

6.1 Results and Discussions

By the use of Smart Cleaner Duster, we can save time and energy as no manpower need to clean the whiteboard manually. The teachers waste time in erasing the whiteboard in classroom as the previous board has no automatic cleaning function.

Table 6.1. Time taken for Manual Whiteboard Cleaning and using Automatic Cleaner Reading Time (second)

	Manual Whiteboard (second)	***Automatic Cleaner(second)***
1	8.50	4.77
2	8.90	4.50
3	9.00	4.13
Average	**8.80**	**4.46**

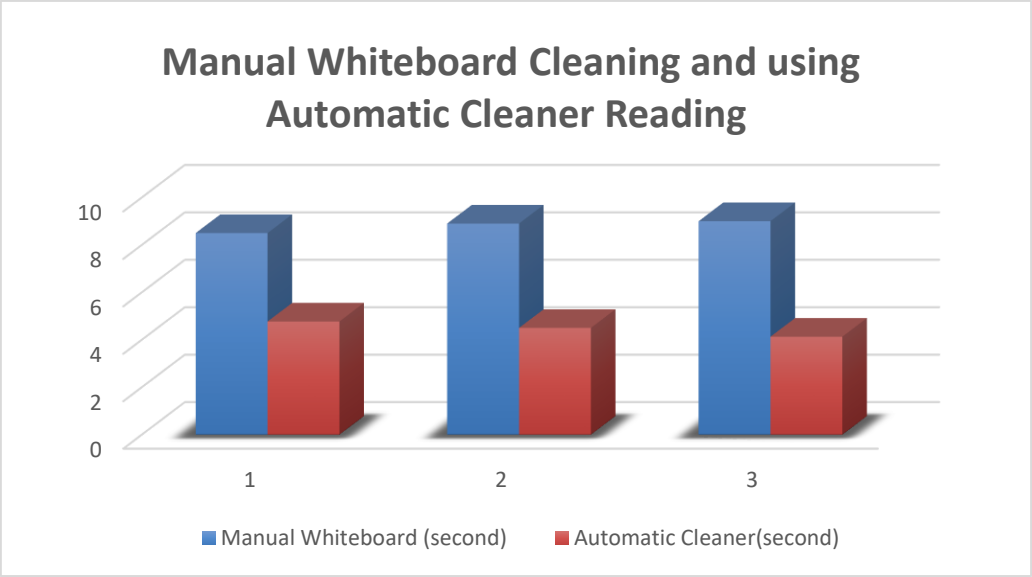

Figure 6.1. Graph time comparison between manual whiteboard cleaning and using Automatic Cleaner

Refer to figure 6.1, the graph shows time comparison between manual whiteboard cleaning and using Smart Cleaner Duster. Finding shows that manual duster cleaning completed after 8.80 seconds while Smart Whiteboard Cleaner only takes 4.46 seconds. This makes Smart Whiteboard Cleaner worth to use as it can save time. Furthermore, the structure of Smart Whiteboard Cleaner is simple, offer a solution of cleaning within time saving and it can provide convenient ways of use.

6.2 Advantage

There are many advantages of our project because of its accuracy. Some of the advantages are pointed out below:

- Automatic Cleaning System.
- Production cost is very low.
- No need of purchase special machine.
- Its operated and maintenance is simple.
- It is compact and portable.

6.3 Application

Some of the application areas of the project have been pointed out below:

- It is used Classrooms and Educational Institutions.
- This machine is used in Business and Meeting Rooms.
- Homes and Home Offices.
- Hospitals and Healthcare Facilities.
- Public Spaces.

CHAPTER 7
CONCLUSION

7.1 Conclusion

In new era of technology, people want something new in their life. They want every single thing they look in front of their life look sophisticated. People want something that can improve their lifestyle and help them to do their job by using the robot or machine. That is why development of machine and robot is now becomes quite popular and faster in marketing. So to help and give benefit to human kind the DESIGN AND FABRICATION AN WHITEBOARD CLEANER is an alternative machine that can help lecturer, teacher and student to keep their board clean by using this machine.

7.2 Future Scope

In the present time not everything is automatic but seeing towards progress of present technology's, In future everything will be operated automatically. So this project will serve as one of the advanced technology in future and will be installed in every college, school, etc. Seeing towards our basic version, there are some ideas for the Design And Development of Board Cleaning System. In future if this project is taken to the next stage then for collecting the dust from duster a vacuum blower can be arranged.

1) Operate in schedule – this machine can be set up the time. It can operate automatically when we set up the time we want it work.
2) Eye of machine – we can make this machine operate with detection of dirty in whiteboard. Machine knows the location of dirty and erases it automatically.

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APPENDIX

Programming Code:

```
int d1=2;
int d2=3;

int in1=5;
int in2=6;

void setup() {
  // put your setup code here, to run once:

Serial.begin(9600);
pinMode(d1,INPUT);
pinMode(d2,INPUT);

pinMode(in1,OUTPUT);
pinMode(in2,OUTPUT);

}

void loop() {
  // put your main code here, to run repeatedly:
int up=digitalRead(d1);
int down=digitalRead(d2);
Serial.print(up);
Serial.println(down);

if(up==1){
  digitalWrite(in1,200);
    digitalWrite(in2,0);
delay(1000);
  }
```

```
if(up==0){
  digitalWrite(in1,0);
    digitalWrite(in2,0);
delay(100);
  }
if(down==1){
  digitalWrite(in1,0);
    digitalWrite(in2,200);
delay(1000);
  }
if(up==0){
  digitalWrite(in1,0);
    digitalWrite(in2,0);
delay(100);
  }
}
```