

**Visvesvaraya Technological University Belgaum,  
Karnataka-590 018**



*A Project Report on*

**“BLACKBOARD CLEANING ROBOT”**

*Project Report submitted in partial fulfillment of the requirement for the  
award of the degree of*

**Bachelor of Engineering  
In  
Electrical & Electronics Engineering**

*Submitted by*

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**2020-2021**

**CMR INSTITUTE OF TECHNOLOGY**  
**DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING**  
**AECS Layout, Bengaluru-560 037**



## Certificate

Certified that the project work entitled “**BLACKBOARD CLEANING ROBOT**” carried out by **Mr. Akshay Rajeev, 1CR17EE004; Mr. K Dinesh Raj, 1CR17EE027; Ms. Ria Augustine, 1CR17EE057; Ms. S. K Yukta Swamy, 1CR17EE058;** are bonafied students of CMR Institute of Technology, Bengaluru, in partial fulfillment for the award of Bachelor of Engineering in Electrical & Electronics Engineering of the Visvesvaraya Technological University, Belgaum, during the year 2020-2021. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the Report deposited in the departmental library.

The project report has been approved as it satisfies the academic requirements in respect of Project work prescribed for the said Degree.

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**DECLARATION**

We, **Mr. Akshay Rajeev, 1CR17EE004; Mr. K Dinesh Raj, 1CR17EE027; Ms. Ria Augustine, 1CR17EE057; Ms. S. K Yukta Swamy, 1CR17EE058**, hereby declare that the report entitled “**BLACKBOARD CLEANING ROBOT**” has been carried out by us under the guidance of **Ms. Anju Das**, Assistant Prof., Department of Electrical & Electronics Engineering, CMR Institute of Technology, Bengaluru, in partial fulfillment of the requirement for the degree of **BACHELOR OF ENGINEERING in ELECTRICAL & ELECTRONICS ENGINEERING**, of Visveswaraya Technological University, Belgaum during the academic year 2020-21. The work done in this report is original and it has not been submitted for any other degree in any university.

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# Abstract

The advancement of technology necessitated the development of higher-performance machines in order to meet human requirements and market demands. Because of its potential applications, this project is being implemented to make human work easier and to reduce the usage of human power. A smart board cleaner is a gadget that automatically cleans the board with the use of a duster. While teaching, cleaning blackboards takes a lot of time. This is an automated blackboard cleaning device that cleans entire boards. To achieve this mechanism, we utilize a series of supporting rods, Dusters, motor, rollers, and driving electronics. By using this device we can not only reduce human effort but also save time. The design will erase the writings on the board without the user exerting so much effort, prevent straining oneself, and be able to reduce the time used. The technique is meant to save a significant amount of time and effort when cleaning boards. It is meant to clean boards in less than half the time it takes a human to clean a blackboard or whiteboard. Dusters installed on shafts that are attached to a supporting frame are used for this function.

The mechanical aspect of the design is based on the idea of a sliding door. The Automatic Blackboard Cleaner's intended application is to erase the writings on the board which would consume less effort and time compared to manual erasing but still efficient. The design is able to achieve automated clean the blackboard and collect dust in one stroke. The primary goal of the current automatic blackboard duster is to give a blackboard attachment in the form of a power-driven erasing device that can be turned on with the flip of a switch, reducing the drudgery of manually cleaning blackboards.

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# CHAPTER 1

## INTRODUCTION

The Automatic Blackboard Cleaning Robot is introduced as a design project that automatically erases the contents of a blackboard with only a push of a button. The Automatic Blackboard Robot will be useful to lecturers who often use blackboards as medium in imparting knowledge to listeners. It will lessen the time and energy required to erase the board, especially for those who have very long lectures. It would be of great help for them since they would not be wasting time in erasing the board, and they would have more time to spend in lecturing.

### 1.1 BRIEF BACKGROUND OF THE RESEARCH

Education is the back bone of a nation. Education comprises of teaching and learning. The resources and materials used in teaching becoming updated along with the teaching and learning techniques. Writing was earlier done on sand, walls, slates made out of wood, chalkboards and in recent times on white/black boards and electronic boards. Chalk dust scatter causes serious health problems. Many variations had been done on cleaning of blackboard surfaces. Remote control motorized cleaners are made in which the dusters are operated with the help of remote control. This type of cleaner moves horizontally by means of motor mechanism and erase the board with the help of dusters attached to it but it could not create sufficient pressure on board . This limitation was solved by using rolling whiteboard surface and fixed dusters. Instead of moving the dusters the whiteboard surface is moved around the rollers. The friction produced between fixed dusters and rolling surface creates sufficient pressure to erase the written data on it but this process is too time consuming to clean the board. This drawback was overcome by using microcontroller and sensors but the longevity of board surface is short because it acts as flat belt. Remote control motorized cleaners makes use of belts which have low wear and tear resistance and with the frequent operation of cleaning process, the belt is likely to cut and hence makes the device or the cleaner less useful.. Instead of belt, chain had been used to improve the cleaning procedure but it creates too much noise. Using cord and pulley arrangement the wiper bar connected to the motors can erase writings on the board which creates less noise but it requires four motors and two motor drivers causing too much cost.



These limitations have been overcome by the proposed design in this paper. Only one motor and one motor driver with rack and pinion mechanism is used instead of belts and large amount of pressure has provided by rack and pinion mechanism with necessary supports. At recent years boards have become a crucial element at almost every educational institute. They are large in size, for that reason, it is very time consuming and tedious process to erase the writings from the board with duster manually. It breaks the concentration of both lecturers and listeners. Automatic board Cleaner can solve these problems.

Automatic board cleaner will reduce the time and also the effort. It takes around few seconds to clear the board smoothly. This paper represents the design and construction of automatic board cleaner. The system consists of microcontroller, the driver module, dc gear motor, rack and pinion mechanism, supports, and a cleaner bar to give that an automation figure. When the switch is on, it moves across the full width of the board and its direction is reversed automatically in order to clean the board. So, this “Blackboard cleaning Robot” is a great 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.

## **1.2 CONTRIBUTION**

To introduce a new advance mechanism for erasing the board. In our lecture rooms, the dire need for a duster that would be readily available at all times for cleaning the blackboards has been a major concern, the height of some boards also affect the section of the board to be cleaned. It can effectively clean in one stroke. Another major advantage would be the wet and as well as dry cleaning. These robots operate semi- or fully autonomously to perform services useful to the well-being of humans and equipment. With the aim of keeping our robot as simple as possible, while able to perform the initial goals.

## **1.3 OBJECTIVES OF THE PROJECT**

- To design and develop a board cleaning system which can overcome the problems related to chalk dust, such as respiratory problem, burning of eyes.
- This technique was selected by us by taking into consideration some comfort for Teachers while cleaning the blackboard/whiteboard.
- Discomfort for the teachers and wastage of time in erasing the board
- It's cost effective since it's a onetime investment.

## **1.4 Layout of the Project**

The whole system is based upon two individual units. One is the cleaning unit which ensures to erase writings and other is the controlling unit which controls the cleaning system. The cleaning unit consists of the necessary arrangement which enable the cleaner slide over the board and the controlling unit consists of micro-controller which controls the motor, rpm, and the time of rotation.

The system is assembled by using all the components as mentioned. The duster holders with the dusters fixed in it are attached longitudinally on the wooden block. A DC motor is fixed on the wooden block with clamp. The pinion is coupled with the motor that means the pinion rotates with the shaft of the motor. The rotary motion of the motor is transferred to the rack & the rack moves in translatory direction. A brush has been attached to the brush holder with the help of glue & the brush holder is attached to the end of the rack with.

## CHAPTER 2

### LITERATURE REVIEW

**1. Article: Design and Fabrication of an AUTOMATIC BLACK BOARD CLEANER Mr. Tumpala Uma Santhosh, Ch. Venkata anvesh, R Art Babu, A Vinutha Publication:2016**

The growth of technologies requested higher performance machine in order to fulfill human needs and market. This project is implemented to make human work easier and can reduce the use of human power because of its potential applications. The project automatic blackboard duster is device that clean the blackboard automatically and reduces the time consume in hand erasing. The report puts forward a kind of mechanism design scheme, the mechanism can automatically detect the blackboard chalk stains, and erase the font, keep the blackboard clean. The duster includes a track structure to permit reciprocation of the duster laterally of an elongate blackboard frame. The chain which is connected to duster includes a drive motor to effect rotation of a drive duster positioned above the blackboard frame. This appertains to new and useful improvements and more particularly to an apparatus whereby blackboards can be cleaned in an easy and convenient manner. The principal object of the present automatic blackboard duster is to provide an attachment for blackboards in the form of a power driven erasing apparatus which can be set in operation by the throw of a switch, thus eliminating the drudgery of manually cleaning blackboards.

**2. Article: Automatic Whiteboard Cleaner Using Microcontroller Based Rack and Pinion Mechanism**

**Sonia Akhter, Anindo Saha, Md. Rayhan Parvez Koushik, Md. Asaduzzaman, Razoana Islam Shorna, Md. Moudud Ahmed  
Publication: 2015**

Recent year's whiteboard has become a crucial element at almost every educational institute. They are large in size, for that reason it is very time consuming and tedious process to erase the writings from the board with duster manually. It breaks concentration of both lecturers and listeners. Automatic Whiteboard Cleaner can solve these problems. Automatic whiteboard cleaner will reduce the time and also the effort. It takes around 6secs to clear the board smoothly.

This paper represents the design and construction of automatic whiteboard cleaner. The system consists of Arduino microcontroller, driver module, dc gear motor, rack and pinion mechanism, sonar sensor, supports, and a cleaner bar to give that an automation figure. When the switch is on, it moves across the full width of the board and its direction is reversed automatically in order to clean and use this to reduce the effort of the board user as well as to introduce the classroom with an automation system.

**3. Article: Design and fabrication of automated duster for cleaning of white board**  
**Makhan Singh Assistant Professor Vardan Sharma Deepak Kumar,**  
**Vikram Kumar Singh Nitesh Kumar**  
**Publication: 2018**

In this paper, design for automated white board duster has been proposed as well as fabricated using combination of different mechanism of operations. These include to and fro motion of duster, horizontal or vertical motion of duster with a switch to restrict movement of duster. Duster is made stationary while white board consists of a rotating film made of polyester with thickness around 200 micron having sound wear and tear resistance. Design used in this paper consists of two primary rollers and three secondary rollers which are used to provide sufficient tension to film for writing purpose. The white board revolves around two rollers and duster is mounted on the frame near the roller. Film can move in both forward and reverse directions. All the electrical equipment's like rectifier, capacitor and transformer are arranged on ply board having switch to provide forward and reverse motion to film. Roller is rotated by a 12 volt DC motor which is mounted on the top of one roller. This automated design is helpful in cleaning of white board along with various positive impacts on the user. It will reduce various health hazards to users which they encountered during cleaning of tiny particles of marker powder that comes in direct contact with eyes, nose and skin. It will also reduce the human efforts required for cleaning after frequent intervals.

**4. Article: Design and Performance Study of Automatic Blackboard Eraser**  
**Mr. Avinash Chandra, Suraj Gupta, Rohit Gupta, Vikas Kumar Singh ,**  
**Ranjeet Kumar Singh Professor**  
**Publication: 2017**

Automatic blackboard dusters are made so as to ease the tedious job of erasing blackboards by teacher or student. Chalk dust or the marker ink may prove hazardous to health to both the teacher as well as student.

So to reduce such problems Automatic Blackboard dusters are one of the alternatives. The manual method of erasing has one more disadvantage 'TIME'.

The time wasted during the blackboard erasing can be utilized for much better purposes like teaching or attendance. So by doing this we are simply making things better for ourselves and the future generation. We propose a system to interface the mechanical aspects of the mechanical raising system with micro controllers so as to enhance it into automation rather than manual.

**5. Article: DESIGN AND FABRICATION OF SMART DUSTER Manyar Imrankha Ajimkha , Khatik Azad Rashid<sup>2</sup> , Khatik Kazim Hanif<sup>3</sup> , Khatik Mohsin Ahemad<sup>4</sup> , Md.Intekhab Aftab<sup>5</sup> , Shaikh Moin Ahmad<sup>6</sup>  
Publication: 2018**

This project was selected by us by taking into some consideration of comfort and saving the time consumed while erasing the black board or white board. At the time of erasing the black board it is seen that the teachers cover mouth with cloth by one hand, and erase by the other hand. For long length black board consume more man power and some potential of the teacher get loss. So we decided to implement our course and some extra knowledge and with the help of mechanical and electronic concept our project theme is made. This project can clean the blackboard and whiteboard automatically with rope ad pulley mechanism and automated by automation by the using of limit switches.

**6. Article: Automated Board Duster Dr. S. Poornachandra<sup>1</sup> , V. S. Jagadhish<sup>2</sup> , B. Vivekanandhan<sup>3</sup> 1Dean and Professor  
Publication: 2018**

An automatic blackboard duster is an instrument, used to clean the board automatically with the help of duster. During teaching, the chalk dusts cause respiratory problem of the teacher as well as the student in the classroom environment. As per current state of knowledge on particulate matter, it remains suspended in the air for some time before settling on the surface. In the existing system involves a moving cradle, which houses a duster to erase the board. This design is usually bulky and consumes a lot of space surrounding the black board and it needs regular maintenance was also required to keep the system functioning efficiently. A huge variety of board cleaners had been developed. However, all the commercially available versions were derived from a basic design.

They all had a belt pulley mechanism driven by a commutated, electric motor, which powers

the system. A major disadvantage of the whole belt-pulley mechanism was that, after being used for a sufficient time, the belt from the pulley wear out, which cause the belts to slip off the pulley. The proposed system overcomes the disadvantage of the present blackboard duster. A tiny, high rpm motor is used to rotate plate which holds the duster. The dust will be collected in the separate container made of transparent plastic material to help the user to easily identify the dust level. This invention saves time and help to maintain a clean classroom environment. The collected dust is bleached and recycled to make a new chalk piece. The board automation is controlled by PIC Microcontroller. Then each and every process is controlled by interfacing with Programmable Logic Controller.

**7. Article: Development of New Design of Automatic Blackboard Cleaning System Neeraj Saraswat1\*, Nikhil Tyagi1  
Publication: 2017**

An Automatic blackboard cleaner is a device that is generally used to clean board automatically with the help of duster. Assembly language is used to program the parallel port to be able to manipulate the movement of the cleaner. The parallel port was used so that the program would be able to interact with the circuitry fully. The design will erase the writings on the board without the user exerting so much effort, prevent straining oneself, and be able to reduce the time used. Electronics, Microprocessors, and Assembly Language are the essential courses used as basis for the design's internal structure. The mechanical aspect of the design is based on the idea of a sliding door. The Automatic Blackboard Cleaner's intended application is to erase the writings on the board which would consume less effort and time compared to manual erasing but still efficient. With the use of Assembly Language, the intended operation of the design could be achieved by a push of a button The project automatic blackboard duster is device that clean the blackboard automatically and reduces the time consume in hand erasing. The traditional blackboard chalk dust is a common problem in the traditional blackboard-eraser-chalk architecture. It is generally known that erasers for cleaning the black boards in college rooms soon become saturated with chalk dust and have to be cleaned. In the past, this has usually been done by clapping the erasers together. This operation produced a great deal of dust that is rather objectionable both from the standpoint of health and cleanliness. The design is able to achieve automated clean the blackboard and collect dust in one stroke.

In this paper, it introduces the design and principles of sliding type wipe mechanism and also

carried out the implementation and experimentation for motion analysis. The principal object of the present automatic blackboard duster is to provide an attachment for blackboards in the form of a power driven erasing apparatus which can be set in operation by the throw of a switch, thus eliminating the drudgery of manually cleaning Blackboard.

## CHAPTER 3

# METHODOLOGY

The most common method of erasing the blackboard is to use a hand-held eraser and to manually erase the blackboard as required. Cleaning of the blackboards by a damp cloth is, of course a technique that has long been employed but is only used when immediate use of the blackboard is not required some efforts have been made to improve the materials used in eraser, although such improvements still require manual manipulation of the eraser in the erasing of the blackboard. Some attempts have also been made to mechanize erasers, but the prior known mechanical or automatic blackboard erasers since they include complicated mechanical connection and driving elements. In this fast-growing world automatic techniques are most adopted thus to reduce the time and energy.



Fig 1: Proposed design

### 3.1 Our Approach

In this project an advanced technology is used for automatic erasing the board. This chapter will discuss on the methodology employed and consideration to be taken account for this project. This chapter is the important part of this project to realize the Blackboard Cleaning Robot. It begins with the process flowchart that will be showed in the coming section followed by mechanism structure, circuit design, and software that will be used. Before this step begins, some research had been done on it.



The selection of part is most important to start the project. What kind of part or materials suitable for the design of the mechanism must be determined? This chapter will also describe the selection of brain for this machine which is a microcontroller and the actuators part of machine which is motor.

### **3.2 Construction**

Construction of mechanism of duster movement is the most important. Without a good or suitable material, it will cause inaccuracy of movement of the machine. In the construction of automatic blackboard duster the board is supported on a frame. The frame is fixed to the wall through the L-shape channels by using of screw. In the frame the guide way is provided at the upper and bottom side of the frame. The slider frame is attached through this guide way. The motor placed at left side of the frame and is attached to the wheels.

The Blackboard Cleaning Robot makes use of a motor, particularly a DC motor that will be responsible in moving the duster from one point to another. A relay module is used to power the duster's motor. This module will be connected to another module containing the parallel port for the interface. Through PC interfacing, using Arduino Uno manipulating the movement of the duster.

### **3.3 Hardware components**

#### **1. Blackboard**

A blackboard or chalkboard is a reusable writing surface on which text or drawings are made with sticks of calcium sulphate or calcium carbonate, known, when used for this purpose, as chalk. Blackboards were originally made of smooth, thin sheets of black or dark grey slate stone. Modern versions are often green because the color is considered easier on the eyes. A blackboard can simply be a piece of board painted with matte dark paint (usually black or dark green). A more modern variation consists of a coiled sheet of plastic drawn across two parallel rollers, which can be scrolled to create additional writing space while saving what has been written. The highest grade blackboards are made of rougher version porcelain enameled steel (black, green, blue or sometimes other colors). Porcelain is very hard wearing and blackboards made of porcelain usually last 10–20 years in intensive use.

Lecture theatres may contain a number of blackboards in a grid arrangement. The lecturer then moves boards into reach for writing and then moves them out of reach, allowing a large amount of material to be shown simultaneously.



Fig 2: Blackboard without proper cleaning has become white

## 2. Motor

An electric motor is an electrical machine that converts electrical energy into mechanical energy. Most electric motors operate through the interaction between the motor's magnetic field and electric current in a wire winding to generate force in the form of torque applied on the motor's shaft. Electric motors can be powered by direct current (DC) sources, such as from batteries, or rectifiers, or by alternating current (AC) sources, such as a power grid, inverters or electrical generators. An electric generator is mechanically identical to an electric motor, but operates with a reversed flow of power, converting mechanical energy into electrical energy.

Electric motors produce linear or rotary force (torque) intended to propel some external mechanism, such as a fan or an elevator. An electric motor is generally designed for continuous rotation, or for linear movement over a significant distance compared to its size. Magnetic solenoids are also transducers that convert electrical power to mechanical motion, but can produce motion over only a limited distance.

Electric motors are much more efficient than the other prime mover used in industry and transportation, the internal combustion engine (ICE); electric motors are typically over 95% efficient while ICEs are well below 50%. They are also lightweight, physically smaller, are mechanically simpler and cheaper to build, can provide instant and consistent torque at any speed, can run on electricity generated by renewable sources and do not exhaust carbon into the atmosphere.

For these reasons electric motors are replacing internal combustion in transportation and industry, although their use in vehicles is currently limited by the high cost and weight of batteries that can give sufficient range between charges.

### 3. DC MOTOR

A DC motor is any of a class of rotary electrical motors that converts direct current electrical energy into mechanical energy. DC motors were the first form of motor widely used, as they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight brushed motor used for portable power tools and appliances. Larger DC motors are currently used in propulsion of electric vehicles, elevator and hoists, and in drives for steel rolling mills.

A simple DC motor has a stationary set of magnets in the stator and an armature with one or more windings of insulated wire wrapped around a soft iron core that concentrates the magnetic field. The windings usually have multiple turns around the core, and in large motors there can be several parallel current paths. The ends of the wire winding are connected to a commutator. The commutator allows each armature coil to be energized in turn and connects the rotating coils with the external power supply through brushes. (Brushless DC motors have electronics that switch the DC current to each coil on and off and have no brushes)



Fig 3: DC motor

#### 4. Duster

Sponge and cloth will be used for now as a duster material. Later we will be adopting the best material which can clean the board even better.

#### 5. Wheels

Wooden wheels are used to get traction on steel rods and move across the board to clean it.



Fig 4: Wooden wheels

#### 6. Driver module: l293d

Motor driver is used along with Arduino to power the motor with 12V DC supply.

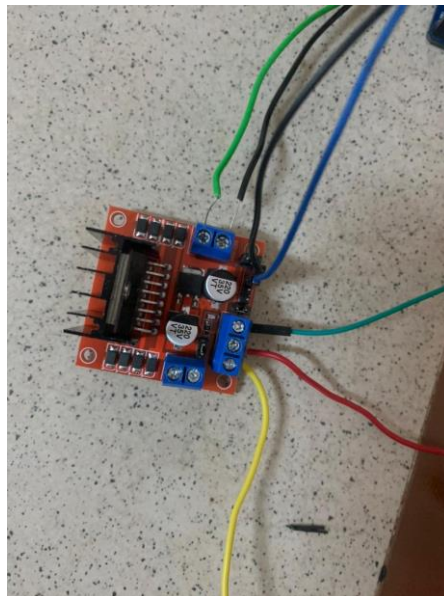


Fig 5: motor driver

## 7. Microcontroller: ARDUINO

Arduino is a microcontroller, it's used here to control the motor to change direction upon getting inputs from limit switch.

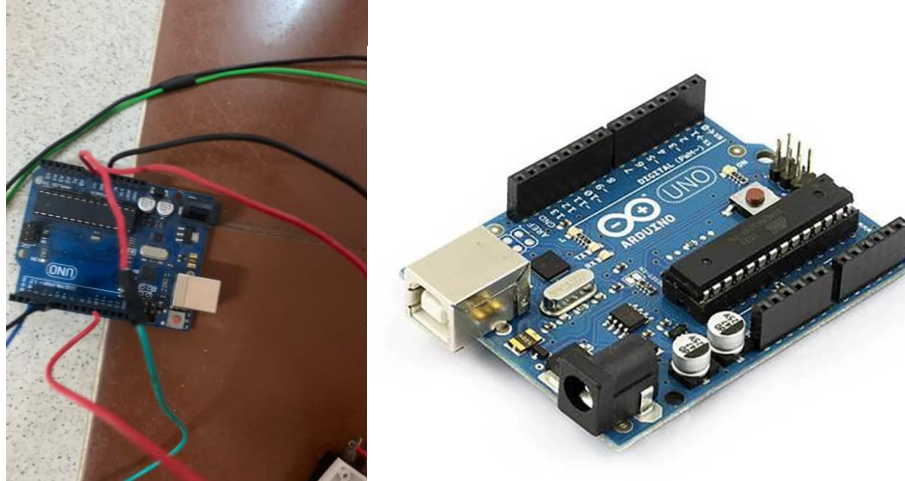


Fig 6: Arduino board

## 8. Limit switch

Limit switch allows Arduino to know that motor assembly has reached the end of the board thereby giving a signal to Arduino to spin the motor in opposite direction, hence saving the whole assembly from any damage.



Fig 7: limit switch

**9. Rods: 10 mm diameter rods – 3 no.**

Rods are placed on top and bottom of the blackboard. It provides smooth motion for the motor assembly across the board. There are 2 rods on the bottom rail and 1 on the top of the board.

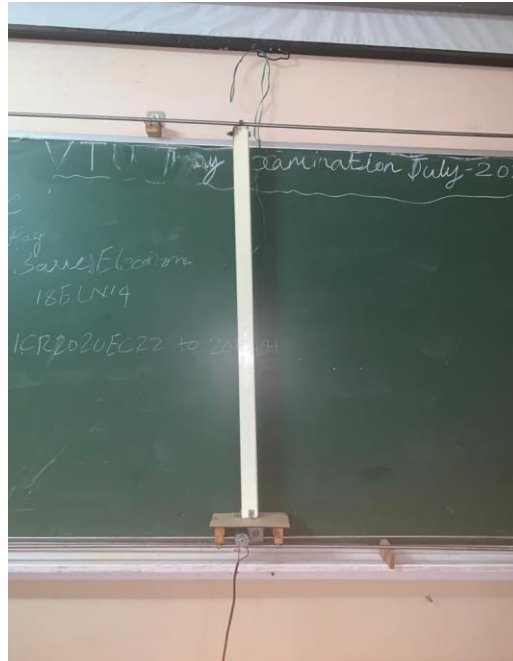


Fig 8: steel rods

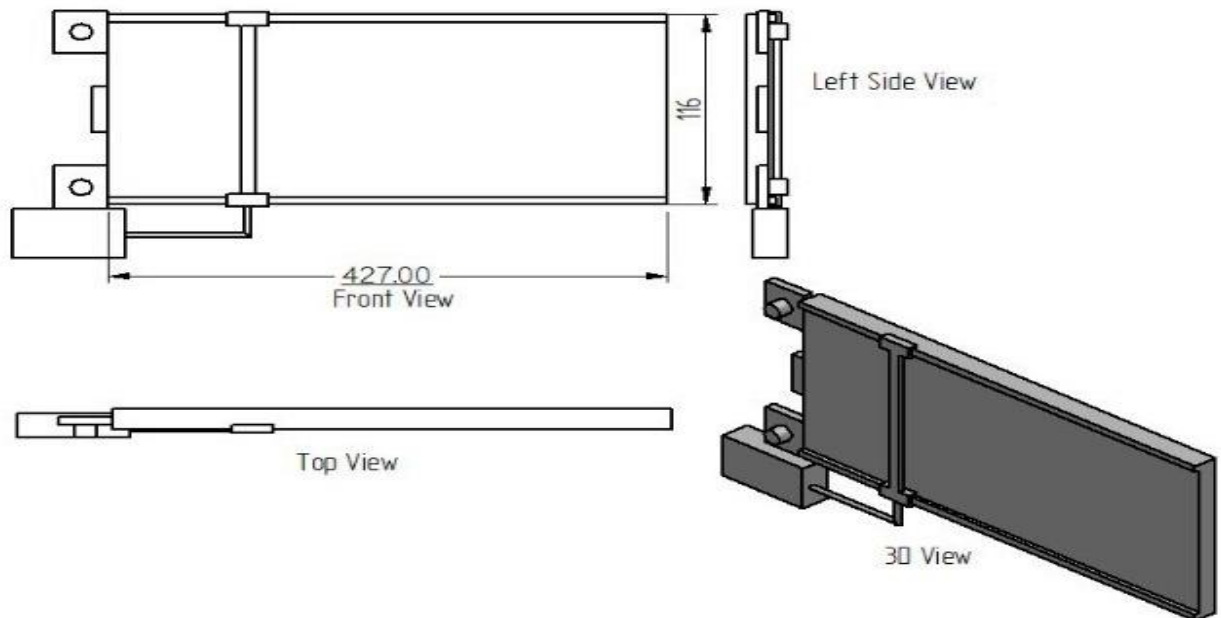


Fig 9: Proposed 3D view of the design

## CHAPTER 4

# SOFTWARE

Code for controlling motor using Arduino:

```
// specifying motor pins
int motor2pin1 = 4;
int motor2pin2 = 5;

// limit switch
byte pin = 10;
byte stopswitch;

void setup() {

  // specifying pin modes
  pinMode(motor2pin1, OUTPUT);
  pinMode(motor2pin2, OUTPUT);
  pinMode(pin, INPUT_PULLUP);
}

void loop() {

  // reading input from limit switch
  stopswitch = digitalRead(pin);

  // if limit switch OFF then
  if(stopswitch == LOW){

    // rotate motor in clockwise dir
    digitalWrite(motor2pin1, HIGH);
    digitalWrite(motor2pin2, LOW);

  }
  // if limit switch ON
  else{

    // rotate motor in anti-clockwise dir
    digitalWrite(motor2pin1, LOW);
    digitalWrite(motor2pin2, HIGH);
  }
}
```

# CHAPTER 5

## RESULTS

BEFORE

AFTER



Fig 10: Blackboard before and after cleaning

Blackboard cleaning robot is able to clean the blackboard clear.

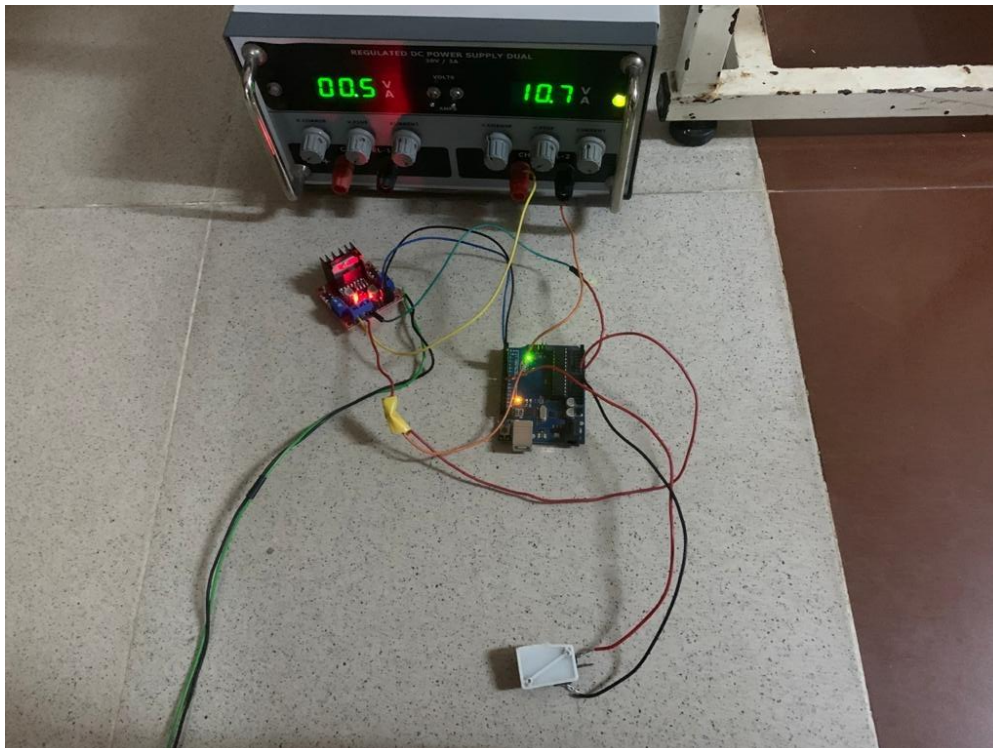


Fig 11: Controller (12V DC supply, driver, Arduino, limit switch)



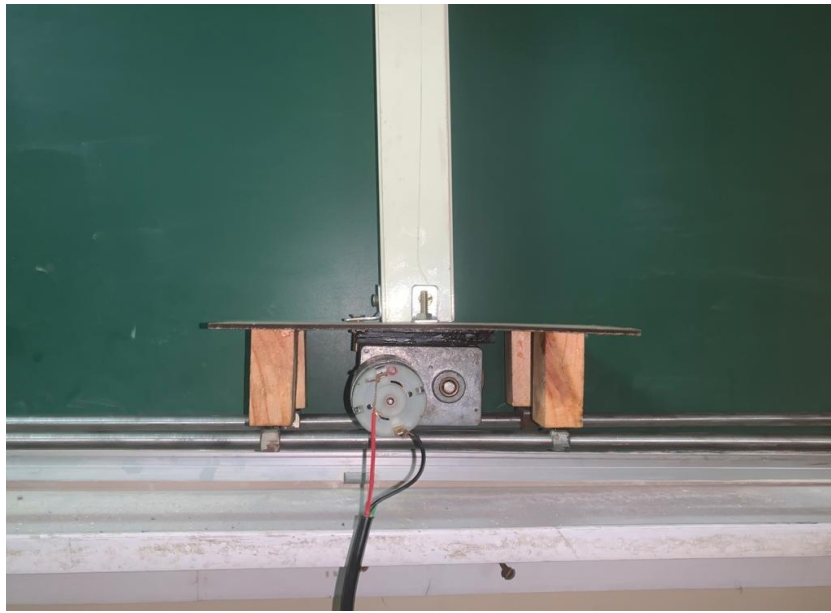


Fig 12: front view of motor assembly



Fig 13: side view of motor assembly



Fig 14: Upper rod and duster arm arrangement



Fig 15: Upper rod center support

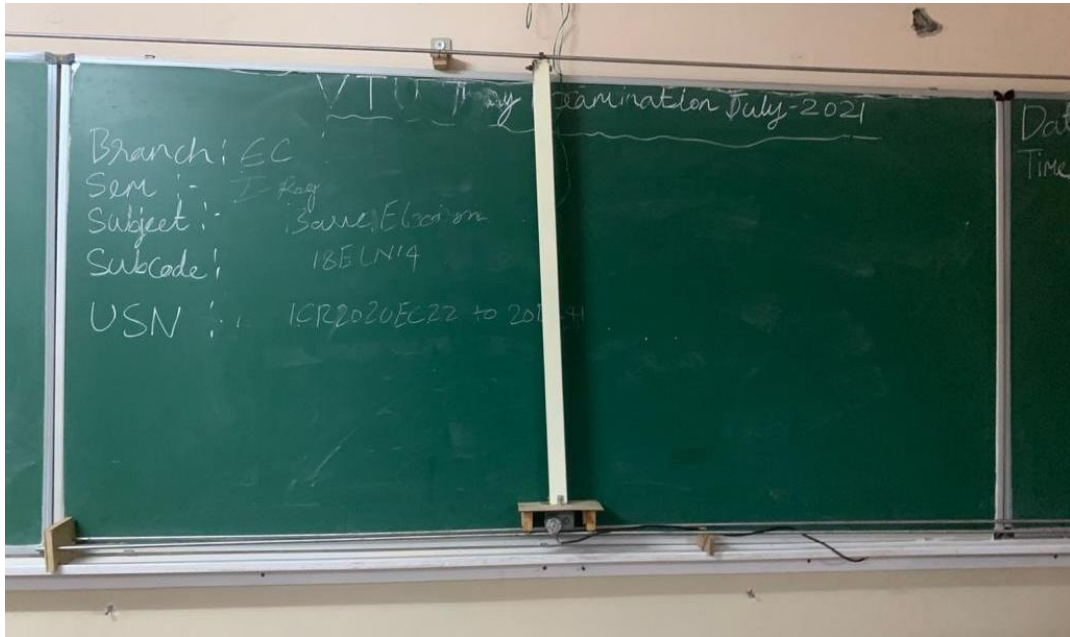


Fig 16: Completed blackboard cleaning robot installed in one of the classrooms of EEE dept

## CHAPTER 6

# ADVANTAGES & APPLICATIONS

### ADVANTAGES

There are many advantages compared to conventional method of cleaning the black board. Few of them are listed below:

- No man power required
- Automatic + Remote control
- Better cleaning every time
- No dust in air
- No more finding duster
- Cost effective
- Light weight

### APPLICATIONS

SCHOOLS AND COLLEGE ACROSS THE GLOBE



Fig 17: Countries across globe

## CHAPTER 7

# CONCLUSION & FUTURE WORK

## CONCLUSION

Board cleaning robot is a breakthrough in classroom-based teaching where students interact with teachers using a blackboard, this project will change the experience of students in the classroom and help them concentrate more in studying rather than waiting for the teacher to clean the board. Some of the major takeaways from this project are:

- Board cleaning robot will revolutionize the existing duster.
- This project will enhance the classroom experience of students.
- Both students and teachers will benefit from this project

## FUTURE WORK

- Implement in large scale.
- Bring it to the market
- Add more features.
- Make the cleaning process efficient & less time consuming

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