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A PROJECT REPORT

ON

"AUTOMATIC FLOOR CLEANER"

Submitted by

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DEPARTMENT OF MECHANICAL ENGINEERING

ANJUMAN-I-ISLAM

KALSEKAR TECHNICAL CAMPUS NEW PANVEL,

NAVI MUMBAI – 410206

UNIVERSITY OF MUMBAI

ACADEMIC YEAR 2020-2021

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CERTIFICATE

This is to certify that the project report titled, **AUTOMATIC FLOOR CLEANER**

MATRIX submitted to **Anjum-i-islam's Kalsekar Technical Campus, Panvel,** submitted by **SHAIKH AAQIB, ABDUL AZIZ, MANSURI MOHAMMAD KHALID AJAJ AHMED AND QAZI KHALID** In **MECHANICAL ENGINEERING** is the bonafide record of project work done by them under our supervision. The contents of this report, in full or in parts, have not been submitted to any other institute or university for the award of any degree or diploma.

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Acknowledgements

In the name of allah, the most benevolent, the most merciful. I wish to record immeasurable gratitude and thankfulness to the one and the almighty creator, the lord and sustainer of the universe, and mankind in particular. It is only through his mercy and help that this work could be completed and it is ardently desired that this little effort be accepted by him to be of some service to the cause of humanity.

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ABSTRACT

Automatic floor cleaner is a system that enables cleaning of the floor by the help of highly stabilized and rapidly functionalized electronic and mechanical control system. Current project work targets to use automatic floor cleaner for large floor in house-hold purposes and office floors. The cleaning purpose is specifically carried out by continuous relative motion between a scrubber and the floor surface. During the cleaning and moving operation of vehicle a propulsion mechanism such as driven wheels and guide wheels for the dry tracking on the floor surface to be cleaned, suction of water is carried out by vacuum pump, scrubbing action is done by the scrubber directing water towards rear end. Preferably, a sweeper mechanism is mounted on the body forwarded by propulsion mechanism and operated with such control system for advance sweeping of a debris-laden floor surface. A PID controller is used to govern the motion of system which takes the input from sensor circuit and feeds it back to microcontroller which gives rise to the simulation of wheel in a synchronized manner. The new automatic floor cleaner will save huge cost of labor in future. The basic advantage of this product is that it will be cost effective and no human control is needed. Once put in on mode it will clean the whole room without any omission of surface.

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AUTOMATIC FLOOR CLEANER

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CHAPTER 1

INTRODUCTION

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1.1 Background

Automatic Floor cleaners are well-known products. Still there are continuously new products introduced on the market, products with new or improved functionality. Automatic Floor cleaners are mainly used in domestic areas for removing particles from indoor floors.
The aim of this thesis was to learn more about the design and its requirement, hopefully be able to improve some functions and finally have a functional prototype for testing.

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1.2 Purpose

- How does a prototype made of cheap parts and controlled by an Arduino compare to Manual Floor cleaners on the market?
- How should sensor and code be designed to get a functional Manual Floor cleaner?
  - Position, type and number of sensors?
  - Driving pattern?
- How can a function that returns the cleaner to a battery charge station, when the battery charge level is low, be designed?

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1.3 Scope

The main purpose with this thesis was to design a Automatic Floor cleaner that can perform tasks that a regular Manual Floor cleaner, on the market, can do. During the design phase, ideas and different designs were tested. The most interesting ones were added on the physical prototype. Criteria for interesting designs were low cost, long drive time, design shape and dimensions. The budget for the prototype was limited to 8000-10000 Rs. Therefore, parts with low cost were used, this did in some way limit the design of the prototype, for example no tooling for included parts were made. The Machine was equipped with sensors to detect its surroundings and the dimensions were chosen so it can manage normal obstacles and clean in a domestic area.

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1.4 Method

The first step of this project was to investigate the requirements for a robot vacuum cleaner. This step provided information about specifications that customers expect from the product. The result was an important input to the design work. The necessary parts included and dimensions could be determined.
A preliminary design was developed, and a first prototype manufactured. Depend- ing on the function of the prototype the design process continued and improved the product. Finally, through numerous iterations, a functional prototype was devel- oped.

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CHAPTER 2
LITERATURE REVIEW

2.1 INTRODUCTION

Traditionally floor is cleaned with the help of dry mop or wet mop using the hand as a potential tool. They have to scrub hard on the surface. The cleaning includes cleaning of various surfaces basically cement floors, highly polished wooden or marble floors. Among these floors the rough surface floor such as cement floor, mostly present in semi urban areas are covered with so much dust.

From early human civilization human is increasingly dependent on the machines. Human is trying to reduce the workload upon himself. By the help of machines also we can get huge efficiency because there is no chance of human error there. Now -a -days from 30 years intelligence and robotics growing with a vast Space. Every human is using 2-3 robot at least per day. If we look at past 30 years we will see

robotics from large structure going to small and smaller in Nano range. Very complicated sensors have been designed to help the robot in various works .Complicated pneumatic and actuating systems have been designed. One of the best examples is the mobile phone. If we look at the floor cleaning robot we can see iRobot is dominating the market with its 90 sq. cm robot having indoor navigation as its principal controlling system. Also for many in-house mobile robots indoor navigation is a big issue. Also currently indoor GPS is evolving which uses unsupervised learning and determining its path in its first run. Since now indoor navigation has not been solved completely.

2.2 NAVIGATION SYSTEM

Navigation system of the robot is basically dependent on the sensors and microcontroller and algorithm fed to it. Basically the data acquisition system (here sensor) first collects the data from the environment and feeds to microcontroller .The microcontroller uses 2 algorithms. The 2 algorithms are:-

- Spiral motion algorithm
- Random Straight path following

2.3 RANDOM STRAIGHT PATH

Basically random straight path searches from one node to another by the help of natural heuristic search. After the spiral motion the robot if detects a collision then it follows the edge of the wall until it gets enough free space for spiral motion again. After some moment if it doesn't get any specific clear area for spiral motion then it will move in random path for some time and the obstacle detection and avoidance system will be carried out by the help of ultrasonic sensors [2]. After that robots stop rotating if the timer is over. In this process we can divide a particular area in the floor as grids and move accordingly so that it will have very confine control over the robot. So it will have grid based search over the floor for movement [4].

Finally we implemented computer vision by the help of ultrasonic imaging and analyzing the image for the dust particles by the help of supervised learning and clustering the data [5]. We have implemented here A* search algorithm for motion planning [7]. The breadth first search implemented here is very effective and provides efficient result for moving [9].

CHAPTER 3

METHODOLOGY

3.1 PROBLEM

During literature survey we got that in many large places it is hard to clean floor properly. Like in colleges, Hospitals, companies, etc.

Brooms and mops may seem like a smart way to save money, but for many businesses, the labour costs associated with manual cleaning are far greater than buying an Automatic floor cleaner. To put it bluntly, just because you're saving money on equipment doesn't mean you're saving money.

Commercial cleaning equipment can eliminate dirt, dust, grease and grime in a fraction of the time it takes someone to sweep or scrub the area manually. Today's auto-scrubbers and industrial sweepers are whisper quiet, have long-lasting batteries and eliminate the safety hazards associated with mops and brooms.

Time is money, and if you have a large area to keep clean, mops and brooms are inefficient.

Spread germs around rather than removing them.

Leave a slick surface that can cause accidents (more than half of slip, trip or fall injuries are due to a problem with the walking surface according to EHS Today)

Are labor-intensive - a small autoscrubber can easily clean under tables and into corners saving the operator lost time moving furniture or cleaning by hand

3.2 SOLUTION

In this places the cleaning of floor takes much time and man power. The cleaning is done on large scale because the area to be covered to clean is so large and this places doesn't clean properly by manual cleaning. Due to this problem we got a idea of Automatic Floor Cleaner that we are working on it.

There are many Advantages of Automatic Floor Cleaner Such as Follows :

1. Reduce Labour cost.
2. Mops and Brooms Don't Get Floors Clean.
3. Commercial Machines Minimize Disruption.
4. Machines are More Eco-Friendly.
5. Your Floors Are Clean and It Shows.

1.Reduce Labour Cost

There's no getting around it, the upfront cost to buy an industrial cleaning machine is much higher than the cost of a mop or broom. Though the upfront cost is higher, most commercial floor cleaning equipment pays for itself over time because labor costs represent about 90 percent of the total cost to maintain floors if you're not using an industrial cleaning machine.

Consider this: an employee can clean 4,000-5,000 square feet in one hour with a mop and bucket. A *small* autoscrubber can clean

almost three times that amount (13,000 square feet) in the same amount of time. Larger machines can clean more than 100,000 square feet per hour. The labor cost of doing the same job is 20 hours or more.

2.Mops and Brooms Don’t Get Floors Clean

Autoscrubbers use 100 percent clean water whereas mops smear germs from one area to another, and brooms kick up dust and debris into the air.

3.Commercial Machines Minimize Disruption

Auto sweepers and scrubbers are fast and quiet. They leave behind clean floors, not a slippery, wet path. They’re quiet enough to allow for day cleaning and allow you to avoid disruptions and hazardous wet floors.

4.Machines are More Eco-Friendly

Compared to a mop and bucket, small commercial floor scrubbers such as the Advance .use minimal water and, depending on your cleaning needs, may not require chemicals. Some applications can be effectively cleaned with water and the strength of the scrubber pads.

5.Your Floors Are Clean and It Shows

Would you like your floors to be 60 percent clean or 95 percent clean? Dust and grime create a safety hazard for customers and employees. When cleaning with a mop and bucket, the more you clean, the dirtier the water gets. Commercial floor cleaning equipment leave your floors cleaner and more hygienic.

CHAPTER 4

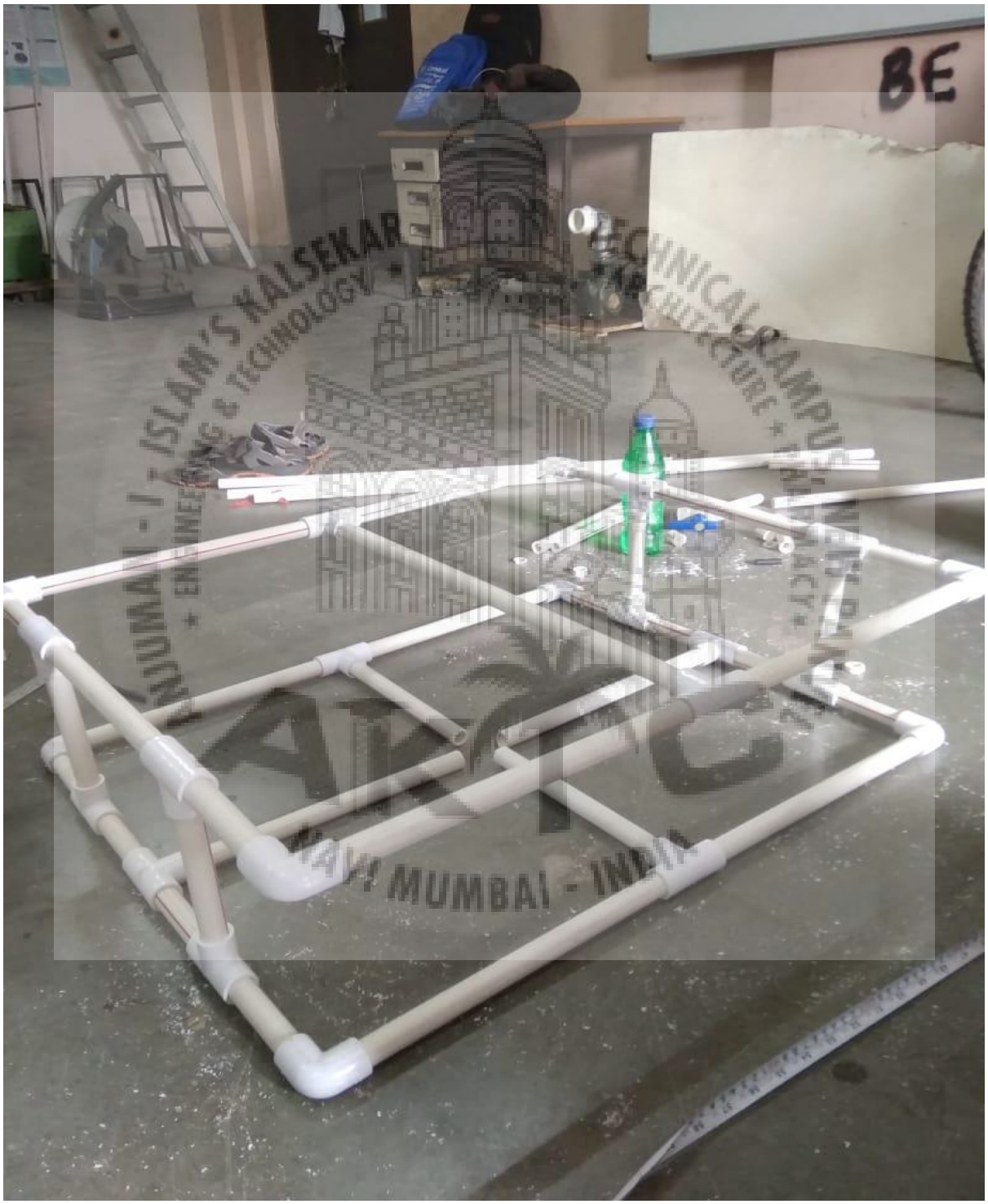
PRESENT WORK

4.1 PREDICTED ANALYZING OF THE WORK

The main aim of this project is to operate on both system Arduino and Wireless respectively, In the present era innovation in Automation is now being applied in each and every field. The principle point of this work is to design and develop a floor cleaning machine which can perform multiple task. The proposed system can be controlled by Android device as well as Wireless Remote. By using couple of sensors for cleaning the most part of the dirty floors and surfaces i.e highly polished wooden surfaces, tiles or stone ,etc.

The machine is able to avoid obstacles and must be capable of cleaning the room upon user commands. This can be helpful in improving the lifestyle of mankind comfortable. The machine can be turned ON and OFF by pressing the external switch which is mounted on the machine.

ANSYS Software which we will going to use to analyze our work.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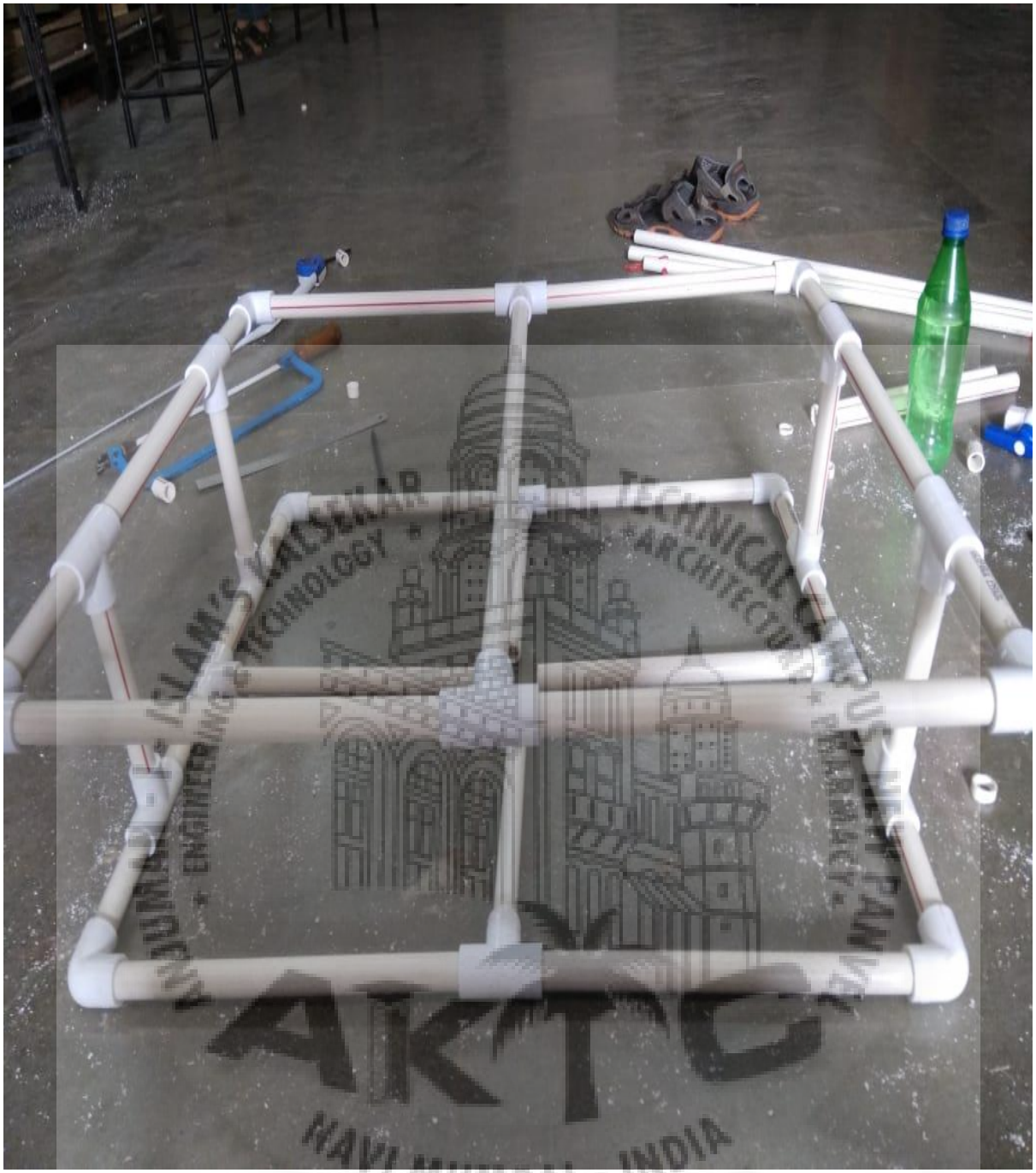

4.2 PREDICTED VALIDATION OF RESULTS

We had analyzed the main two tasks:

1. Cleaning Time
2. Obstacle Detection

1) Cleaning Time:

The path followed by the machine is in zigzag shape, and it gives the best result for the cleaning cycle with less time. The average speed of the machine was 0.50 m2 per second. The proposed system is capable of cleaning a room within 20-25min.

2) Obstacle Detection:

Due to the limitations of the Ultrasonic sensor and IR sensor, there are possibilities for minute errors, but it is negligible and comfortable for the operation of the machine. Similarly ,a zigzag shape path makes it smooth cleaning without any leftover space other than the obstacle area.

IS:303
CM/L-9402671
SIZE
THICKNESS
GRADE
BATCH NO.
YEAR OF MFG.
SPECIES OF TIMBER
ENGINEERING & TECHNOLOGY
CAMPUS, NEW PANVEL
PHARMACY

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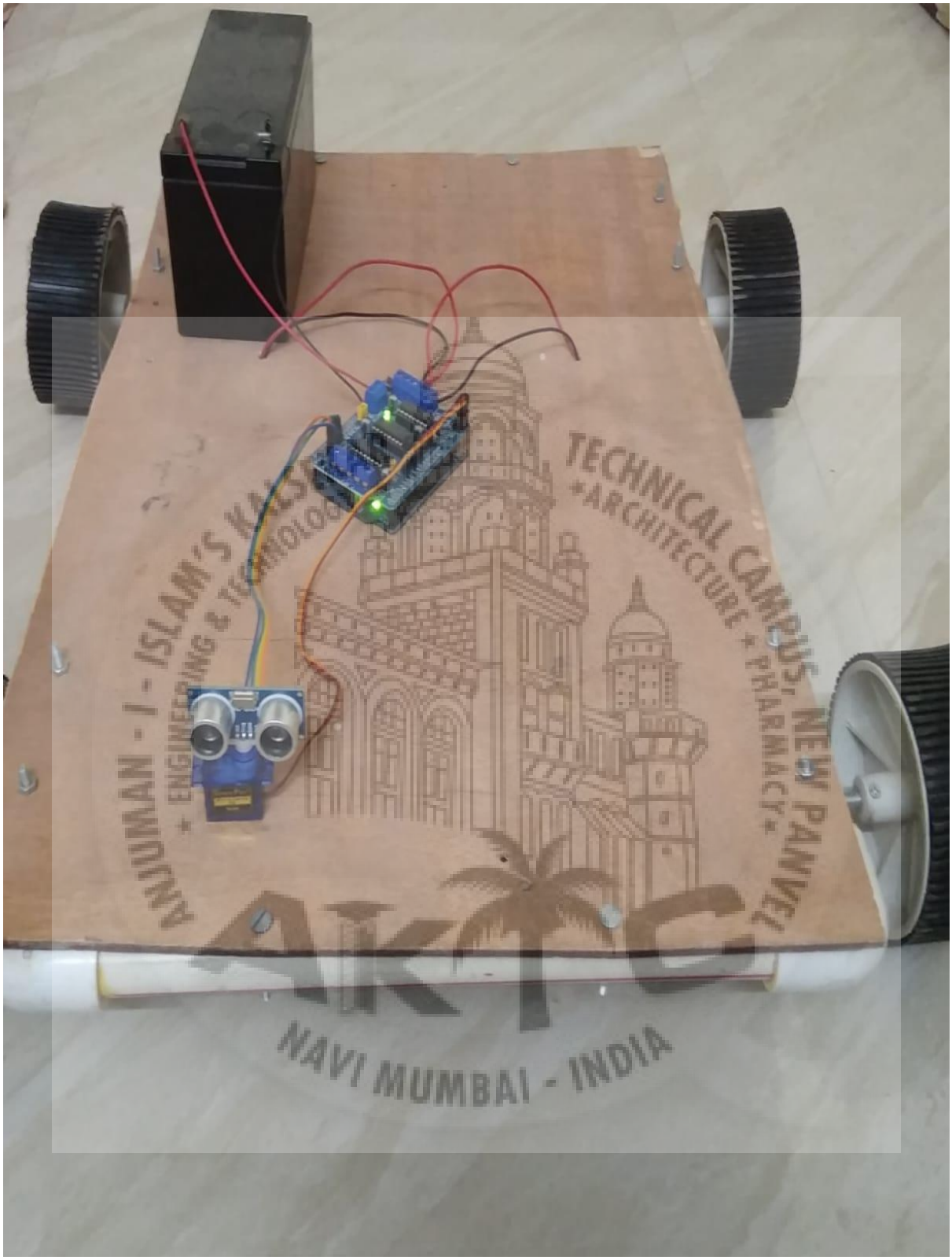
4.3 Expected outcome

The automatic floor cleaner is intelligently programmed to clean a specific area through a vacuum cleaning assembly. The cleaner is cost effective, convenient, environment friendly that saves the valuable time of any person. From industries to homes automatic floor cleaner is used and is becoming a very important part of life as it saves time, money and reduces human efforts to a great extent. It is the future of cleaning in our fast moving life. It is no surprise that they would probably be more reliable than the manual sweeping.

This research facilitates efficient floor cleaning. Since in project the floor cleaner is incorporated with different devices like DC motor(s), ultrasonic sensors etc., so it will be easy to handle it also saves time and will

work automatically for cleaning purpose at homes and offices. With simple algorithm and program, the cleaner will be able to cover large floor areas as well as find its way into and out of small corners. As the cleaner traverses the room, the sweeper installed in it will manage to pick up a significant amount of dirt. Manual Sweeping might not be that effective as it will not be picking up everything in as it is not in sight but using the automatic floor cleaner it can be done easily.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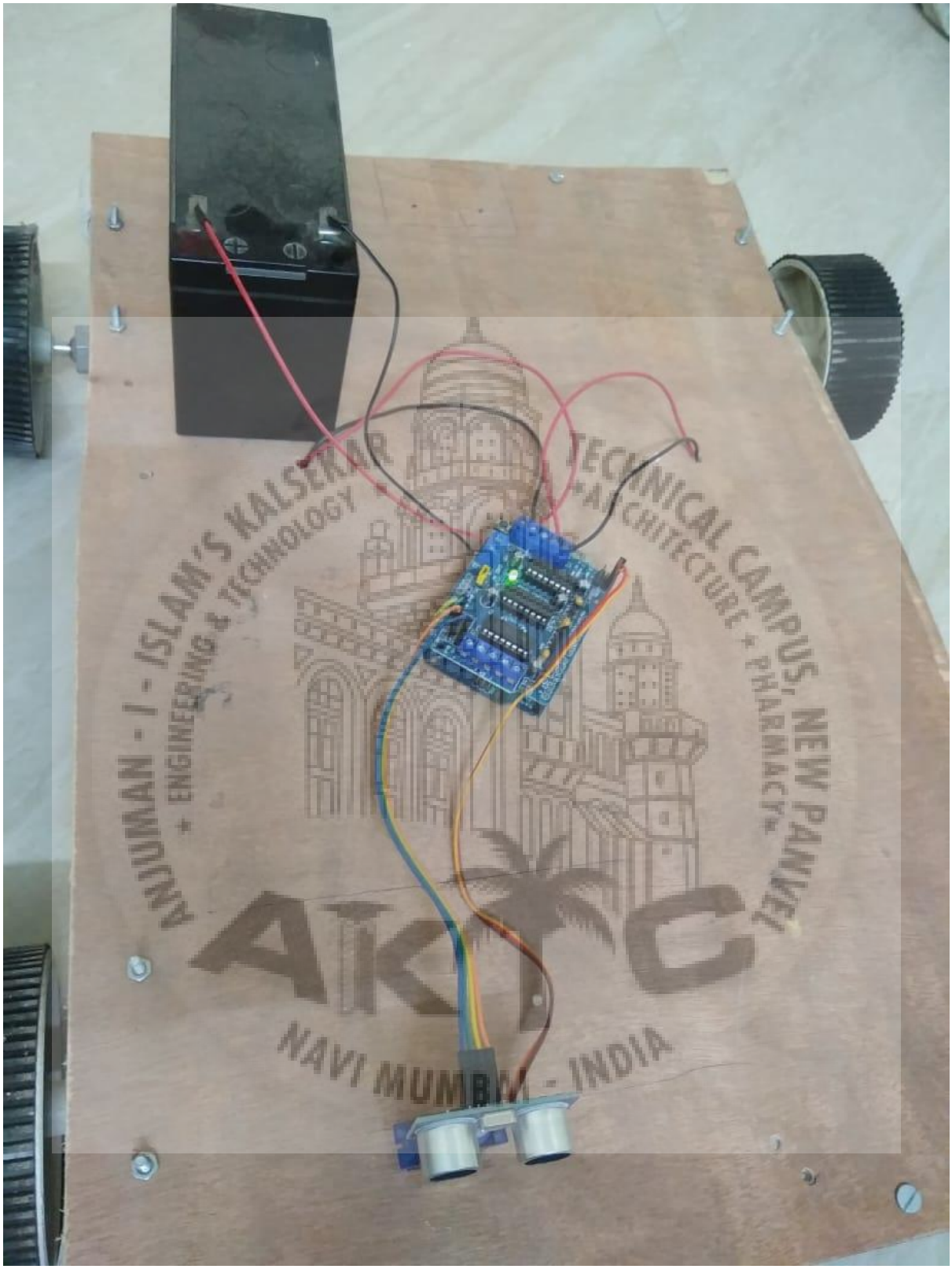
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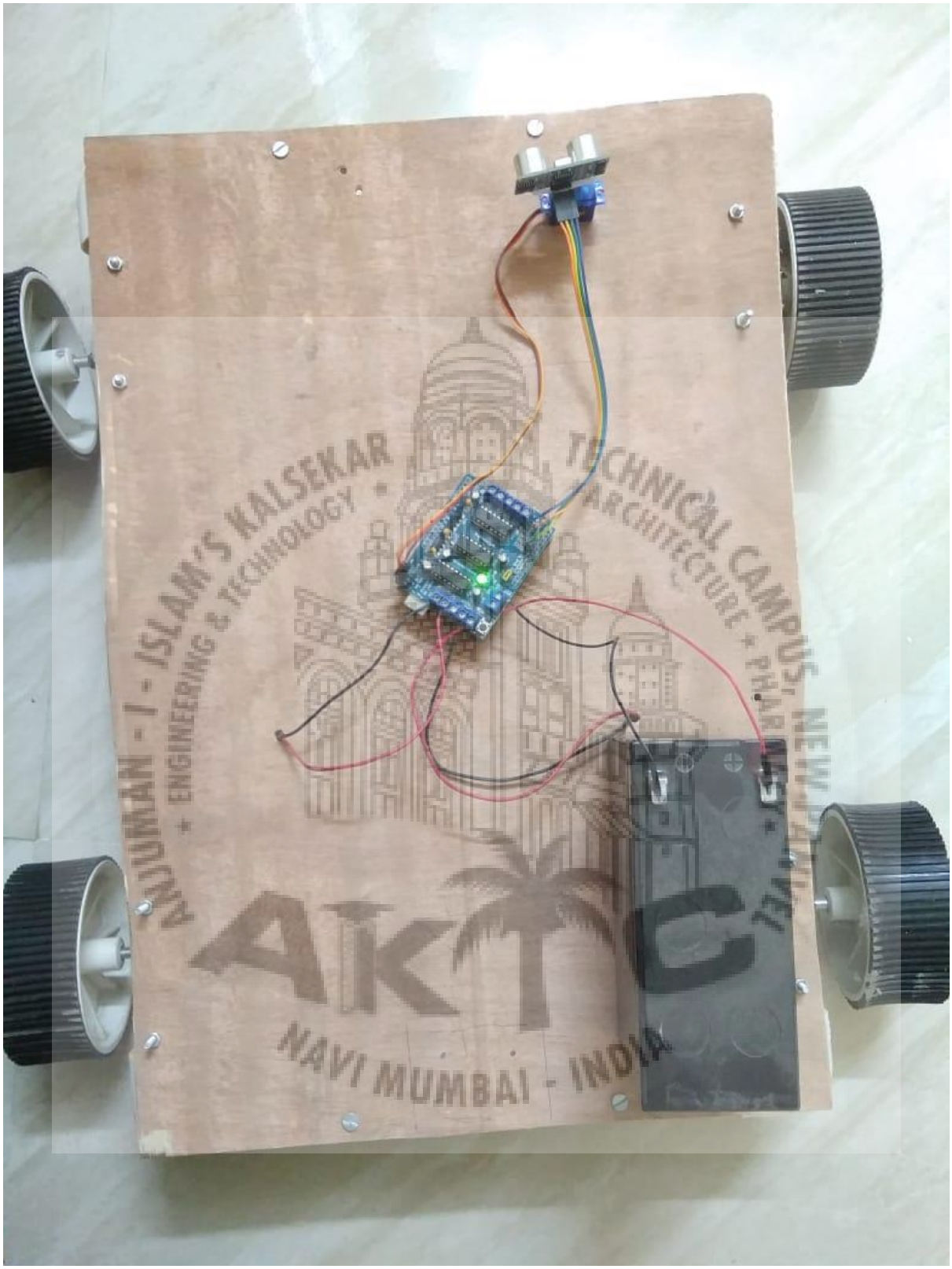
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CHAPTER 5

PARTS USED IN PROJECT

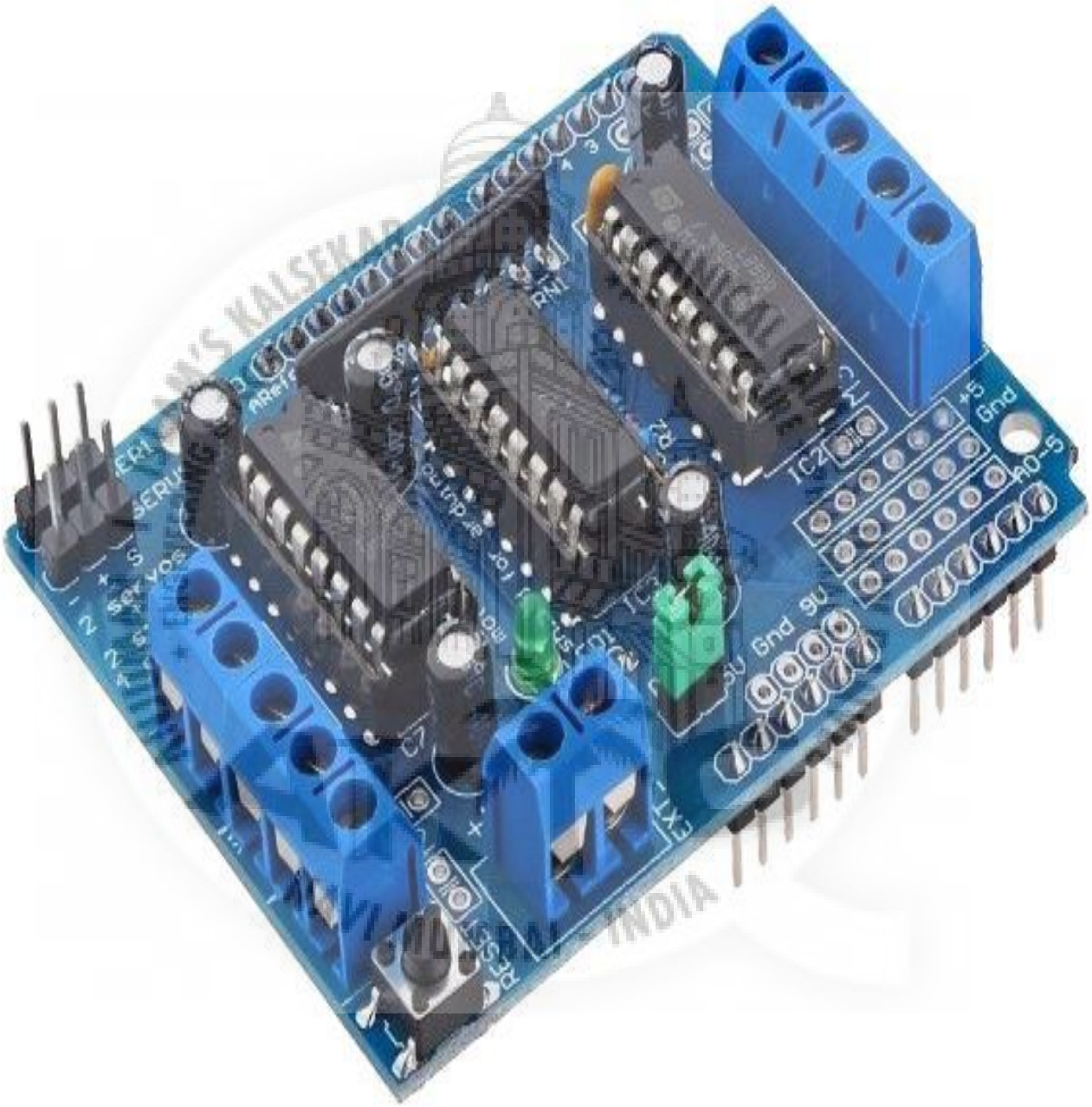
5.1 DC MOTOR

The DC motor working principle is that a current-carrying conductor experiences a mechanical force when placed in a magnetic field. This is known as the Lorentz force. And the direction of this force is given by FLEMING'S LEFT-HAND RULE.

It's very important to know about the DC motor working principle and construction in order to master the basics of DC machines. A DC motor converts electrical energy into mechanical energy. The input electrical energy is obtained from rechargeable batteries, solar cells, etc. The mechanical energy generated is further utilized to rotate pumps, fans, compressors, wheels, etc.Generally, A.C motors are preferred widely in industries. But when it comes to high starting torque or efficient speed control DC motors are the optimal choice. They are used in aluminum rolling mills, electric elevators, railroad locomotives, and large earth-moving equipment.

All DC machines mainly consist of two parts. One is the **stator** and the other is **Rotor**. The stator is a stationary part that includes yoke, pole, pole winding, and Interpoles. The stator produces the magnetic flux.

5.2 L293 MOTOR DRIVER

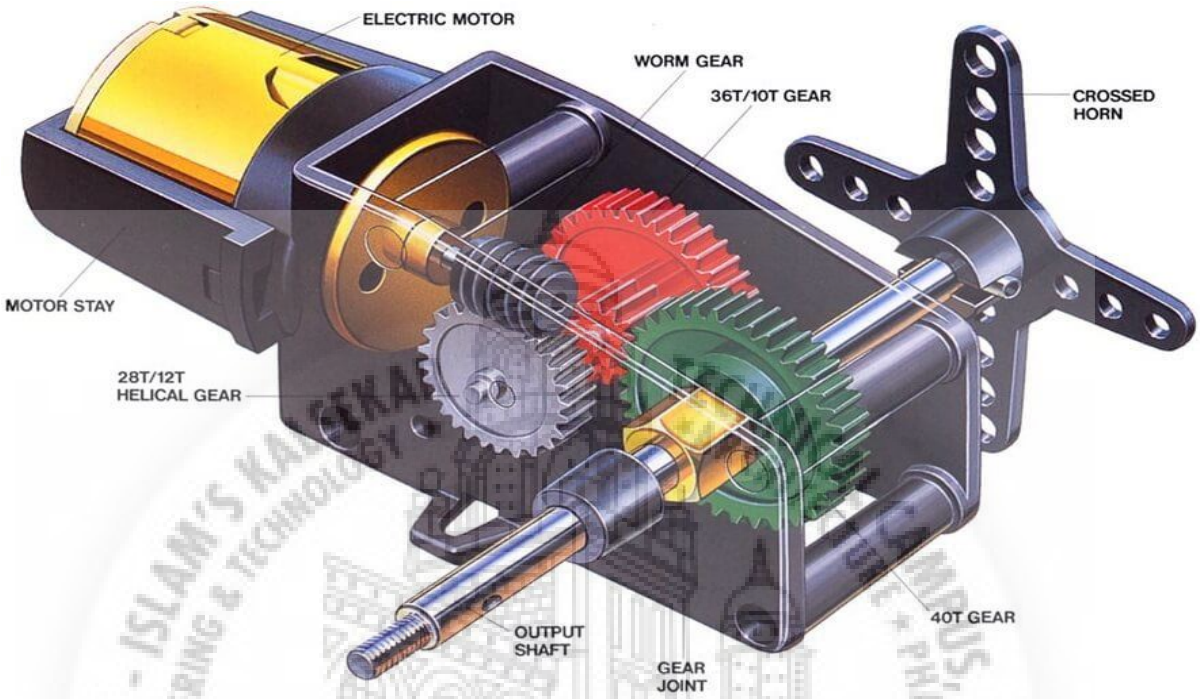


L293D is a monolithic integrated, high voltage, high current, 4-channel driver.Basically this means using this chip you can use DC motors and power supplies of up to 36 Volts, thats some pretty big motors and the chip can supply a maximum current of 600mA per channel, the L293D chip is also what's known as a type of H-Bridge. The H-Bridge is typically an electrical circuit that enables a voltage to be applied across a load in either direction to an output, e.g. motor.

Features:

- 2 interface for 5V Servo connected to For Aduino's high-resolution dedicated timer - no jitter.
- Can drive 4 DC motors or 2 stepper motors or 2 Servo.
- Up to 4 bi-directional DC motors with individual 8-bit speed selection
- Up to 2 stepper motors (unipolar or bipolar) with single coil, double coil or interleaved stepping.
- H-Bridges: per bridge provides 0.6A (1.2A peak
- current) with thermal protection, can run motors on
- 4.5V To 16V DC

5.3 SERVO MOTOR



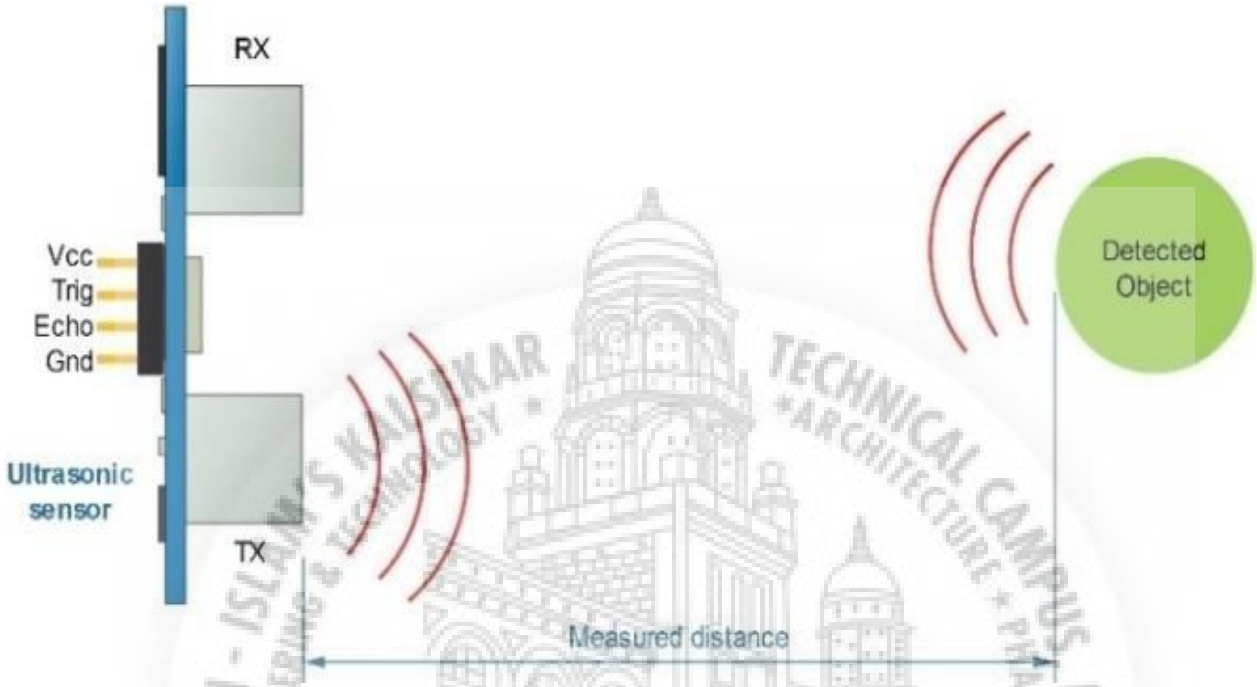
Construction of Servo Motor

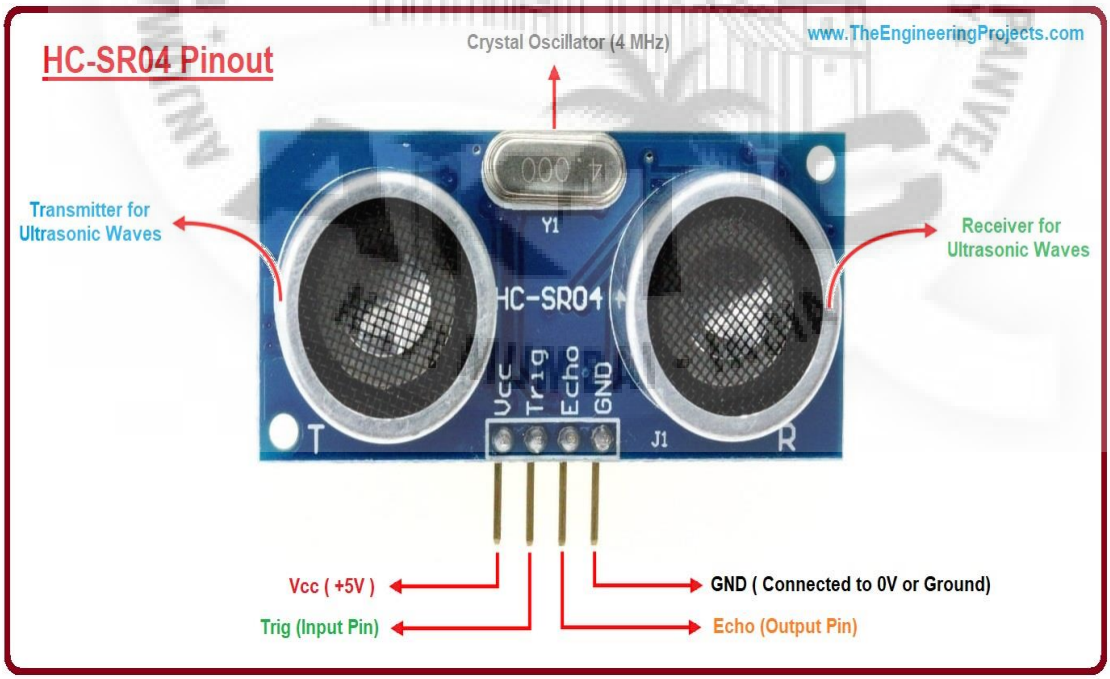
Servo is an electromagnetic device uses a negative feedback mechanism to converts an electric signal into controlled motion. Basically, servos behave like as actuators which provide precise control over velocity, acceleration, and linear or angular position. It consists of four things: DC motor, position sensor, gear train, and a control circuit. The gear mechanism connected with the motor provides the feedback to the position sensor.

If the motor of the servo is operated by DC then it is called a DC servo motor and if it is operated by AC then it is called as AC servo motor. The gear of the servo motor is generally made up of plastic but in high power servos, it is made up of metal.

Servo motors being manufactured by many companies some of them are FUTABA, HITECH, AIRTRONICS, and JR RADIOS. They are the same in manufacturing but different in connector type, wire colors, etc. There are numbers of types of servos are available in the market, AC, DC, continuous, positional and linear servo motor.

5.4 ULTRASONIC SENSOR



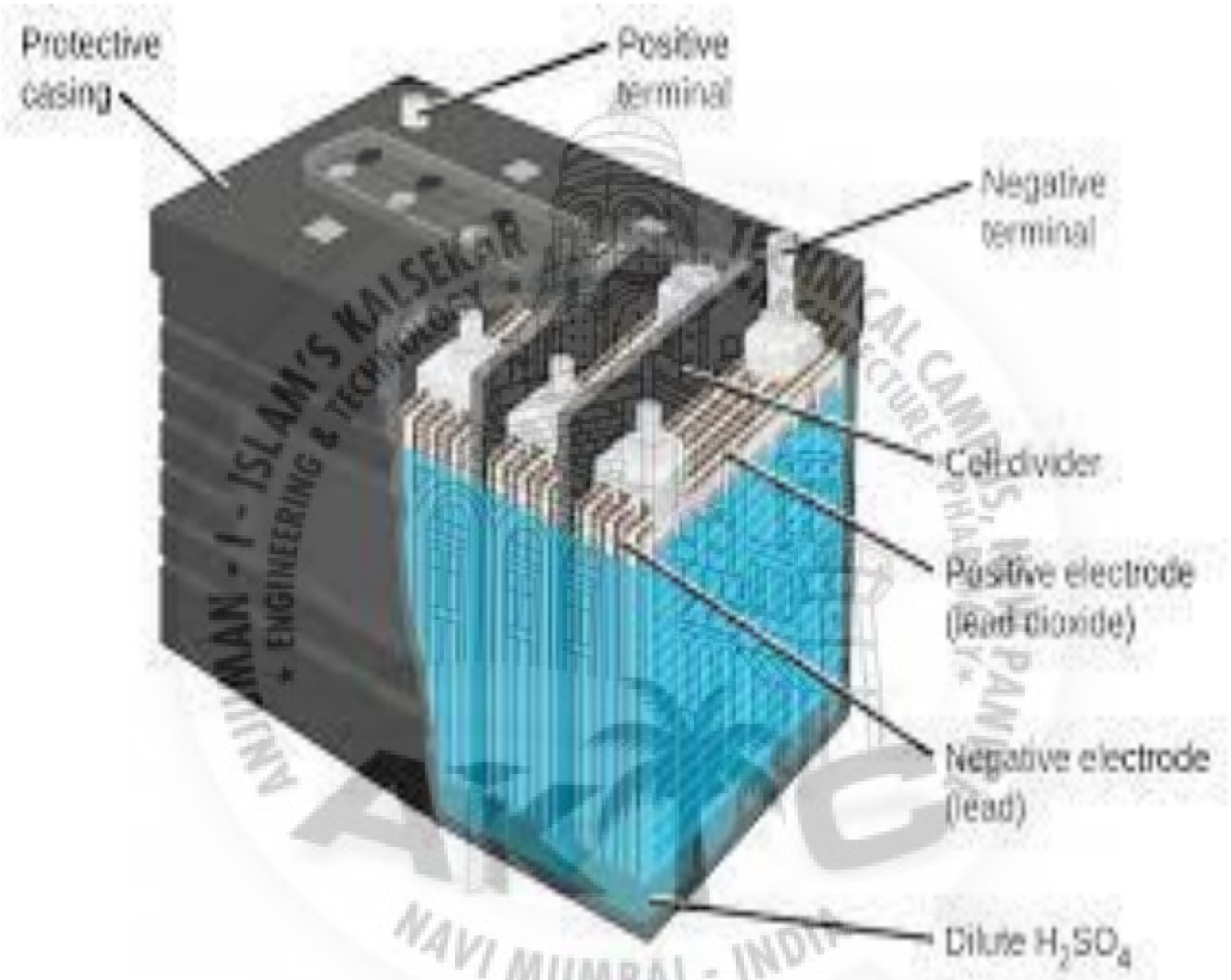


An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound (i.e. the sound that humans can hear). Ultrasonic sensors have two main components: the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target).

Ultrasonic sensors are used primarily as proximity sensors. They can be found in automobile self-parking technology and anti-collision safety systems. Ultrasonic sensors are also used in robotic obstacle detection systems, as well as manufacturing technology. In comparison to infrared (IR) sensors in proximity sensing applications, ultrasonic sensors are not as susceptible to interference of smoke, gas, and other airborne particles (though the physical components are still affected by variables such as heat).

Ultrasonic sensors are also used as level sensors to detect, monitor, and regulate liquid levels in closed containers (such as vats in chemical factories). Most notably, ultrasonic technology has enabled the medical industry to produce images of internal organs, identify tumors, and ensure the health of babies in the womb.

5.5 BATTERY


Protective casing
Positive terminal
Negative terminal
Cell divider
Positive electrode (lead dioxide)
Negative electrode (lead)
Dilute H_2SO_4

A battery is a device that stores chemical energy, and converts it to electricity. This is known as electrochemistry and the system that underpins a battery is called an electrochemical cell. A battery can be made up of one or several (like in Volta's original pile) electrochemical cells. Each electrochemical cell consists of two electrodes separated by an electrolyte.

Voltage = force at which the reaction driving the battery pushes electrons through the cell. This is also known as electrical potential, and depends on the difference in potential between the reactions that occur at each of the electrodes, that is, how strongly the cathode will pull the electrons (through the circuit) from the anode. The higher the voltage, the more work the same number of electrons can do.

Current = the number of electrons that happen to be passing through any one point of a circuit at a given time. The higher the current, the more work it can do at the same voltage. Within the cell, you can also think of current as the number of ions moving through the electrolyte, times the charge of those ions.

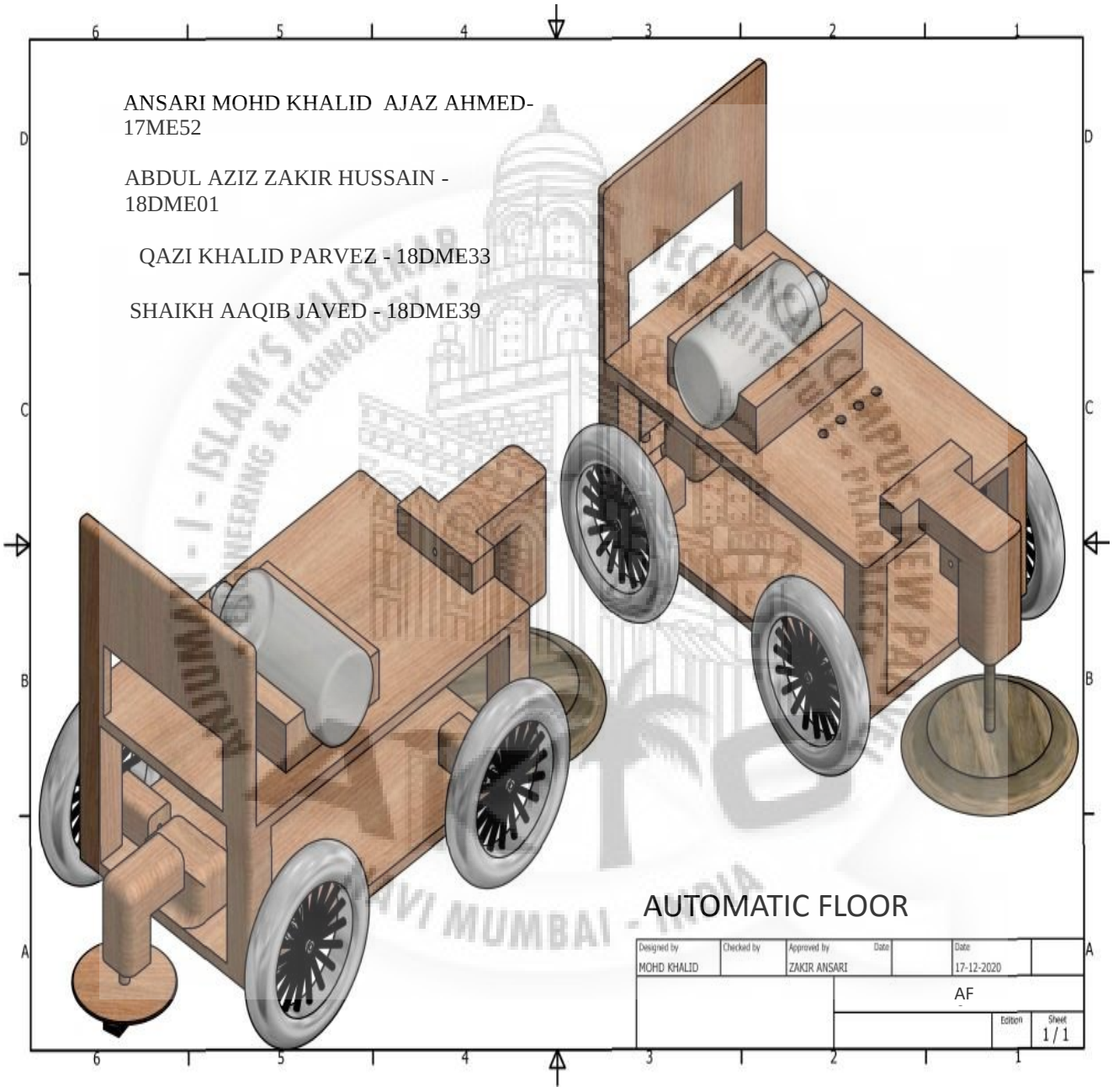
Power = voltage x current. The higher the power, the quicker the rate at which a battery can do work—this relationship shows how voltage and current are both important for working out what a battery is suitable for.

Capacity = the power of the battery as a function of time, which is used to describe the length of time a battery will be able to power a device for. A high-capacity battery will be able to keep going for a longer period before going flat/running out of current.

CHAPTER 6

EXPECTED DESIGN

6.1 ASSEMBLY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ABDUL AZIZ ZAKIR HUSSAIN - 18DME01
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AUTOMATIC FLOOR
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Checked by
Approved by ZAKIR ANSARI
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Date 17-12-2020
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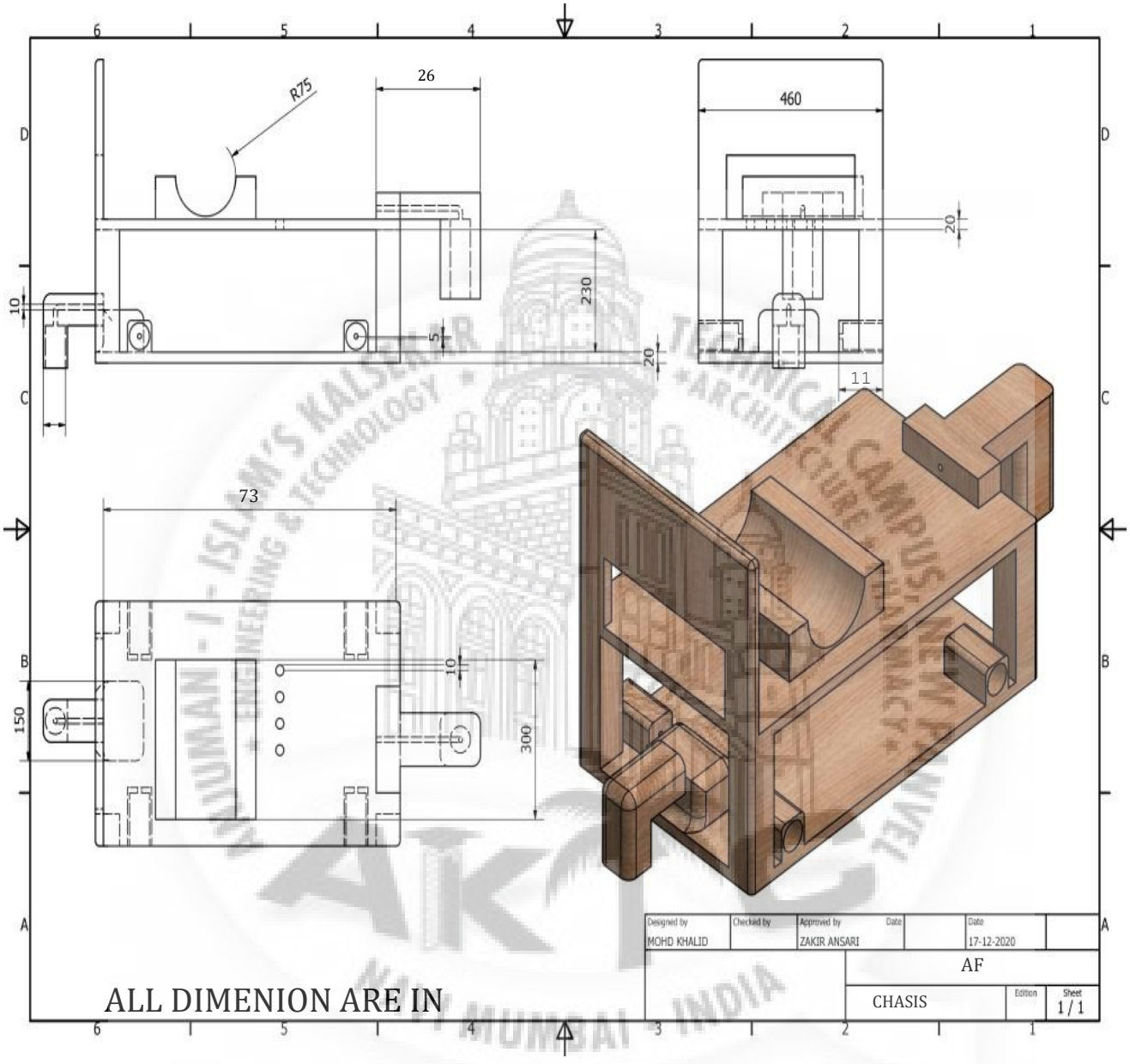
6.2 CHASIS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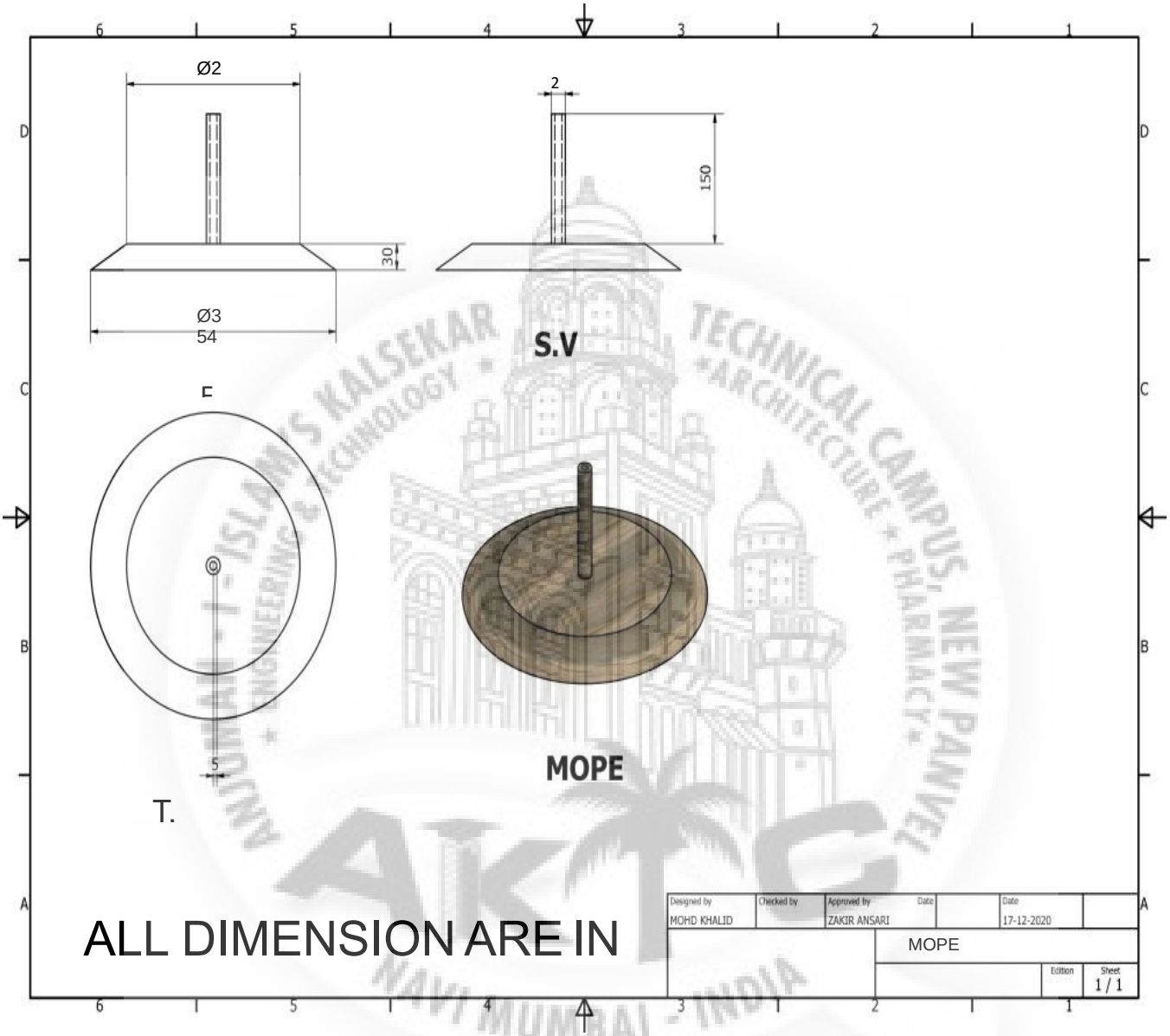
6.3 MOPE


Ø2
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ALL DIMENSION ARE IN
Designed by
MOHD KHALID
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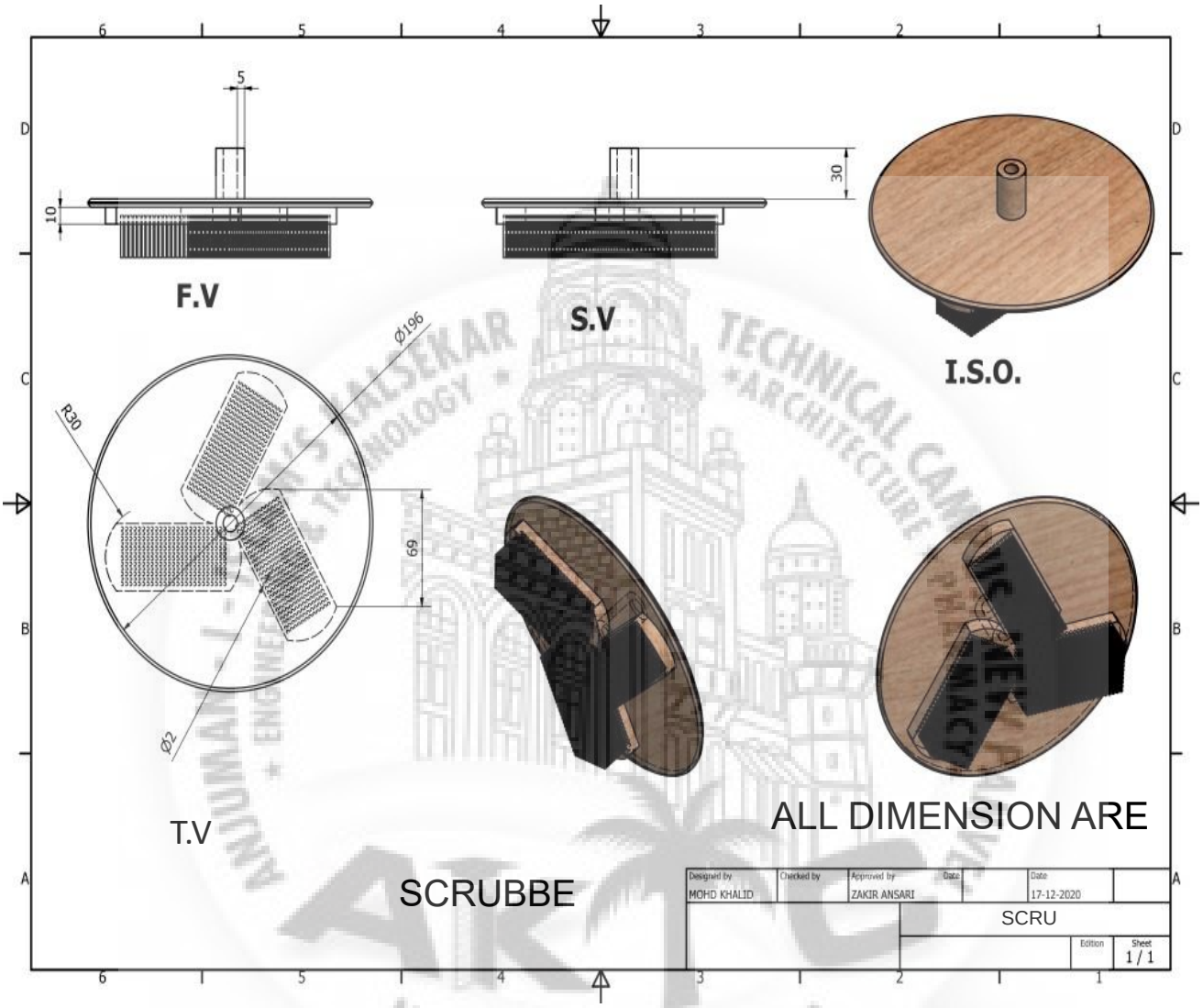
6.4 SCRUBBER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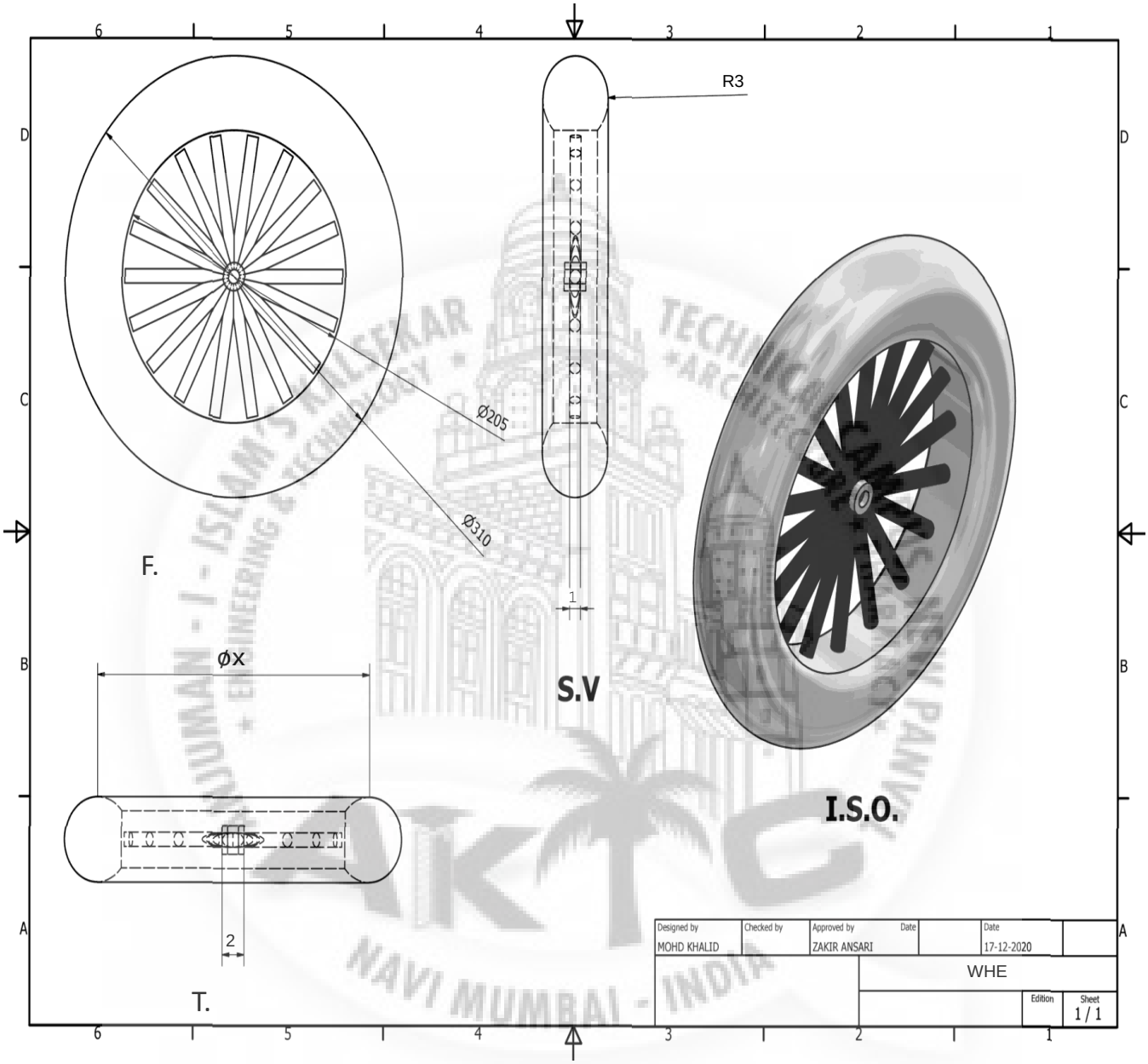
6.5 WHEEL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CHAPTER 7

ESTIMATED COST

7.1 ESTIMATED COST

SR.NO	PARTICULAR	COST (In Rs)
1	Arduino UNO	450
2	DC Motor (4 Piece)	150/piece
3	Battery	500
4	Bluetooth module	100-200
5	Wheels (4 Piece)	40/piece
6	Water Tank	100-150
7	Scrubber	50-100
8	Mope	150-200
	Total	4000-5000

CHAPTER 8

CONCLUSIONS

8.1 CONCLUSIONS

This research facilitates efficient floor cleaning. Since in project the floor cleaner is incorporated with different devices like DC motor(s), ultrasonic sensors etc., so it will be easy to handle it also saves time and will work automatically for cleaning purpose at homes and offices. With simple algorithm and program, the cleaner will be able to cover large floor areas as well as find its way into and out of small corners. As the cleaner traverses the room, the sweeper installed in it will manage to pick up a significant amount of dirt. Manual Sweeping might not be that effective as it will not be picking up everything in as it is not in sight but using the automatic floor cleaner it can be done easily.

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