# A

# PROJECT REPORT

# ON

# "IoT GRASS CUTTER"

**Submitted for award of the degree of**

**BACHELOR OF TECHNOLOGY**

**IN**

**MECHANICAL ENGINEERING**

Submitted by


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**Campus Etawah - 206001**


**(2018-22)**

# CERTIFICATE

This is to certify that the project entitled "**IoT GRASS CUTTER"** submitted to **Baba Saheb Dr. Bhim Rao Ambedkar Collage of Agricultural Engineering & Technology, Etawah** faculty of **Engineering & Technology, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur**, in partial fulfilment of the requirement for the award of the degree of **Bachelor of Technology in Mechanical Engineering**, embodies the results of bonafide project report carried out by **Dushyant Kumar (CT-2885/18)**, **Ashish Kumar (CT-2886/18), Amresh Sharma (CT-2887/18), Ashwani Yadav (CT-2888/18),** under my guidance and supervision, and no part of this project has been submitted to any other degree.

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# ABBREVIATIONS

| | |
|---|---|
| IoT | Internet of things |
| MCU | Micro controller unit |
| Kg | Kilogram |
| CPU | Central processing unit |
| Rpm | Rotation per minute |
| AC | Alternating current |
| DC | Direct current |
| Amp | Amphere |
| Hr | Hour |
| Min | Minute |
| AI | Artificial intelligence |
| ML | Machine learning |
| USB | Universal serial bus |
| GPIO | General purpose input output |
| UART | Universal asynchronous receiver transmitter |
| LED | Light emitting diode |
| ADC | Analog to digital convertor |
| SPI | Serial peripheral interface |

# ABSTRACT

In the conventional grass cutting machines, engines with non-renewable fossil fuels are required, that also contributes to the increase in the air pollution level at very extreme, brings environmental problems such as “greenhouse effect”, health concerns. Often these machines are clunky in nature due to mechanical machinery components, requires frequent maintenance of parts due to wear tear over time and tedious to operate. The primary objective of the project is to design a portable and digitally operated grass cutter that can also reduce dependence on fossil fuels. In this project, we have infused features of IoT (Internet of things) in hand made grass cutter to increase its potential to the way of advancement. Special feature of this grass cutter is that, it can be controlled from any part of the world in return, it just need internet connection. We can even control it from our android phone, which is very common gadget, installed in everyone’s pocket and all this is possible because this machine contains NodeMCU colloquially called as mini CPU at its core. A user-friendly web interface allows us to control mobility of machine.

# CHAPTER – 1
# INTRODUCTION

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# INTRODUCTION

## 1.1 Introduction

You have heard about the word like smart homes, smart streets, smart cities, etc. Many homes have smart functions like turning on and off the lights with voice and many other functionalities. Many cities are also leading towards smart constructions like smart cities and smart streets. Automatic streetlights, automatic parking systems are some of the examples of smart city planning. This is only because of the smart technology 'Internet of Things' commonly known as IoT. The technology helps to communicate between hardware. It helps in robotics also. In this article, we are discussing another project named IoT Grass Cutter using various basic IoT components.

It is a well-known fact that long ago, the grass was being cut by using blades, which highly required time and manpower. Later grass cutters, which used fuels, came into the market. These used gasolines and clunky machinery for their operation, which pollutes the environment. These lawn mowers were massive in size and required manpower for their operation. In today's world, time is the most precious thing. Traditionally, grass cutters are often clunky pieces of machinery that involves a lot of strength and energy to use. The basic idea behind the IoT based grass cutter is to reduce human efforts and to take another step towards the automation by transforming ordinary grass cutter from manual usability to automatic use. We infused latest features and technology of internet of things in handmade ordinary grass cutter. Special feature of this grass cutter is that, it can be control from any part of world because it is connected via internet. We can even control it from our android phone which is very common gadget installed in everyone pockets.

The internet of things is a system of interrelated mechanical and electronic devices, and the ability to connect and exchange data with other devices and systems over the Internet or other communications networks without requiring human-to-machine interaction and enables to automate processes and reduce labor costs. This ecosystem consists of web-enabled smart devices that use embedded systems, such as processors, modules and communication hardware that synchronously facilitates machine to send data and act on receiving command from user.

## 1.2 History of IoT

Kevin Ashton, co-founder of the Auto-ID Center at the Massachusetts Institute of Technology (MIT), first mentioned the internet of things in a presentation he made to Procter &Gamble (P&G) in 1999. Wanting to bring radio frequency ID (RFID) to the attention of P&G's senior management, Ashton called his presentation "Internet of Things" to incorporate the cool new trend of 1999 the internet. MIT professor Neil Gershenfeld's book, “When Things Start to Think” , also appeared in 1999. It did not use the exact term but provided a clear vision of where IoT was headed.

IoT has evolved from the convergence of wireless technologies, micro electromechanical systems (MEMSes), micro services and the internet. The convergence has helped tear down the silos between operational technology and information technology (IT), enabling unstructured machine-generated data to be analyzed for insights to drive improvements. Although Ashton's was the first mention of the internet of things, the idea of connected devices has been around since the 1970s, under the monikers embedded internet and pervasive computing. The first internet appliance, for example, was a coke machine at Carnegie Mellon University in the early 1980s. Using the web, programmers could check the status of the machine and determine whether there would be a cold drink awaiting them, should they decide to make the trip to the machine.

## 1.3 Advantages of IoT grass cutter

1. **Remotely controlled:** This machine can be control by very common gadget that is mobile phone. It just requires internet connection in return to get connected with machine.
2. **Environment:** This machine, completely works on electric supply, does not requires fossil fuel to operate unlike mechanical engine based machines.
3. **Maintenance:** It eliminates most of the cost of maintenance, as its foundation is not based on clunky parts, hence causes less wear-tear.
4. **Ease of Use:** We made a friendly mobile interface contains few navigation buttons to navigate it.
5. **Lightweight:** Its frame is entirely made of plastic and fiber does not have heavy mechanical components.
6. **Portable:** Due to light in weight, it can easily be transported to any place.

## 1.4 Objectives

The proposed topic of project is fulfilling the following objectives:

1. To build a grass cutter which is compact in size and portable in nature.
2. To build mobile controlled functionalities in IoT grass cutter.
3. To build a grass cutter which can carry a suitable load upto 10Kg.
4. To create a design using SOLIDWORKS software.

# CHAPTER – 2
# REVIEW OF LITERATURE

# CHAPTER – 2
# REVIEW OF LITERATURE

In this chapter of our project report that is review and literature, we have reviewed various research papers developed by earlier researchers regarding the development of IoT grass cutter. The objective to review that research papers is to know the technology the design concept that have been used in the development of IoT grass cutter earlier.

The brief research introduction is being presented below as follows: -

**Edwin Beard Budding, (1830)** invented the lawn mower was invented in Brimscombe and Thrupp, just outside Stroud, in Gloucestershire, England. Budding's mower was designed primarily to cut the grass on sports grounds and extensive gardens, as a superior alternative to the scythe, and was granted a British patent on August 31, 1830. [1][2]

**Mark Weiser, (1991)** on his paper on ubiquitous computing, "The Computer of the 21st Century", as well as academic venues such as UbiComp and PerCom produced the contemporary vision of the Internet of Things and its applications in day-to-day life. The idea of integrating computer seamlessly into the world at large runs counter to a number of present day trends “Ubiquitous computing” in this context does not mean just computers that can carry to beach, airport or anywhere. [3]

**Reza Raji**, (**1994)** described the concept in IEEE Spectrum in “Smart networks for control” as moving small packets of data to a large set of nodes, control networks move small packets of data to a large set of nodes, so as to integrate and automate everything from home appliances to entire factories. This is due to the use of embedded microprocessors. The author discusses the control net architecture, network topology and the fast response of the network. [4]

**Kevin Ashton of Procter & Gamble, (1999)** coined term "Internet of things", later MIT's Auto-ID center, in 1999, though he prefers the phrase "Internet for things". At that point, he viewed radio-frequency identification (RFID) as essential to the Internet of things, which would allow computers to manage all individual things. The main theme of the Internet of things is to embed short-range mobile transceivers in various gadgets and daily necessities to enable new forms of communication between people and things, and between things themselves. [5]

**Mary Bellis, (2010)** Write an article, "Greener Pastures – History of the Lawn Mower", about timeline and evolution of lawn movers from mechanical to era of electronics machines with microprocessors, connectivity and algorithms segregated it into various types and use cases. [6]

**Steven Folk man**, (**2014)** analytical studied and estimated that PVC pipe can have a useful life of over 100 years. The earliest widespread use of PVC pipes was in Germany in the late 1930's. These early pipes lacked proper extrusion technology. Extrusion technology was greatly developed during the 1950's and 1960's. Use of PVC pipe in the USA started in the early 1960's. It was desired to try to validate the expected long life of PVC pipe. Recently, Utah State University conducted several tests on PVC pipes that had been in use between 20 and 49 years. The tests conducted include acetone immersion and burst pressure or hydrostatic integrity tests. The purpose of these tests was to examine if the pipe still met the quality control standards that were in place when they were manufactured. This paper will also review these test results along with testing done by other researchers examining the long life expectancy of PVC pipe. [7]

**Ansar Khan, Malvi CS, (2016)** found that Polyvinyl chloride (PVC) products are 100% recyclable physically, chemically and energetically. This can be used to make various products like steam houses, shoes stands, laptop stands, kid's scooters, bookshelves etc. There are many benefits of PVC such as, high impact resistance, good temperature capability, light weight, cost effectiveness and an excellent record of use, makes it capable enough that it can replace traditional building materials such as wood, metal, concrete and clay in many applications. In current scenario of cut-throat competition where new products are coming in the market every day, PVC comes as a 'wonder material' which can be used in any way we want to make enormous products by several methods. [8]

**Neha1 , Syeda Asra, (2016)** According to the author, The idea of autonomous machine used to reduce man power with efficient work has given. Mainly this project explains application of green energy. This knowledge can be used in agricultural field as a future scope. [9]

**Udawant Omkar, Thombare, et.al. (2017)** Authored an article, "Smart ambulance system using IoT", International Conference on Big Data, IoT and Data Science (BID). Pune, India. . In smart ambulance different sensors like heart rate sensor, blood pressure, ECG will be judging status of vital parameters, the status of these parameters will be send to hospital's database simultaneously traffic signals will be operated by using GPRS message through cloud. [10]

**Dong Sun, Ling Feng, et.al. (2018)** Studied about cast iron, which is the basic material of the manufacturing industry. It has excellent casting process ability and good shock absorption and wear resistance, so it is widely used. With the awareness of energy conservation and environmental protection, the defects of low energy and high consumption of traditional materials are gradually revealed. They are gradually being replaced by new alloy cast iron. This paper introduces the latest developments in new alloy cast iron production technology in recent years in detail, involving iron purification, furnace selection, melt ratio, chemical composition control, inoculant type and application, and stress relief annealing. [11]

**Prasher, Onu, Stephen, (2020)** Authored an article, "The Internet of Things (IoT) upheaval: overcoming management challenges". This article looks at the existing literature to find business, management and technical issues with these projects. In order to find solutions to these issues, various IoT stakeholders were surveyed and asked about which tools, processes and management strategies they find most useful. Ultimately, the goal of this article is to provide detailed knowledge about the existing IoT management. [12]

**Seifeddine Messaoud, (2020)** Wrote an article, “A survey on machine learning in Internet of Things Algorithms, strategies, applications, integrated cloud IoT and algorithm” in one platform with a high speed internet to equip with capability of making self-decision during path finding from given set of data points with the help of highly efficient and optimized algorithm. [13]

# CHAPTER – 3
# MATERIALS AND METHODOLOGY

# CHAPTER – 3
# MATERIALS AND METHODOLOGY

## 3.1 Methodology

### Principle of operation

System has four wheels, battery, microcontroller, DC motor, and the cutter assembled. It is operated via android phone using application consists of six keys having commands:

1. Forward
2. Reverse
3. Left
4. Right
5. Turbo

When a particular key is pressed in mobile application, the given instruction is transmitted to the server from the device by internet connection. That command gets stored in cloud server, and then microcontroller periodically fetches the signal, stores in local storage and performs the operation, that is appropriate instruction get sends to the motor driver input pins.

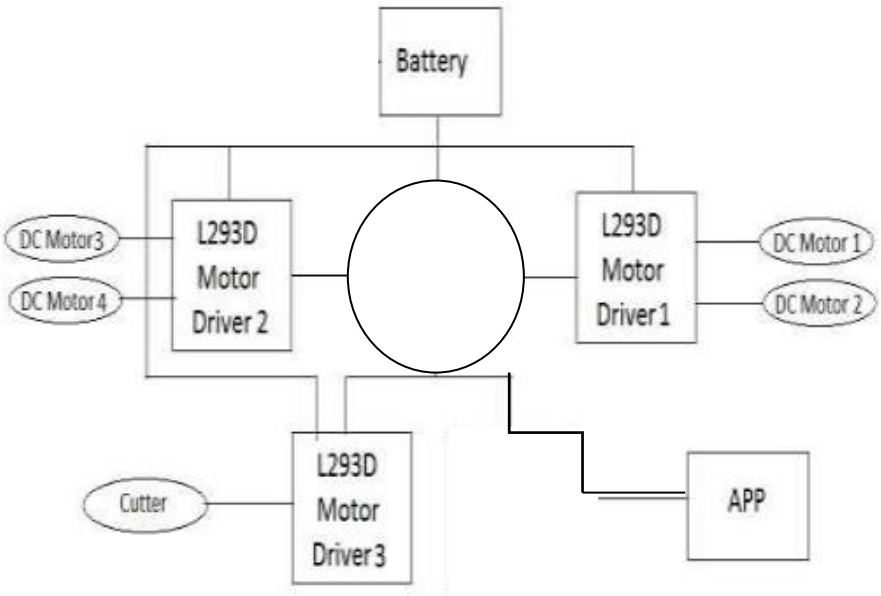


**Fig.3.1 Block diagram of methodology**

## 3.2 Materials used for fabrication of frame

### 3.2.1 PVC pipe

Polyvinyl chloride (colloquial: polyvinyl, or simply vinyl; abbreviated: PVC) is the world's third-most widely produced synthetic polymer of plastic. It is made from a plastic and vinyl combination material. The pipes are durable, hard to damage, and long lasting. They do not rust, nor wear over time. It has to withstand extreme movement and bending.

**Fig. 3.2 PVC pipe**

PVC pipe specifications are given below:

**Table 3.1 PVC pipe specifications**

| S.NO. | ATTRIBUTES | PROPERTIES |
|---|---|---|
| 1 | Length (cm) | 12 |
| 2 | Diameter (cm) | 4 |
| 3 | Thickness (cm) | 0.2 |
| 4 | Weight (gm/cm) | 6 |

### 3.2.2 PVC elbow

Elbow bend with angle 90 degree connects two pipes. There are two types of couplings: "regular" and "slip". A regular coupling has a small ridge or stop internally, to prevent over insertion of a pipe, and thus under insertion of the other pipe segment which would result in an unreliable connection. A slip coupling sometimes also called a repair coupling is deliberately made to allow it to be slipped into place in tight locations.

**Fig. 3.3 PVC elbow**

### 3.2.3. PVC tee

A tee, the most common pipefitting, is used to connect three pipes. Tees can connect pipes of different diameters or change the direction of a pipe run or both. Available in a variety of materials and sizes. Tees may be equal or unequal in size of their three connections, with equal tees the most common.

**Fig. 3.4 PVC tee**

### 3.2.4 PVC solvent cement

Solvent cement is typically a proprietary solution of solvents, stabilizers and fillers combined with a resin (e.g. CPVC). A more common way to distinguish solvent cement is by viscosity. The viscosity of a solvent cement solution is determined by the amount of resin, the more resin, the greater the viscosity. The greater the viscosity, the better it can fill in any material gaps within the joint.


**Fig. 3.5 PVC solvent cement**

### 3.2.5 Plastic wheels

Plastic wheels with outer rubber covering provides good traveling performance on uneven road surface. In addition, these wheels are light in weight allows motor to rotate efficiently without much energy loss due to, wheels, light weight in nature and economic

**Fig. 3.6 Plastic wheels**

The specification of the plastic wheels used are given below in a table:

**Table 3.2 Plastic wheels specifications**

| S.NO. | ATTRIBUTES | PROPERTIES |
|---|---|---|
| 1 | Material | Plastic + Rubber |
| 2 | Shaft diameter (mm) | 6 |
| 3 | Wheel diameter (mm) | 65 |
| 4 | Wheel width (mm) | 40 |

### 3.2.6 Cutter

This component is build from scratch using square wood piece on which sharp blades are attached using nails at right angles. This is light in weight hence does not affect the cutter motor rpm.

**Fig. 3.7 Cutter**

The specification of the cutter used in our project are given below in the table:

**Table 3.3 Cutter**

| S.NO. | ATTRIBUTES | PROPERTIES |
|---|---|---|
| 1 | Material | Iron blade |
| 2 | Length (cm) | 37 |
| 3 | Weight (gm) | 250 |

### 3.2.7 Breadboard [17]

A breadboard or protoboard, is a construction base for prototyping of electronics. Because the solderless breadboard does not require soldering, it is reusable. Breadboards have many tiny sockets called 'holes' arranged on a 0.1" grid. The leads of most components can be pushed straight

into the holes. ICs are inserted across the central gap with their notch or dot to the left of the board. Stranded wire is not suitable because it will crumple when pushed into a hole and it may damage the board if strands break off.

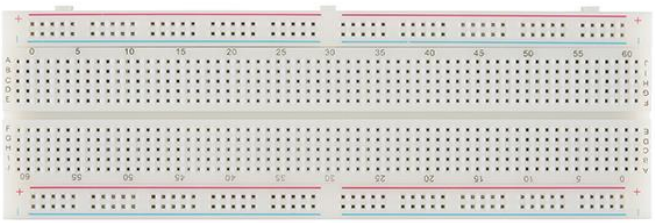

**Fig. 3.8 Breadboard**

### 3.2.8 Jumper wires

A jump wire is an electrical wire or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering. Individual jump wires are fitted by inserting their "end connectors" into the slots provided in a breadboard, the header connector of a circuit board, or a piece of test equipment.

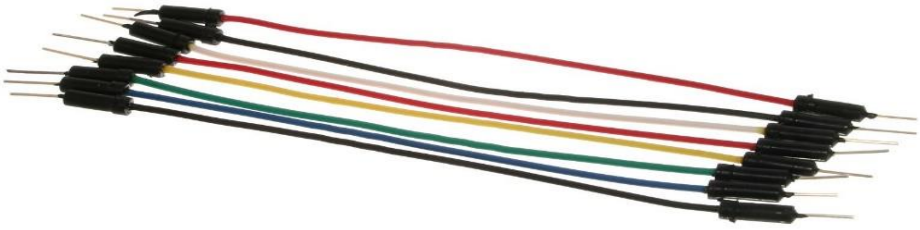

**Fig. 3.9 Jumper wires**

### 3.2.9 Battery

A rechargeable battery that is used. Its main purpose is to provide an electric current to the various electricity-powered components. Each cell of a lead storage battery consists of alternate plates made of a lead alloy grid filled with sponge lead (cathode plates) or coated with lead dioxide (anode). Each cell is filled with a sulphuric acid solution, which is the electrolyte. We took two distributed supplies from battery one supply from single battery used for mobility and another supply from double battery connection is used to drive cutter.


**Fig. 3.10 Battery**

The specification of the battery used in our project are given below in the table:

**Table 3.4 Battery specifications**

| S.NO. | ATTRIBUTES | PROPERTIES |
|---|---|---|
| 1 | Voltage(volt) | 12 |
| 2 | Current (ah) | 7 |
| 3 | Type | Direct current |

### 3.2.10 Gear DC motor

Gear motor refers to a combination of a motor plus a reduction gear train. These are often conveniently packaged together in one unit. It is a simple DC motor featuring metal gearbox for driving the shaft of the motor, so it is a mechanically commutated electric motor, which is powered from DC supply. The gear reduction (gear train) reduces the speed of the motor, with a corresponding increase in torque. Gear ratios range from just a few (e.g. 3) to huge (e.g. 500). A small ratio can be accomplished with a single gear pair, while a large ratio requires a series of gear reduction steps and thus more gears. There are a lot of different kinds of gear reduction.

We have used Johnson gear motor. This motor gives very good torque at an affordable price hence they are widely applicable in pan/tilt camera, auto shutter, welding machines, water meter IC card, grill, oven, cleaning machine garbage disposers, household appliances, slot machines. The motor has sturdy construction. It comes with high quality gears. Shaft equips metal bushes for long life, has a hole for better coupling.

**Fig. 3.11 Gear DC motor**

The specification of the geared motor used in our project are given below in the table:

**Table 3.5 Motor specifications**

| S.NO. | ATTRIBUTES | PROPERTIES |
|---|---|---|
| 1 | Input voltage (DC volt) | 12 |
| 2 | Input current (amp) | 7.5 |
| 3 | RPM | 60 |
| 4 | Diameter shaft (mm) | 6 |
| 5 | Motor diameter | 28.5 |
| 6 | Shaft length (mm) | 30 |
| 7 | Length without shaft (mm) | 63 |
| 8 | Weight (gm) | 180 |

### 3.2.11 L298 motor driver

The L298N is a dual H-Bridge motor driver, which allows speed and direction control of two DC motors at the same time. The module can drive DC motors that have voltages between 5 and 35V. The module has two screw terminal blocks for the motor A and B, and another screw terminal block for the Ground pin, the VCC for motor and a 5V pin, which can be either an input or output. This depends on the voltage used at the motors VCC. The module has either an on-board 5V regulator, which is enabled, or disabled using a jumper. If the motor supply voltage is up to 12V, we can enable the 5V regulator and the 5V pin can be used as output. However, if the motor voltage is greater than 12V we must disconnect the jumper because those voltages will cause damage to the on-board 5V regulator.

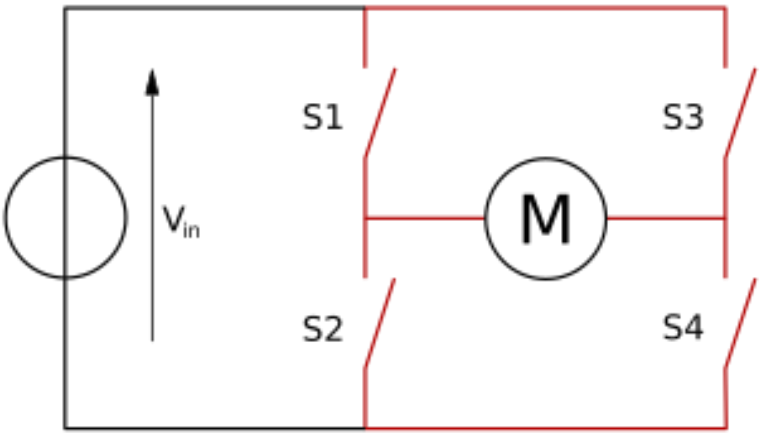


**Fig. 3.12 H-bridge**

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Next are the logic control inputs. The Enable A and Enable B pins are used for enabling and controlling the speed of the motor. If a jumper is present on this pin, the motor will be enabled and work at maximum speed, and if we remove the jumper, we can connect a PWM input to this pin and in that way control the speed of the motor.

L298N motor driver speed and direction control table given below:

**Table 3.6 H-bridge**

| S.NO. | ENA | IN1 | IN2 | DESCRIPTION |
|---|---|---|---|---|
| 1 | 0 | x | x | Motor A is off |
| 2 | 1 | 0 | 0 | Stops |
| 3 | 1 | 0 | 1 | Turns forward |
| 4 | 1 | 1 | 0 | Turns backward |
| 5 | 1 | 1 | 1 | Stops |

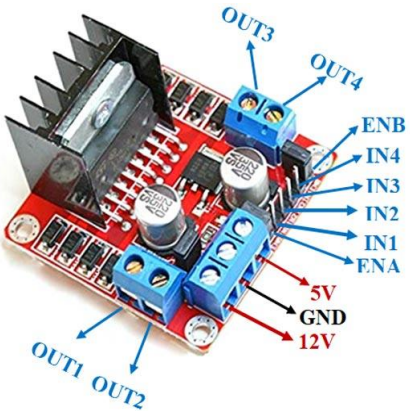



**Fig. 3.13 L298 motor driver**

Next, the Input 1 and Input 2 pins are used for controlling the rotation direction of the motor A and the inputs 3 and 4 for the motor B. Using these pins. We actually control the switches of the H-Bridge inside the L298N IC. If input 1 is LOW and input 2 is HIGH the motor will move forward, and vice versa, if input 1 is HIGH and input 2 is LOW the motor will move backward. In case both inputs are same, either LOW or HIGH the motor will stop. The same applies for the inputs 3 and 4 and the motor B.

### 3.2.12 Microcontroller [11]

A decade back, the process and control operation was performed by microprocessors only. However, nowadays situations are completely changed and the device called Microcontroller controls it and it is used for specific tasks. The development is so radical that we cannot find any electronic gadget without the use of a microcontroller. So, here we just define that the microcontroller is a single-chip computer with all the peripherals like RAM, ROM, I/O ports, timers, ADC's, etc., at the same chip. A microcontroller is a single-chip microcomputer fabricated from VLSI fabrication. Microcontrollers are embedded inside the devices to control the activities and features of a product. Hence, they can also be related to embedded controllers based on this reason normally a microcontroller is also known as an embedded controller. The microcontroller word explains that the word micro is commonly used in electronics and usually in science micro mean 10^-6 and the device includes transistors that are small in size. From here, we define that a microcontroller is a small device employed to control the devices. A microcontroller saves cost, saves power consumption, and does the circuit compact.

Nowadays we use different types of microcontrollers in a number of applications because it gives an effective output. It is an integrated circuit that comprises a processor core along with memory, We have used NodeMCU microcontroller which is a firmware for open source prototyping. The name "NodeMCU" combines "node" and "MCU" (micro-controller unit). The term "NodeMCU" strictly speaking refers to the firmware rather than the associated development kits. It's hardware design is open for edit/modify/build. NodeMCU dev kit/board consist of ESP8266 Wi-Fi enabled chip. The ESP8266 is a low-cost Wi-Fi chip developed by Espressif systems with TCP/IP protocol. More details can be found on ESP8266 Documentation. NodeMCU uses an on-module flash-based SPIFFS (Serial Peripheral Interface Flash File System). NodeMCU is implemented in "C-program" and is layered on the Espressif non-OS SDK. The firmware was initially developed as is a companion project to the popular ESP8266-based NodeMCU development modules, but the project is now community-supported.

**Fig. 3.14 Microcontroller**

ESP8266 NodeMCU require 2.5V to 3.6V operating voltage, on-board 3.3V- 600mA regulator, 80mA operating current, 20 µA current during sleep mode. Power to the ESP8266 NodeMCU is supplied via the on-board micro USB connector. ESP8266 NodeMCU is equipped with 32 Kb RAM, 80 Kb DRAM and 200 Kb flash memory. ESP8266 NodeMCU has pin D0 to pin D10 digital pins, 12 PWM pins, A0 analog pin. It has 5 ground pins, 3 number of 3.3 V pins, 1 input pin for adding 1 external supply of +5V which is not connected to USB. The ESP8266 NodeMCU has total 17 GPIO pins. These pins can be assigned to all sorts of peripheral duties, including one 10-bit ADC channel, 2 UART interface which are used to load code serially, 4 PWM pins for dimming LEDs or controlling motors, SPI and I2C interface to hook up all sorts of sensors and peripherals, I2S interface for adding sound to project. ESP8266 has pin multiplexing feature (Multiple peripherals multiplexed on a single GPIO pin). Meaning a single GPIO pin can act as PWM/UART/SPI. NodeMCU has a RST button to reset the ESP8266 chip, one flash button to download new programs and one blue LED that is user programmable. More details of NodeMCU may found on NodeMCU documentation webpage.

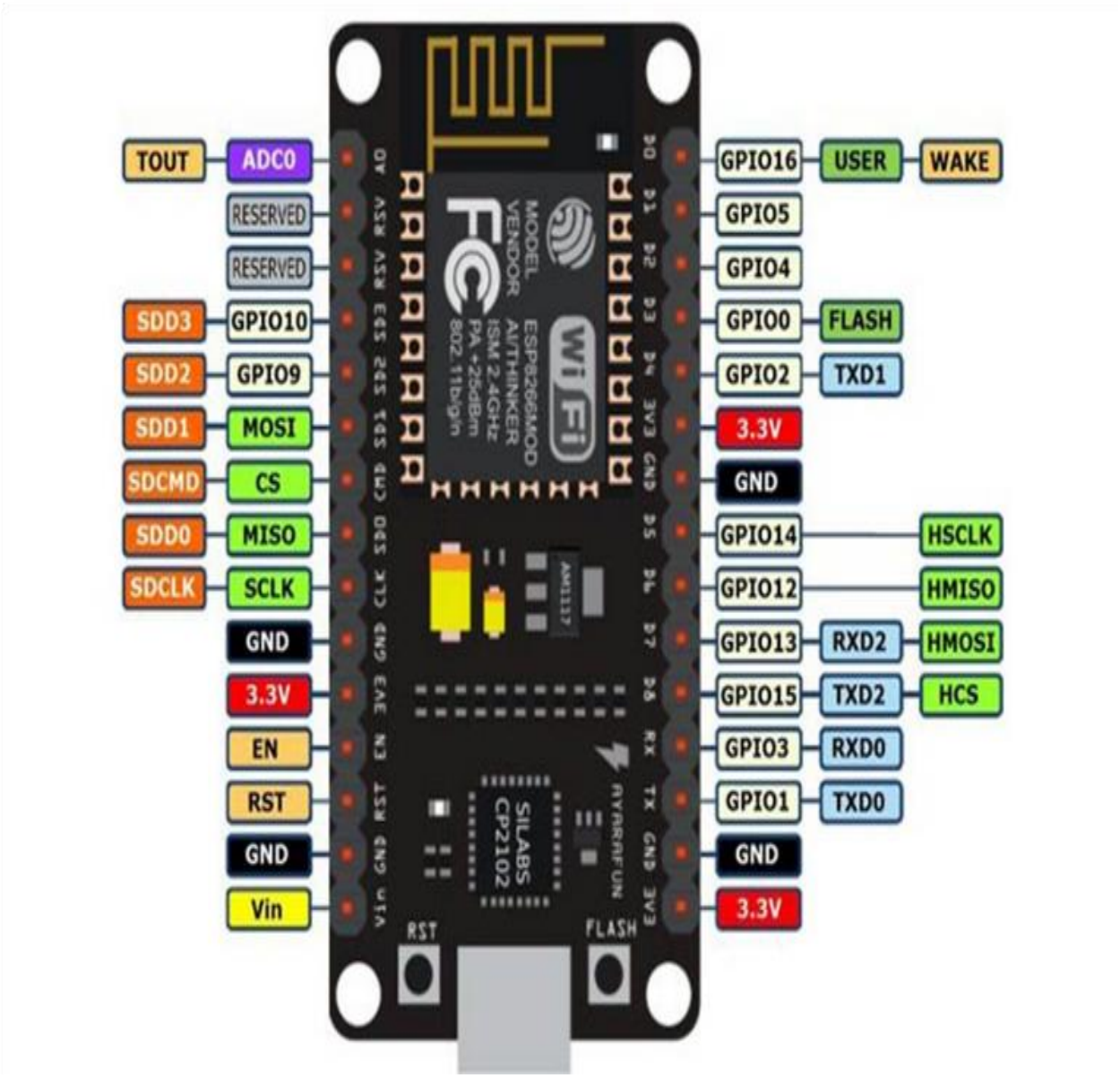



**Fig. 3.15 Microcontroller block diagram**

Specifications of NodeMCU are given below:

**Table 3.7 NodeMCU specifications**

| S.NO. | PIN CATEGORY | NAME | DESCRIPTION |
|---|---|---|---|
| 1 | Power | Micro-USB,3.3V , GND, Vin | Micro USB NodeMCU can be powered through the USB port 3.3V, regulated 3.3V can be supplied to this pin to power the board.<br>GND: Ground pins<br>Vin: External Power Supply |
| 2 | Control Pins | EN, RST | The pin and the button resets the micro controller. |
| 3 | Analog Pin | A0 | Used to measure analog voltage in the range of 0-3.3V. |
| 4 | GPIO Pins | GPIO1 to GPIO16 | NodeMCU has 16 general purpose input-output pins on its board. |
| 5 | SPI Pins | SD1, CMD, SD0, CLK | NodeMCU has four pins available for SPI communication. |
| 6 | UART Pins | TXD0, RXD0, TXD2, RXD2 | NodeMCU has two UART interfaces, UART0 (RXD0 & TXD0) and UART1 (RXD1 & TXD1).<br>UART1 is used to upload the firmware/program. |

Today there is no electronic gadget on the earth that is designed without different types of microcontrollers. Therefore, the modern days' different types of microcontrollers have marked a revolutionary change in every aspect of the automobile designing and manufacturing processes because of their flexibility and adaptability. So, from the above information, we definitely say that there is a lot of importance to the types of microcontrollers.

### 3.2.13 Server [12]

A server is a computer or system that provides resources, data, services or programs to other computers, known as clients, over a network. In theory, whenever computers share resources with client machines they are considered servers. There are many types of servers, including web servers, mail servers, and virtual servers. An individual system can provide resources and use them from another system at the same time. This means that a device could be both a server and a client at the same time.

Some of the first servers were mainframe computers or minicomputers. Minicomputers were much smaller than mainframe computers, hence the name. However, as technology progressed, they ended up becoming much larger than desktop computers, which made the term microcomputer somewhat farcical. Initially, such servers were connected to clients known as terminals that did not do any actual computing. These terminals, referred to as dumb terminals, existed simply to accept input via a keyboard or card reader and to return the results of any computations to a display screen or printer. The actual computing was done on the server. Later, servers were often single, powerful computers connected over a network to a set of less-powerful client computers. This network architecture is often referred to as the client-server model, in which both the client computer and the server possess computing power, but certain tasks are delegated to servers. In previous computing models, such as the mainframe-terminal model, the mainframe did act as a server even though it was not referred to by that name. As technology has evolved, the definition of a server has evolved with it. These days, a server may be nothing more than software running on one or more physical computing devices. Such servers are often referred to as virtual servers

Servers may also perform several tasks, such as a file and print server, which both stores files and accepts print jobs from clients and then sends them on to a network-attached printer. When a client requires data or functionality from a server, it sends a request over the network. The server receives this request and responds with the appropriate information. This is the request and response model of client-server networking, also known as the call and response model. A server will often perform numerous additional tasks as part of a single request and response, including verifying the identity of the requestor, ensuring that the client has permission to access the data or resources requested, and properly formatting or returning the required response in an expected way.

## 1. Database servers

The term database server may refer to both hardware and software used to run a database, according to the context. As software, a database server is the back-end portion of a database application, following the traditional client-server model. This back-end portion is sometimes called the instance. It may also refer to the physical computer used to host the database. When mentioned in this context, the database server is typically a dedicated higher-end computer that hosts the database. In the client-server computing model, there is a dedicated host to run and serve up the resources, typically one or more software applications. There are also several clients who can connect to the server and use the resources offered and hosted by this server. When considering databases in the client-server model, the database server may be the back-end of the database application or it may be the hardware computer that hosts the instance. Sometimes, it may even refer to the combination of both hardware and software.

The hardware database server will also typically host the server part of the software application that uses the database. This application will likely connect to the database via specific ports and use inter-process communication to log into and access the data resident in the database. The users in the bank, seated at their personal computers, will also use the client module of the application installed on their computers to connect to the database. In this example, there are actually two client-server models we are looking at the database and the application. In larger setups, the volume of transactions may be such that one computer will be unable to handle the load. In this case, the database software will reside on a dedicated computer. In this scenario, there is a dedicated database server, which is the combination of the hardware and software.

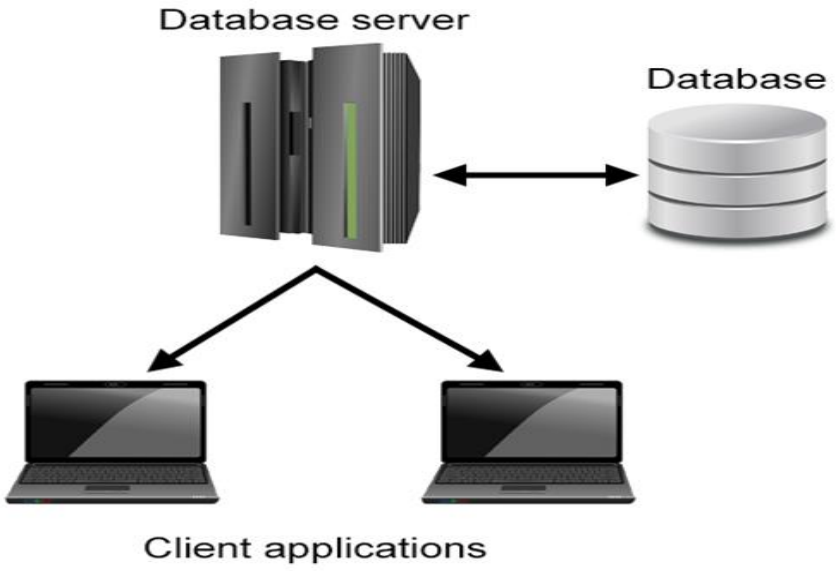



**Fig. 3.16 Server**

### 3.2.14 Miscellaneous

**1. Screws**

Metal screws with helical ridge are used in frame to bind tee, elbow to pipes in order to make frame more stable.

**Fig. 3.17 Screws**

Dimensions of screw used are given below:

**Table 3.8 Screw dimension**

| S.NO. | ATTRIBUTES | PROPERTIES |
|---|---|---|
| 1 | Length (cm) | 2.54 |
| 2 | Material | Iron |

**2. Nails**

To assemble blades with wooden piece and in order to lock cutter, we used small nails.


**Fig. 3.18 Nails**

### 3. Hose clamp

Also known as screw clamps consist of a band, often galvanized or stainless steel, into which a screw thread pattern has been cut or pressed. One end of the band contains a captive screw. The clamp is put around the hose or tube to be connected, with the loose end being fed into a narrow space between the band and the captive screw. When the screw is turned, it acts as a worm drive pulling the threads of the band, causing the band to tighten around the hose. We tighten motors to PVC pipe using hose clamp around them.

**Fig. 3.19 Hose clamp**

### 4. Transparent plastic box

In order to place all connected electronic instruments in one place with well managed condition and to prevent them from external threat of water and dust particles, plastic boxes are great choice. It also helps to debug problems by facilitating us to identify whether components getting power supply or not by checking whether on board LED's on them blinking or not without opening them like in case of opaque boxes.

**Fig. 3.20 Plastic box**

Dimensions of box are given below:

**Table 3.9 Box dimensions**

| S.NO. | ATTRIBUTES | PROPERTIES |
|---|---|---|
| 1 | Length (cm) | 22 |
| 2 | Breadth (cm) | 8 |
| 3 | Height (cm) | 8 |

**5. Switches**

To turn machine on/off manually, plastic switches are used.

**Fig. 3.21 Switch**

## 3.5 Instruments and Tools Used

### 3.5.1. Digital multimeter

Digital multimeter is a test equipment, which offers several electronic measurement task in one tool. It is also known as the voltmeter or Ohmmeter or Volt-Ohmmeter. The standard and basic measurements performed by multimeter are the measurements of amps, volts, and ohms. Apart from that, these digital multimeter perform many additional measurements by using digital and logic technology. These may include temperature, frequency, continuity, capacitance etc.

The new improved integrated circuits of digital multimeter are more efficient, faster and work with a large accuracy as compared to an analogue multimeter. However, in the case of additional features, it is not accurate but close to the reading. A good multimeter is that has continuity and packed with smart features, including the ability to log, graph data and great for troubleshooting.

They are widely used in electrical measurements, AC and DC voltage, AC and DC current, and resistance, voltmeter, ammeter, and ohmmeter, voltages and voltage fluctuations in homes or offices.


**Fig. 3.22 Digital multimeter**

Specifications of digital multimeter are given below:

**Table 3.10 Multimeter specifications**

| S.NO. | ATTRIBUTES | PROPERTIES |
|---|---|---|
| 1 | Type | Digital |
| 2 | Size (cm) | 21X15X5 |
| 3 | Voltage (VDC/VAC) | 1000/750 |
| 4 | Impedance (M-ohm) | 1 |

### 3.4.2. DC regulated power supply

A regulated DC power supply is essentially an unregulated power supply with the addition of a voltage regulator. This allows the voltage to stay stable regardless of the amount of current consumed by the load, provided the predefined limits are not exceeded.


**Fig. 3.23 DC regulated power supply**

This power supply instrument takes the AC from the wall outlet, converts it to unregulated DC, and reduces the voltage using an input power transformer, typically stepping it down to the voltage required by the load. For safety reasons, the transformer also separates the output power supply from the mains

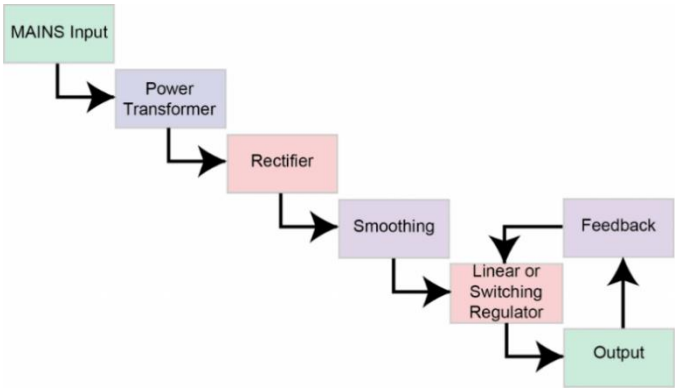



**Fig. 3.24 DC regulated power supply flow chart**

Alternating current takes the form of a sinusoidal wave with the voltage alternating from positive to negative over time.

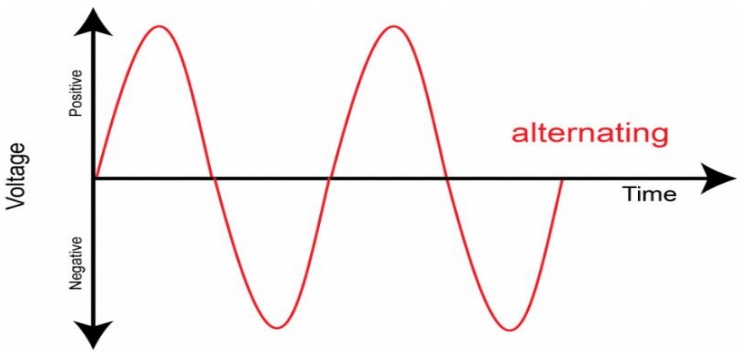



**Fig. 3.25 AC graph**

Once the voltage has been rectified, there is still fluctuation in the waveform—the time between the peaks—that needs to be removed. The rectified AC voltage is then filtered or "smoothed" with a capacitor.

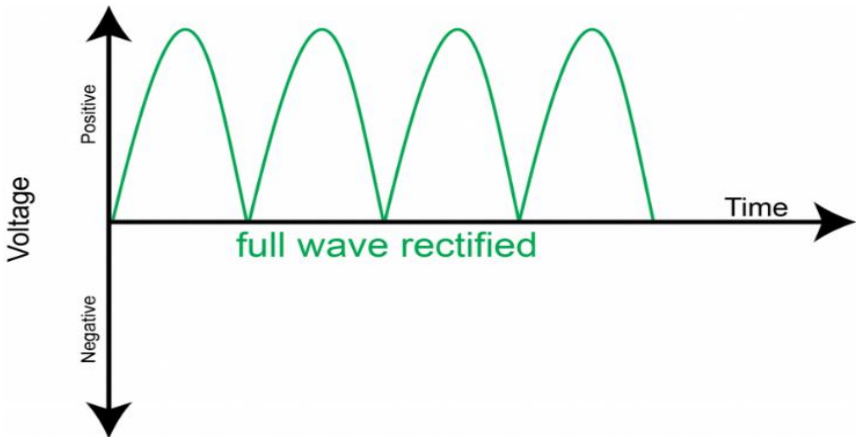



**Fig. 3.26 Full wave graph**

### 3.4.2. Hack saw

You can use almost any kind of saw, but a hacksaw is best as it gives you much more flexibility. Swing in a back and forth motion, all the way through the pipe. Since using a hacksaw or other hand saw is essentially 'hacking' the pipe, you will often be left with 'burrs' on the end of the pipe. These are rough bits that need to be knocked off in order to make the end of the pipe clean. You can use a butter knife to remove these by running it along the end of the pipe to knock them off.

**Fig. 3.27 Hack saw**

### 3.4.2. Screwdriver tool set kit with magnetic holder

This all in one kit consist of various sizes of screw drivers, made from high-carbon alloy steel material. PP + Carbon Steel The body ensures durability and strength of the screwdriver.

It also has magnetic tip due to its strong magnetic force for greater pull screws get stuck to it and facilitates smooth working and due to anti-chafe rubber grip light weight in nature it can easily be hold.

**Fig. 3.28 Screwdriver tool set kit**

# CHAPTER – 4
# FABRICATION AND ASSEMBLY

# CHAPTER – 4

# FABRICATION AND ASSEMBLY

## 4.1 Drafting visuals

An engineering design represents a complex three-dimensional object on a two-dimensional piece of paper or computer screen by a process called projection. Today, engineering drawings are produced on computers with Computer Aided Design (CAD) software such as SolidWorks, AutoCAD. Using the standard design specification with help of Solid works application the isometric view along with top front and side view are given below in panoramic view.

### 1. Wheel

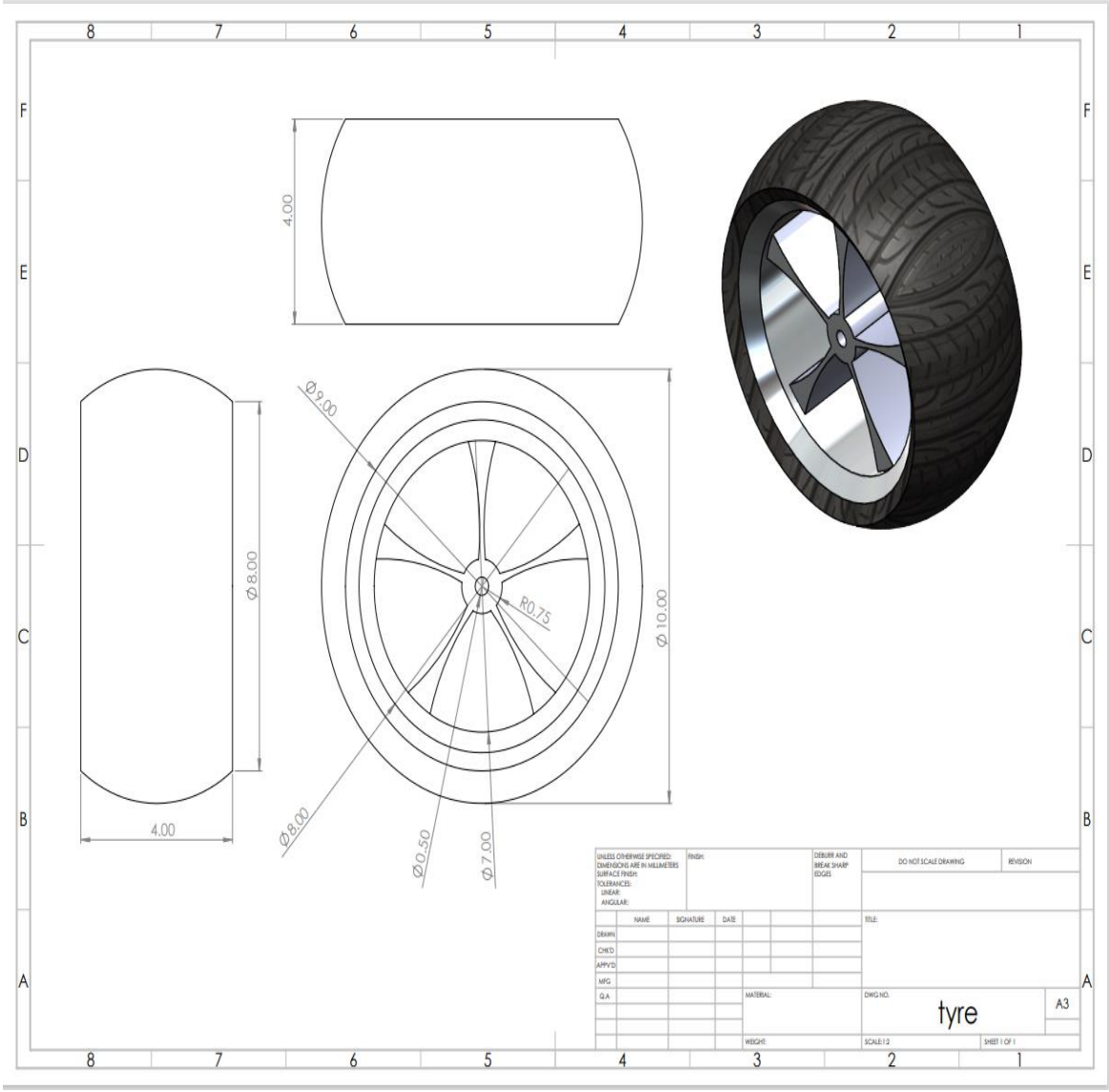



**Fig. 4.1 Wheel drafting**

## 2. Tee

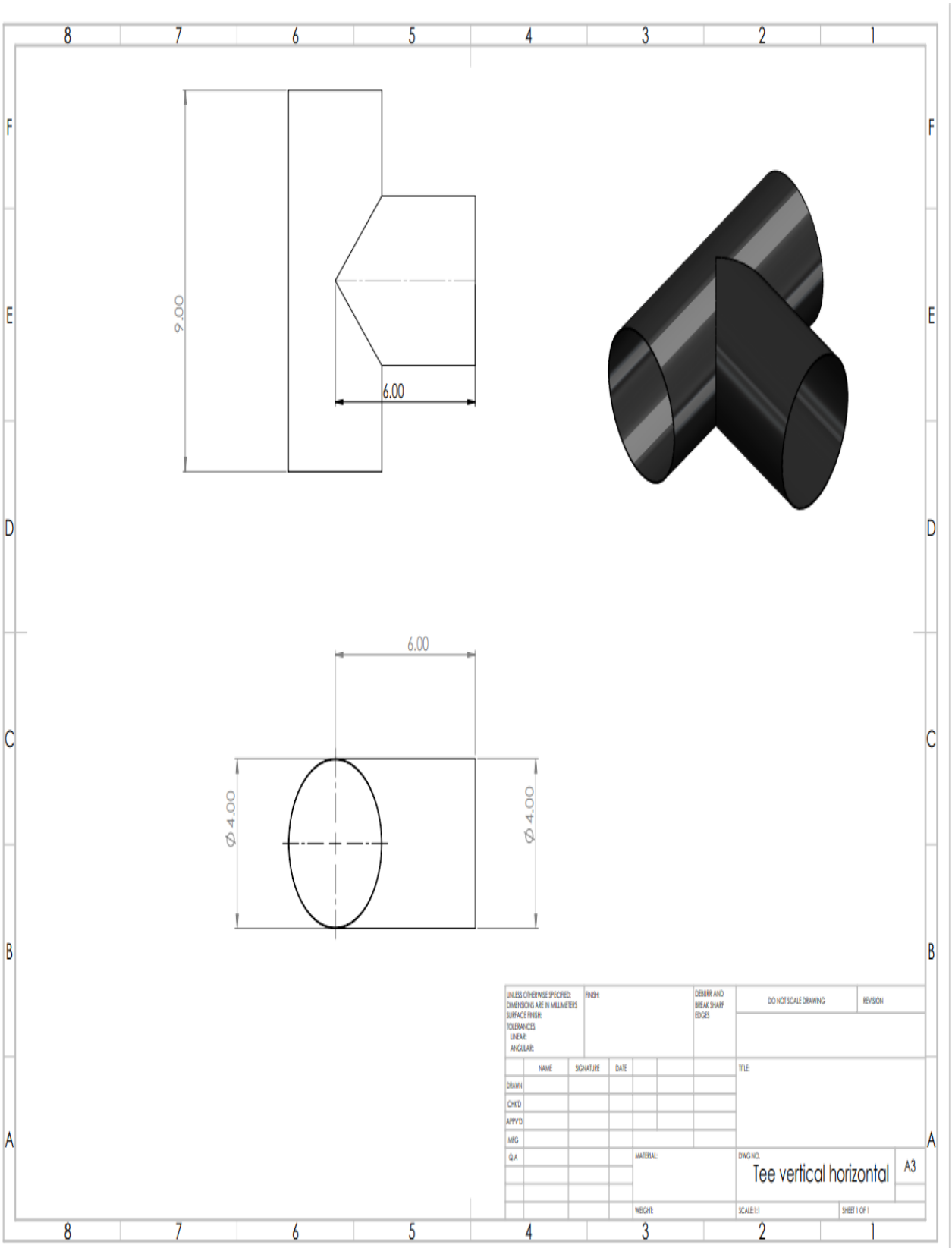



**Fig. 4.2 Tee drafting**

## 3. Pipe

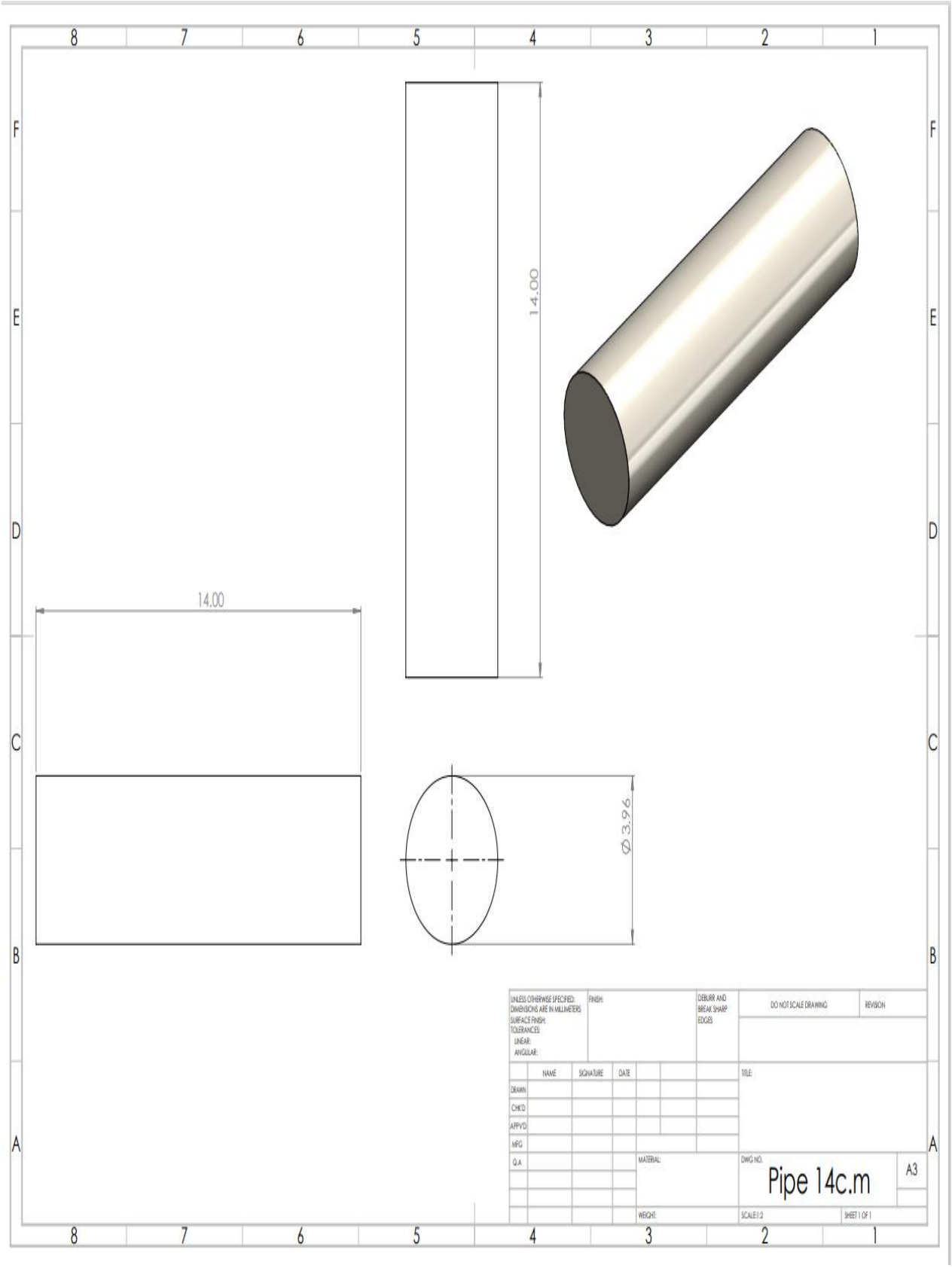



**Fig. 4.3 Pipe drafting**

## 4. Side pipe

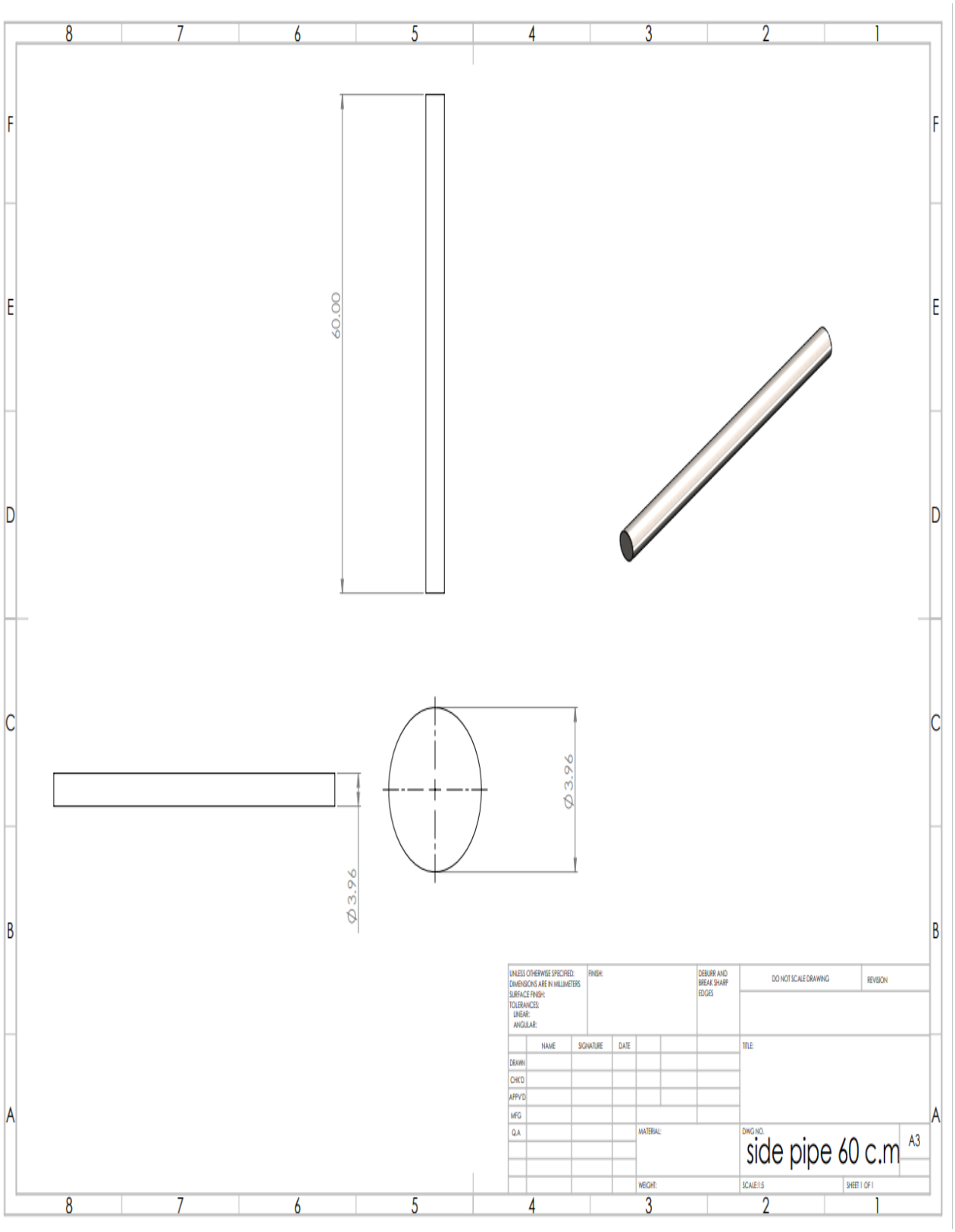



**Fig. 4.4 Side pipe drafting**

## 5. Blade

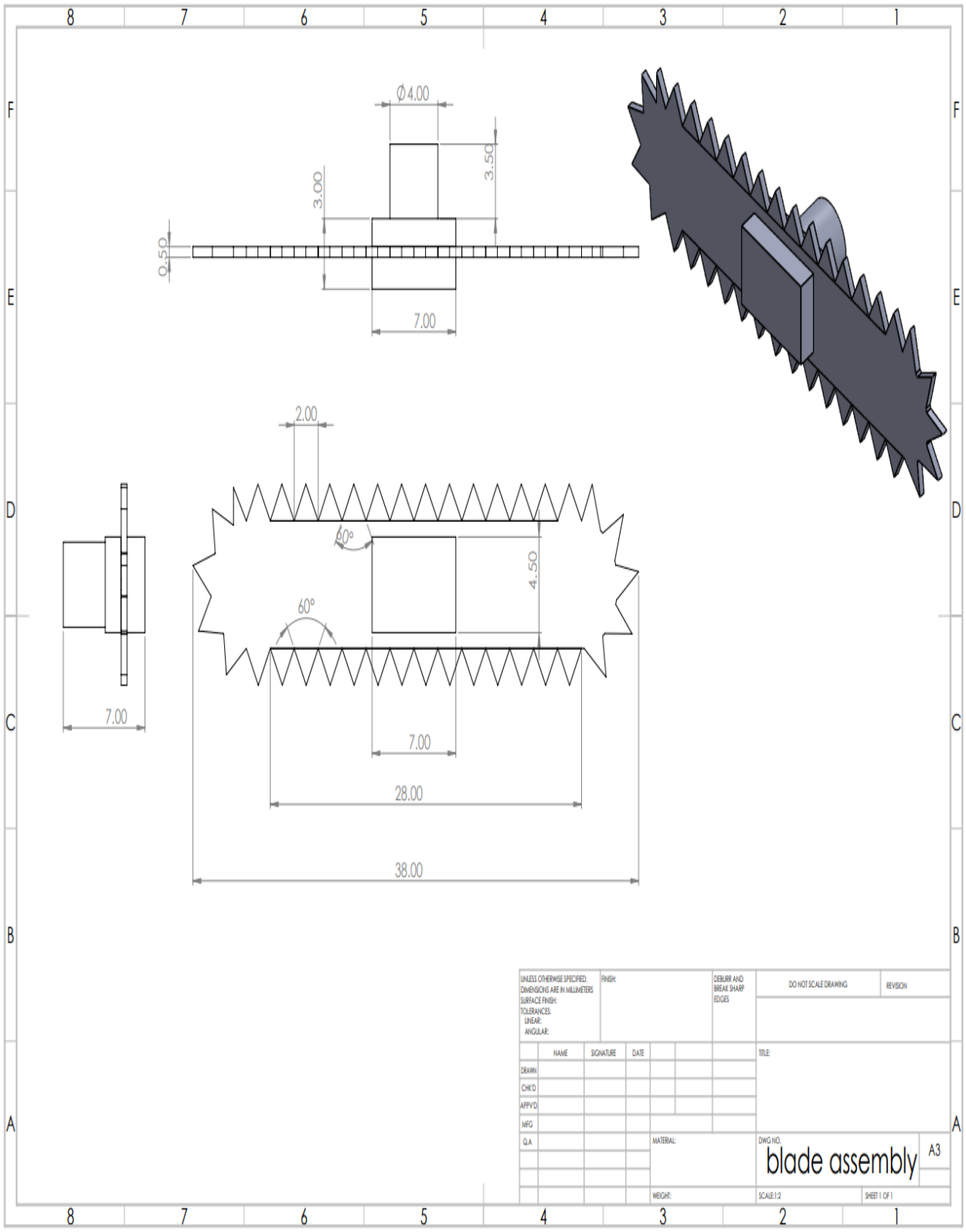



**Fig. 4.5 Blade assembly drafting**

## 6. Blade Upper part

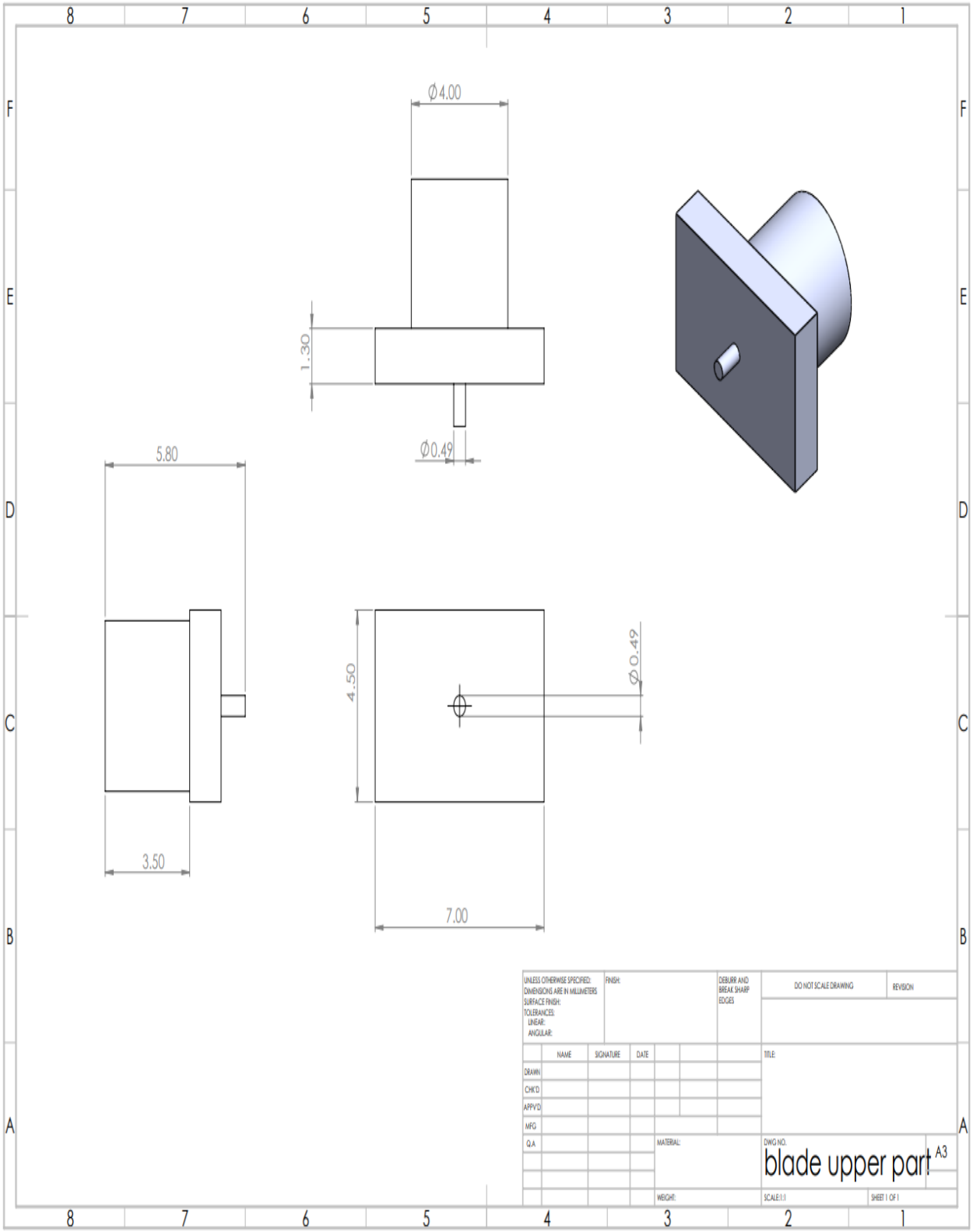



**Fig. 4.6 Blade upper part drafting**

## 7. Battery box

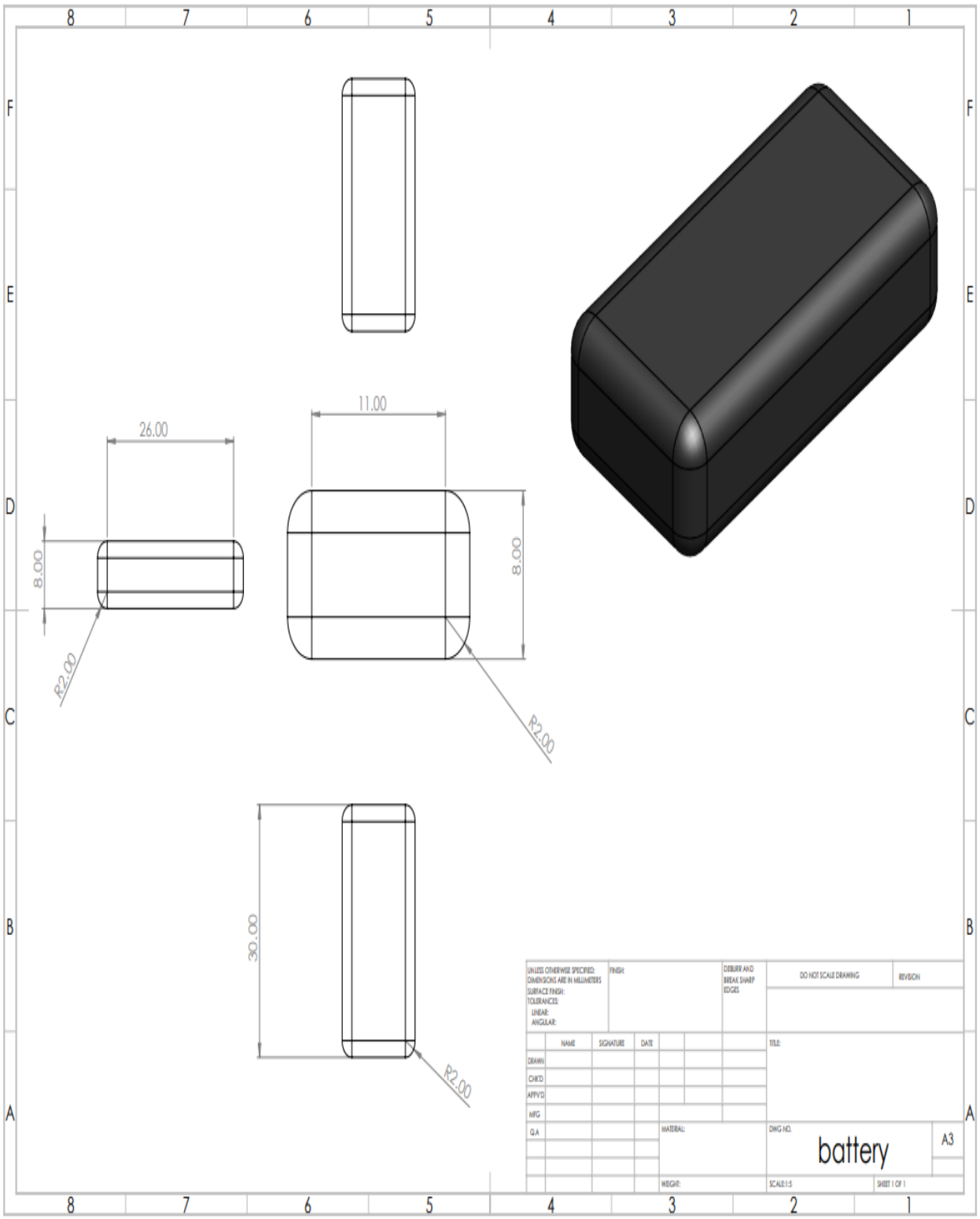



**Fig. 4.7 Battery box drafting**

## 8. Complete model

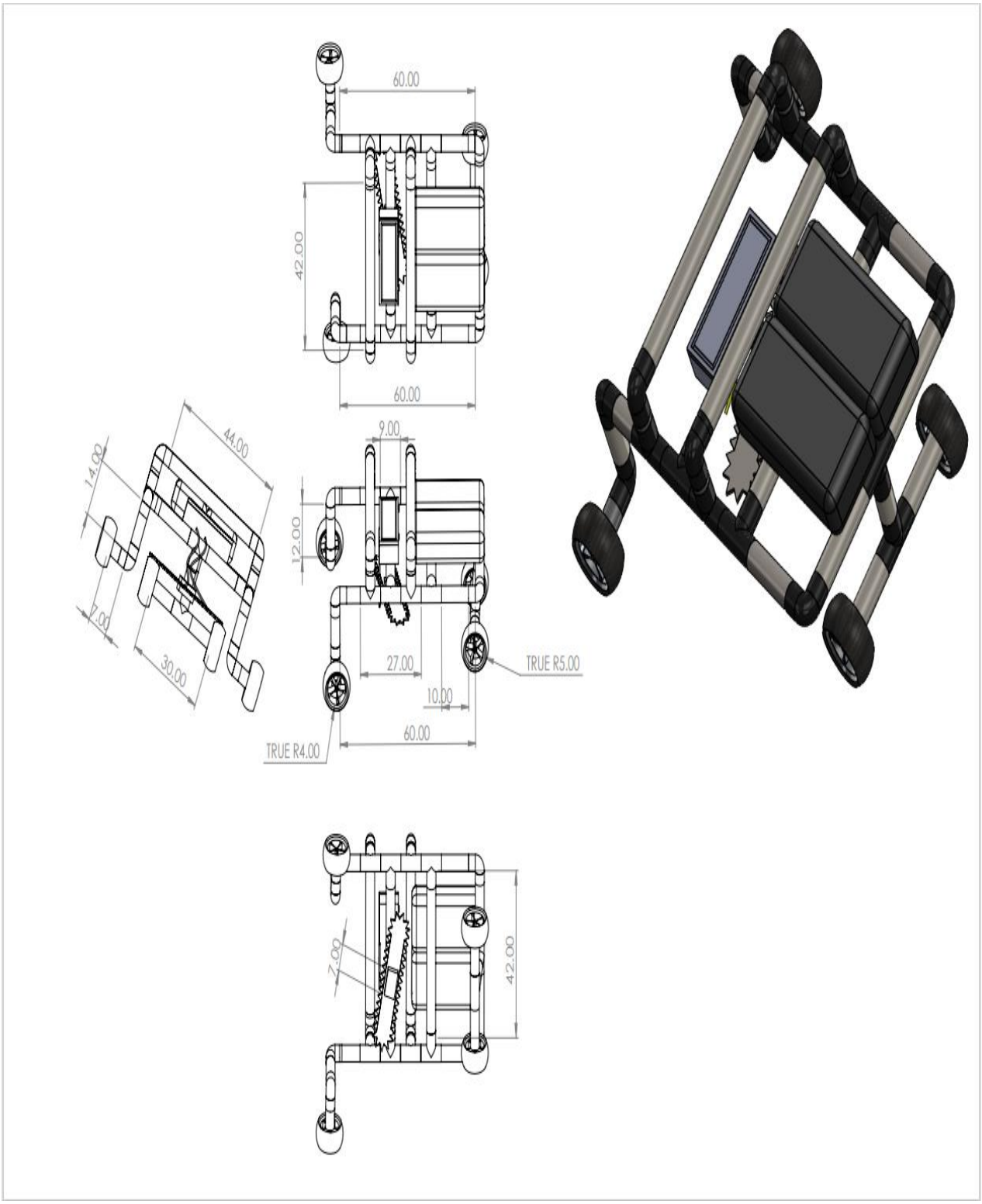



**Fig. 4.8 Complete model drafting**

## 4.2 Assembly of components

### 1. STAGE -I

In this second stage, we have cut the piece of pipes according to the dimension of the desired frame-

**Fig. 4.9 Piece of pipes**

### 2. STAGE -II

In this stage, we have joined our all cut pieces of metals with help of solvent to a full frame.

**Fig. 4.10 Frame**

### 3. STAGE -III

In this stage we built complete electronic circuit and integrated into machine in isolated box.

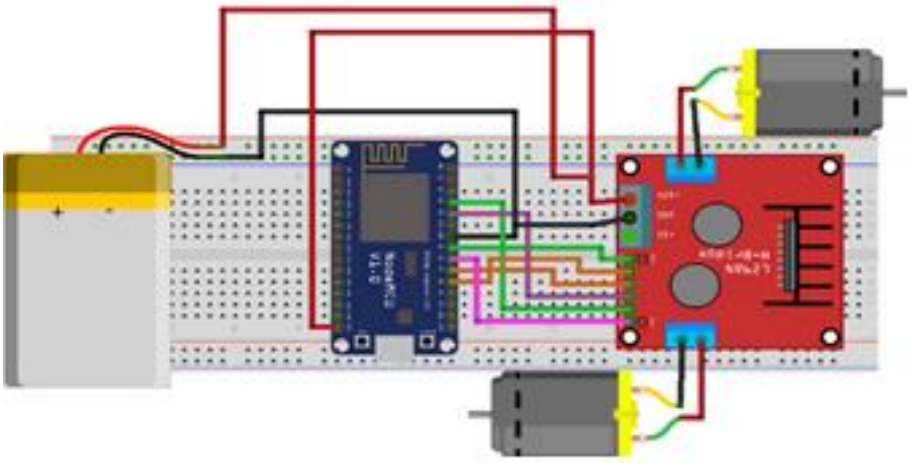


**Fig. 4.11 Circuit**

### 4. Final

**Fig. 4.12 Final visual of IoT grass cutter**

## 4.3 Development of mobile application

Following steps are need to follow for mobile application development that can run on both browser as well as directly on mobile as an android application:

**1. Setting up the arduino cloud IoT account**

Open arduino cloud in your browser and login using your email id.

**2. Setting up the device**

Once in the cloud, click on the "Devices" tab. Then, click on the "Add device" button. Now we need to select what board we are using. Select ESP8266, and then choose the board from the drop-down menu. After naming your device. You will now receive your device id and secret key. Please note that the secret key cannot be recovered, so make sure you note it down. You can also download a pdf with the information

**3. Create a thing**

A thing is a virtual object that resides within the cloud. It is used to securely hold variables and information regarding connected devices and networks. You will build a thing for every project you create inside the cloud, using an online thing editor. Your thing will consist of a mixture of variables, a device, network information, and a sketch. Now, navigate to “things” tab on clicking “create thing” button it will automatically generate thing for you.

**4. Create a cloud variable**

Yes, we all know what variables are, or at least I hope we all know that. In this case, I am referring to a special type of variable, which I will refer to as “cloud variables” for lack of a better term. These variables are the key to getting your IoT applications to work, as they are available to both your attached device and to any other devices or dashboards, you are using. You define your variables when you build your thing, you also get to choose if they are read & write or read only, and if they should synchronize with other cloud variables in other things, which you have constructed. Now, click on “add variables” button, you need to declare four variables two for forward-reverse motion and other two for left-right motion.

**5. Setting up network**

You will need to configure your thing with your network connection information. For most devices, this will be your Wi-Fi credentials, your SSID, and password. Some third-party devices will also require an additional “secret key”, which will be generated by the arduino IoT cloud editor when the device is added. This secret key is entered along with the network information in the “Network Section”

**6. Programming the board**

In order to program the board, navigate to “sketch” tab. Sketches, as all arduino users know, is the

term used for the C++ programs that we write for the arduino and ESP32 boards, and you'll need to create a sketch for the device associated with. For basic sketches, either way will work fine. If you want to include libraries and other dependent files in your sketch, then you will want to use the web editor instead. All of your sketches will be saves online to your arduino account. You can also download a copy of your sketch in a zip file when you use the web editor.

**Code:**

```
#include "arduino_secrets.h"
#include "thingProperties.h"
// front motor1 & motor2 D1-D4/5,4,0,2
int m1r = 5;  //p1 red left motor
int m1b = 4;  //p2 brown
int m2p = 0;  //p3 purple right motor
int m2g = 2;  //p4 grey

// back motor3 & motor4 D5-D8/14,12,13,15
int m3w = 14;  //p1 white right motor
int m3b = 12;  //p2 black
int m4y = 13;  //p3 orange left motor
int m4o = 15;  //p4 yellow
void setup() {
  // Initialize serial and wait for port to open:
  Serial.begin(9600);
  pinMode(m1r, OUTPUT);
  pinMode(m1b, OUTPUT);
  pinMode(m2p, OUTPUT);
  pinMode(m2g, OUTPUT);
  pinMode(m3w, OUTPUT);
  pinMode(m3b, OUTPUT);
  pinMode(m4o, OUTPUT);
  pinMode(m4y, OUTPUT);
  delay(1500);
  initProperties();
  // Connect to Arduino IoT Cloud
```

```
  ArduinoCloud.begin(ArduinoIoTPreferredConnection);
  setDebugMessageLevel(2);
  ArduinoCloud.printDebugInfo();
}
void loop() {
  ArduinoCloud.update();
  Serial.print(ArduinoCloud.connected());
}
void stop(){
void onFrwdChange()  {
  if(frwd == 1){
  digitalWrite(m4y, HIGH);
  digitalWrite(m4o, LOW);
  digitalWrite(m3b, LOW);
  digitalWrite(m3w, HIGH);
  }else{
  digitalWrite(m1r, LOW);
  digitalWrite(m1b, LOW);
  digitalWrite(m2p, LOW);
  digitalWrite(m2g, LOW);
  digitalWrite(m3w, LOW);
  digitalWrite(m3b, LOW);
  digitalWrite(m4o, LOW);
  digitalWrite(m4y, LOW);
  }
}
void onBackChange()  {
  if(back == 1){
  digitalWrite(m4y, LOW);
  digitalWrite(m4o, HIGH);
  digitalWrite(m3b, HIGH);
  digitalWrite(m3w, LOW);
  }else{
  digitalWrite(m1r, LOW);
  digitalWrite(m1b, LOW);
```

```
  digitalWrite(m2p, LOW);
  digitalWrite(m2g, LOW)
  digitalWrite(m3w, LOW);
  digitalWrite(m3b, LOW);
  digitalWrite(m4o, LOW);
  digitalWrite(m4y, LOW);
  }
}
void onLeftChange()  {
  if(left == 1){
  digitalWrite(m1r, HIGH);
  digitalWrite(m1b, LOW);
  digitalWrite(m4y, HIGH);
  digitalWrite(m4o, LOW);
  }else{
  digitalWrite(m1r, LOW);
  digitalWrite(m4o, LOW);
  digitalWrite(m4y, LOW);
  }
}
void onRightChange()  {
   if(right == 1){
  digitalWrite(m2p, HIGH);
  digitalWrite(m2g, LOW);
  digitalWrite(m3w, HIGH);
  digitalWrite(m3b, LOW);
  }else{
  digitalWrite(m2p, LOW);
  digitalWrite(m2g, LOW);
  digitalWrite(m3w, LOW);
  digitalWrite(m3b, LOW);
  }
}
void onTurboChange()  {
   if(turbo == 1){
```

```
 digitalWrite(m1r, HIGH);
 digitalWrite(m1b, LOW);
 digitalWrite(m4y, HIGH);
 digitalWrite(m4o, LOW);

 digitalWrite(m2g, LOW);
 digitalWrite(m2p, HIGH);
 digitalWrite(m3b, LOW);
 digitalWrite(m3w, HIGH);
 }else{
 digitalWrite(m1r, LOW);
 digitalWrite(m1b, LOW);
 digitalWrite(m2p, LOW);
 digitalWrite(m2g, LOW);
 digitalWrite(m3w, LOW);
 digitalWrite(m3b, LOW);
 digitalWrite(m4o, LOW);
 digitalWrite(m4y, LOW);
 }
}
```

**7. Install the arduino create agent**

You have one more task to complete before working with the arduino IoT cloud. You will need to install the arduino create agent onto the workstation that you will be using. It is the link between your workstation's USB port (where you attach your microcontroller) and the arduino IoT cloud. It is required because the security built into your web browser prevents websites from directly connecting to your computer's resources, which is of course a requirement for the thing and web editors. The agent is available for linux, windows and macOS. After completing above all steps, all you need is to upload code.

**8. Creating a dashboard**

A dashboard is noting just a place to design frontend of your application and get integrated it with backend as defined in coding. You build a dashboard by dragging widgets onto a working surface as per your need. You link the widgets to appropriate cloud variables, and then you label them. Your dashboard can then be displayed on a web browser. You can also use the arduino IoT remote app on your android or IOS device to access dashboard.

# CHAPTER – 5
# RESULTS AND DISCUSSION

# CHAPTER – 5

# RESULTS AND DISCUSSION

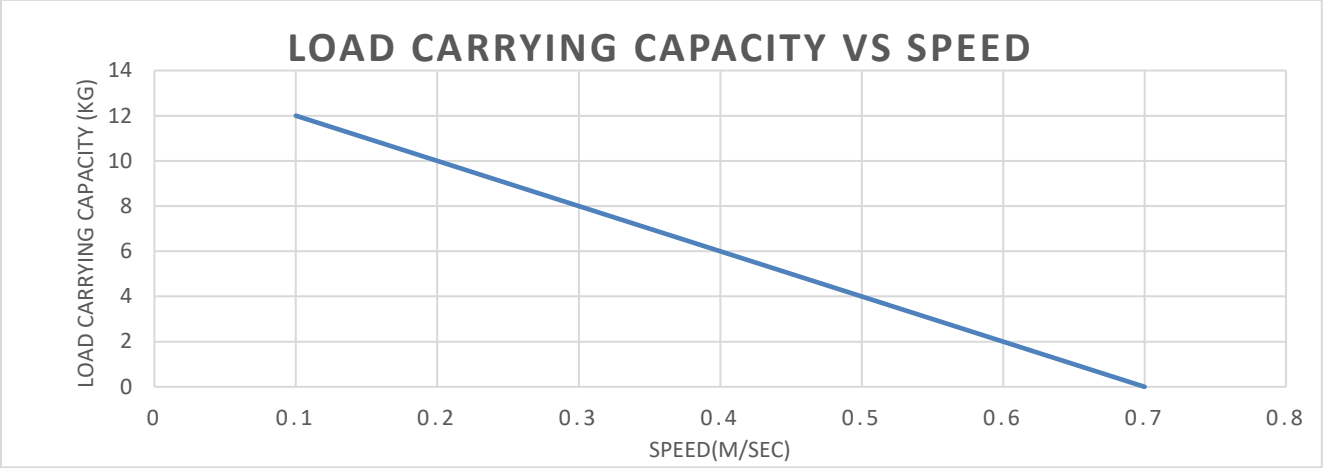
## 5.1 Results

Now here comes to final test our creation in the real world scenarios. In the testing mode we did analysis for the speed, load carrying capacity, connectivity, mobility of grass cutter in case use for transportation of goods and the electricity usage on some conditions given below:

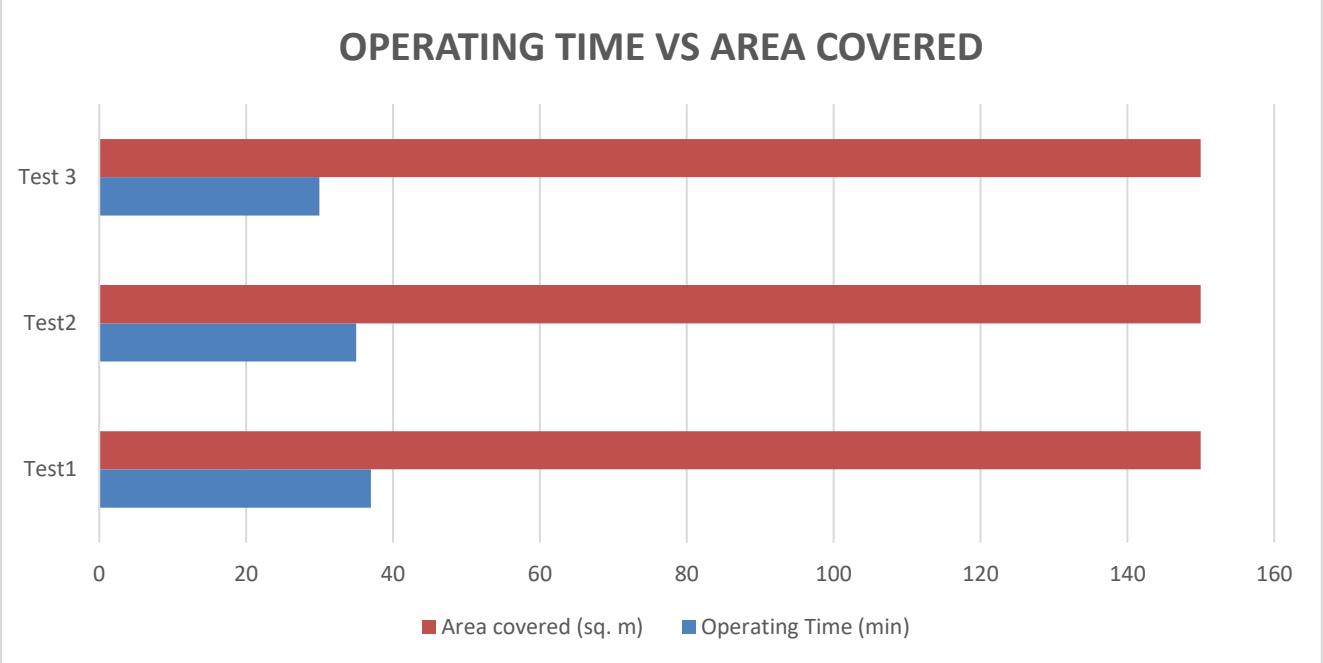
**Table 5.1 Testing Data**

| **S. No.** | **ATTRIBUTES** | **VALUES** |
|---|---|---|
| **(A)** | **Condition of field** | |
| 1 | Location of field | Academic ground of CAET Etawah |
| 2 | Length of field (m) | 15 |
| 3 | Width of field (m) | 10 |
| 4 | Area of field ($m^2$) | 150 |
| 5 | Shape of field | Rectangular |
| | | |
| **(B)** | **Field operation test** | |
| 1 | Actual operating time (min) | 30-35 |
| 2 | Cutter rpm | 1000 |
| 3 | Cutting area at static position ($m^2$) | 0.21 |
| 4 | Travelling speed (m/sec) | 0.72 |
| 5 | Weight of machine (kg) | 8 |
| 6 | Load carrying capacity (kg) | 5 |
| 7 | Cutting height from ground (cm) | 6 |

We did testing on academic ground of CAET, which is rectangular ground of 15 X 10 m and covering area of 150 sq. m area. We operated 8kg grass cutter machine for 35 minutes and found that cutting area covered by a cutter blade is 0.21 sq. m. It travel with a speed of 0.71 m/sec in rough terrain of field to cut fodder and normal grass of 6 cm from ground. We also plot Load carrying capacity vs speed and Operating time vs area covered graph based on testing data.




**Graph No. 5.1 Load carrying capacity vs speed graph**




**Graph no. 5.2 Operating time vs area covered graph**

## 5.2 Economic analysis

In economic analysis, we found that there are various grass cutters available in market but mostly they are fossil fuel based, requires tedious effort to operate, and also are high in cost ranges from (Rs 10,000 – Rs 20,000) without having IoT capabilities.

**Table 5.2 Economic analysis**

| S. No. | ATTRIBUTES | VALUES |
|---|---|---|
| 1 | Cost of machine (Rs) | 15,000 |
| 2 | Duration per charge (min) | 45– 60 |
| 3 | Battery cost (Rs) | 1,800 |
| 5 | Maintenance cost | null |

## 5.3 Comparison between market available grass cutter and IoT grass cutter

We made comparison on market available mechanical grass cutter with IoT grass cutter. Comparison is done on different point of parameters such as fuel type, special features, maintenance, and cost. Some of points are given below:

**Table 5.3 Comparison**

| S. No. | ATTRIBUTES | MECHANICAL GRASS CUTTER | IOT GRASS CUTTER |
|---|---|---|---|
| 1 | Operation fuel type | Diesel | Electricity |
| 2 | Mobile control | Not supported | Supported |
| 3 | Internet connectivity | Not supported | Supported |
| 4 | Weight (kg) | 5-20 | 8 |
| 5 | Cost (Rs) | 10,000-20,000 | 10,000 |
| 6 | Periodic maintenance | Required | Not required |

# CHAPTER – 6
# CONCLUSION AND FUTURE SCOPE

# CHAPTER - 6
# CONCLUSION AND FUTURE SCOPE

After the discussion on its result we come on the conclusion of title “IoT grass cutter” as well as we also discuss their future scope.

## 6.1 Conclusion

On basis of test results and economic analysis, we conclude that we achieved all the objectives and developed a grass cutter that is foundation is lies in internet of things. We find out that our IoT grass cutter is much cheaper in comparison to clunky conventional machine operated via engines, also since its weight is less, it is portable and easy to handle. Very few companies in market provide grass cutter with ability to operate via mobile phone but they are expensive and not affordable for commons. However, we have made a cheap affordable and mobile controlled grass cutter.

1. IoT grass cutter is a just a normal grass cutter with some advance IoT features and capabilities.
2. The most vital feature of the IoT grass cutter is that it can be operated by mobile phone from anywhere in the globe due to internet connectivity.
3. The second most important feature is it does not consume conventional fossil fuels. Hence, it is eco-friendly in nature.
4. It can be charged with the help of any easily available AC adapter that operate on domestic voltage supply.
5. Since it has fewer components, it can be easily dissemble to small components, thus requiring very less or better to say no maintenance.
6. By the economic analysis of our project we find out that our IoT grass cutter is way more cheaper and advanced in comparison to other similar product offered by other tech. companies.

## 6.2 Future Scope

This project is completed with the available resources, and the results are good enough. But as we know every technology have possibility to grow further, that is why We also did further study to solve some existing problem and also to equip our machine with some more advance features.

The following modifications can be incorporate for future work.

1. **Adjustable height cutting motor:** Using appropriate servo motors, adjustable height motor could be build in case if want to change cutting height or for avoiding obstacles collision from cutter.
2. **Self –driving feature-using ML:** Implementation of machine learning with a web cam will help to drive machine without human intervention on its own with smooth obstacle avoidance system.
3. **Complete automation using AI:** Infusion of artificial intelligence can equip it to capability to take decisions like when to activate based on weather condition, navigate to charging point incase battery gets lower than threshold without human intervention.
4. **More compact in size**: Use of 3-d printer can be fruitful to make design of machine further more compact in size and infuse the ability to get assembled and dissembled easily.

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