iFarm – An IoT Based Automated Farming Robot

18MHP109L- MAJOR PROJECT REPORT

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Under the guidance of

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In Partial fulfilment for the degree

of

BACHELOR OF TECHNOLOGY

in

MECHATRONICS ENGINEERING

of

FACULTY OF ENGINEERING & TECHNOLOGY

S.R.M. Nagar, Kattankulathur, Kancheepuram District

May 2022

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY
(Under Section 3 of UGC Act, 1956)

BONAFIDE CERTIFICATE

Certified that this project report titled " **iFarm – An IoT Based Automated Farming Robot** " is the bonafide work of " PRANEESHKUMAR G A **(RA1811018010143),** ARUN BONIFACE **(RA1811018010144), and** GOKUL A **(RA1811018010168)**, who carried out the project work under my supervision. Certified further, that to the best of my knowledge the work reported here in does not form any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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ABSTRACT

The use of contemporary technology like sensors, robots, and Analyzing the data given to automate works that were traditionally done by Farmers is known as digital farming. This research focuses on Semi - Automated Vehicle which is Capable of doing Ploughing, Seed Sowing and Water Irrigation which has some of the most recent breakthroughs in agricultural robotics. In the context of Automated Farming, Object detection in pathway, Programming algorithms, and optimizing the sensor work are all highlighted as concerns. As possible digital agricultural gateways, Multi-Functional Vehicle, humanoid Robot and using aerial pictures and ground-based sensors for the manufacture of virtual farms were all considered. The production of a Bunch of tiny robots and drones to collaborate with farming inputs and uncover previously concealed or denied data is one of the rising technology and research topics in automation of agricultural field. In the case of Automated robot Farming, an automated Programming with a functions might be faster and more efficient than the currently used professional. Despite the fact that robots are colliding with Farming, we feel that an automated agricultural system is unlikely to be implemented in the near future.

ACKNOWLEDGEMENTS

It has been a great honor and privilege to undergo **B.Tech** in **MECHATRONICS** at **SRM Institute of Science and Technology**. We are very much thankful to the **Department of Mechatronics**, **SRM Institute of Science and Technology** for providing all facilities and support to meet our project requirements.

We would like to thank our Head of Department **Dr. G. MURALI, M.E., Ph.D.** and our project guide **Dr. V. KRITHIKA, M.Tech., Ph.D.** who gave us a big helping hand during the entire project.

The success and final outcome of this project required a lot of guidance and assistance from many people and we are extremely fortunate that we have got this all along the completion of our project work. Whatever we have done is only due to such guidance and assistance and we would like to thank them for their kind support.

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LIST OF ABBREVIATIONS

STN	**Station Sensor**
SCL	**Serial clock pin**
GND	**Ground**
SDA	**Serial data pin**
IC	**Integrated circuit**
IDE	**Integrated development Environment**
MCU	**Micro Controller unit**
KB	**Kilo Byte**
DC	**Direct Current**
MHz	**Mega Hertz**
AC	**Alternating Current**
V	**Volts**
Wi-Fi	**Wireless Fidelity**
IoT	**Internet of Things**
RPM	**Revolutions Per Minute**
CAD	**Computer-aided Design**
3D	**Three Dimension**
SS	**Stainless Steel**

1. INTRODUCTION

1.1 AUTOMATION:

Automation is a technique, method, or system for regulating or operating a process with minimum human involvement using highly automated means, such as electronic equipment.

1.2 MODULAR ARCHITECTURE:

It is the design of any system made up of individual components that may be linked together. The benefit of modular design is that any single component (module) may be replaced or added without impacting the rest of the system.

1.3 METHODOLOGY

A Google form was used to create a short questionnaire on agricultural robots, and responses were collected from the general public. The majority of people are unaware of the use of robots in agriculture, according to the results of the survey method. This provided us an advantage in moving on with our plan to build and develop automated farming robots to do fundamental agricultural tasks.

The constructed robot features an electric motor system, two primary wheels, and two Omni wheels, as well as a control unit positioned on top, and it can travel in-between rows without touching them, turn at the end of the row, and enter the next one. Sonar is used by an ultrasonic sensor to determine the distance to an item. The Arduino MEGA is used as the main control unit to interpret data from the sensors, modify motors depending on that data, and drive the robot. The motors are driven by a DC motor card, which allows the control card to control the robot.

The seeds are placed in the funnel by an automated robot. The tank is filled with water.

The front hook will plough the field as the robot is moving. The funnel is packed with seeds. They fall one by one onto the ploughed field, thanks to a servo motor. A submersible pump is used to pump the water from the tank. The ploughed field will be closed by fins at the back. The Arduino MEGA can do this automatically, and the mobile app can do it manually. Solar panels may be used to charge batteries automatically. Using an ultrasonic sensor, the robot can turn automatically.

1.4 DIGITAL ELECTRONICS AND INTELLIGENT SYSTEM

In the realm of digital electronics and intelligent systems, robot-assisted automation has become one of the world's fastest-growing application-based technologies. Users may now operate their farms (for example) from afar using a mobile application on their phone thanks to the integration of mobile communication technology into automation system

1.5 OBJECTIVE

The objectives of this project are as follows:

- ❖ To make the farming robot do the basics activity like Ploughing, Seed Sowing,irrigation and closing the Ploughed field.
- ❖ ·Implementation of IoT in this project.
- ❖ ·Robots can be controlled by both Autonomously and Manually using Android apps.

1.6 PROBLEM STATEMENT

To build an automated farming robot using Arduino and IOT based controllers for the process of operations.

1.7 SCOPE OF WORK

- ❖ Farming will be made easier to do, and the majority of people will profit.
- ❖ This Robot is beneficial to those who do not have the energy or strength to work.

1.8 LITURATURE REVIEW:

S.no	Authors (Year)	Methodology	Inference
1	Sujata Bhosale, Asha Biradar, Kanchan Meshram, Asst.Prof.Mr.P.R.Patil	The System is Capable of Performing of Ploughing, Seed Sowing and Water Spreading and Solar Panel is used for Power Source.	From the system we took three process which is ploughing, Seed Sowing and Water Irrigation and implemented in our System.
2	Redmond Ramin Shamshiri, Cornelia Weltzien, Ibrahim A. Hameed, Ian J. Yule, Tony E. Grift, Siva K. Balasundram, Lenka Pitonakova, Desa Ahmad, Girish Chowdhary	The System is about Digital Farming which modern technologies in farming Such as Sensors and Actuators. Also it says about review of the previous papers and what improvements can be done in future.	Took the system as reference for the implementing object detection in path and changing the course of movement from sensor response.
3	Amol Gothanka, Vishal Soni, Avinash Vishwakarma, Sagar Jankar, Satish Bhoyar	The System is About precision farming using robot. So, they have implemented GPS for precise farming because it helps to improve efficiency and sustainability of farming.	By reviewing this Project we got idea about Precision of farming i.e how efficient and Sustainability got increased.
4	B.Srinath1, Rutveez Roopam Rout2, Vishal Bisht3, Shubhankar Bhardwaj4, A. Maria Jossy5	The System is about to change the agricultural techniques with newest technology which can reduce the wastage. The length and width parameters should be given according to which it can be scaled down.	From the System we got idea of implementing the algorithm to move in path in manual mode and Auto Mode.
5	S Kautsar , E Rosdiana , B Widiawan , D P S Setyohadi , H Y Riskiawan, R Firgiyanto	The system is about using CNC machine for Precision Farming which is achieved by coding the function of robot and initializing the Algorithm of work to follow the coordinate points the given through Input.	From the System we took the Working Algorithm of Robot and How responsive it works.

Table 1.8

2. HARDWARE COMPONENTS :

2.1 Arduino Mega 2568

Arduino MEGA 2560 is a Microcontroller used to control Dc Motor, Servo Motor, Sump Motor and Ultrasonic Sensor. Also, we have connected this Node MCU which acts as Wi-fi Module for This Robot. We selected this Microcontroller because it has 54 digital Input Pins and 16 Analog Input Pins because while using Motor Shield we need extra pins to connect. This Mega has more features and capable of controlling more sensors at same time.

Analog Input Pins: 16 Flash Memory: 256 KB Clock Speed: 16 MHz

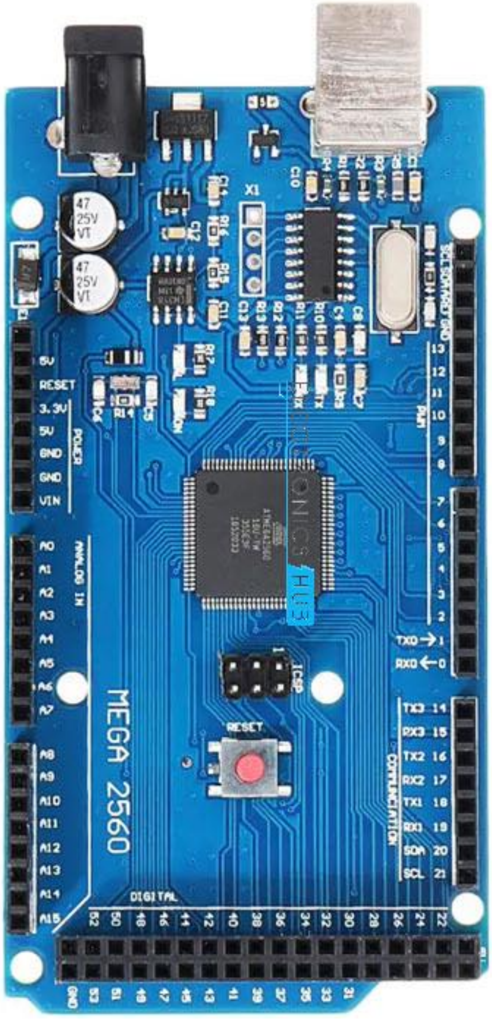

Fig 2.1 (Arduino Mega 2560)

2.2 Arduino Motor Shield

Arduino Motor Shield is Used to Control the Speed and direction of motor. This Motor shield is capable of controlling 4 – Dc Motors/2 Servo Motor at same time. In this, Project we have used 2-Dc Motor,1 – Sump Motor and 1- Servo Motor.

- This Motor Shield as used 2 -L293D Chipset and 1-74HC595 Shift register.
- 2 connectors for 5V in which we can two Servo motors Arduino's dedicated high-resolution timer
- Individual 8-bit speed option for up to four bi-directional DC motors.
- Up to two stepper motors (unipolar or bipolar) with single coil, double coil, or interleaved stepping.

Fig 2.2 (Arduino Motor Shield)

2.3 Node MCU ESP8266

Node MCU is a Microcontroller which is mostly used in IOT applications as Wi-fi Module. For the same reason we used Node MCU as Wi-fi Module which is integrated with Arduino Mega 2560. We used Blynk App to Communicate (Input) from Mobile to Arduino Via Node MCU.

Memory: 128kBytes

CPU: ESP8266(LX106)

Storage: 4Mbytes

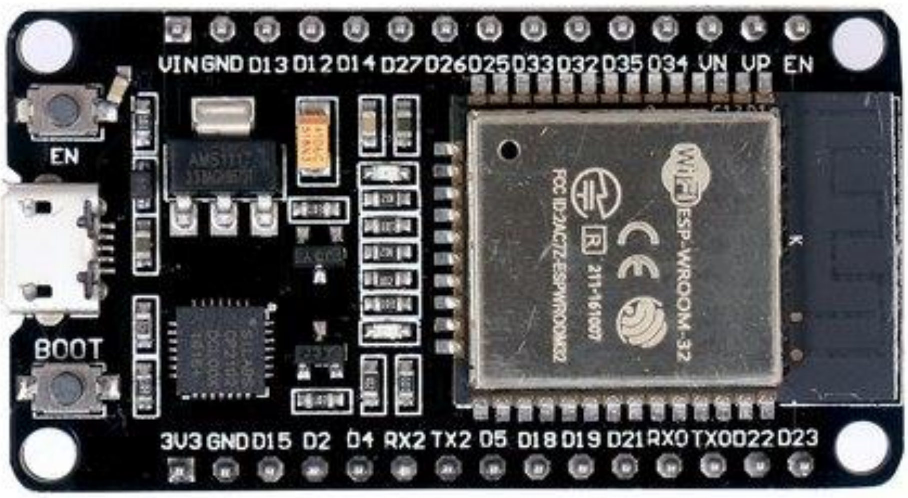

Fig 2.3 (Node MCU ESP8266)

2.4 Power Supply Module

A Breadboard Power Supply Module takes a barrel jack input from a battery, a 12V adaptor, or any other source and gives a 5V or 3.3V voltage to our circuit, according on our demands. We’ll be incorporating Arduino into our circuits shortly, and all of our Arduino circuits will be compatible with those voltage levels.

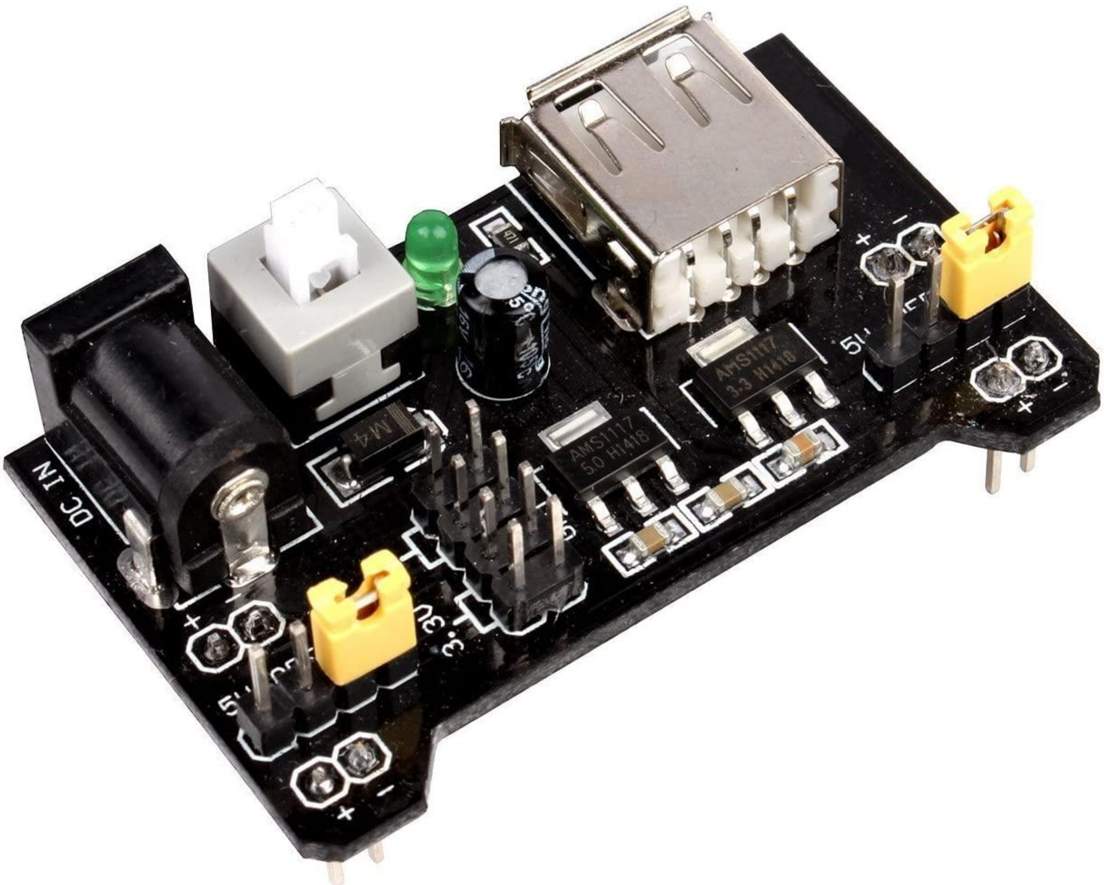

Fig 2.4 (Power Supply Module)

2.5 Humidity Sensor

Humidity sensors work by detecting changes that alter electrical currents or temperature in the air. The DHT11 is a Humidity and Temperature Sensor that outputs an accurate digital output. This sensor can connect to any embedded device, such as an Arduino or a Raspberry Pi, and give us quick results. This sensor is a very affordable humidity and temperature sensor with a protracted endurance and sustainability.

It includes a responsive temperature sensor to analyze the air flow and then gives the modular signal from raw to digital data on the data pin (no analogue input pins needed). The pull up resistor is necessary to utilize the DHT11 sensor is included in this module, making it very basic to connect. To utilize this sensor, we need only three connections are required: Vcc, Gnd, and Output and this has a level of reliability and may be used for a long period of time.

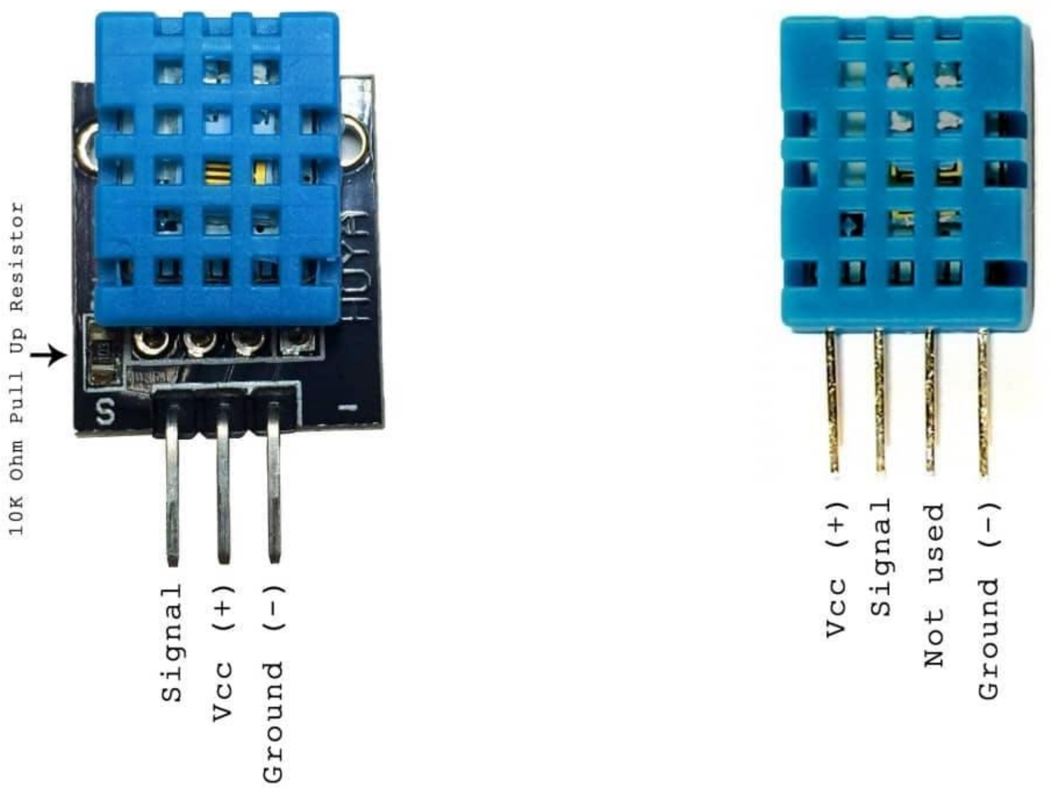

Fig 2.5 (Humidity Sensor)

2.6 Water Level Sensor

Connecting a water sensor to an Arduino is a great way to detect a leak, spill, flood, rain, etc. It can be used to detect the presence, level, volume and/or the absence of water. While this could be used to remind you to water your plants, there is a better Grove sensor forthat. The sensor has an array of exposed traces, which read LOW when water is detected.

Specifications:

- It operates at DC 3 - 5 Voltage.
- Current < 20mA.
- It is Analog Type.
- Detection Area: 40mmx16mm.
- Operating temperature: 10℃-30℃

  Humidity: 10% -90% non-condensing

Fig 2.6 (Water Level Sensor)

2.7 Ultrasonic Sensor

An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. Ultrasonic sensors work by sending out a sound wave at a frequency above the range of human hearing. The transducer of the sensor acts as a microphone to receive and send the ultrasonic sound. Our ultrasonic sensors, like many others, use a single transducer to send a pulse and to receive the echo. The sensor determines the distance to a target by measuring time lapses between the sending and receiving of the ultrasonic pulse. In, this project we kept it for determining the object in front and change the course of vehicle.

Specifications:

- Power Supply: DC 5V
- Working Current: 15mA
- Working Frequency: 40Hz
- Ranging Distance: 2cm – 400cm/4m

Fig 2.7 (Ultrasonic Sensor)

2.8 DC Motor

For movement We have used Johnson Motor Gear 12V 500 RPM. We used two motor one in Front(Right) and another one in Back(Left). We selected this Motor because it is very suitable for Robot with some Load.

- Item Weight - 250 g
- Package Dimensions - 10.6 x 10.4 x 4.7 cm; 250 Grams
- Item model number - ROBO_2
- Voltage - 12 Volts

Fig 2.8 (DC Motor)

2.9 Servo Motor

We have used Servo motor MG996R for Seed Falling/Sowing Mechanism. The work of this motor is to Move Seed filter Plates with given time delay. So, that Seeds fall from funnel to the ground and it is also used to prevent the seed from falling at a time.

Fig 2.9 (Servo Motor)

2.10 Sump Motor

The sump Motor (Submersible Mini Water Pump) is used in irrigation on field for sowing.

Fig 2.10 (Sump Motor)

2.11 Wheels

Plastic Tire Wheel for Arduino Smart Car Robot. The wheel seen above is the one utilized in our robot chassis. A four-wheel and castor wheel chassis was used. Four wheels make it easier for the chassis to support the components and allow them to move freely. But here we are using only two motors for the back wheels for turning Forward, Reverse, Right and Left.

Fig 2.11(Wheels)

2.12 Battery

The Battery we used is 12 V 1.3Ah Lead Acid Battery Rechargeable Battery which weighs 0.5kg. The Main Reason we used this battery because it is cost efficient and capable of delivering Power to Boards and components easily. Also, It is rechargeable battery. The weight of this battery is also one reason.

Fig 2.12 (Battery)

3. SOFTWARE COMPONENTS:

3.1. Arduino IDE:

The Arduino IDE is an open-source programme for writing and uploading code to Arduino boards. The IDE programme is compatible with a variety of operating systems, including Windows, Mac OS X, and Linux. C and C++ are supported programming languages. IDE stands for Integrated Development Environment in this case.

Sketching refers to the process of writing a program or code in the Arduino IDE. To upload the sketch written in the Arduino IDE software, we must connect the Genuino and Arduino boards to the IDE. The '.ino' extension is used to save the drawing.

Its console looks like:

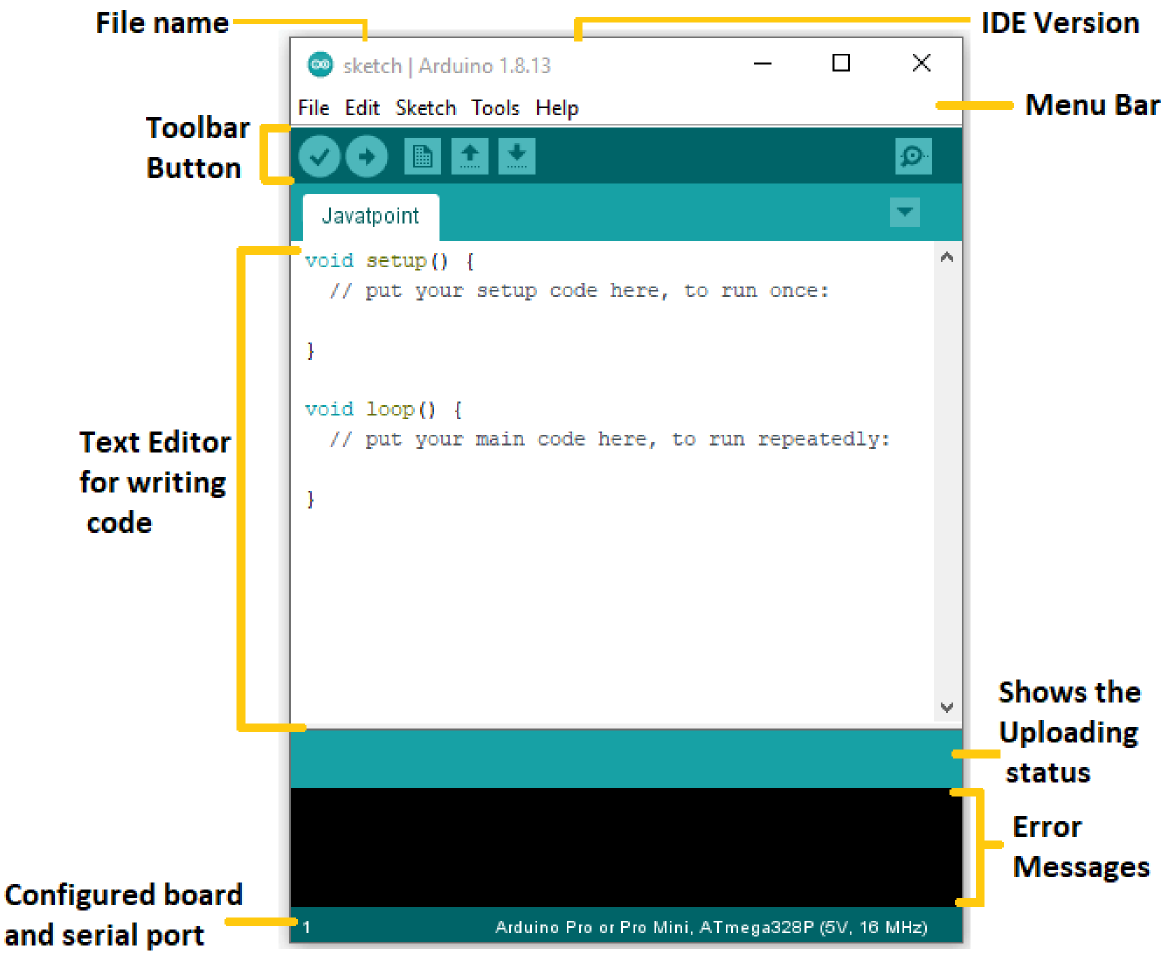

Fig 3.1(Arduino IED)

3.2. Blynk App

Blynk is a platform that allows you to quickly build interfaces for controlling and monitoring your hardware projects from your iOS and Android device. After downloading the Blynk app, you can create a project dashboard and arrange buttons, sliders, graphs, and other widgets onto the screen. Using the widgets, you can turn pins on and off or display data from sensors.

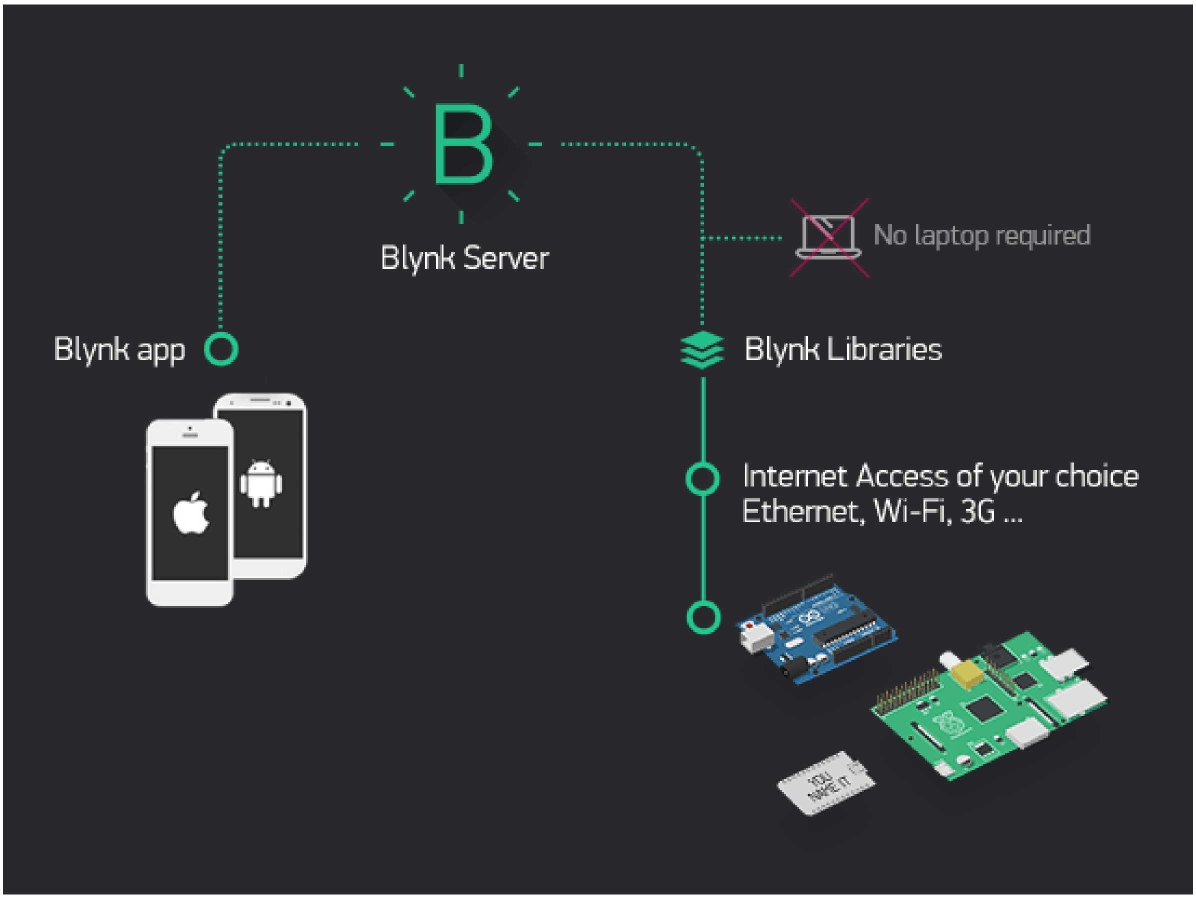

Fig 3.2 (Blynk Connection)

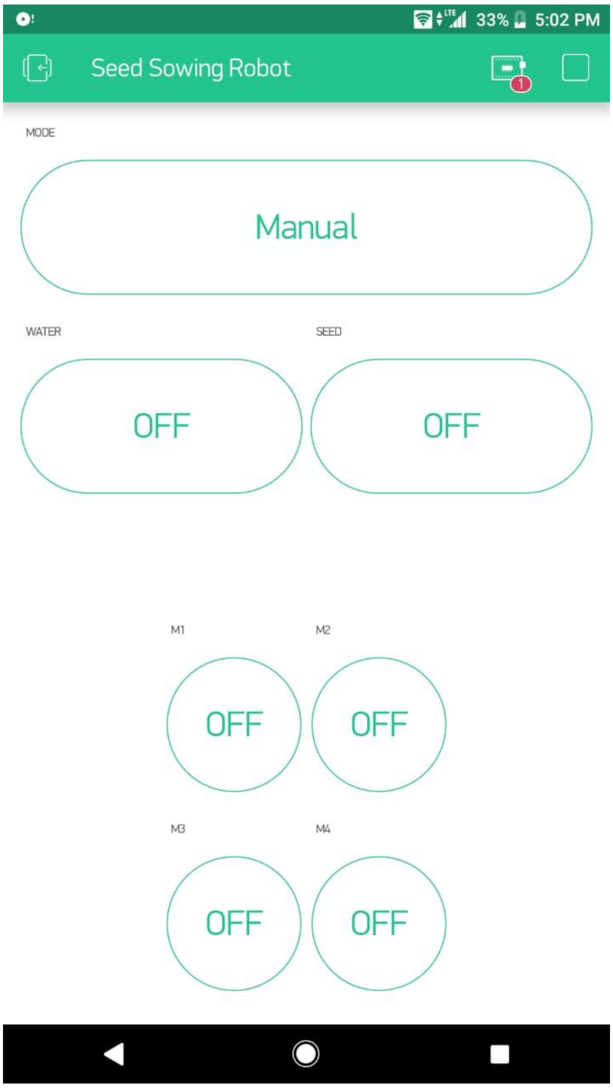

Fig 3.3(Blynk Interface)

4. SYSTEM DESIGN:

4.1. SolidWorks:

SolidWorks is a 3D modelling CAD software used in the development of mechatronics systems from the first stage to the final one. It is used for project management, planning, visual ideation, modelling, feasibility evaluation, prototyping, and feasibility assessment at the initial stage. After that, the software is used to design and build mechanical, electrical, and software components. Finally, it may be used to manage devices, analytics, data automation, and cloud services. Mechanical, electrical, and electronics professionals utilise the SOLIDWORKS software solutions to create an integrated design. The set of applications is designed to keep all engineers in the loop and ready to respond quickly to design modifications or requests.

The console opens with a welcome box where the user should choose between Part, Assembly and Drawing. Accordingly, the console opens the respective workspace with the respective tools and features needed.

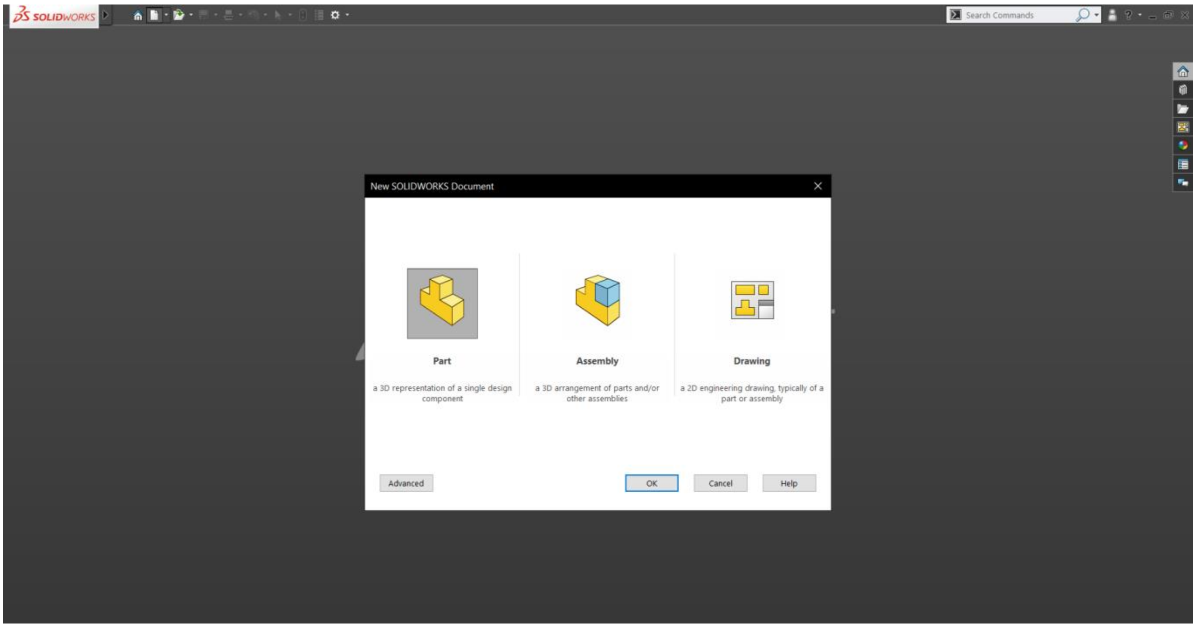

Fig 4.1 (Solid works initial home screen)

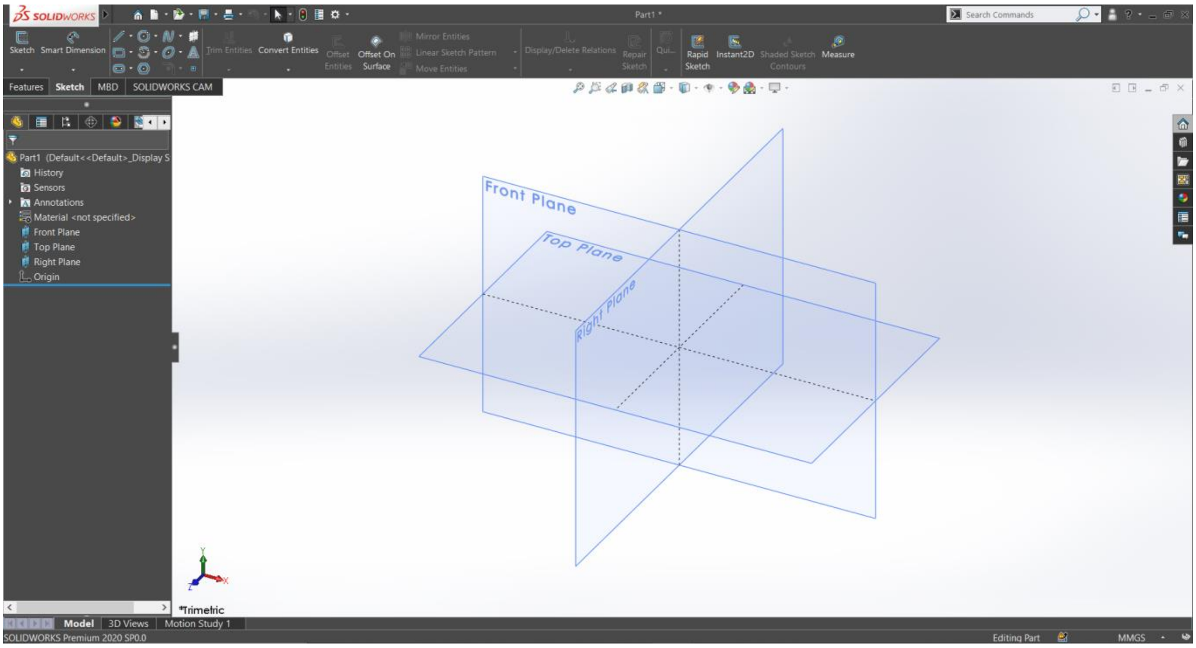

Fig 4.2(The view of all axes)

Part Modelling allows you to design 3D bodies, which are the building blocks of any system. Users can design as much as parts are essential for the system. Assembly let users assemble all part files in the way they want to build the system. Drawing is used to draft 2D drawings and detailing.

4.2. 3D Printing:

3D printing is the technique of creating three-dimensional solid items from a CAD file. It is used to create 3D printed objects. An Object is built in 3D printing by laying down successive layers of material until the product is complete. Each of these layers may be viewed as a cross-section of the item that has been lightly cut. Subtractive manufacturing, which involves cutting or hollowing out a piece of metal or plastic with a milling machine, is the polar opposite of 3D printing. When compared to traditional production processes, 3D printing allows you to create complicated forms with less material. A 3D model, which may be built using CAD software (SolidWorks), is the starting point for any 3D printing process. The model is then split into layers, resulting in a file that can be read by a 3D printer. The 3D printer-processed material is then layered according to the design. There are a variety of 3D printing processes that process various materials in different ways to produce the final thing.

Fig 4.3 (3D Printer)

4.3. Design:

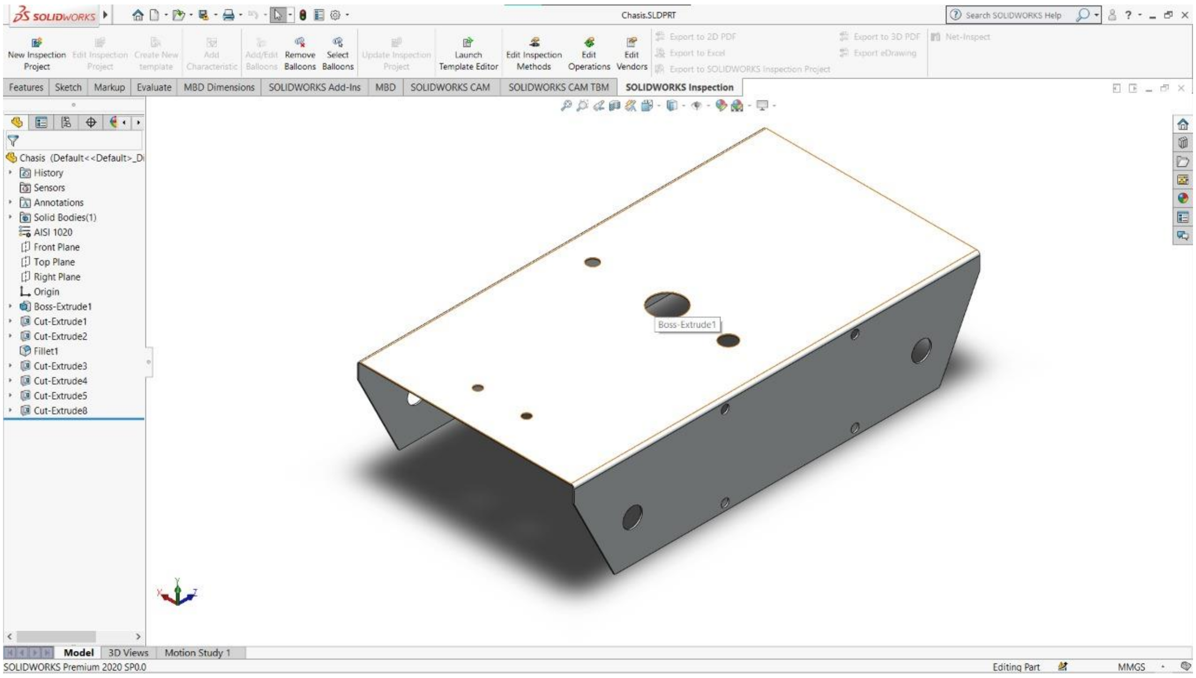

Fig 4.3.1 (Chassis Design in SolidWorks)

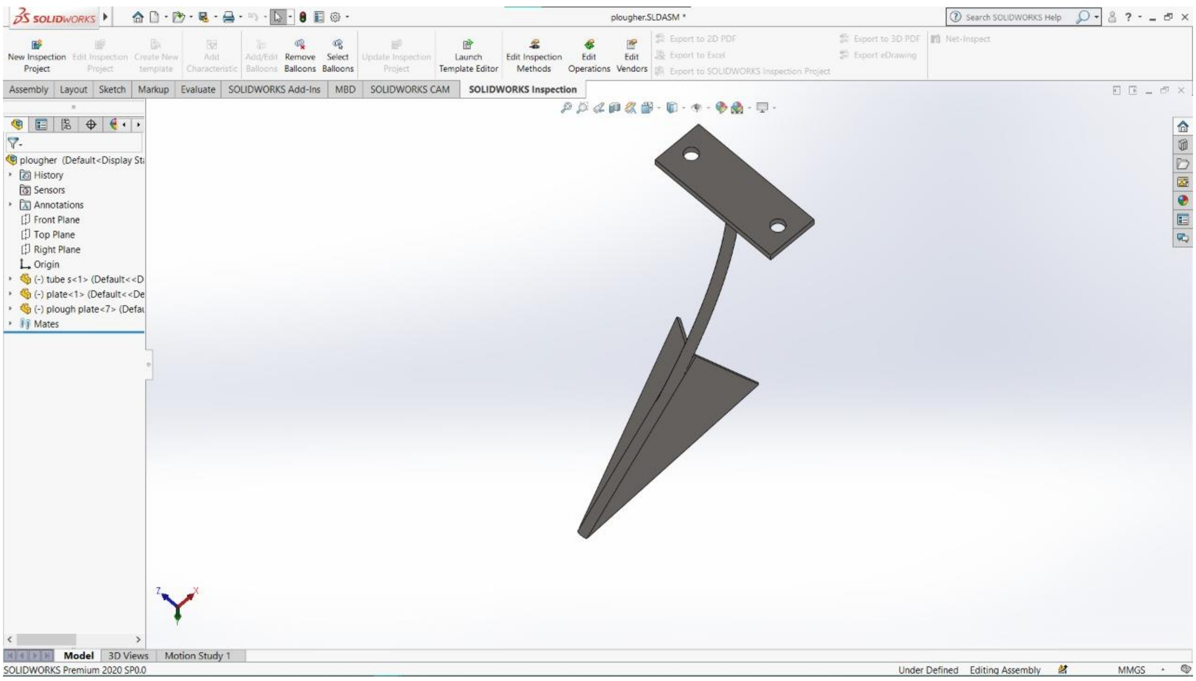

Fig 4.3.2 (Hook Design in SolidWorks)

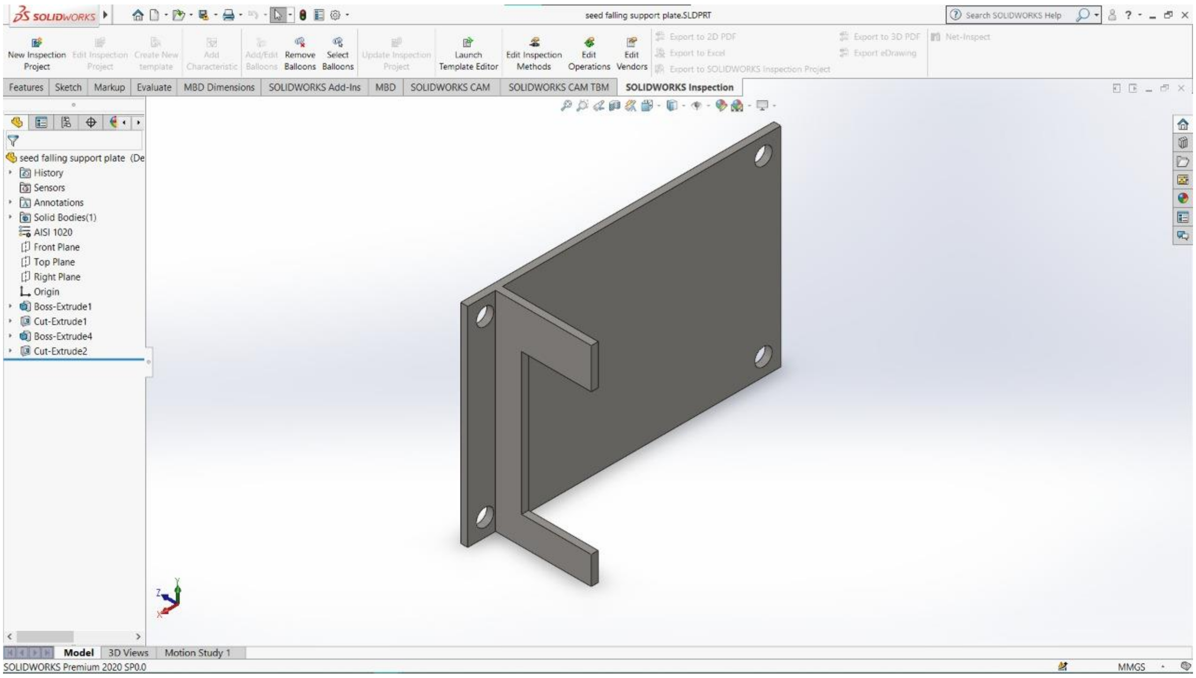

Fig 4.3.3 (Seed Falling Part Design in SolidWorks)

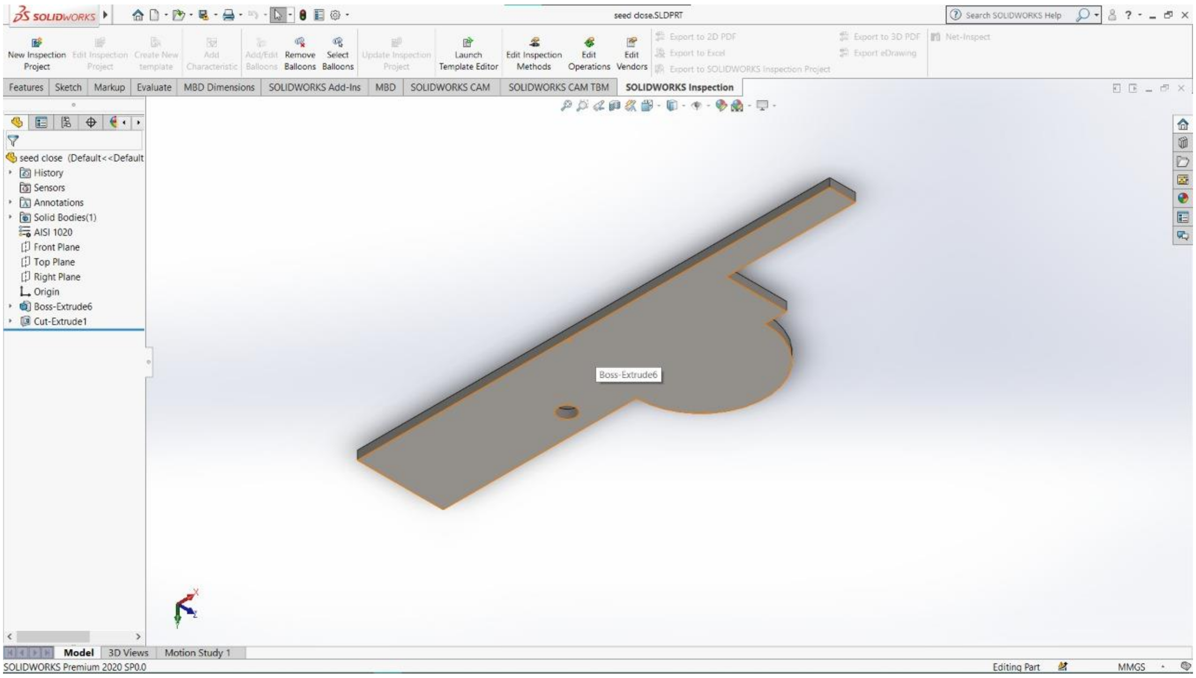

Fig 4.3.4 (Seed Dispensation Part Design in SolidWorks)

4.4. Circuit:

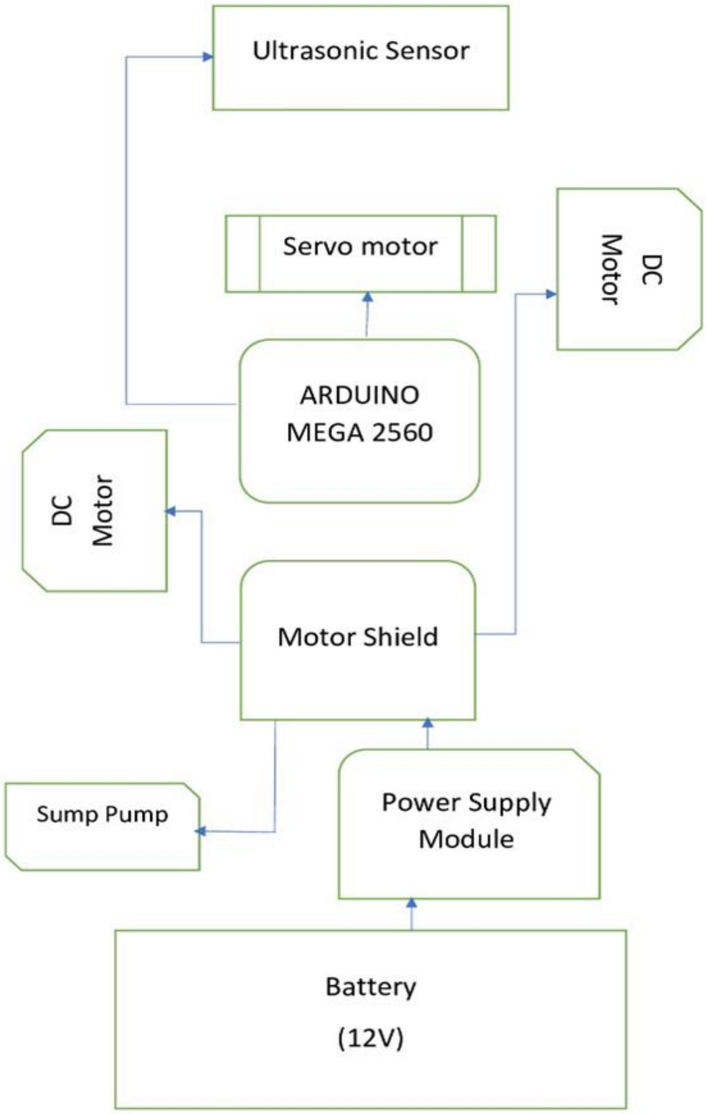

Fig 4.4 (Circuit)

4.5 Electrical Design:

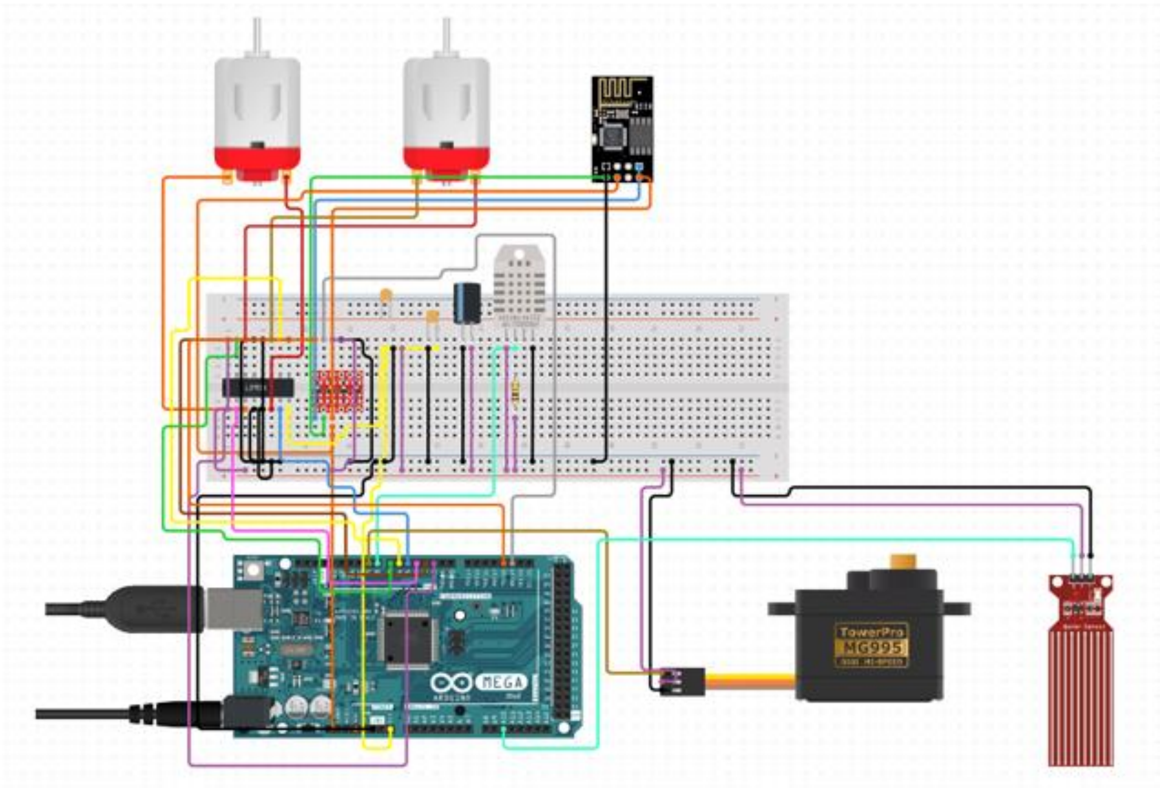

Fig 4.5 (Electrical Design)

5. IMPLEMENTATION DETAILS:

5.1 Robot Design

Our robot is inspired by self-driving cars, and we intend to utilize it in farming. So, using Arduino and Node MCU, we built a robot that will be monitored and controlled by a mobile device. We employed sensors, motors, and motor shields for monitoring and movement. Ploughing, seed sowing, and water pouring are all tasks performed by our robot.

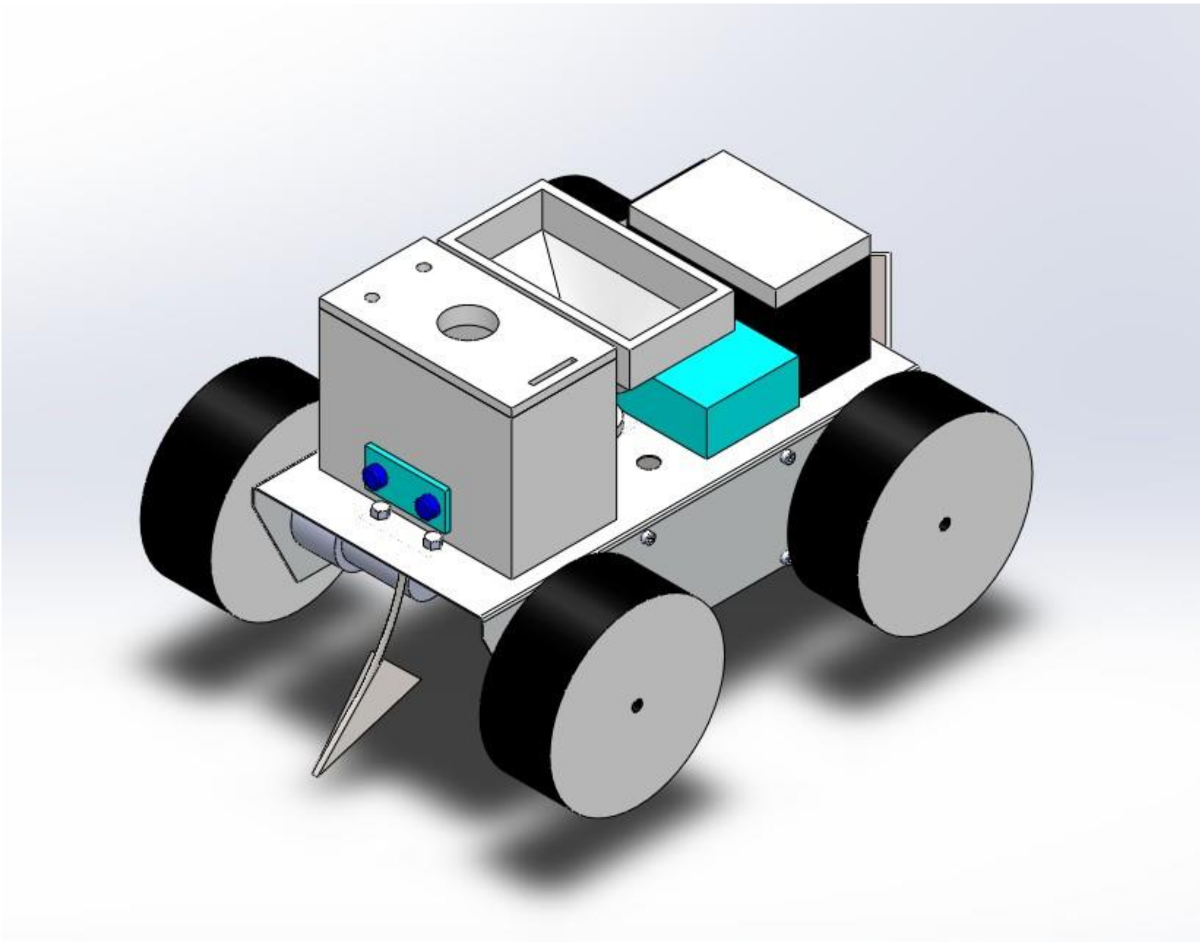

Fig 5.1 (Robot Design)

5.2 Fabrication

Fig 5.2.1 (Fabricated seed Falling Stage)

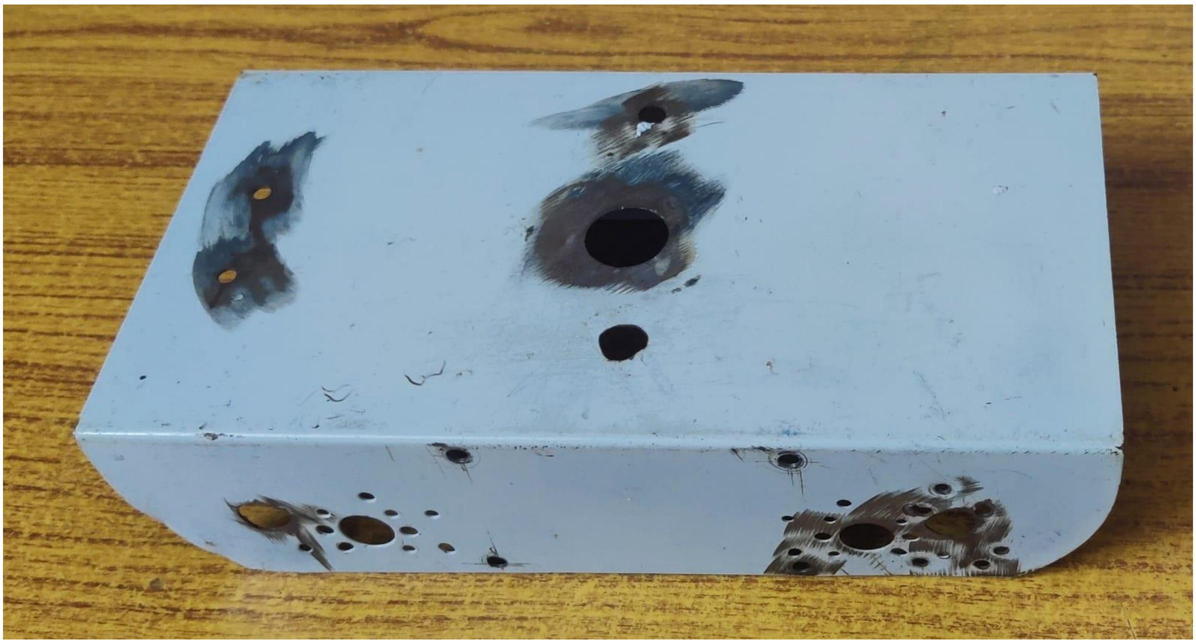

Fig 5.2.2 (Fabricated Chassis [260*130*60]mm)

A 250x250mm Plane (Metal Steel) Sheet with a thickness of 1mm was delivered. The sheet was folded as (250x130x60) per the 3d model, and the chassis was built. The holes for the motor installation have also been changed according to the 3D model. holes for the funnel, water tube, and wiring, as well as the plougher mounting, all of which were created according to our 3D model

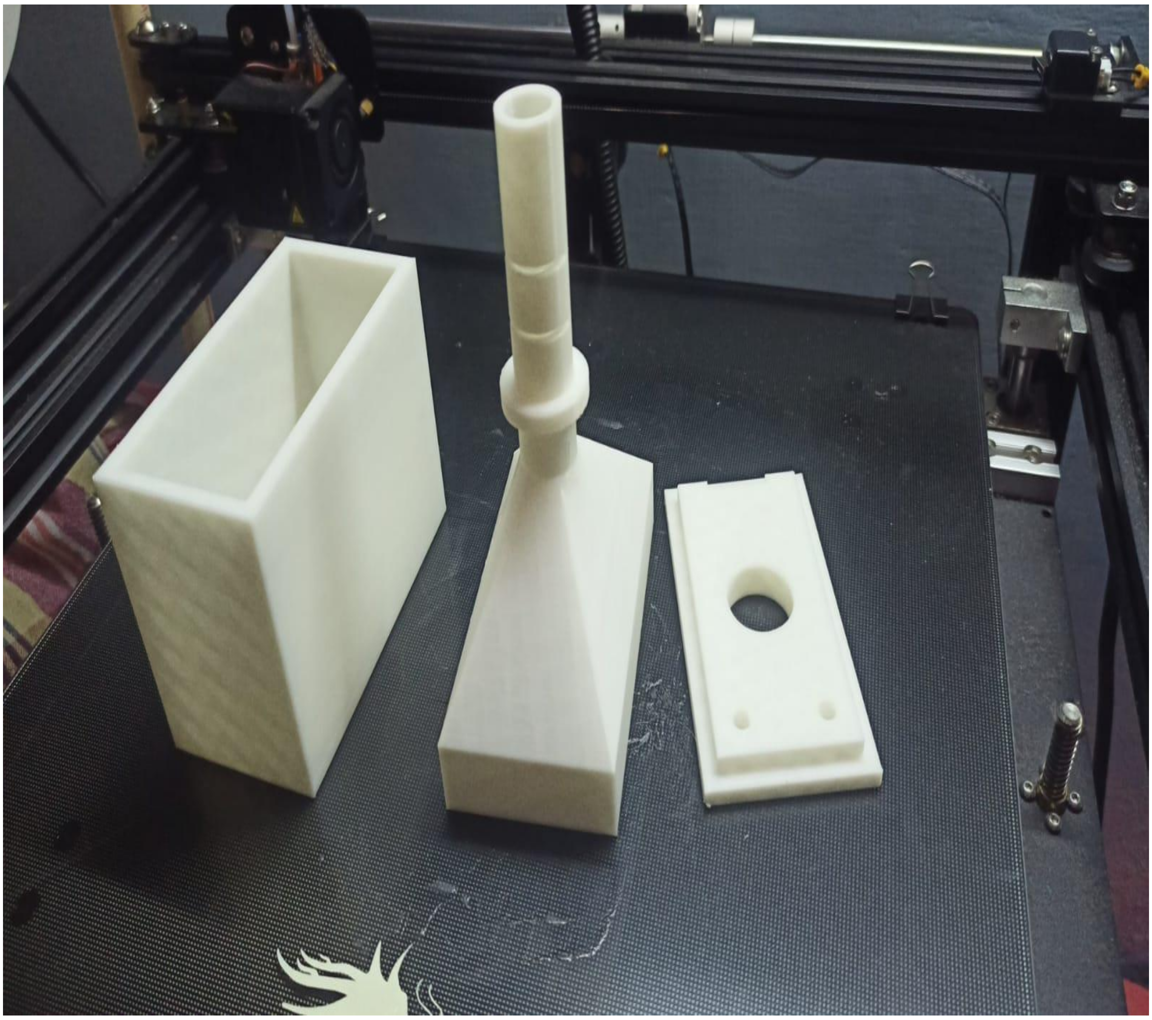

Fig 5.2.3(3D Printed Tank and Funnel)

We Used PLA (Polylactic Acid) Filament to Print this Water Tank and Funnel

Fig 5.2.4 (Fabricated Hook)

This plough is used to prepare the land for sowing. It was created out of 2mm SS sheet (40x15) and 3mm rod (L-90) and 1mm sheet, according to our 3D model (55x40)

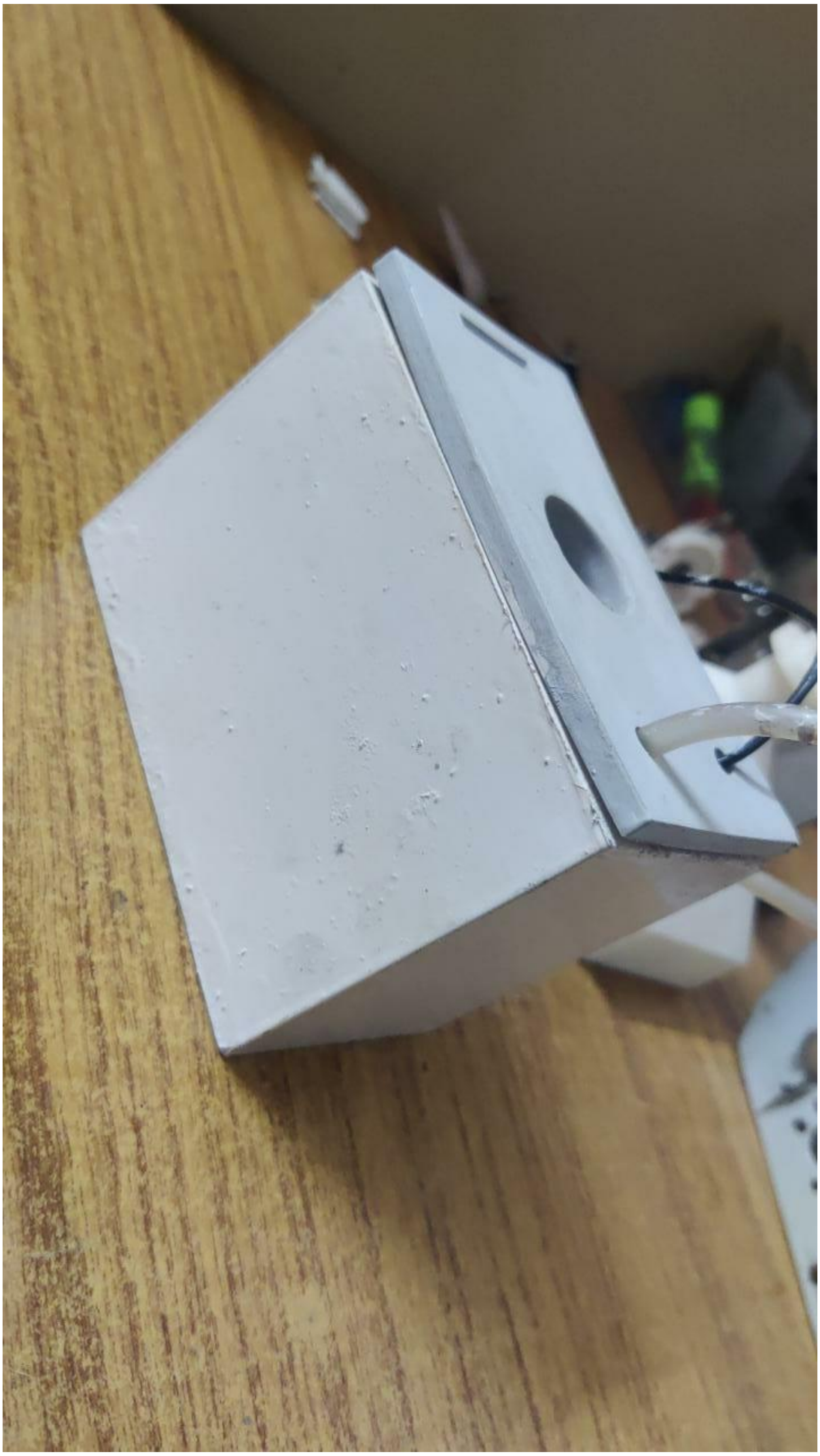

Fig 5.2.5 (Fabricated Water Tank)

5.3 Seed Falling Mechanism

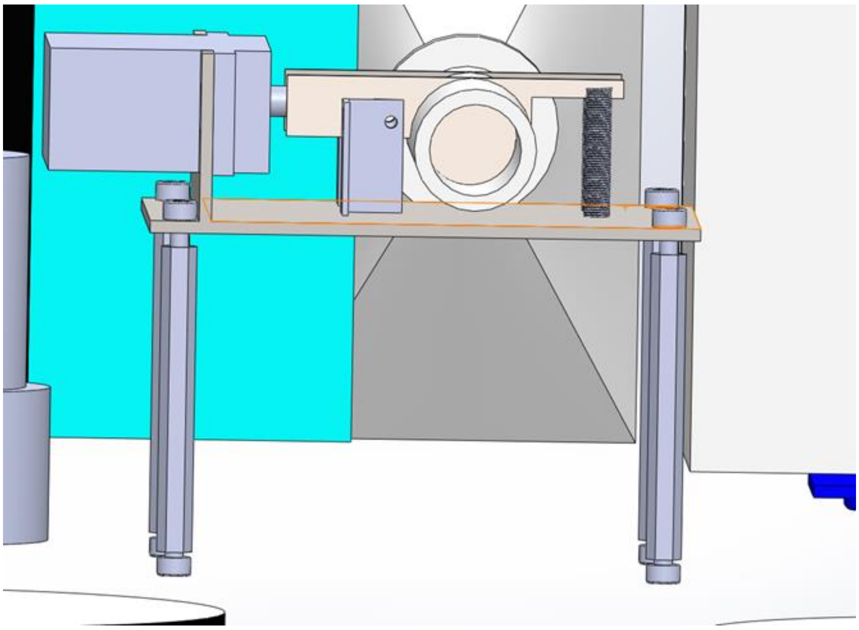

Fig 5.3.1 (Seed Falling Bottom View)

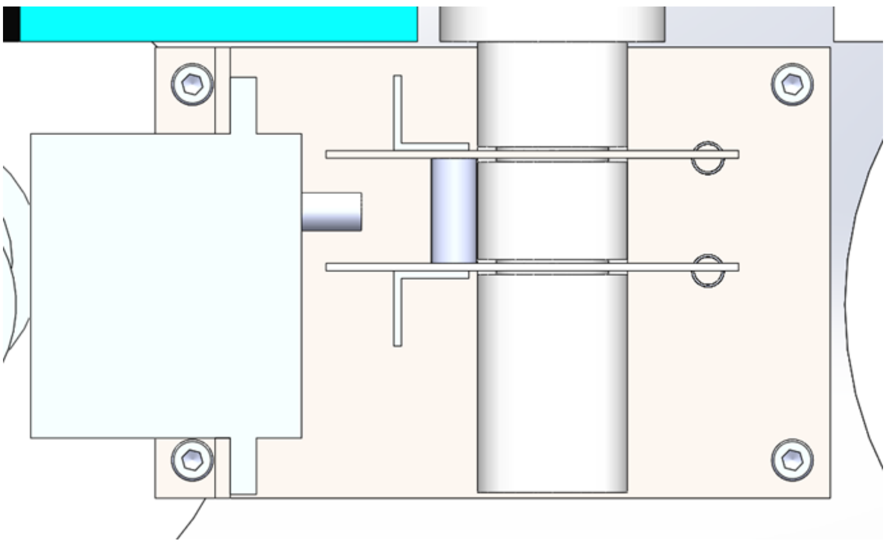

Fig 5.3.2 (Seed Falling Plate Side View)

5.4 Tank and Funnel

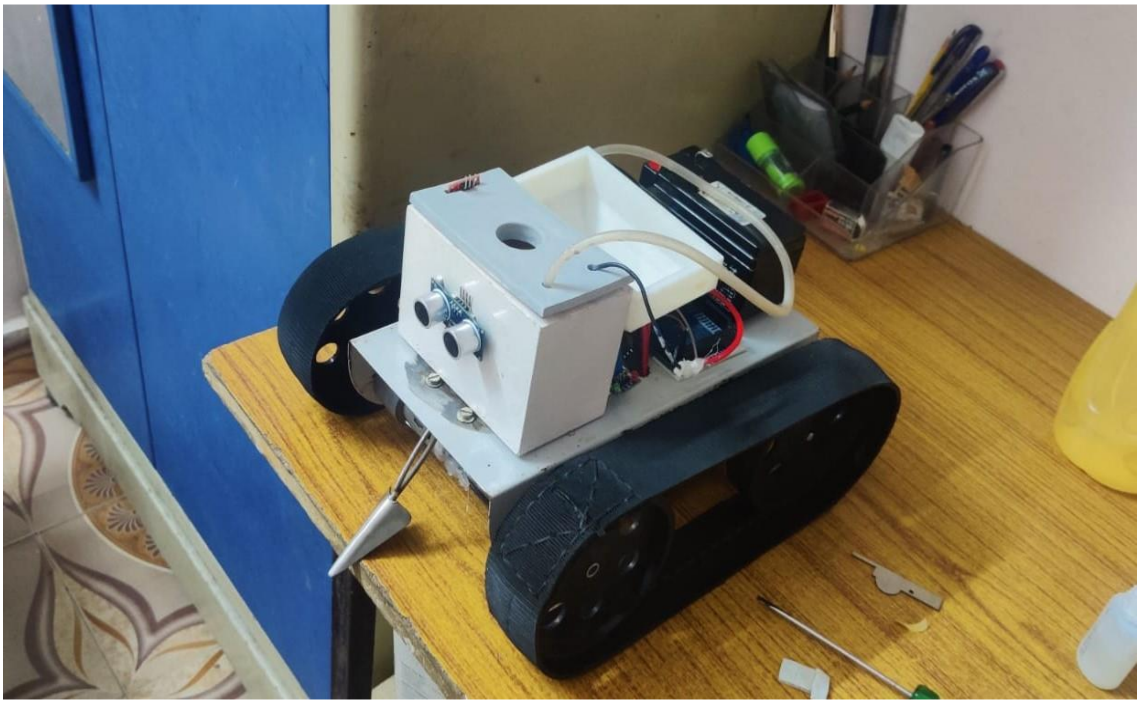

Fig 5.4.1 (Tank and Funnel)

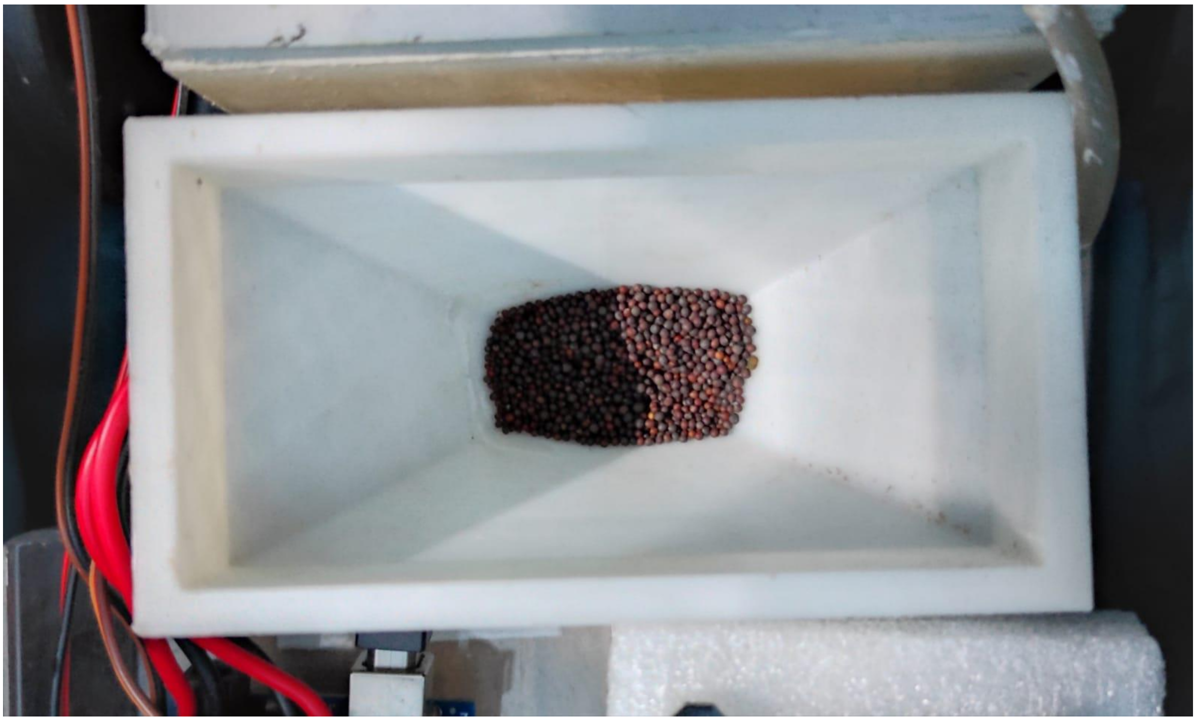

Fig 5.4.2 (Funnel With Seed)

5.5 Programming Algorithm

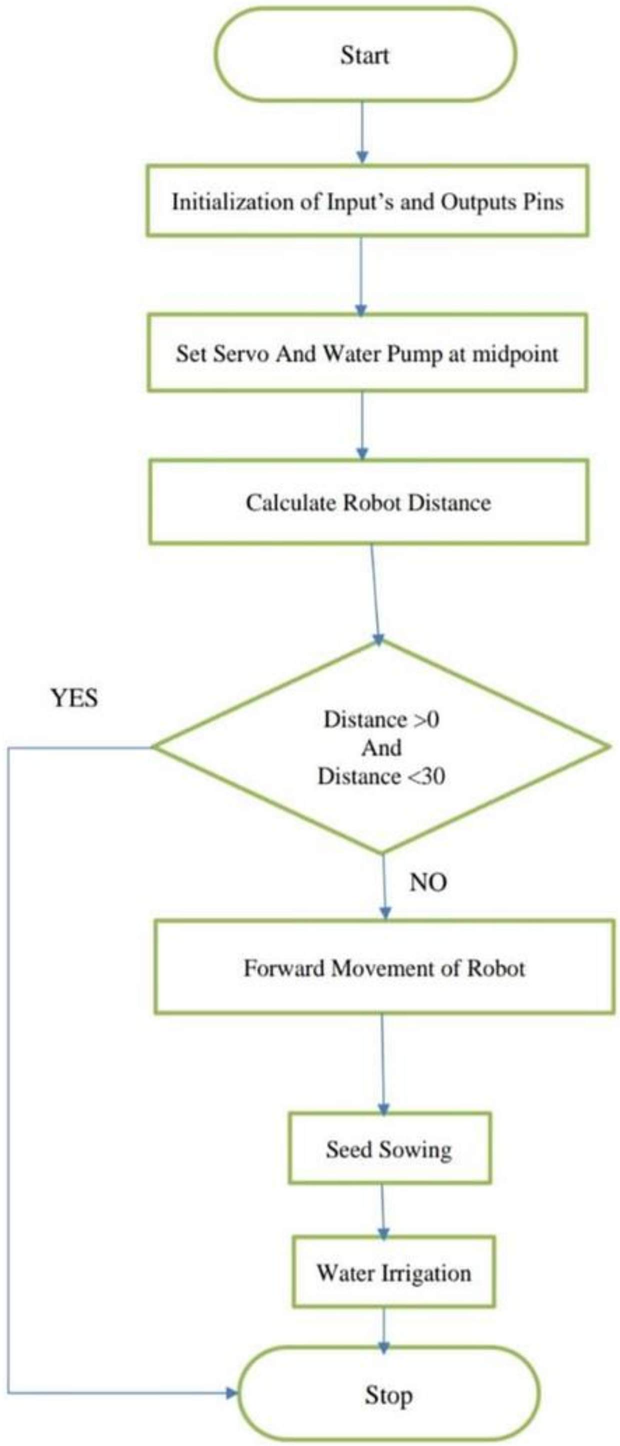

Fig 5.5 (Programming Algorithm)

6.FUTURE DEVELOPMENT:

In Future, we going to improve some functionalities which will improve and optimize the performance of the robot. We planned to change Movement of vehicle through from Normal drive to Belt drive. We are going to add a Solar Panel for Battery charging. Add servo motor for Ploughing tool Adjustment so it can plough uneven lands easily without any disturbances. Increasing range of transmitter so, it can be used in large field Farming. Working of Robot in the field. the seed falling mechanism needs to be improved.

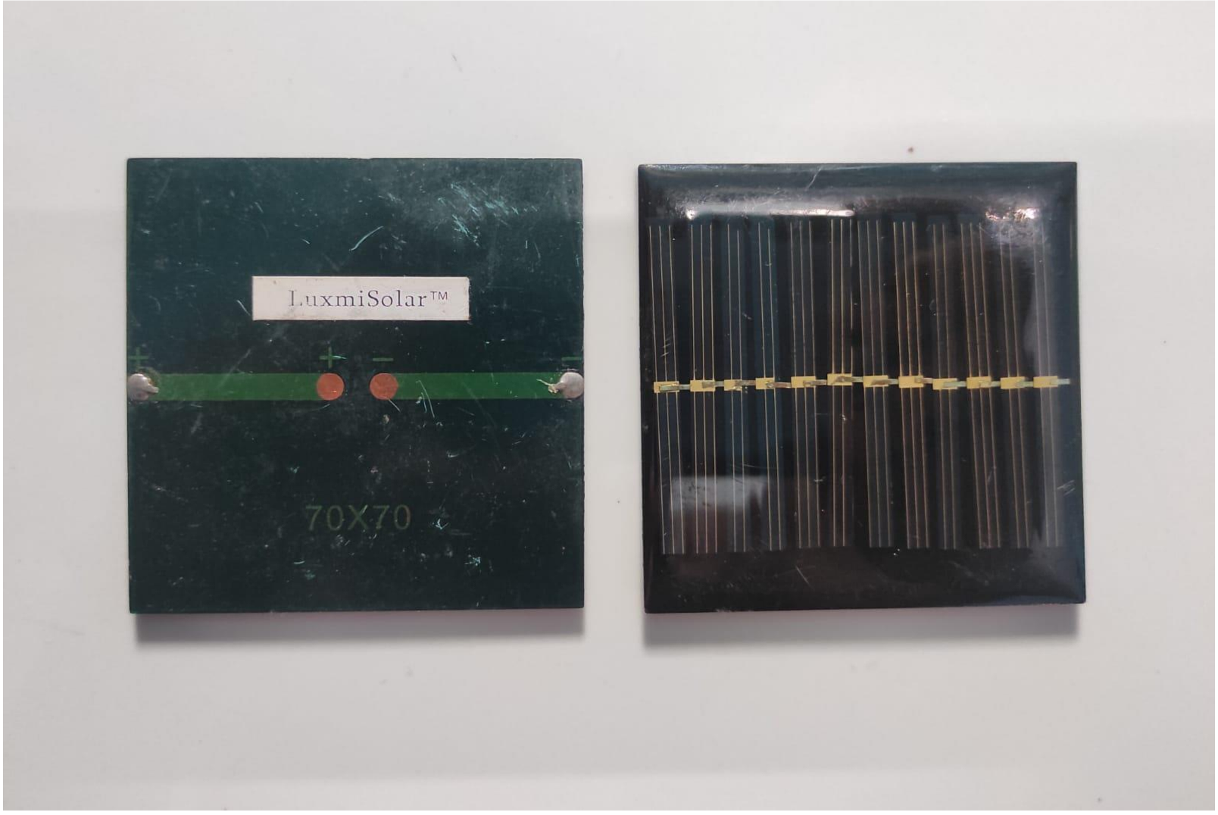

Fig 6.1 (Solar Panel)

Fig 6.2 (Sprocket Wheel)

7.RESULTS AND DISCUSSION:

7.1. Result:

This project has been very useful for the farmers in order to reduce their energy and time. As per our study on research papers, there is no complete robot for the initial process of farming like ploughing, seeding and irrigation. We concluded our project, it’s very efficient and power-saving.

As a result, this one robot can be used for Ploughing, Seeding and Watering in the initial process of farming. Also, Prototype is made in order to work in Both Manual and Auto Mode as per our problem statement and Objective this has been achieved.

7.2. Robot Movements:

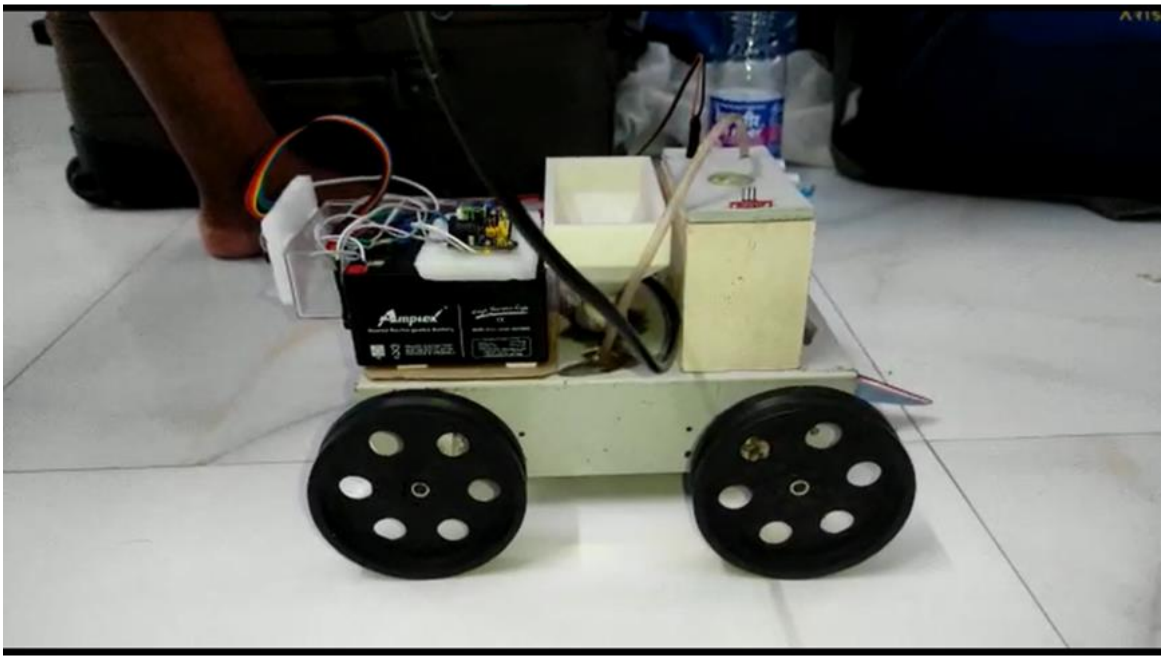

Fig 7.2.1(Robot Moment Forward and Backward)

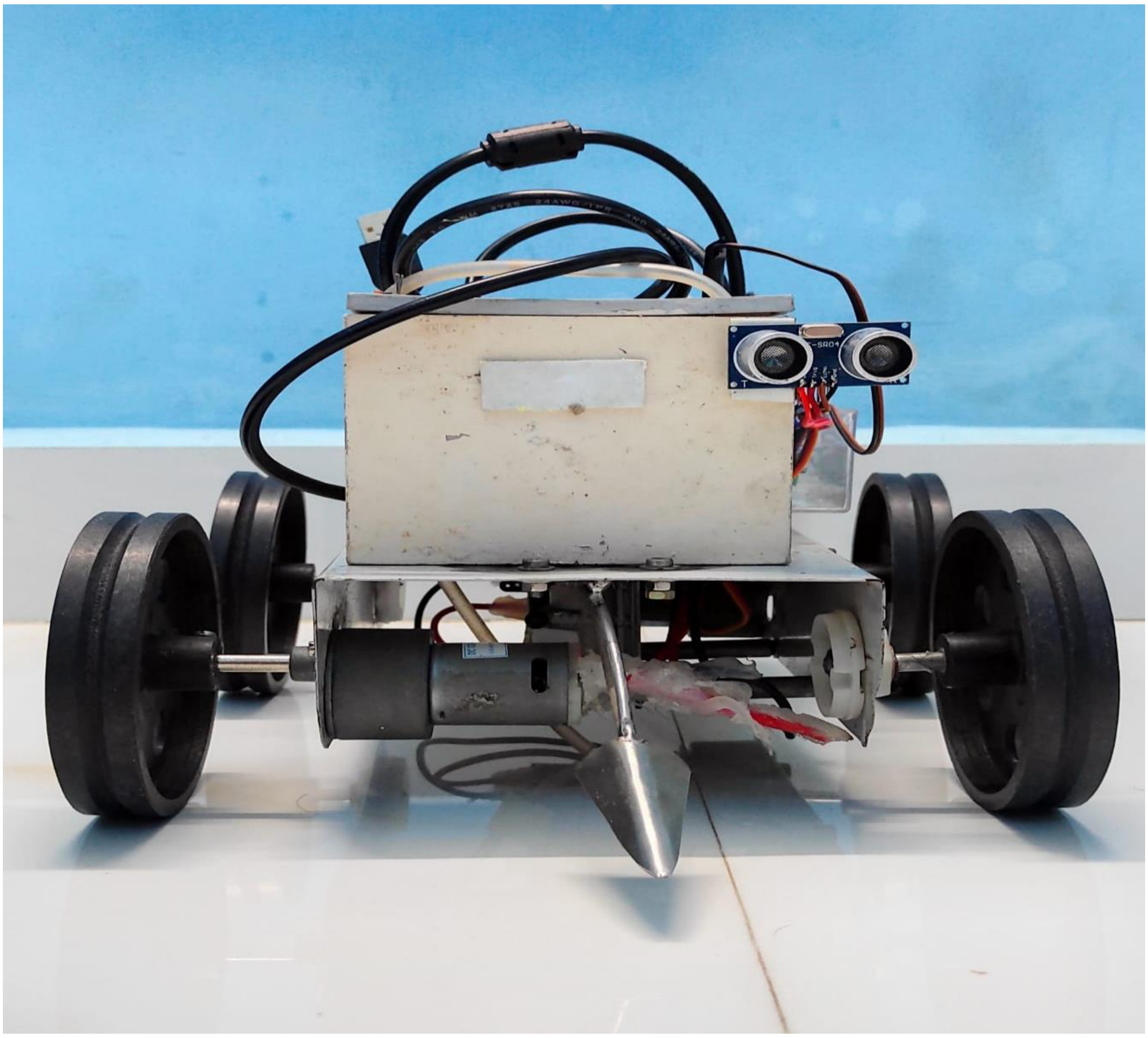

Fig 7.2.2 (Plowing)

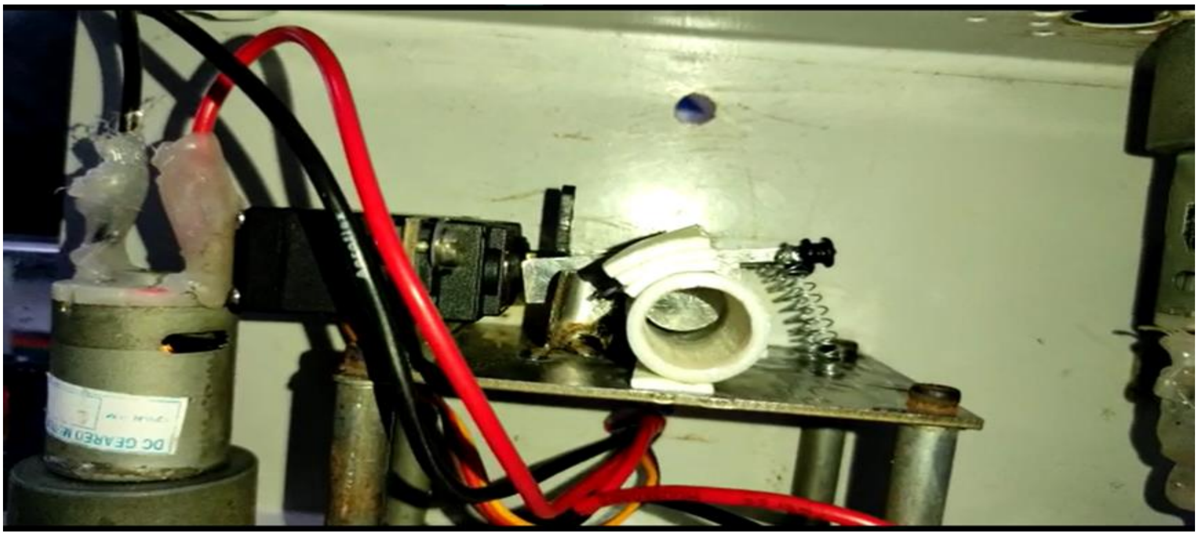

Fig 7.2.3(Seed Falling)

6. CONCLUSION:

Using Arduino, we created an Automated Farming Robot. According to the first findings of this research, most autonomous systems are more adaptable than traditional systems. Reduced labour expenditures and constraints on the number of daily working hours improved the situation greatly. As a result, the most important working processes can now be automated. The project proposes a low-cost, low-power, and simple device control system. This system will be useful in agriculture, gardening, and Agri university. The chassis supports the entire weight of the Water Tank, Hardware and battery put on iFarm, allowing it to do each and every action with expertise and success.

8. REFERENCES:

8.1 Arduino IDE Code:

Both Automatic and Manual

```
#include <Servo.h>
#include <AFMotor.h>

Servo myservo;  // create servo object to control a servo


int pos = 0;    // variable to store the servo position

int m1=29;
int m2=31;
int m3=33;
int m4=35;
int automode=23;
int seed=25;
int water=27;
```

```
#define echoPin 24
#define trigPin 22

long duration;

AF_DCMotor motor(1);
AF_DCMotor motor1(2);
AF_DCMotor pump(4);


int distance;

void setup() {
myservo.attach(10);  // attaches the servo on pin 9 to the servo object
myservo.write(90);
pinMode(trigPin, OUTPUT); // Sets the trigPin as an OUTPUT
pinMode(echoPin, INPUT); // Sets the echoPin as an INPUT

Serial.begin(9600);
pinMode(m1,INPUT);
pinMode(m2,INPUT);
pinMode(m3,INPUT);
pinMode(m4,INPUT);
pinMode(automode,INPUT);
pinMode(seed,INPUT);
pinMode(water,INPUT);



digitalWrite(m1,LOW);
digitalWrite(m2,LOW);
digitalWrite(m3,LOW);
digitalWrite(m4,LOW);
```

```
delay(3000);
motor.setSpeed(100);
motor1.setSpeed(100);
pump.setSpeed(255);

motor.run(RELEASE);
motor1.run(RELEASE);
pump.run(RELEASE);

}
void dist() {
  // Clears the trigPin condition
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  // Sets the trigPin HIGH (ACTIVE) for 10 microseconds
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  // Reads the echoPin, returns the sound wave travel time in microseconds
  duration = pulseIn(echoPin, HIGH);
  // Calculating the distance
  distance = duration * 0.034 / 2; // Speed of sound wave divided by 2 (go and back)
  // Displays the distance on the Serial Monitor
  Serial.print("Distance1: ");
  Serial.print(distance);
  Serial.println(" cm");
}

void seed1(){
  myservo.write(160);  // set servo to mid-point
  delay(2000);
```

```
myservo.write(20);  // set servo to mid-point
 delay(2000);
  myservo.write(90);  // set servo to mid-point
  delay(10);
}



void loop() {
int mode1 = digitalRead(automode);
            Serial.print("mode =");
        Serial.println(mode1);
if(mode1==1){

  dist();
  if(distance>5 && distance<30){
      motor.run(FORWARD);
      motor1.run(BACKWARD);
delay(2000);
      }else{

      motor.run(FORWARD);
      motor1.run(FORWARD);
      delay(3000);
      motor.run(RELEASE);
      motor1.run(RELEASE);
      delay(1000);
      seed1();
      delay(2000);
      pump.run(BACKWARD);
      delay(2000);
     pump.run(RELEASE);
      }
```

```
}else{
  int m11 = digitalRead(m1);
    int m12 = digitalRead(m2);
      int m13 = digitalRead(m3);
        int m14 = digitalRead(m4);
        Serial.print("m1 =");
        Serial.println(m11);
             Serial.print("m2 =");
        Serial.println(m12);
             Serial.print("m3 =");
        Serial.println(m13);
             Serial.print("m4 =");
        Serial.println(m14);
  if(m11==1 && m12==1){
    Serial.println("frwd");
    motor.run(FORWARD);
      motor1.run(FORWARD);
  }else if(m13==1 && m14==1){
     Serial.println("backwrd");
    motor.run(BACKWARD);
      motor1.run(BACKWARD);
  }
  else if(m11==1 && m13==1){
    motor.run(FORWARD);
      motor1.run(BACKWARD);
     Serial.println("left");
  }
  else if(m12==1 && m14==1){
    motor.run(BACKWARD);
      motor1.run(FORWARD);
     Serial.println("right");
  }
  else{
    Serial.println("stop");
```

```
    motor.run(RELEASE);
      motor1.run(RELEASE);
  }

int seed2 = digitalRead(seed);
            Serial.print("seed =");
        Serial.println(seed2);
  if(seed2==1){
   // delay(1000);
    seed1();
  }
int water1 = digitalRead(water);
            Serial.print("water =");
        Serial.println(water1);

  if(water1==1){
    pump.run(BACKWARD);
    delay(3000);
    pump.run(RELEASE);
  }

}

}
```

8.3 Referred Sites:

1. http://oaijse.com/VolumeArticles/FullTextPDF/213_32.AGRICULTURAL_AUTOMATION_ROBOT_USING_ARDUINO.pdf
2. https://www.researchgate.net/publication/326929441_Research_and_development_in_agricultural_robotics_A_perspective_of_digital_farming
3. https://ijisrt.com/assets/upload/files/IJISRT21APR684.pdf
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5. http://www.kscst.iisc.ernet.in/spp/39_series/SPP39S/02_Exhibition_Projects/135_39S_BE_1871.pdf
6. https://iopscience.iop.org/article/10.1088/1755-1315/411/1/012059

iFarm Project Video https://github.com/PK-20-S/iFarm-Working-Video