# DESIGN AND FABRICATION OF IOT BASED SMART SEEDING AND SPRAYING ROBOT

**A PROJECT REPORT**

***Submitted by***


**AJAY S (727722EUMT007)**
**ARUN MANIKANDAN J (727722EUMT018)**
**DEEPAK A (727722EUMT028)**
**GIRITHAR VISWANATH S N (727722EUMT034)**


***In partial fulfillment for the award of the degree***

***of***

**BACHELOR OF ENGINEERING**

**IN**

**MECHATRONICS ENGINEERING**


**SRI KRISHNA COLLEGE OF ENGINEERING AND TECHNOLOGY**

**An Autonomous Institution | Approved by AICTE | Affiliated to Anna University | Accredited by NAAC with A++ Grade**

**Kuniyamuthur, Coimbatore – 641008**


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An Autonomous Institution | Approved by AICTE | Affiliated to Anna University | Accredited by NAAC with A++ Grade
Kuniamuthur, Coimbatore – 641008
Phone : (0422)-2678001 (7 Lines) | Email : info@skcet.ac.in | Website : www.skcet.ac.in

# SUSTAINABLE DEVELOPMENT GOALS

The Sustainable Development Goals are a collection of 17 global goals designed to blue printto achieve a better and more sustainable future for all. The SDGs, set in 2015 by the United Nations General Assembly and intended to be achieved by the year 2030, In 2015, 195 nations agreed as a blue print that they can change the world for the better. The project is based on one of the 17 goals.

| Questions | Answer Samples |
|---|---|
| Which SDGs does the project directly address? | SDG 15 – Life on Land, 2 – Zero Hunger |
| What strategies or actions are being implemented to achieve these goals? | The project is based on IOT Robotic System automated for seeding and spraying to reduce manual labour supporting sustainable agricultural practices. |
| How is progress measured and reported inrelation to the SDGs? | Increase in crop yield due to presicion planting and spraying by monitoring usage data through IOT Sensors. |
| How were these goals identified as relevant to the project's objectives? | SDG 2's focus on ending hunger and promoting sustainable agriculture. SDG 15, as it supports ecosystem sustainability and responsible land use |
| Are there any partnerships or collaborations inplace to enhance this impact? | Agricultural Organizations and Environmental NGOs. |

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# BONAFIDE CERTIFICATE

Certified that this project report **DESIGN AND FABRICATION OF IOT BASED SMART SEEDING AND SPRAYING ROBOT** is the bonafide work Of **AJAY S (727722EUMT007), ARUN MANIKANDAN J (727722EUMT018), DEEPAK A (727722EUMT028), GIRITHAR VISWANATH S N (727722EUMT034)** who carried out the project work under my supervision.

| | |
|---|---|
| **SIGNATURE** | **SIGNATURE** |
| **Dr. M. LYDIA** | **Dr. M. BHUVANESWARI** |
| Professor and Head, | Assistant Professor, |
| Department of Mechatronics Engineering, | Department of Mechatronics Engineering, |
| SKCET, Coimbatore – 641008 | SKCET, Coimbatore - 641008 |

Submitted for the Project viva-voce examination held on ____________

INTERNAL EXAMINER EXTERNAL EXAMINER

# ACKNOWLEDGEMENT

At this juncture, we take the opportunity to convey our sincere thanks and gratitude to the management of the college for providing all the facilities to us.

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We would like to express our grateful thanks to **Dr. M. Lydia**, Head of the Department, Department of Mechatronics Engineering for her encouragement and valuable guidance on this project.

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# ABSTRACT

The increased demand for sustainable agriculture methods has resulted in the integrating IoT and robotics to increase farming efficiency. The proposed effort will address fundamental issues in traditional agricultural operations, such as manual labor reliance, inefficiency, and resource waste. This research is important because it automates repetitious farming chores, reduces human labor and ensures precision in seed distribution and spraying, all of which contribute to greater crop output and sustainable resource utilization. While existing agricultural robots can perform planting or spraying activities independently, there is a distinct absence of systems that combine these functionalities with real-time monitoring capabilities. This work aims to build, prototype, and test a multifunctional robot that uses IoT for real-time control and monitoring and can perform seeding and spraying activities autonomously. The project takes a systematic approach, beginning with conceptual design and hardware selection and progressing to producing a dual-purpose robot with components such as microcontrollers, sensors, and IoT modules. Python programming is used to control and automate the robot, with IoT protocols incorporated for remote access and data collection.  The prototype demonstrated accurate seeding and spraying operations with low resource waste and increased coverage. IoT connectivity enabled remote monitoring and modifications, demonstrating the potential for real-time adaptation in field settings. The findings of this study point to a disruptive strategy in agriculture, allowing for resource-efficient, scalable solutions that minimize labor needs and improve farming precision.

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# CHAPTER-1

# INTRODUCTION

Agriculture in India dates back to Indus Valley Civilization Era and even before that in some parts of Southern India. Today, India ranks second worldwide in farm output. The special vehicles plays a major role in various fields such as industrial, medical, military applications etc., The special vehicle field are gradually increasing its productivity in agriculture field. Some of the major problems in the Indian agricultural are rising of input costs, availability of skilled labour, lack of water resources and crop monitoring. To overcome these problems, the automation technologies were used in agriculture. The automation in the agriculture could help farmers to reduce their efforts. The vehicles are being developed for the processes for weeding, seed sowing, levelling and water spraying. All of these functions have not yet performed using a single vehicle. In this the robots are developed to concentrate in an efficient manner and also it is expected to perform the operations autonomously. The proposed idea implements the vehicle to perform the functions such as ploughing, seed sowing, mud leveling and water spraying. These functions can be integrated into a single vehicle and then performed.

## 1.1 SIGNIFICANCE OF PROPOSED WORK:

Nowadays almost all the manufacturing process is being atomized in order to deliver the products at a faster rate. The manufacturing operation is being atomized for the following reasons.

- To achieve mass production
- To reduce man power

- To increase the efficiency of the plant
- To reduce the work load
- To reduce the production cost
- To reduce the production time
- To reduce the material handling
- To reduce the fatigue of workers
- To achieve good product quality
- Less maintenance

## 1.2 OBJECTIVE

The machine is aimed for using in agricultural works where several operations like ploughing, seed sowing; water/ pesticide spraying is needed. The main objectives of this machine is to, Design an economically efficient, lightweight, and portable agricultural machine that minimizes manpower and reduces work time. It should handle large tasks quickly and use solar energy for battery charging.

The agricultural processes like seed sowing, ploughing, spraying etc can be done through traditional methods, but it is time consuming and requires more man power. The modern machines like tractor, seed sowing machine and sprayer can be used for this purpose. But it is more costly average middle class farmers cannot afford it. In order to tackle this problem, we are creating equipment which can perform several agricultural operations like sowing, ploughing, and spraying, which will minimize the cost and man power. The main aim of this equipment is to support small and medium scale farmers.

### 1.3 ORGANIZATION OF CHAPTERS

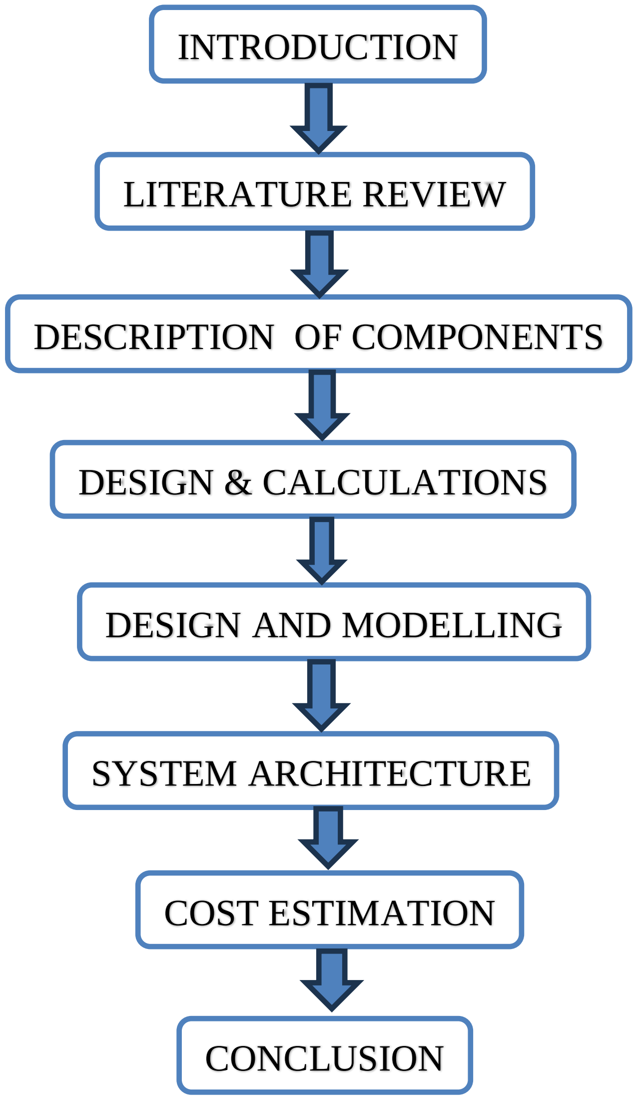


Figure 1.1 Organization Chapters

## 1.4 PROBLEMS DEFINITION:

The main problem we observed was that the cost of equipment's likes spraying machine, seed Sowing Machine and ploughing machine. Also the availability of such machine in the single unit. Also the convectional equipment's used, required the fuel for their working this increase the maintenance of the equipment. Also the problem like pollution is caused by the convectional equipment's. If the equipment's are working on the electricity then the work is stopped during the time when the electricity is not present this cause delay in the working, which can increase the disease in the plant if electricity is not present for the several days. Also the ploughing the grass in the farm field requires number of labors which is quite difficult now a day, also the charges to be pay are increasing day by day which cannot be affordable for the poor farmer. And also the work is not done in time. Also the convectional ploughing machine is very costly and it works on the tractor machine. The cost of tractor machine in very high. This tractor machine and Seed Sowing machine is out of beget of poor farmer. The ploughing price is also very high .The spraying machine is the most important now days due to which the price is increasing, also it is operated with the help of electricity of diesel machine means it will not be able to operate without the electricity or the diesel machine. The diesel machine will cause pollution. The drenching is also the main function to be performed in case of farm field in the Rainey season. The maintenance equipment is very costly of all this instruments. The breakdown of a single part will cost too much to the farmer.

# CHAPTER-2
# LITERATURE REVIEW

Agriculture refers to the production of food and goods through farming and forestry. Agriculture was the key development that led to the rise of civilization; with the husbandry of domesticated animals and plants (i.e. crops) creating food surpluses that enabled the development of more densely populated and stratified societies. The study of agriculture is known as agricultural science.

## 2.1 AGRICULTURE IN INDIA

Agriculture in India has a long history dating back to ten thousand years. Today, India ranks second worldwide in farm output. Agriculture and allied sectors like forestry, logging and fishing accounted for 16.6% of the GDP in 2007, employed 60% of the total workforce[1] and despite a steady decline of its share in the GDP, is still the largest economic sector and plays a significant role in the overall socio-economic development of India. India is the largest producer in the world of milk, cashew nuts, coconuts, tea, ginger, turmeric and black pepper. It also has the world's largest cattle population (281 million). It is the second largest producer of wheat, rice, sugar, groundnut and inland fish. It is the third largest producer of tobacco. India accounts for 10% of the world fruit production with first rank in the production of banana and sapota. India's population is growing faster than its ability to produce rice and wheat.

## 2.2 LITERATURE REVIEW

M.V. Achutha [1] This research paper provides information regarding the design and analysis of a multipurpose farm equipment which can perform operations such as sowing , inter cultivation , spraying for small scale farmers without huge investment and can be operated manually without any external source of energy .

Nitin Kumar Mishra [2] Here the author has suggested a development of a multipurpose agricultural machine which is easy in construction and are economical as it runs on solar energy.

P. Vijay [3] This paper describes a machine which has better and effective design and can be used specifically for rice, wheat crops ,etc.

D.A. Mada [4] In this paper author has tried to prove the importance of mechanization in agriculture by giving certain examples. The paper concluded the need of multifunctional single axel vehicle for pre and post harvesting.

V.K. Tewari [5] In this research papers author has studied the ongoing procedures of farming in West Bengal. As the study was concluded iin india it provides us with clear scenario about the agricultural advancements in India. David D. Wilson [6] Authors have mentioned the use of certain multipurpose machine which helps to derive our attention as to how attachments can be used for making a model more useful in efficient and sustainable way .

Dr. C.N. Saklhale [7] Thisreview paper focus on the basic problems faced by farmers i.e. seed sowing, fertilizer spraying, cultivation and digging and motivating the idea for design of a machine which would use a engine for much faster and efficient working.

‘Mohammad Muneer Uz Zaman’ [8] Author has emphasized on designing parameters of the grass cutter and has done research on reduction of cost of the material to be used for designing of grass cutter.

M.G.Jadhav [9] This paper focus on the design of a manually operated Multi nozzle sprayer which will have a weeder as an attachment to give optimum results in less time . Pushing mechanism require less efforts and 3-wheel mechanism used provides proper balancing to the machine.

Dhiraj N. Kumbhare [10] Author suggests that the machine proposed will reduce cost and save time for spraying fertilizers efficiently on the crops at specific intervals.It also provides a safety factor for humans from the effects of chemical fertilizers and it also helps in reducing the human interference in the process.

Siddharth Kshirsagar [11] This research paper focus on designing a machine which would be able to perform spraying operation more efficiently using pump driver linkage mechanism. Sanjay S [12] In this paper, author proposed a design for a model of a mechanical pest sprayer which can run without any fuel and it is easy to operate by any unskilled person. Spraying is carried out by sprocket mechanism.

Sandeep H. Poratkar [13] This paper focus on manually operated multi nozzle pesticide sprayer pump which is able to carry out spraying at a considerably high rate. Constant flow valves can be added at nozzle as a modification to have uniform nozzle pressure.

Desa Ahmad [14] In this paper the author has studied the effect of various types of rotary blades based on their performance. The test is carried out in a dry-land field. Results concluded that soil clod diameter decreased and soil inversion increased with increasing rotational speed of the rotor. Mohd Ishammudin Bin Mohd Yunus [15]

Paper is about the modified design of a grass cutting machine by using the DFMA methodology.The modification is expected to meet the drastic changes and meet the customer demands.

Mr.R. A. Ghumadwar [19] This research paper aims to design and analyse a small field crop cutter machine. This cutter can be effectively be used to cut crops at a small height. The analysis of the cutter is carried out using the softwares like Pro-E andAnsys.

Gokulavasan [20] These project promotes the idea for a fabrication of a grass cutting machine which uses motor running using solar power . Photo-voltaic principle is used to charge the battery.

Prashant G. Salunkhe [21] Project shows design of an Automatic Seed Plantation Robot whose working is based basically on electronic and mechanical backgrounds. An electromechanical vehicle which is steered by use of an DC motor.

Mr. Shishir Mane [22] This research paper focus on design of smart seed sowing machine which can automatically sow seeds in the field. The machine is provided with an keypad to let the farmers provide a variable pitch as a input data.

Kunal A. Dhande [23] This paper demonstrate a design of a machine with an easy method for seed sowing. In this project the complicated gear system is replaced by hall effect sensor for easier and affordable seed sowing.

Jeevarathinam .A [24] This paper focus on analysis and optimization of rotary tillage tool. The analysis is done by use of FEA and simulation of the design is done by using CAD-software for the structural analysis. Paper gives a rough plan for the design and development of rotavator blade.

## 2.3 PROBLEMS IN AGRICULTURE

Slow agricultural growth is a concern for policymakers as some two-thirds of India’s people depend on rural employment for a living. Current agricultural practices are neither economically nor environmentally sustainable and India's yields for many agricultural commodities are low. Poorly maintained irrigation systems and almost universal lack of good extension services are among the factors responsible. Farmers' access to markets is hampered by poor roads, rudimentary market infrastructure, and excessive regulation.

# CHAPTER - 3
## DESCRIPTION OF COMPONENTS

This section outlines the primary components and technologies integrated into the smart seeding and spraying robot, highlighting their roles and interconnections in achieving the project's objectives. Key elements include sensors, IoT modules, and mechanical components that collectively enable the robot to perform seeding and spraying tasks remotely.

### 3.1 D.C.MOTOR:

Figure 3.1 DC Motor

Principle Of Operation:

In any electric motor, operation is based on simple electromagnetism. A current-carrying conductor generates a magnetic field; when this is then placed in an external magnetic field, it will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field. As you are well aware of from playing with magnets as a kid, opposite (North and South) polarities attract, while like polarities (North and North, South and South) repel. The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion.Let's start by looking at a simple 2-pole DC electric motor (here red represents a magnet or winding with a "North" polarization, while green represents a magnet or winding with a "South" polarization). Every DC motor has six basic parts -- axle, rotor (armature), stator, commutator, field magnet(s), and brushes.

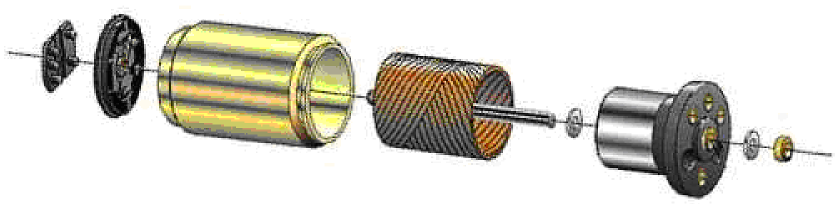

Figure 3.2 DC Motor Exploded View

Again, disassembling a coreless motor can be instructive -- in this case, my hapless victim was a cheap pager vibrator motor. The guts of this disassembled motor are available (on 10 lines / cm graph paper). This is (or more accurately, was) a 3-pole coreless DC motor.

## 3.2. RELAY

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off. So relays have two switch positions and they are double throw (changeover) switches. Relays allow one circuit to switch a second circuit which can be completely separate from the first. The link is magnetic and mechanical. Relays are usually SPDT or DPDT but they can have many more sets of switch contacts, for example relays with 4 sets of changeover contacts are readily available. Most relays are designed for PCB mounting but you can solder wires directly to the pins providing you take care to avoid melting the plastic case of the relay. The animated picture shows a working relay with its coil and switch contacts. You can see a lever on the left being attracted by magnetism when the coil is switched on.

### 3.3 PUMP

A pump is a device used to move gases, liquids or slurries. A pump moves liquids or gases from lower pressure to higher pressure, and overcomes this difference in pressure by adding energy to the system such as a water system. A gas pump is generally called a compressor, except in very low pressure-rise applications, such as in heating, ventilating, and air-conditioning, where the operative equipment consists of fans or blowers. Pumps work by using mechanical forces to push the material, either by physically lifting, or by the force of compression.Hand-operated, reciprocating, positive displacement, water pump. A positive displacement pump causes a liquid or gas to move by trapping a fixed amount of fluid or gas and then forcing displacing that trapped volume into the discharge pipe.

### 3.4 WHEEL

A wheel is a circular device that is capable of rotating on its axis, facilitating movement or transportation or performing labor in machines. Common examples are found in transport applications. More generally the term is also used for other circular objects that rotate or turn, such as a Ship's wheel and flywheel. The wheel most likely originated in ancient. The wheel is a device that enables efficient movement of an object across a surface where there is a force pressing the object to the surface. Common examples are a cart drawn by a horse, and the rollers on an aircraft flap mechanism.The wheel is not a machine, and should not be confused with the wheel and axle, one of the simple machines. A driven wheel is a special case that is a wheel and axle. Wheels are used in conjunction with axles, either the wheel turns on the axle or the axle turns in the object body. The mechanics are the same in either case. The normal force at the sliding interface is the same. The sliding distance is reduced for a given distance of travel. The coefficient of friction at the interface is usually lower.

## 3.5 CONTROL UNIT:

Microcontrollers are destined to play an increasingly important role in revolutionizing various industries and influencing our day-to-day life more strongly than one can imagine. Since its emergence in the early 1980's the microcontroller has been recognized as a general-purpose building block for intelligent digital systems. It is finding using diverse area, starting from simple children's toys to highly complex spacecraft.

Because of its versatility and many advantages, the application domain has spread in all conceivable directions, making it ubiquitous. As a consequence, it has generate a great deal of interest and enthusiasm among students, teachers and practicing engineers, creating an acute education need for imparting the knowledge of microcontroller based system design and development. It identifies the vital features responsible for their tremendous impact; the acute educational need created by them and provides a glimpse of the major application area.

### 3.6 ESP8266 WIFI MODULE

The ESP8266 WiFi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor.

The ESP8266 supports APSD for VoIP applications and Bluetooth co-existance interfaces, it contains a self-calibrated RF allowing it to work under all operating conditions, and requires no external RF parts.

There is an almost limitless fountain of information available for the ESP8266, all of which has been provided by amazing community support. In the Documents section below you will find many resources to aid you in using the ESP8266, even instructions on how to transforming this module into an IoT (Internet of Things) solution!

### 3.7 SPUR GEAR

Spur gears are the simplest and most common type of gear. Their general form is a cylinder or disk The torque ratio can be determined by considering the force that a tooth of one gear exerts on a tooth of the other gear. Consider two teeth in contact at a point on the line joining the shaft axes of the two gears.

Figure 3.3 SPUR GEAR

A gear is component within a transmission device. Transmit rotational force to another gear or device. A gear is different from a pulley in that a gear is a round wheel. Mesh with other gear teeth, allowing force to be fully transferred without slippage.

## 3.8 BLYNK APPLICATION

*How Blynk works*

Blynk was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, it can store data, vizualize it and do many other cool things. There are three major components in the platform:

- **Blynk App** - allows to you create amazing interfaces for your projects using various widgets we provide.
- **Blynk Server** - responsible for all the communications between the smartphone and hardware. You can use our Blynk Cloud or run your private Blynk server locally. It's open-source, could easily handle thousands of devices and can even be launched on a Raspberry Pi.
- **Blynk Libraries** - for all the popular hardware platforms - enable communication with the server and process all the incoming and outcoming commands.

  Now imagine: every time you press a Button in the Blynk app, the message travels to space the Blynk Cloud, where it magically finds its way to your hardware. It works the same in the opposite direction and everything happens in a blynk of an eye.

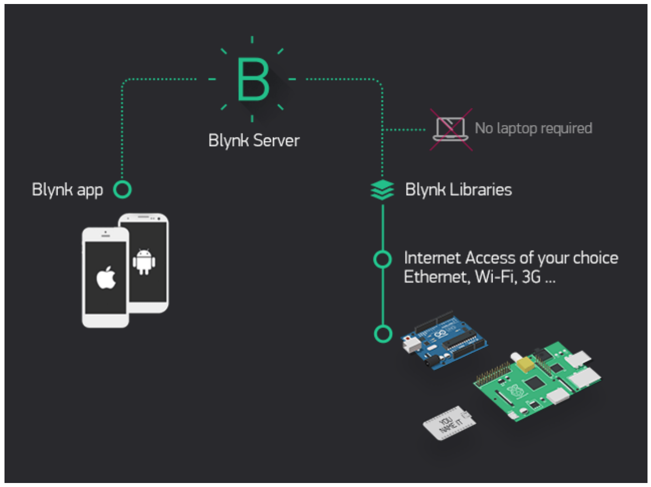


Figure 3.4(a) Blynk IOT Control Flow

**Features**

Similar API & UI for all supported hardware & devices Connection to the cloud using:

- WiFi
- Bluetooth and BLE
- Ethernet
- USB (Serial)
- GSM
- Set of easy-to-use Widgets
- Direct pin manipulation with no code writing
- Easy to integrate and add new functionality using virtual pins
- History data monitoring via Super Chart widget
- Device-to-Device communication using Bridge Widget
- Sending emails, tweets, push notifications, etc.
- new features are constantly added!

**Getting Started With The Blynk App**

1. Create a Blynk Account

After you download the Blynk App, you’ll need to create a New Blynk account. This account is separate from the accounts used for the Blynk Forums, in case you already have one.

We recommend using a **real** email address because it will simplify things later.

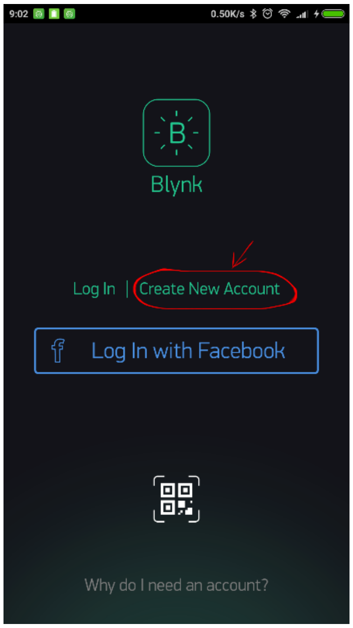


Figure 3.4 (b) Blynk Application Home Page

2. Create a New Project

After you’ve successfully logged into your account, start by creating a new project.

3. Choose Your Hardware

Select the hardware model you will use. Check out the list of supported hardware!

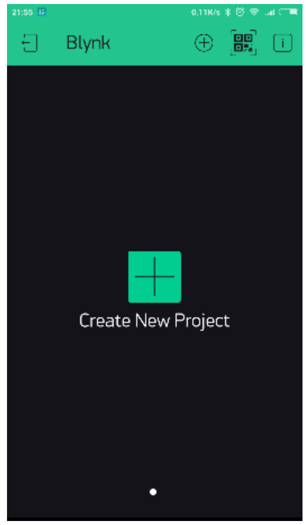


Figure 3.4(c) Blynk Application New Project

**4.** Auth Token

**Auth Token** is a unique identifier which is needed to connect your hardware to your smartphone. Every new project you create will have its own Auth Token. You'll get Auth Token automatically on your email after project creation. You can also copy it manually. Click on devices section and selected required device .Your project canvas is empty, let's add a button to control our LED. Tap anywhere on the canvas to open the widget box. All the available widgets are located here. Now pick a button.

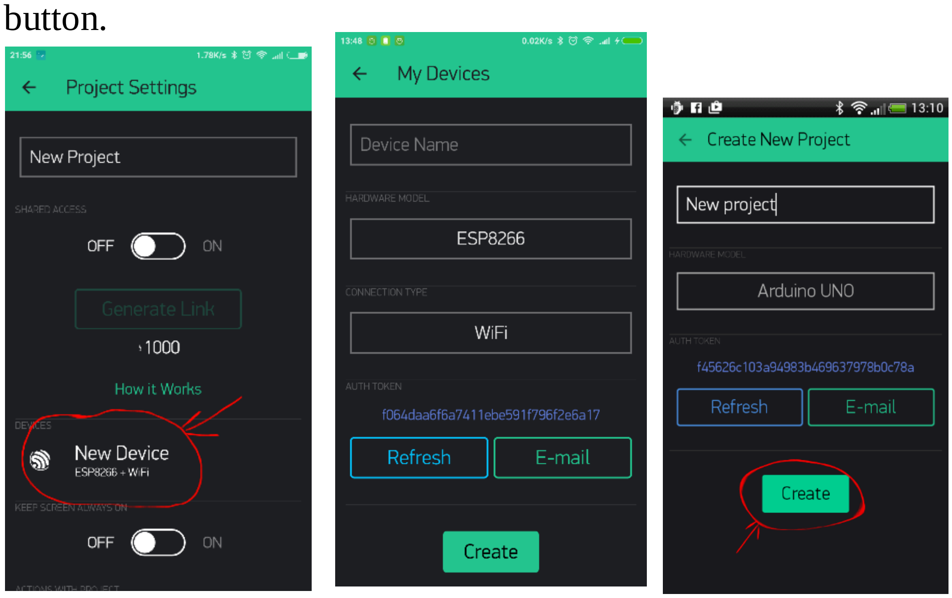


Figure 3.4(d) Blynk Application Configuration

**Drag-n-Drop** - Tap and hold the Widget to drag it to the new position.

Widget Settings - Each Widget has it’s own settings. Tap on the widget to get to them. The most important parameter to set is **PIN**

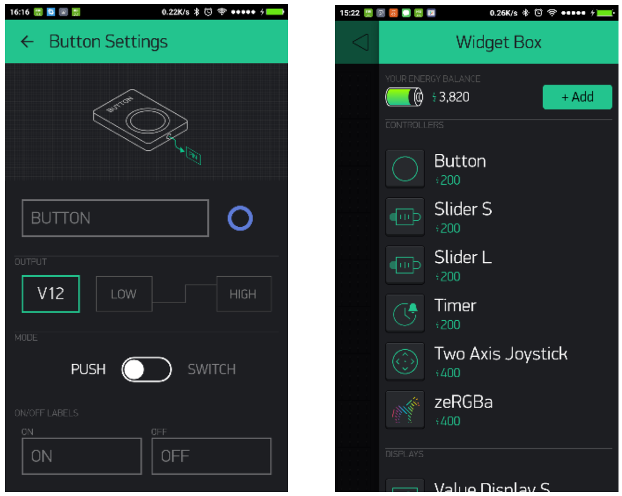


Figure 3.4(e) Blynk Application Interface

## CONCLUSION:

Together, these components enable the robot to Remotely navigate fields, seed crops, and apply sprays with precision, enhancing productivity and promoting sustainable farming practices.

# CHAPTER – 4
# DESIGN & CALCULATIONS

## 4.1 MILD STEEL CALCULATIONS:

To perform calculations for a mild steel square pipe with the following specifications:

- Size: 3/4 inch (which is approximately 19.05 mm)
- Thickness: 1 mm

We can calculate the following:

1. Cross-sectional area
2. Moment of inertia (I)
3. Section modulus (Z)
4. Weight of the pipe per meter

### 4.1.1. Cross Sectional-Area

The formula for the cross-sectional area of a hollow square pipe is:

$A = b^2 - (b - 2t)^2$

Where:

- b = outer dimension of the square pipe (in mm)
- t = thickness of the pipe (in mm)

a. Convert 3/4 inch to mm:

$B = 3 / 4\text{inch} = 19.05\text{mm}$

b. Calculate the outer and inner dimensions:

- Outer side b = 19.05 mm
- Inner side $b - 2t = 19.05 - (2 \times 1) = 17.05$ mm

c. Calculate the area:

$$A = (19.052^2 - 17.052^2) = (362.04025 - 290.6025) \approx 71.43775 mm^2$$

So, the cross-sectional area Ais approximately **71.44 $mm^2$.**

### 4.1.2. Moment Of Inertia (I)

The moment of inertia for a hollow square section is given by:

$I = (b^4 - (b - 2t)^4) / 12$

Substituting the values:

$I = (19.054^4 - 17.054^4) / 12$

Calculating each term:

- $19.054^4 \approx 13099.0416\ mm^4$
- $17.054^4 \approx 10052.6091\ mm^4$

Now plug in:

$I = (13099.0416 - 10052.6091) / 12 = 3046.4325 / 12 \approx 253.8694 mm^4$

So, the moment of inertia III is approximately 253.87 $mm^4$.

### 4.1.3. Section Modulus (Z)

The section modulus Z can be calculated using the formula:

$Z = I / c$

Where c is the distance from the neutral axis to the outer edge. For a square pipe:

$c = B / 2 = 19.05 / 2 = 9.525$ mm

Now calculate Z:

$Z = I / c = 253.8694 / 9.525 \approx 26.63\ mm^3$

Thus, the section modulus Z is approximately 26.63 $mm^3$.

### 4.1.4 Weight of The Pipe Per Meter

To calculate the weight per meter, use the formula:

Weight = $A \times \text{Length} \times \rho$

Where:

- $A$ = cross-sectional area in $mm^2$ (convert $mm^2$ to $m^2$)
- $\rho$ = density of mild steel (approximately 7850 $kg/m^3$)

Convert A to $m^2$

$A = 71.44 mm^2 = 71.44 \times 10^{-6} m^2$

Now calculate the weight for a length of 1 meter:

Weight = $71.44 \times 10^{-6} m^2 \times 1m \times 7850 kg/m^3$

Weight $\approx$ 0.5606kg/m

Thus, the weight of the pipe per meter is approximately 0.56 kg/m.

Summary of Calculations:

- Cross-sectional Area (A): $\approx$ 71.44 $mm^2$
- Moment of Inertia (I): $\approx$ 253.87 $mm^4$
- Section Modulus (Z): $\approx$ 26.63 $mm^3$
- Weight per Meter: $\approx$ 0.56 kg/m

## 4.2 WHEEL AND MOTOR SELECTION:

- Total weight = 50 kg (including payload)
- Wheel diameter = 20 cm (0.1 m radius)
- Coefficient of friction for rough terrain = 0.5

### 4.2.1 Motor Selection

First, calculate the force:

F = m x a

F= 50kg × 9.81m/s, 2 × 0.5 = 245.25N

Then, calculate torque:

T = 245.25N × 0.1m / 0.8 = 30.66Nm

Select a motor with at least 31 Nm of torque.

### 4.2.2. Determination Of Total Load

First, determine the total load on the vehicle, including the weight of the vehicle, battery, motors, sensors, and the payload (tools, seeds, water, etc.).

Assume:

- Vehicle weight: 40 kg
- Payload weight: 20 kg

Total weight:

W total = 40kg + 20kg = 60kg

Convert this to Newtons (N):

W total = 60kg × 9.81m/s² = 588.6N

Determine Number of Wheels

For most agriculture vehicles, a 4-wheel design is standard for stability.

Load on each wheel:

$\mathbf{W}_{\text{wheel}} = \mathbf{W}_{\text{total}}$ / number of wheels = 588.6N / 4 = 147.15N

### 4.2.3. Select Wheel Diameter

The diameter of the wheel depends on the type of terrain. For rough or uneven terrain, larger wheels are preferred. Let's assume:

Rough terrain: A wheel diameter of 20 cm (0.2 m) is chosen.

### 4.2.4 Torque Calculations

Torque is needed to overcome the frictional force of the terrain. The equation to calculate torque is:

$T = F \times r / \eta$

Where:

$F$ = Frictional force (N), estimated by the total weight multiplied by the coefficient of friction for the terrain

$r$ = Radius of the wheel (m)

$\eta$ = Efficiency of the motor (typically around 0.75-0.85)

Assume the coefficient of friction ($\mu$) for rough terrain is 0.5.

So, the force per wheel:

$F_{wheel} = W_{wheel} \times \mu = 147.15N \times 0.5 = 73.575N$

The radius of the wheel is half the diameter:

$r = 0.2m / 2 = 0.1m$

Assume the motor efficiency is 80% ($\eta$=0.8).

Now, calculate the torque:

$T = 73.575 \times 0.1 / 0.8 = 9.197Nm$

Thus, each wheel requires **9.2 Nm** of torque to move the vehicle on rough terrain.

### 4.2.5. Check For Wheel Rpm

Now that you have the torque, check the RPM (rotations per minute) based on the speed you want. Use the equation for speed:

$v = \omega \times r$

Where:

- $V$ = Linear speed of the vehicle (m/s)
- $\omega$ = Angular velocity of the wheel (rad/s)

Assume you want a maximum vehicle speed of 1 m/s. Rearranging the equation:

$\omega = v / r = 1 m/s / 0.1 m = 10 rad/s$

Convert to RPM:

$RPM = \omega \times 60 / 2\pi = 10 \times 60 / 6.28 = 95.5 RPM$

## 4.3 SPUR GEAR CALCULATION:

To calculate the dimensions and other parameters of a 60 mm diameter spur gear with 38 teeth, we need to use some basic formulas of gear design.

### 4.3.1 Module (m) Calculation:

The module is the basic parameter used to define the size of a gear. It is the ratio of the pitch diameter (d) to the number of teeth (z) on the gear.

$m = d / z$

Since $d = 60mm$ and $z = 38$, we get:

$m = 60 / 38 = 1.5789$ mm

So, the module of the gear is 1.5789 mm (rounded off to four decimal places).

### 4.3.2 Pitch Diameter (d) Calculation:

The pitch diameter is the diameter of the circle that passes through the point where the teeth of the two meshing gears contact each other.

d = m x z

Since m = 1.5789 mm and z = 38, we get:

d = 1.5789 x 38 = 60.105 mm

So, the pitch diameter of the gear is 60.105 mm (rounded off to three decimal places).

### 4.3.3 Addendum (a) Calculation:

The addendum is the height of the tooth above the pitch circle.

a = m

Since m = 1.5789 mm, we get:

a = 1.5789 mm

So, the addendum of the gear is 1.5789 mm.

### 4.3.4 Dedendum (b) Calculation:

The dedendum is the height of the tooth below the pitch circle.

b = 1.25 x m

Since m = 1.5789 mm, we get:

b = 1.25 x 1.5789 = 1.9736 mm

So, the dedendum of the gear is 1.9736 mm (rounded off to four decimal places).

### 4.3.5 Tooth Thickness (s) Calculation:

The tooth thickness is the width of the gear tooth measured along the pitch circle.

s = π x m / 2

Since m = 1.5789 mm, we get:

s = π x 1.5789 / 2 = 2.4752 mm

So, the tooth thickness of the gear is 2.4752 mm

## 4.4 BALL BEARING CALCULATION

Radial load of ball bearing (Fr) = 700 N

Thrust load of ball bearing (Fa) = 300 N

Service factor(s) = 1.2

Hours in use per week = 35

Number of years = 3

Speed N = 500 Rpm

Diameter of Shaft = 15 mm

LIFE OF BEARING

Total life of bearing = 35 x 3 x 52

= 5460 hrs

Equivalent Load = P = (X Fr + y Fa) S

Load factor (x) = 0.56

Trust factor = 1.4 (From PSG DDB 4.4 And 4.6)

P = (0.56 X 700 + 1.4 x 300) 1.2

= 812 N

Loading ratio = C/P = 6.2 (FROM PSG DDB 4.14)

C = 6.2 X P

C = 6.2 X 812

C = 5034 N

C = 880 Kg f = 8800 N

Since C = 8800 > 5034, the Selected bearing is suitable.

Selected bearing = SKF6302.

## 4.5 DRAGGING FORCE OF PLOUGH:

F drag = A x P

A – Contact area

P – Pressure

CONTACT AREA CALCULATION:

A = w x d

w – width of plough

d – depth of ploughing

Soil resistance Calculations:

P = $\sigma$ c + ($\mu$ x $\sigma$ n)

A = w x d = 0.2 x 0.1 = 0.02 m

P = $\sigma$ c x $\mu$ x $\sigma$ n = 500 + (0.6 x 980)

= 500 + 588

= 1088 Pa

F drag = A x P = 0.02 x 1088 = 21.76 N.

Thus, the dragging force required = 21.76 N.

Assuming:

- Soil type: Loamy, K=25,000 N/$m^2$
- Width of plough W = 0.5 m
- Depth of plough D = 0.2 m
- Operational speed v = 0.5 m/s
- Spray pressure P = 200,000 Pa

- Nozzle area $A = 0.0001\ m^2$

Step 1: Calculate Ploughing Power

$\mathbf{P}_{plough} = F \times v$

$\mathbf{P}_{plough} = 2{,}500 \times 0.5 = 1250\ W$

Step 2: Calculate Spraying Force

$Fs = P \times A$

$Fs = 200{,}000 \times 0.0001 = 20\ N$

### 4.5.1 FORCE CALCULATION:

$F = m \times g \times \mu$

$m = 18\ Kg$

$\mu = 9.81\ m/s^2$

$F = 9.81 \times 0.3 \times 18 = 52.9\ N.$

## 4.6 SEEDING MECHANISM FORCE:

Force required to push seeds (Fs):

$Fs = A \times P$

A – Area of the seed

P – Soil pressure

### 4.6.1 SEED DISPENSING RATE:

$Rs = ns/dt$

ns – no. of seed dispensed

dt – distance travelled by the robot during seeding

Assuming,

ns = 50 seeds

dt = 10 meters

Rs = 50 / 10 = 5 seeds/m.

### 4.6.2 SPEED OF THE ROBOT:

V = ns / R**s**

Rs = speed release rate

Rs = desired seeding rate

Assuming, Rs = 10 seeds/s

Rs = 5 seeds/m

V = 10 / 2 = 2 m/s = 7.2 km/hr

1m = 0.001 km

1s = 0.000278 hr

Robot drops 1 seed with the gap of 0.2m.

## 4.7 POWER CALCULATIONS FOR EACH COMPONENT:

For each component, power P can be calculated as:

$P = V \times I$

where:

- V is the operating voltage of the component (in volts),
- I is the current drawn by the component (in amperes).

### 4.7.1. Power For Node Mcu

- Operating Voltage: 3.3 V (or 5 V, depending on configuration)
- Current: 70 mA (typical operating current)

$\mathbf{P}_{\text{Node MCU}} = 3.3\text{ V} \times 0.07\text{ A} = 0.231\text{ W}$

### 4.7.2 Power Consumption For Sensors

Temperature Sensor ( DHT11 or DS18B20)

- Operating Voltage: 3.3 V
- Current: 2 mA (typical during data acquisition)

$\mathbf{P}_{\text{Temp Sensor}} = 3.3\text{ V} \times 0.002\text{, A} = 0.0066\text{ W}$

Soil Moisture Sensor

- Operating Voltage: 3.3 V
- Current: 35 mA (typical when active)

$\mathbf{P}_{\text{Moisture Sensor}} = 3.3\text{ V} \times 0.035\text{ A} = 0.1155$

### 4.7.3 DC Motor for Ploughing/Seeding Mechanism

Assume a DC motor with:

- Operating Voltage: 12 V
- Current: 2 A (depends on load and torque requirement)

$\mathbf{P}_{\text{Motor}} = 12\text{ V} \times 2\text{A} = 24\text{ W}$

### 4.7.4 Power Consumption For Relay (for controlling pump or motor)

Assuming a relay with:

- Operating Voltage: 5 V
- Current: 100 mA (during operation)

$\mathbf{P}_{\text{relay}} = 5\text{ V} \times 0.1\text{ A} = 0.5\text{ W}$

.

### 4.7.5 Total Power Calculation

Adding up all the components' power requirements:

$\mathbf{P}_{\text{total}} = \mathbf{P}_{\text{Node MCU}} + \mathbf{P}_{\text{Temp Sensor}} + \mathbf{P}_{\text{Moisture Sensor}} + \mathbf{P}_{\text{Motor}} + \mathbf{P}_{\text{relay}}$

Substituting the values:

$\mathbf{P}_{\text{total}} = 0.231 + 0.0066 + 0.1155 + 24 + 0.5 = \mathbf{24.8531\ W}$

Thus, the total power requirement for the IoT-based smart seeding and spraying robot would be approximately 24.85 W under these assumptions.

### 4.7.6 Battery Selection

Battery Capacity = P Total × runtime

Assume the runtime is 2 hours,

Battery Capacity = 24.85 × 2 = 49.7 W

For a 12V battery, this would translate to:

Battery Capacity (Ah) = 49.712 = 4.14 Ah

# CHAPTER – 5
# DESIGN AND MODELLING

This section outlines the MCU Block Diagram and SolidWorks model of the Robot in various views. And the final output of the Model with labelled components in an Isometric view.

## 5.1 BLOCK DIAGRAM:

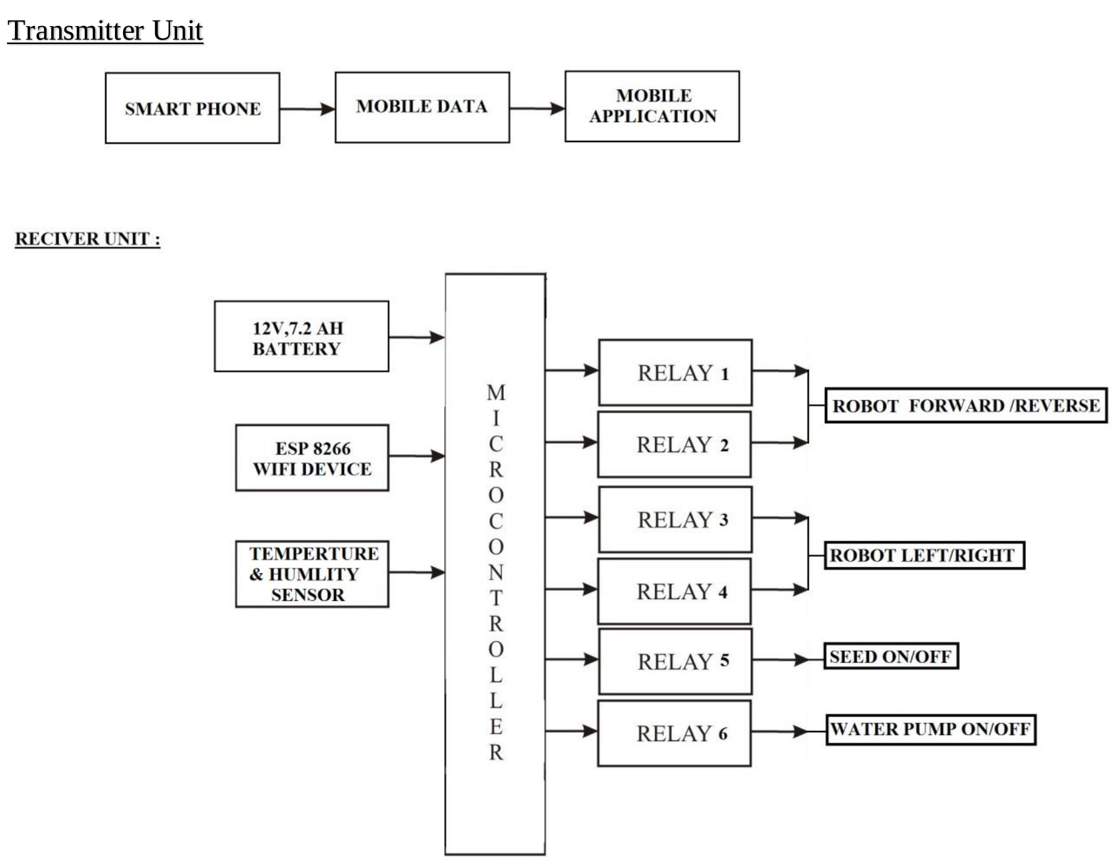


Figure 5.1 BLOCK DIAGRAM

## 5.2 SOLIDWORKS MODEL

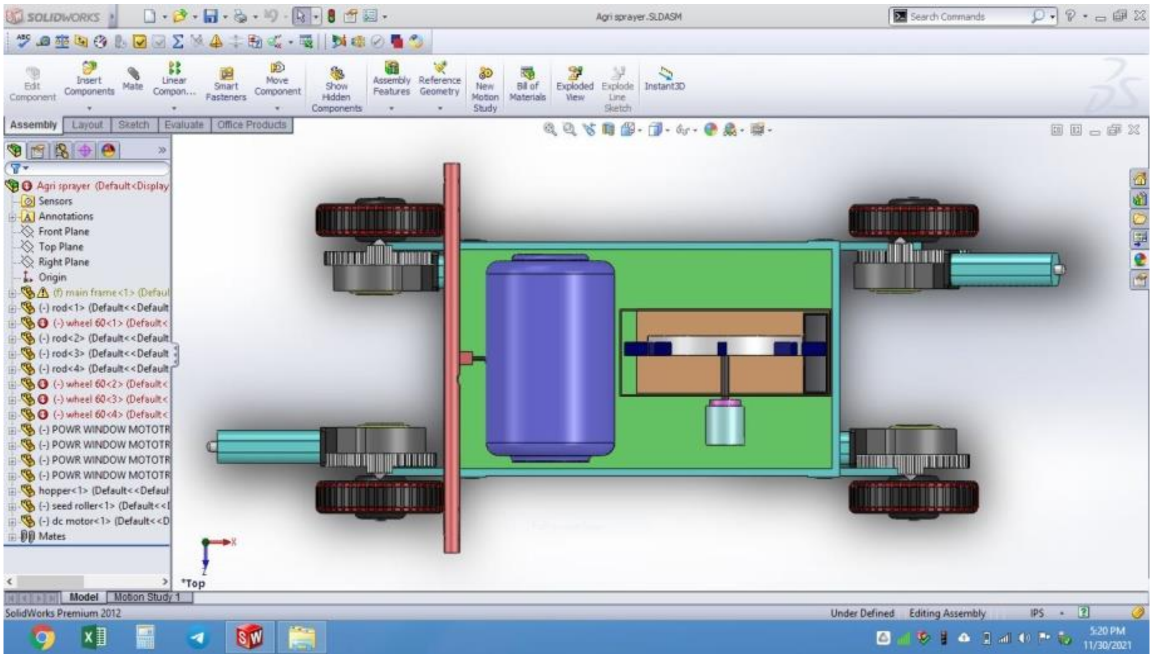


Figure 5.2 TOP VIEW

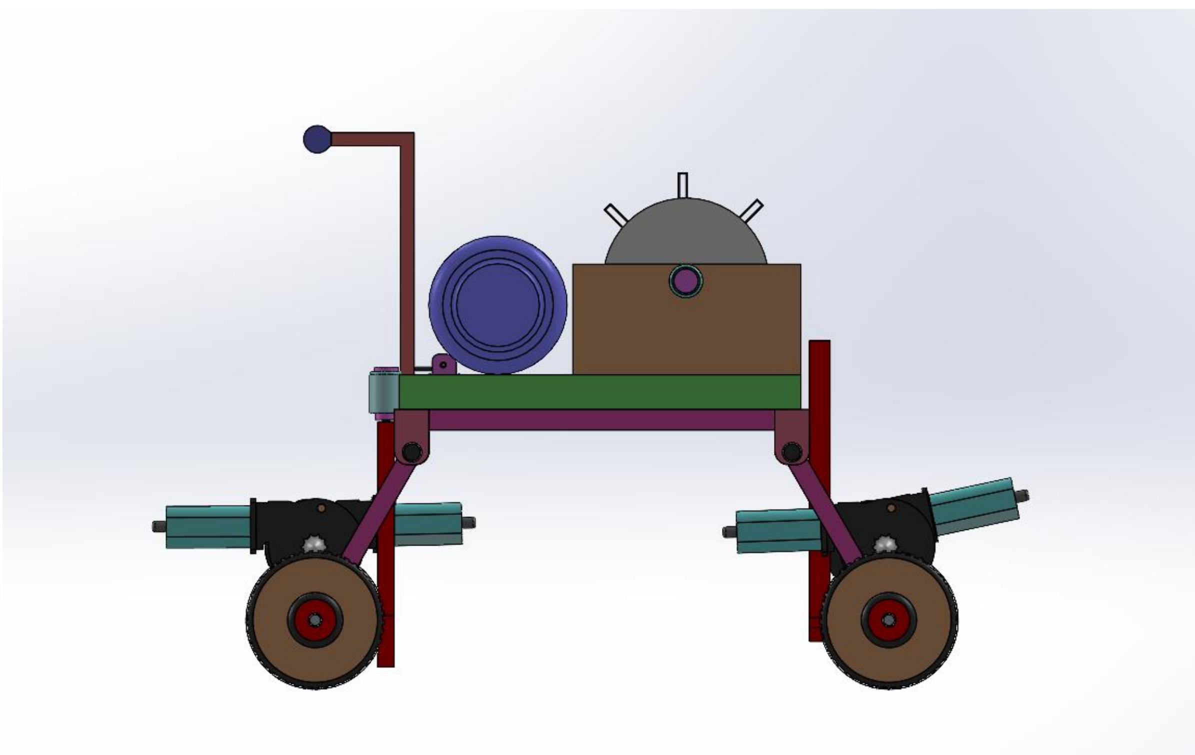

Figure 5.3 RIGHT VIEW

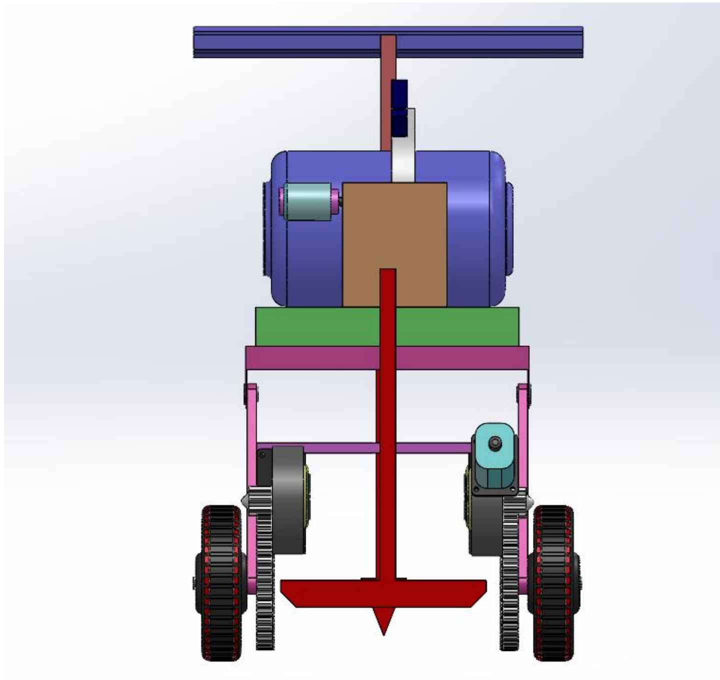

Figure 5.4 (a) Front View

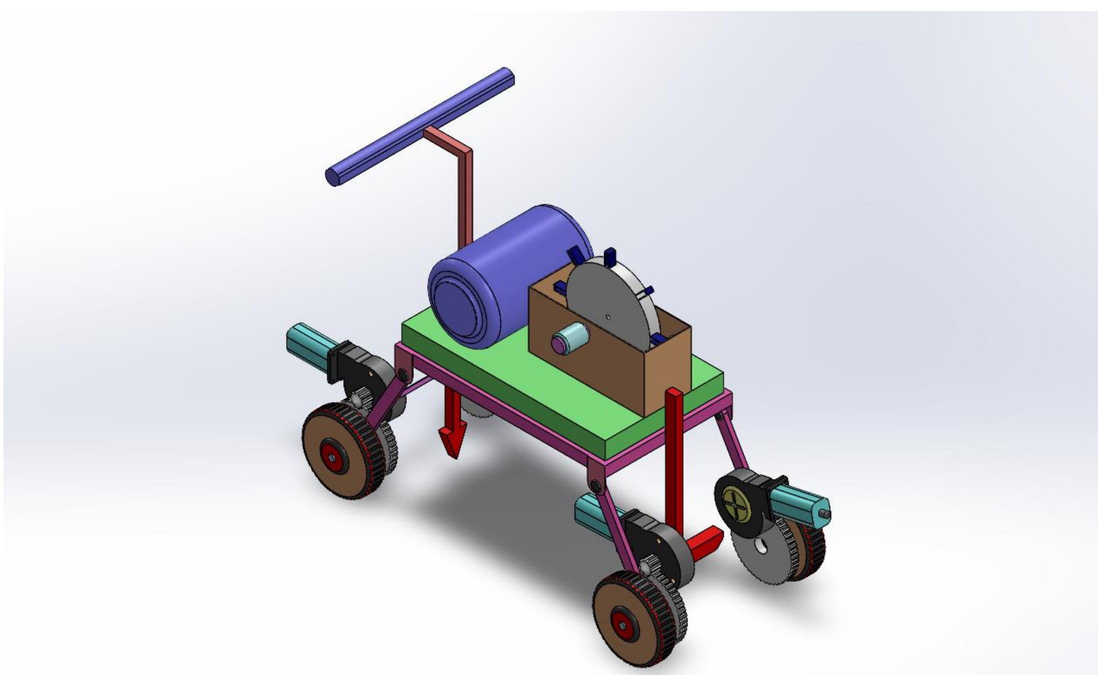

Figure 5.4 (b) 3D VIEW

## 5.3 FINAL OUTPUT

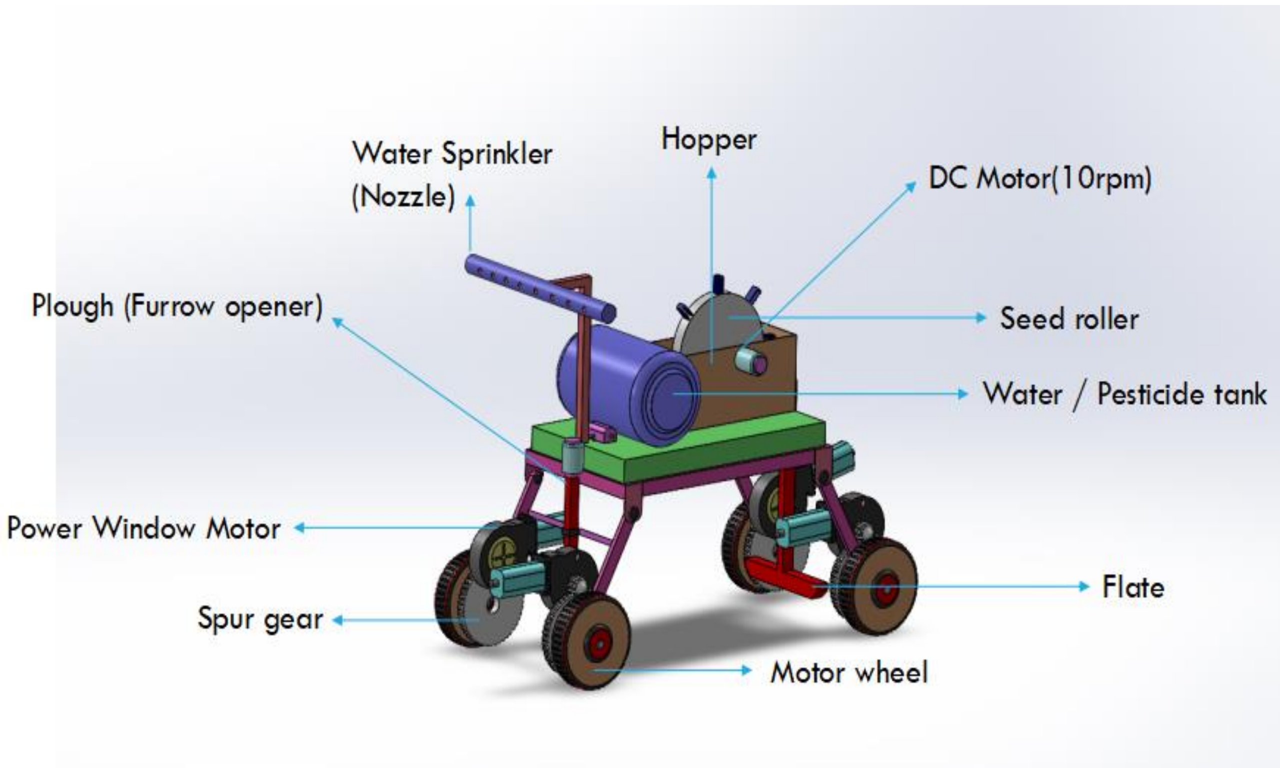


Figure 5.5 ISOMETRIC VIEW

# CHAPTER - 6

# SYSTEM ARCHITECTURE

## 6.1 PRINCIPLE OF OPERATION

This project is designed with Driver circuit with relay, IOT APP (remote), Dc motor and Agriculture model. Blynk app was used to link the seed dispensing rover to the mobile device. The spraying nozzle is coupled with the motor to spray for moving the nozzle. Then the water is pumped from the water tank to the sprayer nozzle. Node MCU connects with the Blynk app. A signal is sent to the Node MCU when a user presses a switch which is connected to a hotspot through the internet .Either the battery power or direct power supply is used to control the motor. Here the every wheel is having separate motors. In which two fronts and two rear wheel is placed in main rigid body frame separately. Each wheel operated with separated motor for all. The IOT app(mobile) keypad is used to control the direction of the motor which is coupled with the wheel. Relay is directly connected with the DC motor. When the start key is pressed the motor is operated in forward direction and the when the stop key is pressed the motor is stops automatically. The forward and reverse button in the remote is used to operate the motor is required directions. . When the seed spray key is pressed the motor is operated in forward direction and the when the stop key is pressed the motor is stops automatically. IOT app Using To Control All Operation Using Wireless Communication.

## 6.2 MERITS AND DEMERITS

MERITS

- Easy in construction
- More economical
- Easy to clean and maintain
- It is a renewable energy powered
- It does not create air pollutant & noise
- Easy to handle
- Do not require fuel hence cost reduce & Light in weight

DEMERITS

- High Maintenance
- High Cost
- Internet Connection needed

# CHAPTER - 7

# COST ESTIMATION

**7.1 Table: Cost Estimation**

| S.NO | COMPONENT NAME | QTY | AMOUNT |
|---|---|---|---|
| 1 | 12 V DC MOTOR | 05 | 3750 |
| 2 | 12 V BATTERY | 01 | 1200 |
| 3 | MOTOR WHEEL | 04 | 500 |
| 4 | NODU MCU WITH CONNECTOR | 01 | 550 |
| 5 | RELAY BOARD | 08 | 800 |
| 6 | MAIN PCB BOARD | 01 | 1800 |
| 7 | POWER SUPPLY | 01 | 350 |
| 8 | 12 V DC MOTOR (10 RPM) | 01 | 250 |
| 9 | TEMPERTURE AND MOITURE SENSOR | 01 | 200 |
| 10 | 12V DC WATER PUMP | 01 | 720 |
| 11 | WATER TANK | 01 | 450 |
| 12 | WATER TANK FITTINGS AND TUBE | - | 400 |
| 13 | BRASE FITTING WITH NOZZLE | 01 | 150 |
| 14 | MATERIAL COST (MS SHEET, MS PIPE) | - | 2500 |
| 15 | SPUR GEAR | 05 | 800 |

| | | | |
|---|---|---|---|
| 16 | BALL BEARING | 12 | 900 |
| 17 | BALL BEARING CUP | 05 | 300 |
| 18 | 15 MM SHAFT | - | 350 |

**TOTAL COST for Manufacturing:**

Lathe, drilling, welding, grinding, power hacksaw, gas cutting cost = **Rs. 3000**

Manufacturing Cost = Material Cost + Labour Cost

= 15970 + 3000

= 18970

Total cost for this project = **Rs 18970**

# CHAPTER - 8

## CONCLUSION AND FUTURE WORK

The project carried out by us made an impressing task in the field of agricultural sector. The multi utility agricultural machine is very usefully for the workers to carry out a number of operations in a single machine. Practically our multi utility agricultural machine can be used for seed sowing, ploughing. All the parts are arranged in such a way that in every stage of agriculture, the equipment can be rearranged to perform the specified action. Our team has successfully combined many ideas from various fields of mechanical engineering and agricultural knowledge to improve the yield and by reducing the labour effort and expenses. The whole idea about multipurpose equipment is a new concept, patentable and can be successfully implemented in real life situations. More operations can be included to the vehicle like soil leveler, grass cutter and many other machines for various operations. Also engine can be used to drive the equipment which will reduce the work load. The tyre can be changed according to the type of the land. The plough tool tip arrangement is made separately, so in case of breakage the tip of the tool is alone changed. A steering mechanism can also be done for the ease
Of control.

**FUTURE SCOPE:**

It is used to focus on the automation in the agricultural field using the IoT in robotic systems by seeding and spraying and inducing many other operations by,

- Integration with Drones and other farm equipment
- Precision agriculture with data analytics
- Enhanced navigation and GPS accuracy

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# ANNEXURE

# PHOTOGRAPHY

Figure (i) Side View Of Agribot

Figure (ii) Front View of AgriBot

Figure (iii) Isometric View

## PROGRAM FOR NodeMCU (ESP8266)

```
#define BLYNK_PRINT Serial
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
#define BLYNK_TEMPLATE_ID "TMPLvaHqlC9N"
#define BLYNK_TEMPLATE_NAME "FIVE RELAY"
#define BLYNK_AUTH_TOKEN "IcqQGM0TmEIfS54qlRnoG5uGPVkn86SL"

// Your WiFi credentials.
// Set password to "" for open networks.
char ssid[] = "IOT";
char pass[] = "123456789";
char auth[] = BLYNK_AUTH_TOKEN;

#define m1 D0
#define m2 D5
#define m3 D6
#define m4 D7
#define m5 D8

void forward()
{
 digitalWrite(m1,HIGH);
  digitalWrite(m2,LOW);
  digitalWrite(m3,HIGH);
  digitalWrite(m4,LOW);
}
void reverse()
{
    digitalWrite(m1,LOW);
  digitalWrite(m2,HIGH);
  digitalWrite(m3,LOW);
  digitalWrite(m4,HIGH);
}
void left()
{
  digitalWrite(m1,HIGH);
  digitalWrite(m2,LOW);
```

```
  digitalWrite(m3,LOW);
  digitalWrite(m4,HIGH);
}
void right()
{
    digitalWrite(m1,LOW);
  digitalWrite(m2,HIGH);
  digitalWrite(m3,HIGH);
  digitalWrite(m4,LOW);
}
void stop()
{
digitalWrite(m1,LOW);
digitalWrite(m2,LOW);
digitalWrite(m3,LOW);
digitalWrite(m4,LOW);
}
void setup() {
  // put your setup code here, to run once:

Serial.begin(9600);
pinMode(m1,OUTPUT);
pinMode(m2,OUTPUT);
pinMode(m3,OUTPUT);
pinMode(m4,OUTPUT);
pinMode(m5,OUTPUT);

digitalWrite(m1,LOW);
digitalWrite(m2,LOW);
digitalWrite(m3,LOW);
digitalWrite(m4,LOW);
digitalWrite(m5,LOW);
Blynk.begin(auth, ssid, pass, "blynk.cloud", 80);
}

BLYNK_WRITE(V0)
{
  int button = param.asInt(); // read button
  if (button == 1)
  {
```

```
  forward();

  }
}
  BLYNK_WRITE(V1)
{
  int button = param.asInt(); // read button
  if (button == 1)
  {
    reverse();

  }
}
  BLYNK_WRITE(V2)
{
  int button = param.asInt(); // read button
  if (button == 1)
  {
left();

  }
  }
  BLYNK_WRITE(V3)
{
  int button = param.asInt(); // read button
  if (button == 1)
  {
    right();

  }
}
  BLYNK_WRITE(V4)
{
  int button = param.asInt(); // read button
  if (button == 1)
  {
    digitalWrite(m5,HIGH);
  }
  else
  {
```

```
    digitalWrite(m5,LOW);
  }
}
  BLYNK_WRITE(V5)
{
  int button = param.asInt(); // read button
  if (button == 1)
  {
      stop();
     }
}

void loop() {


      Blynk.run();
      delay(200);
}
```