A Major Project Report

on

Agrobot

submitted in fulfillment of the requirements for the award of the degree of

Bachelor of Technology

in

(Electronics and Communication Engineering)

Submitted by:

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Candidate's Declaration

I hereby declare that the work presented in the major report entitled "Agrobot" in partial fulfillment of the requirements for the award of the Degree of **Bachelor of Technology** and submitted in the Department of Electronics and Communication Engineering of THDC Institute of Hydropower Engineering Technology, Uttarakhand is an authentic record of my own work carried out under the supervision of Mrs Anoopshri Johari , Assistant Professor Department of Electronics and Communication Engineering of THDC Institute of Hydropower Engineering Technology, Uttarakhand.

The matter presented in this report has not been submitted by me for the award of any other degree of this or any other Institute/University.

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This is to certify that the above statement made by the Student/Students is true to the best of my knowledge and belief.

Place : Tehri
Date: 9 May 2024

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Mrs. Anoopshi Johari
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(Head of the Department)

Place : Tehri
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Acknowledgement

We would like to express my heartfelt gratitude and appreciation to all those who have contributed to the successful completion of this project.

First and foremost, We extend my sincere thanks to my supervisor, **Mrs. Anoopshi Johari,** for their invaluable guidance, unwavering support, and insightful feedback throughout the entire duration of this project. Their expertise, patience, and encouragement have been instrumental in shaping the direction of my research and ensuring its completion.

We are deeply indebted to **Mr. Mahesh Kumar Aghwariya,** Head of the Department for providing the necessary equipment, resources, and an enriching academic environment for the completion of the project. We would also like to extend my special thanks to all the faculty and staff members of the Department of Electronics and Communication Engineering for their kind cooperation and encouragement during the course of work.

We would like to express my deepest appreciation to my family for their unwavering love, encouragement, and understanding. Their constant belief in my abilities and the sacrifices made for my education have been the cornerstone of my achievements. We are grateful to my classmates and friends who have provided encouragement, motivation, and moral support throughout this journey. Their camaraderie and the exchange of ideas have been a constant source of inspiration.

Finally, We are indebted and grateful to the Almighty for the invaluable help and divine guidance that has played an instrumental role in the successful completion of this remarkable endeavor.

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List of Figures

Figure | Page No.

List of Table

INDEX

ABSTRACT

Our project, the "Solar Powered Autonomous Multipurpose Agriculture Robot," represents a significant step forward in modern farming. We're using clean, renewable energy from solar panels to keep the robot running, reducing our reliance on traditional power sources and minimizing harm to the environment. To make the robot move precisely and efficiently, we're using high-performance DC motors. These motors allow it to navigate different types of terrain smoothly. For planting seeds accurately, we've incorporated servo motors. We're also using a dedicated DC motor pump for precise pesticide application to protect crops. And for cutting grass effectively, we rely on a high-torque GC motor, making the robot versatile in various agricultural tasks. All of these components are controlled by an Arduino microcontroller, which acts as the robot's central brain. It manages interactions between the different parts, ensuring that tasks are carried out in real-time. To make the robot user friendly, we've developed an intuitive Android app. This app lets operators control and monitor the robot remotely. The connection between the app and the robot is established through Bluetooth, ensuring a reliable link between the mobile application and the agricultural machine. By combining clean energy, advanced motor technology, and a sophisticated microcontroller, our Solar Powered Autonomous Multipurpose Agriculture Robot is set to improve farming efficiency while minimizing harm to the environment. This abstract provides a glimpse of the critical components and functions we'll delve into in the following sections of our project report.

CHAPTER – 1 INTRODUCTION

In the world, the primary occupation 42% of total population is Agriculture. It plays a significant role in the life of the people. For the betterment of the life and growth of world economy, mechanization of agriculture process especially agricultural autonomous vehicle is important in order to improve the overall productivity. In recent years, the development of autonomous vehicles in agriculture has experienced increased interest. This development has led many researchers to start developing more rational and adaptable vehicles. In the field of agricultural autonomous vehicles, a concept is being developed to investigate if multiple small autonomous machines would be more efficient than traditional large tractors and human force.

These vehicles should be capable of working throughout out the day and year around, in most all weather conditions and have the intelligence embedded within them to behave sensibly in a semi- natural structured or unstructured environment over long periods of time. Applying robotics in plant production requires the integration of robot capabilities, plant culture, and the work environment. Commercial plant production requires certain cultural practices to be performed on the plants under certain environmental conditions.

Agriculture's history dates back thousands of years, and its development was driven and defined by very different climates, cultures and technologies.So the agriculture system should be advanced to reduce the efforts of the farmers. The model developed automatically sows the seeds, spray the pesticides and also cut the grass. The prototype represents the advanced system for improving the agricultural processes such as seed sowing, grass cutting and pesticide spraying based on robotic assistance. The organization of the paper is as follows. Section II presents previously published related works. The proposed design of multipurpose agricultural robot is presented.

Agriculture is considered to be the basis of life for the human species as it is the main source of food grains and other raw materials. It plays a vital role in the growth of country's economy. It also provides large ample employment opportunities to the people. Growth in agricultural sector is necessary for the development of economic condition of the country. Unfortunately, the traditional methods of farming are still used by many farmers which results in low yielding of crops. But wherever automation had been implemented and human beings had been replaced by automatic machineries, the yield has been implemented and human beings had been replaced by automatic machineries, the yield has been improved.

Hence there is need to implement modern science and technology in the agriculture sector for increasing the yield. This paper therefore proposes a system which is useful in ploughing field as well as controlling the field operations which provides the flexibility. The paper aims at making agriculture smart using automation and Bluetooth technologies. The proposed system concentrates on performing functions like ploughing, sowing seeds, irrigation, closing the mud, fertilizing.

The motivation behind the development of the solar-powered autonomous multipurpose agriculture robot project is rooted in the critical challenges and opportunities within the agriculture sector. Agricultural labor shortages have become a common issue in various regions, making it increasingly challenging to perform essential farming tasks. This automation project seeks to address this labor shortage by introducing a robot capable of carrying out various farming activities autonomously.

Furthermore, as the global population continues to grow, there is an ever-increasing demand for higher food production. This project is motivated by the need to enhance agricultural efficiency and yield to meet this growing demand effectively. The project aligns with the global push for environmental sustainability. By utilizing solar power as its energy source, it reduces the carbon footprint associated with conventional farming practices. This commitment to sustainability is a driving force behind the project.

The concept of precision agriculture, which focuses on optimizing resource use and precise application of inputs, is essential in modern farming. The project's motivation is deeply rooted in its ability to conduct seeding and pesticide spraying tasks with precision, contributing to the adoption of precision farming practices. Cost savings are a substantial motivation for this project. Traditional farming can be capital-intensive, with labor costs being a significant portion of expenses.

The automation of various farming operations can lead to significant cost savings, thereby making agriculture more economically viable and sustainable for farmers. This project also aims to make agriculture more accessible to a wider demographic, including individuals with physical limitations. By relieving farmers from physically demanding tasks, it opens the door for a more diverse range of individuals to participate in farming activities. The motivation for this project is also fueled by the rapid advancements in robotics, automation, and renewable energy technologies.

It aims to leverage these technological advancements to modernize and revolutionize farming practices for increased efficiency and productivity. Incorporating remote monitoring and control through an Android application is another key motivation. This feature provides farmers with the convenience and flexibility to manage their agricultural operations from anywhere, contributing to improved farm management and decision-making.

1.1 AIM

The motivation behind the development of the solar-powered autonomous multipurpose agriculture robot project is rooted in the critical challenges and opportunities within the agriculture sector. Agricultural labor shortages have become a common issue in various regions, making it increasingly challenging to perform essential farming tasks. This automation project seeks to address this labor shortage by introducing a robot capable of carrying out various farming activities autonomously. Furthermore, as the global population continues to grow, there is an ever-increasing demand for higher food production. This project is motivated by the need to enhance agricultural efficiency and yield to meet this growing demand effectively.

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1.2 PROBLEM

Problem Definition and Objectives The agriculture sector faces challenges related to labor shortages, increasing food demand, environmental sustainability, and cost-efficiency. To address these issues, there is a need for an autonomous agricultural robot powered by solar energy, capable of performing various tasks, and remotely controllable via an Android app.

This project aims to provide a solution that improves farming efficiency, reduces labor dependence, and promotes ecofriendly practices.

- Automate essential farming tasks such as seeding, pesticide spraying, and grass cutting.
- Increase agricultural efficiency and productivity.
- Reduce the reliance on fossil fuels by utilizing solar power.
- Lower operational costs for farmers through automation.
- Make farming more accessible to a wider demographic.
- Promote precision agriculture practices.
- Enhance environmental sustainability.

- Provide remote monitoring and control for convenience and real-time management.
- Leverage advanced technologies to modernize and optimize farming operations

1.3 LITERATURE SURVEY

IOT based smart multipurpose agricultural robot. Was proposed by prof. Dr. S. B. Dhoble, Mrunmayee Gahukar , Ankita Rahat, Dipali Bansod this robotic system is named as agricultural robot, nothing but the machine which assembles with electronic equipment or components & performs specific operation as directed by instructor. This technology provides optimum and efficient solution for wide range of production in agriculture field. The robot is capable of performing operation like automatic ploughing, seed sowing and chemical spraying. IOT based mechanized robot: an integrated process involving fulltime multipurpose control, automation and surveillance system proposed by Abdullah all Mamun Anik, Istiak Habib , Shuvodip Adhikary, dr. Abdul Gafur — the internet of things (IOT) is the next generation of wireless technology that automates routine tasks and reduces labor. Software, sensors, and actuators are combined into a network of linked devices in the internet of things. The gadgets may exchange data and communicate over a network.

Our laboratories have used this technology to make appliances more convenient and automated. One of the key reasons for this increase is its capacity to both secure and facilitate research. The IOT innovation can provide fantastic content for modern automation. This study proposes an internet-based smart laboratory and laboratory machine automation, cloud storage data gathering, and monitoring system to efficiently operate types of machinery, online live data streaming, and monitor mechanical work devices.

The IOT microcontroller devices are connected to the robot to gather different sensors data, control and monitor the types of machinery and lab appliances in a smart lab environment. Any android phone, laptop, or computer may operate the robot wirelessly. All sensors data and parameters can be collected from Google's cloud storage platform Blynk and used to operate all appliances and devices. It will supply us with live streaming video of the laboratories with a specific IP address, and we can monitor the laboratory using this robot. A multipurpose agricultural robot for automatic ploughing , seeding and plant health monitoring Chandana r, Nisha m, Pavithra b this approach is on the designing of agricultural robot for various tasks. Certainly robots are playing an important role in the field of agriculture for farming process autonomously.

In agriculture, the opportunity for robot is enhancing the productivity and the robots are appearing in the field in large number. The proposed system focuses on implementing all the farming process especially in the field of ploughing and seeding by using micro controller,hc-05 and hc06 Bluetooth models, various sensors etc .The robot detects the planning area by using sensors and seeds need to be planted in the corresponding field using gripper arrangement of the robot. In a continuation, the rest of remaining process could be done automatically. In recent years the development of the autonomous vehicles in the agriculture has experienced more interest.

This robot will help the farmers in doing the farming process more accurate. Multi-functional robot using Arduino for farming purpose Siddhartha Verma, Tushar Srivastava, Vikalp Mishra, er. Ankita Khare in our country agriculture plays an important role for development in food production. In order to this smart farming improves the quality and quantity of agricultural products and the smart agricultural technique is required to save manpower and increase the efficiency with the help of multi-tasking Robot . Smart agriculture is very efficient because the IOT sensors are capable of providing information about agriculture field and then act upon that. Smart farming is a concept that increases the efficiency at low cost without compromising the quality of the crop. The main objective of this paper is to design and development of a multitasking robot which is capable of doing some agricultural activities like ploughing of field, sowing of seeds, watering the crop by measuring the soil moisturizing sensors and tracking the sun for solar energy for the night vision purpose.

This Agri-bot gets energy from the solar plate mounted on the bot and this will also help in conservation of renewable energy resource on a large scale and is operated by Arduino ide .in this revive paper, we discuss the potential of embedded system and IOT, the robotics and automation can play a significant role in agricultural production need and this mechanical vehicle will reduce the work cost, speed up and increase the exactness of the work. An IOT based multifunction Agrobot a. R. Uday , d. Nisarga , Syeda Arshiya, a. Deepak, j. Sudha Agriculture is the science and art of cultivating plants and livestock.

More than 40 percent of the population in the world choose agriculture as the primary occupation. In recent years, increased interest has grown for development of the autonomous vehicles like robots in agriculture. The proposed system aims at designing multipurpose autonomous agriculture robotic vehicle which performs the tasks such as ploughing, seed sowing, watering the crops.

This robotic vehicle is an agricultural machine of a considerable power and great soil clearing capacity. This multipurpose system gives an advance method to sow, plow, water the crops with minimum man power and labor making it an efficient vehicle. The machine will cultivate the farm by considering particular rows and specific column at fixed distance depending on crop. Moreover, the paper aims at making use of evolving technology i.e. IOT and Bluetooth which results in smart agriculture.

The whole process calculation, processing, monitoring is designed with motors & sensor interfaced with microcontroller. IOT and Solar energy based multipurpose agricultural robot for smart farming Ashok g , Kirangouda Biradar, Manoj g h, —in India, nearly 70% of people depend on agriculture. In the agricultural field, various operations such as seed sowing, grass cutting, pesticide spraying, ploughing are carried out. Automation of agricultural operations is a current demand to increase productivity through the use of tools and technology. At the moment seed sowing, pesticide spraying, and grass cutting are all difficult tasks.

The equipment needed for the aforementioned actions is both expensive and inconvenient to use. As a result, India’s agricultural system should be advanced through the development of a system that reduces reliance on human labour and time. The proposed agricultural robot is a user-friendly, internet of things (IOT)-based system that can be used in any type of soil. Users can use a web page to monitor the crop’s condition as well as perform some specific operations.

The objective of this project is to design, develop, and build a robot that can sow seeds, cut grass, spray pesticides, pluck fruit, and detect soil nutrition levels and irrigation. Solar energy is used to power the entire system. IOT based multipurpose surveillance robot Divakar , Ningaraju , Sudarshana Chakravarthy, Suraj Sharma s, - the main goal of IOT based multipurpose surveillance robot is to design and develop a surveillance robot that is capable of being used for rescue and spying in military operations.

It is known that humans cannot venture into hazardous/disaster-affected places as it can be life threatening and hence robots are required where human intervention is nearly impossible. Wireless surveillance robots can help to prevent the endangerment of humans or animals. The robot acts as a surveillance device to capture the intruder's surrounding information before the intruder attacks the soldiers.

The issues related to short-range communication to control the movement of the robot are overcome by using IOT technology and therefore real-time video can be transmitted to the intended recipient. An android phone can control the robot's movement from a distance. This project comprises the following phases: controlling the robot in manual mode using IOT technology via android application, phone acting as a camera for live video streaming, gas and metal detection sensors, and rechargeable batteries. The work aims to reduce loss of lives during military operations, ensure safety on the war field and help provide footage of disaster struck regions.

CHAPTER – 2 COMPONENTS REQUIRED & THEIR DESCRIPTION

COMPONENTS REQUIRED

[1] Jonson motor
[2] 775 Motor for cutter
[3] Dc water pump
[4] Arduino nano
[5] Hight amp motor driver
[6] Bluetooth module
[7] Dc motor speed controller
[8] Solar panel
[9] Solar charge controller
[10] Battery 12 V
[11] Wheel
[12] Relay
[13] Frame

[1] DC MOTOR

An electric motor is an electrical machine which converts electrical energy into mechanical energy. The basic working principle of a DC motor: "whenever a current carrying conductor is placed in a magnetic field, it experiences a mechanical force".

The direction of this force is given by Fleming's left-hand rule and its magnitude is given by F = BIL. Where, B = magnetic flux density, I = current and L = length of the conductor within the magnetic field.

Fleming's left hand rule: If we stretch the first finger, second finger and thumb of our left hand to be perpendicular to each other, and the direction of magnetic field is represented by the first finger, direction of the current is represented by the second finger, then the thumb represents direction of the force experienced by the current carrying conductor

[2] 775 MOTOR FOR CUTTER

The 775 motor is a high-performance DC electric motor that is commonly used in a wide range of applications, including robotics, remote control vehicles, and power tools. The 775 model of DC motor represents a certain ‘size’ of the motor body outer frame. This size is standard for all 775 motors.

The motor is able to deliver a high amount of power while still being relatively lightweight, which makes it well-suited for use in applications that required both higher power and portability.

Additionally, it is also known for its high efficiency, which means that it is able to convert a electrical energy into mechanical energy with lesser losses thus doing more work with less energy. The number 775 is the Size ID of motor accepted as a standard.

Fig 2.1 775 Motor used in Grass cutter

Its casing is made of rustproof material mainly steel with some protective coatings, with few plastic parts. It is a high torque high power device for mid to high-power applications generally in robotics, quad-copters, and industrial.

[3] DC WATER PUMP

The water pump integrated into the Solar Powered Automatic Grass Cutter & Pesticide Spreading Robot is a multifunctional component vital for its operation. Primarily, it facilitates irrigation, pesticide mixing, and cleaning tasks. Its compact and lightweight design ensures seamless integration into the robot's chassis, powered by the same electric motor driving other essential components. With adjustable flow control mechanisms, the pump regulates the flow rate of water or pesticide solution as needed for various tasks, enhancing versatility and efficiency. This pump draws water from the onboard reservoir for irrigation purposes, mixes it with pesticides for targeted application, and aids in cleaning the robot after operations.

Its inclusion minimizes the need for additional components, contributing to the robot's overall energy efficiency and sustainability. Future improvements could entail the integration of advanced sensors and algorithms to optimize water usage, refine flow control mechanisms for finer adjustments, and implement self-diagnostic features for proactive maintenance. Overall, the water pump is a crucial element in the robot's functionality, enabling it to perform lawn maintenance tasks effectively while promoting sustainable practices.

SPECIFIICATIONS

- Operating voltage 12v
- Current-0.1A-0.5A
- Lift-130cm
- Flow Rte-300L/H

Fig 2.2 Pesticide pump

[4] ARDUINO NANO

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328P. It offers the same connectivity and specs of the UNO board in a smaller form factor.

The Arduino Nano is an open-source breadboard-friendly microcontroller board based on the Microchip ATmega328P microcontroller (MCU) and developed by Arduino.cc and initially released in 2008. It offers the same connectivity and specs of the Arduino Uno board in a smaller form factor.

The Arduino Nano is equipped with 30 male I/O headers, in a DIP-30-like configuration, which can be programmed using the Arduino Software integrated development environment (IDE), which is common to all Arduino boards and running both online and offline. The board can be powered through a type-B mini-USB cable or from a 9 V battery.

The Arduino Nano has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL serial (5V) communication, which is available on digital pins 0 (RX) and 1 (TX).

An FTDI FT232RL on the board channels this serial communication over USB and the FTDI drivers (included with the Arduino firmware) provide a virtual com port to software on the computer. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board flash when data is being transmitted via the FTDI chip and the USB connection to the computer (but not for serial communication on pins 0 and 1). A Software Serial library allows for serial communication on any of the Nano's digital pins. The ATmega328 also supports I2C and SPI communication. The Arduino software includes the Wire library to simplify use of the I2C bus.

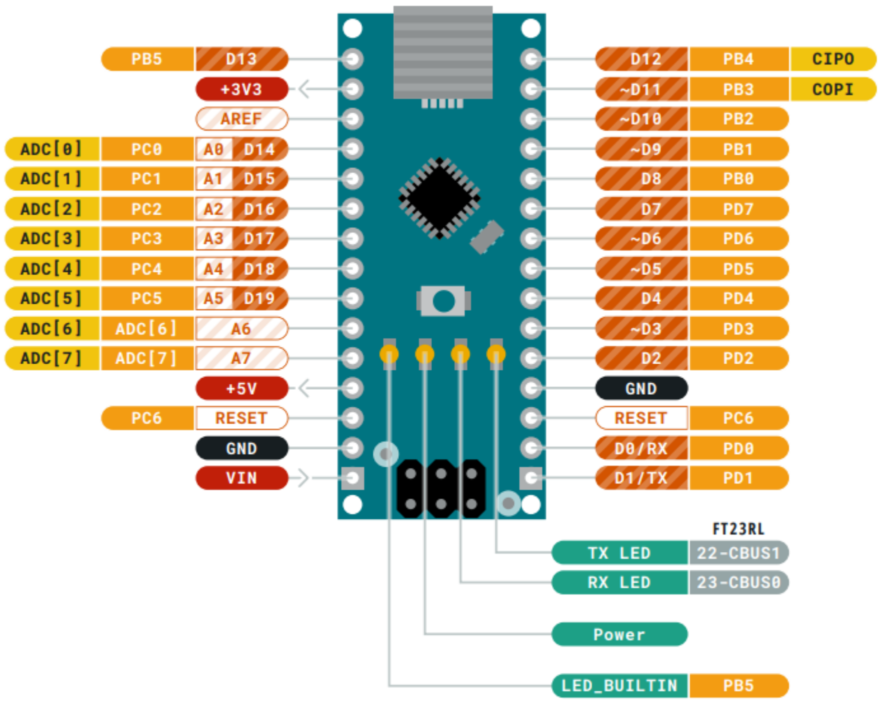

Fig 2.3 Arduino nano

Arduino Nano Technical Specifications

Micro controller	ATmega328P – 8-bit AVR family microcontroller
Operating Voltage	5 V
Recommended Input Voltage for Vin pin	7-12V
Analog Input Pins	6 (A0 – A5)
Digital I/O Pins	14 (Out of which 6 provide PWM output)
DC Current on I/O Pins	50 mA
Flash Memory	32 KB (2 KB is used for Bootloader)
SRAM	2 KB
EEPROM	1 KB

Communication	IIC, SPI, USART
Analog Input Pins	6 (A0 – A5)
Digital I/O Pins	14 (Out of which 6 provide PWM output)
DC Current on 3.3V Pin	50 mA
DC Current on I/O Pins	40 mA

[5] BTS 7960B MOTOR DRIVER

The modules look like this on top and have a thumping big heatsink on the back. More about that later. If you have a search about you will find there is a schematic for this on the net. This schematic appears in multiple places but appears to be the exact same schematic.

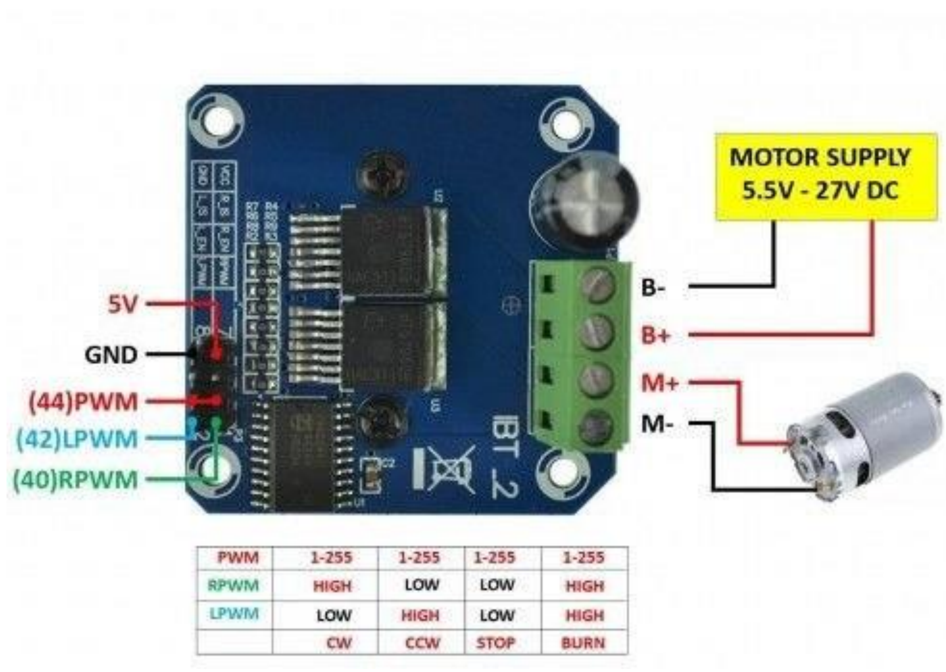

Fig 2.4 Motor Driver

The power IC is made by Infineon. The BTS7960B (TO263 package) was introduced Sep 2008 and end of life March 2009.

The board has a great big heatsink on the back and this is a problem. It is there for show more than anything. The BTS7960B is a TO263 package. The tab (metal back) of the package is soldered to the PCB and the die inside is in close thermal contact with the tab. Almost all of the heat comes out of the tab into the PCB. For the real low down see Infineon application note AN-2021-02.

[6] HC-05 BT

The HC-05 is a very cool module which can add two-way (full-duplex) wireless functionality to your projects. You can use this module to communicate between two microcontrollers like Arduino or communicate with any device with Bluetooth functionality like a Phone or Laptop. There are many android applications that are already available which makes this process a lot easier. The module communicates with the help of USART at 9600 baud rate hence it is easy to interface with any microcontroller that supports USART. We can also configure the default values of the module by using the command mode. So if you looking for a Wireless module that could transfer data from your computer or mobile phone to microcontroller or vice versa then this module might be the right choice for you.

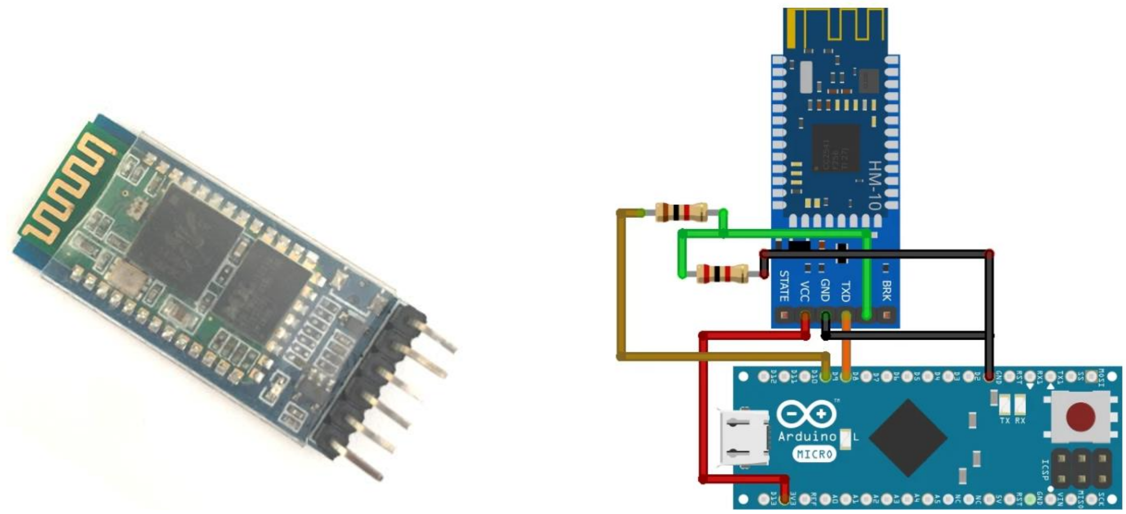

Fig 2.5 Bluetooth Device

HM-10 BT Module Features

HM-10 has the latest 4.0 Bluetooth technology.
There is no limit in sending bytes with HM-10.
Power consumption is much less even in an operating state with this module.
The HC10 module uses the 2.5GHz frequency band at the range of 100meter in an open area.
It is useable as a Master or Slave just by disconnecting the connections.
The module operates at 2-3.7V only which is common in every TTL/CMOS device.
A single module has its 256Kb flash memory and 8Kb SRAM.
There are onboard GPIO pins within the module which are usable through UART communications,

The GFSK (Gaussian Frequency Shift Keying) helps to transfer the data for the module.
The device offers data and command mode which helps to set the internal setting according to the project requirement.

[7] DC MOTOR SPEED CONTROLLER

This is DC Motor Speed Controller Module

- The motor speed controller can easily provide a continuous current of 3A to your DC motor or other DC load.
- This DC speed controller has a voltage range: DC6V-28V and current range within 3A Switch function: None Speed range: 0-100%.
- This DC motor speed controller connected to a DC power supply, do not directly connected to 220V AC
- The 1203B DC Motor Speed Regulator controls the speed of a DC motor by adjusting Pulse-Width-Modulated (PWM).
- The motor speed controller can easily provide a continuous current of 3A to your DC motor or other DC load.

[8] SOLAR PANEL

Solar panels convert solar energy into electricity. They use the concept of photoelectric effect, emission of electrons when light falls on solar panel. Solar panels are made up of silicon cells, silicon has an atomic number 14. When light falls on silicon cell, the outer most electrons of silicon i.e. two electrons are set into motion. This initiates the flow of electricity. Silicon has two different cell structures: monocrystalline and polycrystalline Monocrystalline solar panels are manufacturedfrom one large silicon block and are made in silicon wafer formats. Polycrystalline solar cells are also silicon cells, which are produced by melting multiple silicon crystals together. Mono-crystallinesilicon cells are more efficient but expensive when compared to polycrystalline cells.
A solar panel is a set of solar photovoltaic module which are electrically connected. A photovoltaic module is a packaged, connected assembly of solar cells. The solar panel can be used as componentof larger photovoltaic system to generate and supply electricity in commercial and residential applications. Each module is rated by its dc output power under standard test conditions and typically ranges from 10 to 320 watts. The efficiency of a module determines the area of module. Asingle solar module can produce only limited amount of power, most installation contains multiplemodules. A photovoltaic system typically includes panel or an array of solar modules, an inverter, and sometimes a battery or solar track and interconnection wiring.

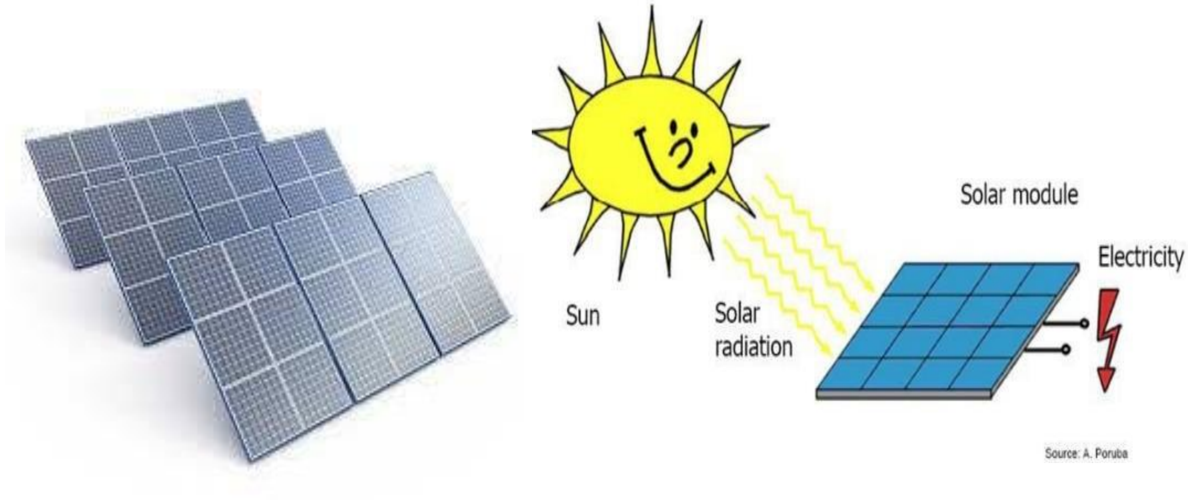

Fig 2.6 Solar Panel

[9] SOLAR CHARGE CONTROLLER

A **solar charge controller**, also known as a **solar regulator,** is basically a solar battery charger connected between the solar panels and battery. Its job is to regulate the battery charging process and ensure the battery is charged correctly, or more importantly, not over-charged. DC-coupled solar charge controllers have been around for decades and are used in almost all small-scale off-grid solar power systems.

Modern solar charge controllers have advanced features to ensure the battery system is charged precisely and efficiently, plus features like DC load output used for lighting. Generally, most smaller 12V-24V charge controllers up to 30A have DC load terminals and are used for caravans, RVs and small buildings.

On the other hand, most larger, more advanced 60A+ MPPT solar charge controllers do not have load output terminals. They are specifically designed for larger-scale off-grid power systems with solar arrays and powerful off-grid inverters.

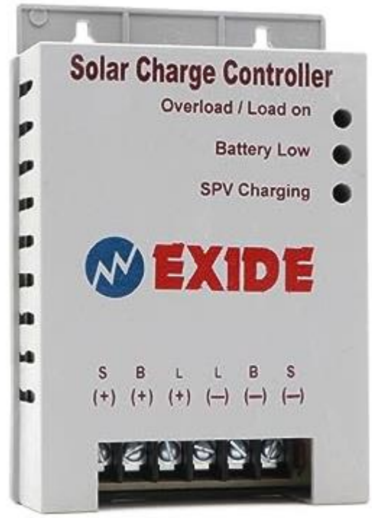

Fig 2.7 Solar Charger Controller

Solar charge controllers are rated according to the maximum input voltage (V) and maximum charge current (A). As explained below, these two ratings determine how **many solar panels can be connected** to the charge controller. Solar panels are generally connected in series, known as a string of panels—the more panels connected in series, the higher the string voltage.

- **Current Amp (A) rating** = Maximum charging current.
- **Voltage (V) rating** = Maximum voltage (Voc) of the solar panel or string of panels.

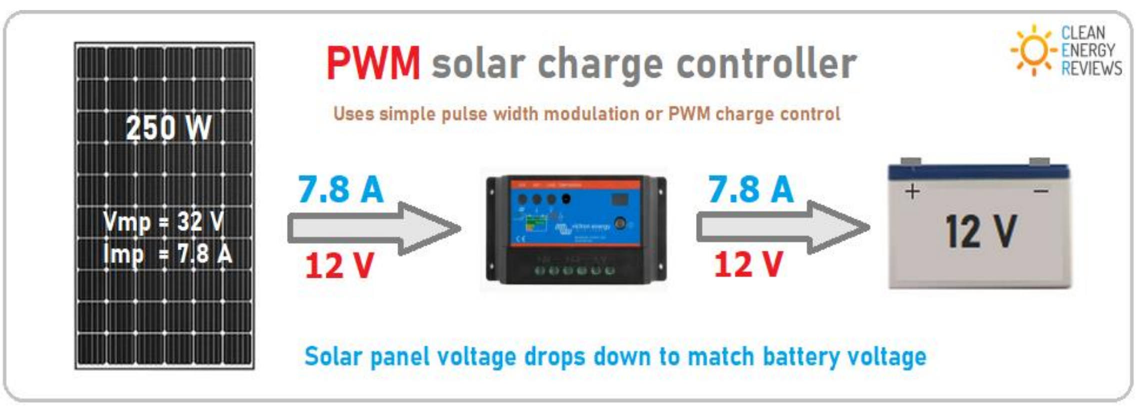

Fig 2.8 Solar Charger Controller

[10] BATTERY

Lead-acid 12V Battery. This battery is composed of 6 x 2V lead-acid cells. Lead-acid batteries are secondary (rechargeable) batteries that consist of a housing, two lead plates or groups of plates, one of them serving as a positive electrode and the other as a negative electrode, and a filling of 37% sulfuric acid (H_2SO_4) as electrolyte. The battery contains liquid electrolyte in an unsealed container, requiring it to be kept upright and the area well ventilated to ensure safe dispersal of the hydrogen gas it produces during overcharging. Lead acid batteries typically have coulombic efficiencies of 85% and energy efficiencies in the order of 70%.

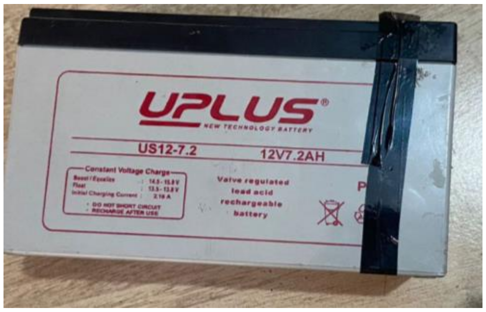

Fig 2.9 Battery

[11] WHEELS

We have taken 6 wheels for our Agrobot and its specification are:

- These wheels can be used with the motors having a 6mm shaft.
- The diameter of the wheels is 10 cm
- The width of the wheels is 2 cm
- Screws are provided to tight wheels with the motor shaft
- These wheels have a nice grip on the surface

Features:

- Durable
- Smooth surface
- Light weight

Fig 2.10 Wheels of Agrobot

[12] FRAME

We have Taken Wooden Frame and some specification are :

- The Length of the frame is 50 cm
- The Width of the frame is 30 cm
- The Height of the frame is 45 cm

Frame for our Project is design to give strength and efficient manage components.
It also provide robust performance.

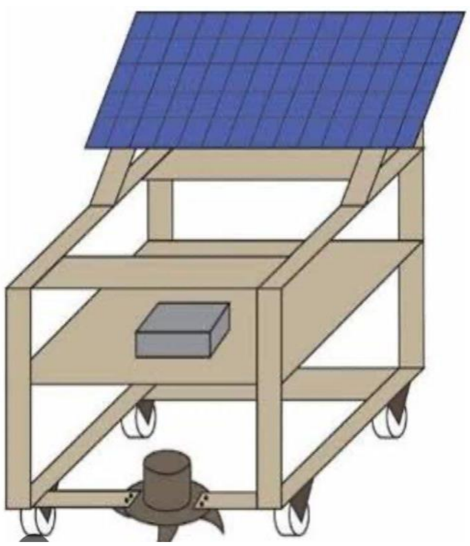

Fig 2.11 Frame of Agrobot

[13] RELAY

As seen in Fig., a relay is a switch that is electrically actuated. It utilizes an electromagnet to function mechanically as a switch, but it also makes use of other working concepts, such as solid-state relays. A circuit can be controlled by a relay using either a separate low-power signal or a single signal that controls several circuits. In early computers and telephone exchanges, relays were widely utilized to carry out logical operation.
The 1-Channel Relay Module is a versatile switching module designed to control high-voltage and high-current circuits with a low-voltage microcontroller or other control devices. This module is specifically designed for 12V DC operation and features a single channel, allowing you to control one circuit at a time.

Fig 2.10 Relay

One notable feature of this relay module is the ability to select the trigger level (HIGH or LOW) using a jumper. This flexibility makes it compatible with a wide range of microcontrollers and control devices, as you can configure it to trigger with either a HIGH or LOW input signal.
The relay module typically provides a load capacity of up to 10A at 250VAC or 30VDC, making it suitable for a variety of applications, such as controlling lights, fans, motors, and other electrical appliances.
Additionally, it includes a terminal block for easy connection to external circuits, an LED indicator to display the relay's activation status, and a freewheeling diode to protect against back electromotive force when switching inductive loads.

CHAPTER -3 METHODOLOGY

3.1 BLOCK DIAGRAM

The methodology for this project is similar to the prototype analysis process. In this project we are fabricating a prototype of the solar powered grass cutter, Pesticides Sprayer & Lighting unit. Agricultural robotic system for agriculture which can be modeled by various purposes using algorithm for comfort to farmers and can be interfaced by using Arduino board and various types of sensors. Various aspects shows Agricultural robot serves better result than manual system. It is expected that recent trends in robots shall make it to be used in enhanced role in future. In agriculture, Agricultural robot can be experienced or several advancements. Implementation of Agricultural robot has significant saving in terms of time, efficiency and saving the wastage of resources and reduced utilization of man power should pay the cost once the system is activated. The scope of the system, especially in metro cities, is located in places where people are unaware of farming. Agriculture is more valuable compared to others fields for occupation. The utility of technology with agriculture consider for automation. The Farming System is a suitable system which aids to sure that it has wide scope for improvement, which in turn eases the agricultural system for the farmers and ultimately helps in effective crop productivity.

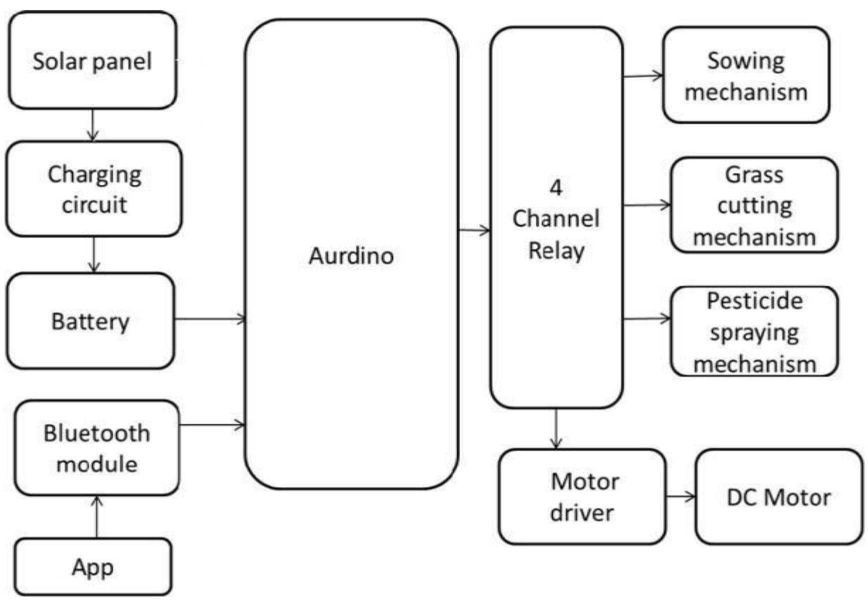

Fig 3.1 Block Diagram

3.2 WORKING

The proposed solar-powered agricultural robot operates seamlessly through the integration and collaboration of its key components. The system begins with the solar panel, positioned at the core, capturing sunlight and converting it into electrical energy. This harvested energy is then directed to the battery, serving as the robot's energy reservoir during periods of sunlight. The rechargeable and long-life battery ensures the robot's sustained operation even in the absence of direct sunlight. At the heart of the robot's intelligence is the Arduino microcontroller, functioning as its central brain. The microcontroller receives commands from the user through the Android app, establishing a communication link via the Bluetooth module.

These commands are translated into precise actions, managing the timing, logic, and sequencing of the robot's tasks. The motor driver, a critical component, governs the DC motors responsible for the robot's movement and the operation of various agricultural implements.

It regulates motor speed, direction, and safeguards against potential damage, providing the necessary precision for tasks like seeding, pesticide spraying, and grass cutting. The choice of high-torque DC motors ensures the robot can efficiently handle the physical demands of diverse agricultural operations. The adaptability and versatility of the robot are realized through agricultural implements, which act as attachments or tools for specific tasks. These implements, such as seeders, pesticide sprayers, and grass cutters, enable the robot to address a wide range of agricultural needs. The ability to switch seamlessly between these implements enhances the robot's functionality and utility in different farming scenarios. The Bluetooth module serves as a vital communication gateway, connecting the robot with the user through the Android app. This allows users to remotely control the robot, directing its movement, switching between implements, and monitoring its status. Real-time information, including battery levels and GPS location, is accessible through the user-friendly app interface. In operation, the solar panel continuously captures sunlight, replenishing the battery's energy reserves. The Arduino microcontroller orchestrates the entire process, ensuring efficient use of energy and precise execution of tasks. The motor driver regulates the DC motors, propelling the robot and activating agricultural implements as needed. The Bluetooth module maintains a seamless link with the Android app, enabling real-time control and monitoring. These solar-powered agricultural robots offer substantial benefits to modern farming practices. Their reduced reliance on fossil fuels makes them environmentally friendly, while their capacity to operate for extended periods without human intervention enhances efficiency and reduces labor costs. The robots' adaptability to various tasks positions them as invaluable tools, representing a harmonious fusion of technology and agriculture for a more sustainable and efficient future in farming.

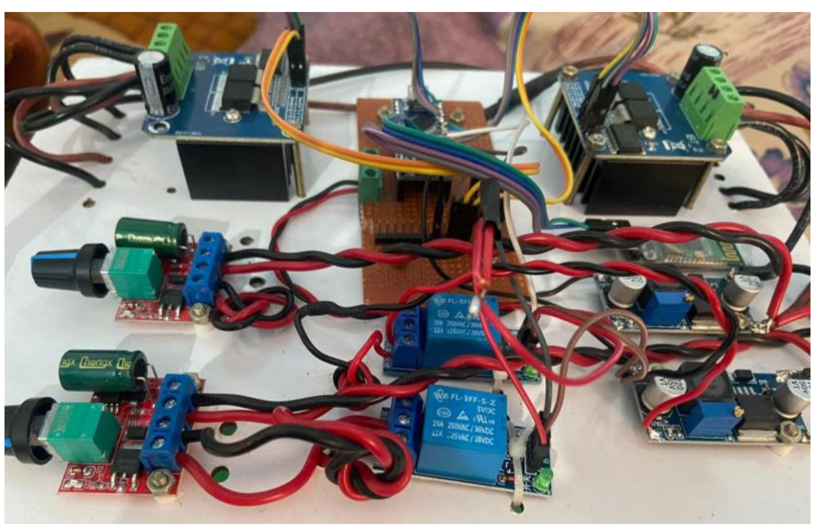

Fig 3.2 Working

3.3 CONTROL

Fig 3.3.1 First Turn On The Bluetooth of Phone as shown Above

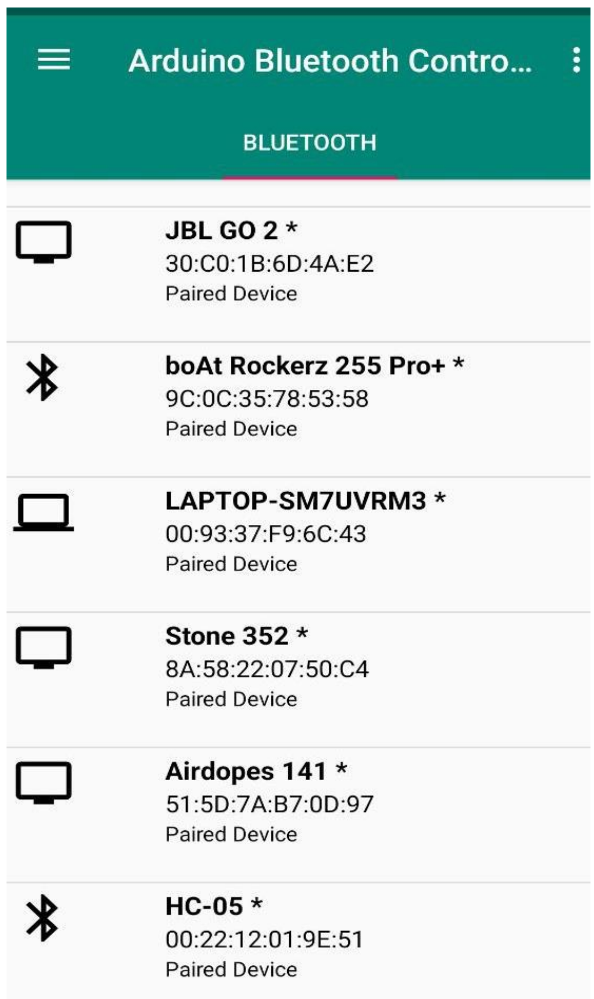

Fig 3.3.2 After Turn on the Bluetooth of Phone we pair to device HC-05 Device.

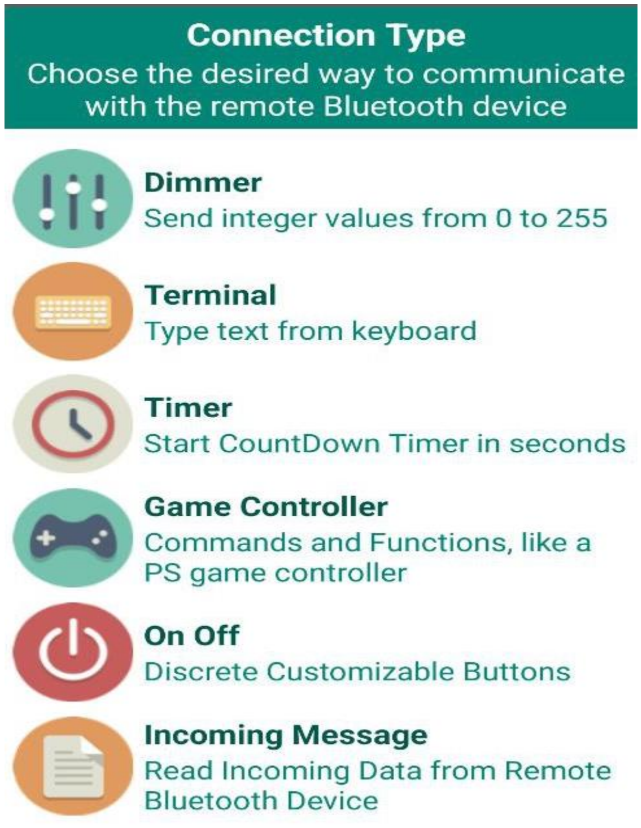

Fig 3.3.3 After Pairing Open Ardino Bluetooth Controller Select the Connection Type Game Controller.

Final Step :-

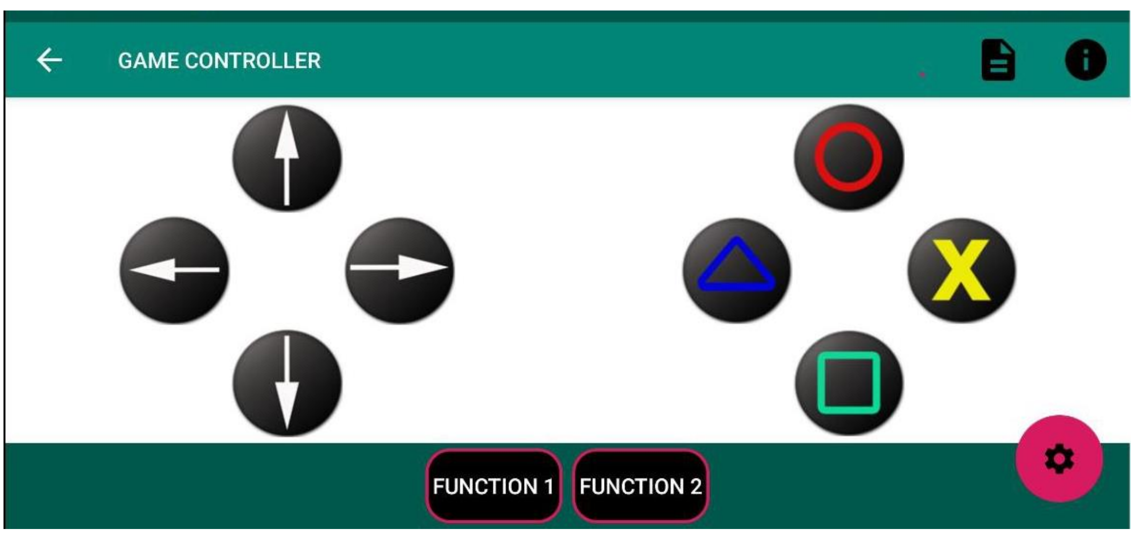

Fig 3.3.4 We can control the Agrobot Through this mobile phone . It is simple to control and justsame as we use game controller

3.4 CODING

sketch_jun4a | Arduino IDE 2.3.2

File Edit Sketch Tools Help

Select Board

sketch_jun4a.ino

```
#include <SoftwareSerial.h>
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27,16,2);

#include "DHT.h"
#define DHTPIN 8
#define DHTTYPE DHT11
DHT dht(DHTPIN, DHTTYPE);
float temp;

#define enA 9//Enable1 L298 Pin enA
#define in1 5 //Motor1  L298 Pin in1
#define in2 4 //Motor1  L298 Pin in2
#define in3 3 //Motor2  L298 Pin in3
#define in4 7 //Motor2  L298 Pin in4
#define ir_R A6
#define ir_F A0
#define ir_L A1
#define servo A2
#define pump A3
#define buzz 13

#define Threshold 55
#define MQ2pin A7
float sensorValue;  //variable to store sensor value
```

sketch_jun4a.ino

```
int Speed = 150; // Write The Duty Cycle 0 to 255 Enable for Motor Speed
int s1, s2, s3;
void setup()
{ // put your setup code here, to run once
Serial.begin(9600); // start serial communication at 9600bps
lcd.begin();
  lcd.backlight();
dht.begin();
lcd.print("   Welcome To ");
   lcd.setCursor(0,1);
  lcd.print("Automatic Fire");
  delay(4000);
  lcd.clear();
   lcd.setCursor(0,0);
  lcd.print("Detection and ");
```

sketch_jun4a | Arduino IDE 2.3.2

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sketch_jun4a.ino

```
  lcd.print(" Detection and ");
   lcd.setCursor(0,1);
lcd.print("Fighting Robot");
  delay(4000);
  lcd.clear();
  lcd.print("Temp:  Humidity:");
pinMode(ir_R, INPUT);// declare fire sensor pin as input
pinMode(ir_F, INPUT);// declare fire sensor pin as input
pinMode(ir_L, INPUT);// declare fire sensor pin as input
pinMode(enA, OUTPUT); // declare as output for L298 Pin enA
pinMode(in1, OUTPUT); // declare as output for L298 Pin in1
pinMode(in2, OUTPUT); // declare as output for L298 Pin in2
pinMode(in3, OUTPUT); // declare as output for L298 Pin in3
pinMode(in4, OUTPUT); // declare as output for L298 Pin in4
pinMode(enB, OUTPUT); // declare as output for L298 Pin enB
pinMode(servo, OUTPUT);
pinMode(pump, OUTPUT);
pinMode(buzz, OUTPUT);

 for (int angle = 90; angle <= 140; angle += 5)  {
   servoPulse(servo, angle);  }
 for (int angle = 140; angle >= 40; angle -= 5)  {
   servoPulse(servo, angle);  }
 for (int angle = 40; angle <= 95; angle += 5)  {
   servoPulse(servo, angle);  }
analogWrite(enA, Speed); // Write The Duty Cycle 0 to 255 Enable Pin A for Motor1 Speed
analogWrite(enB, Speed); // Write The Duty Cycle 0 to 255 Enable Pin B for Motor2 Speed
```

sketch_jun4a | Arduino IDE 2.3.2

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sketch_jun4a.ino

```
delay(500);
}
void loop()
{
lcd.setCursor(0, 1);
 float h = dht.readHumidity();
  //read temperature in Fahrenheit
  temp= dht.readTemperature();
float converted = 0.00;
Serial.print("Celsius = ");
    Serial.print(temp);
    //Print degree symbol
    Serial.write(176);
    Serial.println("temp");
```

sketch_jun4a | Arduino IDE 2.3.2

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Select Board

sketch_jun4a.ino

```
  
  if (isnan(h) || isnan(temp)) {
    lcd.print("ERROR");
    return;
  }

  lcd.print(temp);
  lcd.setCursor(7,1);
  lcd.print(h);

s1 = analogRead(ir_R);
s2 = analogRead(ir_F);
s3 = analogRead(ir_L);

Serial.print(s1);
Serial.print("\t");
Serial.print(s2);
Serial.print("\t");
Serial.println(s3);
delay(50);
if(s1<250){
Stop();
digitalWrite(pump, 1);
for(int angle = 90; angle >= 40; angle -= 3){
servoPulse(servo, angle);
}
```

sketch_jun4a.ino

```
for(int angle = 40; angle <= 90; angle += 3){
servoPulse(servo, angle);
}
}
else if(s2<350){
Stop();
digitalWrite(pump, 1);
for(int angle = 90; angle <= 140; angle += 3){
servoPulse(servo, angle);
}
for(int angle = 140; angle >= 40; angle -= 3){
servoPulse(servo, angle);
}
for(int angle = 40; angle <= 90; angle += 3){
servoPulse(servo, angle);
 }
```

sketch_jun4a | Arduino IDE 2.3.2

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Select Board

sketch_jun4a.ino

```
  }
}
else if(s3<250){
Stop();
digitalWrite(pump, 1);
for(int angle = 90; angle <= 140; angle += 3){
servoPulse(servo, angle);
}
for(int angle = 140; angle >= 90; angle -= 3){
servoPulse(servo, angle);
}
}
else if(s1>=251 && s1<=700){
digitalWrite(pump, 1);
delay(500);
backword();
delay(100);
turnRight();
delay(200);
}
else if(s2>=251 && s2<=800){
digitalWrite(pump, 1);
delay(500);
forword();
}
else if(s3>=251 && s3<=700){
```

sketch_jun4a.ino

```
digitalWrite(pump, 1);
delay(500);
backword();
delay(100);
turnLeft();
delay(200);
}else{
digitalWrite(pump, 0);
Stop();
}
delay(10);
sensorValue = analogRead(MQ2pin); // read analog input pin 0
```

sketch_jun4a | Arduino IDE 2.3.2

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Select Board

sketch_jun4a.ino

```
  Serial.print("Sensor Value: ");
  Serial.print(sensorValue);

  if(sensorValue > Threshold)
  {
    Serial.print(" | Smoke detected!");
    digitalWrite(buzz, HIGH);
    delay(2000);
  }

  Serial.println("");
  delay(2000); // wait 2s for next reading
digitalWrite(buzz, LOW);
}
void servoPulse (int pin, int angle){
int pwm = (angle*11) + 500;      // Convert angle to microseconds
 digitalWrite(pin, HIGH);
 delayMicroseconds(pwm);
 delay(50);                     // Refresh cycle of servo
}
void forword(){  //forword
digitalWrite(in1, HIGH); //Right Motor forword Pin
digitalWrite(in2, LOW);  //Right Motor backword Pin
digitalWrite(in3, LOW);  //Left Motor backword Pin
digitalWrite(in4, HIGH); //Left Motor forword Pin
}
void backword(){ //backword
digitalWrite(in1, LOW);  //Right Motor forword Pin
digitalWrite(in2, HIGH); //Right Motor backword Pin
digitalWrite(in3, HIGH); //Left Motor backword Pin
digitalWrite(in4, LOW);  //Left Motor forword Pin
}
void turnRight(){ //turnRight
digitalWrite(in1, LOW);  //Right Motor forword Pin
digitalWrite(in2, HIGH); //Right Motor backword Pin
digitalWrite(in3, LOW);  //Left Motor backword Pin
digitalWrite(in4, HIGH); //Left Motor forword Pin
}
void turnLeft(){ //turnLeft
digitalWrite(in1, HIGH); //Right Motor forword Pin
digitalWrite(in2, LOW);  //Right Motor backword Pin
digitalWrite(in3, HIGH); //Left Motor backword Pin
digitalWrite(in4, LOW);  //Left Motor forword Pin
}
void Stop(){ //stop
digitalWrite(in1, LOW); //Right Motor forword Pin
digitalWrite(in2, LOW); //Right Motor backword Pin
digitalWrite(in4, LOW); //Left Motor forword Pin
}
```

CHAPTER - 4 CONCLUSION & FUTURE SCOPE

4.1 CONCLUSION

Conclusion The "Solar Powered Autonomous Multipurpose Agriculture Robot" project introduces a sustainable, efficient, and accessible solution for modern farming. By harnessing solar energy and employing advanced robotics, it addresses labor shortages, enhances productivity, and reduces environmental impact. The integration of mobile control via an Android app makes farming operations more convenient and technology- driven. This project exemplifies the potential of innovation in agriculture, promising a brighter, more efficient future for farming.

4.2 FUTURE SCOPE

- **Enhanced Task Automation:** Expand the robot's capabilities to encompass a wider range of agricultural tasks, such as weed control, harvesting, and soil analysis, further reducing the need for manual labor.
- **Sensor Integration:** Integrate advanced sensors for real-time data collection, enabling the robot to make informed decisions and adapt to changing field conditions.
- **Machine Learning and AI:** Implement machine learning and artificial intelligence algorithms to enhance the robot's decision-making capabilities, improving task efficiency and resource management.
- **Multi-Robot Systems:** Develop the concept of swarm robotics, where multiple robots can work collaboratively in a coordinated manner, covering larger areas and tackling complex tasks.
- **Energy Efficiency:** Explore energy-efficient technologies and storage solutions to ensure uninterrupted robot operation, even during cloudy or nighttime conditions.
- **Remote Sensing and Imaging:** Incorporate cameras and sensors for crop health monitoring, disease detection, and yield prediction, providing valuable insights to farmers.
- **Localization and Mapping:** Develop robust navigation and mapping systems that allow the robot to navigate complex and dynamic agricultural environments.

CHAPTER - 5 RESULT & APPLICATION

5.1 RESULT AND DISCUSSION:

The planned robot will simultaneously carry out the tasks of seeding, applying pesticides, and cutting the grass. Heat from the solar panel turns sunlight into power. The charging circuit receives this electrical energy. In order to provide pulsed voltage and prevent reverse current, the charging circuit will operate in accordance with the maximum power point tracking (MPPT) protocol. To charge the battery, the pulsed voltage is applied. Voltage sensors are used to manage the battery's charge.

Due to its bidirectionality, the battery can charge and supply voltage to the Arduino simultaneously. High pass filtering is used to feed the voltage source with continuous oscillation into Arduino. All separate mechanisms receive voltage feed via the channel relay. The DC motors that power the robot are driven by the motor driver.

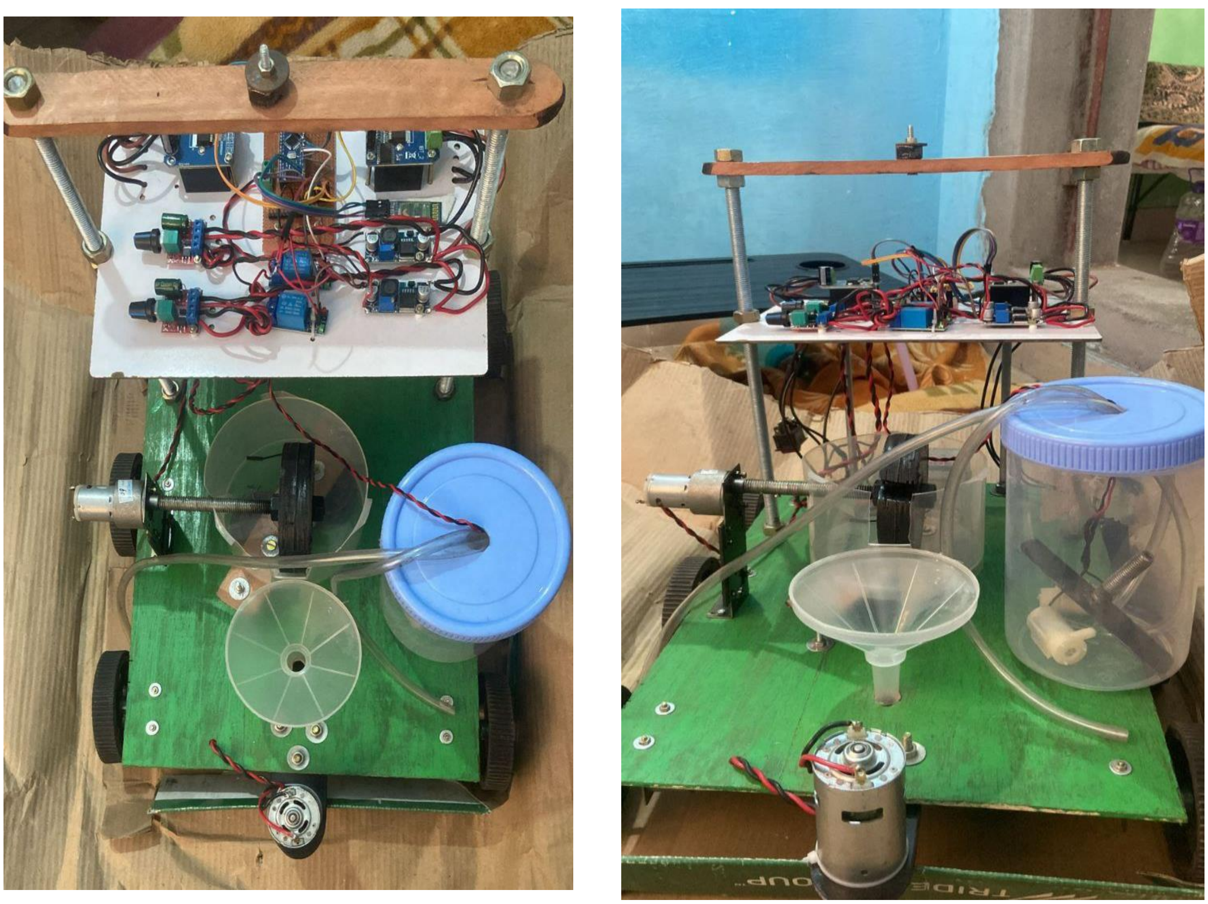

Fig 5.1 Final Model of Our Project

5.2 APPLICATIONS

- **Precision Farming:** The solar-powered autonomous agriculture robot is designed for precision farming, enabling accurate and efficient tasks such as precise seed planting, targeted pesticide application, and effective grass cutting. This application enhances crop yield and reduces resource wastage.
- **Environmentally Friendly Agriculture:** By harnessing clean solar energy, the robot promotes environmentally friendly agricultural practices. It minimizes reliance on traditional power sources, reducing carbon footprint and contributing to sustainable farming methods.
- **Labor Efficiency and Cost Reduction:** The robot's autonomous capabilities and versatility in handling various agricultural tasks contribute to labor efficiency and cost reduction. It operates for extended periods without constant human intervention, optimizing workforce utilization and reducing manual labor costs.
- **Adaptability to Diverse Crops:** With the ability to switch between different agricultural implements, the robot adapts to diverse crops and farming requirements. This application ensures flexibility in addressing the specific needs of various crops throughout the agricultural cycle.
- **Remote Monitoring and Control:** The integration of a user-friendly Android app allows for remote monitoring and control of the robot. Farmers can efficiently manage and supervise agricultural operations, receiving real-time information on the robot's status, battery levels, and GPS location.
- **Energy Sustainability in Agriculture:** The solar-powered design of the robot contributes to energy sustainability in agriculture. It reduces dependence on non-renewable energy sources, offering a more sustainable and eco-friendly solution for modern farming practices.

Fig 5.2 Project Model

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