

# Multipurpose Agriculture Pesticide Sprayer Robot (SprayRo)

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**Abstract** – Agriculture is world's largest sector where millions and trillions of people do farming for their Daily Live hood. world's largest population use to do farming for earning money. To fulfill the daily needs of people, farmers have to increase the crop productivity, amount of production and many more improvements. For that numbers of researchers and innovators are doing too many innovations in agricultural automation system. Day by day they all are improving the existing systems to increase the productivity. They all are making smart changes in agricultural equipment's. As compare to other countries India is facing different kind of problem's, 58% of Indian population use to do farming as a primary source of live hood and it plays vital role in Indian economy. Where 20% of Indian farmers live below poverty line and they can't afford smart systems in their farms. Because of this we have created low-cost solution for farmer. We have created a smart customized agriculture pesticide sprayer robot with multifunctionality approach using advance ARM Dule core processor. We can operate this robot by using customized regional language application to help illiterate farmers and farm workers. Our system support multifunctionality like, pesticide sprayer, weed cutter, seed sowing, drip irrigation and night vision lamps.

**Key Words:** Smart Farming, Agriculture Technology, Embedded System, ARM processor, Robotics, Agricultural automation, Arm Cortex

## 1. INTRODUCTION

The aim of our article/paper is to serve focus of people on our research work. But before writing about our work and research first we have to know about ground reality of India and oversize agricultural sector. As we know the growing global demand for food will be a major challenge for agriculture, together with the necessity to support the emergence of technologies able to meet environmental and ethical standards, also promoting efficiency and healthy work environments. In horticulture and agriculture, research and projects on automatic driverless vehicles and autonomous tractors started in the early 1960s. Where in India situation is different. All across the India 58% of people use to do farming among them 20 % of farmers live below the poverty rate. In the name of technical devices, the only can afford basic equipment's which is available under few thousands' Indian rupees. On other side numbers of

researchers dose a nice and excellent work in agriculture sector. They all have created multiple agricultural automation equipment's which are human less. But potential cost of that equipment's is also high. Robotics plays very important role in innovation. We can reduce the work of human by using robotic technology. As we know Israel is world power in agriculture sector because of their research in different agriculture cultivation equipment's. They have introduced smart gadgets in agriculture. If we think about innovation in agriculture sector, we first have to study earlier researches of innovators. Where they have created robots, irrigation systems, irrigation water pump controllers, smart harvesters, smart multipurpose attachments for tractors. Here in India situation is different, maximum of farm work is done by manual process. As we know farming have different stages like soil preparation, Seed sowing, manuring, irrigation, Weeding, harvesting and storage. This all process needs to be automated for increasing production speed and quality. But no one serve their focused together on maximums process. In India soil preparation, seed sowing, Manuring processes are done by manual process where they use bag pack sprayers for manuring process. This process is easy and spraying pesticide and chemical by using bag pack sprayer is quite easy, efficient, and less costly. But it comes with multiple draw backs, as we know chemical are dangerous for human but in India farmers and farm workers never take the precaution during manuring process. They only follow few safeties instruction like wear masks, hand glows and during mixing stay away from chemical. But at the end of they have to carry that bag pack on their back and during spraying the pesticide the chances of getting contamination of harmful chemicals are high. To solve this kind of issues we have created multipurpose customized agriculture pesticide sprayer robot.

Our robot is going to cover multiple process of farming, during the design of our robot we have worked on multiple process of farming like Seed sowing, Manuring, Irrigation and weed cutting. Our customize agriculture pesticide sprayer robot have this all facilities. Our robot has weed cutter system with it we can perform drip irrigation. Very important and necessary feature of our robot is that, it can carry fifteen litters of pesticide and we can spray it by using flexible fog spray nozzle's. We can increase and decrease the Hight of the nozzle's as per requirement to spray pesticide on crop of different Hight. Spray Ro support Seed sowing

system. And if we want to operate this robot in night, we have night vision lamps with it. We have created this robot to help poor and illiterate farmers and farm workers of India so the cost of it is going to be very affordable for them. As we know literacy rate of farm workers and farmers of India is not that much good. To help illiterate workers and farmers we have created user friendly robot controller application with different Indian regional language support. Because of this anyone can operate this Spray Ro smoothly without any training. The idea behind this project, needs, Design, how we have created it is present in next sections.

**List of Attachments:**

1. Pesticide sprayer system with multiple nozzle attachment
2. Seed sowing system
3. Weed cutter
4. Drip irrigation system
5. Night vision lamps
6. Multiple rechargeable Battery pack as per requirement
7. Renewable energy source charger i.e., Solar Panel

Customer of our Spray-Ro can choose any five attachments for their robot as per their requirement.

This system is also created to help illiterate farmers and farm workers. As we know in India 58% of people dose a farming where maximum of them are illiterate. To solve this problem, we have created a customize regional language application interface in multiple regional languages. Marathi for Maharashtra, Hindi for overall Hindi speaking states of India, Tamil language application for Tami Nadu, Telegu application for Andhra Pradesh and Telangana, and Kanad application for Karnataka. By using this regional language application any illiterate person also can operate our robot very easily.

**2. LITERATURE REVIEW**

At first stage of our research, we dose a survey of multiple agricultural equipment’s available in the market. Some of the researchers dose a work on different agricultural technologies we dose a review of their work. In this process we find out some work done in past which is appreciable but have a little bit problem in it. Some of the earlier work in same research area is what we are going to present in this section.

**Earlier Work**

To know about the standard and effectiveness of earlier innovation we first dose a survey of existing technologies involves in reducing the human efforts of farmers. Numbers

of technologies are invented in all around world from them we have chosen three basic technologies invented to spray pesticide on crop. As we know in India farming is done by traditional ways. The pesticide sprayer is one among them and it is done by traditional farm workers by carrying backpack type sprayer, which requires human effort or by using electric pump. Spraying chemicals is a common operation in agriculture crop protection.

**2.1. Agriculture Bag-Pack Sprayer**

There are three different types of bag pack sprayers are available in Indian market for spraying pesticide manual they are:

**1. Manual pressure Bag Pack Sprayer**

This type of bag pack sprayer work on manual pressure maintained and created by increasing pressure by using hand movement. below figure shows the operation and handling of this kind of product. This kind of product is very affordable it is going to cost you around 1500 Indian rupees which is equivalent to 20US dollars.



**Figure 1. Manual Pressure Bag-Pack Sprayer**

**2. Batter operated Bag pack sprayer**

This type of bag pack sprayer work on same principle like manual pressure bag pack sprayer. Instead of using mechanical pressure system they have introduced dc motor pump with rechargeable battery which is going to provide you eight hours of battery backup for spraying pesticide. It is going to cost you around 2500 to 3000 Indian rupees which is equivalent to 35US dollars. And whole system is affordable for Indian farmer. Figure 2 shows the working of it.



Figure 2. Electric Bag-Pack Sprayer

### 3. Diesel or Petrol operated Bag-Pack Sprayer

In this type of bag pack sprayer system, we can carry more pesticide as compare to manual and battery bag pack sprayer. It is capable of carrying 20 liters of pesticide and we can operate it by using traditional fuels like petrol or diesel. It comes in multiple nozzle's attachment's according to the types of crops. It is going to cost you around 15000 Indian rupees which is equivalent to 190US dollars.

These all types of manual bag pack sprayer are in affordable prize and very cost effective. Every farmer can afford this type of sprayer system but it also has some dangerous side effects. As we know spraying pesticide operation is essential, but it can create some problems such as human and environmental damages by overdosing using pesticides. These all the system are manual where we have to mix a pesticide in tank first and this process is manual. Whenever human carry this bag packs on back in the name of protection we only have single precaution as we have to wear a mask during pesticide spraying. We can't eliminate the physical contact of frame worker with pesticide. To improve such problems inventors, introduce a pesticide sprayer drone.

### 2.2. Pesticide Sprayer Drones

To overcome the issues of earlier existing system some of the researcher's invented a quadcopters and drones to spray pesticide on farm.

1. **Yallappa et al. (2017)** developed a hex copter with 6 BLDC motors and two LiPo batteries of 6 cells- 8000 mAh.

Their study also involves performance evaluation on discharge and pressure of spray liquid, spray liquid loss and determination of droplet size and density. Through their project, they finally made a drone capable of carrying 5.5 L of liquid with an endurance time of 16 min.



Figure 3. Pesticide Sprayer Drones

2. **Kurkute et al. (2018)** worked on quadcopter UAV and its spraying mechanism using simple cost-effective equipment.

The universal sprayer system is used to spray for both liquid and solid content. In their research, they have also compared different controllers needed for agricultural purposes and concluded that quadcopter system with Atmega644PA is the most suitable due to its efficient implementation.

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Followed by this kind of research some of the Indian and foreign countries jumped in the market of drones and they have started a start up in drone manufacturing. And they all are selling drones in market successfully. But as we know the ground reality of Indian farmers, they can't afford this kind of costly system. They only can get the benefits of system on rent basis. This type of drones going to cost you around 500000 to 800000 lakh Indian rupees which is too costly for poor Indian farmers.

Drones are practically perfect for pesticide spraying but cost of it is very high. One more drawback is there with drones, it is capable of driving very low amount of pesticide with it. After each fifteen minute you have to feed pesticide in empty tank of drones. We can't run drones for too much time because of less tank storage capacity. It is quite difficult task for poor and alliterate people to learn precision level of flying drone. Drone companies provide fifteen to twenty days of training period to teach people about drone flying. Drone controllers are quite difficult for learning and each time we can't afford drone pilots to spray the pesticide. In India average numbers of farmers spend their whole life to do

farming and they can't even afford tractors which is multipurpose vehicle. Main question arises that how they can afford the cost of drone which is created to do only single task as pesticide sprayer. To overcome these problems some researchers have invented multipurpose pesticide sprayer robots.

### 2.3. Pesticide and multipurpose Robots

To overcome problems of pesticide drones and to reduce the cost some of the inventors and researchers comes in market with new affordable designs of multipurpose agriculture pesticide sprayer robots. They dose a too much research in this specific zone where they have created robots to sow a seed in land with it, they can spray pesticide. Some of them serve multifunctionality like harvesting, seed sowing, weed cutting, grass cutting and usage of renewable power supply. Some of the work is we are going to discuss in following section as shown.

#### 1. Philip J. Sammons, Furukawa Tomonari, and Bulgin

Andrew proposed in their paper –Autonomous Pesticide Spraying Robot for use in a Greenhouse|| That an engineering solution includes spraying potentially toxic chemicals in the confined space of a hot and steamy glasshouse to the current human health hazards. This is done by designing and building an independent mobile robot that can be used in commercial greenhouses for Tools to control insects and prevent disease. The efficacy of this method is shown by the ability of the platforms to maneuver themselves efficiently down the rows of a greenhouse, while the pesticide spraying system effectively covers the plants with spray uniformly in the specified dosages. The results showed that the robot was able to meet the physical standards set by the National Greenhouse Horticulture Centre, so that it could work in its greenhouses. The robot also met the time it had to face and economic constraints. The robot could drive up and down the tracks in the greenhouse. The rails are sensed effectively by the Induction Proximity Sensors and operated satisfactorily. The spraying system developed by another thesis student, when travelling along the rails, was able to selectively spray designated plant groups in the greenhouse. The spray protection provided adequate and consistent dosage to the crops.

2. Lokesh Krishna, Omayo Silver, K. Anuradha, designed a novel wireless robot is remotely controlled using necessary commands from the PC section in the receiver side. Based on the written program, independent operations such as making the wireless robot move in the correct path whenever the robot experiences an obstacle, giving some strange sounds whenever wireless robot experiences an unknown movement nearby, spraying of pesticides and switching on the electric motor whenever there is shortage of moisture content in the crop fields.

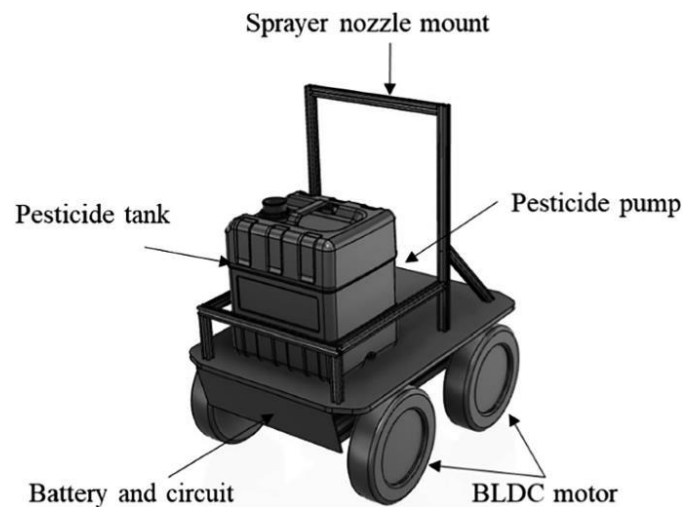


Figure 4. Pesticide Sprayer Robot Design

3. Aishwarya. B. V, Archana. G, C. Umayal, created an agricultural robot car that navigates between the crops using a joystick and motion switches in response to the farmer's instructions.

This truck has lower-cost components, making it more cost-effective. The robot navigates between the crops, provides a way to view the crops or path of the robot using wireless camera. The signal is received at the operating end and viewed using television. Thus, identification of the pest affected crops is made very much possible and simple.

They all have made to much effort to create a successful prototype of multipurpose agriculture pesticide sprayer robot. But each system has its different disadvantages and advantages. For example, some of the robots are capable to operate using IR controller but IR technology is too older and have its own connectivity problems. To overcome these issues some of inventors introduce the Wi-Fi connectivity with it with high connectivity range. But Wi-Fi also have its cones and bugs where we can't provide exact interface over every single farmer it is good for research but practical approach of it is not that much great.

Biggest issues with earlier design are that they have used very older microcontrollers which is very basic follows 8-bit architecture. The system response of 8-bit microcontrollers is not that much great. Simplicity and user-friendly nature should be always there with each innovation, because it is created for poor, aliterate and untechnical person. They should run the system easily but with earlier designs this kind of approach is missing. Still, some of researchers and innovators are doing nice and excellent work in the same zone to improve earlier existing systems.

### 3. METHODOLOGY

As per earlier section we do a literature review of multiple pesticide and smart robotic technics developed for agriculture sector. Among all of the work each work is excellent but have different problems. Like some of them made compromise on safety, some of it are complex and not user-friendly and some of them are quite expensive and unaffordable. To solve this problem, we first decide to work on same system but in improved manner. Where we are going to improve each and every aspect of existing system. Older systems are designed using old version of microcontrollers like intel 8051, PIC microcontroller and AVR 8-bit processor which have less memories, 8-bit architecture, less accuracy and speed. I/O compatibility of it is not that much good. Some of it use IR, Wi-Fi, GSM connectivity which is not that much user-friendly and practical approach.

To create something different from earlier work we first made a planning where we have created a block diagram as per component requirement. And then we have designed a flow of system for code designing. The methodological block diagram and flow diagram is shown in this section.

Figure 5 shows basic building blocks of our system where at the center we have hart of the system. We have used latest ARM architecture process as a brain of our SprayRo. It is connected with multiple clocks. HC-05 Bluetooth module is provided to create interface between Customized regional language application. SprayRo System is going to operate with the help of four gear motors and by motor driver. Driver is connected to controller and motors are with motor driver. System support four different relay driving circuit for multiple attachments like seed sowing, weed cutting, pesticide sprayer and drip irrigation.

This System have Bluetooth application controller capability where we can use any regional language of India according to region and state. One universal controller is also there with English and Hindi language.

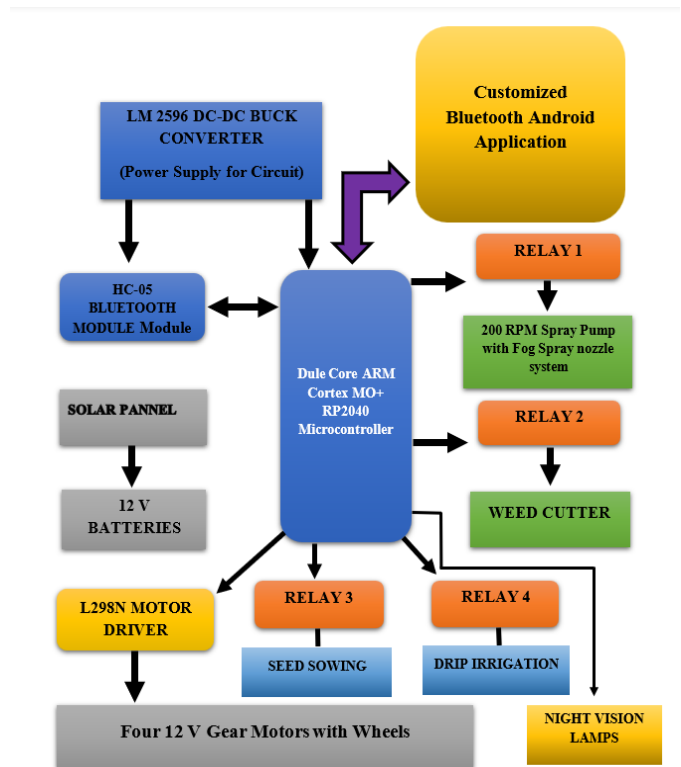


Figure 5. Blpck Diagram

#### FLOW CHART:

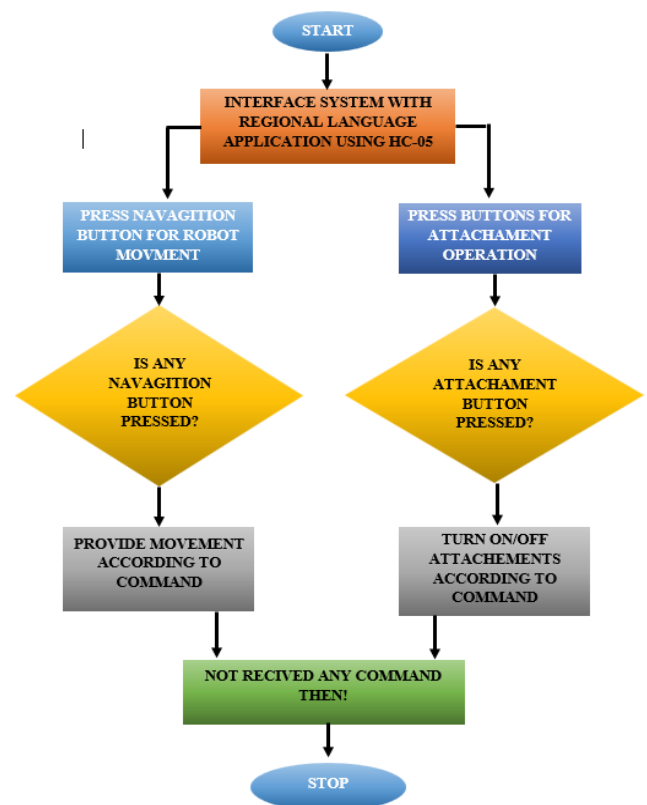


Figure 6. Flow chart of system

#### 4. COMPONENT DESCRIPTION

##### LIAT OF COMPONENT

1. DULE CORE ARM CORTEX MO+ RP 2040 MICROCONTROLLER
2. 4 CHANNEL 5 V RELAY MODULE
3. HC 05 BLUETOOTH MODULE
4. DC-DC BUCK COBVERTER
5. 12 V 100 RPM 4KG TORQUE MOTORS
6. 12 V 10 RPM DC GEAR MOTOR
7. 775 1000 RPM WEED CUTTER MOTOR
8. 200 PSI KRUSHI PUMP
9. FOG SPRAY NOZZELS
10. 12 V WATER PUMP
11. 12 V 7.5 AMP DC BATTERY
12. 12 V 1 AMP DC BATTERY
13. SOLID CUSTOMIZE ROBOT CHASSIS
14. WIRES, SWITCHES AND MALE FEMALE DC CONNECTORS
15. GRASS CUTTER BLADES

##### DULE CORE ARM CORTEX MO+ RP 2040 MICROCONTROLLER

RP2040 is the debut microcontroller from Raspberry Pi. It brings our signature values of high performance, low cost, and ease of use to the microcontroller space.

With a large on-chip memory, symmetric dual-core processor complex, deterministic bus fabric, and rich peripheral set augmented with our unique Programmable I/O (PIO) subsystem, it provides professional users with unrivalled power and flexibility. With detailed documentation, a polished Micro Python port, and a UF2 bootloader in ROM, it has the lowest possible barrier to entry for beginner and hobbyist users.

RP2040 is a stateless device, with support for cached execute-in-place from external QSPI memory. This design decision allows you to choose the appropriate density of non-volatile storage for your application, and to benefit from the low pricing of commodity Flash parts.

RP2040 is manufactured on a modern 40nm process node, delivering high performance, low dynamic power consumption, and low leakage, with a variety of low-power modes to support extended-duration operation on battery power

##### Key features:

- Dual ARM Cortex-M0+ @ 133MHz

- 264kB on-chip SRAM in six independent banks
- Support for up to 16MB of off-chip Flash memory via dedicated QSPI bus
- DMA controller
- Fully-connected AHB crossbar
- Interpolator and integer divider peripherals
- On-chip programmable LDO to generate core voltage
- 2 on-chip PLLs to generate USB and core clocks
- 30 GPIO pins, 4 of which can be used as analogue inputs



Figure 7. RP 2040 Dule Core Microcontroller

##### Peripherals

- 2 UARTs
- 2 SPI controllers
- 2 I2C controllers
- 16 PWM channels
- USB 1.1 controller and PHY, with host and device support
- 8 PIO state machines

##### 4 CHANNEL 5 V RELAY MODULE



Figure 8. 4 Channel 5V Relay Module

This is a 5V 4-channel relay interface board, and each channel needs a 15-20mA driver current. It can be used to control various appliances and equipment with large current. It is equipped with high-current relays that work under AC250V 10A or DC30V 10A. It has a standard interface that can be controlled directly by microcontroller.

A power relay module is an electrical switch that is operated by an electromagnet. The electromagnet is activated by a separate low-power signal from a micro controller. When activated, the electromagnet pulls to either open or close an electrical circuit.

A simple relay consists of wire coil wrapped around a soft iron core, or solenoid, an iron yoke that delivers a low reluctance path for magnetic flux, a movable iron armature and one or more sets of contacts. The movable armature is hinged to the yoke and linked to one or more set of the moving contacts. Held in place by a spring, the armature leaves a gap in the magnetic circuit when the relay is de-energized. While in this position, one of the two sets of contacts is closed while the other set remains open.

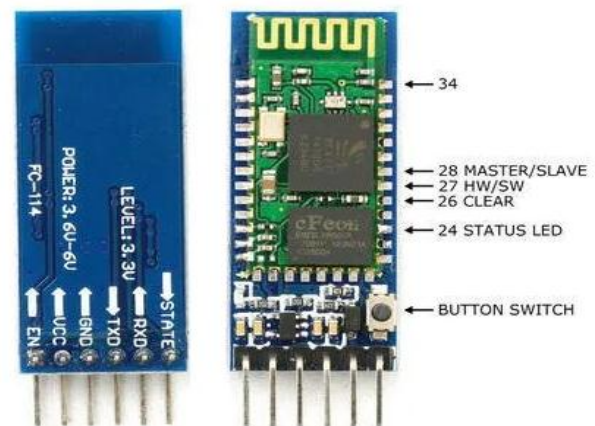
When electrical current is passed through a coil, it generates a magnetic field that in turn activates the armature. This movement of the movable contacts makes or breaks a connection with the fixed contact. When the relay is de-energized, the sets of contacts that were closed, open and breaks the connection and vice versa if the contacts were open.

## HC 05 BLUETOOTH MODULE

### HC-05 Bluetooth Module

HC-05 is a Bluetooth module which is designed for wireless communication. This module can be used in a master or slave configuration. It is used for many applications like wireless headset, game controllers, wireless mouse, wireless keyboard, and many more consumer applications. It has range up to <100m which depends upon transmitter and receiver, atmosphere, geographic & urban conditions. It is IEEE 802.15.1 standardized protocol, through which one can build wireless Personal Area Network (PAN). It uses frequency-hopping spread spectrum (FHSS) radio technology to send data over air.

It uses serial communication to communicate with devices. It communicates with microcontroller using serial port (USART).



**Figure 9. HC-05 Module**

**It has 6 pins,**

1. **Key/EN:** It is used to bring Bluetooth module in AT commands mode. If Key/EN pin is set to high, then this module will work in command mode. Otherwise by default it is in data mode. The default baud rate of HC-05 in command mode is 38400bps and 9600 in data mode.

**HC-05 module has two modes,**

**Data mode:** Exchange of data between devices.

**Command mode:** It uses AT commands which are used to change setting of HC-05. To send these commands to module serial (USART) port is used.

2. VCC: Connect 5 V or 3.3 V to this Pin.
3. GND: Ground Pin of module.
4. TXD: Transmit Serial data (wirelessly received data by Bluetooth module transmitted out serially on TXD pin)
5. RXD: Receive data serially (received data will be transmitted wirelessly by Bluetooth module).
6. State: It tells whether module is connected or not.

## DC-DC BUCK COBVERTER

A buck converter or step-down converter is a DC-to-DC converter which steps down voltage (while stepping up current) from its input (supply) to its output (load). It is a class of switched-mode power supply. Switching converters (such as buck converters) provide much greater power efficiency as DC-to-DC converters than linear regulators, which are simpler circuits that lower voltages by dissipating power as heat, but do not step-up output current. The efficiency of buck converters can be very high, often over 90%, making them useful for tasks such as converting a computer's main supply voltage, which is usually 12 V, down

to lower voltages needed by USB, DRAM and the CPU, which are usually 5, 3.3 or 1.8 V.

Buck converters typically contain at least two semiconductors (a diode and a transistor, although modern buck converters frequently replace the diode with a second transistor used for synchronous rectification) and at least one energy storage element (a capacitor, inductor, or the two in combination). To reduce voltage ripple, filters made of capacitors (sometimes in combination with inductors) are normally added to such a converter's output (load-side filter) and input (supply-side filter). Its name derives from the inductor that "bucks" or opposes the supply voltage.



**Figure 10. DC-DC Buck Converter**

Buck converters typically operate with a switching frequency range from 100 kHz to a few MHz. A higher switching frequency allows for use of smaller inductors and capacitors, but also increases lost efficiency to more frequent transistor switching.

**12 V 100 RPM 4KG TORQUE MOTORS, 775 WEED CUTTER MOTOR**



**Figure 11. 12 V 100 RPM 4KG Torque Motors**

DC Gear motor, is also called Geared Dc Motor and gearhead motor or gearbox motor. It consists of a electric DC motor and a gearbox or gearhead; these gearheads are used to reduce the DC motor speed, while increase the DC motor torque. Therefore, user can get lower speed and higher torque from gear motor.

**DC Motor – 10RPM – 12Volts.**

This can be used in all-terrain robots and variety of robotic applications. These motors have a 3 mm threaded drill hole in the middle of the shaft thus making it simple to connect it to the wheels or any other mechanical assembly. 10 RPM 12V DC geared motors widely used for robotics applications. Very easy to use and available in standard size. Also, you don't have to spend a lot of money to control motors with an Arduino or compatible board. The most popular L298N H-bridge module with onboard voltage regulator motor driver can be used with this motor that has a voltage of between 5 and 35V DC or you can choose the most precise motor driver module from the wide range available in our Motor drivers' category as per your specific requirements.



**Figure 12. 10 RPM DC Gear**

Nut and threads on the shaft to easily connect and internally threaded shaft for easily connecting it to the wheel. DC Geared motors with robust metal gearbox for heavy-duty applications, available in the wide RPM range and ideally suited for robotics and industrial applications. Very easy to use and available in standard size. Nut and threads on the shaft to easily connect and internally threaded shaft for easily connecting it to the wheel.

**775 DC motor**



**Figure 13. 775 DC motor**



**200 PSI KRISHI PUMP, FOG SPRAY NOZZELS**



**FIGURE 14. 200 PSI Krishi pump& Nozzles**

Sprayer pumps are mechanical devices designed to generate a pressure differential to drive spray fluid from a storage tank, through system plumbing, and out to the spray nozzle.

**12 V 7.5 AMP & 12 V 1 AMP DC BATTERY**



**Figure 15. Batteries**

These two batteries are used to provide power supply to different motors and to electronic circuit. These batteries are rechargeable and recyclable.

**WIRES, SWITCHES AND MALE FEMALE DC CONNECTORS**

Wires switches and different DC male female connectors are used to interconnect power supply, control signals among all the circuit of Spray Ro.

**GRASS CUTTER BLADES**

These blades are used with high RPM motors for grass and weed cutting

**SOLAR PANNEL**

A solar panel is a device that converts sunlight into electricity by using photovoltaic (PV) cells. PV cells are made

of materials that generate electrons when exposed to light. The electrons flow through a circuit and produce direct current (DC) electricity, which can be used to power various devices or stored in batteries. Solar panels are also known as solar cell panels, solar electric panels, or PV modules.



**Figure 16. Solar Panel 15 W.**

Some advantages of solar panels are that they use a renewable and clean source of energy, reduce greenhouse gas emissions, and lower electricity bills. Some disadvantages are that they depend on the availability and intensity of sunlight, require maintenance and cleaning, and have high initial costs. Solar panels are widely used for residential, commercial, and industrial purposes, as well as for space and transportation applications.

**5. WORKING AND APPLICATION DESIGNING**

**APPLICATION DESIGNING**

As per earlier section we mention that we have created multiple regional language application according to different regions of India.

Application interface is get designed by using open-source platform. MIT app inventor is an online open-source app development support drag and drop facility for front end design of any application. We simply have to create push buttons and click buttons according to our need. We can customize the graphics by adding images and icons in it. For Bluetooth connectivity we have to add a list picker in screen which is not visible on front screen. Front end design of our application is shown in figure 16. As per figure we have added a connect Bluetooth list picker after that we have used two labels, one for application name i.e., "SprayRo controller" and second for research institute name. we have created total fourteen buttons as shown. Four for robot movement and remaining 10 is for attachment on-off purpose.



Figure 16. Front End Design of Regional Language Application

After front end design we have to save all the buttons to provide Bluetooth serial read commands to RP 2040 microcontroller through Bluetooth module. For that we have to create blocks in back-end section of application design. Block design screen is shown in figure 16 and as per this we have design different blocks for fourteen blocks and for list picker.

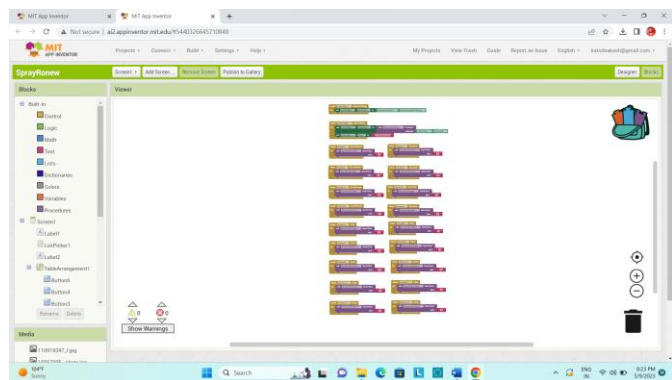


Figure 17. Back End Block design

## 6. PHYSICAL CONNECTION RESULT ANALYSIS

As per discussed in earlier in section 4 we have used different components for “SprayRo” system design. We have simulated the design and circuit. We have created a code for robot in micro python and we have compiled and simulated it in tony IDE. Tony Ide is specially created for RP 2040 Microcontroller and for python programing.

After code writing we have created hardware chassis by using metal frame in combination with plywood. This system is capable to bear 20 kg of load where we can drive 15 liters of pesticide with it. After that we have fixed all the motors with chassis and then connected it with motor driver circuit. After that we have interfaced all the circuit, modules and power supply with ARM RP 2040 microcontroller.

## WORKING

After hardware connection now our system is ready to operate. Working of our robot is very simple. To observe the working of system and to get a result we first have to download regional language customized Bluetooth controller application which is created by using MIT app inventor. After downloading it we have to turn on the device Bluetooth and after pairing it with HC 05 module turn on the application. Application interface and front panel buttons are shown in figure 17.

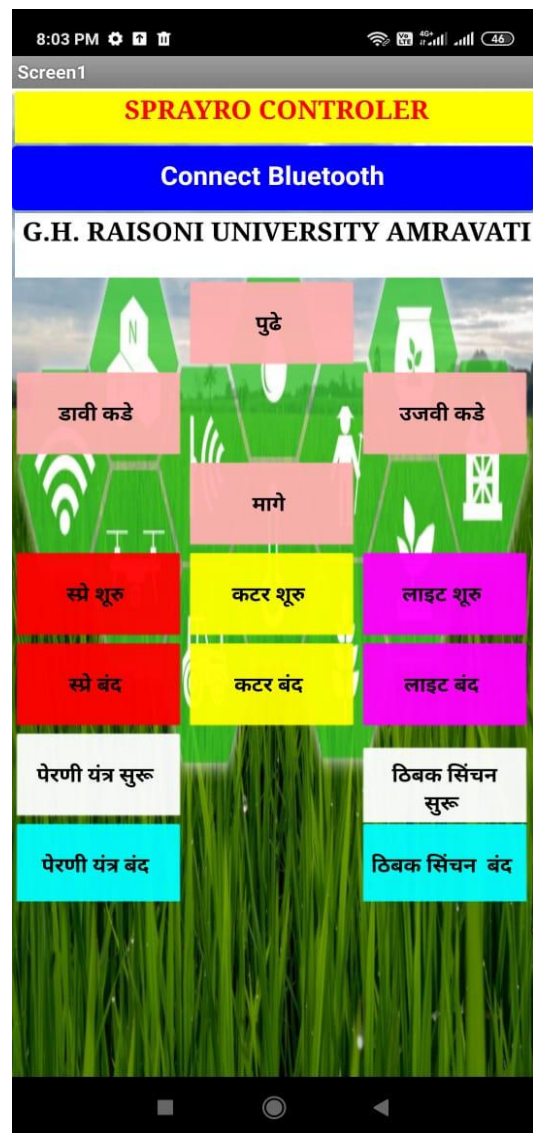


Figure 18. application interface

Now press connect Bluetooth button and choose HC 05 module and connect “SprayRO” System with application. After successful connection we can operate robot using various command. Here whenever we press navigation buttons robot moves in four different directions as per different button. When we want to turn on any attachment,

we just have to press buttons according to attachment. We have run this robot multiple times and it is working properly. Some of test result and physical look of our robot is shown in figure 19. This system is also provided with 15-watt solar panel which is capable to recharge all the batteries using renewable power supply. Robot is painted with black color to attract UV radiation on solar panel.



Figure 19. Physical look and end result of our designed Pesticide sprayer Robot (SprayRo)

## 7. CONCLUSION

As per market research and literature review, we have picked overall problems present in existing systems. Where we have to work. We worked too hard to overcome all the problems as per our research we can conclude that we have created most promising and practical design for different agriculture work. We can provide this system in very less cost which is going to be very affordable to poor farmers and farm workers. We also can eliminate physical contact of farmers and farm workers with harmful chemical pesticide. And illiterate farm workers and farmers also can operate our pesticide customized multipurpose robot very easily by using their regional language.

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## 8. ADVANTAGES AND APPLICATION

1. System is very powerful and system response of pesticide sprayer Robot is very high because of dual core ARM microcontroller.
2. Customization of multiple attachment can attract customers to buy this product in future.
3. It uses renewable energy source so the overall power consumption requirement is very less.
4. System is also useful for lawns and gardens.
5. User-friendly nature can help any people to operate this pesticide sprayer robot easily using regional language controller.
6. Flexibility in nozzles attachment is very useful and we can increase decrease the Height, length and numbers of nozzles as per requirements.

## 9. FUTURE SCOPE

We can increase the load bearing capacity of system by making change in motors. We also can improve range of operation using different communication protocol like WIFI and by using Laura device. By connecting more powerful batteries we can increase battery backup of our future design. System can be provided with camera to get a live footage during pesticide spraying operation. We also can convert this system as agriculture data collection system by providing multiple sensors with it like moisture, humidity, PH and object detection.

## REFERENCES

- [1] Z. Zhang, and Y. Liu, "Effects of chemical pesticides on human health," *Shanghai Journal of Preventive Medicine*, vol. 15, no. 8, pp 383-384, 2013.
- [2] R. Berenstein, O. B. Shahar, A. Shapiro, and Y. Edan, "Grape clusters and foliage detection algorithms for autonomous selective vineyard sprayer," *Intelligent Service Robotics*, vol. 3, no. 4, pp. 233-243
- [3] R. Gadow, A. Candel, and M. Floristán, "Optimized robot trajectory generation for thermal spraying operations and high-quality coatings on free-form surfaces," *Surface*

Coatings Technology, vol. 205, no.4, pp. 1074-1079, 2010.

- [4] S. H. Deng, Z. Cai, D. D. Fang, H. Liao, and G. Montavon, "Application of robot offline programming in thermal spraying original research article," *Surface Coatings Technology*, vol. 206, no. 19, pp. 3875-3882, 2012.
- [5] G. Gao, H. Zhou, and X. Niu, "An intelligent variable spraying decision-making system based on fuzzy neural network for greenhouse mobile robot," *Intelligent Computing for Sustainable Energy and Environment*, vol. 355, pp. 257-265, 2013.
- [6] J. Peng, Q. He, and Q. Wei, "Design of smart things robot system," *Information Technology Journal*, vol. 12, no. 24, pp. 8514-8520, 2013.