

## ***Solar powered seed sowing and agriculture robot***

Ambarao, Sanjay Shahapur, Shivakumar .L, Vishal.D.H

Department Of Electrical And Electronics Engineering

Under the guidance of :-Assistant Prof. Rajath.G.R

DAYANANDA SAGAR ACADEMY OF TECHNOLOGY AND MANAGEMENT

Udayapura,kanakapura main road ,opp. Art of living ,Bangalore -82

Email:-[ambaraokolkunda@gmail.com](mailto:ambaraokolkunda@gmail.com), [sshahapur27@gmail.com](mailto:sshahapur27@gmail.com), [shivurathod78999@gmail.com](mailto:shivurathod78999@gmail.com)

**Abstract**— Agriculture is a major sector for any developing country. The Discovery of Agriculture is the first big step towards civilized life, advancement of agricultural tools is the basic trend of agricultural improvement. Now the qualitative approach of this project is to develop a system which minimizes the working cost and also reduces the time for digging operation and seed sowing operation by utilizing solar energy to run the agri-bot. In this machine, solar panel is used to capture solar energy and then it is converted into electrical energy which is used to charge battery, which then gives the necessary power to a permanent magnet DC motor(PMDC), ultrasonic sensor used for obstacle detection, controlled using Arduino at-mega and renewable energy source like solar energy used to propel the agribot and operation is using Bluetooth and controlled automatic and manual through mobile application thus this agri-bot is clean energy based and farmer friendly and the purpose of this project is to increase the productivity for farmer.

**KEYWORDS:** Agribot, Obstacles Detection, Arduino, PMDC Motor, Solar Panel, Seed Sowing, Bluetooth, Mobile Application, Charge Battery .

### **INTRODUCTION**

Agriculture is the Backbone of the Indian economy it will keep on playing a noteworthy part in the future years as well. The historical backdrop of Agriculture in India dates to quite a while back, today India stands second worldwide in the farm yield, and however the majority of the horticultural practices in India is very primitive and includes a massive human labour for even a lesser area of land. The traditional tools used are wooden plough, yoke, mallet etc. These instruments are utilized for setting up the land sowing seeds, weeding and harvesting. These techniques lack accuracy and hence the productivity is less.

Though there are advancements in the field of technology that are used to develop the agriculture, they are not being used by the farmers because of

their economic status. The methods of modern farming are not effectively introduced and hence the outcome is also not as expected to the given amount of land. By the adoption of Scientific Farming the farmer will get high yields and also it avoids them from being bankrupt. The current technologies implemented in the farming does not suit the type of the farming practiced in India and also it does not efficiently be applied to the type of the crops that are grown here. Hence the need for the specialized vehicles to do the required tasks to be carried out.

There are Vehicles that are developed to perform individual tasks such as ploughing and sowing and other farming tasks. There has no such vehicle that does a combined task of the agriculture as a complete package to do all the required tasks that are otherwise had to be done by human labour which isn't extremely precise. So our idea in this project is to impart a specialized vehicle for the purpose of agriculture which is capable of performing all the regularly required farming activities with a great precision. In our project we have designed a TRI-WHEEL vehicle which is a completely automated robot which performs the activities with the help of a remote control/mobile phone. The proposed Idea implements the vehicle to perform the farming activities such as Ploughing, Sowing, Leveling, Water sprinkling etc.

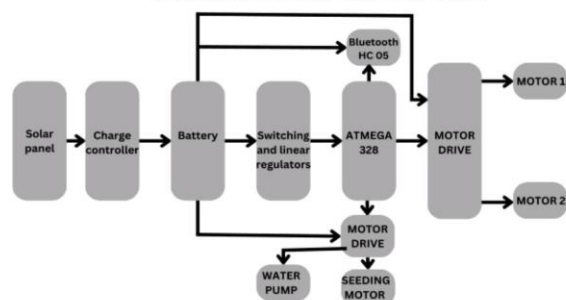
### **PROBLEM STATEMENT**

In the recent days, the technology has changed tremendously. Along with improvement in technology, the human must also cope-up with updating environment. In order to diminish human work the vehicles are evolved. The main drawback which the farmers are experiencing now is lack of advance mechanization in farming. Due to manual sowing of seeds distance between the seeds are not symmetrically maintained which in turn affects the growth of crops and wastage of area. Due to manual farming excess efforts for different process are necessary which requires more man power. Manual farming also requires excess time consumption for performing individual process. Now, the idea is to



solve this problem by developing intelligent robotic vehicle by integrating sensors and modernizing the agriculture for better result.

## METHODOLOGY



The first step involved the selection of the project. After weighing in various factors like feasibility, cost, usefulness and challenges involved we settled on this project. After selection of the project we will select the various general elements required for the project. This involved sourcing a welder and getting a quote on the steel pipes used. We will next design the chassis of the sprayer unit. The electrical components will be selected to best suit the project requirements. The circuit diagram will be used as a basis for selection of components. The next step involved two steps carried out almost simultaneously – the fabrication of the model according to the design and putting together the electrical circuits, calibrating the sensors and the microcontroller.

After the fabrication of the model and the completion of the electrical circuits, we will integrate the mechanical and electronic parts into one unit for further testing. We will test the integrated unit on accuracy and robustness.

The central control unit of the system is a microcontroller, the micro controller which we are using is node MCU version 0.9 ESP8266. It communicates with the Bluetooth module, the Bluetooth module which we are using is the HC 05. Whenever the Bluetooth module receives the instructions, it forwards the instructions to the microcontroller. The communication between the micro controller and the Bluetooth module is through the serial interface UART i.e. Rx & Tx. The Tx pin of the Bluetooth module is connected with the Rx pin of the NodeMCU.

The other peripheral is the moisture

sensor, it has a sensing unit i.e. moisture sensor which consists of two electrodes. The sensing element is going through a operational amplifier which acts like a comparator. We can also vary the potential by varying the potentiometer. If we desire to sense more moisture, we can vary it using the potention meter, based on the threshold set, the signal is sent to the relay board unit.

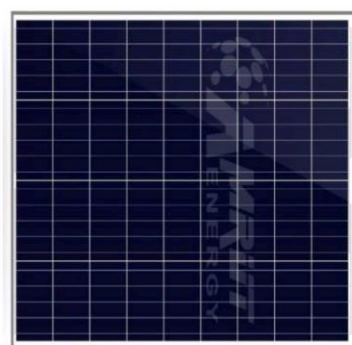
It acts like a motor driver, it consists of 8 channel relay, each relay is a SPDT relay i.e. Single Pole Dual Throw, it is capable of handling current upto 10A, it gets activated by 12v. Here the ULN 2003 is required because we cannot drive the relay directly by microcontroller because the relay requires 12V and the micro controller requires 3V, that's the reason why we require a driver in between.

Another important part of the model is that we have two solar panels of 6V around 100mA current, which is delivering power to the battery through a diode, the diode is added to ensure that the current is flowing in one direction only, we have a lead acid battery of 12V.

To power the movement of wheels 100rpm Dc gear motors have been used at each wheel. A water tank and pump is also being installed in the system for the purpose of water spraying. The pump is also driven by the relay which is controlled by the micro controller. Seeding unit of the system is powered by the DC gear motor & the ploughing unit is controlled by the PO gear motor.

## HARDWARE DESIGN

### Main supply



Solar panel converts solar energy to electrical



energy. Solar panels actually comprise many, smaller units called photovoltaic cells. When photons hit a solar cell, they knock electrons loose from their atoms. If conductors are attached to the positive and negative sides of a cell, it forms an electrical circuit. When electrons flow through such a circuit, they generate electricity. Multiple cells make up a solar panel, and multiple panels (modules) can be wired together to form a solar array. Each photovoltaic cell is basically a sandwich made up of two slices of semi-conducting material, usually silicon — the same stuff used in microelectronics. To work, photovoltaic cells need to establish an electric field. Much like a magnetic field, which occurs due to opposite poles, an electric field occurs when opposite charges are separated. To get this field, silicon is doped with other materials, giving each slice of the sandwich a positive or negative electrical charge.

Specifically, they seed phosphorous into the top layer of silicon, which adds extra electrons, with a negative charge, to that layer. Meanwhile, the bottom layer gets a dose of boron, which results in fewer electrons, or a positive charge. This all adds up to an electric field at the junction between the silicon layers. Then, when a photon of sunlight knocks an electron free, the electric field will push that electron out of the silicon junction. A couple of other components of the cell turn these electrons into usable power. Metal conductive plates on the sides of the cell collect the electrons and transfer them to wires. At that point, the electrons can flow like any other source of electricity. The photovoltaic cell module is as shown

## Battery

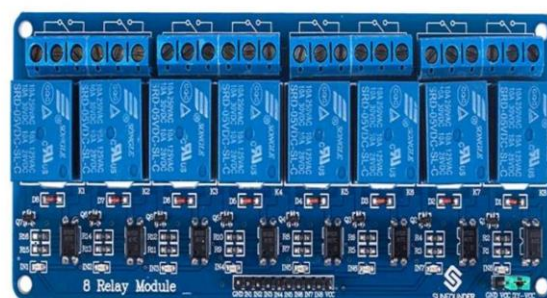


Dry cell batteries are batteries that use an extremely low-moisture electrolyte. They are contrasted by wet cell batteries such as lead-acid batteries, which use a liquid electrolyte. The electrolyte that is used in most dry cell batteries is a sort of paste which, though containing moisture

is still relatively dry.

Dry cell batteries create electrical energy by converting chemical energy into electricity. The exact means of doing so depends on the type of dry cell battery in question, but the materials that are used are generally zinc and carbon or zinc and manganese dioxide. These materials are placed within the electrolyte paste within the battery. They react with each other through a chemical process in which the electrolyte (carbon or manganese dioxide) reacts with the zinc, creating electricity. This is transmitted out of the battery using positive and negative electrodes. The inner view of a battery

## 8 Channel Relay Module



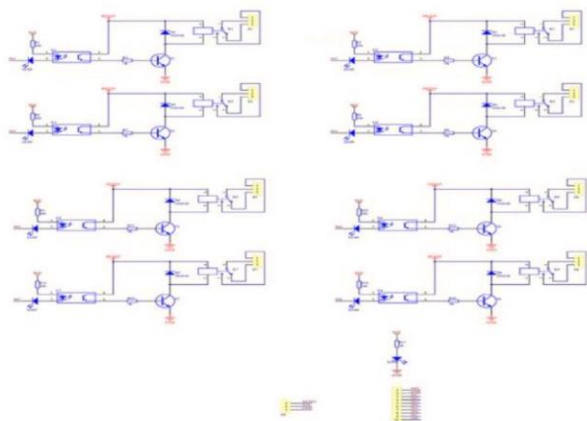
An eight-channel relay module fig 3.3 is an electronic device. In fact, these include eight 5V relays along with switching and isolating components. It also contains eight terminal blocks, with each block sharing two relays. At the same time, sensors and microcontrollers can connect to it with minimal connections. Thus, allowing high voltage controllability via low voltage. Once the relay coil energizes, the LED indicators illuminate, verifying that the relay functions. Furthermore, screw terminals make it much easier to create connections with the mains' wiring

Meanwhile, optocouplers generate another isolation layer between the inputs and load. The input jumper consists of GND, VCC, and input pins. For this purpose, it provides easy connectivity with female jumper wires. Above all, freewheeling diodes stop voltage spikes from occurring on the transistors when the relay deactivates. And this happens due to the inductive load coils.

Arduino and Raspberry pi boards can also integrate with the 8-channel LOW-level trigger relay

Table 3.1 Pins Description of 8 Channel Relay Module

Number	Name	Description
1	GND	Module ground reference
2	IN1	Relay 1 input
3	IN2	Relay 2 input
4	IN3	Relay 3 input
5	IN4	Relay 4 input
6	IN5	Relay 5 input
7	IN6	Relay 6 input
8	IN7	Relay 7 input
9	IN9	Relay 8 input
10	VCC	Relay module power supply
11	GND	Module ground reference
12	VCC	Power supply selection jumper
13	RY-VCC	Relay module alternative power pin

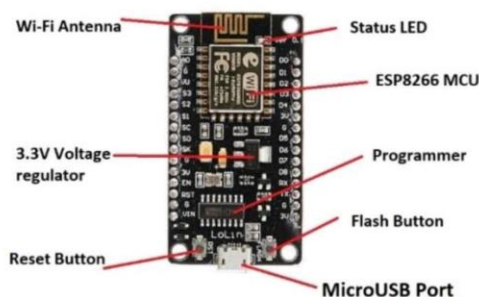


Schematic Diagram 8 Channel Relay Module

Table:3.2. 8Channel Relay Module Specifications

Parameter	Rating
Supply voltage	3.75v to 6v
Trigger current	5mA
Active relay current level	70mA(one relay ), 600mA(eight relays)
Relay maximum contact voltage	250v AC, 30V DC
Relay maximum current	10A

## Node MCU (AT mega 328)



Node MCU stands for Node Microcontroller Unit shown in fig 3.3. It is an open-source Lua-based firmware that is designed for IoT (Internet of Things) applications. The module that runs this firmware is ESP-12E and that module is based on 32-bit ESP8266 MCU. It has 2.4 GHz Wi-Fi that supports WPA/WP2. The ESP-12E comes with a programmer and a 3.3v SMPS unit. So, you do not need any external programmer to program this board and you can easily run this board directly on 5V from USB.

## Features of Node MCU ESP-12E development board

1. Operating Voltage: 3.0-3.6 V
2. Operating Current: 80mA
3. Operating temperature: -40 to 125 degree Celsius
4. 32-bit MCU
5. Integrated 10-bit ADC
6. 802.11 b/g/n
7. Integrated TCP/IP protocol
8. 2.4 GHz Wi-Fi that supports WPA/WPA2
9. It supports remote control (IR)





10. It has 20 I/O ports

### Applications of Node MCU ESP-12E development board

1. IP cameras
2. Home security
3. Home Automation
4. Wireless Control Systems

### Mesh network Submersible water pump



This is Micro Submersible Water Pump DC 3V-5V, can be easily integrate to your water system project shown in fig 3.6. The water pump works using water suction method which drain the water through its inlet and released it through the outlet. You can use the water pump as exhaust system for your aquarium and controlled water flow fountain..

#### Specification:

1. Input voltage: dc 3v-5v
2. Flow rate: 1.2-1.6 l/min
3. Operation temperature: 80 deg.c
4. Operating current: 0.1-0.2a
5. Suction distance: 0.8 meter (max)
6. Outside diameter of water outlet: 7.5mm
7. Inside diameter of water outlet: 5.0 mm
8. Diameter of water inlet : 5.0 mm
9. Wire length: 200 mm
10. size: 45 x 30 x 25 mm
11. weight: 30g

### Bluetooth Module HC-05

The HC-05 is a popular Bluetooth module commonly used in electronic projects for wireless communication. It is known for its ease of use and versatility, making it a popular choice among hobbyists and professionals alike. Here are some

key points related to the HC- 05 Bluetooth module

**Bluetooth Communication:** The HC-05 module allows for wireless communication between electronic devices using Bluetooth technology, enabling data transfer and communication without the need for physical connections.

**Serial Communication:** The HC-05 module communicates using serial communication, making it compatible with various microcontrollers, Arduino boards, and other electronic devices that support serial communication protocols.

**Dual Mode:** The HC-05 module supports both the Bluetooth Basic Rate (BR) and Enhanced Data Rate (EDR) modes, allowing for compatibility with different Bluetooth devices.

**Master/Slave Operation:** The HC-05 module can be configured to operate as either a master or a slave device, allowing for flexibility in creating different types of Bluetooth communication setups.**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.

1. data mode: exchange of data between devices.
2. 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.
3. **Vcc:** connect 5 v or 3.3 v to this pin.
4. **Gnd:** ground pin of module.
5. **Txd:** transmit serial data (wirelessly received data by bluetooth module transmitted out serially on txd pin)
6. **Rxd:** receive data serially (received data will be transmitted wirelessly by bluetooth module)
7. **State:** it tells whether module is connected or not.

#### Specification of HC-05 Bluetooth Module

1. Bluetooth version: 2.0 + edr (enhanced data

rate)

2. Frequency: 2.4 ghz ism band
3. Modulation: gfsk (gaussian frequency shift keying)
4. Transmit power: class 2 (up to 4 dbm)
5. Sensitivity: -80 dbm typical
6. Range: approximately 10 meters (or 33 feet) in open air
7. Profiles supported: spp (serial port profile), hid (human interface device) and others
8. Operating voltage: 3.3v to 5v dc
9. Operating current: less than 50ma
10. Standby current: less than 2.5ma
11. Sleep current: less than 1ma
12. Interface: uart (universal asynchronous receiver/transmitter)
13. Baud rates: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, and 460800
14. Operating temperature: -20°C to 75°C (-4°F to 167°F)

### DC Motor



Generally speaking, there are two groups of electric motors: DC (Direct Current) and AC (Alternating Current). There are various varieties within these categories, and each one has certain skills that make them ideal for particular uses. Electric motors typically have a stator (stationary field) and a rotor (the revolving field or armature), regardless of the type. They work by combining magnetic flux and electric current to generate rotational speed and torque. The ability of DC motors to run on direct current sets them apart

from other types of motors.

D.C. motors come in many varieties, but they all operate according to the same principles. We shall examine their fundamental mode of operation and traits in this chapter

Understanding motor characteristics can help us select the ideal motor for our application. The following is a list of the chapter's learning goals. Learning Objectives:

Have a fundamental understanding of how a DC motor works.

Recognize the function and fundamental attributes of straightforward DC motors.

### Features:

1. 100rpm 12v dc motors with metal gearbox and metal gears
2. 18000 rpm base motor
3. 6mm dia shaft with m3 thread hole
4. Gearbox diameter 37 mm.
5. Motor diameter 28.5 mm
6. Length 63 mm without shaft
7. Shaft length 30mm
8. 180gm weight
9. 27.18kgcm holding torque
10. No-load current = 800 ma, load current = upto 7.5 a(max)
11. Recommended to be used with dual dc motor driver 20 or dual dc motor driver 20

### Seed Sower

In this section, we design and build a completely automated seed sower that uses a DC motor and a smartphone application to manage speed. The seeds are stored in a funnel. For the purpose of scattering seeds across the ground at regular intervals, a slider with a hole is offered. With the assistance of a DC motor that is fixed to the slider, the slider moves back and forth on a basis of motion.



## WORKING MODEL



The System Multi Utility Agriculture Bot is a Collaboration of all the basic farming activities. These farming activities include Sowing, Ploughing, levelling etc. The system is a Quad Wheel vehicle where all these mechanisms are mounted. This Vehicle is a remote- controlled device here the illustration is shown by the switches. The main purpose of this is to implement these farming methods with a greater precision than the human labour currently used.

The ploughing and sowing mechanisms are mounted and the sowing and ploughing mechanisms are properly monitored and the required distances are provided. The levelling process is carried out simultaneously as the Bot moves forward. The system also has the sprinkling mechanism to provide the moisture to the field if there is low moisture in the soil. The system also has the Moisture connected to it and it provides the information to the farmer about the moisture content in the soil and if required he can use the remote to sprinkler water.

## FLOW CHART

The designed robot will perform the seed sowing, pesticide spraying and grass cutting operations simultaneously. When the solar panel gets heated it converts sunlight into electricity. This electrical energy is fed into the charging circuit. The charging circuit will work according to maximum power point tracking (MPPT) protocol to generate pulsed voltage and also avoids reverse current. The pulsed voltage is given to battery in order to charge it. The charging of battery is controlled with the help of voltage sensors. Since battery is bidirectional it will charge and supply voltage to arduino at a time. The voltage supply with sustained oscillation is fed into arduino with the aid of



high pass filter. The channel relay provides voltage supply to all different mechanisms.

The algorithm of automated seed sowing, robot using bluetooth/android app.

Algorithm for the robot is as follows:-

Step 1: Start

Step 2: Switching on the robot

Step 3: Pairing the bluetooth device with the mobile phone

Step 4: robot should wait until it receives signal from the app.

Step 5: If it receives signal, robot works accordingly

Step 6: If the signal is not received go to step 4

Step 7: universal OFF signal is used to deactivate.

The motor driver is used to drive the DC motors which run the robot. The model consists of android app and bluetooth HC-05 to transmit and receive the signals respectively. The robot waits until it gets signals from app. When the signal is received, the respective operations will be activated and robot will work accordingly. The prototype has the different output sections and the main idea of the work is fulfilled.



prototype of the automated multipurpose robot which is controlled through app. It performs seed sowing, grass cutting and pesticide spraying simultaneously on all the types of farming land.

The solar panel stores and converts the solar energy into electrical energy which is given to charging circuit in order to charge the battery to 12 V which will give the necessary power to controller, DC motor and different mechanisms. The bluetooth/android app which is used to control the robot It consists of 12 keys. Scan key are used for pairing of app with HC-05 module and set keys is used to add further keys if required. The stop, right, left, forward and backward keys are used to control the movements of the robot.

### **CONCLUSION**

An autonomous multipurpose agricultural robot is developed to perform challenging farming tasks like watering and seed sowing. In this experiment, urea and seeds of two different sizes will be sown. Two benefits of robotics are reduced human interaction and efficient resource use. The system receives instructions through Bluetooth, preventing any direct human contact and protecting the operator's safety. Renewable energy is being used because the robot is solar-powered. The actions are completed by using an Android app. New irrigation and sowing technology has a significant impact on agriculture. By implementing this cutting-edge work, farmers can save a lot of money on labour and more time.

### **FUTURE SCOPE**

Further we can include some other functions in this robot like levelling the field. And with the use of technologies like edge detection and image segmentation we can also identify the diseased leaves of the particular crop by mounting a camera on the top of the bot. We can also implement IOT to know about how much area of the field is cultivated during a particular period of time. Leveling of the field is also possible.

I.

LITERATURE REVIEW

Sl.no.	TITLE	AUTHOR	YEAR PUBLISHING	FINDINGS	OUTCOMES	FUTURE SCOPE
1	Solar powered autonomus multipurpose agricultural robot using bluetooth	B Ranjitha; M N Nikhitha; K Aruna; Afreen; BT Venkatesh Murthy	2019	IEEE	seed sowing, grass cutting and pesticide spraying using solar power with help of bluetooth	seed sowing, irrigation system urea throwing using solar power with help of bluetooth and remote control
2	Smart Agriculture with AI Sensor by Using Agrobot	B. Ragavi;L. Pavithra;P. Sandhiyadevi;G.K. Mohanapriya;S. Harikirubha	2020	IEEE	Using IOT ,seed sowing,	Using remote control with help of mobile
3	Obstacle Detecting Multifunctional AGRIBOT Driven By Solar Power	Farha Rafath; Sohail Rana; Syeda Zaara Ahmed; Juveria;Raahela Begum; Nishad Sultana	2020	IEEE	seeding, sowing, spraying pesticides with obstacle detection	
4	Automated Seed Sowing Agribot	Y Nikhil Kumar; Ch Haswanth; M Hima Kiran;M Koteswar Rao; Rahul Raj;Gopi Krishna Saramakala;Proma Anonya Chakrobarty	2019	IEEE	The main function is seed sowing	Seed sowing , putting solid fertilizers , Obstacle dition



5	Automated Seed Sowing Agribot using Arduino	Saurabh Umarkar; Anil Karwankar	2016	IEEE	It handles the complete weight of solar panel, battery and the hardware mounted on Agribot which is able to perform each and every operation skillfully and successfully	Using bluetooth and remote control
6	Solar E-bot for Agriculture	P.Jothimurugan, J.Muthu Saravanan, R.Sushanth, V.Suresh,,, H.Siva Subramaniam, S.Vasantharaj., S.Yogeswaran	2013	IEEE	designed to work in the agriculture field in order to reduce the work of the farmers.the main progress of the project which is the spraying system and Weeding unit that entirely works on solar energy.	Seed sowing ,urea sprinkling , irrigation system , obstacle ditecton , remote control using Bluetooth
10	Solar Powered Automated Multi-Tasking Agricultural Robot	Jerosheja B R Dr. Mythili C	2020	IEEE	This system is run by sewing motor. The mechanism used in automatic seed feeder is reduces manual efforts and also reduces the time	Same process by solar energy with irrigation and remote control

					required for seed feeding.	
8	Multipurpose autonomous agriculture robot	K Durga Sowjanya1, R Sindhu1, M Parijatham1, K Srikanth1, P Bhargav1	2017	IEEE	ploughing, seeding, leveling and water spraying	Seed sowing obstacles detection urea throwing, irrigation remote control with the help of mobile & automatic using bluetooth.
9	Agri robot- a multipurpose agricultural robot	Akhila Gollakota, M.B. Srinivas	2018	IEEE	An autonomous robot and field control system which is used for overall functioning of the farm with least use of manpower.	Complete automatic and remote control operated by solar power
7	Solar -Powered Android-Based Speed Control of DC Motor via Secure Bluetooth	Abhishek Khanna, Priya Ranjan	2015	IEEE	Android based speed control of DC motor” smartphone control experimental setup that can be accessed via the Bluetooth.	Same process with seed sowing and irrigation



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