

DESIGNING A SOLAR-POWERED AUTONOMOUS MULTIPURPOSE AGRICULTURAL ROBOT WITH BLUETOOTH/ANDROID APP CONTROL

¹J. Nageswara Rao,²M. Rajyalakshmi, ³Md.Younus,⁴Bandaru Santhi

^{1,2}Assistant Professor, Department of EEE, G V R & S College of Engineering & Technology, Guntur, AP

³Associate Professor, Department of EEE, G V R & S College of Engineering & Technology, Guntur, AP

⁴Student, Department of EEE, G V R & S College of Engineering & Technology, Guntur, AP

Abstract— The paper presents about the multiple agricultural tasks done by the single robot. To develop the efficiency of the agricultural tasks we have to find the new ways. This project deals with a novel approach for cultivating lands in very efficient way. The distinctiveness of this agriculture robot system is it is multitasking abilities which can drill, pick and place, seeding, pumping water & fertilizers, weather monitoring to work in both agriculture, afforestation and gardening platform. The project aim is design, development and the fabrication of the robot which can dig soil, put seeds, roller to close the mud and sprayer to spray water, this whole system of robot works with the help of battery and solar power. More than 40% of the population in the world chooses agriculture as the primary occupation, in recent years the development of the autonomous vehicles in the agriculture has experienced increased interest.

I. INTRODUCTION

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 in Section III. The algorithm implementation is discussed in Section IV. In Section V prototype results of the work are discussed. In Section VI work is concluded.

RELATED WORKS

As there are no efficient equipment's to aid the farmers. There is a need for new techniques to be implemented. Once the idea was formulated, design options were finalised.

In [1], Saurabh Umkar and Anil Karwankar, discussed that the process of seed sowing is a key component of agriculture field. For many crop varieties, high-precision pneumatic planting has been developed for a wide range of seed sizes, resulting to uniform seed distribution in seed spacing along the travel path. Wifi is used as receiver. Main disadvantage of the system is robot moves in only one direction. Whenever there is obstacle power supply is automatically turned OFF.

In [2], M.D. I. Sujon, R. Nasir and Jayasree Baidya, agricultural researcher determined the effects of various seeding techniques and machines and also different rates of oilseed rape application on establishment of seed emergence plant and final yield of grain. The robot will perform farming using analogy of ultrasonic detection in order to change its position. The main disadvantage of this system is, it does not work well on all types of soil.

In [3], H. Pota R Eaton, J Katupitiya and S D Pathirana, concludes that bullock drawn planting becomes a necessity to sow as skilled sowing workers are almost decreasing. Planting distance and plant population are acute factors in maximizing the yield of crops. In this Microcontroller 8051 is used for communication between the input and output devices. The main drawback of this model is, it consists of only one mechanism.

In [4], S. Kareemulla, K Shaik, E Prajwal, B Mahesh, V Reddy, the system benefits farmers in the basic operation of seed sowing. This machine's operating mode is simple. It is possible to increase the total yield percentage effectively. Labour problem can be reduced. As compared to the manual and tractor based sowing time and energy required for this robot machine is less. Also wastage of seed is less. The disadvantage of model is, it consists of only one mechanism.

The above research papers helped to understand the different aspects posed by the research on the agricultural robot. The robots designed in the above literature surveys have many issues with movement of the robot and grass cutting. These problems are effectively addressed in this work. Three mechanisms are implemented in the designed robot unlike the robots designed previously. This work also throws light on the future scope of robots.

I. PROPOSED DESIGN OF MULTIPURPOSE AGRICULTURAL ROBOT

Multipurpose agricultural robot is shown in Fig.1.

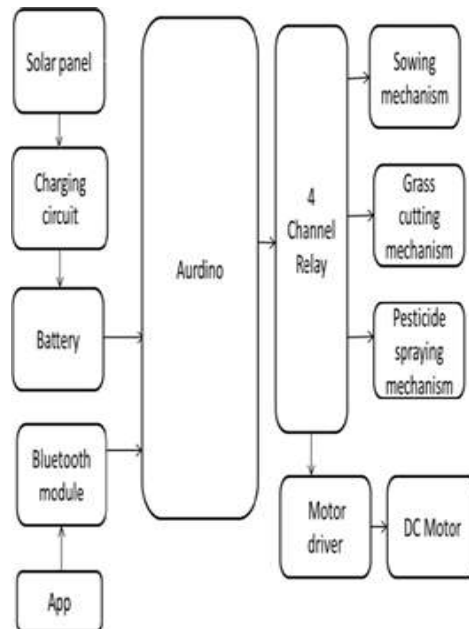


Fig.1. Block diagram of the Automated Seed Sowing, Grass Cutting and Pesticide Sprayer Robot Using Bluetooth/AndroidApp.

The block diagram consists of arduino microcontroller which is controller for the whole system as shown in Fig.1 and solar panel is connected to the battery for storing energy and further it is given to power supply charging circuitry which is providing +5 V for arduino board and +12 V supply for driving DC motors using L298 motor driver module. Bluetooth HC05 is connected with arduino and wirelessly with Android smartphone to controlling the whole system.

A. Arduino Microcontroller (ATmega 328)

Arduino Atmega328 microcontroller as shown in Fig. 2 is used to command the various components. The arduino atmega328 microcontroller and its architecture is shown in Fig. 2. The Atmega328 microcontroller has 28 pins. It has 13 I/O digital pins, of which 5 can be used as PWM outputs and 5 as analog input pins.

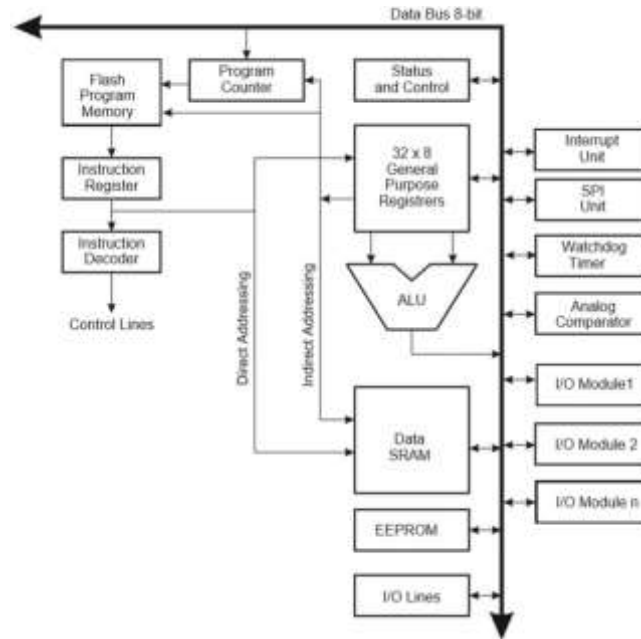


Fig.2. Architecture of Arduino Atmega328 microcontroller.

B. Solar Panel

The solar cells that are seen on satellites and calculators are also called photo voltaic (PV) cells as shown in Fig.3, which as the name implies (photo meaning "light" and voltaic meaning "electricity"), convert solar energy directly into electrical energy. A module is a group of cells which is electrically connected and packed into a frame (most commonly referred to as solar panel). Solar panels are a great way to cut your electricity that everyone wants to live on their own or at least reduce our home's carbon footprint, and solar panels make this dream possible. Solar panels are made of photovoltaic (PV) cells, which convert sunlight into electricity.



Fig. 3. Solar panel.

C. Bluetooth Module HC-05

HC05 module is pretty easy to use and bluetooth Serial Port Protocol (SPP) module is fabricated for transparent wireless serial connection setup. The HC-05 bluetooth module can be used to communicate between two microcontrollers like arduino or communicate with any device with Bluetooth functionality like a Phone or Laptop and is shown in the Fig.4. To control the entire system, Bluetooth HC05 is connected to arduino and to android smartphone wirelessly. Pairing the HC-05 module with microcontrollers is very easy because it works using the SPP [5-8].

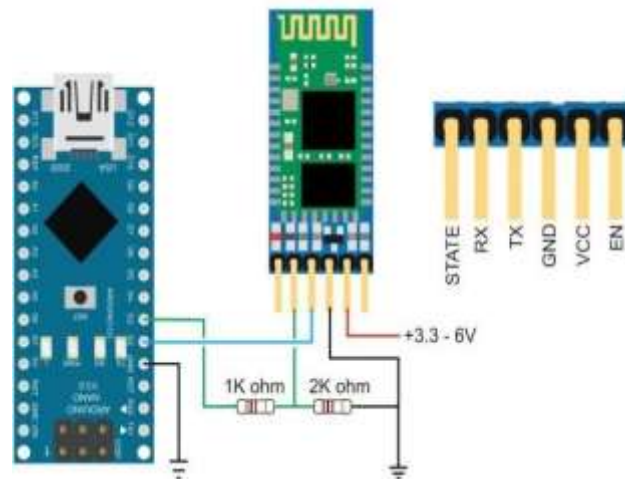


Fig.4. Interfacing relay with Arduino.

D.Motor Driver IC L293D

The motor driver is a module for motors that allows to control the working speed and direction of two motors simultaneously. The motor driver is designed and developed on the basis of L293D IC. L293D is a 16 pin motor driver IC as shown in Fig.5. It provides bidirectional drive currents at voltages ranging from 5 V to 36 V. The L293D is an IC with eight pins on each side to control two DC motors simultaneously. It consists of 4 input pins, 4 output pins and 2 enable pins for each motor[9-10].

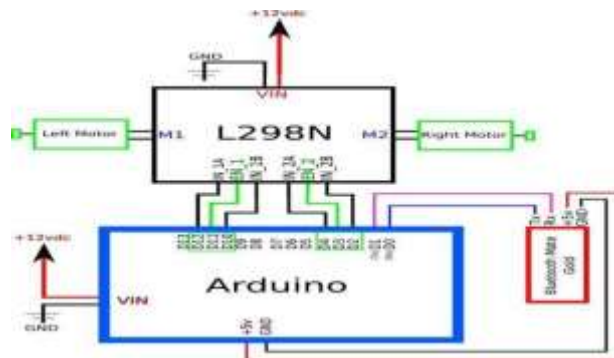


Fig.5. Interfacing Motor Driver with Arduino.

E. Relay

A relay is an electrically operated switch as shown in Fig.6. It uses an electromagnet to operate mechanically as a switch, but other operating principles are also used such as solid-state relays. Relays are used by a separate low-power signal to control a circuit, or by a single signal to control multiple circuits. Relays were used extensively to perform logical operations in telephone exchanges and early in computers [11- 12].

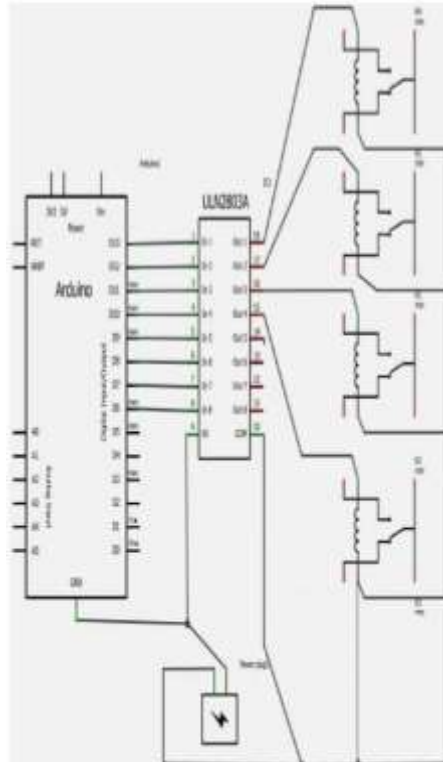


Fig.6. Interfacing relay with Arduino.

II. IMPLEMENTATION OF ALGORITHM

The flow chart in Fig.7 explains the algorithm of automated seed sowing, grass cutting and pesticide sprayer 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 4robot 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.

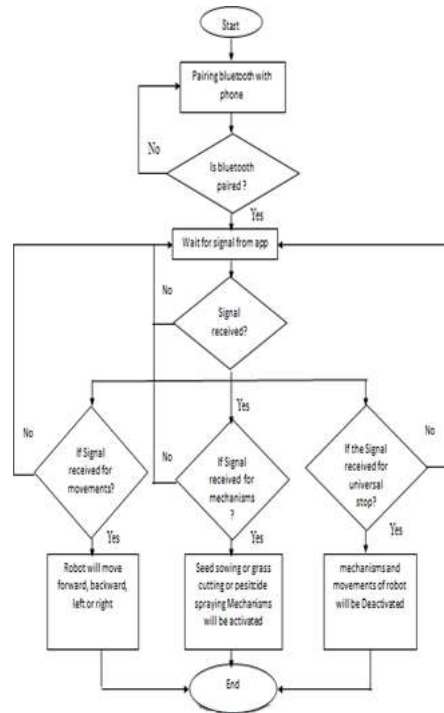


Fig.7. Flowchart of the Automated Seed Sowing, Grass Cutting and Pesticide Sprayer Robot Using Bluetooth/AndroidApp.

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.

Fig.8 shows the entire 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.

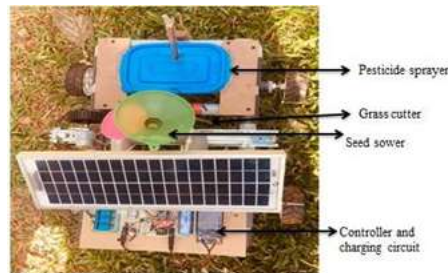


Fig.8. Snapshot of the Automated Seed Sowing, Grass Cutting and Pesticide Sprayer Robot Using Bluetooth/Android App.

The solar panel shown in Fig.9 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.

II. PROTOTYPE RESULTS AND DISCUSSION

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 motor driver is used to drive the DC motors which run the robot. The model

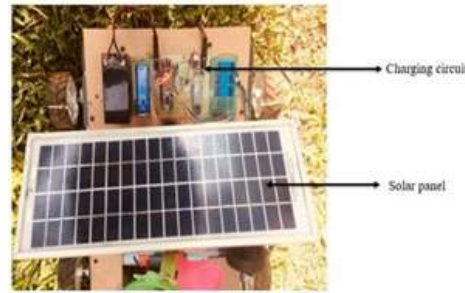


Fig.9. Snapshot of solar charging.

The bluetooth/android app which is used to control the robot is shown in Fig.10. 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. The remaining keys like grass, spray, see dare used to activate the mechanisms. All OFF key is helpful in deactivating the mechanisms and it will stop the movement of robot.

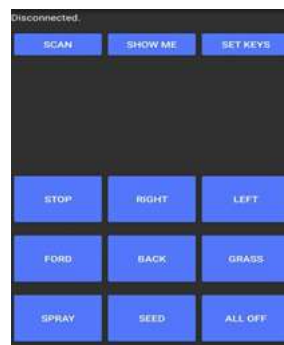


Fig.10. Snapshot of Bluetooth/Android App.

In seed sowing mechanism, a funnel is used to store the seeds. A slider with hole is provided in order to sow the seeds in ground at regular intervals. The slider moves on the basis of toand fro motion with the help of DC motor which is fixed to slider as shown in Fig.11.

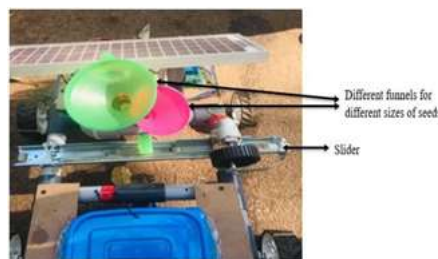


Fig.11. Snapshot of seed sowing mechanism.

The grass cutting mechanism consists of rotating blades having a sharpened knife edge on both sides to cut the waste grass efficiently is as shown in Fig.12. The blades work according to the principle of slicing with the help of DC motor.

In pesticide sprayer mechanism, a container is used for the storage of the pesticide solution. A mini submersible pump which is used for pumping the pesticide to the pesticide sprayer which is kept inside the container. The pesticide sprayer is as shown in the Fig.13.



Fig.12. Snapshot of Grass cutting mechanism

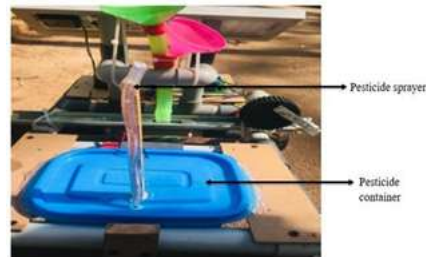


Fig.13. Snapshot of seed Pesticide sprayer mechanism.

III. CONCLUSION

An autonomous multipurpose agricultural robot is designed to perform the complex farming tasks like seed sowing, grass cutting and pesticide spraying. This work is designed to perform sowing of two different sized seeds. The benefits of robot are reduced human intervention and efficient resources utilization. Instructions are passed to the system using bluetooth which ensures no direct contact with human and thus safety of operator is ensured. The robot is solar powered hence it is renewable energy source. The operations are performed using android app. Innovative seed sowing, grass cutting and pesticide sprayer equipment has significant influence in agriculture. By using this advanced work, farmer can save more time and also reduce lot of labour cost.

IV. REFERENCES

- [1] S. Umalkar and A. Karwankar, "Automated Seed Sowing Agrirobot using Arduino," in IEEE Conference on Communication and Signal Processing, April 2016, pp. 1379-1383.
- [2] M.D.I. Sujon, R. Nasir, M.M.I. Habib, M.I. Nomaan J. Baidya and M.R. Islam "Agrirobot: Arduino Controlled Autonomous Multipurpose Farm Machinery Robot for Small to medium scale cultivation," in IEEE conference on intelligent autonomous systems, March 2018, pp. 155-159.
- [3] H. Pota, R. Eaton, J. Katapriya and S. D. Pathirana, "Agricultural robotics: A streamlined approach to realization autonomous farming," in IEEE conference on industrial and information systems, 2007, pp. 85-90.
- [4] S. Kareemulla, E. Prajwal, B. Sujeshkumar, B. Mahesh, and V Reddy, "GPS based Autonomous Agriculture Robot," in IEEE International conference on design innovations for 3Cs compute communicate control, 2018, pp. 100-105.
- [5] HC-05 - Bluetooth Module, Available: <https://components101.com/wireless/hc-05-bluetooth-module>", accessed on September 2018.
- [6] P.V. Santhi, N. Kapileswar, V.K.R. Chenchela and C.H.V.S Prasad, "Sensor and vision based autonomous agrirobot for sowing seeds," in IEEE International conference on energy communication, data analysis and soft computing(ICECDS), 2017, pp. 242-245.
- [7] P.V.S. Jayakrishna, M.S. Reddy, N.J. Sai, N. Susheel and P. Peeyush, "Autonomous seed sowing agricultural robot," in IEEE Conference on advances in computing, communications and informatics (ICACCI), 2018, pp. 2332-2336.
- [8] N.S. Naik, V.V. Shete and S.R. Danve, "Precision agriculture robot for seeding function," in IEEE International conference on inventive computation technologies (ICICT), 2016, pp. 1-3.
- [9] M.U. Hassan, M. Ullah and J. Iqbal, "Towards autonomy in agriculture: Design and prototyping of a robotic vehicle with seed selector," in IEEE International conference on robotics and artificial intelligence (ICRAI), 2016, pp. 37-44.
- [10] S. Konam, N. Srinivasa Rao and K. Mohan Krishna, "Design encompassing mechanical aspects of

- ROTAAI: Robot to aid agricultural industry,” in IEEE International conference on soft computing and machine intelligence, 2014, pp.15-19.
- [11]C.M. Barber, R.J. Shucksmith, B.M. Donald and B.C. Wunsche, “Sketch-based robot programming,” in IEEE International conference of image and vision computing newzealand, 2010, pp. 1-8.
- [12]A. Srinivastava, S.Vijay, A. Negi, P.Shrivastva, A.Singh, “DTMF based intelligent farming robot vechile: An ease to farmers, “in IEEE International conference on embedded systems, 2014, pp. 206-210.