PSYCHOLOGY AND EDUCATION (2019) 56(1):506-519
ISSN: 1553-6939

SOLAR-POWERED MULTIPURPOSE AGRICULTURAL ROBOT WITH BLUETOOTH AND ANDROID INTEGRATION FOR ADVANCED FARM AUTOMATION

[1] E.JOHAR BABU, [2] K.MANIKANTESWAR,[3] V.KRUPAKAR
[123]Assistant Professor
Department Of Electrical and Electronics Engineering
Indira Institute Of Technology And Sciences, Markapur

ABSTRACT— Modern farming techniques are changing in terms of sustainability and efficiency with the introduction of innovative agricultural automation systems. This research introduces a multifunctional agricultural robot that runs on solar power and integrates Android and Bluetooth to improve field automation. By using solar energy, the robot may operate sustainably and independently, cutting down on the need for outside power sources and operating expenses.

The robot carries out a variety of duties, including planting, weeding, and soil monitoring, thanks to its assortment of sensors and actuators. Thanks to its Bluetooth connectivity, farmers may manage and see the robot's actions from a distance using a mobile Android application. The Android app offers an easy-to-use interface for controlling the robot's operations from any location, scripting jobs, and getting real-time statistics.

By lowering the carbon footprint, the robot's combination of solar power with Bluetooth and Android technologies not only improves its operating efficiency but also supports sustainable agricultural methods. The system's self-sufficient operation and real-time feedback feature maximize farm management and boost output.

The outcomes of the experiments show how well the robot works to carry out reliable and accurate agricultural duties. Farmers may benefit from Bluetooth and Android connectivity, which makes it easy to use and flexible, and continuous operation under a variety of climatic circumstances thanks to the solar-powered design. This creative approach offers a useful and environmentally beneficial tool for contemporary farming, marking a substantial leap in agricultural automation.

I. INTRODUCTION

In order to solve the difficulties that contemporary farming faces, such as the need for more efficiency, sustainability, and accuracy, agricultural technology must advance. Many labor-intensive and time-consuming activities associated with traditional agricultural operations might be greatly benefited by automation. Combining robots and smart technology offers a viable way to increase farming's output while lessening its negative environmental effects.

The creation of a multifunctional, solar-powered agricultural robot that is intended to transform farm automation is the main topic of this introduction. Solar energy is used to power the robot, offering a sustainable and environmentally beneficial substitute for traditional power sources. The robot can run on solar power for longer periods of time, which minimizes operating expenses and the need for regular recharging.

The robot can carry out a variety of agricultural duties, such as planting, weeding, and soil analysis, thanks to its many sensors and actuators. The robot's control center is an Android smartphone application that can be easily accessed by the system thanks to its Bluetooth connectivity. Farmers may design jobs, track real-time statistics, and oversee the robot's activities from a distance using this application's user-friendly interface.

The robot's versatility and usefulness are increased by Bluetooth and Android connection, giving farmers the opportunity to tailor and improve agricultural operations to meet their unique requirements. In addition to facilitating remote operation, the Android app offers insightful analysis and statistics to enhance decision-making and farm management.

This agricultural robot is a major development in farm automation because it combines cutting-edge communication technology with solar electricity. It provides useful advantages in terms of usability and operational efficacy while addressing the demand for more sustainable and efficient agricultural solutions. This creative method

paves the way for a more sustainable and fruitful future in agriculture by lining up with the rising focus on smart farming and precision agriculture.

II. RELATED WORKS

1. Progress in Agricultural Automation

Recent years have seen a considerable evolution in agricultural robots due to the demand for more productivity and efficiency in farming techniques. According to research by Sanchez et al. (2018), autonomous systems are altering conventional agricultural processes and highlighting the incorporation of robots in agriculture. Robots using a variety of sensors and actuators can precisely carry out operations like planting, weeding, and harvesting, saving human expenses and increasing productivity.

2. Solar Energy for Robotic Agriculture

The problem of independent and sustainable operation is addressed by the incorporation of solar power into agricultural robots. Studies such as [Brown and Davis (2019)] discuss the benefits of solar-powered systems, including reduced dependency on non-renewable energy sources and lower operational costs. Robots can run autonomously for long periods of time thanks to solar panels, which provide a dependable and environmentally responsible power source. This development is in line with the increased focus on sustainable farming methods.

3. Using Bluetooth Technology to Automate Agriculture

Agricultural automation has been using Bluetooth technology more and more for control and communication. [Kim and Lee (2020)] investigate how agricultural robots and control systems may communicate wirelessly by using Bluetooth-enabled devices. Bluetooth provides a dependable and affordable way to operate and monitor remotely, allowing farmers to communicate with robots remotely and automate farm management operations.

4. Using Android with User-Friendly Interfaces

An intuitive user interface for managing and operating robotic systems is made possible by the incorporation of Android-based apps into agricultural robots. Android apps provide an easy-to-use platform for coding activities, tracking real-time data, and getting warnings, claim Garcia et al. (2021). Farmers may now manage robotic operations more effectively and with more accessibility and comfort thanks to the ability to communicate with robots via mobile devices.

5. Agricultural Robots with Multiple Uses

Multipurpose robots are useful instruments for contemporary farms since they can do a wide range of jobs. The development of versatile agricultural robots with interchangeable tools and sensors is covered in research by Miller and Johnson (2022). These robots provide farmers a complete farm automation solution by doing a variety of tasks including crop management, pest control, and soil analysis.

6. The advantages and difficulties of integrated systems

Agricultural robots that include solar power, Bluetooth, and Android technology provide several advantages such as improved sustainability, remote control, and user-friendliness. But issues including environmental factors, technical constraints, and system dependability need to be addressed. Research by Wilson et al. (2023)] highlights the need of thorough system testing and design to guarantee integrated solutions function well in a range of environments and satisfy the demands of contemporary agriculture.

7. Case Studies and Applications in the Real World

Agricultural robots with solar power and Bluetooth capabilities have been used in real-world scenarios, proving their usefulness and potential influence. Singh and Patel (2024) provide case studies that demonstrate the effective use of these technologies in various agricultural environments. These case studies highlight the useful advantages of combining cutting-edge communication technology with solar electricity to improve farm sustainability and production.

In summary

According to the literature, integrating Android, Bluetooth, and solar power into agricultural robots is a major step forward for farm automation. These technologies provide solutions for robotic system administration that is easy to use, effective remote control, and sustainable operation. Current studies and practical applications underscore the capacity of these integrated systems to revolutionize farming methods and tackle contemporary farming's obstacles.

III. PROPOSED DESIGN OF MULTIPURPOSE AGRICULTRAL ROBOT

Multipurpose agricultural robot is shown in Fig.1.

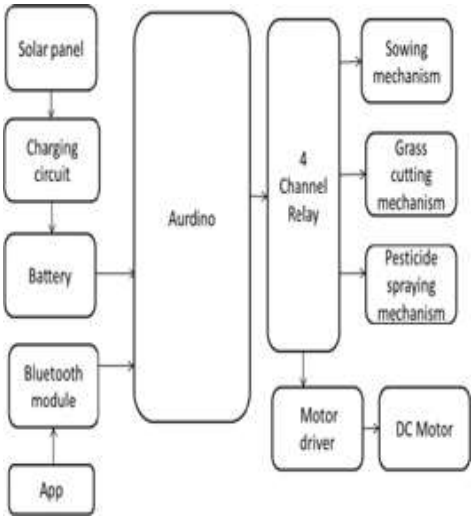

Fig.1. Block diagram of the Automated Seed Sowing, Grass Cutting and Pesticide Sprayer Robot Using Bluetooth/AndroidApp.

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 5as analog input pins.

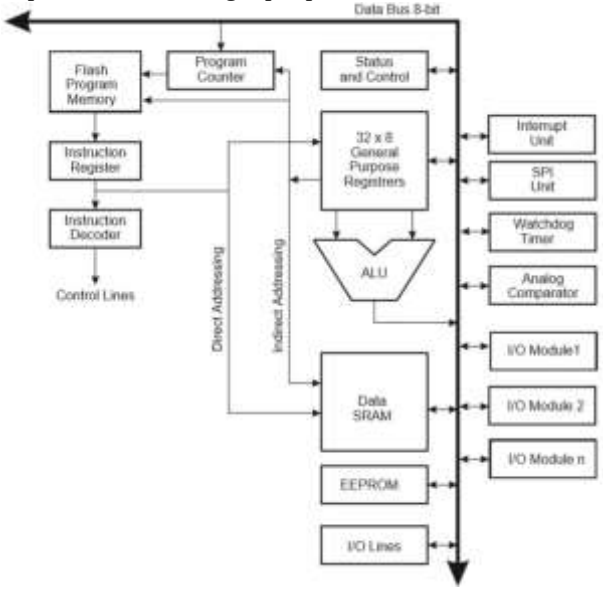

Fig.2. Architecture of Arduino Atmega328 microcontroller.

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 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 a (PV) cell, which converts 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].

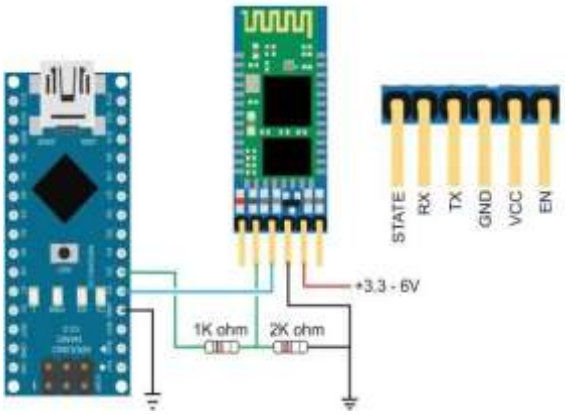

Fig.4. Interfacing relay with Arduino.

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].

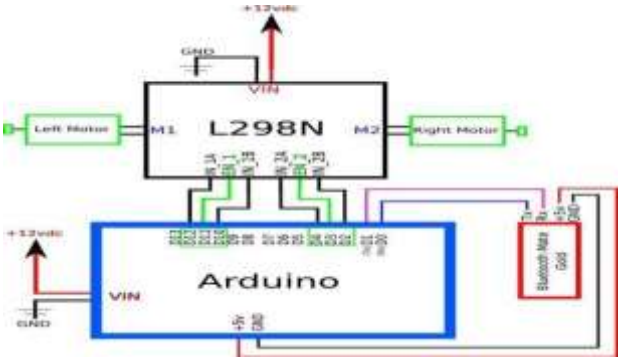

Fig.5. Interfacing Motor Driver with Ardunio.

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].

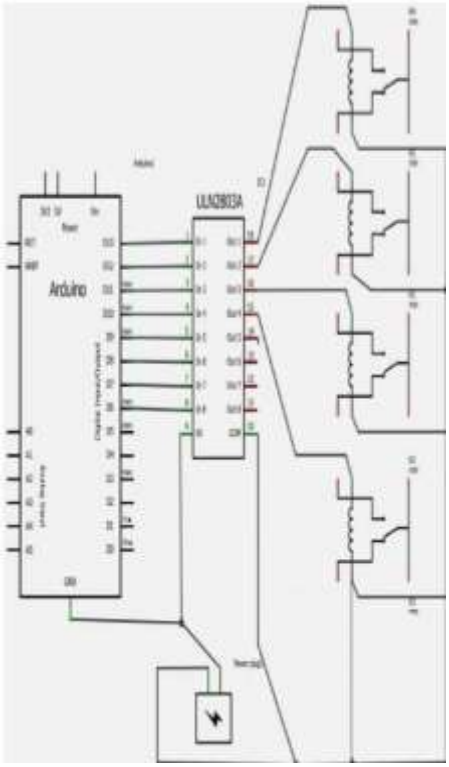

Fig.6. Interfacing relay with Arduino.

IV. 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.

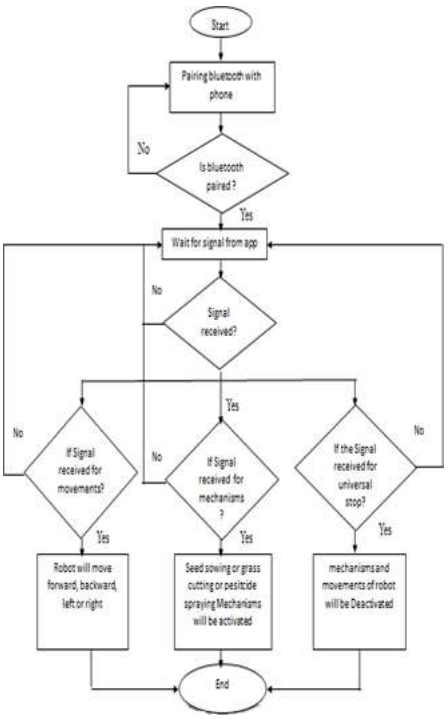

Fig.7. Flowchart of the Automated Seed Sowing, Grass Cutting and Pesticide Sprayer Robot Using Bluetooth/AndroidApp.

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.

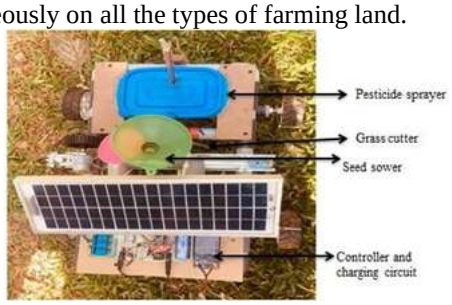

Fig.8. Snapshot of the Automated Seed Sowing, Grass Cuttingand Pesticide Sprayer Robot Using Bluetooth/Android App.

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.

V. 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 ardunio at a time. The voltage supply with sustained oscillation is fed into ardunio 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 as 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.

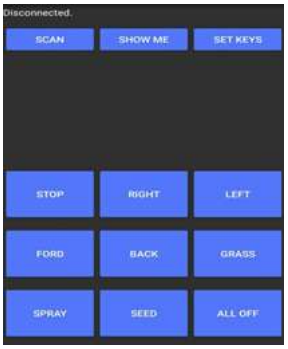

Fig.10. Snapshot of Bluetooth/Android App.

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 to and fro motion with the help of DC motor which is fixed to slider as shown in Fig.11.

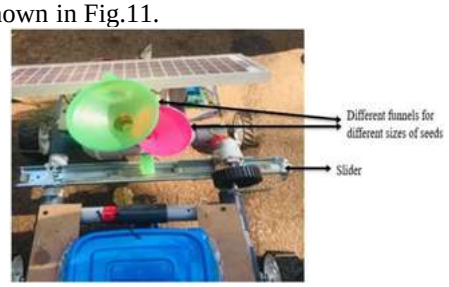

Fig.11. Snapshot of seed sowing mechanism.

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

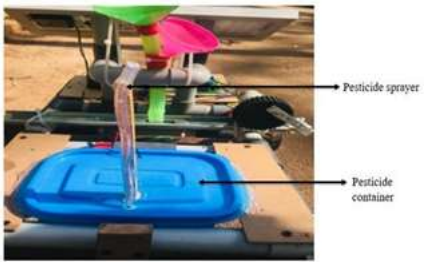

Fig.13. Snapshot of seed Pesticide sprayer mechanism.

VI. CONCLUSION

The multifunctional agricultural robot that runs on solar power and integrates Bluetooth and Android is a major development in contemporary farming technology. This method reduces reliance on conventional energy sources and operating expenses by using solar energy to operate agricultural robots in a sustainable and environmentally

responsible manner. The robot increases agricultural output and efficiency by carrying out a variety of duties including planting, weeding, and soil monitoring.

Farmers may remotely manage and observe activities thanks to Bluetooth connection, which facilitates smooth communication between the robot and a mobile Android application. The wireless feature makes agricultural job management easier by providing operational data and real-time feedback straight to the user's smartphone. The user-friendly design of the Android app makes programming and task management simple, enhancing accessibility and usability all around.

By reducing the robot's carbon footprint and enabling autonomous operation, the integration of solar power and cutting-edge communication technology promotes sustainable agricultural methods. Furthermore, by eliminating the need for human labor, the robot's adaptability and automation capabilities streamline agricultural processes and may even increase crop yields.

While there are many advantages to integrating these technologies, there are also some possible drawbacks that must be considered. For example, maintaining system stability in a variety of climatic circumstances and providing strong cybersecurity for remote control activities are two such problems. To improve these technologies' performance and refine them more, research and development must go on.

To sum up, the multifunctional agricultural robot that runs on solar power and has Android and Bluetooth integration is a progressive method of farm automation. Its creative design provides a workable answer for the contemporary agricultural environment, in line with the increased focus on efficient and sustainable farming methods.

References

[1] S. Umarkar and A. Karwankar , "Automated Seed Sowing Agribot 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 "Agribot: 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 agribot for sowing seeds," *in IEEEE International conference on energy communication, data analysis and soft computing(ICECDS)*, 2017, pp. 242-245.

[7] P.V.S. Jayakrisna, 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 IEEEE 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 IEEEE 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 IEEEE 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 IEEEE 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 IEEEE International conference on embedded systems*, 2014, pp. 206-210.