International Journal of Electrical and Electronics Engineers
Volume 17, Issue No. 01, Jan-June 2025
ISSN (O) 2321-2055
ISSN (P) 2321-2045

DESIGN AND IMPLEMENTATION OF SOLAR POWERED MULTIFUNCTION AGRIBOT FOR INCREASED AGRICULTURE YIELD

S.G.Huddar[1], Suraj. N. Satwar[2], Shivam. R. Metri[3], Satyagouda. K. Patil[4], Arun. B. Ghatage[5]

[1,2,3,4,5]. *Electrical and Electronics Engineering Department,*
Hirasugar Institute of Technology, Nidasoshi, Karnataka, India

ABSTRACT

The agricultural area faces numerous challenges, including shortage of labor, inefficient resource use, and climate unpredictability. This paper demonstrates a smart agricultural robot (Agribot) designed using block-based programming to address these issues. By integrating IoT technologies, the Agribot performs essential farming tasks such as ploughing, sowing, and monitoring environmental conditions. Real-time data acquisition and control are facilitated through a Bluetooth-enabled mobile application developed using MIT App Inventor. The system's hardware, powered by an Arduino Uno, includes moisture and NPK sensors and servo motors. This user-friendly, cost-effective solution has the potential to modernize farming practices, improving productivity and sustainability.
Keywords: ploughing, sowing.

INTRODUCTION

Agriculture, a cornerstone of human civilization, is at a crossroads where traditional practices must evolve to meet modern challenges. Factors such as shortage of labor, resource inefficiencies, and climate variations makes it necessary to adopt different technology-driven solutions. IoT and robotics are transforming farming practices, enabling automation and data-driven decision-making. This paper proposes a smart Agribot that automates critical farming tasks, leveraging block based programming for rapid development. The Agribot integrates sensors for monitoring environmental conditions and actuators for executing tasks like ploughing, sowing and watering. It's controlled through a user-friendly mobile app, providing real-time control capabilities. This innovation aims to bridge the gap between small-scale farmers and advanced agricultural technologies.

1.1 Objectives

- To develop a low-cost, multifunctional Agribot for smart agriculture.
- To simplify IoT prototype development using block-based programming.
- To enable real-time monitoring and control of farming operations through a mobile application.

International Journal of Electrical and Electronics Engineers
Volume 17, Issue No. 01, Jan-June 2025
ISSN (O) 2321-2055
ISSN (P) 2321-2045

1. METHODOLOGY

The agriculture robot is an advanced solution designed to automate key farming tasks such as soil testing, seed dispensing, nutrient addition, and ploughing. At the heart of the system is an Arduino microcontroller, which serves as the brain of the robot, controlling all its functions based on inputs from sensors and commands received via a Bluetooth-enabled mobile app. The robot uses NPK and moisture sensors to assess soil quality and nutrient content, with the data being transmitted to the app for real-time monitoring by the user. The robot is powered by a robust power supply unit that ensures reliable operation of all components, including servo motors, DC motors, and sensors. Servo motors are employed for precise actions such as dispensing seeds and nutrients (Nitrogen, Phosphorus, Potassium) and dipping a soiltesting probe into the ground. The DC motors, controlled by a motor driver, handle the robot's movement, enabling it to navigate forward, backward, and turn left or right, as well as drive the ploughing mechanism. The working of the robot begins with initialization, during which it establishes a Bluetooth connection with the user’s mobile device. Soil testing is conducted first, where the robot dips the soil probe and collects NPK and moisture data, which is displayed on the mobile app. Based on these readings, the user can command the robot to dispense seeds and nutrients in precise quantities. Movement commands allow the robot to navigate to the next area for processing. The ploughing mechanism can also be activated and deactivated as needed to prepare the soil for planting. This project is designed for efficiency & automating repetitive farming tasks to reduce human effort while improving productivity. With its modular design, the robot can easily integrate additional functionalities such as irrigation systems or more advanced soil analysis tools. It is a scalable and userfriendly solution that leverages automation, IoT technology to address modern agricultural challenges. The fig 2.1 block diagram represents an automated agriculture robot designed for efficient farming tasks. At its core is an Arduino Uno microcontroller, which serves as the brain of the system, controlling all operations and ensuring seamless coordination between various components. The robot is powered by a solar panel and a battery, with the solar panel providing sustainable energy while the battery ensures consistent power supply. To navigate and perform its tasks, the robot uses four DC motors connected to a motor driver L298N, which translates the Arduino’s control signals into highcurrent outputs to drive the motors. These motors enable the robot to move forward, backward, or turn left and right, providing complete mobility.The system includes several sensors for monitoring soil conditions. A moisture sensor measures the soil's water content, while an NPK sensor analyses the levels of nitrogen, phosphorus, and potassium, providing critical data on soil fertility. This information is processed by the Arduino and displayed on a mobile app created using MIT App Inventor. The Bluetooth module (HC-05) facilitates wireless communication between the robot and the app, allowing the user to send commands and monitor real-time data remotely. The robot is equipped with servo motors for precise mechanical operations. One servo motor dispenses seeds into the soil, while three additional servo motors dispense nutrients (nitrogen, phosphorus, and potassium) based on the NPK sensor readings. Another servo motor handles the dipping mechanism for soil testing, lowering and raising the soil probe as needed. Additionally, a geared motor powers the ploughing mechanism to prepare the soil, while a motor pump irrigates the field when moisture levels are insufficient.The entire system is controlled via a mobile app, which acts as a user-friendly interface. The app allows the user to send movement commands, activate ploughing, dispense seeds and nutrients, and control irrigation. This integration of renewable energy, sensor technology, and automated mechanisms makes the robot a versatile and efficient tool for modern agriculture, reducing labour and improving productivity.

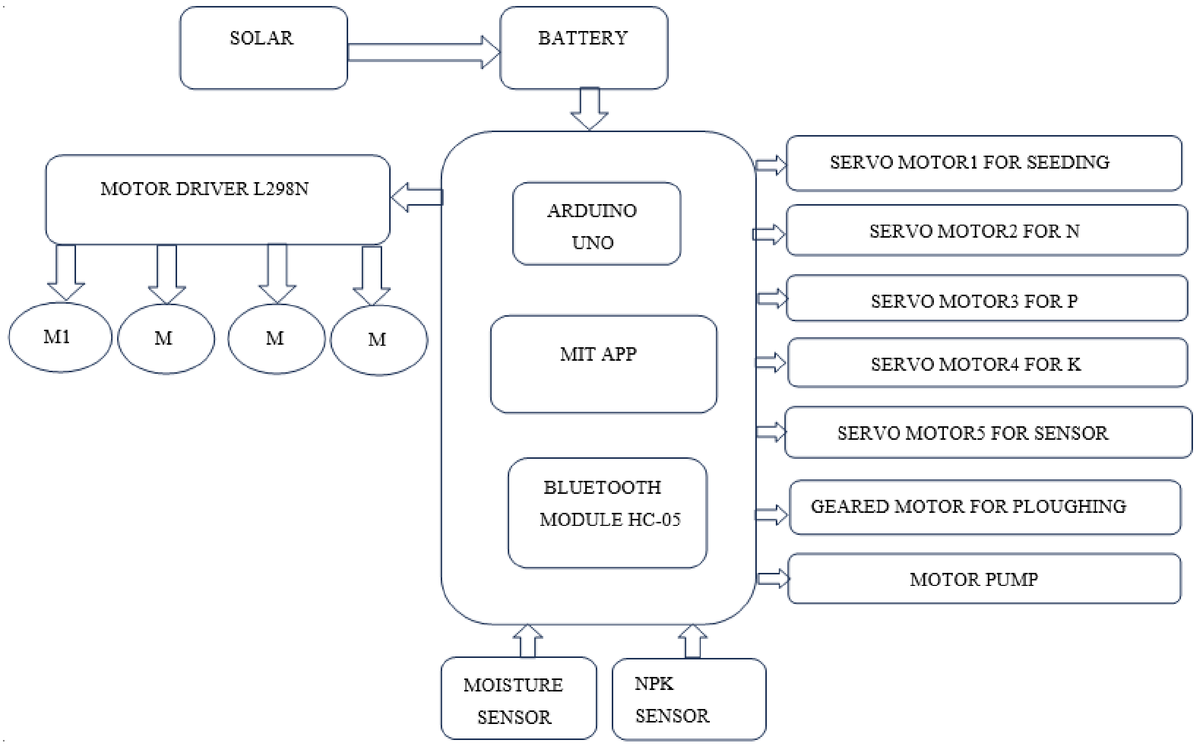

Fig 2.1Block Diagram

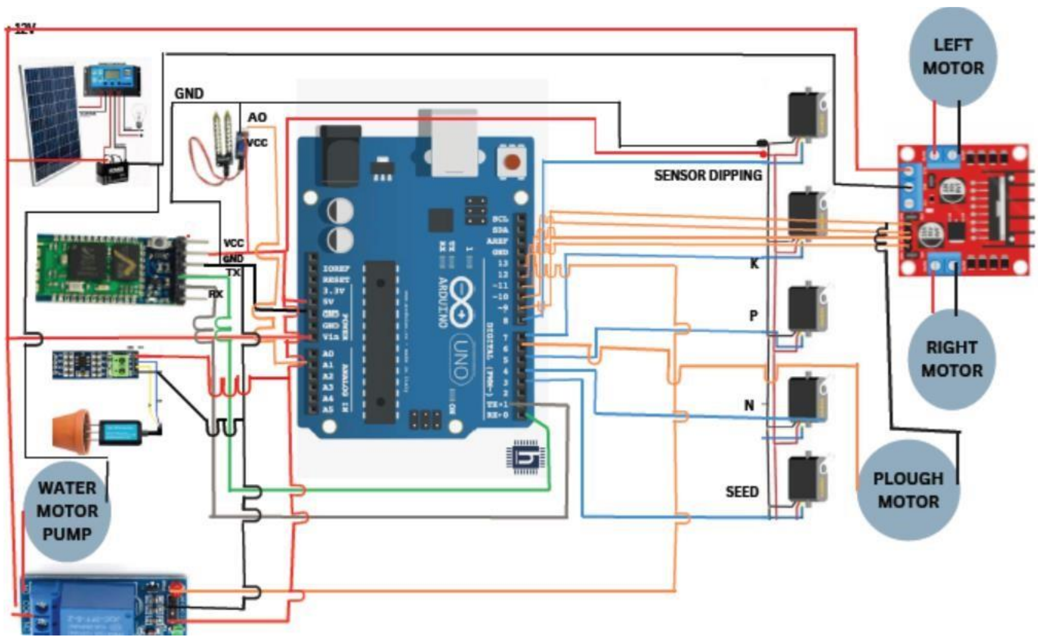

Fig 2.2: Circuit diagram

Circuit is the integration of the Arduino Uno, sensors, motors, and other components. The Arduino Uno acts as the central processing unit, connected to various inputs and outputs. Power is supplied by a combination of a battery and solar panel, ensuring consistent operation. The motor driver L298N controls the movement of the robot through its left and right motors, as well as the water pump motor and plough motor. The connections for the motor driver include inputs from the Arduino's digital pins, which send control signals to enable forward, backward, and directional movements. The servo motors, responsible for seeding, nutrient dispensing (N, P, K), and sensor dipping, are connected to specific PWM pins of the Arduino, allowing precise angular control. The sensors, including the moisture and NPK sensors, are connected to the analog pins of the Arduino for data acquisition. The Bluetooth module facilitates communication with the MIT App, enabling the user to send commands wirelessly and monitor system status. All components are grounded to ensure a common electrical reference.

3. SOFTWARE TOOLS

Here's an explanation of the **Software Tools** used in this project:

1. MIT App Inventor

- **Purpose:** To create a custom mobile application for controlling the robot wirelessly via Bluetooth.
- **Features Utilized:**
  - **User Interface Design:** Allows the creation of an intuitive interface for users to send commands (e.g., move forward, backward, turn, or start irrigation).
  - **Bluetooth Integration:** Provides blocks to connect to the Bluetooth module for realtime communication with the robot.
- **Function in Project:**
  - Acts as the remote control for the robot.
  - Sends instructions to the Arduino through the Bluetooth module based on user input.
- **Advantages:**
  - No need for extensive programming knowledge.
  - Provides a platform-independent application that works on Android devices.

Programming Interface: Drag-and-drop block programming enables simple and visual implementation of logic. The block codes are:

3. ADVANTAGES, DISADVANTAGES, AND APPLICATIONS

3.1 **Advantages:**

a. Cost-effective and scalable solution for small-scale farmers: The robot's design and functionality are tailored to meet the needs of small-scale farmers without incurring high costs. Its modular and scalable nature allows farmers to start small and expand the system as their needs grow.

b. Real-time data acquisition enhances decision-making: With built-in sensors and data collection capabilities, the robot provides farmers with real-time information about soil, crops, and environmental conditions. This data helps optimize farming practices and improves productivity by enabling precise decision-making.

c. Simplified development using block-based programming: The use of block-based programming simplifies the process of customizing and operating the robot. Even individuals with minimal programming experience can design tasks and workflows, making it accessible to a wider audience.

3.2 Disadvantages:

a. Limited scalability for large-scale agricultural applications:

b. The robot is primarily designed for small-scale operations, which may limit its efficiency in handling larger agricultural areas or more complex farming needs.

c. Battery maintenance requirements:

d. The robot relies on battery power, which requires regular charging and maintenance. This dependency might be a challenge in regions with inconsistent power supplies or for users unfamiliar with battery upkeep.

3.3 Applications:

a. Small-scale precision farming: The robot is ideal for tasks that require precise control over planting, fertilization, and pest management in small-scale farming operations.

b. Automated seeding and irrigation: It can automate repetitive farming tasks such as planting seeds and delivering water to crops, saving time and reducing manual labour.

c. Environmental monitoring in greenhouses: Equipped with sensors, the robot can monitor temperature, humidity, and soil conditions in greenhouses, helping maintain optimal growth environments for plants.

4. CONCLUSION

The Agribot prototype successfully automates essential farming tasks. Testing in simulated environments demonstrated its effectiveness in reducing manual labour and improving resource efficiency. Real-time monitoring via a mobile app ensures farmers can make informed decisions, promoting sustainable practices.

REFERENCES

[1]. Meenaxi M Raikar et al., "IoT Prototyping Using Block-based Programming: A Use Case of Smart Agriculture," IEEE Conference, 2023.

[2]. MIT App Inventor, "Online IoT Development Platform," Accessed December 2022.

[3]. N. Perumalsamy et al., "Design of Faulty Switching Detection and Alert System," IEEE Access, 2022.

[4]. M. Ayaz et al., "Internet-of-Things (IoT)-Based Smart Agriculture," IEEE Access, 2019.