IoT-based Agribot with Parameter Monitoring using Android Application

B. Suresh Kumar[1], B. Venkata Sresta[2], A. Penchala Kalpana Devi[2], G. Varalakshmi[2], K. Swetha[2]

[1]Associate Professor, Dept. of ECE, Geethanjali Institute of Science and Technology, Nellore, Andhra Pradesh

[2]UG Students, Dept. of ECE, Geethanjali Institute of Science and Technology, Nellore, Andhra Pradesh

ABSTRACT

Farmers today spend a lot of money on machines that help them decrease labor and increase yield of crops we introduced the automatic machine called Agricultural Robot for automatic ploughing and seeding. This paper strives to develop a solar powered robot capable of performing operations like automatic plough, seed dispensing, and water spraying through IOT application. This system monitor the temperature, humidity and soil moisture parameters status will upload into IOT application. It also provides automatic control robot using IOT module. The main component here is the AVR At mega microcontroller that supervises the entire process. Initially the robot tills the entire field and proceeds to plough, simultaneously dispensing seeds side by side. The device controlled by IOT which continuously sends data to the microcontroller. IOT module used to control the b\robot for directions. Dc geared motors used to plough the soil and releases the seed then water sprinkler automatically sprinkle water for automatic seeding in agriculture. All components are associated to micro controller Arduino. Arduino ATMEGA328 micro controller used to process input and produce output by using ARDUINO IDE with Embedded C programming and operated through Regulated power supply which gives 5v of DC voltage to all hardware modules.

Keywords: Internet of things, Arduino UNO controller, irrigation system, Android application.

1. Introduction

Many agribusinesses are now automated and many automatic machinery and robots commercially available. Seeding, weeding and spraying processes are some of the major farming operations under research and automation. When designing a robot to automate these operations, its idea must be divided into two considerations: the agricultural environment in which the robot system works and amount of precision it provides in the over conventional methods. Based on these environmental considerations, the following are: The robot must traverse on a bumpy farmland road properly in a straight line, the content of soil moisture may vary. The function of soil measuring Sensors to be used in system must be selected by taking into account the environmental effects of agriculture on their operation. In the present situation, accessibility of energy and water are inadequate to full fill the farmer's necessities As the world is inclining towards new advances and usage it is an essential objective to trend up in farming as well. Numerous looks are done in the field of farming and a large portion of them can note and organize the remote sensor use that gather different sensor information conveyed at different hubs and send it through the remote agreement. The information collected give the details of the different agricultural variables. In order to give answer, it is important for these issues to build up a synchronized framework for which wills improve efficiency in each stage. Be that as it may, total robotization in farming isn't accomplished because of different issues. In spite of the fact that it is executed in the exploration level, it isn't given to the farmers as an item to get profited by the assets. Thus, this paper bargains about creating savvy agribusiness utilizing IoT and given to the farmers.The utilizations of helpful robotics technology sector is spreading each day after day to shield furthermore territories, it's like the chance of exchanging human being to remote innovation in farming fields. Looking the farmers day and night for an operational report, affirm to farmers to diminish the ecologically neighbourly effect, increment the working speed, capacity, exactness, hardware size and proficiency, furthermore, oversee singular plants in crisp systems. This is particularly vital when the specialists need be performed their obligations, are really hurtful for the safety or the strength of the workers.

An IoT-based agribot can help automate several farming processes, making them more efficient and precise. With the help of sensors, the agribot can gather real-time data on soil moisture, temperature, and other important parameters, allowing farmers to make data-driven decisions. By automating several processes, the need for manual labor can be reduced, which significantly lower labor costs for farmers.A solar-powered agribot can help reduce dependence on fossil fuels, making farming more sustainable. With the use of renewable energy, farmers can reduce their carbon footprint and contribute to the fight against climate change. By monitoring soil conditions and plant growth patterns, an IoT-based agribot can help farmers optimize crop yields. This can lead to better crop quality and increased profitability. An IoT-based agribot can be remotely monitored, allowing farmers to keep an eye on their fields from anywhere. This can help detect issues early and take corrective action before they become major problems. Overall, an IoT-based solar-powered agribot has the potential to revolutionize the agriculture industry by making farming more efficient, sustainable, and profitable.

2. Literature Survey

Suresh, K., et al.(2019)[1], The basic goal of seed sowing process is to sow the seeds at required depth and at required spacing. The foremost objective of this paper is to design the Agribot (Automatic Seed Sowing Machine) using solar energy. In this proposed system, ultrasonic sensors give the signal to the micro-controller. It gives the signal to the motor driver circuit, then Agribot turns automatically and with the help of a linear actuator it sows the seeds in the next line after sensing the furrows in the agricultural field. Solar panel is used to charge the battery that provides the necessary power to the gear motors. The boost converter is connected between the solar panel and the battery.Rafath, Farha, et al(2020)[2], Mahapurush et al proposed a solar operated automatic pesticide spraying robot to reduce the manpower and use of electricity. The author implemented the prototype with Arduino, ultrasonic sensor,motor drive circuit, relay circuit to pump the sprayer circuit and the battery powered with the help of solar panel. The robot is operated with transmitter and receiver operating at high frequency of 434 Mhz. It is an automated robot that is controlled by Arduino UNO R3. Automation of the robot is achieved by using ultrasonic sensors and Arduino UNO R3. DC motors are used for the operation of cutting of the grass. DC battery is used to power all the components of the system.Sapkal, Kranti G., and Avinash B. Kadam(2020)[3], To enhance the efficiency and safety of production and management of modern agriculture in China, based on the new generation of information technology (IT), an integrated framework system platform incorporating the Internet of Things (IoT). designed. To analyse the information and data collected from different datasets, machine learning techniques plays a big role. The real-time analytics is performed to predict the future condition of the crops based on its past data. Limitations of the system are capturing correct data from large data set and security.Theresearch deployed a sensing network to gather the field data of some crops (Potatoes, Tomatoes, etc). The field data collected from the deployed sensors (air temperature, air humidity, soil moisture, soil temperature, radiation).

YURTSEVER, Cihan, et al(2020)[3], andey, Amit Kumar, and Arpita Mukherjee(2022)[4] In this paper, a comprehensive review of available IoT solution in the areas of the agriculture is presented. Some of the major targeted areas in the agriculture are selected, e.g. soil monitoring, crop monitoring, IoT-based smart irrigation and real-time weather forecasting where automation can be implemented. The IoT-based crop and soil monitoring to reduce wastage by the effective usage of water, thereby increasing crop yield. An IoT architecture in smart agricultural model and a schematic model of IoT-based automated smart agricultural system comprising subsystems like soil health monitoring, crop monitoring, IoT-based smart irrigation and real- time weather forecasting have been presented. Alotaibi, Alanoud, and Farrukh Nadeem(2021)[5], Quantitative methods help farmers plan and make decisions. These methods acknowledge the importance of economizing on available resources among them being water supply and labor. It is through this economizing that farmers maximize their profit. The significance of linear programming is to provide a solution to the existing real-world problems through the evaluation of existing resources and the provision of relevant solutions. This research studies various applications including crop pattern and rotation plan, irrigation water, and product transformation; that have the main role to enhance various facts of the agriculture sector. The review will culminate in a discussion on the different approaches that help optimize agricultural solutions.

Nugraha, Adis Kusyadi, et al(2023)[6], In cultivating timber trees, farmers must pay attention to the seed selection with superior heredity and the condition of the plantation area that supports the growth of nursery plants properly. Several factors that support the growth of nursery plants are nutritional factors, sunlight, temperature, water, and soil moisture. In terms of effectiveness and ease of access to information in monitoring the supporting condition factors and facilitating the farmers, an Android-based monitoring system was built to monitor the growth of nursery plants. The system consists of several sensors, such as soil moisture sensor. S. Umarkar and A. Karwankar (2016)[7], Devoloped 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 agribot. 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 shunt wound DC motor. The sensors are used with the help of Wi-Fi interface operated on Android Application to manoeuvre robot in the field. This brings down labour dependency. Seed sowing and digging robot will move on various ground contours and performs digging, sowing the seed and covers the ground by closing it. D. S. Rahul, S. K. Sudarshan, K. Meghana, K. N. Nandan, R. Kirthana and P. Sure (2018)[9], Designed an IoT based solar powered Agribot that automates irrigation task and enables remote farm monitoring. The Agribot is developed using an Arduino microcontroller. It harvests solar power when not performing irrigation. While executing the task of irrigation, it moves along a pre-determined path of a given farm, and senses soil moisture content and temperature at regular points. At each sensing point, data acquired from multiple sensors is processed locally to decide the necessity of irrigation and accordingly farm is watered. Further, Agribot acts as an IoT device and transmits the data collected from multiple sensors to a remote server using Wi-Fi link. S. Gupta, R. Devsani, S. Katkar, R. Ingale, P. A. Kulkarni and M. Wyawhare (2020)[10], fabricated an agribot which is a multipurpose bot can perform all the farming operations including ploughing the soil of the field, sowing seeds in the ploughing area, making the field in plain by using leveler, watering the crops, fertilizing them and monitor the agribot by using camera. The traditional farming methods consume a lot of manual labour. Some of the operations are manual, while others are operated using manually operated machines. Therefore, there are no such robots, which can perform all these operations autonomously. The farmer has to keep a check on the field for various reasons. This is achieved by the monitoring system. Various parameters such as irrigation, maintaining temperature (for green house farming) will be taken care by using monitoring system.

3. Proposed Methodology

The Agribot based automated irrigation system is controlled using ATmega2560 micro controller programmed on Arduino platform. The Agribot is intended to move on the contour of the rectangular field. Two principle factors required to choose the measure of water required to irrigate the field are soil moisture content and temperature of surrounding environment. Hence, two sensors soil moisture (YL-69 and temperature sensor (LM-35) are utilized to assess the required water for irrigation. These sensors collect the data on the contour of the rectangular field with the help of screw rod mechanism. The data is processed in Arduino micro controller. The Agribot processes and evaluates the data according to which it irrigates the soil near the sensing point uniformly. Furthermore, the data collected from Arduino was transferred to cloud (Thing-Speak) by use of P8266 module. This raw data includes the information of soil moisture sensor and temperature sensor. These data represent the state of the soil. Thus any analysis on this will help to take a decision on future action of irrigation. The primary analysis that this work deals with is the filtering, prediction and compression aspects of the raw data collected. The system has three major parts; sensing, control section and the output section. The soil humidity was detected using YL- 69 soil sensor (a resistance type sensor) and LM35 temperature sensor. The control unit was achieved using ATMega2560 microcontroller based on Arduino platform. The output of the control unit was used to control the irrigation system by switching it on and off depending on the soil moisture content and surrounding environment temperature. The hardware connected to the Agribot comprises of various components required to drive the Agribot. Two H bridges are used to drive the DC motor of the wheels of Agribot, another H bridge is used to run the screw rod mechanism to sense the soil moisture. Relay is used to drive the pump. Solar panels are used to convert solar energy into usable electrical energy using boost convertor. A LM7805 IC regulator is used to convert 12 V DC supply into 5V DC supply which is used to drive the relay.

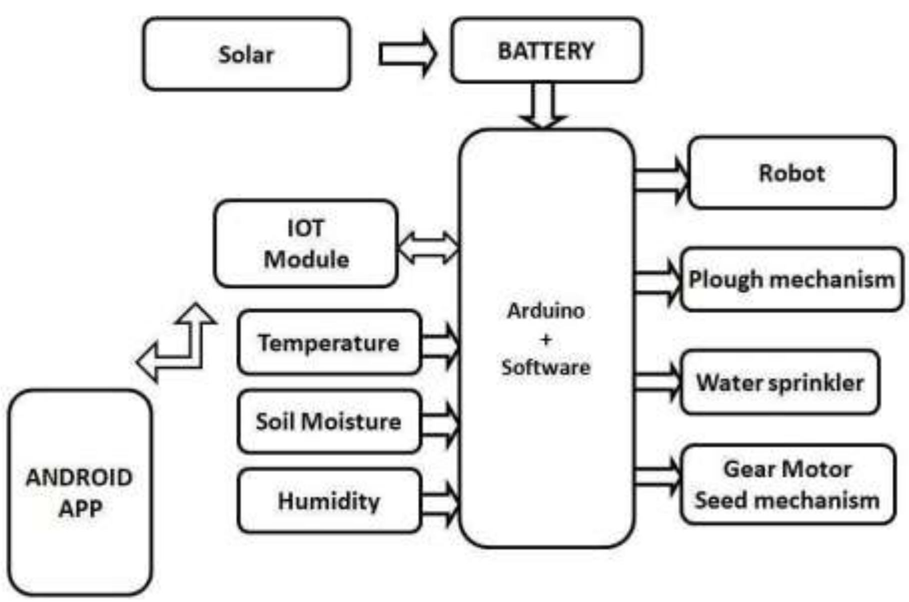

Fig 1: Block diagram of proposed system

3.1 Working

In this system there are totally five sections:

- Regulated power supply
- Input Section
- Output Section
- Arduino Microcontroller
- Software

The RPS module converts the 230 ac volts into 5v of dc. The5v of power supply goes to all components in the system. The IOT server can send the data and display the data in the IOT server app. The output has LCD, motors and IOT module also. In the Arduino microcontroller contains the software programming code Embedded C. The main purpose of the microcontroller is for the data can be control by the microcontroller. Once we should ON the kit first Reset the kit because to connect wi-fi to IOT server. The kit is reset the LCD displays the Solar IOT Agri Robo. After we configure the IOT server by using an TCP Telnet Terminal app. By using our mobile phone we can connect the wi-fi to IOT server. Once the wi-fi is ON the mobile data should be OFF. By using the IP address 192.168.4.1 and port:23 connect the IOT server. We have soil moisture sensor, humidity and temperature sensor to monitor the data. Once the wi-fi is connected the live temperature, humidity and soil moisture levels are displayed on LCD. Here we fix some commands for certain operations. Based on these commands the robot will perform its operations. If the temperature range is greater than 40 then it displays high temperature in the app. Similarly, if the humidity range is greater than 80 then it displays high humidity. If the soil is wet, then only it displays in the app. Here we use two L293D motor driver ICs to control four motors. Two motors are used to control the robot for different operations like moving forward, backward, left, right and stop. The other two motors are used for ploughing, seeding in clock-wise and anti-clockwise directions. After the relay is connected to the pump, water is pumped from the tank.

3.2 Schematic diagram

In this project we are using Atmega328p Microcontroller. It has total 28 pins. In these 28 pins we are using all the pins. D0-D13 are the Digital pins(14) and A0-A5 are the Analog pins(6). Here the D0, D1 are connected to the IOT, for transmitting and receiving the data. D2- D7 pins are connected to 16*2 LCD display, D8-D11 pins are connected to L293D 2 motor driver IC which controls two motors M3 and M4.D12 pin is connected to DHT11.D13 is connected to pump. A0,A1,A4 and A5 pins are connected to L293D 1 motor driver IC to control M1 and M2 motors.A2 pin is connected to soil moisture sensor. The Solar energy is stored in battery which converts 12v Ac into 5V of DC by RPS and that is given to the circuit through pin7 and pin20. Reset is given to the pin 1 which is used to Reset the circuit for connecting to the IOT module. The oscillator is connected to the pin9 and pin10, the GND is connected to the pin8 and pin22.

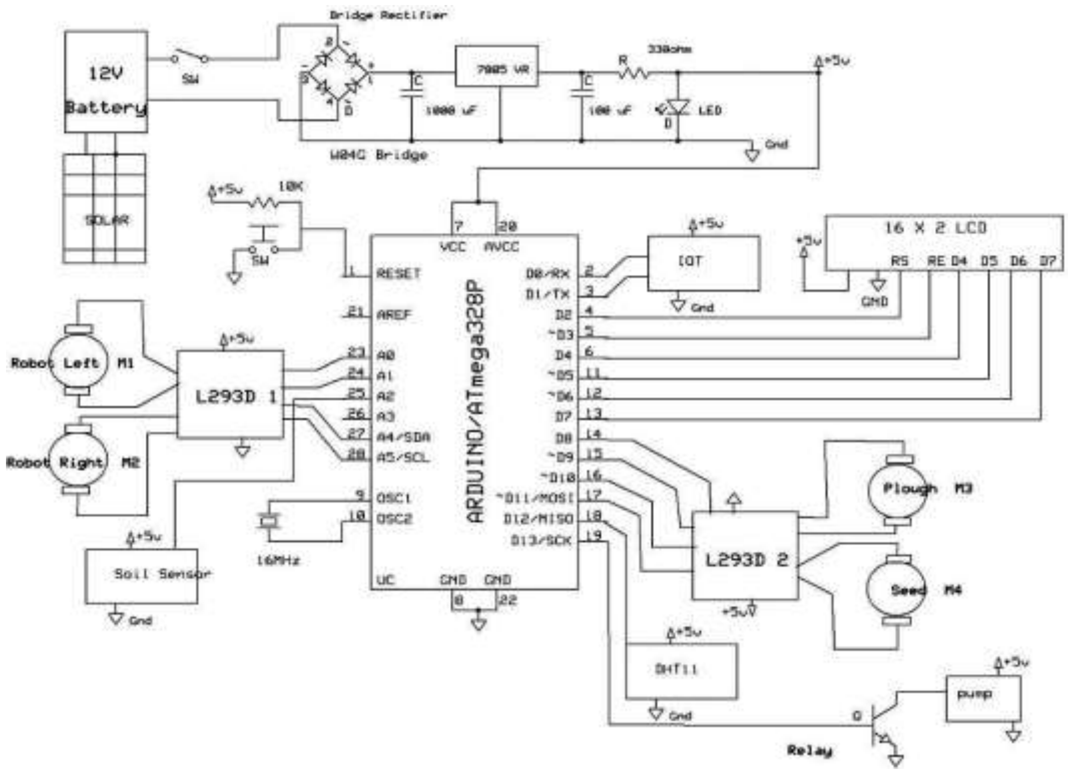

Fig 2 Schematic diagram for proposed system

4. Results and Discussion

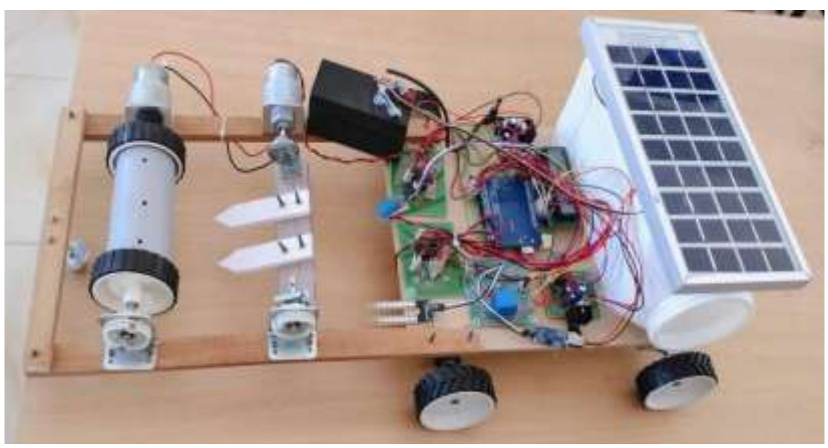

Figure 3: IoT based solar powered agribot kit

The prototype of the project is shown in the above picture. The setup contains a seed drum for seeding, ploughing rods for ploughing the soil and a tank to supply water to the field.

Figure 3: Lcd displaying the title

The above image shows the title of the project in 16*2 LCD display. Later on it displays as waiting for connection until the IOT module is connected to wifi.

Figure 4 Lcd indicating the soil is dry

Connect to the IOT server using port 23 and IP address 192.168.4.1. Once the wifi is connected to the IOT server, it shows live temperature, humidity levels present in the atmosphere and it also shows soil moisture level present in agricultural field.

Figure 5 Lcd indicating the soil is wet

If some moisture is present in the soil then it indicates that the soil is wet and the same is displayed in the LCD. Based on the atmospheric conditions the values of temperature and humidity varies.

Figure 6 Tcp Telnet app

This image displays the project's finished product. First, we were able to save commands and at the same time, the iot server was able to display the actions performed by the robot in the app.

5. Conclusion & Future Scope

Overview of the project "IOT based Solar Powered Agribot" is to perform various farming activities like ploughing, seeding and sprinkling. The agricultural robot is operated by using solar energy which eliminates the need for conventional energy sources like electricity, making the agribot eco-friendly and cost-effective. The IOT agribot collect and analyze real- time data on various parameters such as soil moisture, temperature, humidity and the data can be controlled by Microcontroller. By using the wifi connect the IOT server. The data can display on the LCD display and at the same time IOT server. The IoT-based solar-powered agribot is a promising technology that can address some of the major challenges faced by the agriculture industry, such as labor shortages, sustainability, and increasing demand for food production. Precision farming is a farming technique that uses data analytics, IoT sensors, and other technologies to optimize crop production. With an IoT-based solar-powered agribot, farmers can monitor soil moisture, temperature, humidity, and other environmental factors in real- time. This data can be used to adjust irrigation, fertilization, and pest control strategies to maximize crop yields. In the future, agribot could operate autonomously with the help of artificial intelligence and machine learning algorithms. Farmers can program the agribot to perform specific tasks such as planting, harvesting, and spraying pesticides. The IoT-based solar-powered agribot can help farmers monitor the health of their crops more effectively. The agribot can detect pests, diseases, and nutrient deficiencies early on, allowing farmers to take corrective action before the crops are irreparably damaged. Additionally, the agribot can help reduce water usage and fertilizer waste, promoting more sustainable farming practices. Overall, the IoT-based solar-powered agribot has enormous potential in transforming the agriculture industry. With its ability to monitor and optimize crop production, reduce environmental impact, and reduce costs, this technology could be a game-changer for farmers around the world.

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