Asian Journal of Research in Social Sciences and Humanities
Asian Research consortium
www.aijsh.com

ISSN: 2249-7315
Vol. 11, Issue 10, October 2021
SJIF –Impact Factor = 8.037 (2021)
DOI: 10.5958/2249-7315.2021.00106.4

AGRIBOT: AN INTERNET OF THINGS BASED FARMBOT

Shakuli Saxena*

*Department of Agricultural Sciences,
Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, INDIA
Email id: shakuli2803@gmail.com

ABSTRACT

Agriculture has long been a major profession in countries like India, where two-thirds of the population relies on it for survival. The conventional agricultural system is mostly reliant on natural resources, which sometimes provide excellent results and sometimes result in losses. Furthermore, rising population, shrinking farmland, and natural disasters such as drought, unwelcome heavy rain, and storms exacerbate the problem. Various scientific breakthroughs, however, have altered agriculture and farming practices during the last several decades. Smart farming employs IoT, AI, and machine learning methods to maximize agricultural production. In this paper, an IoT-based technological platform for farming is presented. The suggested agricultural bot "Agribot" is fitted with a substantial sensor for monitoring environmental factors that are important to farming. The android application that comes with this bot displays data collected from all of the sensors as well as photos of the crop/veggies produced in the farm on a regular basis so that anybody can keep track of it from anywhere. It also does data analytics on sensor data to calculate watering intervals for a particular crop, which can be seen via an Android app.

KEYWORDS: *Data analysis, Farming Bot, IoT, Sensors, Smart Farming..*

1. INTRODUCTION

According to the most recent United Nations estimates compiled by Worldometer, the world's current population is 7.8 billion people[1]. According to the United Nations, the world's population will reach 9.8 billion by 2050 [2]. This worldwide population explosion will become a global issue, resulting in food shortages, urbanization, and a reduction in agricultural area, as well as an increase in demand for all resources. Food is a fundamental need, and crop production with high yields is a prerequisite for every country's national stability.

Rainfall, soil quality, temperature, and other climatic variables are the most important elements influencing this profession. Soil testing is done by hand to determine the land's fertility. Varying crops/vegetables need different amounts of water. Water is often squandered in the fields; nevertheless, in certain areas, drop irrigation methods are utilized. Sudden changes in weather may have a negative impact on output. Using new automated methods, all of these issues may be addressed to a certain extent. With the rise of smart cities across the globe, agriculture is becoming smarter as well. Sensors based on the Internet of

Things may be used to track air pressure, moisture, sunshine, rainfall, insect infestation, soil moisture, and nutrition[3].

The information gathered by these sensors may be utilized for data analysis and decision-making. If sensors are connected to Bots, the data collected may be utilized to do suitable activities like as watering crops/plants with a particular quantity of water at a specific time, spraying fertilizers in the correct amount, photographing the plant for monitoring and disease diagnosis, and so on. Furthermore, these smart Bots may be linked to cellphones, allowing data to be accessed from anywhere on the planet. Smartphones may be used as dashboards, providing all of the information on a certain piece of property. In smart farming, this combination of gadgets would be helpful. The Internet of Things (IoT) has shown to be helpful to the agricultural supply chain and is a vital technology for ensuring a smooth flow of agricultural logistics[4]. The following are the main benefits of smart farming:

- Soil management, which involves monitoring the pH and moisture levels in the soil.
- Effective water management to avoid water waste.
- Weather monitoring for real-time agricultural planting and monitoring.
- Crop surveillance using cameras to identify infections and illnesses in the crop.

2. LITERATURE REVIEW

IoT frameworks and platforms have been utilized in various areas as technology has advanced, such as smart healthcare, smart cities, and so on, however large-scale adoption of IoT solutions in agriculture has yet to be seen in many nations. We attempted to explain some of the IoT-based solutions suggested by some of the researchers in this area.

AnandNayyar et al. developed the “Agriculture Stick,” a smart IoT-based device that helps farmers get real-time data (temperature, soil moisture) for effective environmental monitoring[5]. This stick was created utilizing a mixture of Arduino, Cloud Computing, and Solar Technology, as well as a breadboard and several sensors. The live data stream was obtained from Thingsspeak.com. The data streams collected from the sensors were stated to be 98 percent accurate by the author.

Andreas Kamilaris and colleagues created Agri-IoT, a semantic framework for IoT-based smart agricultural applications that enables real-time reasoning over a variety of heterogeneous sensor data streams[6]. Large-scale data analytics and event detection are also supported by the framework, enabling smooth interoperability across sensors, services, processes, operations, farmers, and other important players, such as online information sources and connected open datasets and streams accessible on the Web. They placed 100-300 sensors in the field for this project's testing. The results of a comparison of two RDF Stream Processing (RSP) engines, CSPARQL and CQELS, are shown.

Amandeep et al. suggested a GPS-based remote controlled vehicle that can work in both automated and manual modes for a variety of agricultural tasks such as spraying, cutting, and weeding[7]. Temperature, humidity, soil condition, and water supply may all be monitored. The researchers devised the notion of a linked farm, which may offer an ideal setting for agricultural cultivation. All sensors and actuators used to monitor and cultivate crops in this project were linked to a gateway running &Cube, a device software platform for IoT systems.

The “Mobius” IoT service server was utilized to monitor the linked farm's environmental state, interact with expert agricultural knowledge systems, and operate actuators based on it. By dividing the area in a grid pattern and installing an automated plant irrigation system that includes soil sensors, water level indicators, and chemical sprinklers, the experiment indicated that various crops may be grown on a single field. The GSM+ARDUINO technology may be used to extract information about the field. They utilized Things for data processing and visualization. They also utilized Speak, an open source platform, for future recordings or in the event that the GSM fails due to technical difficulties. Some of the researchers attempted to utilize IoT-based Precision Agriculture technologies. Precision agriculture primarily consists of data gathering, processing, and variable rate input application. Precision agriculture is one of the concepts that may take use of the Internet of Things to increase production efficiency across agricultural areas, improve crop quality, and reduce negative environmental effect. They suggested that the internet of things be used to gather local information data from different crops on precision agriculture, such as water level, temperature, humidity, soil moisture, and light.

Using time series methods with historical yield data for use in a forecasting model, Li Hong-ying et al suggested that the maximum yield of the crop may be achieved in the given environment[8]. From 1949 to 2005, the crop production forecasting model was tested in China's Liaoning Province. Some academics attempted to use a Decision Tree Classifier to environmental data in order to forecast agricultural output. The suggested system will be described in depth in the parts that follow.

3. DISCUSSION

The workings and methods of the proposed system are summarized in this paper. This project's hardware is built on a Computerized Numerical Control (CNC) machine, which offers a free arm for movement in a restricted space. A soil moisture sensor, humidity sensor, light detecting sensor, temperature sensor, tiny camera, and water outlet pipe for watering the plants are all included in one arm. These sensors aid in the monitoring of the environment as well as its impact on crops. This gadget is linked to the internet, allowing it to provide real-time data from all of the aforementioned sensors to a smartphone. This information may be utilized for analytics and machine learning algorithms to improve agricultural production. The following sections make up the majority of this project:

- Agribot Structure
- Hardware Devices
- Software Component
- Android Application Development
- Data-Analytics

3.1. Agribot Structure:

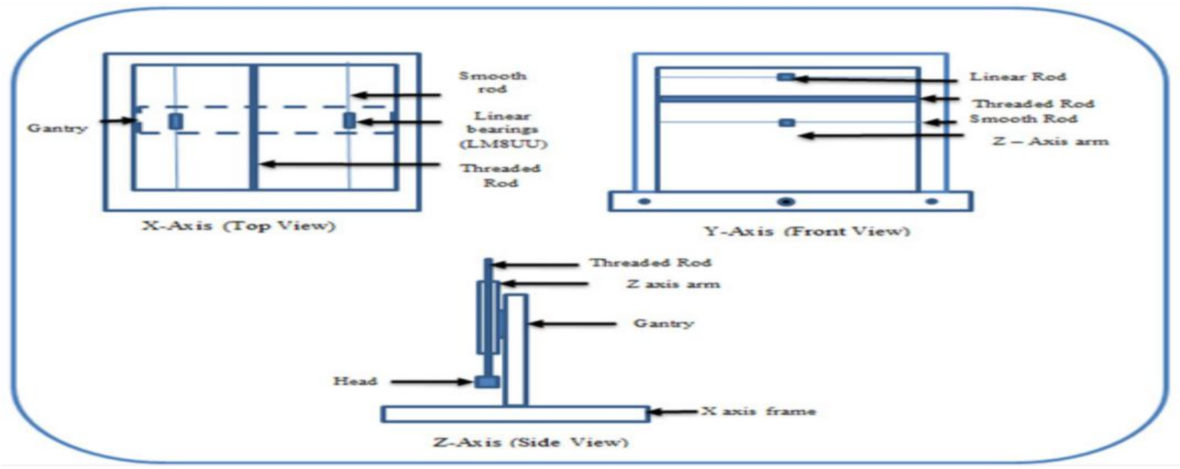

Figure 1: Diagrammatic structure of Agribot Model

3.1.1. X-Axis:

A wooden block serves as the foundation for the construction. The diagrammatic depiction of the hardware structure is given in figure 1. Two smooth rods run parallel to one other in this block, each equipped with a linear bearing for smooth gantry motion (the structure that supports y and z-axis). By translating rotational motion into linear motion, forward and backward motion may be produced. The threaded rod is inserted between the blocks to do this. A stepper motor drives the motion of this rod.

3.1.2. Y-Axis:

Figure 1 shows the y-axis construction, which is identical to the x-axis. The main difference is that instead of laying down, the building stands on the x-axis (as a Gantry). Rotation of the threaded rod provides motion once again. This axis is responsible for left and right movement.

3.1.3. Z-Axis:

The Z-axis moves upward and downward and follows the same principles as the x and y axes. The z-axis is linked to a head that houses the soil moisture sensor and the water outflow pipe. We obtain a 3-D axis motion by combining all three axes X, Y, and Z, where the head may move to any place in the restricted area and the plants are planted in a grid pattern (for ex. 4 x 4 grid planting). The advantages of multi-cropping by planting various plants in separate grids may also be taken use of in this design. As in a matrix, each grid is assigned a column and row number.

3.2. Hardware Devices:

3.2.1. Raspberry pi-3:

It serves as the system's CPU and oversees all internet-related activity[9]. It instructs Arduino to do activities like as moving the head to a certain position, watering the soil, checking sensor readings, photographing the plant, and uploading the photographs to the database.

3.2.2. Arduino Uno:

Arduino is linked to all of the sensors. The A4988 stepper motor driver is used to regulate the rotation of the stepper motor[10]. It is directly linked to the Raspberry Pi through the USB port and responds to the Raspberry Pi's instructions.

3.2.3. Stepper Motor and Stepper Motor Driver:

Different steps may be used to precisely regulate this stepper motor. The three stepper motors are connected to the threaded rod in the X, Y, and Z axis to give 3D motion to the head. This motor is supplied by a 12v DC and is controlled by Arduino using the motor driver A4988.

3.2.4. Temperature and humidity sensor, LDR, Soil Moisture sensor, Camera, Water pump, Relay:

These sensors are connected to Arduino and provide it with real-time data. The relay is used to turn on a power pump that is powered by an external source. When the soil moisture sensor detects low moisture in the soil, the relay is activated, and plants are watered as needed.

3.3. Software Components:

This project's early software controls the arm's mobility in a restricted space. The soil moisture sensor, which is connected to the arm, is pushed into the soil to determine the exact moisture level. A threshold value is established based on the readings of all sensors, and a decision is made whether or not to water the plant. A camera connected to the arm top is used to take photos of the plant from above. The images are uploaded to the Firebase database. In addition, it uploads the sensor's data so that a user may receive more information about the day. This data may then be utilized in the Data-Analytics procedure.

3.4. Android Application Development:

For monitoring the information of all the sensors, an Android application is being created. This Android app may be used to monitor the plant in real time. The data from the sensors, which is kept on the Raspberry Pi, is sent to the Firebase database. The mobile application has access to the database. This program displays a graphical representation of the sensor data for each day, as well as a navigation bar with other functions such as plant images. This information may then be utilized to do data analysis utilizing machine learning or forecasting techniques.

3.5. Data-Analytics:

One of the most important aspects of the project is using Data-Analytics to analyze the temperature, humidity of the environment, quantity of sunshine, and soil moisture for various plants. Weather data for the area is gathered from many sources. This information may be used to analyze the unique and exact water requirements of various plants. As a consequence, the watering of the plants will be more efficient, and the device's general performance will improve.

The data collected from sensors for temperature, ambient moisture, sunshine intensity, and soil moisture serves as the analytics' input. The system analyzes the data and outputs the length of time the gadget will wait before watering the plant the following time. Data analytics and Machine Learning algorithms are used to estimate the plants' water needs. For example, after processing two days of data from a medium-sized Tulsi plant, it shows the change in soil moisture as a function of temperature, sunshine, and humidity. The data visualization depicts how the quantity of sunshine rises as the day progresses, reaches a peak, and then decreases as the sun sets.

The temperature follows the same pattern as the sun; humidity, on the other hand, varies little but has a significant impact on soil moisture. The trend of soil moisture is inverse, with low moisture levels while other variables are rising and the soil retaining less water, and vice versa. This pattern is caused by two factors:

i. *High evaporation rate:*

The rate of evaporation on a hot day is significantly greater than during a cold night.

ii. *Transpiration pull:*

It's the plant's attraction to subterranean water, which causes it to evaporate from leaves so the plant can obtain water and minerals.

When gathered in large quantities for multiple plants, this data may be utilized to create an accurate Machine Learning model for predicting the time interval between watering different plants.

4. CONCLUSION

We attempted to explain Agribot, an IoT-based farmbot that will help farmers in smart farming, in this paper. It has an automatic arm that irrigate the plants on a regular basis, avoiding water waste. It also uses an Android application to give all of the information about the environment and plant condition at the user's fingertips. It will lessen the need for human involvement. All of the sensors' data is retrieved and utilized in the study. The future scope of this research may include machine learning algorithms or time series forecasting algorithms that can predict the plant's water requirements, the crop to be planted, and other forecasts.

REFERENCES

1. "Worldometer." https://www.worldometers.info/world-population/ (accessed Sep. 20, 2018).
2. "World population projected to reach 9.8 billion in 2050, and 11.2 billion in 2100." https://www.un.org/development/desa/en/news/population/world-population-prospects-2017.html (accessed Sep. 20, 2018).
3. R. L. Aronson, "FarmBot: Humanity's open-source automated precision farming machine," *FarmBot*, 2013.

4. R. C. Rory Aronson, “FarmBot,” *Chron. High. Educ.*, 2011.

5. A. Nayyar and V. Puri, “Smart farming: Iot based smart sensors agriculture stick for live temperature and moisture monitoring using arduino, cloud computing & solar technology,” 2017, doi: 10.1201/9781315364094-121.

6. A. Kamilaris, F. Gao, F. X. Prenafeta-Boldu, and M. I. Ali, “Agri-IoT: A semantic framework for Internet of Things-enabled smart farming applications,” 2017, doi: 10.1109/WF-IoT.2016.7845467.

7. Amandeep *et al.*, “Smart farming using IOT,” 2017, doi: 10.1109/IEMCON.2017.8117219.

8. L. Hong-ying, H. Yan-lin, Z. Yong-juan, and Z. Hui-ming, “Crop Yield Forecasted Model Based on Time Series Techniques,” *J. Northeast Agric. Univ. (English Ed.*, 2012, doi: 10.1016/s1006-8104(12)60042-7.

9. Raspberry pi Foundation, “Raspberry Pi 3 model B+,” 2018.

10. Y. Shekhar, E. Dagur, S. Mishra, R. J. Tom, M. Veeramanikandan, and S. Sankaranarayanan, “Intelligent IoT based automated irrigation system,” *Int. J. Appl. Eng. Res.*, 2017.