Automated Agrobot For Smart Farming UsingUbiquitous Computing

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***Abstract*—The use of pesticides in agriculture plays a critical role in controlling pest populations and increasing crop yields. However, conventional methods of pesticide spraying can be inefficient and pose potential risks to human health and the environment. In this paper, we present a novel approach to pesticide spraying using an autonomous robot equipped with sensors to measure plant moisture, temperature, and humidity. The robot follows a predefined path, and the pesticide is sprayed when needed, based on the sensor data. The sensor data is uploaded to ThingSpeak, a cloud platform for the Internet of Things (IoT), allowing for remote monitoring of the plant health. We also present the design and implementation of the robot, including the hardware components, software architecture, and communication with ThingSpeak. Finally, we evaluate the performance of the robot in terms of pesticide efficiency and environmental impact. Our results show that the proposed approach significantly improves the efficiency of pesticide spraying and reduces the negative impact on the environment, making it a promising alternative to conventional methods.**

***Index Terms*—Autonomous robot, Precision agriculture, Pesticide spraying, Sensor data, Internet of Things (IoT), ThingSpeak**

I. Introduction

Agriculture is a vital industry that plays a significant role in feeding the growing global population. However, conventional methods of crop production often rely on the use of pesticides, which can have detrimental effects on the environment and human health. To address this issue, there is a need to develop more sustainable and efficient methods of pesticide application that can minimize chemical use and reduce the negative impact on the environment. Water is essential for every plant, human and animal. Water wastage is one of the big complications in agriculture. Also, there are issues involved in huge manpower and also in irrigation systems. One of the solutions, for the above described problems, can be given by the Internet of Things. The devices are getting smarter each day from smart TV to smart car to smart kitchen to Smartphone. Now everything is connected to the internet. IoT transforms the agricultural sector and empowers farmers to tackle the major difficulties they face. By using the Internet of Things (IoT), the above problems can be overcome. Agriculture IoT helps to increase crop production by manipulating and controlling crop water management. Adequate water supply is an important part of agriculture and crops can be damaged by excessive water supply or water scarcity . IoT can significantly improve the utilization of water production. IoT is concerned with connecting interconnected objects at different locations from each other. IoT is a type of network technology that senses information from various sensors and adds anything to the Internet for communication. In this research, we propose a novel approach to precision pesticide application using an autonomous robot equipped with sensors to measure plant moisture, temperature, and humidity. The robot follows a predefined path and applies pesticides only when necessary, based on real-time sensor data. The system also includes a cloud platform for remote monitoring of the plant health, allowing for optimization of pesticide use. The primary objective of this project is to develop a system that can increase cropyields, reduce chemical use, and minimize the negative impacton the environment. This sustainable alternative to traditional methods of pesticide application offers a promising solution to the challenges faced in agriculture. The ”Thingspeak Cloud Based Smart Irrigation System” [4] The suggested system is an autonomous irrigation system that monitors soil moisture levels and regulates crop watering using sensors and the Internet of Things (IoT). The system is made up of input and output modules, as well as an IoT module with a cloud server and connectivity components. A soil moisture sensor and a power supply unit are in the input part, and a relay module and a DC motor pump are in the output area.

II. Literature Survey

Design and Development of Autonomous Pesticide Sprayer Robot for Fertigation [1] Farm portrays that Every subsystem is provided, including navigation and propulsion systems. Using obstacles detection, the autonomous pesticide sprayer robot can self-navigate by turning at the intersection. One environmental factor, such as temperature, humidity, air quality, and light intensity, is collected by weather monitoring devices. Smart Irrigation System [2] The proposed system is an automatic irrigation system that uses sensors and the Internet of Things (IoT) to detect soil moisture levels and control the watering of crops.

”Agricultural Pesticide Spraying Robot” [3] This android application uses an HC05 Bluetooth module to control a spraying rover. The rover is driven by a 12V battery and contains four brushless DC motors that are managed by an Arduino Uno microcontroller and an L293D motor driver. The sprayer may be moved by the rover’s servo motors as well. To control the high voltage required to run the pump, the rover employs a 6V pump, a buck converter, and a relay module.

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”IoT-based Humidity, Temperature, and Gas Monitoring Using Arduino Uno” [5] The DHT-11 sensor, which measures temperature and humidity, the MQ-6 sensor, which measures gas levels, and the ESP8266 WiFi module, which transmits this data to the Thingspeak IoT platform, are just a few of the sensors this system uses to gather information about the local weather conditions. These sensors’ data are gathered by the Arduino Uno microcontroller, which also handles any necessary calculations before sending the information to the Thingspeak platform through WiFi. The user can access the data after it has been transmitted by going to the Thingspeak website.

The phrase ”Real Time Environment Monitoring System Using IOT” [6] Utilising contemporary tools and methods to boost agricultural output and efficiency is known as smart agriculture. In order to improve many areas of farming, such as irrigation, pest management, and crop selection, this can include the use of sensors, drones, automation, and data analysis. IoT (Internet of Things) utilisation is crucial in smart agriculture since it enables real-time monitoring and management of numerous farming processes.

The ”Adaptive Planting Robot for Precision Agriculture” [7] This research introduces a robot that can perform precise and controlled tasks including seeding and fertiliser application. In addition to a control system that can be configured to carry out various activities based on the requirements of the crops, the robot is equipped with a number of sensors and other gear that enable it to manoeuvre around a field and avoid obstacles.Using the Internet of Things (IOT), a solar-powered agribot is used to monitor farms [8] The suggested Agribot is equipped with temperature, moisture, and infrared sensors. They have solar panels in order to take advantage of the sunlight that is already present. The sensors measure the soil’s temperature, water the land accordingly, and then send the information to the cloud. If an obstruction is encountered, this robot will alter its course.

IoT based Climate Monitoring System using Arduino” [9] In conclusion, the system consists of a rain sensor, temperature, humidity, and pressure sensors.The information gathered by these sensors is transmitted to an Arduino board, which then analyses it and employs an ESP8266 Wi-Fi module to transmit it to the ThingSpeak server. The work on ”Automatic Arduino Controlled Agribot For Multi-Purpose Cultivation”[10] This idea is how the Agribot recognises and avoids impediments along its route. The robot’s front, left, and right sides are equipped with ultrasonic sensors that measure the distance to any adjacent objects continuously. Additionally, the Agribot has manual control features that let the operator direct the device’s motion and operations through Bluetooth.

III. MATERIALS AND METHODOLOGY

Automated Agrobot for Smart Farming Using Ubiquitous Computing can be achieved by identifying the tasks that can be automated, collecting data through sensors and automated equipment, processing and analyzing the data, designing and developing the agrobot, implementing the system, and monitoring and refining the system over time. The process starts with spraying the pesticides , Sensors such as temperature, humidity, soil moisture, can be used to collect data on the environment, ThingSpeak can be used to analyze the data and make predictions. The agrobot can then be designed and developed, tested, implemented, and refined over time to improve its efficiency and effectiveness.

A. Temperature Sensor

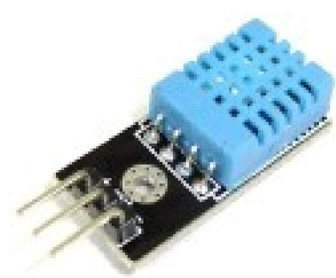

Fig. 1. Temperature Sensor.

A smart agrobot with temperature, humidity, soil mois-ture, and pesticide/water spray sensors would be extremely useful because these sensors would be utilised to gauge the temperature of the air and soil where the crops are being grown. Given that various crops require distinct temperature ranges for optimum growth, this information could be utilised to improve the growing circumstances for various types of crops. For instance, cool-season crops like lettuce and spinach like temperatures in the 50-70°F range, while warm-season crops like tomatoes and peppers typically grow best at temps between 70 and 85°F.

B. DC Motor

DC motors work on the premise that when a magnetic field is supplied to a conductor, the conductor experiences

Fig. 2. DC Motor.

a mechanical force. In order to move the wheelchair, a DC motor is used. Here, three DC motor drivers are utilised 2 for movement and one for spraying system at 60 RPM while being powered by a 12 V mains supply. The agrobot's direction and potential motions are displayed. Both motors are set to forward motion. Reverse: The reverse gear is on both motors. Left: Motor1 is not moving, whereas Motor2 is. Motor1 is moving forward, and Motor2 is stopped. Both motors have come to an end.

C. Soil Moisture Sensor

Fig. 3. Soil Moisture Sensor.

A smart agrobot would need a soil moisture sensor since it would be used to gauge how much moisture is in the soil where the crops are growing. The crops could receive the ideal amount of water for growth by using this data to optimise irrigation practises. For instance, the agrobot may be programmed to water the crops to bring the moisture levels up to an ideal range if the soil moisture sensors indicate that the soil is too dry. On the other side, the agrobot might be configured to reduce or stop irrigation if the sensors detect that the soil is excessively wet in order to prevent over-watering.

D. Ardunio UNO

The different hardware parts of the agrobot, such as the motors that drive the wheels, the sensors that gather information on temperature, humidity, and soil moisture, and any other devices that are required to operate the agrobot, are all controlled by the Arduino microcontroller. The Arduino

Fig. 4. Ardunio UNO.

can gather sensor data, make judgements based on that data, and execute actions (such moving the agrobot or spraying pesticides) in response when programmed with a variety of control algorithms and other software. The Arduino can be used to build an extremely adaptable and adjustable system that can be programmed to carry out a variety of duties by serving as the main "brain" of the agrobot.

E. System ArchicetUre

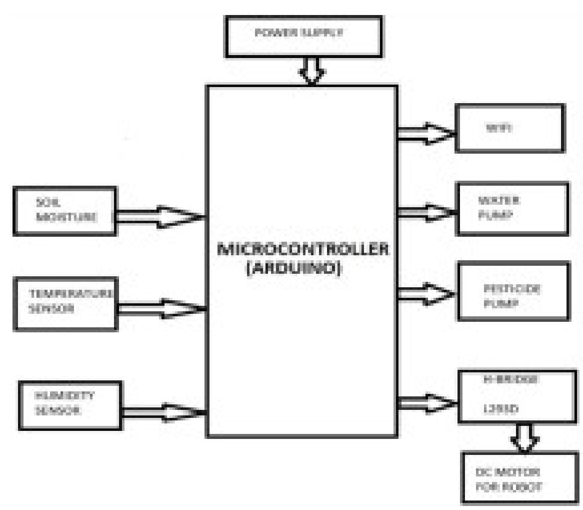

Fig. 5. System Architecture.

The system architecture of smart farming using ubiquitous computing with sensors, water pump, Wi-Fi, and ThingSpeak involves a multi-layered approach that enables farmers to collect, analyze, and act on data to optimize their farming processes. The agrobot consists of various sensors, including humidity, temperature, and soil moisture sensors, that collect data on environmental conditions in the field. The data is transmitted via Wi-Fi to ThingSpeak, a cloud-based platform that stores, analyzes, and visualizes the data. The data processing layer uses ThingSpeak analyze the data. The ThingSpeak Cloud provides the user interface for farmers to interact with the system, access data and analytics. Overall, the system architecture of smart farming using ubiquitous computing with sensors, water pump, Wi-Fi, and ThingSpeak is designed to optimize farming processes, increase efficiency, reduce waste, and improve crop yields.

IV. RESULTS

In order to assist farmers in making knowledgeable judgements about crop management practises, agrobots can gather and analyse data on soil characteristics, weather patterns, and other environmental aspects. Agrobots can be integrated into smart farming systems to enable precision agriculture, which directs inputs like water and fertiliser to particular fields in order to increase yields and optimise resource use.

Fig. 6. Agrobot.

Fig. 7. Circuit Design.

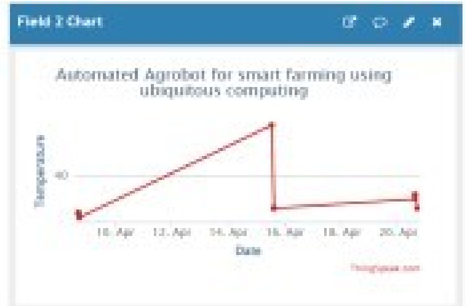

Fig. 8. Temperature sensor readings over time.

Fig. 9. Moisture and Humidity sensor readings over time.

V. CONCLUSION

The manner that crops are cultivated and handled may be completely altered by an intelligent agrobot equipped with sensors for soil moisture, temperature, humidity, pesticide/water spray, and soil moisture. The agrobot can help farmers save time, labour, and resources while also enhancing the health and yield of their crops by automating operations like data collecting and pesticide application. The agrobot can assist farmers in reducing their reliance on chemical pesticides and promoting more environmentally friendly practises by employing sensors to optimise the growth conditions and identify pests and illnesses early. Overall, a smart agrobot has the potential to significantly increase agriculture's productivity and sustainability, making it an important tool for farmers all over the world.The agrobot can monitor and manage irrigation systems, assisting farmers in water conservation and lowering the possibility of over-irrigation. Overall, a smart agrobot has a wide range of possible uses in agriculture, making it an important tool for growers and agribusinesses all over the world.

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