



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 13, Issue 3, March 2024

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.423

IoT Platform Based Monitoring and Automation of Plant Growth

Mr. P. Anil Kumar¹, K. Sasivardhan Reddy², K. Vamsi³, A. Vasanthi⁴, P.Vemabindu⁵

Assistant Professor, Department of ECE, Annamacharya Institute of Technology & Sciences, Tirupati, India¹

Department of ECE, Annamacharya Institute of Technology & Sciences, Tirupati, India^{2,3,4,5}

ABSTRACT: In this paper we try to improve greenhouse farming practices and provide farmers and landowners with the relevant data they need to make decisions that will optimize output with the help of internet of things, or IoT. In our IoT-based plant growth monitoring and automation project, we use DHT11, water, ultrasonic, and soil moisture sensors. The recommended approach offers an intelligent system built on the Internet of Things concept that provides users with remote temperature, humidity, and soil moisture intensity data to monitor plant conditions. The brain of the system, the Arduino Uno, collects data from the sensors and sends it to the users through the Thing Speak application. The recommended strategy reduces plant cultivation failures and farmers' workload by using less energy and time.

KEYWORDS: IoT, Node MCU, Thingspeak.

I. INTRODUCTION

Greenhouses will find it easier to monitor their plants with the aid of this project. Using their smartphones, which are equipped with sensor data, they can keep an eye on their field from any location. This idea also assists in preventing water scarcity, which is the primary issue facing farmers in the agricultural sector, as well as saving electricity and water. By using a Wi-Fi module, the Temperature Sensor detects the field's temperature and transmits the data to computers and smartphones, where it is also shown on an LCD. The farmland's humidity is measured by the humidity sensor, which then communicates its findings to the smartphone. When the water in the tank is empty, the water sensor detects this and notifies the smartphone. The plant's average length is also detected by the ultrasonic sensor; if this is abnormal, we must provide the plant nutrients following its needs. When the soil moisture sensor detects a low moisture range, it transmits the information to the Arduino, which activates the relay and turns on the motor automatically. When the soil moisture level reaches a certain point, the motor turns off automatically.

II. RELATED WORKS

2.1 OBJECTIVE

The main objective is to propose a model that can monitor and maintain the growth and health of plants, helps in detecting several factors such as temperature, humidity, length, soil moisture levels and inform the users via IoT.

III. LITERATURE REVIEW

Abhiram MSD, Jyothsnavi Kuppili, et.al. has proposed a Smart Farming system that aims to increase the amount and nature of agricultural items. In this, the device gives information about the idea of cultivating fields and making a move depending on farm workers' input. From anywhere in the world, a farmer can know about the environmental condition of the field through the Blynk app where he receives an SMS to his Smartphone. Meili Liu and Caizhong Zhang have focused on developing a system that can be able to briefly monitor the parameters for effective crop growth. It uses temperature, humidity, light intensity, and CO₂ sensors to monitor the field's agricultural parameters. It aims to provide better financial benefits to the farmer by reducing the cost of much equipment. Ayyaswamy, Eswaran.et.al. have proposed Agri soil- Maintenance for protecting crops from excess water and improving micro-nutrients in the soil. To avoid a lack of water in the yield. So, this project overcomes that problem. Rahul Dager et.al. has proposed smart husbandry using IoT. It uses sensors that accumulate data and direct the information to the server through a WIFI network. So, that farming can be made more resourceful and accurate. Khampheth Bounnady has proposed a system to concentrate on the impacts of the development rate, delivery rate, and water-saving rate of the farm. In this research,

the system monitors temperature and soil moisture accordingly, the plants are watered, this total process is done with the help of some sensors, node MCU, and cloud computing. All collected data is effectively useful for the farmer to monitor and can adjust some values in the system through an application. Rama Prasad SS, Sunil Kumar BS, et.al. has developed a smart crop shielding device that ensures better crop growth by monitoring continuously. An Arduino microcontroller and some sensors work to screen the moisture levels of the soil, because of which the pump will turn ON or OFF, this promotes the ideal utilization of water in a specific way. Thus, this monitoring device will ensure great quality yield by saving the water that is streaming in overabundance and secures the farming field from intruders.

EXISTING MODEL

In the current scenario, conventional greenhouses face several challenges related to plant cultivation. Here are some key points about the existing system:

- A. **Resource Limitations:** Conventional greenhouses lack smart environments, suffer from plant diseases, have limited farmland, and face soil degradation. These factors lead to decreased crop production.
- B. **Manual Monitoring:** Monitoring plant health parameters manually is time-consuming and often impractical. Environmental conditions (such as high temperatures, abnormal humidity, and poor soil quality) can adversely affect plant growth.
- C. **Inefficient Resource Utilization:** Efficient resource utilization (energy and water) is crucial for increased crop yield. However, existing systems struggle to optimize resource usage effectively.

IV. PROPOSED MODEL

To address these limitations, researchers propose intelligent IoT-based systems for plant monitoring and automation. The system remotely provides users with real-time information related to plant conditions. It focuses on critical parameters such as temperature, humidity, soil moisture intensity, length of the plant and Thing Speak. Based on plant conditions, users can control the growth and health of plants by monitoring critical parameters, the system optimizes water usage and energy consumption. Users can track plant health from anywhere, ensuring timely interventions. Proper monitoring and timely actions lead to healthier plant production.

V. BLOCK DIAGRAM & WORKING PROCESS

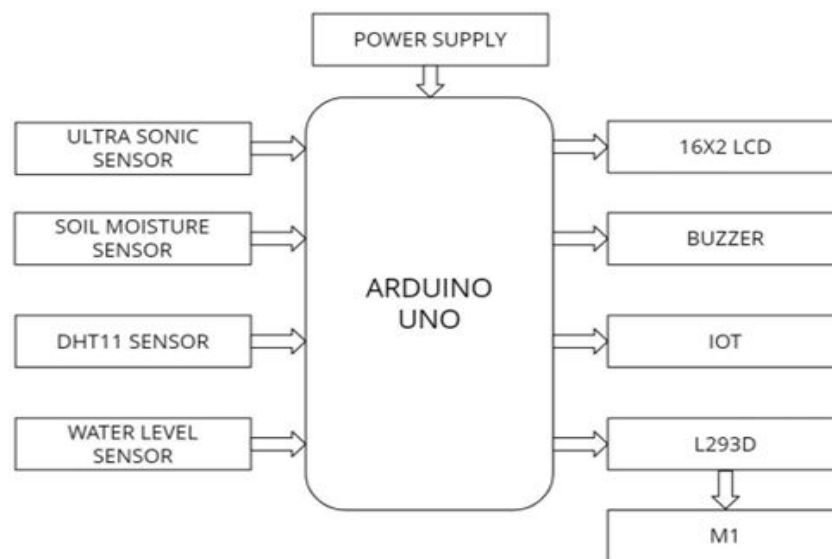


Fig5.0.1: Block Diagram of Proposed Model

5.1 Arduino Uno

The Arduino Uno is one of the most popular microcontroller boards in the Arduino ecosystem. It is based on the ATmega328P microcontroller and features 14 digital input/output pins (of which 6 can be used as PWM outputs), 6

analog inputs, a 16 MHz quartz-crystal, a USB connection, a power jack, an ICSP header, and a reset button. The Uno is widely used by hobbyists, students, and professionals for a wide range of projects due to its simplicity, versatility, and ease of use. It's suitable for beginners learning about electronics and programming, as well as for more advanced projects such as home automation, sensor monitoring, and interactive art installations. Additionally, the Uno is compatible with a vast array of shields and modules, which extend its functionality and allow users to easily add capabilities such as Wi-Fi, Bluetooth, motor control, and more.

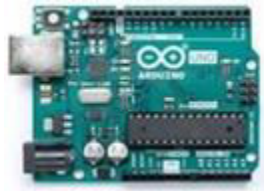


Fig 5.1.1: Arduino Uno

5.2 ESP8266 and Sensors

ESP8266 are used as the Wireless-Fidelity module to convey the values from sensors to the thingSpeak. When we connect it to a local Wi-Fi network the module gets internet access and provides IoT. DHT11 sensor measures the humidity temperature and sends these values to the Arduino and then Thing speak. A water sensor is used to know the water level in the tank. An ultrasonic sensor is used to identify the length of the plant. Soil moisture changes its resistance based on the wetness of the soil.



Fig 5.2.1: DHT11 Sensor



Fig3.2.2: Soil Moisture Sensor



Fig3.2.3: Water Sensor



Fig3.2.4: Ultra Sonic Sensor

5.3 Relay and Motors

Relays are devices that use a DC signal to control AC appliances. The Arduino microcontroller sends a DC signal that can be either high or low depending on the user's input and the moisture content of the soil. A motor is connected to a single relay network and is triggered by the soil moisture output values.

5.4 Software used Arduino IDE

To write the code for our Arduino boards, we need to download and install a piece of software called the Arduino IDE (Integrated Development Environment) on our computers. The code is one that we can upload to our Arduino board. It features an integrated library manager that is also very user-friendly, and it supports all Arduino boards. It is quite simple to use. A cross-platform tool called Arduino IDE allows many users to build and upload programs to an Arduino board. It can write programs for Windows operating systems such as MAC OSX and Linux.

5.5 ThingSpeak

ThingSpeak, developed by MathWorks, is an IoT platform designed for real-time data collection, analysis, and visualization from sensors or devices. It offers a cloud-based infrastructure for managing IoT data and supports various

connection protocols such as HTTP, MQTT, and its REST API. Users can create customizable dashboards and visualizations to monitor and analyze data trends effectively. Integration with MATLAB enables advanced data analysis and processing using MATLAB scripts. ThingSpeak also supports IoT analytics and machine learning algorithms for tasks like anomaly detection and predictive maintenance. Overall, it provides a comprehensive solution for a wide range of IoT applications, from environmental monitoring to industrial automation.

VI. EXPERIMENTAL SETUP & RESULTS

The overall hardware assembly with the entire experimental setup is shown in the following figure:

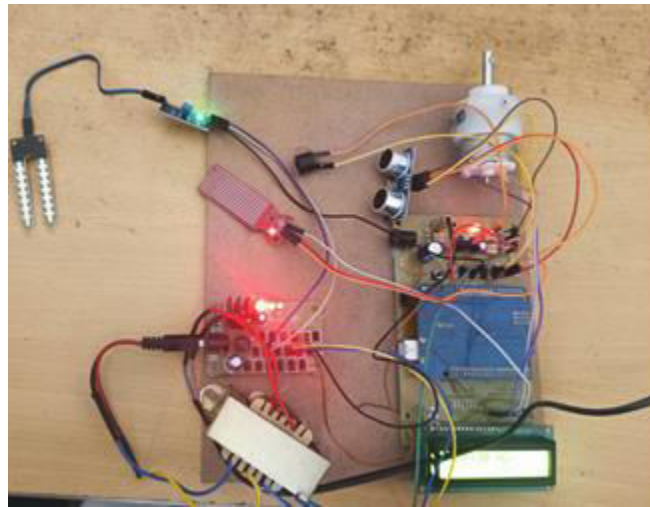


Fig 4.1: Complete setup of proposed model

CASE:1 Switch on the power supply to the entire system and wait for about 50-60 seconds to activate the whole setup. The temperature sensor detects the temperature and humidity at regular time intervals and is displayed on an LCD screen.

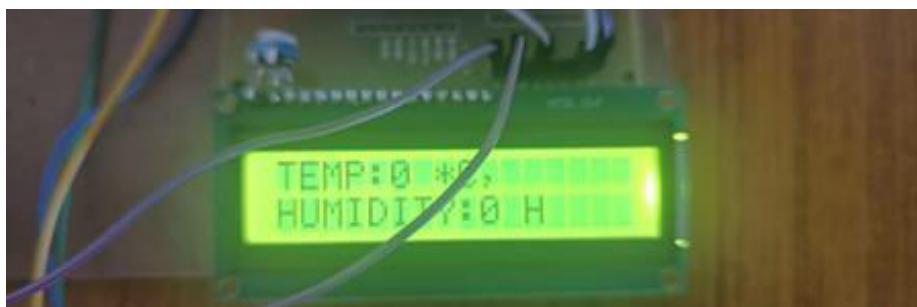


Fig4.2: Temperature and Humidity data is displayed

CASE:2 If there is no presence of water in the tank, then the water sensor gets triggered and notifies the user through a buzzer as well as shown on the LCD screen.



Fig4.3: Message is displayed that there is no presence of water

CASE:3 If there is water moisture level is increased in the soil more than the plant requirement, then the soil moisture sensor is triggered and notifies the user through the buzzer as well as shown in LCD screen.



Fig4.4: Soil moisture level is detected

CASE:4 Ultrasonic sensor is used to identify the length of the plant. If the infrared rays are stopped by the plant, then the user is notified through a buzzer as well as shown on an LCD screen.



Fig4.5: Distance is detected

VII. CONCLUSION

The growth of the crop depends mainly upon temperature, humidity, soil moisture, water level, and many other factors. We need to maintain these parameters accurately. To help farmers monitor the plant, our project plays a vital role in temperature, humidity, soil moisture, and water level. Our project is designed to reduce the workload of farmers by saving their time and energy. In the future the project can be upgraded in more ways, one of the solutions is the greenhouse method.

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BIOGRAPHY



Mr.P. Anil Kumar, working as an assistant professor at Annamacharya Institute of Technology and Sciences, Tirupati. He is pursuing Ph.D. at SV University, in the field of speech emotion recognition. He completed his M.Tech in 2015 at JNTUA. His current research interest's speech processing, signal processing, and Antenna Wave Propagation.



Mr. Sasivardhan Reddy is studying 4th year B.Tech degree in the ECE department at Annamacharya Institute of Technology and Sciences, Tirupati Dist., A.P, India. His interest areas are Electronics.



Mr.Vamsi Katari is studying 4th year, B.Tech degree in the ECE department at Annamacharya Institute of Technology and Sciences, Tirupati Dist., A.P, India. His interest areas are Electronics.



Ms.Vasanthi Abbavaram is studying 4th year, B.Tech degree in the ECE department at Annamacharya Institute of Technology and Sciences, Tirupati Dist., A.P, India. Her interest areas are Electronics.



Ms.Vemabindu Puli is studying 4th year, B.Tech degree in the ECE department at Annamacharya Institute of Technology and Sciences, Tirupati Dist, A.P, India. Her interest areas are Electronics.



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