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An Automated Greenhouse Monitoring System.

Abstract- Currently, a significant issue in Kerala is its substantial reliance on adjacent states for food supplies. A major factor contributing to the collapse of agriculture in our state is the scarcity of affordable labor. This issue may be resolved by automation in agriculture [1]. The implementation of the "AUTOMATED GREENHOUSE MONITORING SYSTEM" has the potential to initiate a green revolution in agriculture. The use of this method may enhance cultivation inside a regulated environment. The greenhouse environment, used for cultivating plants under regulated climatic conditions for optimal output, is a significant component of the agricultural and horticulture industries. Optimal environmental conditions are essential for maximum plant development, enhanced agricultural yields, and effective resource use, including water. Automating the data collecting procedure for soil conditions and numerous meteorological elements that influence plant development facilitates information collection with reduced manpower demands. Current EMSs are cumbersome, prohibitively expensive, difficult to operate, and less valued by a technologically inexperienced workforce. This project utilizes the very advanced PIC 16F877A microcontroller to analyze temperature, humidity, soil moisture, and lighting conditions [2].

Keywords: Sensors, LM35, PIC16F877A, LDR, Relay

INTRODUCTION

Greenhouses are vital in contemporary agriculture, allowing farmers to surmount the constraints of natural climatic conditions and enhance crop yield. Maintaining an appropriate atmosphere inside a greenhouse is essential for maximizing plant development, avoiding illnesses, and assuring high-quality outputs. To tackle this difficulty, sophisticated monitoring and control systems are needed for delivering real-time data and automatic modifications.

In recent years, the advent of inexpensive microcontroller platforms, such as Arduino, has transformed the domain of automation and control. Arduino provides a flexible and accessible platform that facilitates the integration of sensors, actuators, and sophisticated algorithms for the development of efficient monitoring and control systems. This project seeks to use Arduino's functionalities for greenhouse management.

This project aims to develop a greenhouse monitoring and control system that use Arduino as the primary control unit. The system may gather data on essential environmental factors inside the greenhouse by combining many sensors, such as temperature, humidity, light intensity, and soil moisture. The Arduino microcontroller then evaluates and analyzes this data to make intelligent judgments about adjusting greenhouse conditions. The suggested approach has several benefits compared to conventional manual greenhouse management. It offers real-time monitoring capabilities, enabling farmers to remotely view and oversee the greenhouse's environmental data. By presenting this information via an intuitive interface, users may acquire insights into prevailing situations and detect possible difficulties prior to their escalation. Implementing an Arduino-based greenhouse monitoring and control system enables farmers to optimize resource management, decrease labor demands, and improve overall crop output and quality. The system's automated features facilitate prompt execution.
This system has many sensors, namely soil moisture, temperature, and light sensors. These sensors detect numerous characteristics, including temperature, soil moisture, and light intensity, which are then sent to the PIC microcontroller. The microcontroller continuously assesses the digitized characteristics from numerous sensors, comparing them against predetermined threshold levels to determine whether remedial action is necessary at that moment. Should such a circumstance occur, it engages the actuators to execute a regulated action. A variety of actuators may be used in the system, including relays, contactors, and changeover switches, among others. They are used to activate alternating current equipment, including motors, refrigerators, pumps, fogging machines, and sprayers. Relays have been used to operate AC lamps, therefore simulating actuators and AC equipment for

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demonstration purposes. A fully operational system may be achieved by just substituting these simulation devices with the actual hardware.

LITERATURE SURVEY

Azahar -2019 has suggested a technique for an automated greenhouse system designed to enhance agricultural productivity inside a controlled environment. Specifically, temperature, light, humidity, and soil moisture sensors are used to gather essential data. The Arduino Mega 2560 is used to make essential judgments depending on the threshold values of certain environmental elements. The control system thereafter produces control signals to activate the exhaust fan and sprinklers, contingent upon the ambient factors. Users may monitor environmental conditions and crop health using an Android application. Furthermore, actuators may be controlled via an Android application if necessary. To enhance crop development and sustain crop health, a specific mix of red and blue light-emitting diodes (LEDs) is used. The greenhouse system is powered by solar panels, making it a self-sufficient unit.

In 2019, Nuttakaran proposed a method whereby the Internet of Things (IoT) significantly contributes to the agricultural industry by offering support to farmers through systems for monitoring growth parameters such as temperature, humidity, and water supply, as well as early disease monitoring and detection. This study proposes an IoT system with bot notifications for the various phases of tomato cultivation to provide intelligent agricultural solutions. The tomato dataset was sourced from Shin Chi Agri Green, a tomato nursery located near Fukushima, Japan. We developed and evaluated the deep learning model to identify the fruit proposal area. The identified locations were categorized into six phases of categorization, achieving a weight accuracy of 91.5%.

B M Bhavani (2018) developed a strategy for greenhouse deployment in agriculture that offers farmers the prospect of increased crop yields by mitigating risks associated with pests, insects, and severe climatic conditions. The automation of greenhouses aids farmers via the monitoring of soil and water quality and the implementation of autonomous watering systems. Incorporating scientific processes into this automation enhances the advantages of agricultural operations. The greenhouse's present condition may be gathered and transmitted to the cloud infrastructure for further decision-making. This work addresses the design and execution of a model for an IoT-based agricultural greenhouse system aimed at enhancing crop output. The system employs the lightweight MQTT protocol for inter-device communication. This paper seeks to utilize an IoT-based agricultural system within a greenhouse to minimize human intervention by autonomously detecting and regulating climatic factors such as soil moisture, air humidity, and light intensity, thereby facilitating automatic monitoring of irrigation, aeration, and lighting systems in the greenhouse.

Lijun Liu (2018) presented a technique for the In light of the swift advancement of agriculture in our nation, the demand for the quality and yield of greenhouse agricultural products is continually escalating. To effectively address the requirements for monitoring the greenhouse environment for vegetables, this paper proposes a vegetable greenhouse monitoring system utilizing ZigBee and GPRS technologies. The system integrates wireless sensor network technology with GPRS for data acquisition, wireless transmission, remote communication, and monitoring. The system establishes a wireless sensor LAN network utilizing ZigBee technology to gather temperature, humidity, and light intensity data, which is transmitted to the coordinator node. Subsequently, GPRS technology is employed to relay this data to the Internet. Finally, Visual Studio software is utilized to create a human-computer interaction interface using ASP.NET technology, facilitating remote monitoring of the vegetable greenhouse environment. The system exhibits mobile flexibility, rapid network formation, cheap cost, and little power usage. Experiments have shown that the system is robust and has enhanced measurement precision, hence fulfilling the requirements for greenhouse monitoring and being suitable for extensive use in agricultural output.

Hugo Sampaio (2017) provided a solution for a greenhouse monitoring system using a hierarchical wireless sensor network (WSN) in this research. The primary criteria necessary for monitoring and regulating a greenhouse are air humidity, temperature, soil moisture, and ambient light levels. This study presents a hierarchical wireless sensor network for the data collection of these characteristics. In this design, the sensors, which include all collection functions, processing abilities, and wireless data transmission capabilities, referred to as sensor nodes, occupy the lowest tier. The router nodes are situated at the intermediate level to facilitate data transmission from sensor nodes to a controller known as the coordination node. The coordinator node, in the highest level, is used to communicate with a central base, where all data received are analysed. The specifics of a straightforward deployment of this monitoring system are outlined. A multitude of tests were conducted, and the results indicated that the built monitoring system is functioning well.

METHODOLOGY

This work presents a system that takes three parameters from sensors and activates actuators when the actual values exceed the threshold values, while also storing these values in a database for remote access at any time. This research elucidates the automated regulation of climatic conditions inside the greenhouse. Various seasonal crops may be cultivated exclusively under certain circumstances. Onions, garlic, shallots, and similar vegetables are winter crops that need chilly temperatures for optimal development. Cucumbers, melons, and similar crops are summer cultivars that need moderate to warm climatic conditions.

The prototype consists of moisture sensors, temperature and humidity sensors, a Raspberry Pi, and water pipes for supplying water from a tank regulated by DC motors. Moisture sensors (YL 69) are positioned next to the roots, while the temperature and humidity sensor (DHT11) is situated at a further distance to measure temperature and humidity. These sensors transmit their data to the Raspberry Pi for analysis of the findings. The Raspberry Pi will activate the intake valve to irrigate the spinach till the soil moisture level exceeds the threshold value. In the greenhouse, if the temperature and humidity exceed the reference values established for spinach, the sliding door will be opened and the fan activated to keep conditions within the threshold levels.

PROBLEM STATEMENT

Growing diverse crops under unfavorable environmental circumstances is a formidable challenge today. One must maintain vigilant oversight of growth and development at regular periods. Sudden climate fluctuations badly harm crops. The necessary levels of temperature, soil moisture, light, humidity, air (Oxygen, Carbon Dioxide, and Nitrogen), and nutrients for optimal plant growth must be meticulously maintained to enhance production. Therefore, a greenhouse monitoring and automation system is essential for the appropriate cultivation of plants and the provision of requisite environmental conditions.

BLOCK DIAGRAM

Sensors

The soil moisture sensor circuit operates on a 5V supply and incorporates a fixed resistance of 1kΩ, a resistance of 10Ω, two copper lines as sensor probes, and a BC548 transistor. It produces a voltage output that correlates with the soil's conductivity. The conductivity of soil is contingent upon its moisture content. It escalates with the augmentation of the soil's water content. The voltage output is measured at the transmitter coupled to a 10 kΩ resistor. The two copper leads function as the sensor probes. They are submerged in the soil specimen whose moisture content is being tested. The soil is analyzed under three conditions:

1. Arid environments - The probes are positioned in the soil in arid circumstances and are inserted to a considerable depth. The absence of a conduction route between the two copper leads results in an open sensor circuit.
2. Optimal condition - When water is introduced to the soil, it percolates through the successive strata and disseminates over the soil layers owing to capillary action. This water enhances the soil's moisture level. This results in enhanced conductivity, establishing a conductive pathway between the two sensor probes, so creating a closed circuit for the current flowing from the supply to the transistor via the sensor probes.
3. Excess water situation - An increase in water content above the optimal level significantly elevates soil conductivity, establishing a consistent conduction pathway between the two sensor leads, resulting in a voltage output from the sensor that does not exceed a certain threshold.

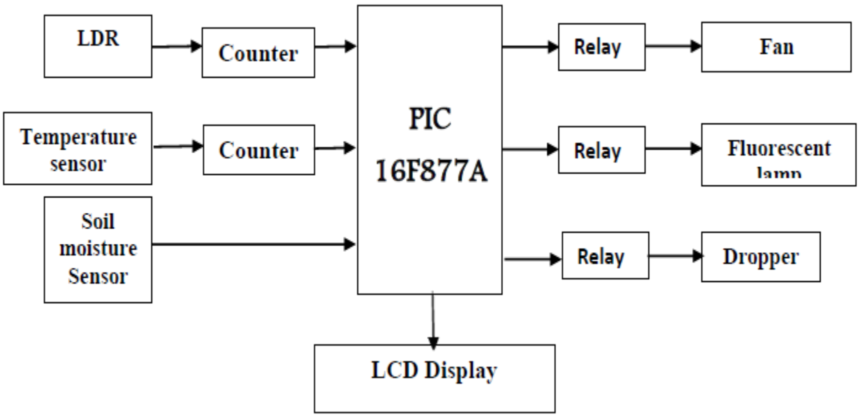

Fig. 1: Block Diagram of the System

ARDUINO UNO

Built on the Microchip ATMega328p microprocessor, the Arduino UNO is ARDUINO's open-source microcontroller board. If you want to connect it to other circuits or add other expansion boards, you may use the board's digital and analog input/output (I/O) pins. The ARDUINO IDE (Integrated Development Environment) may be used with a type B USB connection to program the board, which contains 14 digital pins and 6 analog pins. It works with voltages ranging from 7 to 20 volts and may be powered by a USB connection or an external 9 volt battery. It has some similarities with Leonardo and the Arduino Nano as well.

MOISTURE SENSOR

The soil's water content may be determined with the use of a moisture sensor. The module's output is high when there is a water scarcity in the soil and low otherwise. In addition to tracking soil moisture, this sensor serves as a helpful reminder to water plants. The capacitance is a measure of the dielectric permittivity of the medium around the soil moisture sensor. The amount of water in soil determines its dielectric permittivity. The sensor generates a voltage that is directly proportional to the soil's water content, which is determined by the dielectric permittivity. The sensor takes an average reading of the water content throughout its whole length. Among its many applications are the following: determining the ideal soil moisture content for different plant species, controlling irrigation in greenhouses based on soil moisture, improving bottle biology studies, and measuring the time-dependent loss of moisture due to evaporation and plant absorption.

TEMPERATURE AND HUMIDITY SENSOR

One simple and very inexpensive digital temperature and humidity sensor is the DHT11. No analogous input pins are required since it measures environmental humidity using a thermistor and a capacitive humidity sensor, and then outputs a digital signal on the data pin. Though easy to operate, it needs precise timing in order to get data. This sensor's one and only major drawback is that it only updates its data every two seconds; as a result, the values you obtain from our library may be as old as two seconds ago.

Hardware Implementation

The gate sheet used to construct the greenhouse acts as an insulator, drawing in heat from the sun and preventing it from escaping. The greenhouse houses the several sensors and their corresponding actuators.

RESULTS

The greenhouses were constructed, and the seeds were planted inside them. The tomato plant was chosen for the demonstration. Figures 4 and 5 illustrate the developmental phases of the tomato plant.

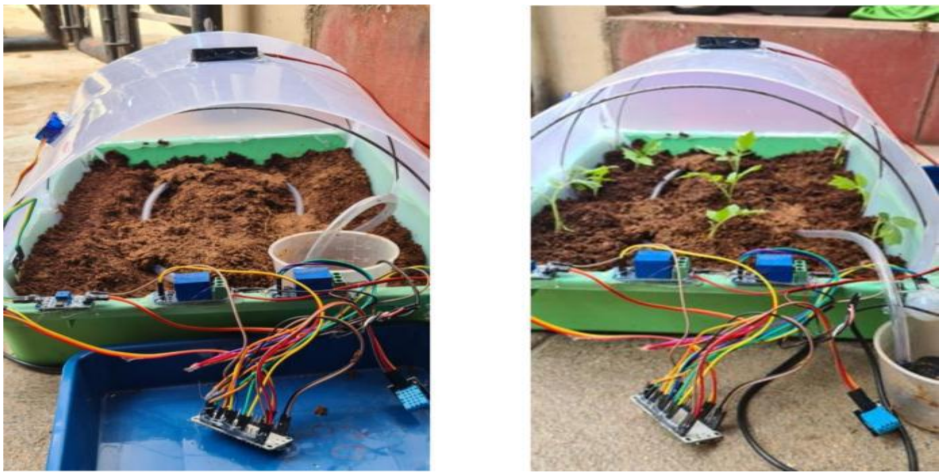

Fig-3: Day 1 and day 15 of tomato plant

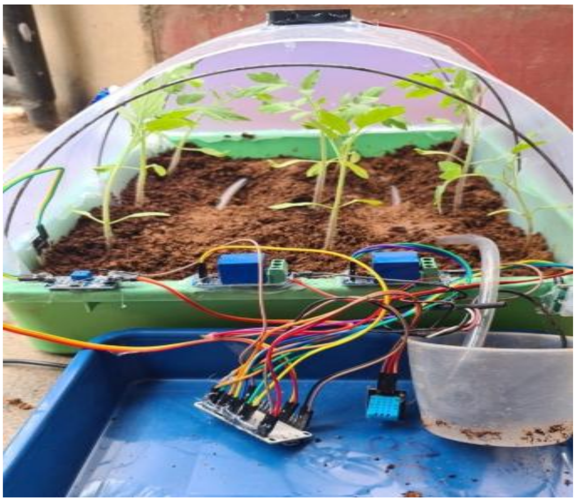

Fig-4: Day 30 of tomato plant

CONCLUSION

The automated greenhouse monitoring system comprises different sensors, including soil moisture, temperature, and light sensors. These sensors detect numerous characteristics, including temperature, soil moisture, and light intensity, which are then sent to the PIC microcontroller to provide control actions based on comparisons with predetermined values. AGMS mitigates the possibility of greenhouse maintenance failing to meet precise environmental conditions owing to human mistake, reduces labor costs, and is environmentally sustainable. This technique eradicates pests and enhances yield quality.

FUTURE SCOPE

The circuit, in its current form, may be enhanced in several ways and is applicable in various domains [5]. It may be positioned and used in all environmental circumstances. Non-conventional energy sources, including as solar panels and wind turbines, are used to provide power to the automated greenhouse equipment. AGMS has significant potential for advancement in the agricultural sector and is poised to instigate a revolution therein.

REFERENCES

1. Greenhouse Structures (University of Arizona, 2001) http://ag.arizona.edu/ceac/sites/ag.arizona.edu.ceac/files/Greenhouse%20Structures.pdf
2. 7805 Datasheets B.Vidyasagar, "Green House Monitoring and Automation using GSM", in International journal of Scientific and Research Publications, Volume 2,Issue 5, May 2012
3. Chandankumar Sahu, Pramitee Behera, "A Low Cost Smart Irrigation Control System", IEEE Sponsored 2nd International Conference on Electronics and Communication System (ICECS), 2015.

4. Krishna S. Nemali, Marc W. van Iersel, “An automated system for controlling drought stress and irrigation in potted plants”, Scientia Horticulturae, Vol. 110, no. 3, pp. 292– 297,July 2006.
5. Tanu Sahu, Ashok Verma, “Automated Smart Irrigation System using Raspberry PI”, International Journal of Computer Applications, Volume 172 – No.6, August 2017
6. Parameswaran, G., Sivaprasath, K, “Arduino Based Smart Drip Irrigation System Using Internet Of Things” IJESC, Volume 6 Issue No. 5, 2016.
7. Keerthi.v, “Cloud based greenhouse monitoring system” ,Int. Journal of Engineering Research and Applications ISSN: 2248-9622, Vol. 5, Issue 10, (Part -3) October 2015, pp.35-41.
8. HILALI, “Control based on the temperature and moisture using the fuzzy logic”, Int. Journal of Engineering Research and Application ISSN: 2248-9622, Vol. 7, Issue 5, (Part -3) May 2017, pp.60-64.
9. Ramya Koshy, “Greenhouse monitoring and controlling based on IOT using win”, ITSI Transactions on Electrical and Electronics Engineering (ITSI-TEEE) ISSN (PRINT) : 2320 –8945, Volume -4, Issue -3, 2016.
10. Sharad Shinde, “Automated Irrigation System Using a Wireless Sensor Network and GPRS Module “, Int. Journal of Engineering Research and Application ISSN: 2248-9622, Vol. 7, Issue 4, (Part -6) April 2017, pp.58-63.
11. Chaudhary, S. Nayse, and L. Waghmare, "Application of wireless sensor networks for greenhouse parameter control in precision agriculture," International Journal of Wireless & Mobile Networks (IJWMN) Vol, vol. 3, pp. 140-149, 2011. Both, "Greenhouse temperature management,"