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Implementing an Internet of Things-Based Intelligent Management System for a Farm's Greenhouse

[1]N Lalitha Devi, [2]Ashok.K, [2]B.Sujatha, [3]D.Phani Kumar

[1]PG Student, Dept of CSE, Godavari Institute of Engineering and Technology (A),Rajahmundry,AP
[2]Professor, Dept of CSE, Godavari Institute of Engineering and Technology (A),Rajahmundry,AP
[4]Assistant Professor, Dept of CSE, Godavari Institute of Engineering and Technology (A),Rajahmundry,AP
Corresponding Author: noolulalithadevi@gmail.com[1] drashok@giet.ac.in[2], bsujatha@giet.ac.in[2], phanikumar@giet.ac.in[3]

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ABSTRACT

Over the last several decades, the globe has made great strides in automating many processes. Domestic life, manufacturing, and farming are just a few examples of the areas where automation is used. Automatic monitoring and management of the greenhouse environment in lieu of human supervisions is the technology technique known as "greenhouse," which will be beneficial to farmers in rural regions. The study focuses on a generalized architecture that may be used in a wide variety of different kinds of automation. Improved agricultural production is a top priority, especially in light of recent technological developments. Greenhouses are enclosed, climate-controlled buildings with roofs and walls that are used to cultivate plants in inclement weather. The Internet of Things is a cutting-edge IT development that enables the networked, decentralized administration of sensors, devices, and user data on a worldwide scale. Utilize a cooling fan, an LED light, and a motor to create the optimal environment for plant development and harvesting by controlling the greenhouse's temperature, humidity, and light levels.

Keywords: Environment,Agriculture, IoT, Greenhouse, Arduino, PH Sensor

1. INTRODUCTION

Plants that thrive in controlled environments are often cultivated in greenhouses, which are structures with walls and a roof composed mostly of transparent material, such as glass. A greenhouse, in the strict sense of the term, is a covered structure that serves as a refuge for plants from harsh weather and disease, fosters an ideal microclimate for plant development, and provides an adaptable answer to the problem of how to grow plants sustainably and efficiently all through the year. As a system, a contemporary greenhouse is also known as controlled environment agriculture or a controlled environment plant production system. These days, commercial greenhouses and hothouses are often state-of-the-art factories for growing plants. The glass greenhouses may have a variety of features installed, including as screening, heating, cooling, and lighting, all of which can be controlled by a computer to provide optimal growing conditions for the plants. In order to minimise production risks prior to cultivating a particular crop, a number of methods are employed to assess the optimality-degrees and comfort ratio of the greenhouse micro-climate (i.e., air temperature, relative humidity, and vapour pressure deficit) [4]. Almost every home may accommodate a greenhouse, whether it is a huge freestanding building or a tiny window-mounted construction. When it rains unexpectedly, you may still get some gardening done in a greenhouse, even though many people prefer working outside in the garden. Furthermore, greenhouses are ideal environments for plant growth. An array of atmospheric factors significantly affect plant development.

The primary function of a greenhouse is to create a stable climate for the year-round cultivation of a select range of plant species that would otherwise struggle to survive outside. It's also used to crops that improve their output (both in terms of quality and quantity) under constant observation and management. Most greenhouses need human intervention to operate and keep track of at present. Humidity, temperature, wetness, and light are some of the most important climatic factors in a greenhouse. As a result, it's safe to say that the greenhouse system contributes to increased agricultural productivity and income. With the help of the Internet of Things, the novel architecture proposed here can monitor and control operations from afar. There will be no need for the farmer or greenhouse worker to physically visit the location in order to adjust any greenhouse parameters. Some tasks, including as operating the water pump on and off, sliding the greenhouse windows, activating the sprinklers, etc., may be done from within the house without the need to physically enter the greenhouse. The developed system includes a Windows programme, a number of sensors (including temperature, humidity, and LDR sensors), and an Arduino Uno microcontroller for managing greenhouse conditions. The sensors constantly provide data values to the microcontroller in real time, and the microcontroller automatically takes control action when the numbers exceed a predetermined threshold or critical value. If the temperature inside the greenhouse reaches a certain threshold, for instance, the fan will begin to rotate automatically.

2. LITERATURE SURVEY

1. Somnath D. Bhagwat, Akash I.Hulloli, Suraj B.Patil, Abulkalam.A.Khan, Mr.A.S.Kamble, "SMART GREENHOUSE USING IOT AND CLOUD COMPUTING", International Research Journal of Engineering and Technology, Volume 5,issue 3,March 2018. The authors of this study present the first iteration of the "smart greenhouse farm," an innovative facility that makes use of the Internet of Things and cloud computing. Because of their usefulness in maintaining stable environmental conditions for plant growth, greenhouses have historically played a significant role in both the agricultural and gardening industries. There are a variety of sensors being utilised to monitor and manage the farm, including ones that detect temperature, soil moisture, and light. In addition to sensors, a microcontroller, actuators, and analog-to-digital converters (ADCs) are employed. When the defined climatic variables have exceeded the threshold, the sensors first detect the change. After being converted by the ADC to digital form, the data is read by the microcontroller at its input ports. This system relies on a microcontroller as its brain. Using cloud services, alarm messages are sent continuously to the user. The "cloud" where these communications are stored means that the recipient's physical location is irrelevant. The farmers will be able to keep an eye on their greenhouse operation with the use of this data. Fans, water pumps, buzzers, and lights may all be readily monitored without human intervention. By minimising human involvement as much as possible, this method is helping to do away with any problems that may arise.

2. Mohammad Woli Ullah, Mohammad Golam Mortuza, Md Humayan Kabir, Zia Uddin Ahmed, Sovan Kumar Dey Supta, ParthoDas,"Internet of Things Based Smart Greenhouse: Remote Monitoring and Automatic Control", International Conference on Electric and Intelligent Vehicles(ICEIV 2018) In this study, we provide the details of a system that keeps tabs on environmental conditions including humidity, temperature, and soil moisture, and responds accordingly. A database is included, which may be used in further research and publications. Wherever humans dwell but plants are unable to grow as a result of harsh winters, such as the North Pole or nations with a similar environment, this technology would be an excellent choice for deployment. There are three parameters to

monitor to ensure the greenhouse is at an appropriate temperature and humidity. Initially, soil moisture, then temperature, and last, humidity. A combination of these three sensors and an LDR is used to determine whether it is day or night outside. Additionally, LCD displays current humidity and temperature readings. When the temperature falls below 140 degrees Celsius, the heating system kicks on and the fans begin exhausting the hot air. High humidity is also required in greenhouses. When the humidity level within the greenhouse drops below 90%, the system activates the sprayers and switches them off when the humidity level reaches 96%, allowing for optimal growing conditions by maintaining a constant high level of humidity. It also does the math and displays the current temperature and humidity at various periods.

3. Prof. D.O.Shirsath, Punam kamble, Rohini Mane, Ashwini kopla, prof.R.S.More "IOT Based Smart Green HouseAutomationusingArduino."InternationalJournal of Innovative Research in computer Science & Technology (IJIRCST), Volume-5, Issue-2, March 2017In this article, we will see how they used Arduino and the Internet of Things to automate a greenhouse. The Greenhouse was operated by android phone using IoT. One of them is the Global System for Mobile Communication (GSM), which is used to transmit the notice to the Android phones; however, the major drawback of this method is that users must manually input the message, which may be a little time-consuming. The microcontroller board utilised here is an Arduino ATmega328. It has 14 digital I/O pins, where the analogue input is used. Atmospheric sensors, specifically a soil moisture sensor buried in the target soil, were employed to determine its moisture content for this study. For low-light situations, a light-dependent resistor (LDR) might be utilised. A device that measures the moisture content of the air (a humidity sensor). In response to a high reading from a temperature sensor (LM35), turn on the ventilation system. Parts of the software implementation are coded in C and C++, while the ArduinoUno integrated development environment (IDE) is utilised for the rest.

3. EXISTING SYSTEM

AVR Microcontroller was originally used in the construction of this system, allowing for human monitoring of this sensor through LCD Module. The information collected by sensors may be seen, and the user can exercise direct control over the gadgets. Compared to the suggested system, this one is far less efficient and takes a very long time.

4. PROPOSED SYSTEM

The proposed system connects sensors to the input pins of the Arduino to keep tabs on things like temperature, humidity, wetness, and light; the Arduino then sends signals to the motors and relays to control the airflow, mitigating the negative effects of the current setup. Arduino controls the driver circuit to modify the air flow and temperature based on the threshold value set for temperature, moisture, humidity, and light. Information collected by sensors may be uploaded through Wi-Fi in the cloud and kept in an online database. The farmer's mobile device is routinely updated with data from the cloud through an internet connection, allowing for remote monitoring to be performed. Through this, it's possible to sidestep human-machine communication in favor of robotic dialogue.

4.1 ADVANTAGES

1. The automated smart greenhouse always maintains ideal micro-climate conditions.
2. The greenhouse controllers are able to simultaneously leverage the availability of sunlight.
3. Automated greenhouse provides an affordable infrastructure to monitor status and detect suspicious activities.
4. By unlocking massive crop insights, a smart greenhouse allows growers to minimize labor work.
5. IOT sensors allow farmers to collect various data points at unprecedented granularity.
6. The sensors in the field or in the greenhouse can help the farmers plan an optimum time to carry out the harvesting.

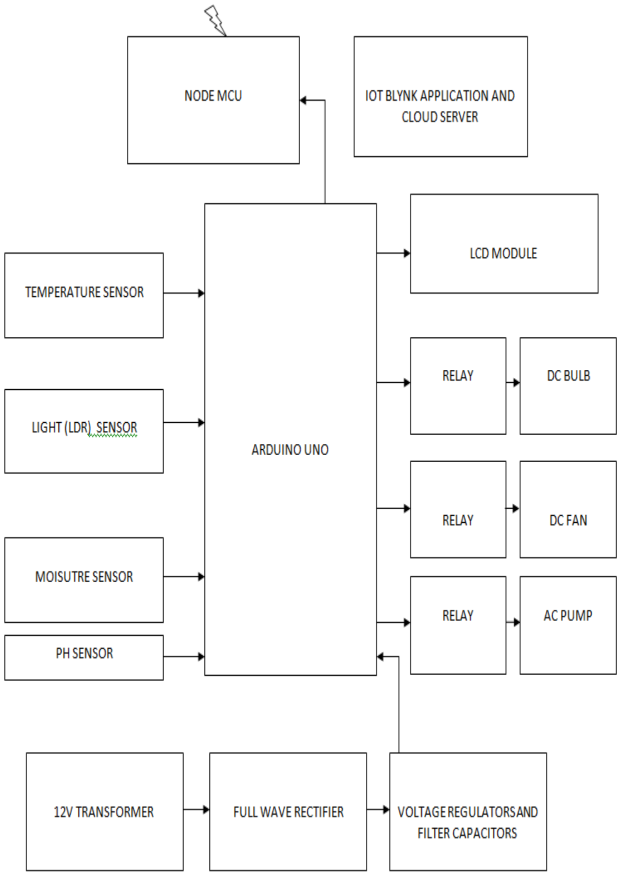


Fig1: System Architecture

5. METHODOLOGY

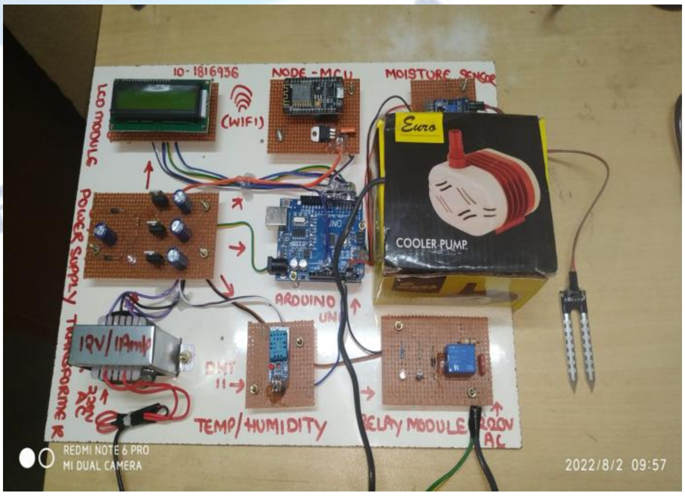
Green houses are used to cultivate various plant species, including ornamentals and edibles. During the day, greenhouses warm up as the sun's rays pass through, warming the plants, soil, and structure. Many plant diseases are transmitted from soil to plants via the rain. Greenhouses are useful for preventing the spread of these diseases. The greenhouse effect is a natural occurrence that really helps humanity. Many farmers' attempts to develop profitable greenhouse crops fail because they lack control over two factors: plant growth and production. Minimum temperatures in greenhouses are unsafe. Water vapour condenses on greenhouse surfaces, and soil moisture is lost by evaporation if the humidity is too high. This greenhouse tracking and management system is the solution to such problems.

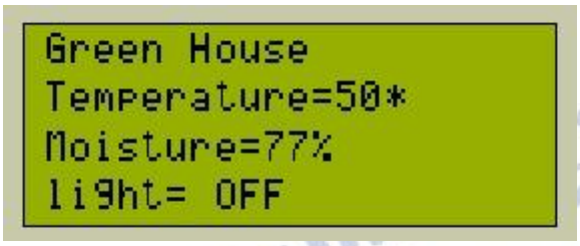
This project showcases the planning and execution of a suite of sensors for use in monitoring and managing greenhouse environments. The Atmega328 microcontroller runs the show for this greenhouse management system, which includes a thermometer, luminometer, reed switch, soil moisture sensor, LDR sensor, liquid crystal display module, 12 V DC fan, bulb, and pump. A temperature sensor is a device that measures thermal conditions. In extreme heat, DC fans kick on; in cooler conditions, they shut down. If a soil moisture sensor detects a drop in moisture, the water pump will activate. The LDR sensor detects dark conditions and triggers the light bulb to turn on. The level of acidity or alkalinity in the water in the tank may be determined with the use of a pH sensor. The sensor readings are displayed on an LCD Module for in-person inspection. It will be much simpler to monitor and regulate the system in this manner. There is also a connection to an Internet of Things monitoring system. These three sensor data are tracked using the Blynk Android app and a cloud server based on Blynk and Thingspeak. A Blynk app is made available to the user, which can be used to monitor the data in real time from any location. In order to connect to the internet and send data to a cloud server, the system is interfaced with a node MCU.

The microcontroller's Analog Pin is used to interface with the sensor modules, while the microcontroller's Digital Pins are used to link the various control devices, such as a relay. The Arduino UNO LCD Module plugs onto pins 2, 3, 4, 5, and 6.

The system's power supply configuration includes a 230/12V step down transformer for reducing the incoming 230V to 12V. A bridge rectifier is used to turn the AC into DC. In order to eliminate noise and ensure that the +5V required for the microcontroller and other components can be reliably supplied, a capacitor filter is used in conjunction with a 7805 voltage regulator.

6. RESULTS





7. CONCLUSION

The Internet of Things (IoT) based greenhouse monitoring system is a comprehensive solution for keeping tabs on and adjusting the greenhouse's climate. The standard method of greenhouse surveillance requires a lot of man hours and is quite time consuming. Time, money, and effort are all reduced by the suggested solution. A controlled environment is provided for the plants, protecting them from harm and enhancing yield as a whole. Within the greenhouse, we have the ability to regulate and track environmental variables including temperature, humidity, and soil moisture. Since the greenhouse's environment can be controlled, almost any crop may be grown in it.

Future Scope

Furthermore, a GSM-based notification or text-message alert system may be added to this infrastructure. When activated, the user will get an SMS notification whenever any controlled devices are activated or deactivated.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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