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Design and Development of Greenhouse Monitoring and Control System Using Iot

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ABSTRACT: Conventional greenhouses need regulated climate conditions to grow plants in there. Without an automatic control system, it is quite impossible to maintain the accurate climate conditions inside the green houses. This paper proposes such an automatic system for greenhouses to control its' internal environment, to store each climate properties in a database for future analysis and to ensure remote monitoring to those data. Internet of Things (IOT) is used for remote monitoring and analysis of data. Also, an android application is developed to display those data in a short range through Bluetooth technology. The system controls the temperature, humidity, light and soil moisture level by sensing the values from sensor and controlling heaters/coolers, sprayers, bulbs and water pumps accordingly.

Keywords: Internet of Things, Greenhouse, Android Application, Remote Monitoring, Automatic control.

I. INTRODUCTION:

The greenhouse manufacturing is the quickest developing part of the world. This manufacturing isolates, the yield from nature, subsequently giving some method for protection from the immediate impact of the outside climate conditions. This empowers the manufacture of harvests which generally couldn't be created at that particular area. The greenhouse walled in area empowers the control of the harvest condition. This advantage enables the farmer to enhance the development in a way the plants require. It prompts higher harvest yield, extended manufacturing period, higher quality, and less utilization of defensive synthetic substances. The introduced cost per unit region in greenhouse vegetation is significantly higher than that in open-field farming. In modest macroclimate zones, energy is required, while in dry zones, the cooling and accessibility of water is of primary concern. The utilization of materials and energy and in addition crop yield and quality can be impacted by working the flexible segments of the greenhouse, for example, warming and cooling inputs, window opening, dribble water system, showing and CO_2 dose. Consequently, it can be anticipated that the manner in which these controls are worked impacts the final financial result. To absolutely take advantage of the stronger probabilities for harvest and asset administration in a greenhouse, it is vital to know the control factors with a remote detecting framework utilizing the GSM. In fact, remote correspondence structures are an essential issue of the arrangement of modernization and innovation exchange, because of the expanding advancement of portable media communications. Internet of Things (IOT) can be expressed as the architecture of physical things implanted with electronic circuits, sensors and programming along with an associative system that empowers these things to trade information from each other. IOT is the combination of the computerized and physical world. In a universe of IOT, a huge number of things or apparatuses will be interconnected and interestingly recognized on the Internet. The Internet of Things enables the system to detect and control other devices remotely transversely over existing system foundation, making good interrelation between the physical world and different computer-based frameworks and creating chances for enhanced effectiveness, financial advantage and precision. In near future, IOT is relied upon to give numerous more administrations like propelled availability of physical questions over a wide system and furthermore numerous applications. It is apparent to think that in utilizing these administrations given by this innovation, it is conceivable to control and screen frameworks from a separation utilizing the GSM arrange. Mobile internet is coordinated applications as valuable as home automation, industrial purposes for managing and far off monitoring of complicated systems however also in safety systems and ensure property and individuals. Most physical factors important in a greenhouse can be estimated via automatic sensors. This holds

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for temperature, light, soil dampness, and relative humidity. Precipitation can additionally be detected, even though it is truly much less common.

All the specified physical factors are inspected and put away electronically at normal interims when something is evolving. Inclusive, the estimations give a significant decent info yield snap of the physical phase of the greenhouse harvest structure. We suggest a commitment to the improvement of greenhouse monitoring. The remainder of this paper is organized as follows – Section I includes the introduction. Related Works has been discussed in section II and methodology of the research is discussed in Section III. Section IV discusses the performance measurements of the research; Section V contain the conclusion.

A. Internet of Things (IOT):

IERC (European Research Cluster on the Internet of Things) defines Internet of Things as a global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies. It is a concept and a paradigm that considers ubiquitous presence of variety of things or objects which are connected via wired or wireless communication networks and are able to interact, cooperate and communicate with each other in the environment with minimal or without any human intervention, this concept revolutionizes user experiences and producers' understanding of user requirements and their production methods; which in turn will revolutionize our way of life as a whole. Primarily it suggests that virtually everything right from a conventional thermostat to a huge assembly line on a factory floor can be connected to the internet and can be converted into computer which have positive effect on their efficiency.

B. IOT in Agriculture:

Very often farmer or Agriculturists rely upon their gut to figure out the vital operations which can have an adverse effect on their production, here sensor data in the fields or in the greenhouse can help farmers plan an optimum time to carry out the harvesting would then ensure that the crop is ready and the value generated is maximized. Thus agriculture is one of the largest use cases of IOT, besides this selective Irrigation, livestock monitoring, remote equipment operation and monitoring, predictive analytics for crops and livestock, etc. are other use cases where IOT is most helpful.

II. RELATED WORKS:

Recently, the developments in the field of the IOT technology have led to renewed interest in developing the greenhouse technology system. The pleasant was grumblings from a few things, for example, keep track the irrigation system process and doing it manually. Also, the plants may suffer from bad effects of awful conditions like temperature and light. An Intelligent Agriculture Greenhouse Environment Monitoring System Based on IOT Technology to those Mediterranean nations, for example, Italy, Turkey, Greece Also Spain the place mechanical transformation level of greenhouse development may be low. The task means should increment the innovations of greenhouse societies toward the formation about a coordinated circuit organize for sensors and automation technologies, controlled by an ICT (Information and Communication Technologies) approach, for the agronomic development of horticultural crops. The data identified with the greenhouse environment and yield status and control the system automatically in view of the gathered data. By throatily observing periodic conditions, this study has the reason for securing the connection between sensors signals and reference estimations. To monitor the environment inside greenhouse different parameters have been considered such as light, temperature, humidity, soil moisture etc. using different sensors like DHT22 temperature and humidity Sensor, LDR, grovemoisture sensor etc. which will be interfaced with the microcontroller. With the development of agriculture needs, the greenhouse has huge development prospects, it can bring huge economic benefits to agriculture. ZigBee technology to carry out remote wireless monitoring of temperature and humidity signals in vegetable greenhouses. It sends data signal from the temperature and humidity sensor of each node gaining to the main control system through the wireless communication way. According to the monitoring and management needs of the modern greenhouse design and implementation of modern greenhouse remote monitoring system based on the Web. Ajax technology is applied to the development of web applications, which improves the response and interactivity of the system. Also presents agreeable correspondence based remote sensor organize for checking greenhouse related parameters, for example, Temperature, Humidity, and Carbon-di-oxide. This product utilizes an Android cell phone, associated utilizing Wi-Fi to a local server which interfaces by means of serial correspondence to a microcontroller and mugginess sensor. In designing this device, there is a restriction on issues, to

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perceive how far this framework can do its errands. ARM-based remote monitoring and Control System for environmental parameters in the greenhouse. It overcomes the disadvantages of wired and wireless constraints such as complicated wiring, difficult maintenance, and distance, to monitor and control the applications. All the works described above, and any other papers didn't show IOT based greenhouse automation system. The major objective of this paper is to develop a practical smart greenhouse with intelligent control systems in order to obtain suitable circumstances. The proposed system has the ability to monitor and control the greenhouse from any place in the world. Fig 1 depicts the block diagram of the entire system. The overall designed system could be divided into three different parts: hardware, software and IOT structure.

HARDWARE ARCHITECTURE OF THE SYSTEM:

Temperature and Humidity Sensor Node.

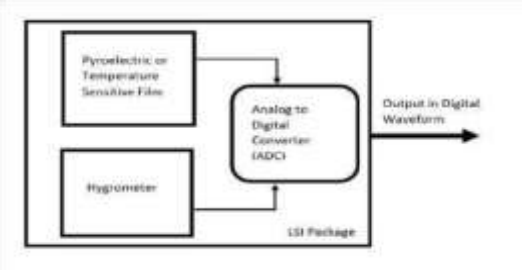
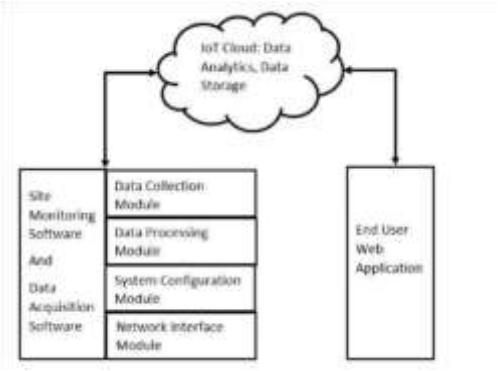


Figure 2. Temperature and Humidity Sensor Node

This node senses the temperature and humidity inside the greenhouse using a pyroelectric film for temperature and a hygrometer which is a Resistive type humidity sensor [11] that pick up changes in the resistance value of the sensor element in response to the change in the humidity. The changes recorded by both are sent to a common ADC system which will convert the analog form of data to digital form which is easy to decode and understandable by the server. For our system we have use DHT 11 sensor which is a composite sensor containing a calibrated digital signal output of the temperature and humidity, it works on the low power input, and is highly reliable as it can be operated in the temperatures till 50o C and humidity till 80% RH.



The Above figure depicts the overview of our software design. It consists of Site monitoring and Data acquisition software, IOT Cloud (containing Data analytics and storage and End user web application.

Data Collection Module

This module collects and decodes the digital signals input from the sensor nodes and extracts the useable data.

Data Processing Module

This module preprocesses the usable data for analytics to be done. Also, it uses this data for actuation purpose and timing and sensor based node.

System Configuration Module

This module is used to configure the system primarily for setting threshold values and preprocessing fine tuning.

IOT Cloud

Being an IOT system on site we cannot load resource intensive the analytics code in the server thus using IOT cloud we can perform analytics and store the data collected for future use easily and efficiency.

TEST ENVIRONMENT:

The wireless embedded system has been tested in the small version of greenhouse environment. The proposed embedded systems consist of COZIR and CC3200 Launchpad designed by Texas instrument. The sensor has been designed by Gas Sensing Solution. The Sensor has been connected with the CC3200 using the UART as shown in figure.

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III. METHODOLOGY:

The proposed system will give a smart solution for green house. It happens to implement the technology of internet of things along with the conventional systems available. We created a total model of smart greenhouse for implementing our system. Our System consists of simple but efficient algorithm, which happens to manage all the aspects. An ATmega328 microcontroller is used as the brain of the system. Here microcontroller is used because of its low cost and faster response to handle our system. To check the climate conditions of the green house, three things are to be measured.

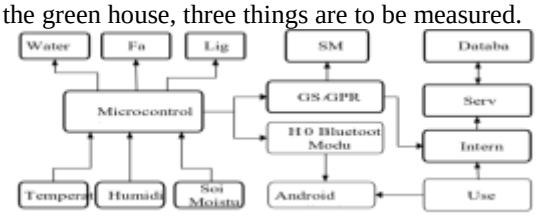

Figure 1 Block diagram of the system

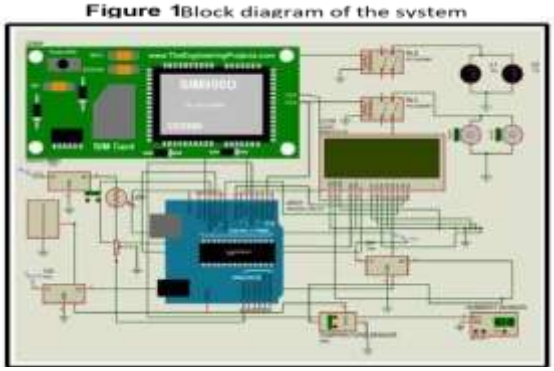

Figure 2 Partial circuit diagram of the system

First of all, soil moisture, secondly environment temperature and the last of all is humidity. So for this, three sensors are implemented and an LDR is used for detecting Day/Night condition. Microcontrollers go through the following manner given in Figure 02. At the beginning the microcontroller initializes the GSM/GPRS module and HC05 Bluetooth module to connect the system to a network.

Microcontroller measures the condition of soil moisture and water of the plants if the level is lower than usual then it takes value of both temp and humidity and takes air in or out and starts/stops the sprayers accordingly depending on the condition. Then it determines Day or Night condition using LDR sensor. And at the end, all the data is sent to the user by sending a SMS using GSM, to the mobile application by HC05 and to the server using GPRS. There's also a LCD display along with the android app to show real time data.

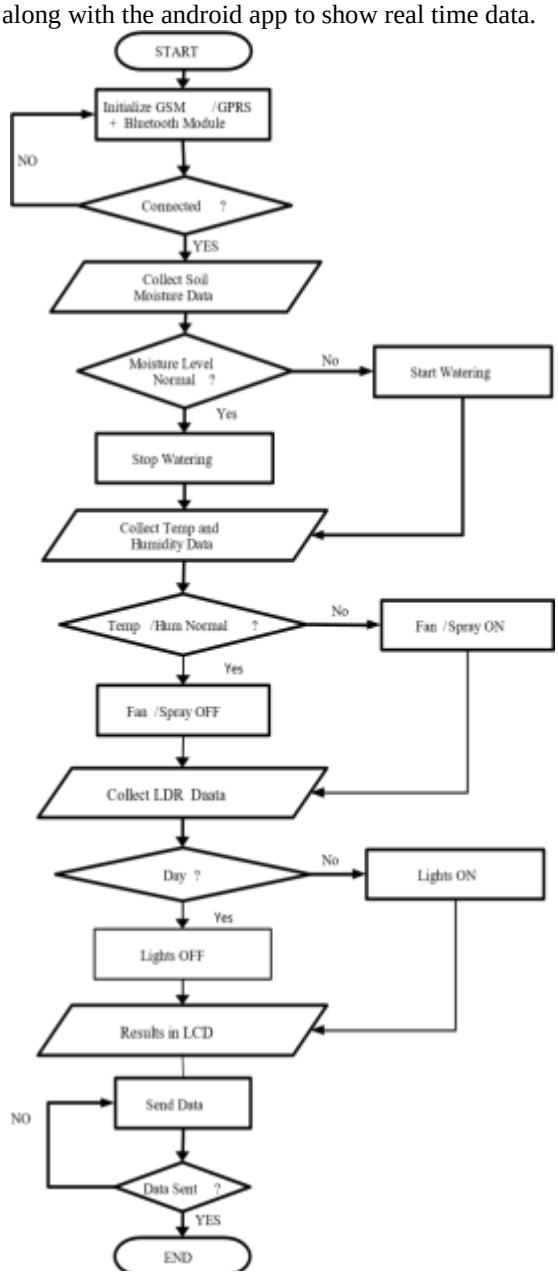

Figure 3 Flow chart of the system

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Performance measurements

Following figures explain working procedures of our system. Figure 4 represents the model of our whole system.

At figure 5, LCD showing the real-time data of humidity and temperature. The fans take out air if temperature gets higher than 27° C and starts the heating system if temperature gets lower than 14° C. Also, greenhouses need high humidity conditions.

Figure 5 Real-time humidity and Temperature

For maintain high humidity inside the greenhouse, the system turns ON the sprayers whenever it detects the humidity level inside the greenhouse goes lower than 90% and turns them OFF after achieving humidity level of 96%.

Figure 6 Day/night condition

Figure 6 illustrates the condition of light intensity. If light intensity is lower outside, then it automatically turns ON the lights inside the greenhouse. Also turns them OFF if the ambient light intensity around the greenhouse becomes average.

The real-time data in a mobile device through android application which is communicating the system via Bluetooth. It also shows which actions have to take in according with the data.

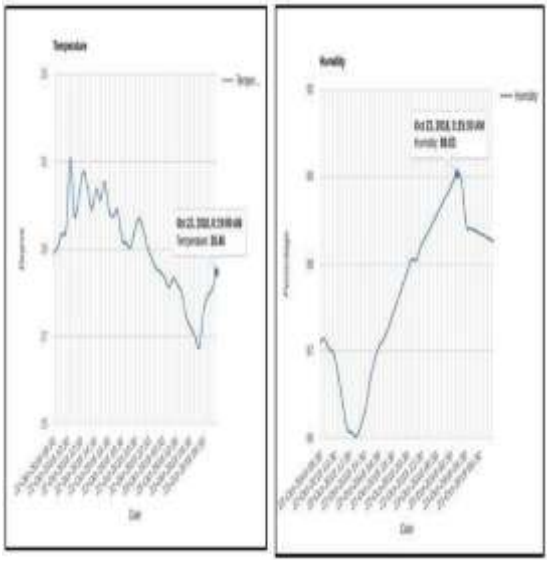

Figure 7 Temperature in different times.
Figure 8 Humidity in different times.

IV. CONCLUSION:

Our proposed system monitors temperature and humidity, soil moisture and take action according to results. The systems do not need any human interaction. It also includes with a database helpful for future analysis and reports. This system is very suitable to be deployed at places like North Pole and winter climate countries where people live but plant does not grow due to heavy winter. If this system is used in those countries, one person can manage multiple Green-houses to grow a vast number of plants due to its efficient use of time and automatic controlling ability. That person will only need to monitor about the condition of the green-houses and fix something that cannot fixed by the proposed system such as cutting off any infected leaves of the plants, uprooting any infected trees and so on. Also, IOT will enable a person to monitor from remote distances and efficiently utilize the time and energy. Comparing to other devices with similar perspective, our system is more precise and stable. As we have used GSM-GPRS module to send data over internet, it is more reliable, fast and efficient comparing to ZigBee technology and RF modules. But there are still some improvement needs in our project like determining soil texture and providing

fertilizer aptly. Besides, determining the health condition of plants and the type of plants suitable for soil will be the future concerns of our system. Also with the help of IOT, multiple greenhouses will be monitored and data will be shared for better understanding and improved production rates of plants and foods. Our system enables people to monitor and manage growing conditions of their greenhouse.

The use sensor nodes, internet connection, and the cloud will deliver real-time updates about plants and help people grow plants more efficiently, with all observation and conventional tests results conclude that our project will provide a solution for automating greenhouse activities and irrigation activities. Implementation of such a system in the field can definitely help to improve the yield of the crops and overall production, and with its quality to cost ratio, it will be affordable to the majority of the agricultural community and also to agro-based industries.

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