

GREENHOUSE AUTOMATION USING IOT

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Abstract: The technology of Internet of Thing (IoT) has been used to develop numerous applications. This paper comprises design and implementation of greenhouse automation system integrated with the IoT feature in order to monitor and control system's parameters from any place in the world. The greenhouse prototype presented here involves monitoring and control of three vital parameters of greenhouse system namely temperature, water level in soil, and light intensity inside the greenhouse. The details of system implementation can be presented in two parts- hardware and software. Because of the use of IoT feature, the greenhouse parameters can be monitored and controlled continuously and the collected real-time data from the sensors can be displayed on web-page or app from anywhere in the world at any time. The variation in individual sensor's data over time can be graphically plotted for improved monitoring and analysis.

Keywords: IoT, Microcontroller, Arduino Uno, Remote monitoring, Control, Greenhouse

1. Introduction

A greenhouse is mainly used to provide controlled environment in terms of temperature and humidity in order to grow certain types of plants throughout the year. It is also used for plants that can produce better yield in terms of quality and quantity when subjected to continuous monitoring and control. At present most of the greenhouses are manually controlled and monitored. Greenhouse mainly deals with the vital environmental parameters for plant growth such as humidity, temperature, moisture, and light. Thus we can conclude that the greenhouse system helps in boosting the efficiency and profitability of farming. The innovative design presented here can perform the monitoring and control activity from remote location using IoT. Thus farmer or greenhouse worker need not go to the site to control any parameter of greenhouse. For example, it may be required to turn on and off the water pump, sliding the windows, turning on and off sprinklers etc. which may be performed sitting at home without going to greenhouse. The designed system consists of Arduino Uno microcontroller, various sensors such as temperature sensors, humidity sensors, and LDR sensors along with windows application for controlling greenhouse parameters. The sensors continuously send real time data values to microcontroller and when the value reaches a certain threshold or critical value microcontroller takes control action automatically. For example; fan can automatically start when temperature inside the greenhouse crosses the critical value.

2. Literature Survey

An overview of related research work has been presented in this section. Several authors have carried out work using IoT concept in greenhouse. Zao et al. [1] and Wenshun et al. [2] have carried out similar work. Rangan and Vigneswaran [3] have described an embedded system approach for monitoring greenhouse based on parameters such as humidity, pH of water, wetness of soil, temperature and light intensity. These parameters are measured using sensors, and then they are controlled using microcontrollers. Also the parameter values are informed to the proprietor of the greenhouse using messaging service of GSM. Prakash H. Patil et al. [4] have developed a greenhouse monitoring system using GSM which monitors the levels of temperature, humidity, light, and CO₂. Their system uses different sensors for parameter measurement and GSM for messaging. The system offers a mechanism to alert farmers regarding the parameter changes in the greenhouse. However, both systems lack a real-time graphical representation of the measured data and the feature of controlling the greenhouse system remotely. This paper mainly aims to describe the greenhouse monitoring system which will display the sensed data on a webpage and will also provide the facility of controlling and monitoring the system remotely.

3. Current Scenario

Greenhouses in India are now commonly found even in remote locations. However it is an essential requirement to grow plant in extreme climatic conditions not suited for plant growth. For example in high altitude regions where the temperature can be as low as -40° C, any kind of plantation is almost impossible. Similarly in arid regions the conditions for plant growth are hostile. In such places greenhouse can come for rescue to fight against environmental extremities to grow plant. The existing greenhouse set-ups can be primarily classified amongst three types as- Manual set-up mode, partially automated set-up mode, and fully automated set-up mode.

3.1 Manual set-up mode:

This set-up involves visual inspection of the plant growth, manual irrigation of plants, turning ON and OFF the temperature controllers, manual spraying of the fertilizers and pesticides. It is time consuming, vulnerable to human error and hence less accurate and unreliable.

3.2 Partially automated set-up mode:

This set-up is midway between manual set-up mode and fully automated set-up mode. In this mode, the user of the system can get messages if the parameters values goes beyond the threshold and then user can manually take any kind of control measure like turning on the water pump. This mode will can reduce the labor workforce to some extent.

3.3 Fully automated set-up mode:

This is a sophisticated set-up mode which is well equipped to react to the climatic changes that occur inside the greenhouse and also to produce a fast quick efficient result with respect to the human expectation. It works on the feedback system which gives a benefit to respond to the external stimuli efficiently. Automated set-up system will avoid the errors that are done by the human. Presently for developing such kind of fully automated set-up mode the best supporting technology is IoT.

3.4 Internet of things (IoT):

IoT is not only a theoretical concept but also a practical reality. Currently the operation of the IoT is in such a way that machine communicates with machine and devices through embedded sensors. The development of IoT has significantly changed scenario of infrastructure of the network. A survey estimates that by 2020 there will be 26 billion devices connected to IoT. Some estimators have estimated that this number may reach up to 100 billion. Thus there is no doubt that IoT will play a vital role in future technologies. IoT has created a drastic change in this technical world.

4. System Implementation

Fig. 1 shows the block diagram of the greenhouse automation system presented here.

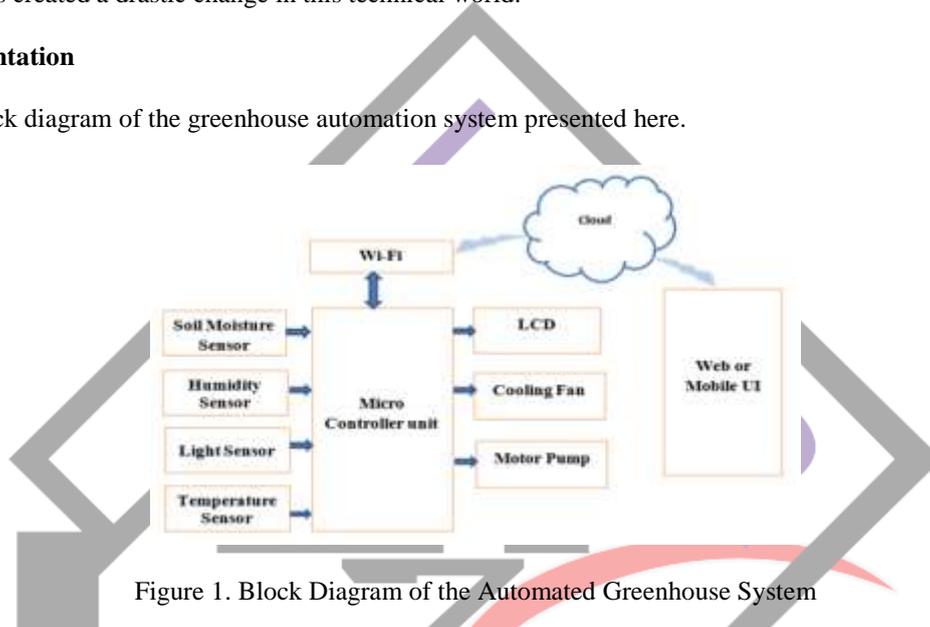


Figure 1. Block Diagram of the Automated Greenhouse System

In our implementation, use of IoT for greenhouse automation has resulted in a great benefit in terms of remote monitoring and graphical representation of parameters. The implementation is carried out by designing a microcontroller-based system which monitors and records the values of various parameters such as temperature, light intensity, humidity. All these values are continually monitored and controlled in an order to get maximum yield. We have created a webpage on which we can observe the real time daat of different sensors. Some of the important sensors that are going to be used in this project are- Light Sensors, Temperature and Humidity Sensors, and Soil moisture sensor (Fig.2).



Fig.2. Different Sensors Used in the Project

4.1 Light Sensors:

Light Dependent Resistor (LDR) is the light sensor used in our project. Its main function is to monitor the intensity of light. It turns off the light when it needs to save the power and a turn on the light when light is required in the greenhouse.

4.2 Temperature and Humidity Sensors:

We have used DHT11 sensors in our project for humidity and temperature measurement. It provides digital output for temperature and humidity values. It is quite reliable and has good stability and at the same time is cost effective. It comprises of three main elements- a resistive type humidity sensor, an NTC thermistor (for temperature measurement) and an eight-bit microcontroller which helps in converting analog signals from both sensors and helps in sending out digital signal. When the temperature inside the greenhouse reaches above a threshold value, the coolant is provided to cool down the temperature. Humidity Sensors are basically used for measuring the relative humidity, which is the measure of the total amount of vapour that could be held in the air for a given temperature.

4.3 Soil Moisture Sensor:

Soil Moisture Sensor is used for measuring the moisture in soil and similar materials. It consists of two large probes which function as sensor by together acting as a variable resistor. The more water in the soil, more is the conductivity between the pads and thus this result in a lower resistance, and a higher output signal.

4.4 Wi-Fi Module:

The Wi-Fi module used in our project is ESP8266 (Fig.3). ESP8266 has been designed for mobile, wearable electronics and IoT application to reach the objectives like lowest power consumption with a combination of several proprietary techniques.



Fig.3. Wi-Fi Module

5. Results and Discussuion

The threshold levels that we have considered in our project implmemetation are- minimum relativitive humidity of soil equal to 50%, maximum temperature equal to 30° C, minimum light illumination equal to 300 lumen per square foot, and minimum soil moisture equal to 80%. Whenever the sensors fitted in greenhouse measure a value beyond this threshold levels, control action is carried out to keep parameters within the acceptable range. LCD display showing plant parameters in the plant premises (Fig.4).

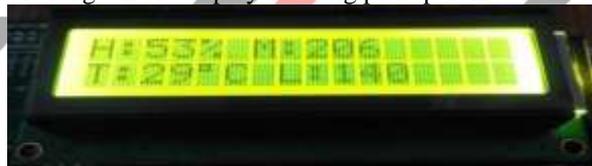


Fig.4. LCD displaying parameter values

The diagram of the implemented system is as shown in Fig.5.



Fig.5. Project Implementation

CONCLUSION

A smart greenhouse monitoring system has been implemented successfully using the concept of IoT which can prove to be a boon for agriculture sector. The traditional system for greenhouse monitoring is labor-intensive and time consuming. The proposed system saves time, money and human effort. It provides a controlled environment for the plants and thus increase the overall yield. The smart greenhouse automatically optimizes the various parameters for the plant growth. It sends the real time data of parameters to a customized webpage for continuous and effective monitoring.

The project can be used in greenhouses, botanical gardens and agriculture farms. Temperature monitoring and controlling action can be used in home or various halls like conference room, seminar hall to control the temperature of room. With little modification, this project can be used in mechanical companies to measure various parameters of operating machines like temperature and light.

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