

Design and Implementation of IOT Based Greenhouse Environment Monitoring and Controlling System Using Arduino Platform

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Abstract - Greenhouses are controlled area environment to grow plants. As the limitation of existing greenhouse plants is that it is not operated automatically and has to be operated manually with different records. In order to achieve the optimum growth of plants, the continuous monitoring and controlling of environmental parameters such as temperature, humidity, soil moisture, light intensity etc. are necessary for our greenhouse system. This paper demonstrates a checking and control system for nursery through Internet of Things (IOT). The system will screen the undeniable common conditions, for instance, moistness, soil immersion, temperature, closeness of fire, etc. All the environment parameters data are send to cloud using WiFi module NodeMCU esp8266. If any condition crosses certain limits related actuator will be turned ON. The microcontroller will as such turn on the motor if the earth stickiness isn't generally a particular worth. The user can screen and control parameters through mobile and computer. The model was attempted under various blends of obligations to our examination office and the test outcomes were found as expected.

Key Words: Greenhouse, Monitoring, Controlling, Arduino, Sensors, IOT, NodeMCU.

1. INTRODUCTION

The atmospheric or environmental condition plays an important role for growth of the plants Greenhouse farmers cannot precisely detect level of level of humidity inside the green house. They only know the condition inside the green house manually and by feel it by themselves. Ultimately, experiences play a bigger part on their daily operations. If the condition is too dry, they will give water to the plants, but if it is too humid, they will open the rooftop of the green house, especially in the daylight.

In order to achieve the modifications of optimum growth to achieve high yield of plants at lower cost, good quality and low environmental loads, it is necessary to have the effectiveness in greenhouse crop production. With the help of IOT we are going to control the greenhouse which is equipped with the cooling, heating, soil immersion etc. This IOT based greenhouse can be controlled from anywhere by focusing the environmental parameters like temperature and humidity. An individual person can controlled these environmental parameters of greenhouse by automatically. Automation plays an important role for doing the things

automatically by reducing the need of tasks of turning ON/OFF switches. Automation cannot completely eliminate or reduces the human errors but it minimizes them at certain levels. It is the need of today's world that everything should be realistic or remotely controlled. Here, assuming the owner of greenhouse can control and monitored his greenhouse from anywhere. Owner need not to go over their continuously at every time and check the conditions. Owner has to sit at one place and continuously monitored and controlled the number of greenhouses at a time with comfortably.. WiFi module NodeMCU plays an important role in send the data to platform, eliminating the needs of cables or wired connections which automatically reduces the cost. So, considering all the facts in the mind we are designing the IOT based greenhouse system.

The rest of the paper is organized as follows: Section II deals with the literature survey. Section III presents the Methodology of the system. Section IV deals with the Hardware and Software tools used to implement the system. Section V gives flow chat. Section VI gives case study. VII gives Computational Analysis on Environmental Parameters. Section. VIII gives Experimental results and analysis. Finally Section IX presents concluding remarks.

2. LITERATURE SURVEY

The demand for the food crops is more in the present scenario. Now a day the cultivation of the crops in the greenhouse under specified conditions which is suitable for the crops is increased.

In sensor based automated irrigation system with IoT Karan Kansara, et al [1] explains about the automated technology of irrigation. The sensors used send the interrupt signal to the microcontroller by gathering temperature and humidity conditions. Using MAX232, the GSM and microcontroller were connected. The moisture sensor detects the moisture

value and the signal to mobile through microcontroller thus it reduces the power resulting in lower power consumption.

An Arduino based control system in an intelligent farming Narayut Putjaika, et al [2] explains about the improvement of the production process in plating which composes of two parts which are a sensor system and a control system. Kalman filtering is used to smooth the sensed data where the

weather condition is predicted based on a decision tree method.

An IoT based smart GPS system robot was implemented to perform tasks like splashing, moisture sensing, etc by Nikesh, et al [3]

3. METHODOLOGY

The implemented greenhouse system consists of two section, monitoring section and controlling section. The monitoring section consists of DHT11 sensor, LDR sensor, Soil moisture sensor, pH sensor, fire sensor, DS18B20 temperature sensor and flow meter sensor to monitor the environmental parameters. A NodeMCU esp8266 is used to send environmental parameters to IOT cloud platform. The controlling section consists of cooling fan, exhausts fan, water pump, artificial light and buzzer. Arduino microcontroller forms the heart of the system. The block diagram of greenhouse monitoring and controlling system is shown in fig. 1.

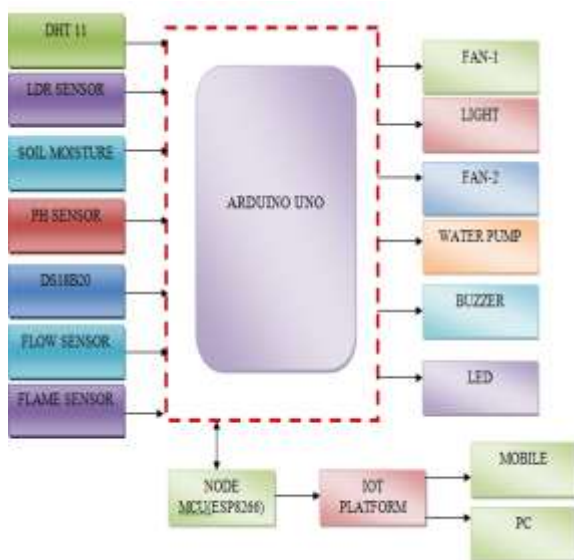


Fig -1: Block Diagram

In this endeavor Arduino is the standard controller used to interface all the sensors. When the soil doused state sensor regard isn't ordinarily the motivation driving constraintment regard, controller recollects that it and turns on the water siphon. precisely when water siphon is on water will course through the water stream meter sensor and water meter sensor will look at the dimension of water travel through the pipe in liters and when the immersion of soil regard taking off to the ordinary run, again controller sense it and turns off the water siphon. In the event that fire is going on in any condition, controller recalls that it and turns on the LED and ringer. DHT 11 sensor is used to check both humidity and temperature, when temperature and humidity looking dht11 sensor crosses the edge regard then the two fans will be turned on. Else the two fans will be in the off condition. LDR sensor is used to measure the intensity of the light, when

light power isn't regularly fixed motivation driving confinement regard then electric light which is connected with the hand-off will be turned on or else light will in the off condition. PH sensor is used to measure ph of the soil.

Then the entire sensor data are sending to cloud through NODEMCU (esp8266) module is interfaced with Arduino. User can monitor and control the environment parameters using computer or mobile.

4. HARDWARE AND SOFTWARE TOOLS USED TO IMPLEMENT THE SYSTEM

4.1 Arduino UNO

Arduino is an open-source gadgets sort out dependent on simple to-utilize rigging and programming. Arduino sheets can inspect inputs - light on a sensor, a finger on a catch, or a Twitter message - and transform it into a yield - prompting an engine, turning on a LED, dispersing something on the web. You can control your board by sending a lot of guidelines to the microcontroller on the board. To do everything thought of you as utilize the Arduino programming language, and the Arduino Software (IDE), in context on Processing. Arduino has been the cerebrum of thousands of activities, from typical articles to complex reasonable instruments. Fig. 2 shows Arduino Uno.



Fig -2: Arduino UNO

4.2 NodeMCU

NodeMCU is an open source IoT platform. It wires firmware which keeps running on the ESP8266 Wi-Fi SoC from Espressif Systems, and apparatus which depends upon the ESP-12 module. The verbalization "NodeMCU" according to ordinary technique suggests the firmware instead of the improvement units. The firmware utilizes the Lua scripting language. It depends upon the eLua experience, and reliant on the Espressif Non-OS SDK for ESP8266. Fig. 3 shows NodeMCU



Fig -3: Node MCU

4.3 DHT11 Sensor

DHT11 Temperature and Humidity Sensor is used to measure the both temperature and humidity. It joins a temperature and dampness sensor complex with a balanced automated sign yield. By utilizing the five star pushed sign confirming technique, temperature and stickiness perceiving progression, it guarantees high relentless quality and brilliant entire arrangement quality. This sensor combines a resistive-type soaked quality estimation part and a NTC temperature estimation piece, and associates with a dominating 8-bit microcontroller, offering unbelievable quality, quick reaction, antagonistic as far as possible and cost-reasonableness. Fig. 4 shows DHT11 sensor



Fig -4: DHT 11 Sensor

4.4 Soil Moisture Sensor

The Soil Moisture Sensor uses capacitance to survey dielectric permittivity of the joining medium. The sensor makes a voltage relating to the dielectric permittivity, and everything considered the water substance of the earth. Soil soaked state an earth wetness sensor assesses the extent of water contained in a material, for instance, soil on a volumetric or gravimetric reason.. Soil soaked quality sensors routinely insight sensors that measure volumetric water content. Fig. 5 shows soil moisture sensor.



Fig -5: Soil Moisture Sensor

4.5 PH Sensor

pH sensor is used to measure pH of the soil. The pH indicates a solution's acidity or alkalinity. pH sensor consists of a pH probe and a pH sensor module. The pH probe has two electrodes, one is a glass electrode and other is reference electrode. Both electrodes are hollow bulbs containing a potassium chloride solution with a silver chloride wire suspended into it. pH probe measures the electrochemical potential between a known liquid inside the glass electrode and an unknown liquid outside. pH sensor module consists of potentiometer to vary the value of the sensor. Fig. 6 shows PH sensor.



Fig -6: PH Sensor

4.6 LDR Sensor

LDR (Light Dependent Resistor) sensor module is used to measure light intensity. It has both analog output pin and digital output pin. If light intensity increases, resistance of LDR decreases. If light intensity decreases, resistance of LDR increases. The sensor has a potentiometer knob that can be used to adjust the sensitivity of LDR towards light Fig. 7 shows LDR sensor.



Fig -7: LDR Sensor

4.7 Arduino IDE

The Arduino Integrated Development Environment or Arduino Software (IDE). Arduino IDE is official software introduced by Arduino.cc, contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino / Genuino hardware to upload programs and communicate with them. Fig. 8 shows Environment of Arduino IDE



Fig -8: Environment of Arduino IDE

5. Flow Chart

The flow chart of the system was shown in Fig. 9 flow chart explains the flow of project, the microcontroller, NodeMCU and all sensors are initialized, and then the sensors will read the physical data from the environment .once data is read sensors will send to the microcontroller. From the microcontroller data will sent to the user which will further shown in the users mobile , then if sensors values crosses the Threshold value actuator will turn on else actuators will be in the off condition.

All the components are initialized by supplying the required power of +5V. All sensors, DHT11 sensor, LDR sensor, Soil

moisture sensor, flame sensor, flow meter sensor, DS18B20 sensor and pH sensor are used. A cooling fan, exhaust, fan, water pump, artificial light and Buzzer are also connected to the Arduino. An ESP8266 NODEMCU is used to send environmental parameters to cloud. All environmental parameters are sending to server through NODEMCU and stored in the database. So the user can monitor and control parameters through mobile. The user can log in the platform by using username and password.

DHT11 sensor is used to measure temperature and humidity. High temperature causes leaves to wilt and affect the ability of crops to produce fruit. An overheated greenhouse causes the soil to dry out quickly and use more water. By using a monitoring system, users can be alerted to threatening conditions. When temperature exceeds a defined level, the system turns on the fan. The present status of the environmental parameters is sent to the mobile user. When the temperature comes to the normal range, the system turns off the fan. High humidity affects plants transpiration and photosynthesis process. When plants absorb water and minerals from the soil through their roots, transpiration assists these nutrients to the leaves. If the humidity is too high, the process slows down, preventing the absorption of nutrients. Without the release of moisture, plants lose their ability to cool themselves. When humidity exceeds a defined level, the system turns on the exhaust fan. When the humidity comes to the normal range, the system turns off the exhaust fan.

LDR sensor measures light intensity. As the light quantity decreases the photosynthetic process decreases. When light intensity is lower than a defined level, the system turns on the artificial light. When the light intensity comes to the normal range, the system turns off the artificial light. Soil moisture sensor measures the moisture content in soil. Water is very important for plant growth. When the soil moisture sensor does not sense moisture in soil then the system turns on the water pump. When the moisture in soil comes to the normal range, the system turns off the water pump. Water flow sensor is used to measure the total amount of water flows to the plants. Flame sensor is used to detect the fires flames, when the fire flame detected the system turns on the Buzzer and LED. DS18B20 Temperature sensor is used to measure the temperature of the soil. pH sensor is used to measure pH of the soil. The pH indicates a solution's acidity or alkalinity. The pH value usually varies between 0 and 14. A solution with a pH value less than 7 is acid and greater than 7 are alkaline. Plants need mildly acidic soil.

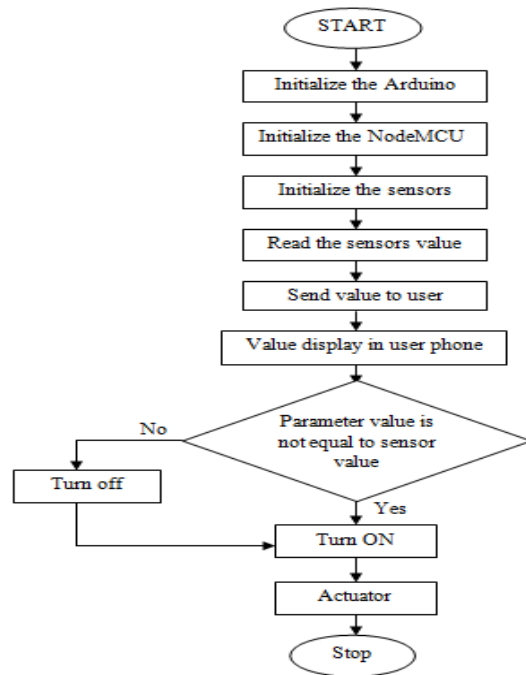


Fig -9: Flow Chart

6. CASE STUDY

Case study is the process of examining data sets in order to draw conclusions about the information they contain, increasingly with the aid of specialized systems and software. The Tomato and Brinjal is the crop used for the case study for implemented system.

6.1 CASE STUDY 1: TOMATO PLANT

To grow the healthy and good tomato plant ,thus required temperature between 17-35°C, light intensity 35- 70 Lux, moisture content is greater than 10%, humidity is 20-60. By implementing our system we can grow the good and healthy plant. Whenever the temperature and humidity increase above the required temperature fan turn on and cool down the temperature, when light intensity is less the required the system turns on the light and when it comes to required level system turn off the light. When moisture content in the soil is than required level system turn on the water pump. By using our system we get good yield plant. Graphical representation was shown in fig 10.

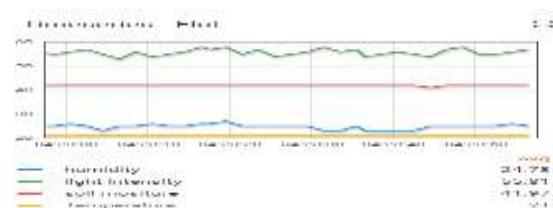


Fig -10: Graphical representation of tomato plant

6.2 CASE STUDY 1: BRINJAL PLANT

To grow the healthy and good tomato plant ,thus required temperature between 17-40°C, light intensity 35- 70 Lux, moisture content is greater than 10%, humidity is 20-60. By implementing our system we can grow the good and healthy plant. Whenever the temperature and humidity increase above the required temperature fan turn on and cool down the temperature, when light intensity is less the required the system turns on the light and when it comes to required level system turn off the light. When moisture content in the soil is than required level system turn on the water pump. By using our system we get good yield plant. Fig 11 shows the graphical representation of environment parameters.



Fig -11: Graphical representation of Brinjal plant

7. EXPERIMENTAL RESULTS

We designed this project to monitor and control the environmental parameters. We got result based on effective management of greenhouse environment by automatic manner. Automatic controlling process is fully done based on coding. The temperature,, humidity, soil moisture content, PH of the soil are monitored through handheld device like mobile. Arduino Serial Monitor Output, Dashboard output on platform and Graphical representation on platform are shown in Fig.12 and 13 respectively.



Fig -12: Dashboard output on platform

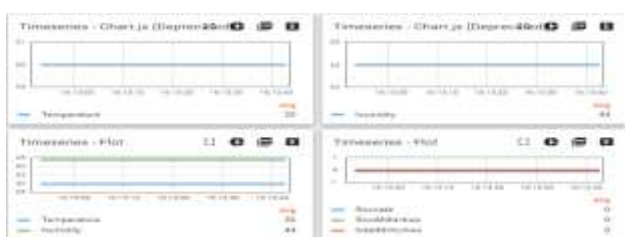


Fig -13: Graphical representation on platform

8. CONCLUSION

An Arduino based greenhouse checking and controlling framework is masterminded. DHT11 sensor, Soil Moisture sensor, LDR sensor and pH sensor are the basic sensors utilized in this experience which give the careful estimation of temperature, wetness, stickiness content, light power and soil pH freely. This framework is normal for controlling and observing ecological parameters in nursery by a reasonable mobile application. NodeMCU esp8266 is likewise utilized to send the information parameters to telephone which disposes of the SMS charges. This structure lessens the power utilization, support and complexity. This system can be utilized in plant field, in nursery and in home developed garden.

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