IoT Based Remote Control of Green House Agriculture System

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Abstract: ***The world climate change has brought about unpredictable weather conditions that have resulted in the global food shortage being experienced. A possible solution to this problem will likely involve households growing a reasonable percentage of the vegetables and crops they need in a greenhouse which does not require too much land space. A greenhouse will normally produce more crops per square meter when compared to open field cultivation since the microclimatic parameters that determine crop yield are continuously monitored and controlled to ensure that an optimum environment is created. The automated greenhouse control system achieves monitoring and control of a greenhouse environment by using sensors and actuators which are under the control of a microcontroller running a computer program. The system is composed of two stations: Remote monitoring station and the Actuators/Sensors Station. The controller used in the actuators/ sensors station which ensures that the microclimatic parameters stay within pre-defined values as determined and set by the user is the Arduino prototyping platform. The proposed system is a remote sensing of agriculture parameters and control system to the greenhouse agriculture. The plan is to control CO2, soil moisture, temperature, and light, based on the soil moisture the controlling action is accomplished for the greenhouse windows/doors based on crops once a quarter complete round the year. The objective is to increase the yield and to provide organic farming. The result shows the remote control of CO2, soil moisture, temperature, and light for the green house.***

Index Terms**:** ***IoT, Green House, Arduino, Soil moisture, Light Sensor, Humidity Sensor, Servo Motor.***

1. INTRODUCTION

Food shortage is one of the greatest problems confronting mankind in the 21st century. Global warming and other weather elements have claimed substantial land mass that was available for crops cultivation. In order to address the problem, greenhouse practice which has been in existence for a very long time is now modernized and deployed in many parts of the world. This technology is yet to be embraced by many developing countries. Developing plants has turned out to be innovative test in light of the fact that the field and strength of the plants are vital parameter now a day either for cash crops or food crops .One of the significant issues in the present agriculture is the less learning of the agriculture parameters, and less information about the developing innovations. In the past agribusiness structure, our people of old avoid the use of a specific development for specific plant growth, they rather used regular marvel for all plants. There is continuous increase in demand for food production technology. Weather conditions are characterized by having predominantly long and hot summers and short and mild winters. Such climatic conditions put a great strain on the types of crops that could be successfully grown. This is very much true with most horticultural vegetables with medium thermal requirements (tomato, pepper, cucumber, watermelon, marrow, green bean, eggplant).

Agricultural means can satisfy the food production demand. But due to isotropic climatic conditions. This ultimately affects the plant growth. Also, there are many such problems associated with it. To overcome from this problem. Pests and diseases, and extremes of heat, humidity, light and temperature, and irrigation is necessary to provide water. The farmers have been using different irrigation technique for increasing production. These techniques were done by human intervention. But due to this sometimes either the plants consume more water or the water reaches late up to the plants.The technological change in the agriculture can develop plants under uncommon normal natural conditions, also this develops specific plants under specific condition which in turn help to get more yield and less compost. Presently the advancement of precision agriculture in green house, for plant development has turned out to be prominent on account of less cost innovations for the agriculturists to re arrive yield. Greenhouses protect crops from too much heat or cold, shield plants from dust storms and help to keep out pests. Light and temperature control allows greenhouses to become suitable place for growing plants. The cultivation exhibition of plants under controlled conditions. Greenhouses also are often used for growing flowers, vegetables and fruits.

Modern greenhouse technology deploys automation in agriculture which is now common place due to the low costs of electronic components required for its implementation. A lot of efforts have been made by many researchers to automate the traditional greenhouse system.

This paper is organized in five sections. After this introduction, in Section II, motivation discussed of the paper, Section III about Implementation of the project explained, as well as the novel feature of the proposed method. Finally, Sections IV and V provide the experimental results and the conclusions, respectively.

2. MOTIVATION

A. Problem Statement

There is a need to provide suitable environment for the cultivation of plant in all seasons of the year. There are many disadvantages of the conventional systems such as; high effort and cost expended in the old system. Besides, plant productivity is not optimum. The conventional manual controlling of cultivation environments (greenhouse).

B. Solution Statement

A climate control system is designed to provide a suitable environment for growing the plant by reading the temperature, humidity, lighting, CO_2 and the amount of irrigation by special sensors. And Control the fans for cooling, heating, humidity, the proportion of lighting and irrigation through an electrical circuit governed by a specific program automatically.

C. Objectives

The objectives of this research are to implement, design and realize a low cost the microcontroller (Arduino) based system technology for monitoring and controlling greenhouse climate, and implement prototype hardware in a real time environment.

D. Methodology

In order to achieve the objective of the scope few tasks need to be done for the hardware of the system and the GUI application software. For the hardware of the system there are three parts which have to be considered. They are the microcontroller board (Arduino) based system, the transmitted and the received frame and software of the system. First of all, in this system, the microcontroller has to be test and check for its functionality. Secondly, transmitter and the receiver need to be test for its functionality. It can be done by sending a bit of data from the transmitter to the receiver. The push button and the LED can be used as the representation of data sending and receiving. Or displaying the transition frame in virtual terminal.

Finally, the software of the system, for that there are two parts which have to be considered. They are the software for the programming and the thing speak/ubidots for GUI application. The Arduino sketch software used to make a connection to the remote monitoring using GUI application and also used to record data that have been received through the serial connection.

2. IMPLEMENTATION OF PROJECT

A. What is Green House?

Green house is a structural building which allows sun light to enter. It consists on two parts.

- Structural building
- Covering Material(Glass, Plastic sheet, UV covering sheet)
- Structural building (Frame) can be of Aluminium or iron pipes, woods and the covering material can be of glass or plastic sheet.

Greenhouse is such kind of house which has mainly two parts. One part is its structural building frame and other one is its covering material. Structural building frame may be made of iron rode or wooden structure and covering material may be glass or plastic sheet. For understanding greenhouse first of all we should have to know about what is greenhouse effect in greenhouse.

Fig.1: Greenhouse

Greenhouse is such kind of house which has mainly two parts. Green house shown in fig 1. One part is its structural building frame and other one is its covering material. Structural building frame may be made of iron rode or wooden structure and covering material may be glass or plastic sheet. For understanding greenhouse first of all we should have to know about what is greenhouse effect in greenhouse. When the light coming from sun entered from the covering material that is transparent for sun light and come into the greenhouse then energy coming from the sun in form of rays absorbed by the plants, soil and structure and this energy is trapped into the greenhouse. Infrared rays are very useful for the growth of plants so by using the greenhouse these infrared rays trapped into the greenhouse. In this way overall energy inside the greenhouse increase and plant growth rate increase and plant growth are impressive.

Greenhouse protects and a controls environmental climate as plants is being planted inside the covered structural building frame. Mostly the farmers and gardener use manual system for irrigation (watering) to their plant in the farms, garden and also in the greenhouse. Such kind of manual system is inefficient, due to the loss of water and also power loss if water pump is being used for the supply of water. In order to overcome such kind of problem, automatic greenhouse should be used.

For every plant growth there are four major Environmental plant growth factors which are Light, Temperature, Humidity and Soil Moisture. This fully controlled greenhouse system will fully control and monitors light intensity, soil moisture and air humidity using Arduino mega and Wi-Fi modules. Every plant has its own plant profile. Plant profile of every plant tells about what kind of environmental factors and what ranges of these factors are suitable for the plenty growth of plant. For example, plant profile of winder plants is quietly different from the plant profile of summer plants.

In figure 2 shows block diagram of proposed method. First of all, we load the plant profile that is its environmental parameters into the system. This system has sensors, actuators (controlling devices) and Wi-Fi. Environmental factors will sense by sensors and display on LCD. If any one of the parameter changes with respect to the plant profile then Arduino will actuate the respective device for that parameter and will keep it turned on until it reached to its required range that is into the set of environmental parameters loaded into the system. As when the parameter reached to the required range then the Arduino will turn off that device.

Fig. 2.Architecture of the proposed system

B. Hardware Components

1) Arduino

Arduino is an open-source microcontroller board based on ATmega 328P.It has 16 MHZ clock, 14 pins for an inputoutput purpose, USB connection, reset button and power jack. It contains everything which is required to implement or design the microcontroller based embedded system applications. In order to process the analog data given by analog sensors it also contains 10 bit ADC (Analog to Digital converter). Moreover, Arduino has inbuilt libraries for almost every application.

Fig.3 Arduino Micro Controller

2) Temp Sensor & Humidity Sensor

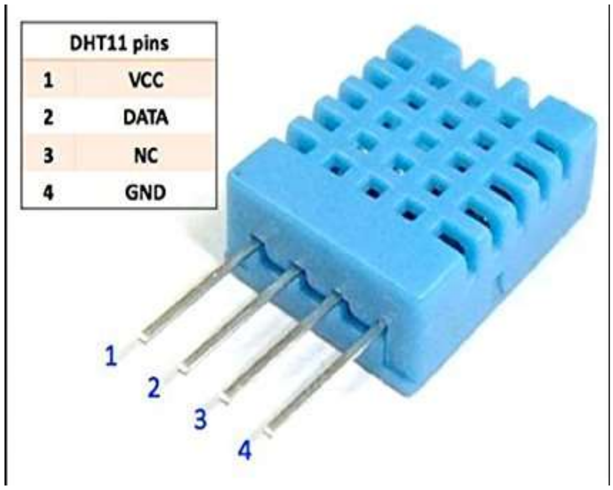

Fig 4. Temp & Humidity Sensor

DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness.

3. Light Sensor

A Light Sensor is something that a robot can use to detect the current ambient light level - i.e. how bright/dark it is. There are a range of different types of light sensors, including 'Photo resistors', 'Photodiodes', and 'Phototransistors'.

Fig 5. Light Sensor

4) Wi-fi ESP8266

Fig.6. *Wi-Fi ESP8266*

The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much WiFi-ability as a WiFi Shield offers (and that's just out of the box)! The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community.

5. Gas Sensor (MQ 135 Sensors)

Fig. 7: MQ 135 Sensor

The MQ 135 Air Quality Detector Sensor Module for Arduino has lower conductivity in clean air. When the target combustible gas exists, the conductivity of the sensor is higher along with the gas concentration rising. Convert change of conductivity to the corresponding output signal of gas concentration. The MQ135 gas sensor has high sensitivity to Ammonia, Sulphide and Benzene steam, also sensitive to smoke and other harmful gases. It is with low cost and suitable for different applications such as harmful gases/smoke detection.

6. Soil moisture Sensor

Fig. 8: Soil Moisture Sensor

This is an easy to use digital soil moisture sensor. Just insert the sensor in the soil and it can measure moisture or water level content in it. It gives a digital output of 5V when moisture level is high and 0V when the moisture level is low in the soil.

7. Servo Motor

Fig.9: Servo Motor

Servo motors are used to control the position of objects, rotate objects, move legs, arms or hands of robots, move sensors etc. with high precision. Servo motors are small in size, and because they have built-in circuitry to control their movement, they can be connected directly to an Arduino.

C. Software Components

Think Speak Cloud/Ubi dots software can be used to display the data in cloud.

4. EXPERIMENTAL RESULTS

Fig.10: Green House monitoring Experimental setup

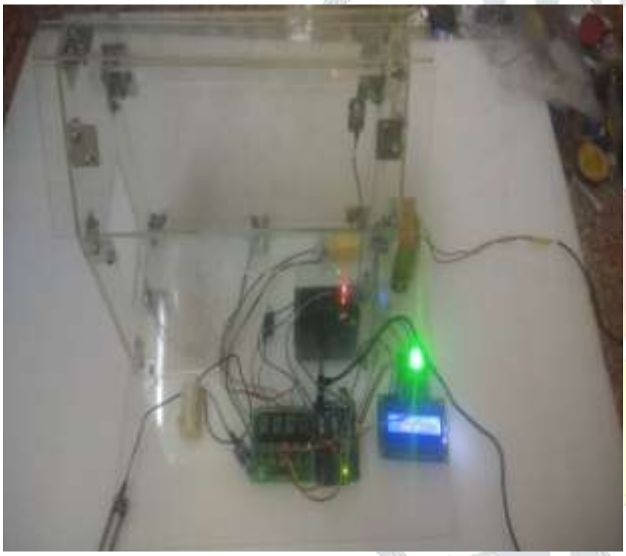

Fig.11: Working condition

Fig.12: shows CO_2 sensor in setup

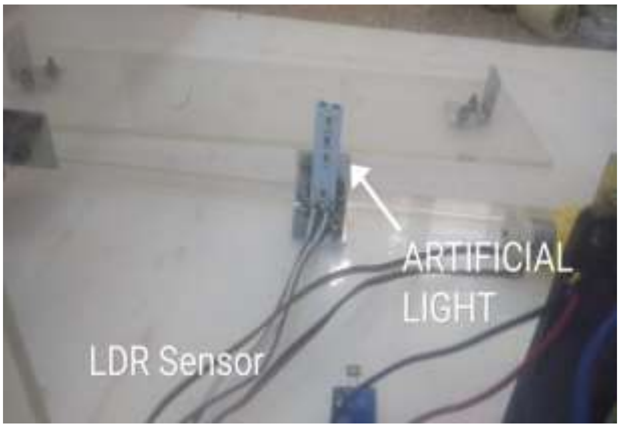

Fig.13: shows LDR sensor and artificial light in setup

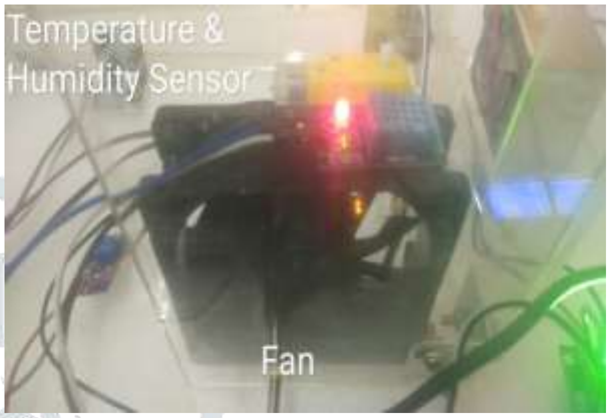

Fig.14: shows temperature and humidity sensor and fan in setup

Fig.15: Water pumps and soil moisture sensor in setup

Fig.16: Temperature and humidity values displayed on LCD when setup working condition

Fig.17: shows roof opened in setup

Fig.18: shows motor ON condition when soil dry

Fig.19: Power supply unit

5. CONCLUSION

Finally this paper concludes that the controlling CO2, soil moisture, temperature, and light for the green house. The controlling action is accomplished for the greenhouse windows/doors based on crops once a quarter complete around the year. This proposed work increases the yield and provides organic farming. The result shows the remote control of CO2, soil moisture, temperature, and light for the greenhouse.

REFERENCESS

1. Floreano D, Wood RJ (2015) Science, technology and the future of small autonomous drones. Nature 521:460–466.

2. Li F, Mistele B, Hu Y, Chen X, Schmidhalter U (2014) Reflectance estimation of canopy nitrogen content in winter wheat using optimised hyperspectral spectral indices and partial least squares regression. Euro J Agron 52:198–209.

3.Bareth G, Aasen H, Bendig J, Soukkamäki J (2015) Low-weight and UAV-based hyperspectral full-frame cameras for monitoring crops: Spectral comparison with portable spectroradiometer measurements. Photogrammetrie, Fernerkundung, Geoinformation 2015:69–79.

4.Wahabzada M, et al. (2016) Plant phenotyping using probabilistic topic models: Uncovering the hyperspectral language of plants. Sci Rep 6:22482.

5. Umstatter C (2011) The evolution of virtual fences: A review. Comput Electron Agric 75:10–22.

6. Schulze ED, et al. (2009) Importance of methane and nitrous oxide for Europe's terrestrial greenhouse-gas balance. Nat Geosci 2:842–850.

7. Dalhaus T, Finger R (2016) Can gridded precipitation data and phenological observations reduce basis risk of weather index-based insurance? Weather Clim Soc 8:409–419.

8.Poppe KJ, Wolfert S, Verdouw C, Verwaart T (2013) Information and communication technology as a driver for change in agri-food chains. EuroChoices 12:60–65.

9. DeFries R, et al. (2015) Global nutrition. Metrics for land-scarce agriculture. Science 349:238–240.

10. Charo RA (2015) SCIENCE AND GOVERNMENT. Yellow lights for emerging technologies. Science 349:384–385.

11. Iozzio C (2016) Who's responsible when a car controls the wheel? Scientific American 314:12–13.

12. Kutter T, Tiemann S, Siebert R, Fountas S (2011) The role of communication and co-operation in the adoption of precision farming. Precis Agric 12:2–17.

13. Baumgart-Getz A, Prokopy LS, Floress K (2012) Why farmers adopt best management practice in the United States: A meta-analysis of the adoption literature. J Environ Manage 96:17–25.

14. Tilman D, Cassman KG, Matson PA, Naylor R, Polasky S (2002) Agricultural sustainability and intensive production practices. Nature 418:671–677.

15. Sachs JD (2015) The Age of Sustainable Development (Columbia Univ Press, New York).