Smart Irrigation and Temperature Control for a Greenhouse System

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Abstract
This project is designed with the aim to facilitate the farmer or gardener to engage in green house systems and to improve agricultural technology. In order to reduce continuous monitoring of the soil parameters, excess time consumption for the farmers and excessive usage of water, "Smart irrigation and temperature control for a greenhouse system" has been developed. There are two different ways to irrigate the land namely traditional irrigation methods and modern irrigation methods.

Keywords:
Green House, Smart Irrigation, Temperature control and agriculture technology

1. Introduction

The increased agriculture productivity through irrigated land is developed in arid and sub-humid zones. Agriculture has started to compete for water use with industries and other sectors. This increasing demand along with increments in water and energy costs have made it necessary to develop new technologies for the adequate management of water. The intelligent use of water for crops requires understanding of evapotranspiration processes and use of efficient irrigation methods. Unfortunately, often less than half of water applied is used by the crop-irrigation water may be lost through runoff, which may also cause damaging soil-erosion. The main objective of irrigation is to provide plants with sufficient water to prevent stress that may increase the yield.

The green house system provides a better environment for the crops by maintaining proper temperature, moisture and humidity levels .This system helps the crops to grow in a healthy condition which leads to increased productivity. Green house agriculture protects the crops from various environmental and atmospheric agents with suitable and appropriate equipments by simultaneously controlling the crops climate which further leads to increased quality of the crops and allows a way for higher yield. Amount of water content present in the soil is termed as moisture and this factor determines the sustainability of the land for the growth of crops. Plants grown in greenhouse environment promotes faster growth and increased quality as the crops are maintained in a proper temperature controlled green house environment with are suitable and necessary for the growth of crops.

The Smart irrigation and temperature control for a greenhouse system will control the watering of crops by monitoring the necessary conditions like soil moisture, temperature and humidity to sense the current nature of the soil. By collecting the soil moisture, watering of crops can be controlled. When the moisture value is low it denotes that the soil is dry and it needs to be watered and so the motor is switched on and when sufficient water is pumped into the field then again the motor is switched off. By controlling the temperature value, the temperature level can be controlled that is when the temperature is too high then the cooling fan is on which reduces the current temperature which helps the user to cultivate the crops even in hot climatic regions.

This project is designed with the aim to facilitate the farmer or gardener to engage in green house systems and to improve agricultural technology. In order to reduce continuous monitoring of the soil parameters, excess time consumption for the farmers and excessive usage of water, "Smart irrigation and temperature control for a greenhouse system" has been developed.

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Smart irrigation and temperature control for a greenhouse system is a IOT solution to monitor and irrigate the crop. It reduces the burden of monitoring the crops regularly and watering them. The Internet of things (IOT) is the inter-networking of physical devices also referred connected device and smart device vehicles, building, and other items -embedded with electronics, software, and exchange data. A sensor, actuators and network connectivity that enables these objects to collect and exchange data. A sensor is device which detects or measure the physical property and records indicates or otherwise responds to it. Soil moisture sensor measure the volumetric water content in the soil. The DHT11 sensor is basic, ultralow-cost Temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and splits out a digital signal on the data pin.

2. Methodologies

2.1 Existing system

This irrigation system consists of DHT11 and hygrometer sensor which is used to measure the temperature, humidity and moisture values of the soil and it also consists of the nodemcu with the inbuild wifi shield which is used to store the data to the database. Android application is developed to display these values and to control the motor.

Initially the values of temperature, humidity and moisture are collected from the soil by using the DHT11 and hygrometer sensor then these values are stored in the database by using the nodemcu with the inbuild wifi shield which is used to transfer the data from arduino to database.

Then the values are retrieved in android, this android application also has provision to view the values of soil parameters and then to control the motor that is when the moisture value is greater than the threshold value then the user can able to on the motor then if the moisture value is lesser than the threshold value then the motor is switched off.

2.2 Proposed system

This irrigation system consists of DHT11 and hygrometer sensor which is used to measure the temperature, humidity and moisture values of the soil and it also consists of the nodemcu with the inbuild wifi shield which is used to store the data to the firebase. Android application is developed to display these values and to control the motor and the cooling fan.

Initially the values of temperature, humidity and moisture are collected from the soil by using the DHT11 and hygrometer sensor then these values are stored in the cloud firebase by using the nodemcu with the inbuild wifi shield which is used to transfer the data from arduino to cloud firebase.

Then the values are retrieved in android ,this android application also has provision to view the values of soil parameters and then to control the motor that is when the moisture value is greater than the threshold value then alert is send to the user then the user can able to on the motor then if the moisture value is lesser than the threshold value then the motor is switched off ,similarly when the temperature value is greater than the threshold value that is when temperature is too high then the cooling fan is switched on then when the temperature value is low then the cooling value is switched off. Thus this method is used to minimize the wastage of water.

Steps involved in smart irrigation and temperature control for a greenhouse system are the soil parameters like temperature, humidity and moisture are collected from the soil, collected data are then fed into the firebase (Real time database) for remote access, Android application is developed, the current values of soil parameters like temperature, humidity, moisture is displayed by using this application, when the moisture value is greater or less than threshold value, alert is sent through the

application, farmers can able to on/off the motor, when the temperature value is greater or less than the threshold value, alert is sent through the application and farmers can on/off the cooling fan.

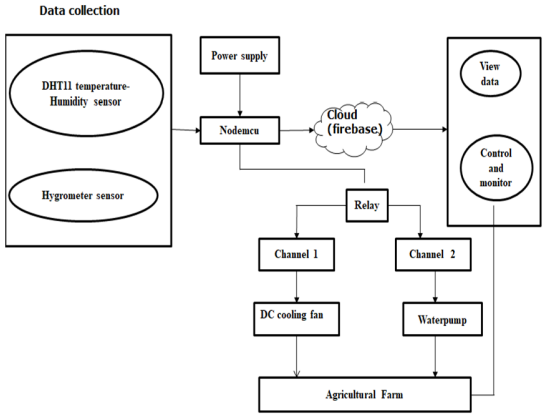

Fig. 1 **System flow Diagram**

2.2 System Flow Diagram

Soil moisture content is sensed by the soil moisture sensor, temperature and humidity is sensed by the DHT11 sensor. The collected sensor values are sent to the cloud firebase by using the 17 ESP8266 wifi module which is embedded in nodemcu. From the obtained value the alert is send to the farmers thus the motor and the cooling fan is controlled.

2.3 *Data Acquisition*

In the project, soil moisture sensor (hygrometer), temperature - humidity sensor (DHT11) and Wi-Fi module are used. The real time data are sensed by using the sensors and are sent to cloud (Firebase). For transferring the data to cloud ESP8266 Wi-Fi module is used.

2.4 *Data sent to the firebase*

In order to view the data from remote location, the data are sent to the cloud Firebase and the values are updated for every 30 minutes.

2.5 *View data through mobile application.*

In order to promote the display of data such as temperature, humidity and moisture to the user, Android Studio is used.

2.6 *Control of watering based on moisture value*

The control of watering by the user is done by using the mobile application (ON/OFF) with the help of water pumping motor. By using this method water can be used efficiently which leads to less usage of water. The moisture value is displayed automatically 20 whenever the application is opened in the mobile. By this the user can view the real time condition of the soil moisture from any distant location. Once the moisture value reaches the lower threshold value, the alert message is sent to the user to turn ON the pumping motor. The user by viewing the alert and by checking the necessity of water to the crops can decide whether to water the plants. Besides if the moisture value reaches the upper threshold value, the alert message is sent to the user to turn OFF the pumping motor. The user by viewing the alert and checking the moisture level can decide whether to turn OFF the motor. The water requirement will not be same for all the plants it differs from one plant to another. . Hence the moisture value differs from one plant to another.

3. Results and Discussion

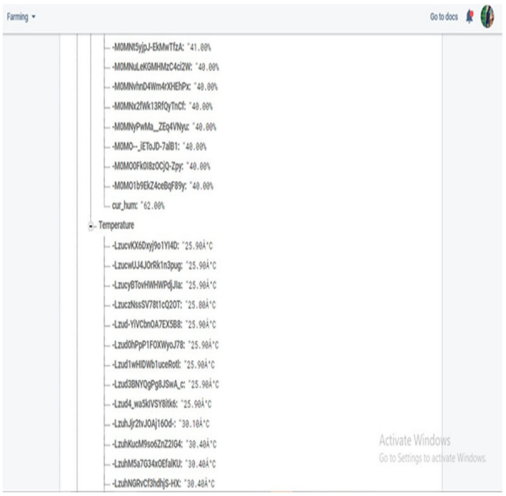

Figure 2 Firebase displaying Temperature values

This displays the temperature value from arduino uno, the new values from arduino uno are also updated frequently.

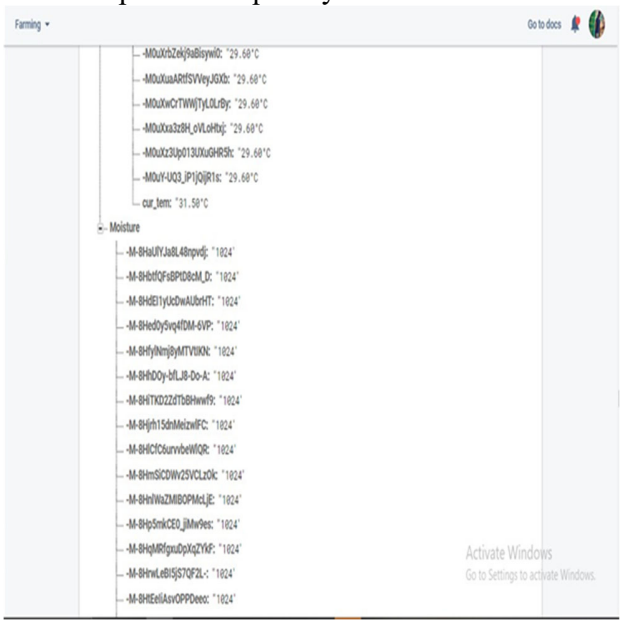

Figure 3 Firebase displaying Moisture values

This displays the moisture value from arduino uno, the new values from arduino uno are also updated frequently.

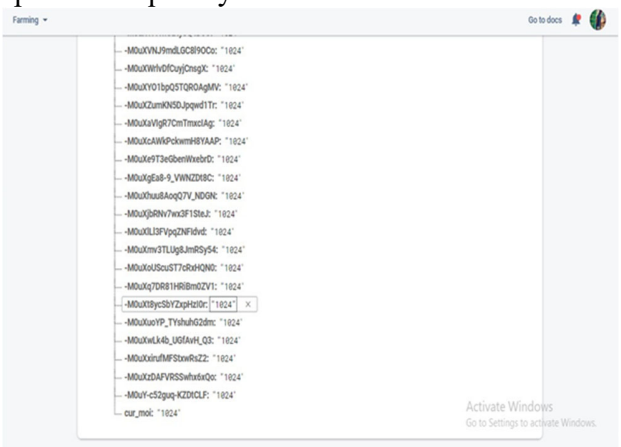

Figure 4 Firebase displaying Humidity values

This displays the humidity value from arduino uno, the new values from arduino uno are also updated frequently.

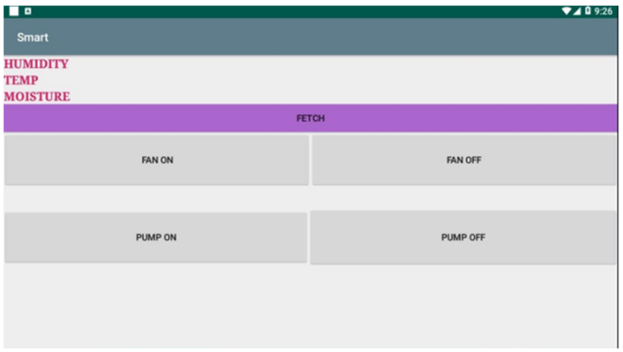

Figure 5 Android studio output

4. Conclusion and future work

This system includes a working hardware prototype and an android application for irrigation and temperature control. The wireless transmission is achieved using WiFi. The data are retrieved successfully from cloud Firebase, which is used for monitoring purpose. The mobile application paves the way to view the current values of the soil parameters even from remote locations and provides a user interface. By implementing this system we can improve the traditional way of agriculture and establishment of greenhouse system in different regions of India.

In future this design will be enabling the user to select the crop and thus the moisture, temperature and humidity content for that particular crop can be viewed and then the controlled based on the threshold value of the moisture and temperature. Further the system can perform data analysis, based on the crops selected and the threshold value is changed automatically.

References

[1] Jirapond Muangprathub, Nathaphon Boonnam, Siriwan Kajornkasirat, Narongsak Lekbangpong, Apirat Wanichsombat, Pichetwut Nillaor.,2019 IoT and agriculture data analysis for smart farm, In: Computers and Electronics in Agriculture 156(2019) 467-474.

[2] Capello, F., Toja, M., Trapani, N., 2016. A real-time monitoring service based on industrial internet of things to manage agrifood logistics. In: 6th

International Conference on Information Systems, Logistics and Supply Chain, pp. 1–8.
[3] Chen, K.T., Zhang, H.H., Wu, T.T., Hu, J., Zhai, C.Y., Wang, D., 2014. Design of monitoring system for multilayer soil temperature and moisture based on WSN. In: International Conference on Wireless Communication and Sensor Network (WCSN). IEEE, Wuhan, pp.425–430. https://doi.org/10.1109/WCSN.2014.9.
[4] Lukas, Tanumihardja, W.A., Gunawan, E., 2015. On the application of IoT: monitoring of troughs water level using WSN. In: Conference on Wireless Sensors (ICWiSe). IEEE, pp.58–62.
[5] Fourati, M.A., Chebbi, W., Kamoun, A., 2014. Development of a web-based weather station for irrigation scheduling. In: Information Science and Technology (CIST), 2014 Third IEEE International Colloquium in IEEE, pp. 37–42
[6] Luan, Q., Fang, X., Ye, C., Liu, Y., 2015. An integrated service system for agricultural drought monitoring and forecasting and irrigation amount forecasting. In: 23rd International Conference on Geoinformatics. IEEE, pp. 1–7.
[7] Abinaya, Vinoth Kumar, Swathika, "Ontology Based Public Healthcare System in Internet of Things (IoT)," Procedia Computer Science., vol. 50, pp. 99– 102, Oct. 2015
[8] B. Vinoth Kumar, M. Ramaswami, P. Swathika, and P. Abinaya, "IPv6 based Patient Monitoring Architecture for Future Healthcare Application" International Journal of Computer Science and Information Security Vol. 14, ISSN 1947-5500, Oct. 2016.
[9] B. Vinoth Kumar, P. Swathika, and P. Abinaya, "Computional Diagnosis Of Parkinson Disease Using Speech Signal" International Journal of Current Engineering and Scientific Research (IJCESR) Vol. 03, ISSN (PRINT): 2393-8374, 2016
[10] Abinaya, P; Aruna; Dharini, Anusha; Devi, Aruna; Devi, Abarna, "Intrusion Detection in Agriculture Field Based on Internet of Things (IoT)", Journal of Computational and Theoretical Nanoscience, Vol. 15, Numbers 6-7, pp. 1996-1998(3), June 2018.

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