IoT Based Smart Irrigation in Greenhouse using Raspberry Pi

A thesis submitted in the fulfillment of the requirements for the award for the degree of

BACHELOR OF TECHNOLOGY

By

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...techniques. ... more advantageous

1.2 Aims and objectives

The main objective of our proposed work include:

1. A Smart irrigation system that uses IoT and cloud connectivity to aggregate and store information, an optimization model to compute the optimal irrigation parameters.
2. Design aspects of IoT hardware, software, and their integration along with networking as well as cloud connectivity are discussed.
3. Controlled and monitored the crop from anywhere using a web application.
4. Reduced the man labour in agriculture.

1.3 Organization of the thesis

The thesis is organised as follows:

Chapter 1 provides an introduction on this proposed system Smart irrigation in Greenhouse

Chapter 2 presents a comprehensive literature survey on related areas.

Chapter 3 describes the proposed work of the system

Chapter 4 describes the working principle of the system

Chapter 5 offers conclusion. The future works are also included.

References

List of Publications

Chapter 4

Working Principle

This green house monitoring system is based on Raspberry Pi. Raspberry pi being a low priced computer it is more than enough for a household greenhouse management system. The system also includes various sensors and modules, such as, DHT11 sensor, soil moisture sensor etc. The sensors detect the soil moisture if the moisture is adequate it monitors the data and sends it to cloud and then web application. If the moisture drops, water is being released in to soil. Next is the temperature sensor, it detects any change in the temperature accurately and turns On and Off the exhaust fan as required by the system. Also the data uploaded to the cloud. And display through web application.

4.1 Algorithm and Flow Chart

4.1.1 Algorithm

1. : Start.

2. : Initialize on Raspberry Pi.

3. : The ultrasonic sensor constantly checks for the water level of the tank.

4. : If water level of tank reach the minimum threshold level then turn ON the relay connect to first motor.

5. : The soil moisture sensor checks the soil moisture level constantly and update the sense data to the cloud and show in the web application.

6. : The sensor constantly senses the temperature and humidity of the field and updates the sense data in the cloud and show in the web application.

7. : If the permissible level of water is reduces, then the relay which is connected to the Raspberry Pi will turn ON the motor.

8. : Similarly, if the soil becomes dry, the motor which is connected to the relay will be turned ON to wet the field.

9. : If the step 8 is completed, it will go to the step 4.

10. : Similarly, if the step 7 is over, the command will go to the step 3.

The Smart Irrigation System is integrated into the mobile application system to enable the user to easily monitor and control the irrigation of the farm field. On the mobile application system, there is an interface to view data collected directly from the sensors via the help of the Firebase, which is the cloud that creates a bridge between hardware and the cloud database. The main interface of the mobile application is the main menu that displays the login page of the system. This is to create a secured login for each user and to prevent others from knowing data owned by another client. Once the user successfully login to the app, there is another menu display the options control the irrigation system. The user can control and monitored the system using our we application The

Fig. 4.1: Implementation of System

control option leads the user to control the water pump to either force "ON" or "OFF", orautomatically run where it navigates the pump's control based on the sensor's value that set in the system.

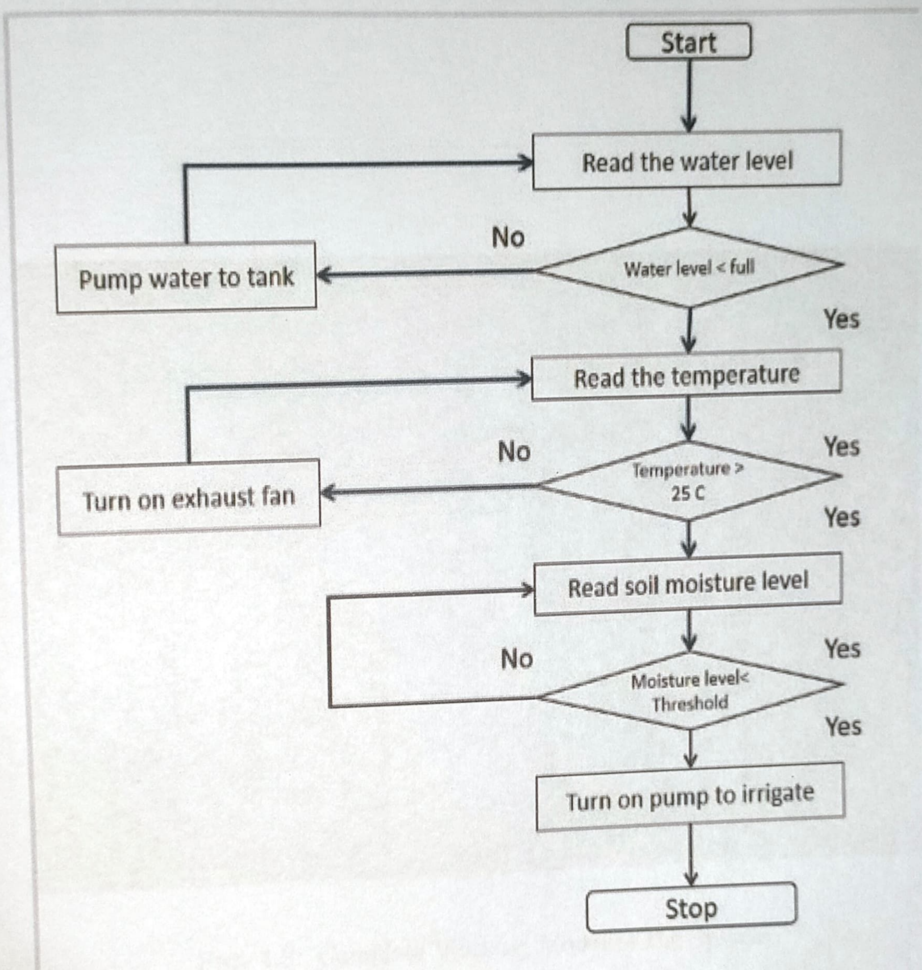

FIG. 4.2: Flow Chart of the System

The flow chart of the system is shown in the figure 4.1 .The reading of moisture and water level compared with the threshold .The motor and fan will be ON and OFF according to the threshold values.

Chapter 3

Proposed Work

The main goal of the proposed work is to improve the available technologies in agriculture and to make it easier for the farmers. This system will be useful for the farmers and other people who are dealing with agriculture. Various sensors are in place to detect the factors like temperature, humidity content of the soil. The sensor for temperature senses the environmental temperature level. The opportunity to save basically has improved control and eco-fulfilling even as simultaneously keeping up an extravagant and radiant scene are just two or three the central habitats an astounding irrigation structure gives. It makes a remarkable improvement to any house.

3.1 Trasmitting Section

The figure shows that main block diagram of Irrigation control system. In that main model is Raspberry pi 3 model, Relays, Sensors. In this control system three sensors are such as soil moisture sensor, temperature sensor, ultrasonic sensors are connected to the raspberry pi 3 model also Wi-Fi connection is connected to the model. The connection of raspberry pi is given to the relay 1,relay 2 and relay 3which are again given to the two motor, and exhaust fan respectively.

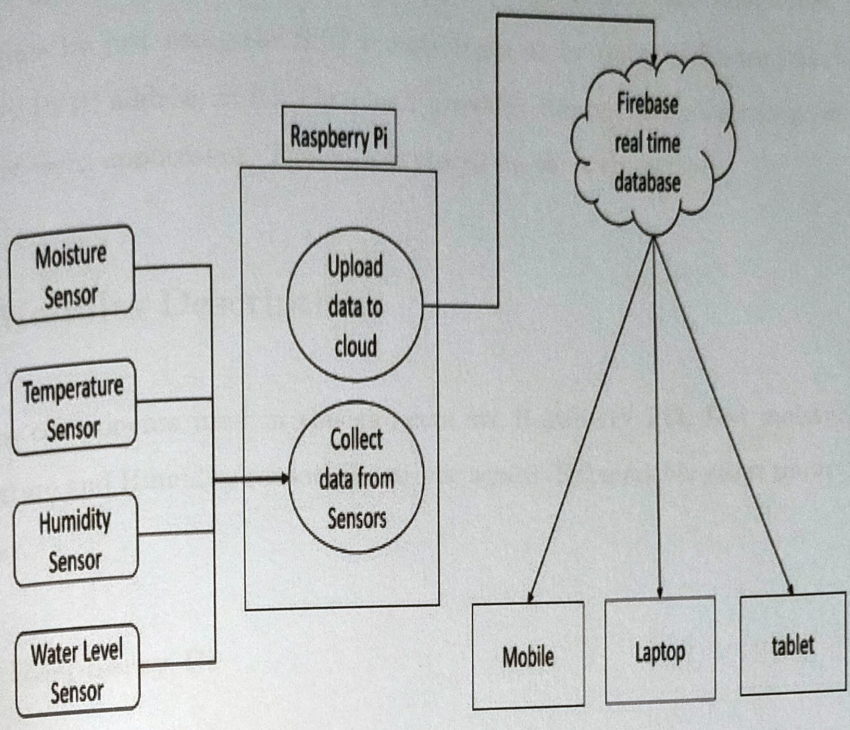

FIG. 3.1: Irrigation Control System

3.2 Sensors Unit

The sensors are deployed in the greenhouse which senses the current climatic values of greenhouse. The overall system is controlled by microcontroller of raspberry Pi. Different types of sensors are attached to the sensor nodes. There is serial communication between sensor unit and raspberry Pi.Three types of sensors are attached to it i.e temperature and humidity, soil moisture, Ultrasonic Sensor. The humidity and temperature sensor DHT 11 is used here. Humidity sensor will measure the water content in the atmosphere. The rated voltage is DC 5.0 V. and its operating temperature is 0-600C. The temperature sensor is modulated on DHT 11. It will measure both temperature as well as humidity. The soil moisture sensor can be used to test the moisture of soil, when the soil is having water shortage, For detecting water level of tank we use ultrasonic sensor.When it detect the minimum threshold , submersive pump will ON to pump water from external source and when it detect the maximum threshold pump will be OFF. IoT is used for transferring of data of devices via internet. By using IoT we can control the appliances anywhere and anytime by just using the SSH remote login or by putty software just by adding Raspberry Pi IP address in it. The cloud provides storage and computing resources to implement webs application. The data is stored on the web server.

3.3 Modules Descriptions

Hardware components used in this projects are Raspberry Pi3, Soil moisture sensor, Temperature and Humidity sensor, Ultrasonic sensor, Submersible water pump, Exhaust Fan,Relay.

3.3.1 Raspberry Pi

Raspberry Pi is a credit size single-board computers (SBCs) which is developed in United Kingdom by the Raspberry Pi Foundation in association with Broadcom.It is a capable to explore computing, and to learn how to program in languages like Scratch and Python. It's capable of doing everything we'd expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games.It has 40 GPIO pins, 1GB RAM, 2 USB 3.0 and 2 USB 2.0 , 1.5 GHz ARMv8 64 Bit CPU and an Ethernet port, HDMI & RCA ports for display,3.5mm Audio jack, SD card slot (bootable), General purpose I/O pins, runs on 5v. It is flexible for choice of Operating System and Software. Raspbian OS or Debian for Raspberry Pi is used and provided by official. But there are different Linux flavors, Windows and Real-Time Operating systems that support Raspberry Pi.

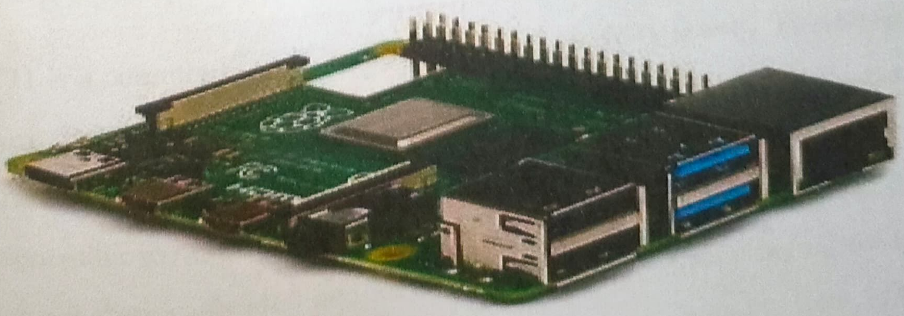

FIG. 3.2: Raspberry Pi

3.3.2 Soil moisture sensor(YL-69)

The soil moisture sensor YL-69 used to gauge the volumetric content of water within the soil. As the straight gravimetric dimension of soil moisture needs eliminating, drying, as well as sample weighting. These sensors measure the volumetric water content not directly with the help of some other rules of soil like dielectric constant, electrical resistance, otherwise interaction with neutrons, and replacement of the moisture content.At the point of evaporation of the dirt state, the present progression will not pass across it. But it functions like a circuit that's open. The O/P would be amplified as a result. The progression of the existing moves from one terminal to the next at the point where the dirt state is splashed. So it functions like a circuit shut-down. The o/p would be zero in this way. In order to establish greater efficiency just as long life, the sensor is coated with titanium, and against rust. The detection range is also high, which at least costs the rancher can pay for.

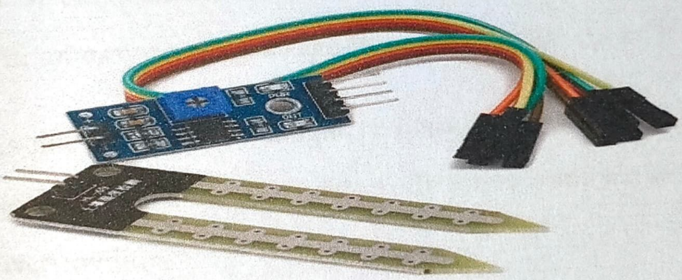

FIG. 3.3: Soil moisture sensor (YL-69)

3.3.3 Temperature and Humadity Sensor

The DHT11 is a commonly used Temperature and humidity sensor. This sensor DHT11 will measure the ambient atmospheric temperature and humidity. There is a control unit in DHT11. The sensor comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data. The sensor is also factory calibrated and hence easy to interface with other microcontrollers. The sensor can measure temperature from 0°C to 50°C and humidity from 20% to 90% with an accuracy of ±1°C and ±1%.

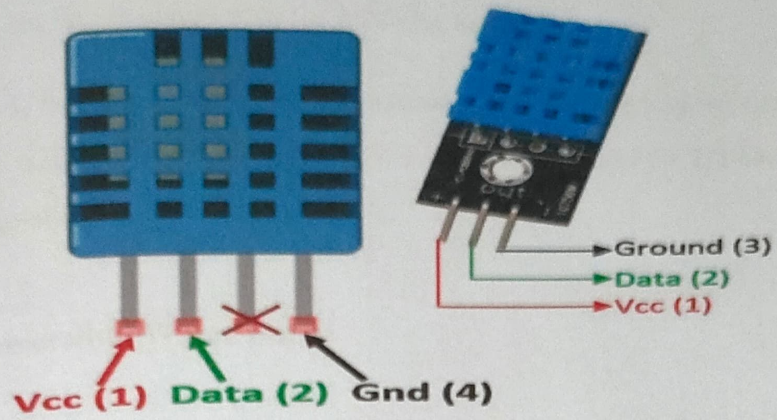

FIG. 3.4: Temperature and Humidity Sensor (DHT11)

3.3.4 Ultrasonic Sensor

The HC-SR04 ultrasonic sensor uses SONAR to determine the distance of an object just like the bats do. It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package from 2 cm to 400 cm or 1" to 13 feet.

The operation is not affected by sunlight or black material, although acoustically, soft materials like cloth can be difficult to detect. It comes complete with ultrasonic transmitter and receiver module.

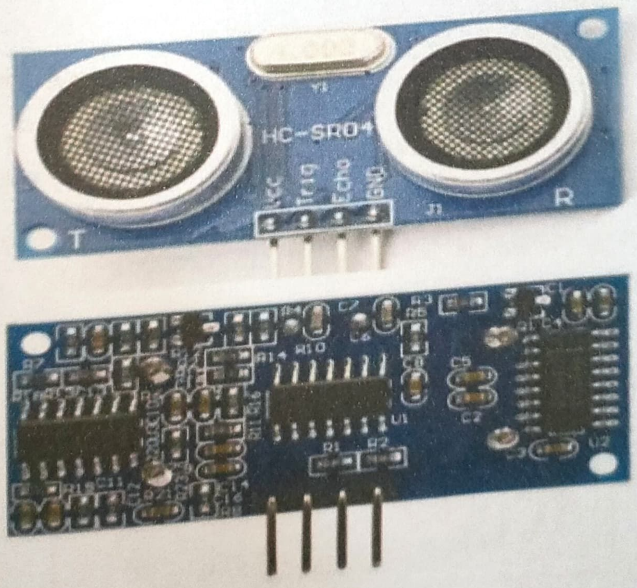

FIG. 3.5: Ultrasonic sensor (HC-SR04)

The distance can be calculated with the following formula:

Distance L = 1/2 × T × C where L is the distance, T is the time between the emission and reception, and C is the sonic speed. (The value is multiplied by 1/2 because T is the time for go-and-return distance.)

3.3.5 Submersible Water pump

This is a low cost mini submersible type water pump that works on 3-6V DC. It is extremely simple and easy to use. Just immerse the pump in water, connect a suitable pipe to the outlet and power the motor with 3-6V to start pumping water.

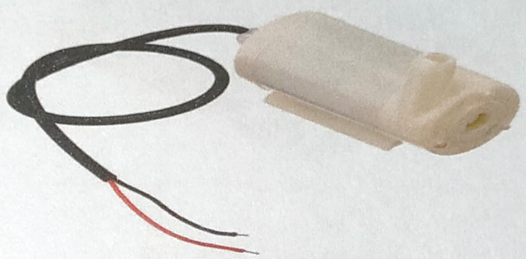

FIG. 3.6: Submersible Water Pump

3.3.6 Exhaust Fan

An exhaust fan is a fan which is used to control the interior environment by venting out unwanted odors, particulates, smoke, moisture, and other contaminants which may be present in the air. Exhaust fans can also be integrated into a heating and cooling system.

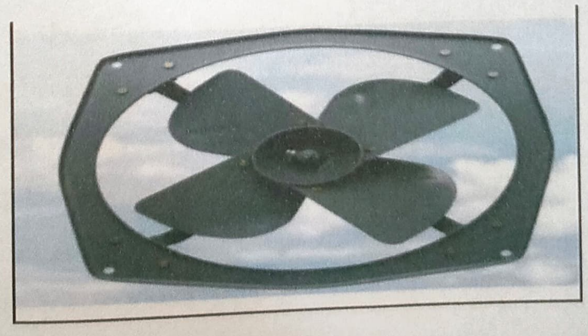

FIG. 3.7: Exhaust Fan

3.3.7 Relay Module

A relay is an electrically operated switch. Relays are used where it is necessary to control a circuit by a separate low-power signal. A relay with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload. As shown in above figure raspberry pi is connected to the devices via relay. Here relay can be operated as switch to on or off the devices.

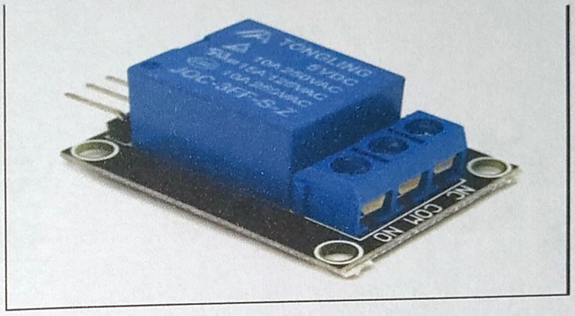

FIG. 3.8: Relay Module

3.4 Cloud and Software Platform

From the raspberry pi using python code the data is push to the firebase database.Data from database will be show to web application. HTML is used to create a webpage and CSS is used to enhance the look of the webpage. To make it available on the internet these HTML files are uploaded to the free server created by 000webhost.com. One is Index.html which is used to design the main page. If the sensed value goes beyond the threshold value set in the program then automatically the data's will be uploaded on the webpage. In the webpage developed, the sensed data's are continuously uploaded and the page gets refreshed every 30 seconds.One link is made available to the end-user for which after pressing the link, opens up another new page where all the sensor values are displayed. In that, First page the real time data of soil moisture content, temperature values and humidity values where display. From these parameters, the environmental conditions within the greenhouse are continuously monitored and maintained, enabling the necessary climatic conditions are always maintained in the Green house.