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Greenhouse Automation using IoT and Cloud Computing

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Abstract: *Irrigation is an important task when comes to farming. India is also known for its farming outputs based on several methods used while irrigating a farm field which involves manpower, water resource and most importantly availability of water. So to save these efforts and the water, we are proposing a system where the manual work will be replaced with automated system which is capable enough to irrigate field automatically without human interventions. Automated system here is designed for Green-house which consist of Soil moisture sensor which will sense the soil- moisture content of the soil and based on that the system will operate the pumps and irrigation process is carried out. Another parameter is temperature within Green-house, so we are using temperature sensor to sense the temperature in Green-house and the temperature cooling mechanism will get operated. Android will act as a user interface where the user can manipulate system using the device and also gets the information related toits farm field.*

Keywords: Cloud Computing

I. INTRODUCTION

The history of agriculture in India dates back to the Indus Valley Civilization. India ranks second worldwide in farm outputs. As per 2018, agriculture employed more than 50% of the Indian workforce and contributed 17-18% to country's GDP. Slow agricultural growth is a concern for policymakers as some two-thirds of India's people depend on rural employment for a living. Current agricultural practices are neither economically nor environmentally sustainable and India's yields for many agricultural commodities are low. Poorly maintained irrigation systems and almost universallack of good extension services are among the factors responsible. Irrigation is an important task when comes to farming. While manually irrigating a farm field involves manpower, water resource and most importantly is availability of water. Due to climatic conditions sometimes it becomes difficult to manage the irrigation. We propose a smart method of farming with automation of Greenhouse to make irrigation easier and manage the Greenhouse parameters like humidity, temperature automatically as well as from android app.

II. RELATED WORK

Many of the researchers have worked to bring automation in agriculture field. Few of them are summarized here.
The authors have developed a system with soil moisture sensor, temperature and humidity sensors placed in root zone of plant and transmit data to android application. Threshold value of soil moisture sensor that wasprogrammed into amicro-controller to control water quantity. Temperature, humidity and soil moisture values are displayed on theandroid application [1].The authors have developed a system which promises about increase in systems life by reducing the power consumption resulting in lower power consumption. It is considered to beused at Cricket stadiums or Golf stadiums and also in public garden area for proper irrigation[2].The authors have developed a smart drip irrigation system which proves to be a usefulsystem as it automates and regulates the watering without any manual intervention. Sending the emails to the system can be automated but manual sending of the emails has control overthe systemregarding whether or not to run the system depending upon the weather conditions[3].In this combination of hardware and software the authors have developed a system whichprovides a irrigation controller that can be implemented atrelatively low cost and which isextremely user friendly [4].The authors are proposing use of IoT in a poly house and poly house is a fully coveredstructure so there is almost no effect of outside factors like insects

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do not enter andcannot harm the crop so there will be less need of insecticides. By using sensors the crop field that isconnected to internet, an appropriate decision can be taken [5].The authors have developed an irrigation system in which the drip is ON/OFFusing a Bluetooth module
[6].The authors in the paper designs an automated irrigation system to water the crop and itwill optimize the usage of water by reducing wastage. By providing Android application theuser can monitor and control the water requirement in the farm, the system will reduce thehuman intervention [7].The authors have developed a system which gives the idea to monitor the soil moisturecontent and temperature in a farming area and the user can control watering system usingAndroid device provided with Wi-Fi facility [8].Agriculture is base for all the industries for raw material and cultivation requires differentwater levels at different periods, so the authors have developed a system for minimizing andmaintaining water level [9].

III. METHODOLOGY

Block Diagram:

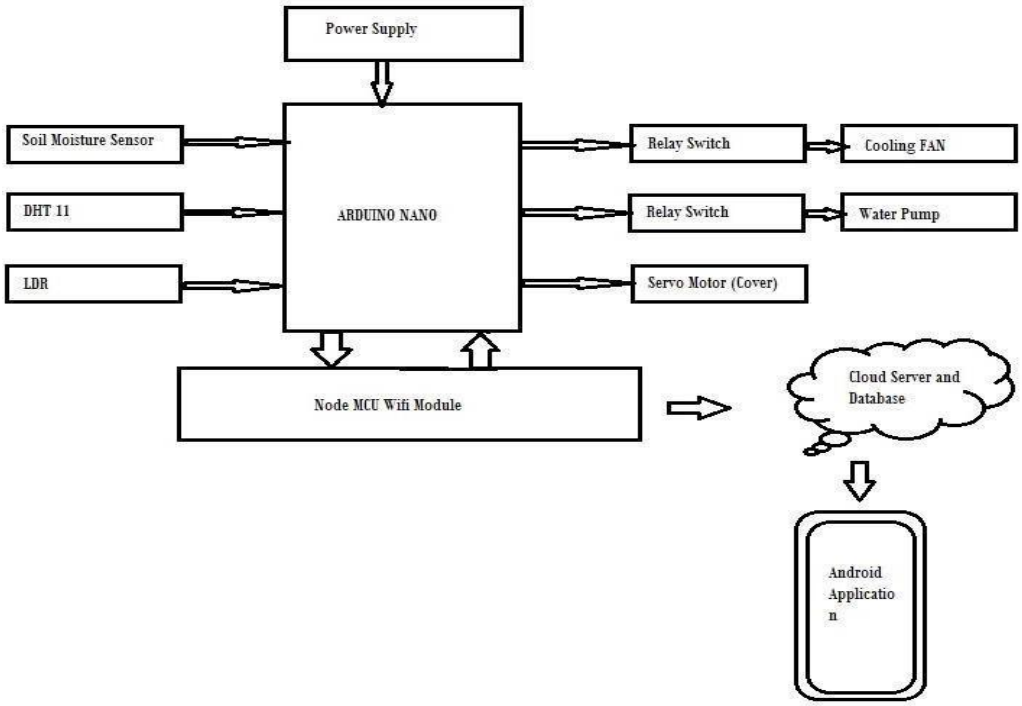

Figure 1. Block Diagram of System

Block Diagram Description:

- **Arduino nano:** Arduino nano is the center hardware where the other component are connected.
- **Node mcu:** It is used to collect the data through arduino kit and sends to the remote devices e.g: Smart phone, Tablet, PC etc.
- **Smart phone:** It is used to access the details and get the feedback through system and also can give permission to the system to work.
- **Relay switch:** Through relay switch the water pump and fan is connected to arduino kit and it switches the pump on and off while irrigating farm land.
- **LDR sensor:** Senses the light intensity and send the data to controller, the cover of greenhouse open and close depending upon the intensity.
- **Soil-Moisture sensor:** Senses the moisture content of soil bases on threshold values and regulates the water pumps forirrigation

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- **DHT11:** used for sensing the humidity and temperature of greenhouse and it is connected to arduino nano.
- **Fan :** The fan is used to control the temperature in greenhouse. If temperature goes high the fan starts to bring down the temperature.
- **Water pump:** it is a submersible dc water pump used for irrigation system.

Flowchart:

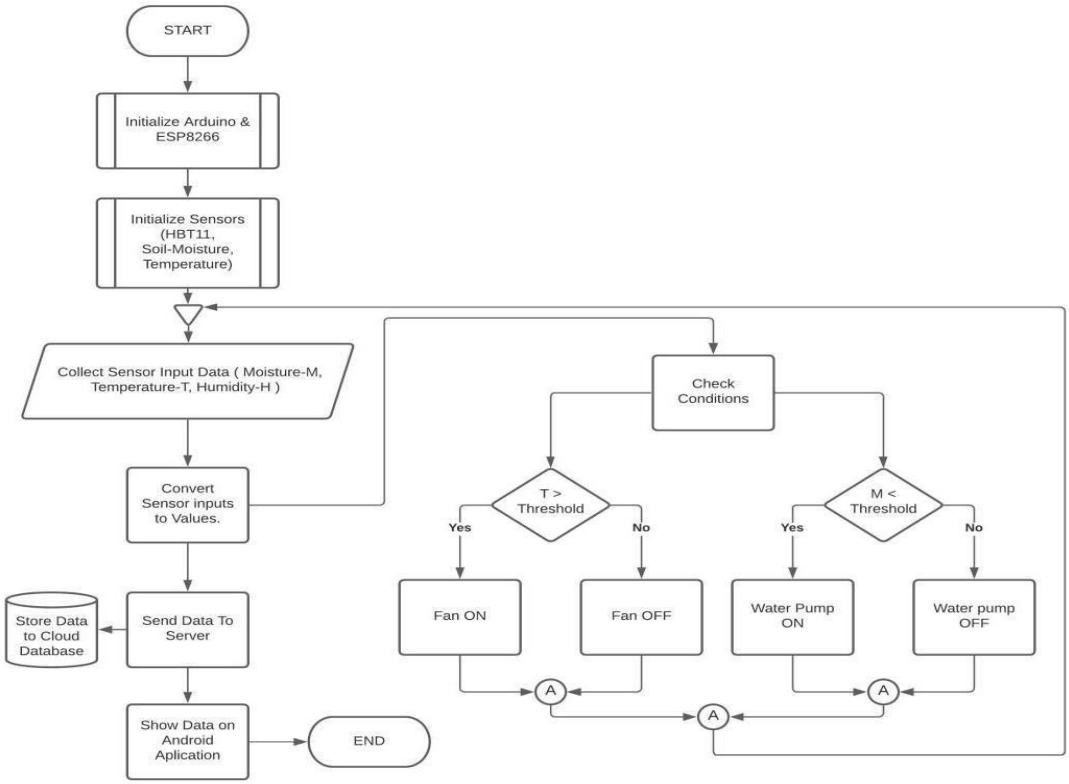

Figure 2: Flowchart of System

Algorithm:

The detailed step wise working of the system is mentioned below.

1. Start
2. Initialize Arduino Nano and connect ESP8266 WiFi module and setup
3. Initialize Sensors to take environmental data and initialize actuators with default state (off)
4. Collect environmental data such as Soil-Moisture level using Soil Moisture Sensor, Temperature using Temperature sensor (LM35), Humidity using DHT11 Sensor
5. Convert sensor data to values (if needed) and send the data to server using WiFi Connectivity and store in Cloud Database as well as send data to Android application from server
6. Check and compare the environmental conditions data with predefined threshold values such as temperature and soil-moisture level
7. If (temperature > threshold(40°)) switch ON the Cooling System (Fan), If (temperature <= threshold(40°)) keep orswitch OFF the Cooling System (Fan)
8. If (moisture level < threshold(80%)) switch ON the Irrigation System (Water Pump), If (moisture level
9. >=threshold(80%)) keep or switch OFF the Irrigation System (Water Pump)
   Go to step 4 and repeat
10. 10.Stop

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IV. EXPERIMENTAL RESULTS

Using the Soil-Moisture Sensor, the moisture level is measured and the Irrigation system is operated. The DHT11 sensor measured the temperature and Humidity in greenhouse and using the data , the Cooling system (Fan) is operated accordingly. The LDR used to measure the light intensity, based on which the cover of greenhouse is operated. The sensor data and status of system is successfully communicated to an android app as shown in figure 5,6,7.

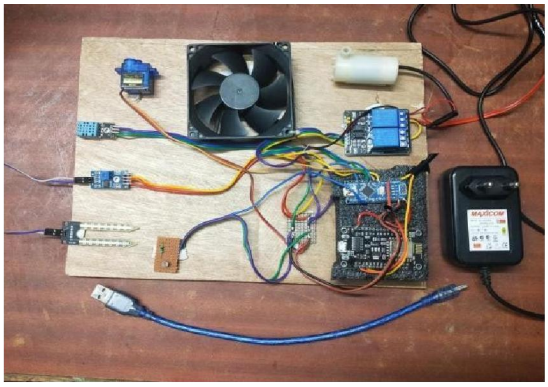

Figure 3: Hardware assembly of system

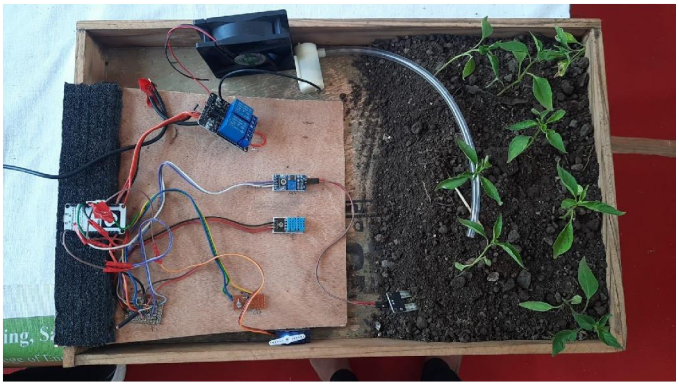

Figure 4: System implemented in greenhouse

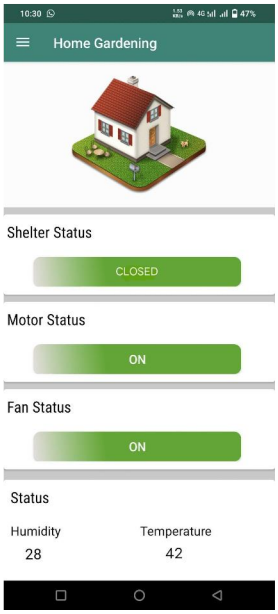

Figure 5: Motor status ON

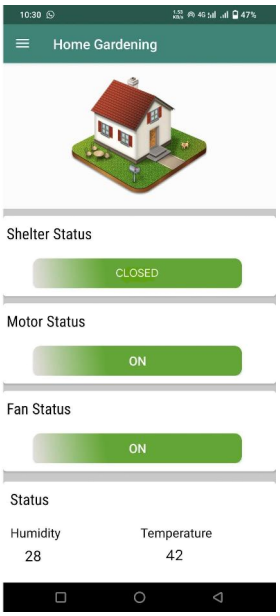

Figure 6: Motor and Fan status ON

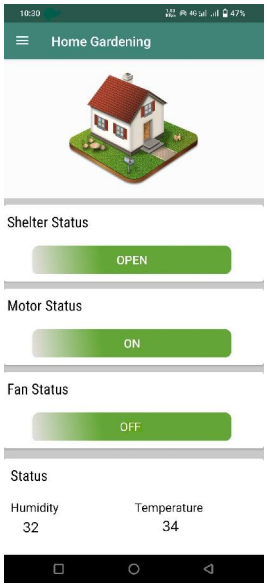

Figure 7: Motor and Cover status ON

V. CONCLUSION

The system can provide the better and convenient way of farming so that farmers can work with proper knowledge and can cultivate crops with better quality and quantity. The system also facilitates an adequate useof water and can reduce the human efforts. Due to the monitoring and controlling the temperature, a better yield can be harvested form the farmwhich can improve the economy of farmers. Further improvements can beincorporated in the system with the use of cameras to capture images of crops for implementing image processing based system. Solar panels can also be used for energy generation to avoid the possibility of power failure

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