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SMART IRRIGATION SYSTEM USING IoT

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Abstract - *In India most of people are doing work connected directly or indirectly to agriculture. Economy of India is mostly affected by activities related to agriculture. There's challenge in front of every major country to reduce the water consumption used for farming and provide fresh and healthy food. In this project, we made a smart irrigation system that will inform farmers on their registered mobile devices and email addresses. These days the industries are using automatically controlled machines which are high in cost and not advisable for garden field. So in this project we designed a irrigation technology based on IoT using Raspberry pi which is smart. This system can be used to control the water pump automatically and also monitor the growth of crops or plants by using webcam that is connected using a wireless module through mobile phone using a software application by using a Wi-Fi network or module. If the moisture level of the soil is less than the given input value and it need to be watered using the moisture sensor the motor will be switched on that is attached with main controller. For fire detection we can use flame detection sensor and when there is any fire accident in farm, the system will notify the farmer through email or mobile application.*

Key Words: Raspberry pi, Automation, IoT, MCU, Soil moisture sensor.

1. INTRODUCTION

India is one amongst the largest fresh users within the world, and our country uses great deal of H2O than alternative country. There's an outsized quantity of water utilized in agriculture field instead of domestic and industrial sector. Sixty fifth of total water is contributes as a groundwater. These days water has become one among the necessary supply on the world and most of utilized in the agriculture field. As our technology becomes progressively connected through the increase of IoT and cloud computing, we've not solely benefited our lives however our planet similarly. Sensible farming has taken the planet by storm as farmers have learned to embrace the planet of IoT, not reject it. These farmers are ready to exactly monitor the conditions of their manufacture similarly as management each cc of their resources.

The Smart irrigation System has wide scope to automate the entire irrigation system. We are building an IoT based smart Irrigation System using NodeMCU Module and DHT11 Sensor. It will not only automatically irrigate the water supported on the moisture level within the soil but also send the info to ThingSpeak Server to keep the track on the conditions of the land. The System contains a pump which can be used to sprinkle water on the land depending upon the land conditions like Moisture, Temperature and Humidity.

The soil-moisture sensor and temperature sensor are placed within the root zone of the plants the system will distribute this info through a wireless network. Raspberry pi is that the heart of the system and also the webcam is interfaced with Raspberry pi via Wi-Fi Module. Python artificial language is employed for automation purpose. The system could be a network of wireless sensors and a wireless base station which might be used to give the sensors information to automatize the irrigation system. The system will use the sensors like soil moisture sensor and temperature sensor and conjointly ultrasonic sensor.

The system design consists of three main steps:

(i) Setup of the system hardware along with the setup of Raspberry Pi.
(ii) Development of the monitoring system by using Android application as GUI in order to monitor and control the parameter of sensors remotely.
(iii) Creating of a notification system that can be used for sending email.

2. LITERATURE REVIEW

This paper focuses on greenhouse technology which is understood as irrigation system. Nowadays, many researchers have invented greenhouse technology with home automation system and called it as smart home watering or irrigation system. The purpose of this system is to monitor and control the plant growth in home garden area based on environmental factors, like weather and soil moisture. This technology creates suitable conditions for growing plants such as flowers and vegetables which prevent bad effects that are caused by weather change. This irrigation system also helps in using the water and fertilizer efficiently.

Most mini gardens in residential districts aren't covered with house roof and it is likely to be exposed to weather change like heavy rain or a superhot day. This various environmental conditions may affect the plant growth within the garden. This mini garden should be monitored by the house owner frequently to make sure the plants are growing healthily. However, it would be difficult for the owners of the place who are away for an extended time to watch their plants. One system should be built to monitor

and control the system which will help in irrigating their plant from other places.

Boselin Prabhu et.al proposed wireless sensor network system which is reduces the evaporation of water by drip irrigation. In this system, the information is collected from sensors and sends it to the base station. Now whenever sensor send data to base station as packet so to reduce impact a packet author set a sensor in bulk mode. Now if plant need water so base system start watering that plant using drip irrigation, these will save water as well reduce evaporation of water.

Minwoo Ryu et.al built a system to make a smart farming by connecting farms based on Internet of Things (IoT). In this system they are using different type of sensors like temperature sensor and humidity sensors. Now they are using REST APIs to transfer data, Mobius which is IoT supporting platform and Cube which is a middleware between physical devices i.e. sensor and Mobius. Data which is collected from sensors sends to Mobius using cube and end user send a request for particular farm using REST APIs to Mobius. End user can see result of request on Mobile Application.

In this Paper author proposed a system with wireless sensor network using RFID. In this system, author put soil moisture on different location in the field or it can be a farm and each sensor has its very own unique ID. The sensor now sends the data to ZigBee at 2.45 GHz. Now sensor sends that data to base station and if soil is dry then pump station will start sprinkling water only on that portion of the field.

Raspberry Pi is that the heart of the entire system. This method contains digital camera that is interfaced to Raspberry Pi via Wi-Fi module. The Raspberry Pi Model zero incorporates variety of enhancements and new options. These options of raspberry pi are improved power consumption, enhanced property and larger IO that created this powerful, tiny and light-weight ARM primarily based laptop. Raspberry Pi can't drive the relay directly as it can't read analog signals. It wants 12V to drive mechanical device relay. In this case it uses a driver circuit that provides 12V amplitude to drive the relay. Numerous sensors are connected to the Raspberry Pi board provides a resistance variation at the output. This signal is applied to the comparator and signal learning circuit that has potentiometer to come to a decision the wet level on top of that the output of comparator goes high. This signal is sent to Raspberry Pi. If the soil wet worth is on top of the wet level then the three section induction motor are going to be OFF, whereas if the wet level is low motor are going to be ON through the relay.

3. OBJECTIVES

The objectives are:

1. To learn, develop and furnish the project.
2. To see, step-wise how things are implemented and put together to bring the project live. Our edible food items and everything is produced through a system which is called irrigation system.
3. To take the irrigation, a next step further. The major parameters like temperature and humidity of the soil are to be measured and then control the watering system through the submersible pump.

4. COMPONENTS AND SPECIFICATION

I. Soil moisture sensors:

The soil moisture sensor measures the volumetric content of water in the soil. The soil moisture sensor uses the capacitance to measure the volumetric content of water present in soil. Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighing of a sample, moisture sensor measures the volumetric content of water indirectly by using some property of soil, like electrical resistance, dielectric constant, or interaction with neutrons interaction, as a proxy for the moisture content. This is the main reason to use this sensor in diverse fields such as botany, biology, horticulture and mainly in soil science.

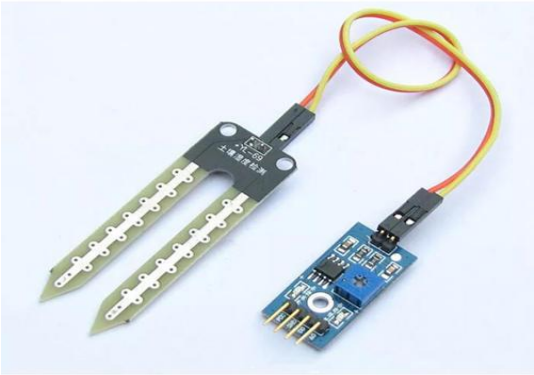

Figure 1: Soil moisture sensor.

II. Temperature sensor:

A temperature sensor is an electronic module that is used to measure the temperature of the environment around it and converts the input data into electronic signals to record and keep monitoring the surrounding temperature. There are various types of temperature sensors. Some sensors require direct contact with object

that is being monitored (contact temperature sensors), while others do not require any type of contact, they indirectly measure the temperature of an object (non-contact temperature sensors). Temperature sensors are of two different types, they are digital and analogue temperature sensors. We are using a Resistance Temperature Detector over here which gives the accurate value for the experiment in which we are performing.

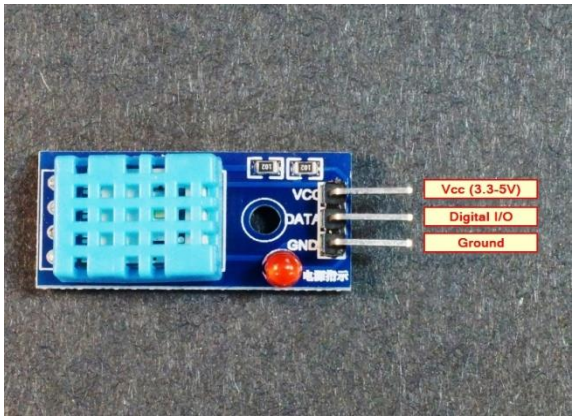

Figure 2: Temperature sensor.

Sensor	DHT11 (Temperature & humidity sensor)
Operating voltage	3.3V-5.5V
Humility measuring range	20%-95% (0℃-50℃)
Humility measuring error	+-5%
Temperature measuring range	0℃-50℃
Temperature measuring error	+-2℃
Dimensions	29.0mm*18.0mm
Fixing hole size	2.0mm

Figure 3: DHT11 features.

III. Relay:

A relay is an electrically operated switch. It consists of a small group of input terminals for one or multiple control signals, and another group of operating contact terminals. The switch may have any number of contacts in any number contact forms, like make contacts, break contacts, or combinations. Relays are used where it's necessary to regulate a circuit by an independent low-power signal, or where several circuits must be controlled by one signal.

Figure 4: Relay 5V.

IV. Raspberry pi:

Raspberry Pi is a credit card sized mono board computer that is totally capable of doing the entire job that a regular desktop computer does like spread sheets, Word processing, Internet usage, Programming, Gaming etc. It contain 2GB RAM, 2 USB, ARM V8 Processor and an Ethernet port, micro HDMI & RCA ports for display,3.5mm Audio jack, SD card slot (bootable), GPIO pins, it runs on 5v. But it too has some limitation, it doesn't come with any Hard Disk Drive (HDD) or Solid State Drive (SSD) but we can use a Micro SD card with it so we can boot the Operating System of Raspberry Pi. Raspberry Pi uses Python programming language for this development.

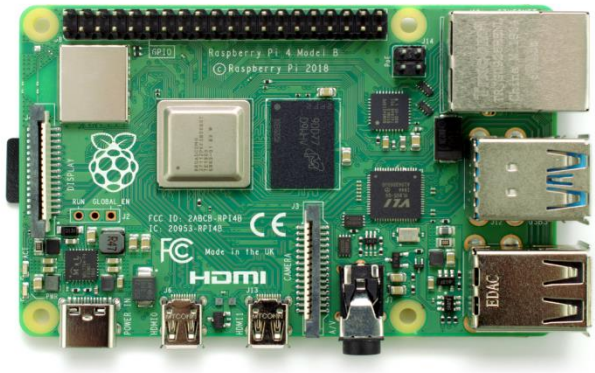

Figure 5: Raspberry pi 4 model b.

5. DESIGN AND WORKING:

The Pi monitors the Temperature and Humidity though the respective sensors. And, on the other hand Pi checks the condition and judges if the watering is necessary or not. The following steps guides through the procedure undertaken to make Irrigation Smart:

Step1: In the above proposed system two types of sensors that are temperature sensor and moisture sensor are used to detect the required scarcity of water in the soil for proper undergoing of the process, that is, for proper irrigation.

Step2: Required action by the help of Raspberry pi is to be taken for the deficit of the physical parameters like moisture and temperature of the soil for a healthy process.

Step3: An automatic system is implemented here for taking the action by supplying adequate amount of water through the pump which is indeed controlled by the mini-computer that is Raspberry Pi itself.

Step4: To measure the exact amount of water present in the soil is to read the analog output of the Moisture Sensor. But since, Raspberry Pi can't read analog outputs an external open source microcontroller must be used.

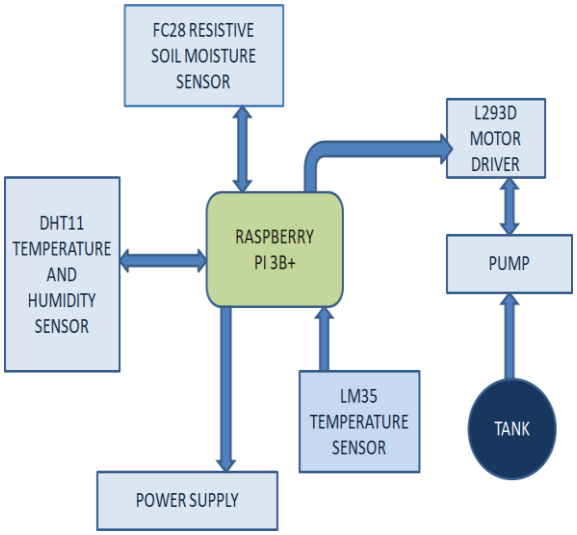

Figure 5: Block diagram of proposed system.

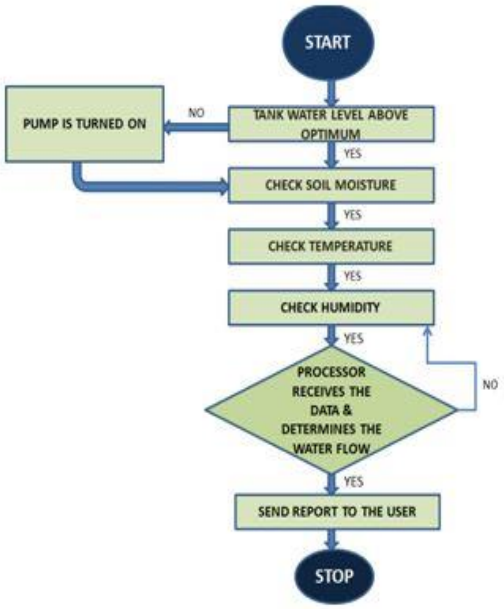

Figure 6: Work flow

Work flow of the system:

Step 1: Start power supply initiate.

Step 2: The system can be initialized on Raspberry pi module.

Step 3: The soil moisture sensor checks the moisture in soil constantly.

Step 4: The sensor constantly senses the temperature and humidity of the field and updates the date in the web server.

Step 5: If the permissible level of water is reduces, through Wi-Fi module message will be sent to user.

Step 6: If user sets automatic, then the relay which is connected to the Raspberry Pi will turn ON the motor

Step 7: Similarly, if the soil becomes dry, the motor which is connected to the relay will be turned ON to wet the field.

Step 8: when the permissible level reaches, the relay will automatically switch OFF the motor.

Step 9: If the step 8 is completed, then the system will go to step 3 as it is a continuous process.

Step 10: This process will run continuous until the input power for the system is cut OFF.

6. CONCLUSIONS

This project has been implemented using raspberry pi. It is an automated system and beneficial for mankind. This project proposes a design for smart irrigation system that is energy-efficient, and cost effective.

- The implemented system is integrated with multi-sensors such as soil moisture sensors, humidity and temperature sensors.
- This system managed to reduce the cost, minimize wastage of water, and reduce human interface physically.
- This whole system is controlled by a powerful device which is in the size of a credit-card and this microcomputer is called Raspberry Pi.
- The system is capable of automatic watering of plants depending upon certain parameters.

7. FUTURE SCOPE

- Sensors like fire detection sensor can be added to safe guard the yield by any fire accidents.
- To avoid top soil erosion, addition of rain gun device can be added to sprinkle the water.
- This system can be developed by using renewable energy which is solar power to run the "single board computer (SBC)" i.e. raspberry pi, using solar energy will help to reduce future cost.

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10. BIOGRAPHIES

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