Agricultural Soil Monitoring using NB-IoT Tools

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Abstract:

In each geographical location, agriculture begins from a time whilst it was considered a technological know-how and artwork of cultivation. Technology has been updated in contemporary society and is also vital to support the improvement of agriculture. IoT plays a crucial role in clever agriculture. Internet of things (IoT) sensors are used to offer data approximately soil and its different additives. The principal benefit of IoT is to reveal agriculture using wi-fi sensor networks and accumulate information from distinct sensors utilized in one-of-a-kind nodes and ship them thru wireless systems. The usage of IoT system, clever agriculture is applied by Node MCU. It consists of distinct kinds of sensors which include humidity sensor, temperature sensor, moisture sensor etc.. The gadget robotically detects soil temperature and moisture content material. The sensor is used to decide the water level, if the water degree falls underneath the restriction, the device routinely begins watering with the help of the water motor. Relying on the temperature trade, the sensor does its job. IoT additionally shows information about humidity, humidity via including date and time. It may also alter the temperature in line with the sort of crop planted.

Keywords: IoT, Node MCU Soil Moisture and Temperature sensors, Wi-Fi module.
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1. Introduction

One of India's largest food source is agriculture. Agriculture plays an important role in sustaining human life. Population growth is directly proportional to agricultural growth. In fact, agriculture depends on the seasonality of water scarcity. IoT-based smart agriculture is used to achieve good results in agriculture and to overcome these problems.

Monitoring agriculture on a global and regional scale aims to provide new insights into food production. In IoT-based smart agriculture, a method has been developed to monitor the land with the help of sensors such as light, humidity, temperature, humidity. Farmers can monitor the field from any location. IoT-based smart agriculture is more efficient than traditional methods.

Water-based IoT concept using ESP8266 Node MCU module and DHT11 sensor.

It will not only automatically release water according to soil moisture, but also send data to a dedicated server to monitor the condition of the land.

Thanks to recent advances in sensors for agricultural irrigation systems and advances in wireless sensor networks and IoT technologies, they can be used to automatically improve tap water. The system will detect faults in the water supply system related to water quantity and quality, soil properties, climate and fertilizer use, and most nodes and wireless technologies are used to implement WSN and IoT based smart irrigation systems.

2. Literature Survey

An IOT Based Crop-field monitoring an irrigation automation system describes how to monitor a crop field. A system is developed by using sensors and according to the decision from a server based on sensed data, the irrigation system is automated. Through wireless transmission the sensed data is forwarded to web server database. If the irrigation is automated then the moisture and temperature fields are decreased below the potential range. The user can monitor and control the system remotely with the help of application which provides a web interface to user [1].

By smart Agriculture monitoring system and one of the oldest ways in agriculture is the manual method of checking the parameters. In this method farmers by themselves verify all the parameter and calculate the reading [2].

The system focuses on developing devices and tool to manage, display and alert the users using the advantages of a wireless sensor network system. It aims at making agriculture smart using automation and IoT technologies [3].

The cloud computing devices are used at the end of the system that can create a whole computing system from sensors to tools that observe data from agriculture field. It proposes a novel methodology for smart farming by including a smart sensing system and smart irrigator system through wireless communication technology [4].This system is cheap at cost for installation. Here one can access and also control the agriculture system in laptop, cell phone or a computer [5].

3. Block diagram

The Block diagram of the proposed system which gives information of the required modules is shown in Figure 1.

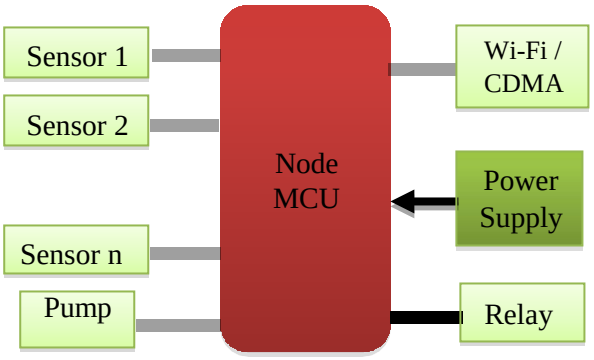

Figure1: Block Diagram

4. Required Modules

Hardware

1. Soil Moisture Sensor
2. Temperature sensor(DHT-11)
3. Relay
4. Pump
5. IoT (WI-FI module ESP8266)
6. Power supply:5V,700mA Regulated power supply

Software

1. Arduino IDE
2. Thing speak website

➢ Soil Moisture Sensor

A device which is used to sense the moisture level in these and is called soil moisture sensor and is shown in Figure 2.When the sensor senses the water shortage in the field, the module output is at high level else the output is at low level. This sensor reminds the user to water their plants and also monitors the moisture content of soil. It has been widely used in agriculture, land irrigation and botanical gardening.

Figure2: Soil Moisture Sensor

- **Temperature Sensor (DHT-11)**

Temperature Sensor (DHT-11) is used t monitor temperature and humidity of the atmosphere. The DHT-11 shown in Figure3 is a basic ultra low cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermostat to measure the surrounding air and split out a digital signal on the data pin. The DHT-11 calculate relative humidity by measuring the electrical resistance between two electrodes.

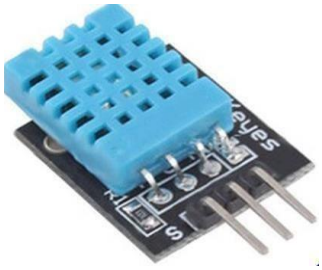

Figure3: Temperature sensor

- **Relay**

A relay is used as electrically operated switch which is shown in Figure 4. It has a set of input terminals for a single or multiple control signals and a set of operating contact terminals. The switch may contain number of contacts in multiple contact forms which make contacts or break contacts. Relay is used to turn on the water pump in order to maintain the moisture level of the crop.

Figure4: Relay

- **Water pump**

The DC 3-6V Mini Micro Submersible Water Pump showninFigure5isalow cost, small size Submersible Pump Motor. It operates with a 2.5 to 6V power supply. It can pump up to 120litres per hour with a very low current consumption of 220mA. Just connect the tube pipe to the motor outlet, submerge it in water, and power it.

Figure5: Mini water pump

- **IoT (WI-FI module ESP8266)**

The Node MCU (ESP8266) shown in Figure 6 is a microcontroller with an inbuilt Wi-Fi module. The total pins on this device are 30 out of which 17 are GPIO (General Purpose Input/output) pins which are connected to various sensors to receive data from the sensors and send output data to the connected devices. The Node MCU has 128 KB of RAM and 4MB flash memory storage to store programs and data. The code is dumped into the Node MCU through USB and is stored in it. Whenever the Node MCU receives input data from the sensors, it crosschecks the data received and stores the received data. Depending on the data received it sends a pulse to the Relay Module which in-turn acts as a switch to on or off the pump. The operating frequency of the Node MCU ranges from 80 to 160 MHZ and the operating voltage of this device range from 3to3.6V.TheWi-Fi module presents in the Node MCU range from 46 (indoors) to 92 (Outdoors) Meters.

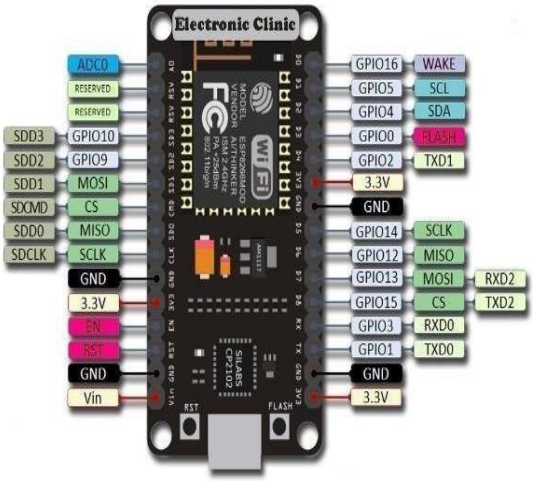

Figure6: Node MCU

➢ **Power Supply**

Power supply shown in Figure7 is an electrical device which supplies electric power to an electrical load. The first function of a power supply is to convert electric current from a source to the correct voltage, current and frequency to power up the load. As a result, power supplies are also referred to as electric power converters. Some power supplies are separate standalone pieces of equipment while others are built into the load appliances that they power.

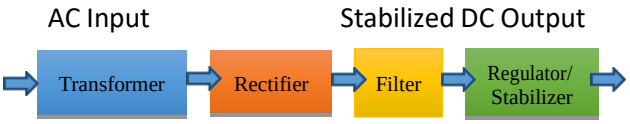

Figure7: Block diagram of a fixed regulated power supply

➢ **Arduino IDE**

The Arduino Integrated Development Environment (IDE) is a cross-platform application in which the functions are written in C and C++ languages. It is used to write and dump the written programs to Arduino compatible boards with the help of third party cores and other vendor development boards.

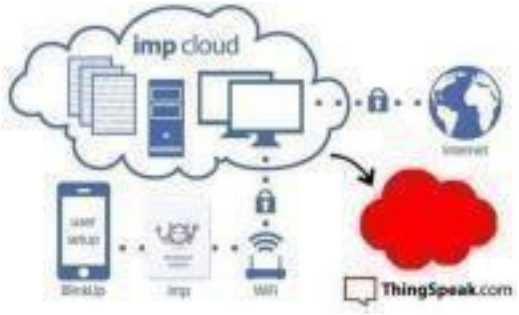

Figure8: Internal Work of Thing Speak

➢ **Thing speak website**

Thing Speak is an IoT analytics platform which is used to aggregate, visualize, and analyze live data streams in the cloud. When the data is sent to Thing speak from the devices, it creates instant visualization of live data and sends an alert. Internal Work of Thing Speak is shown in Figure8.

5. Working

The smart agriculture monitoring system is tested under various conditions. The soil moisture sensor is used to test the soil for all climatic conditions and results are interpreted successfully. The moisture output readings at different weather conditions is taken and updated. Wi-Fi is used to achieve the wireless transmission.

The values of soil moisture sensor purely depend on their sensitivity of the soil. The value of the sensor at beginning of wet condition is 0. The sensed value is sent to microcontroller through Node MCU and motor pump gets OFF in this condition. The maximum threshold value upon dry soil is 1023. When the sensed value by sensor reaches the threshold value, the microcontroller trigger the relay and motor gets ON. When sufficient amount of water is supplied, the motor pump is turned OFF automatically.

6. Advantages

1. The cost is reasonable to purchase.

The whole model is easy to maintain. The components which are used are easily available.

2. It has advantage to observe the status on smartphone or laptop using internet. The information is up to date evening absence of farmer.

3. The collected data is updated and the farmers are conscious about the status of the crops.

4. To achieve more effective and accurate details of crops several additional sensors can also be included.

7. Goals and Analysis

The main aim of this project is to implement the modern technology in required fields like agriculture. Using IoT technology in agriculture, this system makes agriculture monitoring easy. The benefits as mentioned like water saving and lab-our saving are required the maximum in current agricultural state of affairs. Consequently, using the sensor network in fields of agriculture makes clever irrigation. The information from IoT is sent to the client using cloud. Consequently, any changes inside the crop maybe identified effortlessly and early analysis is achieved as such.

8. Conclusion and Future Scope

➢ Conclusion

IoT will help to enhance smart farming. Using IoT the system can predict the soil moisture level and humidity so that the irrigation system can be monitored and controlled. IoT works in different domains of farming to improve time efficiency, water management, crop monitoring, soil management and control of insecticides and pesticides. This system also minimizes human efforts, simplifies techniques of farming and helps to gain smart farming. Besides the advantages provided by this system, smart farming can also help to grow the market for farmer with single touch and minimum effort.

➢ Future Scope

The project has vast scope in developing the system and making it more user friendly and the additional features of the system like:

1. By installing a webcam in the system, photos of the crops can be captured and the data can be sent to database.
2. Speech based option can be implemented in the system for the people who are less literate.
3. GPS can being rated to provide specific location of the farmer and more accurate weather reports of agriculture field and garden.
4. Regional language feature can be implemented to make it easy for the farmers who are aware of only their regional language.

References

[1] S. Kumar and Prashant K.Yadav, “Internet of Things (IoT): A Review of Security Issues”, International Journal of Creative Research and Thoughts (IJCRT), Vol 6. no 2. pp 557-550, 2018.

[2] Rajalakshmi.P and S. Devi Mahalakshmi, “IOT Based Crop Field Monitoring and Irrigation Automation”, 10th International conference on Intelligent systems and control(ISCO),2016.

[3] Joaquin Gutierrez, Juan Francisco Villa-Medina et.al,“Automated Irrigation System Using a Wireless Sensor Network and GPRS Module”, IEEE Transactions on Instrumentation and Measurement,2013.

[4] Dr. V. Vidya Devi and G. MeenaKumari, “Real Time Automation and Monitoring System for Modernized Agriculture”, International Journal of Review and Research in Applied Sciences and Engineering, Vol3no.1. pp7-12,2013.

[5] Basha, Elizabeth, and Daniela Rus,“Design of early warning flood detection systems for developing countries”, International Conference on Information and Communication Technologies and Development,2007.

[6] K.Jyostsna Vanaja, Aala Sureshet.al,“ IOT based Agriculture System Using

Node MCU", International Research Journal of Engineering andTechnology,Vol.05.

[7] T. Rajesh, Y. Thrinayana and D. Srinivasulu "IoT based smart agriculture monitoring system", International Research Journal of Engineering and Technology, Vol.07.