Design and Implementation of Cloud Computing Smart Irrigation System

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ABSTRACT:
A multidimensional approach to technology breakthroughs, including innovations in sensors, artificial intelligence and cloud technology, is driving automation. In past few years, people have started for using electronic machines more frequently than traditional ones. As a result, this study suggests a technique wherein moisture sensors are positioned beneath plants or trees. The microcontroller activates the motor and reuses the water flow after receiving sensor data from the gateway unit. The irrigation system makes use of the Internet of Things (IoT), which is composed of two microcontrollers: the Arduino Uno for controlling relay that acts as switch for water flow and the NodeMCU with Wifi module for cloud computing. It also includes two sensors: the DHT11 and Soil Moisture. In order to monitor the state of the land, this should automatically irrigate dependent on the soil moisture, ambient temperature, and humidity. It will also communicate data to the ThingSpeak program as a cloud server. A water pump unit is also a component of the system, and it will be used to spray water on the land depending on weather and soil conditions read by sensors.This method can be used to create smart farming practices and smart lives in the future.

KEYWORDS: Smart Irrigation , ThingSpeak, NodeMCU, IOT**.**

1. INTRODUCTION

Farming is one of the areas where IoT can assist with regular tasks. Now, smart farming may take agriculture to a level that was previously unimaginable because of the seamless integration of wireless sensors and IoT. Real-time management of the creation, production, and circulation of farm products is necessary since selling farm goods has historically been difficult [1]. Using technology for automation and decision-making to assist farmers is one of the goals of agriculture. The number of people who integrate goods, information, and services to improve excellence, production, and profit is anticipated to rise between 30 million in the year 2015 to 75 million in the year 2020 [2].The growth of humanity's population depends on agriculture. After some individuals started growing, one type of food and dependent on others for other food, clothing, housing, and information, even the first society swiftly developed. A growing population necessitates a constant demand for more food. But because our farmlands have already been fully utilized, we must switch to more efficient irrigation and farming practices. In order to promote responsible water management and increase crop productivity, our research suggests a method for irrigating farm plants just when they require it. This method is based on multiple climate indicators and precipitation projection. IoT has been proven useful in a number of industries, including finance, energy, security, and healthcare. IoT applications have considerably increased the expansion of the agricultural sector in recent years. Using an IoT control scheme enables farmers to administer their crops from a distance, potentially reducing labor-intensive tasks and enhancing farmers' quality of life. Our study suggests a strategy for choosing the best date, duration, and volume of water to apply depending on various plant requirements and meteorological conditions, which can dramatically increase the development of agricultural plants. Limiting the quantity of water and electricity lost has recently become a focus of research into the optimum irrigation technique. Based on the moisture sensor which is

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attached to the microcontroller and determines the amount of soil dryness in the root zone automated spray irrigation can be accomplished. The sensor needs to be positioned at least distance of five feet from down pouts in order to avoid areas with excessive moisture levels. The irrigation technique reduces the amount of electricity that is used from the power grid and reduces water wastage when keeping water. [3],[4]. Humans exploited 85 percentage of freshwater supplies for growing crops. Because of population growth, a greater proportion of water will be used for specialized purposes, necessitating the development of technological plans based on science and technology for long-term water usage [5–7]. Nowadays, Manufacturing is widely used, and Internet-of-Things (IoT) is well-known due to its focus on automation. Because it is connected to all other devices, machines, items, animals, and people, the Internet of Things (IoT) can be characterized as connection that does not involve physical contact. It also has multiple unique IDs and the ability to transmit and receive information through a system. IoT has expanded in many creative directions and is assured to enhance people's lives and close the generational gap between the older & modern technology [8]. In order to enhance the farming techniques, IoT has also been used extremely actively [9],[10].

In [11], it is suggested that irrigation systems be automated. The suggested solution is centered around the Internet –of-Things (IoT), which could provide a more affordable and accurate way to address the requirements of the farm, a tracking system with the primary goal of addressing over watering. The suggested system depends on two different types of micro-controllers, Arduino and the Raspberry Pi , and a variety of sensors. It will be built by setting up a global wireless sensor network (WSN). In a comparison of different methods, Random Forest Regression is shown to have the greatest F score and a high accuracy of 81.6% for predicting RH (%) different algorithms.

Another research study [12] makes use of a Simple Connect WI-Fi module (CC3200), which attaches the system to the internet and supervises the PV system. It also handles the motor and solenoid valve for drawing water to the field based on data collected from the soil moisture sensor and water level sensor. Soil moisture sensors and Control valves, whose quantity is regulated to the variety of plants, establish a mechanical plant watering system.

Another model of the technology has been examined using different soil moisture levels. The outcome of the study demonstrate that the model is capable of correctly performing irrigation in accordance with the required specified requirements and reading the soil moisture value[13].

When it comes to the final product's quality, this study illustrates that strawberries constitute the most delicate fruit. We build, execute, and assess an intelligent strawberry watering system in greenhouses using a three-step methodology in this study. We demonstrate that our design greatly outperforms the traditional approach in the areas of soil moisture fluctuation with water utilization[14].

In another research [15], the fundamental problem is the fluid motion of water and roots growth in the soil layer, which must be taken into account when choosing an acceptable position for sensing the water content of the soil . In general, it is advised to set soil detectors, like tensiometers, at a thickness of 10–20 cm below the soil's surface and a distance of 5–20 cm from the plant, whereas drip-tape is positioned close to the corn row. The goal of the study was to build, create, and assess a low-cost automatic system for drip irrigation. Despite constant supervision, the automated system dependent on soil sensors was shown to be operating effectively and maintaining the root zone's pre-set moisture content.

To guarantee they are going to develop effectively and be in good health, individual plants will require varied amounts of necessities including water, light, and nutrients. Yet, there are a number of situations that make it hard for them to grow, such as on summer weather when they become very drying or during a rain storm when they become very soggy [16]. This study outlines the use of an automatic irrigation system, in which irrigation will be carried out by Wireless - Sensor- Units (WSUs) and a Wireless-Information-Unit (WIU), utilizing a wireless sensor network (WSN) that employs the Zigbee protocol, and linked via radio communication systems that permitted the data to be transmitted about soil moisture and temperature. It is controlled by a microprocessor and features a sensor for temperature and moisture measurement. The WIU also has a GPRS module for transmitting data to a web server via a public mobile network. The information may be remotely seen with the help of an online visual software and Internet access tools. This irrigation method is a useful technology that allows agricultural in moisture regions, improving sustainability[17]. As a result, intelligent irrigation systems will be needed to replace traditional irrigation, particularly on farms. Hence, the goal of this research is on the Internet - of - things intelligent irrigation tracking and management systems that enable users to track and control crop growth even when they are in a different place. The tracking method uses thingspeak cloud application on the smartphone as a platform where the user can do monitoring from a reasonable distance , see Fig. [1].

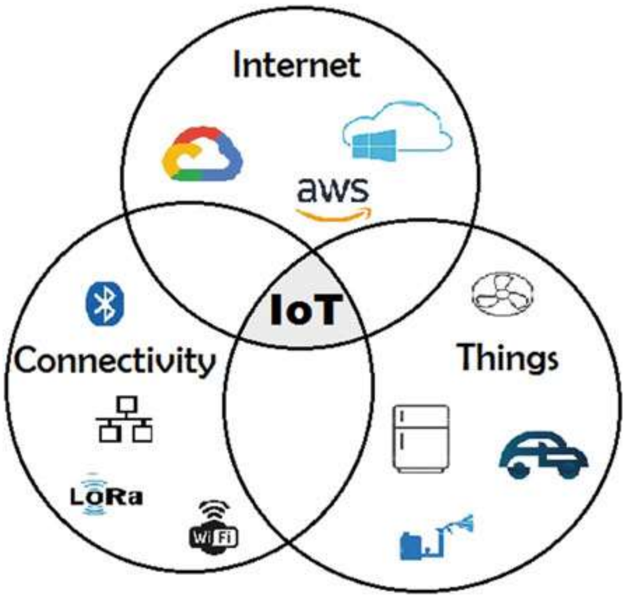

Fig. 1. Internet of Things architecture [18].

2. THE SYSTEM STRUCTURE AND COMPONENTS

As shown in Fig. 2. The system uses a variety of sensors to determine when, how much, and how long to provide water to crop plants based on the local environmental circumstances (using the Humidity and temperature detector and soil-moisture sensor). Data acquired by the sensors are then accessed to the Arduino Uno, NodeMCU and thingspeak cloud applications for processing and monitoring, respectively.

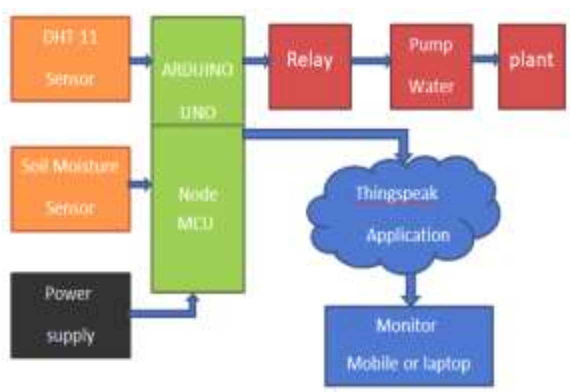

Fig. 2. The block diagram of the system.

The device is itself autonomous and need only a small fraction of power supply to keep it running for days. The NodeMCU and motor are installed, it has very low cost of running and maintenance. It requires only 5V and 200mA for routine running (including sensors and microprocessor).The connection all parts are shown in Fig. 3.

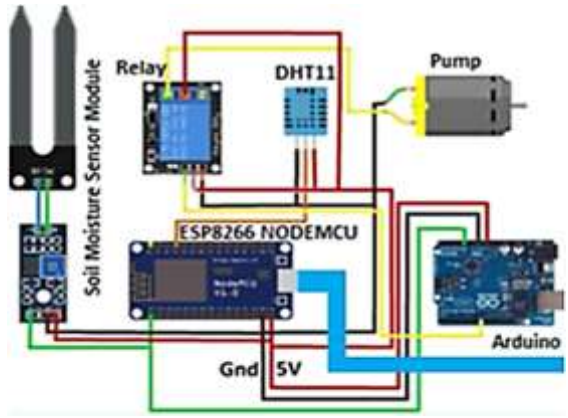

Fig. 3. Architecture of smart irrigation system.

A. Components Of The System

We will describe all components for implementing the irrigation system.

1) NodeMCU

A cheap source code Development kit is (NodeMCU) as shown in Fig.4. It originally consisted of hardware built upon that (ESP-12) module and software that runs on Systems consisted of (ESP8266 Wi-Fi SoC). The Node MCU examines all of the information gathered by numerous sensors to ascertain the timing, and the quantity of water that the tree needs. It is connected to the internet for information transmission to cloud service[19].

Fig. 4. Node MCU processor.

2) Arduino Uno

It contains a 16 MHz crystal oscillator, 6 analog inputs, 14 digital input/output pins (of which 6 can be used as PWM outputs), a USB port, a power jack, an ICSP header, and a reset button. It comes with just about everything required to run the microcontroller; to get began, just plug in an USB port, an AC-to-DC adapter, or a battery. as seen in Fig.5[20].

Fig. 5. Microcontroller chip.

3) Soil Moisture Sensor

By examining the volumetric water content, a soil moisture sensing can be employed to determine the amount of moisture present in the soil. Measurements of the high resistance, dielectric constant, or contact with neutrons are some of the mechanisms needed for the moisture measurement in order to clean the sample and weigh it. As seen in Fig.6[21].

Fig. 6. Soil moisture sensor.

4) DHT 11 Sensor

The popular DHT11 humidity and temperature sensor outputs temperature and humidity values as serial data using an 8-bit CPU and a unique NTC for temperature measurement. The sensor has an accuracy of 1°C and 1% for measuring temperature from 0°C to 50°C and humidity from 20% to 90%, as seen in Fig.7 [22].

Fig. 7. DHT 11 sensor.

5) Relay

An electromechanical device switch is known relay. It is composed of a number of working contact terminals and a set of input port for one or more control signals. With the aid of a microcontroller like an Arduino, or PIC, we may switch (control) AC/DC loads. The 5V relay module's parameters are as follows: Current consumption: 20mA, AC load voltage: up to 250V, DC load voltage: up to 30V, Load current: up to 10A. A typical relay is shown in Fig. 8[19].

Fig. 8. 3-pins relay**.**

6) Water Pump

It is a machine that uses kinetic energy to create a flow of liquid as shown in Fig. 9[24].

Fig.9.water pumb

B) Thingspeak Cloud Service

Thingspeak is an "Internet of Things" (IoT) platform that allows you to develop your own apps for remotely controlling particular devices. We need to transmit some data in real time in order to read values from Thingspeak. To do this, I am sending humidity and temperature as input information and the servo motor operations as system output data. The Thingspeak uses ESP8266 to inter connect with system. The setting up of the channel is as shown in Fig. 10. An API key makes it possible for us to read from or write to a private channel. When we start a new channel, API keys are automatically created as shown in Fig. 11. This key number is used in code program.

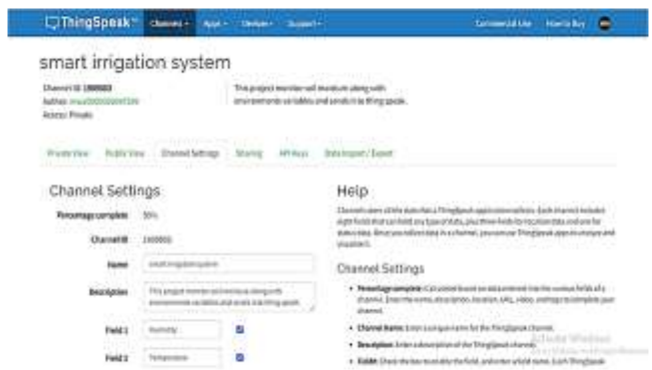

Fig. 10. Channel setting of thingspeak.

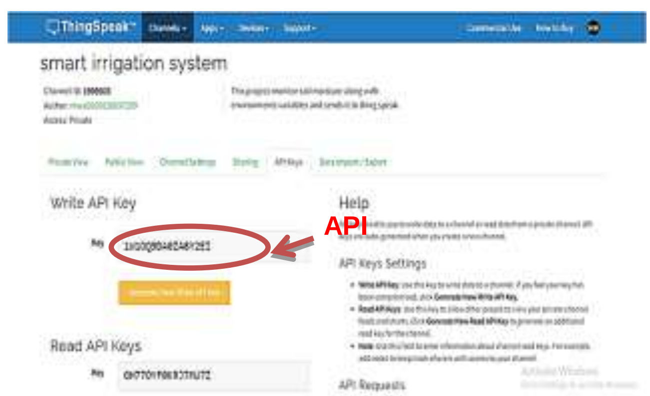

Fig. 11. API key of thinspeak.

C) Programming

The most of well-known embedded systems, including ESP8266, , Arduino, SparkFun, and Raspberry Pi are supported via libraries in Thingspeak. The flowchart represents all program in arduino ide for the system, as shown in Fig.12. The experimental design of the smart irrigation system is as Fig.13 with all components.

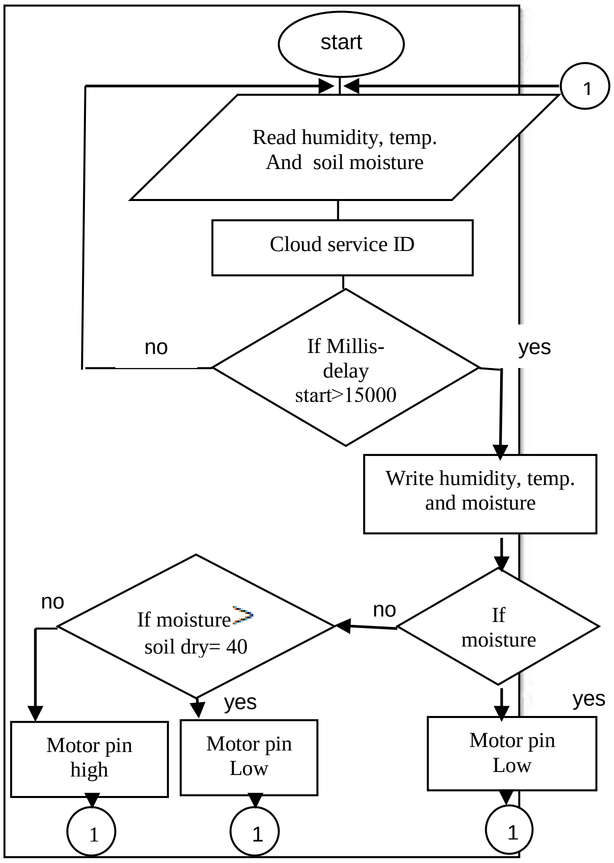

Fig. 12. The flowchart of the design system.

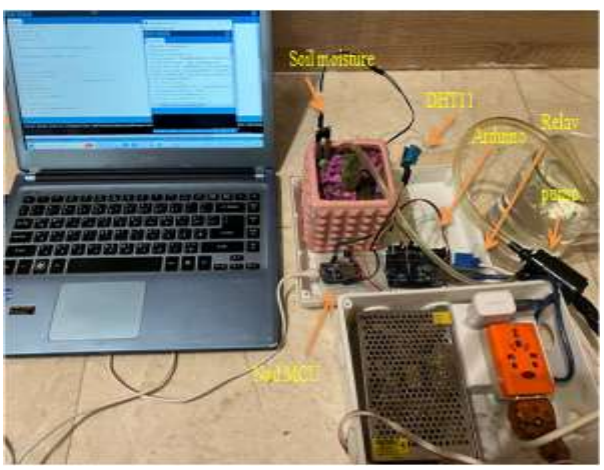

Fig. 13. The experimental of smart irrigation.

3. RESULTS

The sensors receive data in the shape of volt, which is then delivered to the microcontroller. After validating these readings, the microcontroller provides us with the percentage values representing the soil's moisture levels. The Internet of Things (IoT) device continuously transmits data via the Wi-Fi network to the internet website where it is presented on the user's computer. The monitoring thinkspeak cloud application is as shown in Fig. 14, It worked correctly and thus, the microcontroller is sending the Data to ThingSpeak Server i.e., Fig. 14. shows humidity of the weather, Fig. 15 shows temperature of the weather and Fig. 16 shows moisture information of the soil. Data were collected from each sensor node at real-time information about the environmental conditions of the sample plant. The agriculturalists will be able to increase agricultural yield and conserve water by using this device model. For plants, the continuous monitoring of the 24-hour information is for rainfall pattern, temperature, soil moisture and humidity.

It was discovered during the test that the relay was not functioning with the Node-MCU, thus for actuating we are using an Arduino Uno. It was confirmed that the data is sent to the server each 10 seconds, and the same has been verified in serial port. The graph below, referred to as Fig. 14, shows the humidity measured by the DTH11 sensor.

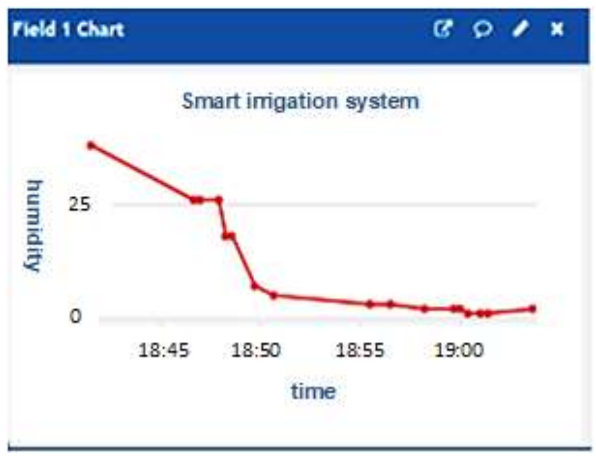

Fig. 14. Thinkspeak cloud server response for humidity with time.

Similarly, the temperature measured by the DTH11 sensor at several times i is depicted in Fig. 15 below.

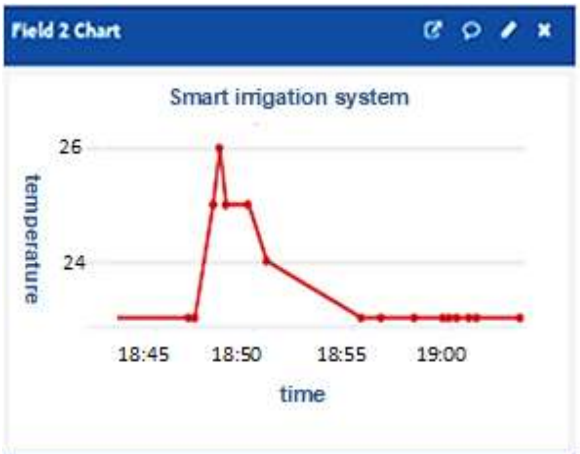

Fig. 15. Thinkspeak cloud server response for temperature with time.

Fig. 16 shows a graphic representation of the moisture in the soil status as measured by the soil moisture devices. After that the conditions require Arduino microcontroller decision for flowing the water, when the soil wet is less than 40%, the motor automatically is turn ON and when soil moisture reading is upper than 40% the motor automatically is turn OFF.

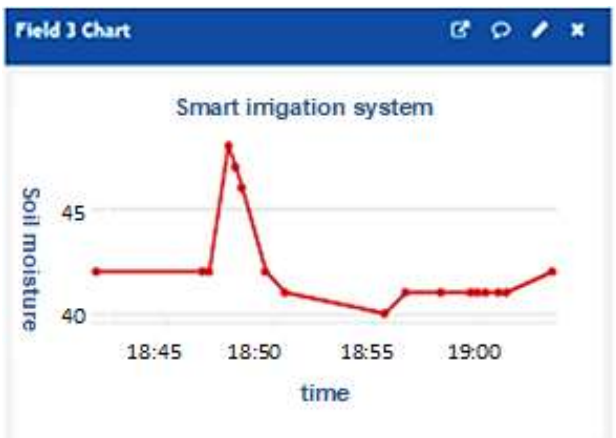

Fig. 16. Thinkspeak cloud server response for soil moisture with time.

Table 1. Comparator with other systems.

NO.	Comparators		
	System specifications	Cloud system	Another systems
1	Accuracy	excellent	Good
2	Real-time data	yes	Yes
3	Dynamic	Contain relay for controlling water flow	Depend on drip
	Sensing	Good response	Good response
	Cost	low	Low
	Monitoring	with mobile or laptop by Wi-Fi and cloud application	Not connected

4. CONCLUSION

We were able to develop a net in ThingSpeak and figure out how to connect it to a NodeMCU through the project in order to send environmental data to a webpage at predefined intervals. The controlled irrigation systems currently in use do not allow for the variety of agricultural tasks that the novel irrigation technique presented in this study does. A device like this also allows growers to save energy that would otherwise be wasted. Since the activity is mechanized, the farmers' main responsibility is to watch the automated system. Field installation is no longer a problem thanks to the device's tiny size, low cost, and ability to connect to the web via WI-FI. The proposed system just needs access to a water source so that it can draw water from it to completely automate the irrigation of agricultural plants. One merely needs to connect to the internet unless they wish to maintain track of the statistics for the plant and the surrounding environment. The system's peripheral sensors and devices only require a very little amount of power. We plan to perform a thorough investigation of increased production and water conservation during extensive cropping in the future. This type can be powered by the sun's energy, which helps to reduce the carbon footprint issue while also enabling total independence from traditional forms.

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