Remote Access of Irrigation System using Cloud-Technology: Smart Irrigation

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Abstract

Smart farming is a type of technology that focuses on allowing agricultural businesses to utilize advanced technology – such as smart sensors, the cloud, and the internet of things (IoT) to measure, monitor, automate, and analyze activities. Precision farming is another term for smart farming. Software controls it, and sensors keep an eye on it. Smart farming is becoming increasingly important as the demand for higher crop yields, the need to use natural resources efficiently, the increasing use and sophistication of information and communication technology, and the growing need for climate-smart agriculture all contribute to its rise in importance. In this paper, a smart irrigation system is demonstrated utilizing the Node MCU and the Internet of Things with cloud technologies. Online Adafruit IO Cloud Service is used for cloud services.

Keywords: *NodeMCU, Cloud, IoT, Smart Irrigation, sensors, relays*

1. Introduction

In this era due to global warming scarcity of water is one of the most pressing issue in today's world. Agriculture is one field that requires more water. In agriculture, water waste is a big problem. Water is provided to the fields when there is an excess [1]. Due to this we require a system that uses water wisely. To manage an irrigation system, smart irrigation systems estimate and measure the loss of existing plant moisture, restoring water as needed while limiting excess water use [2]. In India, where agriculture accounts for 60-70 percent of the GDP, there is a pressing need to modernize traditional agricultural practices in order to increase output. There are numerous strategies for reducing or controlling water waste in agriculture. The use of a wireless sensor network (WSN) for irrigation management has proven to be beneficial in terms of water conservation. WSN, as the name implies, is a network of sensor nodes that interact directly with the environment and offer real-time data that can be used to identify farm areas in need [3]. The project's primary goal is a) Energy and water resources should be conserved b) detection of the soil moisture level automatically c) controlling the irrigation system from a remote place. In India, irrigation is typically accomplished by canal systems, in which water is pushed into fields at regular intervals without regard for the water level in the field. Crop health and agricultural productivity are both affected by this form of irrigation. To optimize water consumption for agricultural crops, an automated irrigation system is required. In locations with high evaporation, inefficient irrigation water management leads to increased soil salinity and a deposit of harmful salts on the soil surface [4]. This suggested irrigation system focuses on conserving water resources by watering crops only when they are needed, and it is implemented using moisture sensors in the fields. Based on the weather and the moisture level of the land, this device intelligently adjusts the water flow and irrigation. It lowers the expense of maintenance, and it's more suited to the complexity of high-yield crops. Moisture sensors, soil sensors, energy harvesting systems, and

NodeMCU are among the subsystems in the system. This system can be controlled manually from a remote place using cloud technology.

2. Literature Survey:

Jagadeesh. et al in 2015 proposed a system in which they developed a project that uses a moisture sensor to autonomously adjust water delivery in water-scarce places. The research discussed the use of wireless sensor networks to implement a sensor-based irrigation system that employs renewable energy as a source. Wireless Sensor Networks are used in that system. It contributes significantly to the environmental monitoring system and provides unattended watering. Moisture sensors, energy harvesting systems, integrated controllers, and super capacitors are used as storage devices in the WSN [5].

Pernapati. et al in 2018 proposed IoT based irrigation system in which the ESP8266 NodeMCU Microcontroller is connected to the soil moisture sensor, humidity and temperature sensor, an ultrasonic sensor, and the sensors communicate from the respective positions to the NodeMCU. The analogue data received can be processed by the controller and then sent to receivers end through an MQTT server, such as a web server or a mobile device. The Microcontroller receives inputs from the different sensors. A relay was used to connect the water pump. Temperature and humidity readings are sent to the end-user. The moisture sensor detects the amount of water in the soil, and the water pump kicks in when the amount of water in the soil drops [6].

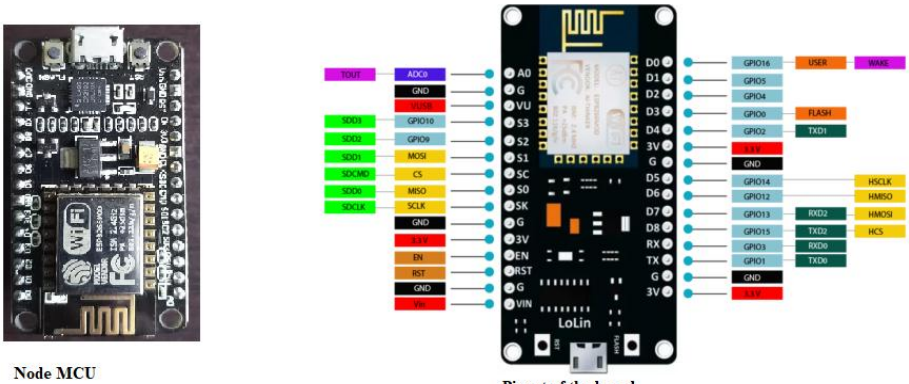
Srishti Rawal in 2017 suggested an irrigation system using IoT [7] in which the system consists of both hardware and software components. The embedded system is the hardware component, whereas the software component is the PHP-based webpage. The webpage is accessible through the internet and consists of sensor readings.

In 2014 Roy. et al proposed a system to create self-contained irrigation systems that modify daily irrigation depths to plant needs based on daily climate conditions PLCs can directly assess temperature, total radiation, and total wind, and then change the irrigation schedule to the recorded conditions, resulting in a reasonable reduction in irrigation water use. As a result, the goal of this project is to create a low-cost irrigation controller which adapts to everyday climate circumstances without the use of expensive sensors or weather stations. It must also be dependable and simple to deploy in order to perform in severe outdoor environments without the need for constant supervision or monitoring [8].

Tyagi. et al in 2017 proposed a model in which the Arduino microcontroller is used in the Smart Irrigation System. This prototype keeps track of moisture in the soil. Soil moisture is fixed at a predetermined level that can be adjusted as crops grow. The watering system is operated based on the soil moisture falls outside of the specified range. If the soil is dry, it will start the irrigation system, which will pump water to the plants [9].

3. Hardware Requirements:

3.1 NodeMCU



Node MCU

Pinout of the board

Figure 1: NodeMCU and Pinout (Source: www.theengineeringprojects.com)

The NodeMCU (Node Microcontroller Unit) is an open source software and hardware development, which is low-cost System on Chip (SoC). Espressif Systems designs and manufactures ESP8266 which features all of the required components of a modern computer, which includes CPU, Wi-Fi, RAM, operating system and SDK. It includes an ESP-12 Wi-Fi module with 6 additional GPIOs, a Micro USB connector for programming, debugging, and power, and a 15-pin header with access to UART, ADC GPIOs, SPI, and power pins. It costs □ 209 - □ 345 in India. Fig 1 shows NodeMCU and its pinout on the board. We can read inputs from many points like sensor, button or twitter post and turn them into outputs - turning on an LED, triggering a motor, or publishing anything online - using its pins. It also has Wi-Fi capabilities, allowing us to control it wirelessly and easily set it up on a remote site. By delivering a set of instructions to the board's microcontroller, we can tell it what to do. We can do this by using the Arduino Software (IDE).

3.2 Soil Moisture sensor

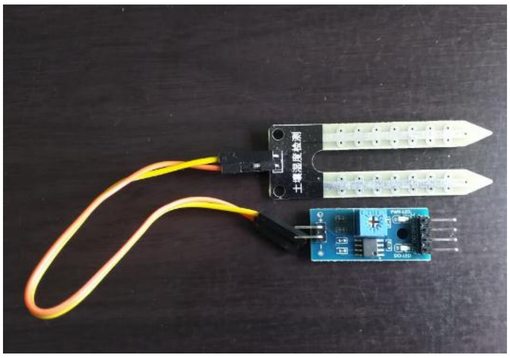


Figure 2: Soil Moisture sensor

Soil moisture is an important component in the irrigation field as well as in plant gardens. A moisture sensor determines the amount of moisture in irrigation field [10]. Soil moisture sensor is a sensor that is used to determine the water content inside the soil. Capacitance is the primary method used by this sensor to determine the water content of the soil. This sensor can be utilised by embedding it in the ground, and the status of the soil's water content can be expressed as a percentage. In this project, a moisture sensor like the one illustrated in figure 2 is employed.

3.3 IR sensor

Figure 3: IR sensor

An infrared sensor is a light-emitting electrical gadget that detects objects in the environment. An infrared sensor can both detect motion and measure the temperature of an object. These sorts of radiations are invisible to our sight, but they can be detected by an infrared sensor. The following components make up an infrared detection system: an infrared source, infrared detectors or receivers, a transmission channel, an optical component, and signal processing. Infrared lasers and infrared LEDs with specific wavelengths are examples of infrared sources. The IR sensor used in the project is as shown in the figure 3.

3.4 12C Module

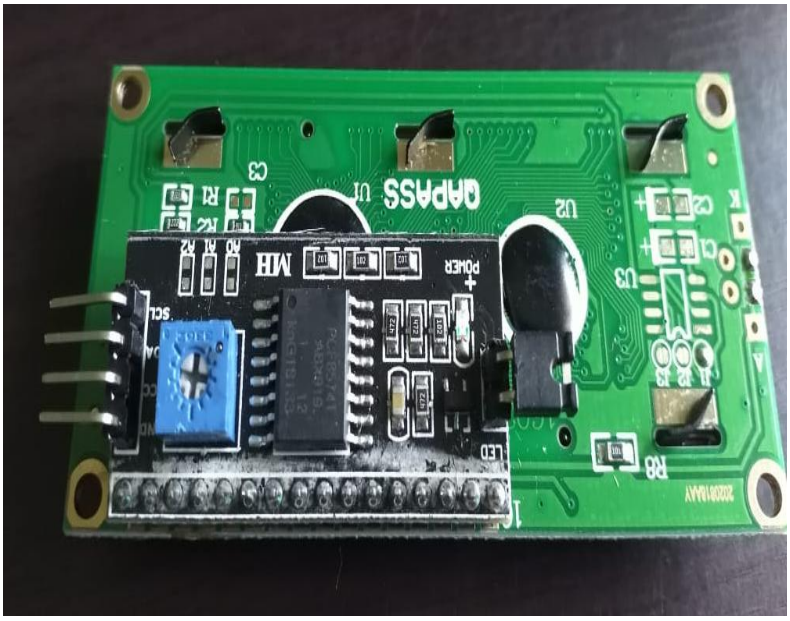


Fig 4: 12C Module

An I2C Interface Adapter Module is utilized for the 162 LCD Display. It employs the PCF8574T IC chip to convert I2C serial data to parallel data for the LCD display. This interface module also makes it easier to connect an Arduino to a 162 Liquid Crystal Display with just four cables. Fig 4 shows the picture of 12C module used in the project.

3.5 LCD

Figure 5: LCD

LCD is a Crystal Display, which is a flat panel display used in computer monitors and televisions, smartphones, tablets, and other mobile devices. LCD 16 X 2 is a type of electronic display device that shows data and messages. It has 16 columns and 2 rows, allowing it to display 32 characters (16x2=32). The total number of pixels in this LCD is 32 x 40, i.e. 1280 pixels. There are other sorts of displays with various sizes available on the market, but the LCD 16x2 is widely utilized in electronics. Figure 5 shows the LCD used to display the content.

4. Proposed System:

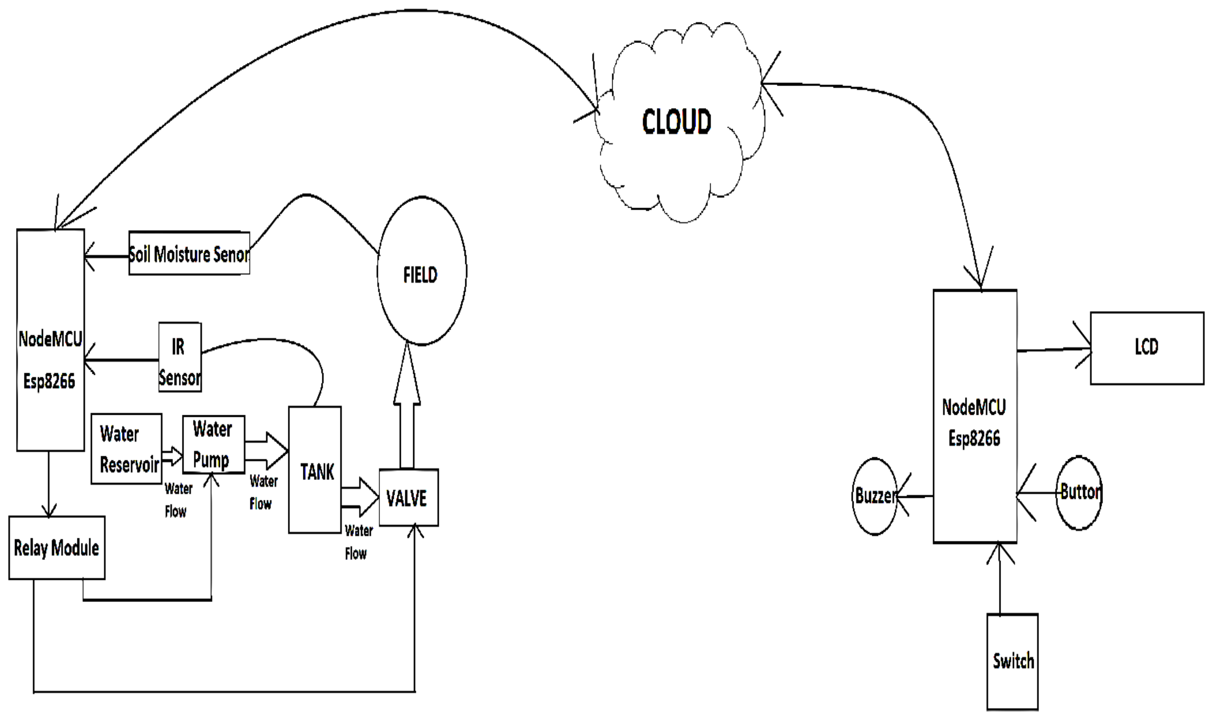


Figure 6: Architecture of proposed system

As shown in the Figure 6, two NodeMCU microcontrollers communicate with each other over the cloud in this example. It is equipped with the Esp8266 Wi-Fi Module chip, which enables it to connect to the internet through Wi-Fi. We have interfaced the soil moisture sensor, IR sensor, and relay module with the first NodeMCU, which has the responsibility of receiving the readings from the sensor and providing the needed action accordingly. A water pump is linked to channel 1 of the relay module, and a solenoid valve is attached to channel 2. The water pump will start and draw water from the reservoir and deliver it to the tank, where a solenoid valve opens and closes according to the soil moisture level threshold we specified. So, if the soil moisture level is low, the valve will open, allowing water to flow to the field; but, if the moisture in the soil is sufficient, the valve will close, allowing the tank to fill; thus, the valve's opening and closing are linked to the value provided by the soil moisture sensor. The second microcontroller is connected to an LCD module that shows if the water pump is on or off, irrespective of the valve status and whether the tank is full. A switch is also connected, which will transfer data of ON or OFF to the relay module's channel where the water pump is connected, as well as display its status on the LCD panel. There is a buzzer that will sound if the tank is full, so the first nodeMCU will take the IR sensor value and send it to the cloud, where it will be received by the second nodeMCU, who will then show it on the LCD screen. There is also a button switch that, with each switch press, changes the display on the LCD to indicate the status of different modules at the same time.

5. Block Diagram:

5.1 First Module

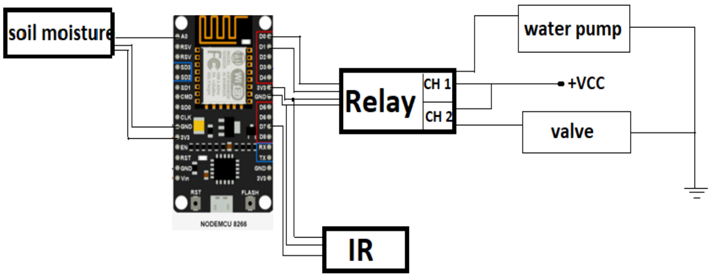


Figure 8: block diagram of first module

5.2 Second Module

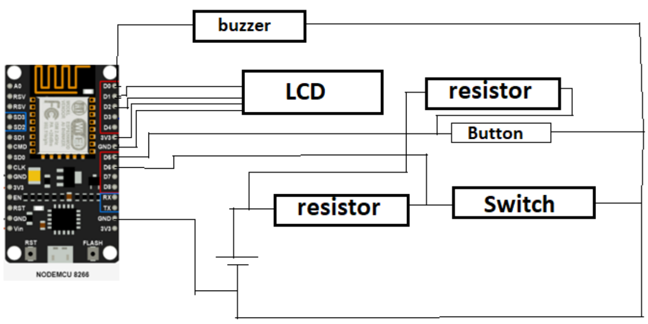


Figure 9: block diagram of first module

6. Limitations:

In the proposed system we are pumping the water from the reservoir, but we need to check the availability of water in the reservoir. If the reservoir does not have water say during summer seasons then the overall setup will not work. Secondly in order to operate the system, we are depending on the internet, hence this system will work effectively only when we have proper network connectivity. In the country like India, Network connectivity issues are more in rural areas.

7. Conclusion:

In traditional irrigation systems, the farmers manually operate and regulate the irrigation system. But the traditional procedures take more time and require more water. A healthy plant requires constant watering, and the automatic system aids in obtaining accurate results in this regard. A smart irrigation system is one of the greatest solutions that produces more in less time. This smart irrigation system is created and fully automated to reduce manual handling in agriculture to a large extent. It can correctly determine soil moisture levels with the help of the sensors. Sensors can readily detect and control temperature, humidity, and sun radiation. Farmers will be quite comfortable with the concept of IoT and sensors for smart irrigation. It can assist them in learning how to deploy various sensors and how to use their data to generate events and operate irrigation systems. This type of irrigation system in agriculture provides farmers with better time convenience, utilization of water in the best way possible, controlling the irrigation system from the remote place. The amount of power required to operate the hardware components used here is low hence the cost of implantation will also be less.

8. Reference:

8.1. Journal Article

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