IoT Based Smart Irrigation System

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***Abstract*— In the agricultural sector, an intelligent irrigation system is built up of various hardware tools and software programs that employ various technologies. Technological innovation related to machine learning is important in research. It is an approach to data analysis that learns a variety of approaches and builds models that extract information from datasets. The study evaluates the effectiveness of used methods and aids farmers in customizing an appropriate system to meet their needs. Through the use of soil monitoring parameters such as soil humidity, temperature of the soil, and ambient variables as well as online weather prediction data, this work proposes a freely available automated system that can estimate a field's irrigation demands. Internet services and an online user interface that have been developed and implemented on working model dimensions are used to wirelessly gather all of the sensor node's information via the cloud server.**

***Index Terms*— Intelligent Irrigation, Arduino Uno (R3), Soil Moisture Sensor, DHT11 Temperature Sensor, Android Application.**

I. INTRODUCTION

All industrialized nations rely heavily on agriculture. Agriculture consumes 85% of the freshwater resources that are accessible on a global scale, and because of population expansion and rising food demand, this percentage still represents the majority of water consumption. As a result, in several dry and semi-dry agricultural systems, effective use of water is a significant difficulty. A smart irrigation system is necessary to optimize water use for agricultural crops. An automated irrigation system's objective is to prevent both oversupplies of water and low supply of water. Water contamination results from ineffective wastewater management or distribution. Irrigation raises soil salinity in areas with significant evaporation, which causes a buildup of dangerous salts on the soil's surface. A clever irrigation system was put in place as a solution to these problems and to minimize manpower.

A. Motivation

The entire amount of water accessible on Earth has been calculated to be 1.4 billion km3, which is enough to cover the globe with a 3 km3 layer. The oceans contain approximately ninety-five percent of the Earth's water, which is unsuitable for human consumption. Approximately 4% is trapped in the polar ice caps, while the remaining 1% is all clean water that exists in streams, rivers, and lakes that is appropriate for human use. According to one survey, the average Indian uses 135 liters of water every day. By 2025, this consumption would have increased by 40%. This represents the importance of preserving our fresh water supplies.

B. Objective

- To develop a significantly inexpensive and stable water supply regulator achievable by utilizing as few resources as feasible.
- Evaluate the architecture of control unit and its properties.
- To compare the controller to traditional controllers on the market and determine the positive impacts of the proposed one over the alternative.
- To provide any ideas or enhancements that might contribute to the controller's future development.

The water level regulator suggested in our idea is based on two oxygenated hydrocarbons sensing sites. At both of these locations, the water supply must be managed. We employ sensors to make this possible. These sensors in our case are metallic connections having gap separating them at each detecting location. Whenever water level approaches a sensor's surface, an appropriate circuits needs to be provided to detect the existence of water and generate a signal. To provide the right actuator output, this signal must travel via logic circuits. It must also be powerful enough to trigger the actuator. When water hits another sensor, a similar process must occur.

II. LITERATURE SURVEY

[1]The authors presented a paper wherein soil moisture and humidity detectors are positioned in the root region of a plant. The microcontroller is utilized to manage the flow of water to the location according to the measured data. The farmer is not informed using this method of the condition of the field. [2] In order to acquire a good yield from the soil, a study is provided in which soil factors including pH; humidity, wetness, and temperature are monitored. This completely automated device regulates the motor pump's ON/OFF status based on the amount of soil moisture.

[3] This paper proposed an analysis that involves the system harnessing solar energy using solar panels. There is no reliance on electricity in this method. The motor pump was turned on and off depending on the detected values using the soil moisture sensor and a PIC microcontroller. This method does not include weather forecasting. [4] All operational issues will be resolved by the suggested Arduino and GSM automation solution. According to the sensor readings for soil moisture, temperature, and humidity, the GSM transmits an alert to the user. The amount of nutrients in the soil cannot be determined by this plan.

[5] According to the study, an automated irrigation system could sense the humidity and temperature of the soil and regulate the water flow based on that information. GSM is going to alarm the farmer. The amount of nutrients in the soil is not monitored by this plan. [6] A vital component of any nation's GDP is agriculture. Every nation's economic foundation is built on it. Numerous problems have been found in this field. The lack of water resources for both the present and future generations is the most important problem. It is essential to use certain cutting-edge methods in order to preserve the water. The most noticeable feature is sending all of the information to the landowner's Smartphone application using the Wi-Fi Relay Adapter and Arduino UNO R3.

III. CONNECTIVITY AND COMMUNICATION

The hardware utilized for information sensing includes DHT sensors and soil moisture sensors. The DHT detector measures the degree of heat and moisture levels. The soil moisture sensor is used to measure moisture concentrations. A Wi-Fi module with the name of NodeMCU is employed to link to a wireless connectivity network, and communication is carried out through the internet. It has an internet connection and communicates with Arduino, the cloud, and both. The dashboard on the website serves as a representation of the temperature, humidity, and temperature levels.

Cloud Service: Any service that is developed and provided by a cloud-based computing server instead of an organization's local servers and made available to consumers on demand through the Internet is referred to as a cloud service. Access to managed apps, resources, and services is made simple and scalable by the cloud service provider (CSP). ThingSpeak, an open cloud service specifically created for IoT experiments and cloud deployment, is the cloud service that is being used in this article. Application Programming Interface (API) and a (RESTful) are provided by ThingSpeak for transferring data from an Arduino to the cloud and from the cloud to any other retrieval device, such as this website.

IV. PROPOSED SYSTEM

These days, agriculture is facing several difficulties as a result of water shortage. Farmers have been helped by the use of intelligent irrigation systems to overcome their difficulties. This system's transmitter module, as shown in Fig. 1, is made up of a temperature-humidity sensor and a soil moisture detector both are connected to the MCU. The microcontroller is connected to the internet using the Esp8266, which functions as a Wi-Fi module. A channel is built using ThingSpeak, an available Internet of Things (IoT) application. The API key provided by ThingSpeak is used to upload information from sensors to the server and maintain it in the designated channel and fields. The microcontroller gathers the sensor readings and uses the HTTP protocol to send them over the internet to the ThingSpeak cloud.

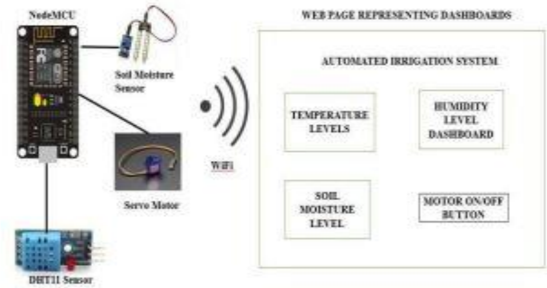


Figure 1: Proposed system

A. *Working of Water Level Controller*

After the system has been put together, all that is left to do is watch how it functions. This may be achieved by segmenting the controller's activities into determining the presence of water and pump operation. We discuss the results received when water contacts the sensing devices and the reasoning used to produce them.

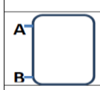
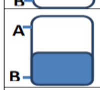
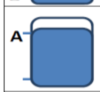
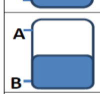
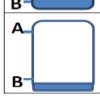
Water Level	Input Signal A	Input Signal B	NAND Output	555 timer output	NOT gate output	Pump State
	1	1	0	0	1	1
	1	0	1	0	1	1
	0	0	1	1	0	0
	1	0	1	1	0	0
	1	1	0	0	1	1

Figure 2: Truth table for water level controller

We positioned metallic connections at the OHT's top and lower halves. A signal current flowed whenever water filled the space between them, closing the adjacent circuit. A NAND gate received these inputs and generated the output signal Q.

The 555 timer integrated circuit received a reset signal from this signal Q. Additionally, signal A was sent into the 555 timer IC's Trigger input. To obtain the necessary signal for regulating the pump, the timer's output was routed through a NOT gate. A BJT was then used to magnify the output of NOT thus rendering it powerful enough to turn on the relay. The relay was used to turn on the pump, and water was supplied to the overhead tank.

V. EXPERIMENTAL RESULTS

Figure 3: Complete experimental setup

The intelligent system for irrigation is a straightforward IoT-based approach. It is made up of an IoT device that aids in the real-time updating of data in the system and a cloud website that serves as the user interface. The Internet of Things handles all the background tasks. The Internet of Things (IoT) device is linked to several sensors, which gather data on a variety of features of a plantation field and transmit value to the IoT device. The Wi-Fi ESP8266 module and Arduino UNO IoT Device utilized here assist in connecting the system to a wireless network.

Through this network developed with the Wi-Fi ESP8266 module, the data gathered in the Arduino UNO device via the temperature detector, moisture level detector, and humidity detector is communicated and recorded in ThingSpeak. The sensor measurements allow us to determine if irrigation is taking place or not. The sensor that detects moisture sends an indication to the Arduino Uno if the amount of moisture is determined to be below the acceptable level; this causes the water pump's motor to turn ON and automatically deliver water to the plant. They upload the values they record to the cloud. The ThingSpeak is then updated with the new status data. Gardeners and farmers who lack the time to irrigate their fields are the ones to have more benefits from the work.

VI. ADVANTAGES AND APPLICATIONS

- Maintenance: Since it lacks intricate circuits and sensitive mechanics, it is a system that requires far less maintenance than traditional systems. This avoids paying for further maintenance.
- Cost: The water level controller's major benefit is that it is far less expensive than the standard

models seen in stores. As an illustration, some commercial controllers employ microcontrollers, each of which costs around Rs. 800. Even some controllers are priced between Rs. 2000 and Rs. 4000. However, the parts employed in our system are fewer in number and more widely accessible. As a result, there will be fewer losses, which will improve efficiency.

- A water level regulator is incredibly easy to build because it only needs a few parts.
- The water level controller system is easier to make at home than the ones that are typically available since it is less complex. Anyone may simply use the controller as well.
- Last but not least, capacitive sensors along with microcontrollers are primarily used in market-available conventional controllers. Both the price and the system's complexity rise as a result.

A. Applications

- The advanced irrigation system may be used in plantations, greenhouses, vineyards, and agricultural areas.
- Both sprinkler irrigation systems and drip irrigation systems may be linked to it.
- Additionally, it may be utilized in small backyard gardens and parks.
- Additionally, the user may receive real-time data from it. Commercial crops like sugarcane, tobacco, and other such crops may be grown using the technique. It may be used for potted plants and indoor gardening as well.
- Giving the crops the necessary quantity of water and preventing overwatering, it would aid in water conservation. The irrigation system will be automated, reducing the need for manual labor and increasing efficiency.

VII. CONCLUSION AND FUTURE SCOPE

When creating a smart irrigation system, it's necessary to take the soil's moisture level into account. A number of meteorological variables, such as environmental temperature, humidity in the atmosphere, ultraviolet radiation, temperature of the soil, and others, have an impact on soil moisture. Thanks to technology developments, weather prediction accuracy has significantly increased, and soil moisture variations may now be predicted using weather projections. As a result, we have built a circuit that relies on the flow of electricity via water. The output of this circuit, which utilizes logic gates, is the centrifugal submersible pump's ON and OFF states.

From a future standpoint, this system may be the more intelligent one that anticipates user behavior, plant nutrition levels, harvesting times, etc. The use of machine learning algorithms will allow for future breakthroughs that will greatly benefit farmers and minimize water use in agriculture.

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