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A Research paper on Auto Controlling Irrigation System Using Arduino UNO

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Abstract: ***The rise in population has resulted in food and water shortages in the modern period. So, in order to avoid this situation, we must promote agriculture. Water loss, on the other hand, is more typical in this sector, with irrigate logging happening as irrigation is utilized to water agricultural crops. As a result, an automated plant irrigation system for adequate water delivery in the fields must be created. This article discusses a fully automated irrigation system that monitors soil moisture content and determines whether or not irrigation is necessary, as well as how much water the land requires. The Arduino UNO microcontroller is used in this setup. It has been programmed to monitor the soil's moisture content over time. When the moisture content falls below a specified threshold, it will start supplying the required amount of water until the threshold is attained. As a consequence, when the soil is dry, the pump will automatically water the fields; when the soil is moist, the pump will switch off, decreasing the need for personnel and saving time.***
Keywords: Arduino UNO, Irrigation, Moisture.

I. INTRODUCTION

A. *Overview*

The most serious problem in contemporary times is a major setback in the agriculture industry. Material or financial losses are the most common types of losses in agriculture, and the majority of them are

Related to crop health and quality. If the crops are discovered at range, it may result in a loss. So, in order to manage this, we need to ensure that the crops are protected. This is nearly hard for a farmer with big fields to watch and maintain on a consistent Basis. This, however, is currently handled manually. However, because people currently favour basic employment, there is a manpower crisis. As a result, automation will become a crucial component of the future. The most common reason of crops that aren't doing well is excessive irrigation. As a result, this is the area that requires technological upgrades. Farmers will reap enormous benefits from automation. Farmers will benefit from the automated plant watering system since it will make their jobs easier and keep their lands moist. Most farmers throughout the world struggle to keep their crops moist, but they are powerless to do so. Farmers are experiencing a lot of difficulties these days, and their lives are becoming increasingly difficult. Politicians are unconcerned about them as well. They are looking for persons or firms who can assist them in their professions

B. *Aim of The Project*

The goal of the research is to use sensors to detect soil dryness and deliver water to the plants as needed. This project makes it simple to care the plants. We are monitoring soil moisture and the requirement for irrigation in this project.

C. *Review of Related Works*

1) *Wireless Sensor Network with GPRS Module:* During 2014, a system that employed Zigbee technology to establish a distributed wireless network of soil moisture and temperature sensors was developed. In addition, a gateway device processed sensor data, operated actuators, and sent data to the web application. Solar panels powered the system, which also contained a duplex communication link. [1] The system was designed with agricultural methods in mind.
2) *GSM Activated System:* The system is constructed using GSM technology in such a manner that, in addition to basic features, it allows the user to operate the system via SMS. The user replies to the system by sending ON/OFF messages. The user has primary control. It's a semi-automated system [2].
3) *Mobile Application:* For the senior, a smartphone app has been developed. The analogue sensor, database, and android application are all connected using Arduino. The MySQL database is utilised, and PHP connects Arduino to the database. To transfer data to the PHP server, you must utilise the HTTP protocol [3]. The system facilitates effective system monitoring and control.

4) *Automation along with Web Application:* Drasti and her colleagues described a prototype that used an ATmega328 microcontroller in 2016. Moisture sensor and motor/pump are the two working components. If the moisture content goes below a certain threshold, the plant receives the necessary quantity of water. The microcontroller is set to provide water twice a day. In this method, the user is alerted by a buzzer. As a result, scalable, supporting technology [4] has emerged. Data is saved in Arduino IDE software and concurrently delivered to a web browser over Ethernet in another existing work [5]. To regulate water flow for hectored, sprinkler, or drip segment irrigation, a wireless sensor network with an integrated DTMF (Dual Tone Multiple Frequency) signalling mechanism is employed. [6].

D. Proposed System

This project is used to identify water scarcity in soil only based on data supplied by sensors. The most notable benefit of this Automated Irrigation System is that water is only delivered when soil moisture falls below a pre-set threshold value. This technique might be employed in roof gardens in densely populated places where land is scarce and rooftop gardening appears to be the only realistic choice. These technologies can manage the lawns of residences, decreasing the need for human supervision.

The following purposes will be served by the automated irrigation system:

1) A lot of water is saved from being squandered since there is no unplanned water consumption.
2) Irrigation is only utilised when the soil is dry, and sensors decide if the pump should be turned on or off. Farmers will save a significant amount of time as a result of this. Farmers will be able to get some much-needed rest now that they will no longer have to turn the pump on and off manually.

II. PROBLEM STATEMENT

The goal of this "Automated Plant Irrigation System" project is to build an automated irrigation mechanism that detects the dampness/moisture content of the ground and turns the pumping motor ON and OFF. In the farming business, the utilization of appropriate irrigation technologies is crucial. The benefit of employing these systems is that they reduce human intervention while yet assuring appropriate irrigation.

There are three steps to the suggested model: The first step is to determine the moisture content of the ground. The second stage is to determine if it is dry or moist. The final and third level is motor control. To build an automated irrigation system that detects the earth's dampness/moisture content and controls the pumping motor on and off. The benefit of employing these systems is that they minimize human intervention while yet assuring appropriate irrigation.

III. RESEARCH AREA AND DISCUSSION

Farmers in agricultural subjects were unable to utilize their expensive and complex irrigation equipment on their fields. As a result, spreading the low-cost, simpler irrigation system is crucial for improving farmers' livelihoods [7]. The writers of the works listed above examine characteristics like as temperature, humidity, and moisture of soil at a specific region to manage the flow of water. This knowledge is insufficient to accurately estimate the state of a field [8]. As a result, it advocates for the installation of numerous such sensors to continually reflect the status of the soil. [9] WSN may be used to assess the soil's condition. Costly Wi-Fi equipment, such as GSM and GPS, should be avoided, and low-cost ZigBee-based devices should be utilised instead to keep the system's overall cost low. The novel device may be powered by a battery backup in distant areas such as farmland [10]. Low-energy microcontrollers, sensors, and wireless working devices will be used to extend battery life. In harsh situations, it is also vital for battery-powered devices to remain in power-down mode. Climate change may also be addressed in order to improve water management and reduce agricultural water demand.

IV. MATERIALS AND METHODS

A. Arduino UNO

The Arduino Uno microcontroller board employs the ATmega328P CPU. There are 14 digital I/O pins (six of which are PWM outputs), six analogue inputs, a 16 MHz quartz crystal, a USB connection, a power connector, an ICSP header, and a reset button on the board. Everything you need to get started with the microcontroller is included; simply connect it to a computer via USB or power it with an AC-to-DC converter or battery. You may fiddle with your UNO without worrying about making a mistake; if something goes wrong, you can replace the chip for a little fee and start over.

B. Soil Moisture Sensor

Soil moisture is difficult to define since different fields use different terminologies to describe it. For example, a farmer's perception of soil moisture differs from that of a water resource manager or a meteorologist. Soil moisture, on the other hand, is the water that is held between soil particles. Topsoil moisture refers to the water present in the top 10 centimetres of soil, whereas root zone soil moisture refers to the water present in the top 200 centimetres of soil. A soil moisture sensor was used to measure the spores' water content. Soil moisture sensors feature two probes that are responsible for current flow inside the soil and, as a result, aid in detecting resistance values for monitoring spore moisture levels. It is common landscaping practise to supplement rainfall with the use of an irrigation system to keep plants looking their best. Many systems are self-contained: the more complex ones are linked to a climate-based electronic controller and function when weather and evapotranspiration data dictate; the better ones work on a predetermined schedule and are just connected to a clock. Either strategy may demand more water than is necessary to keep the landscape healthy. Agricultural managers have traditionally relied on soil moisture readings to provide a clear picture of when and how much to water their crops.

C. Relay Module

Relay is an electromechanical switch that's controlled by a comparatively bit of current. A little amount of electrical current is also used to manage the switching activity of large electrical phenomena operating devices. High voltages and currents cannot be controlled by the Arduino.

D. DC Motor

A direct current (DC) motor is an electrical mechanism that converts voltage into energy. DC motors transform electricity into mechanical rotation by utilising electrical energy. DC motors use magnetic fields produced by electrical currents to power the movement of a rotor positioned within the output shaft. Because of the motor's architecture, the output torque and speed are still governed by the electrical input.

E. Water Pump

To pump water, this project will use a 12-volt submersible pump with an 18-watt motor that may raise water up to 1.7 metres. For best results, this pump should only be used while entirely submerged in water; nevertheless, we must retain water within the bucket since if the pump is employed without water, it'll be broken.

F. Resistor

A resistor is a passive electrical component that provides resistance to the flow of electricity. They are present in almost all electrical networks and electronic circuits. Resistance is measured in ohms. When a current of one ampere flows through a resistor with a voltage difference of one volt between its terminals, the resistance is measured in ohms. The current is determined by the voltage at the terminal ends. A breadboard may be a circuit card that's wont to prototype electronics projects. For best results, use the 10-k resistor with the sunshine dependent resistor during this project.

G. Breadboard

A breadboard is a surface - mount device used to develop circuits and evaluate circuit designs on a temporary basis. The majority of electrical components in electronic circuits will be linked by inserting their leads or terminals into the holes and connecting them with wires as needed. Metal strips go beneath the breadboard, connecting the holes on the top of the board. A breadboard is a low-cost and simple-to-use piece of hardware for connecting electrical circuits. Breadboards acquire their name from their resemblance to cutting boards for unsliced bread.

H. Jumper Wires

Jumper wires are basic cables with connector pins on both ends that are used to link two locations without the need of solder. Jumper wires are frequently used with breadboards and other prototyping tools to allow for rapid circuit adjustments. Despite the fact that jumper wires exist in a variety of colour’s, the colours have no meaning. This implies that a red jumper wire is equivalent to a black jumper wire. Colours, on the other hand, are used to distinguish between different sorts of connections, such as ground and electricity. In this project, two types of jumper wires were used: male to male and female to male.

I. Power Supply

A device that supplies electric power component that enables electricity to a load. A power supply's primary function is to convert electric current from a source to the proper voltage, current, and frequency to power the load. As a result, power supplies are sometimes known as electric power converters. Some power supplies are stand-alone units, while others are integrated into the load appliances they power. Power supply seen in desktop computers and consumer electronics devices are examples of the latter. Other roles of power supplies include regulating the current consumed by the load to safe levels, switching off the current in the case of an electrical malfunction, and power conditioning to reduce electronic noise or voltage spikes on the input from reaching the load, power-factor adjustment, and energy storage so that the load may continue to be powered in the case of a brief interruption in the source power.

V. SYSTEM DESIGN & ARCHITECTURE

1) This system discusses an automated irrigation system that can provide water to crops as needed and alter the quantity of water provided based on soil moisture content. The sensors measure moisture content by sending an electrical current through the soil and measuring the output resistance. Because water conducts electricity, the output resistance determines the amount of water present in the soil. When the resistance increases, it shows that the moisture content of the soil has reduced.
2) The system's main control system is an Arduino Uno microcontroller. The Arduino is linked to a 4 module, 5V relay. The two solenoid valves and the pump are controlled by this relay. The Arduino is also linked to the soil moisture sensor. The solenoids are supplied with water via a pump that takes water from a reservoir
3) The Arduino receives power from a 5V DC power bank. The relay and the soil moisture sensor both use the Arduino board's 5V DC pass through
4) The system is based on the sensing and actuation concept. The soil moisture sensor, which is coupled to a microcontroller, is used to measure moisture in the soil. After detecting, the sensor offers the moisture content of the soil in that segment. If the percentage goes below 20%, the Arduino sends a signal to the relay, which activates the pump. When water is required, the pump is linked to a solenoid valve, which sends the water to the required area.

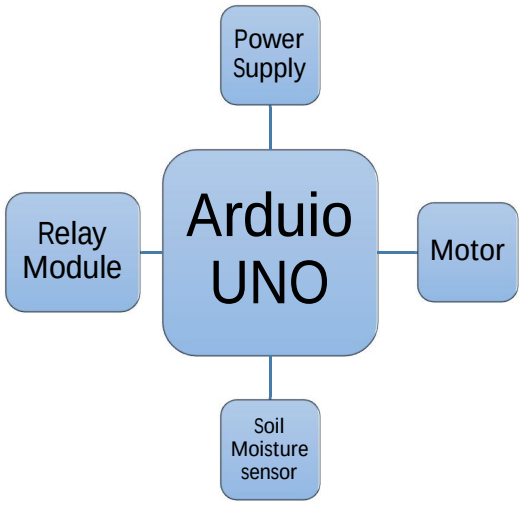

Fig: 4.1 – Block Diagram of Automated Plant Irrigation System.

A. The Procedure for Implementing a Framework

The board in concern is an Arduino UNO. The application can be built from a PC or laptop prior to use. The software is ready to use once it has been compiled.

1) *Step 1:* Install the Arduino UNO board, relay module, power supply, and moisture sensor on the board.
2) *Step 2:* Next, connect all of the relay's and Arduino UNO board's pins.
3) *Step 3:* To monitor the plant's water content, a moisture sensor is also added to the UNO board.
4) *Step 4:* In this phase, the motor is connected to the relay.

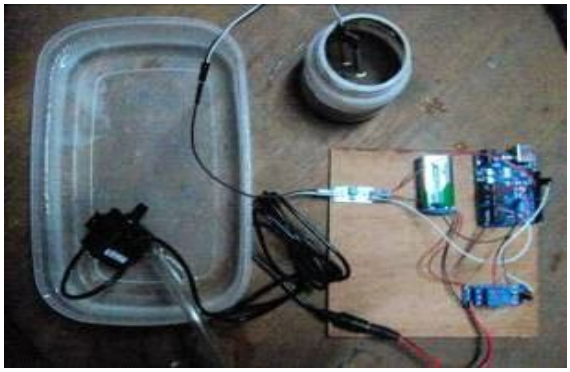

Fig: 4.2 – Automated Plant Irrigation System

VI. ADVANTAGES OF AUTOMATED PLANT IRRIGATION CONTROL

A. Prevents Disease and Weeds.

Drip irrigation systems, as opposed to showering the entire garden like a conventional deluge, send water to each plant's root ball. As a result, nearby weed seeds will not germinate, requiring less weeding. Standing droplets on the leaves produce leaf diseases, which are prevented by water at the roots. Blight diseases have no chance of spreading because the water does not come into contact with the leaves or flowers.

B. Saves Water and Time.

Mostly in beginning, watering by hand with a hose or a watering can takes a long time. Evening watering procedures take time away from family and work. Drip and sprinkler are both effective. Irrigation systems contain timers that may be set to water on a daily or weekly basis, allowing you to save time and money. There's no need to keep an eye on the watering because the timer cuts it off when it's done.

Has been completed. If your irrigation system is working properly, your water cost should be reduced.

C. Maintains soil structure and nutrients.

Irrigation with a fully open garden hose may cause the soil to absorb an excessive amount of water. As a result, nutrients leach off with the water runoff, making less nutrients available to the plants. When you irrigate with a hose, the earth may become compacted as well. With stifling, compacted soil, plants may exhibit indications of wilting or root disease. Smaller droplets are produced by drip or sprinkler watering, which helps to maintain nutrients and reduce soil compaction.

D. Gardening Flexibility.

You'll like to be able to work in the garden while the plants are being watered if you have a busy schedule. You can plant and trim in one garden patch while another is being watered.

E. Low Cost and Maintenance.

The System implementation is very low and also it is cheap for maintenance so this system is well-suited for farmers.

VII. CONCLUSION

Although it appears to be more demanding and difficult, there are a range of different options, such as the so-called "Internet of Plants," which consists of complicated linkages of plants of related types. Using a large number of sensors is also an experimental endeavour, but there are many more experimental and challenge-like notions, such as using solar power or a timer to set up an irrigation system and so on. Regardless of how it was built, there is little doubt that this system may be quite useful in a variety of situations. Tackling a wide range of issues, from seemingly innocuous issues to those that are among the most critical and detrimental to the human population. Using this approach, it is feasible to regulate the amount of water emitted from the process of watering the plant. This system automation is meant to assist farmers, Terrace-farming and small Vegetation farms. Although it has the potential to benefit mankind as a whole, agriculturists, craftspeople, and botanists may profit the most from it.

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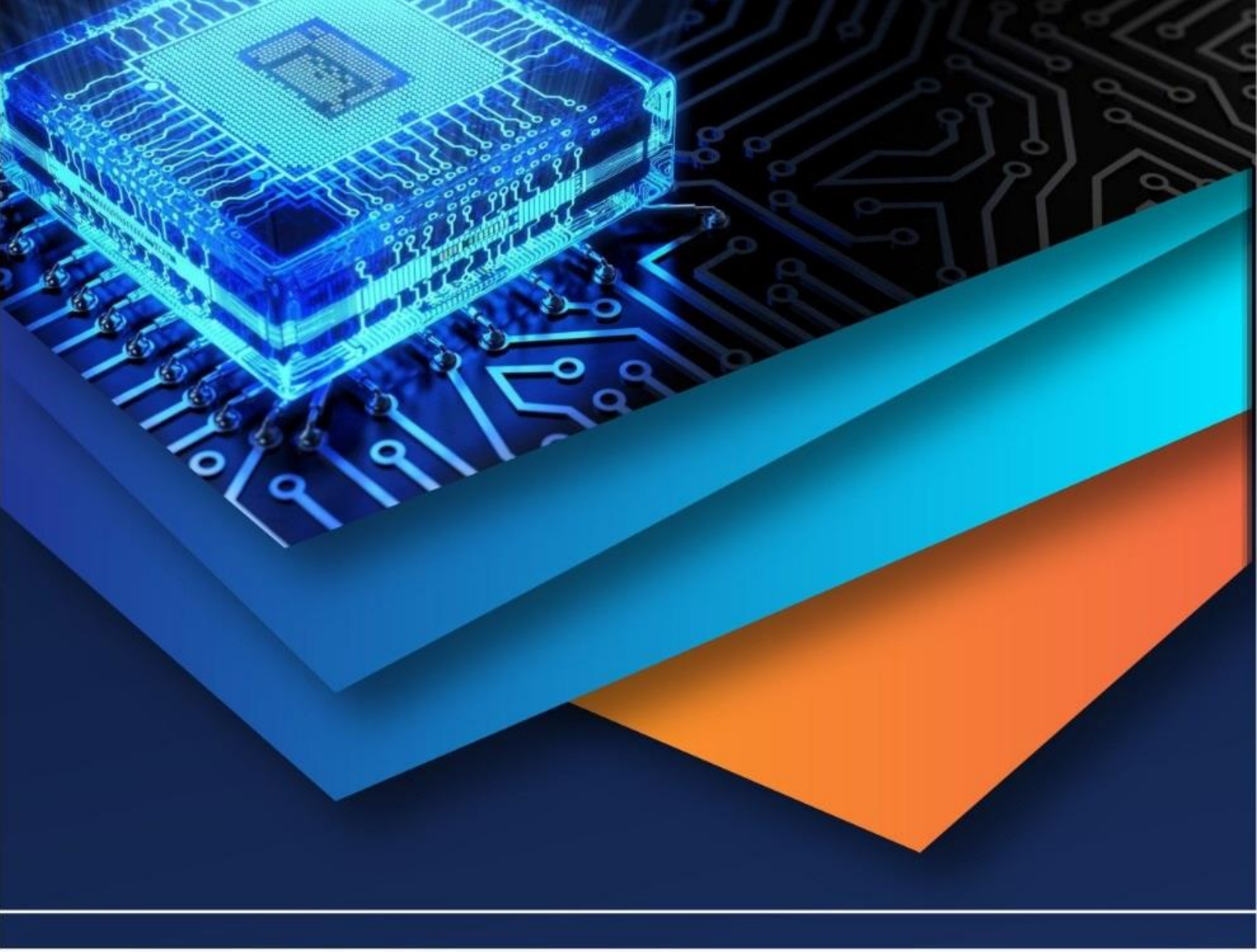

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