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Smart Plant Watering System using IOT: Arduino UNO-based Solution

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ABSTRACT: Many people are cognizant of the many ways in which plants are highly valuable to people. Among the most ex-pensive daily tasks related to planting is watering plants, whether they're in in gardens or at home. When they frequently forget supplying sufficient water to their plants in the thick of everyday duties, lots of people find it difficult to maintain their gardens. The deployment of modern irrigation technology allows for the efficient and controlled treatment of plants. This project uses an Arduino Uno, an LCD display, a relay module, and a breadboard to demonstrate an automated plant watering system with little assistance from humans, the modern technology is made to guarantee ideal soil moisture levels and healthier plant growth. Arduino controller receives real-time data from a moisture detection device that continuously measures amount of moisture in the soil. The Arduino triggers a relay module, which in turn drives a water pump to irrigate the plants, when humidity drops below a pre-set threshold Users can get real-time contribution to soil moisture levels and system condition from the liquid crystal screen. By avoiding overwatering this automated method not only saves water but also reduces the time and labor needed for manual plant care. The deployment of modern irrigation technology allows for the efficient and controlled treatment of plants. The planning and execution of an automatic drip irrigation systems to plant powered by an
Arduino is examined in this paper.

KEYWORDS: Arduino Uno, Relay module, Soil Moisture Sensor, Water pump.

I. INTRODUCTION

In order to make sure that plants get the right amount of water to grow, plant irrigation systems are crucial tools. The plant requires regular breeding procedure, such as watering along with a sufficient amount of direct sunlight, To be capable survive and thrive You want to have control on how much water gets to your plants, regardless of the weather—whether it's too hot and dry or too cloudy and damp. Long-distance passengers find challenging whenever they've got gardens or other plants in their houses. To efficiently manage plant hydration an Arduino microcontroller, soil moisture, and a relay module are integrated in an automated watering system. The Arduino receives data from the moisture sensor, which detects the soil's water content. After evaluating this data, the Arduino compares it to a pre-set moisture threshold. The Arduino triggers a relay component, which in turn drives a water pump to supply the plant, if the level of moisture falls below the threshold, The Arduino disables the switch on the relay then shuts the pump when the soil reaches the right moisture level. This machinery makes sure that plants get the exact amount of water they want in the ideal time promoting healthy growth while limiting overwatering and water waste. Through its reasonable cost, scalability, and user-friendliness, It might be utilized in several applications, spanning from commercial landscaping and agricultural areas to backyard plants and greenhouses. Those connected to missing a computerized mechanism for watering plants include uneven and ineffective watering, laborious maintenance, and a greater chance of human error that may end in overwatering or under watering. In addition, hand watering can lead to uneven water distribution, stress on plants from their surroundings, and difficulties in monitoring and adjusting care for various plant demands. These challenges may impair plant health and inhibit growth and yield.

II. RELATED WORK

In [1], "Automatic Plant Watering System" By, M. Mayuree,P. Aishwarya and A. Bagubali, uses GSM module, Arduino, moisture detector, and water level indicator. In this present work an automated irrigation system with a 6V pump driven by an L293D motor driver and an Arduino linked to a soil moisture monitor is discussed. The probe of soil moisture gauge, which is positioned near the plant roots, measures the soils' conductivity to ascertain the moisture content. The sensor's output pin turns high when the soil gets dry, which turns on the pump that waters the plant. The sensor's output pin stays low in wet soil, which prevents the pump from operating. When the surface is sufficiently

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irrigated and the The tank's water level is low, the system's GSM module alerts the user through SMS, urging them to top off the barrel. The driver's purpose is to provide enough power.

In [2], "Smart watering of plants" By, Kotni.Naga Siva, Raj Kumar.G, A.Bagubali, Kishore V Krishnan,uses ArduinoUNO, Moisture sensor.It covers drip irrigation system that connects a motor, sensor for soil moisture, and an Arduino Uno. The sensor measures the soil's moisture content and transmits the information to the Arduino, which interprets it based on a pre-set threshold. The Arduino triggers the motor to pump water down to the ground through sprinklers if the moisture content is below the threshold. The motor continues to run until the required moisture level is attained,at which time it shuts off. This technique decreases work, lowers soil erosion, and guarantees efficient water use. The technology may also become accustomed to supply fertilizers, which improves its usefulness for gardens and farmers.

In [3], "Smart Garden Automated and Real Time Plant Watering and Lighting System with Security Features" By, Md.Adib Muhtasim, Syeda Ramisa Fariha, Ashique Mohaimin uses Arduino. This is a comprehensive garden automation as well as monitoring system included regarding this project setup. A relay module connects the three HC-SR04 sonar sensors that have been carefully placed around the garden to an AC power source, and two light bulbs are put at the top left and bottom right corners. The bottom right corner features a webcam fixed atop a servo motor, and the middle water pip in sprinkler is linked to a 12V DC water pump that runs on a 12V rechargeable battery. The Arduino Uno R3, which lives in a control box and controls every component in the system, is coupled with an IR sensor, a buzzer, an RTC module, soil moisture indicator.

In [4], "Automatic Plant Irrigation System Using Arduino" By, Devika CM uses control system, weight sensor. In this presentation causes a basic Arduino-based automatic irrigation system prototype with few components is described in the article. As a way to keep track on the surroundings, the technique utilizes sensors for clay and warmth moisture. The analog moisture sensor signals are converted to a digital by an ADC in the Arduino; higher resistance denotes dry soil and lower resistance denotes wet soil. Based on these data and a pre-set threshold, the device automatically Enables or disables the settings of the AtMega 328 controller range from 0 (completely wet to 1023 (totally dry).

In [5], "Sensor Based Automatic Irrigation System and Soil pH Detection using Image Processing" By, Sanjay Kumawat, Mayur Bhamare, Apurva Nagare , Ashwini Kapadnis4 uses HC-SR04 sonar sensors, Light bulbs, Webcam, 12V DC water pump. In this paper, the initiative intends to give farmers access to an automated irrigation system, saving them money, time, and effort. Three soil moisture sensors, positioned at various soil depths, are employed by the frame to track moisture levels. The irrigation system stays off if moisture is detected by the middle or top sensors. Whatever the deep sensor's data, the system activates if neither finds wetness. Through the usage of IoT, the moisture data is transmitted to the cloud, where it is accessible through a website or an Android app that permits semi-automated control in the event the internet is down. Furthermore, a Pi camera takes pictures to measure the pH quantity of the soil and recommends appropriate crops for the field based on how basic or acidic the soil is.

In [6], "OO Design for an IoT based Automated Plant Watering System" By, Shrinidhi Rajagopal , Vallidevi Krish-namurthy uses HC-SR04 sonar sensors, Light bulbs, Relay module, Webcam, Servo motor. The paper highlights a self-sustaining plant watering system based to the Internet of Things that makes sure plants get enough water on a regular basis. When the soil's level of moisture drops below a certain point, the system employs a water pump to irrigate the plants. Utilizing sensors for soil moisture, it measures moisture percentage of the soil. It has an alarm to notify the user when the storage tank needs to be refilled and a weight sensor to track the water level in the in the tank. This device has an object-oriented design, and its functioning can be observed through a several diagrams, including use-case, sequence, and state-chart diagrams. A board for Arduino and and a relay module are utilized in the hardware implementation to regulate the liquid pump and sensors.

In [7], "Automatic Irrigation System: Design and Implementation " By, Surenthar A/L Munusamy, Safaa NajahSaud Al-Humair, Muhammad Irsyad Abdullah , uses Arduino Mega 2560, Soil Moisture Sensor, Temperature sensor probe(DS18B20), Bluetooth module HC 05, Electric Clear Water Pump, Plastic Water Solenoid Valve, and Rechargeable battery. In this paper sensors for temperature and moisture in the soil are utilized by the independent maintaining system to keep an eye on plant conditions. Sensors detect low soil moisture levels, as well as the machine analyzes those signals before activating the water tap and pump to begin irrigation. The microprocessor in the system shuts off the valve and pump when the target moisture level is reached, and the system audits moisture levels continuously. A Bluetooth module (HC-05) transfers data based on the sensors to a mobile app,providing remote irrigation process monitoring and control.

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In [8], "Automatic Plant Watering System Using Arduino And Moisture Sensor" By, Anitha Sethumadhavan, Janani Sakthivel, Nivetha Vridhagiri, Chitra Raman uses Arduino UNO, soil moisture, dc motor. In this paper An Arduino with a 6V electric motor pump connect to a moisture content in the soil. That is tightly buried in dry soil in this irrigation system for plants that operates automatically. When the sensor is turned on, it measures the soil's moisture content and compares it to - levels. The submerged pump is powered on by the Arduino to irrigate the plant from a pool of water the quantity of moisture is low. An effective plant watering prototype, the system continuously measures soil moisture to ensure that the appropriate volume of water is used regardless of what kind of soil.

In [9], "Automated Plant Watering System" By Drashti Divani, Pallavi Patil, Sunil K. Punjabi uses Arduino-board,Relay, Soil Moisture Sensor. In this work An Arduino board utilizing the Arduino IDE to develop and detects the moisture contents of the soil, and a motor or pump delivers water to plants as a component of an automated plant watering system. The system functions within specified temperature and oil moisture variables that are suited to the needs specific plants. The warmth and dampness sensors are linked to the ATmega328 microcontroller's input pins, which process the data and use the output pins to manage the servo motor or pump. To make sure plants get enough moisture, the system turns on the water pump when the amount of moisture in the soil falls below a threshold that has been set. This process repeats until the quantity of moisture reaches ideal levels. Via the mobile application, users may monitor and manage plant watering required remotely with acquiring real-time activity data.

In [10], "Microcontroller Based Automatic Plant Watering System" By Mritunjay ojha , Sheethl Mohite, Shraddhakathole , Diksha tarware uses Arduino-board, Soil Moisture Sensor, Micro Controller, Temperature Sensor. The goal behind of this Arduino-based project's goal is to construct a computerized system capable of detecting that soil moisture levels and regulate a water pump to keep plant conditions at their ideal state. The Uno Arduino microcontroller, a soil moisture, and a water pump are the main parts. When the soil moisture falls below a certain threshold, the Arduino receives a digital input from the sensor of soil moisture, the soil moisture detector is employed to ascertain the soil's moisture content. The space's humidity and temperature are as determined by the DHT11 sensor. When the soil's amount of water is low, the pump motor is administered by a relay, which functions as a computerized switch and waters the plant. For effective plant monitoring and watering, an OLED display displays real-time readings from sensors for humidity, temperature, and soil moisture.

III. SYSTEM DESIGN

An Arduino , moisture detector, a relay component, a breadboard, jumper cables, and an LCD I2C display are are employed in the building process of the automated system for watering plants. As the Arduino receives details from the moisture sensor, comprehends it, and uses it to drive the relay module. The sensor for moisture measures the quantity of moisture of the soil. In accordance with the soil's moisture content, the relay module functions on or off switch of a fluid pump. Users receive immediate assistance from the LCD I2C display, which displays system status as well as soil humidity levels in real time. Using jumper wires on the breadboard, An Arduino is linked to the LCD display, relay module, and moisture sensor to produce a single structure and functioning agreement. The relay module turns on when a soil's moisture content in the soil drops below a set threshold. To hydrate the plants, the pump for water turns on by the relay module. The relay module stops the pump when the right amount of humidity is achieved, saving water and avoiding overwatering. Besides to being an effective and dependable means to automate plant watering, this framework has an additional benefit of continuous monitoring via the LCD display putting in place an automated plant-watering framework while considering the needs of both large and small crop fields and gardens. The project's primary parts are the Arduino UNO, the detector for soil moisture, water-moving machinery, Relay module, Breadboard, LCD and I2C module, Jumper wires. With the Arduino IDE software, we can set up the Arduino board to irrigate the plants in accordance with the moisture content of the soil detector provides. When the dampness content falls below a specified threshold, the water-powered generator initiates irrigation. The purposes of water pumps are irrigation.

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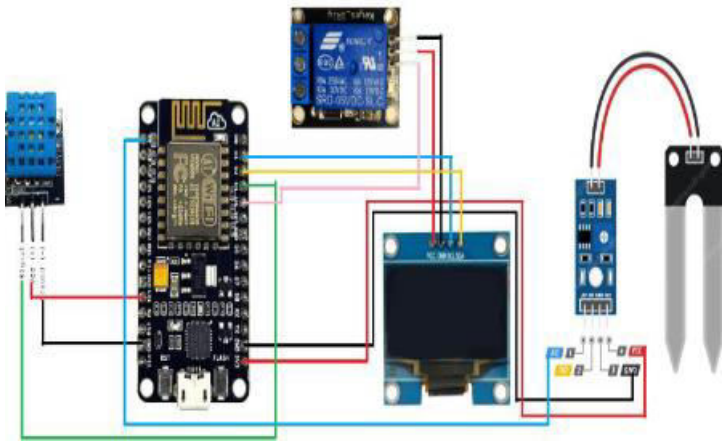

Fig. 1. Block Diagram of the System

IV. PROPOSED SYSTEM

Near plant roots, sensors for soil moisture are positioned as an element of the network and connect to a microcontroller such as an Arduino or Raspberry Pi. The microcontroller, which is programmed with moisture threshold values, receives information obtained from these sensors, which, which ascertain the soil's moisture content. Using the microcontroller, the water pump is activated and connected to a reservoir when the level of soil moisture falls below a certain level. Plants get water delivery via tubing by the pump. Efficient watering occurs via a relay that utilizes signals from the microcontroller to regulate the pump. A proper power source powers the system. It may be improved with features like data logging to maximize watering schedules, Wi-Fi connectivity for remote monitoring, and more sensors for different zones. System integrity, reservoir levels, and sensor calibration are all checked in regular service.

A.COMPONENTS

Arduino UNO: An open-source microcontroller board called an Arduino. It is customary for create various type of electronic projects. It consisting a microcontroller, input/output pins, and other components that allow it to interact with other electronic components and sensor. The board will be configured to detect the soil's moisture content and provide the user with a reading.

Soil moisture sensor: Sensor for soil moisture measures the water in the soil. It calculates the amount of water in the soil using some features of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, in place of the method used to calculate the moisture value and assess the resistance value.

Relay module: An electrical component called a relay module makes it possible to switch a greater power load using a low power control signal. It is frequently employed in circumstances where low voltage or low current control signals a are needed to operate high voltage or high current devices, like microcontrollers or other digital circuits.

Breadboard: For novices, enthusiasts, and experts in electronics alike, breadboards are indispensable instruments. They enable quick prototyping and experimentation by making circuit assembly and modification simple and solder-free.

LCD and I2C module: In electronics projects, LCD (Liquid Crystal Display) and I2C (Inter-Integrated Circuit) modules are often used parts, particularly when integrating with microcontrollers like Arduino Because they facilitate easier communication between microcontrollers and peripherals and provide visual feedback LCD modules crucial parts of electronics projects.

Jumper wire: A jumper wire is an electrical wire or collection of them in a cable with a connector or pin at each end which is normally used to interconnect the components of a breadboard or other test circuit.

Water pump: A microcontroller (such as an Arduino or Raspberry Pi) controls a water pump in an IoT-based An automated Framework for plant watering. When the soil is not too wet, the microcontroller receives information

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derived from soil moisture sensors and turns on the pump. This guarantees that plants receive automatic watering, fostering powerful development and economical water usage.

B. IMPLEMENTATION:

All of the parts should be connected correctly one by one. The connection between the Arduino Uno, relay module, as well as soil moisture is visible. Arduino, a moisture-containing soil, a single channel relay, and any water pump has been have all been interfaced. Here, we used a 5 volt power supply for the Arduino and an alternative type for the water pump. The capacitive soil moisture sensor's analog pin keeps being connected to the A0 from Arduinopin, the + pin to 3.3 volts, and the - pin to ground. Attach the trigger pin (IN) to Among the Arduino's digital pins (we used pin 13 for this example), additional the GND and VCC pins to the GND and 5v, respectively. Incorporate pipes for the intake and disposal of water.

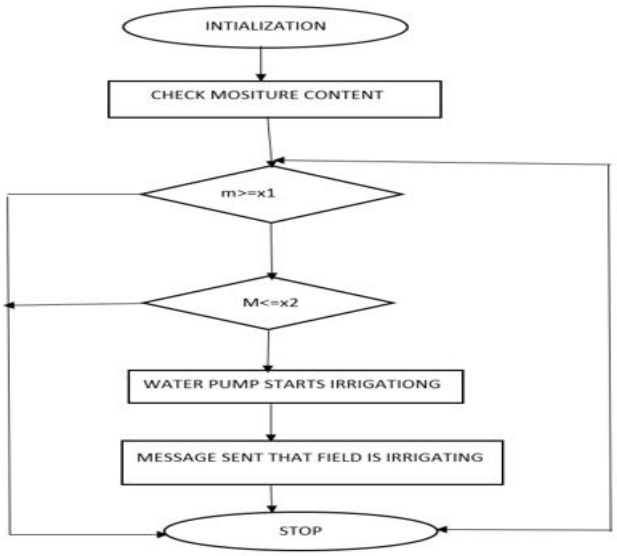

Fig. 2. Flowchart

V. RESULT AND DISCUSSION

Using an Arduino, water sensor, switch module, and LCD I2C display, the World Wide Web of Things-driven automated watering of plants system showed excellent results in preserving soil moisture levels. The LCD panel displayed real-time soil moisture readings that were consistently accurate because of the moisture sensor. The relay module turns the pump with water to make sure the plants got enough water when the moisture level of the soil fell below a certain threshold. For several weeks, the system functioned dependably, and the precision of the moisture sensor was confirmed by the way its readings matched well with measurements made by hand. The water pump and relay module functioned erratically, which reduced power usage. After initial difficulties with sensor calibration and standardized water distribution were resolved, the system demonstrated perseverance in a range of circumstances. Future improvements might include integrating solar power, adding more sensors for wider regions, and enabling remote monitoring using a smartphone app. All things considered, the gadget effectively automated the irrigation process, providing significant benefits to small-scale farmers and household landscapes alike.

VI. FUTURE WORK

The plant watering system's functionality, potency, and utility might all be enhanced in the future. A more comprehensive understanding of the plant's environs will be possible through the integration of complex sensors, such as light, humidity, and temperature sensors, allowing more accurate watering regimens. By including connectivity options like Wi-Fi or Bluetooth, consumers will possess the ability to monitor and operate their garden from far away using a smartphone app, which makes it simple for them to do so. By evaluating past data and weather patterns to forecast the ideal watering timings. Furthermore, machine learning techniques could be utilized to improve the system

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and assure ideal plant growth. By integrating sunlight, the system could get fewer reliant on outside power sources and become more energy-efficient and sustainable. Lastly, using a modular design

VII. CONCLUSION

Using a relay module to implement a system for watering plants offers an effective and automated way to keep plants, healthy. By ensuring that plants receive the proper amount of liquid at the appropriate time, this system minimizes the chance of over- or under-watering and eliminates the criteria for manual intervention. The choice of a plant watering system depends on various factors, including the scale of the garden, type of plants, climate conditions, and budget. Advanced systems, especially those incorporating smart technology, offer greater convenience and efficiency, ensuring optimal plant health and water conservation.

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