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Automatic Plant Watering System

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Abstract: In ancient times, farmers and gardeners relied on observation, experience, and traditional methods to monitor and care for their plants. This intelligent plant monitoring system utilized simple yet effective techniques to detect changes in plant health, soil moisture, and weather conditions. Observations of plant color, texture, and growth patterns were used to identify potential issues. Soil moisture was monitored by inserting sticks or stones into the soil, while weather conditions were predicted using astronomical observations and natural signs. This ancient system, although rudimentary, demonstrates the ingenuity and resourcefulness of our ancestors in maintaining optimal plant growth and productivity.

This project presents an automatic plant watering system that utilizes Arduino and moisture sensor technology to optimize plant care. The system is designed to automate the watering process, ensuring that plants receive the right amount of water at the right time. The soil moisture sensor continuously monitors the soil moisture levels and sends data to the Arduino board, which processes the information and controls the watering system. When the soil moisture level falls below a predetermined threshold, the Arduino board activates the water pump, supplying water to the plants until the optimal moisture level is reached. The system also includes a water sensor that monitors the water tank level, preventing overwatering and ensuring efficient water usage. The temperature sensor monitors the ambient temperature and sends data to the Arduino Uno board, which then activates a heating or cooling system to maintain an optimal temperature range for plant growth. The system also includes a notification system that sends alerts to the user's Smartphone or email if any parameter falls outside the optimal range. This feature ensures that the user can take prompt action to address any issues, even remotely

Index Terms **– Arduino Uno, Humidity Sensor, Watering System, Motor driver**

I. INTRODUCTION

The smart plant system is an innovative project that utilizes Arduino Uno to automate plant care. The system ensures optimal growing conditions for plants by monitoring and controlling soil moisture, temperature, and light levels. The Arduino Uno board is the brain of the system, receiving data from sensors and sending signals to various components to maintain a perfect environment for plant growth. Soil moisture is detected by a soil moisture sensor, which sends data to the Arduino Uno. If the moisture level falls below a set threshold, the board activates a water pump to supply water to the plants. The system also includesa temperature sensor to monitor the ambient temperature and a light sensor to detect the intensity of light. If the temperature or light levels exceed or fall below optimal ranges, the system adjusts accordingly.

The smart plant system also includes a notification system that sends alerts to the user's Smartphone or email if any parameter falls outside the optimal range. This feature ensures that the user can take prompt action to address any issues, even remotely. The system is powered by a rechargeable battery, making it suitable for indoor and outdoor applications.

An Automatic Plant Watering System is an innovative solution designed to ensure that plants receive the optimal amount of waterrequired for their growth without the need for manual intervention. This system is

particularly beneficial for individuals who may not have the time or expertise to water their plants regularly, as well as for maintaining large gardens, agricultural fields, and greenhouses. By automating the watering process, the system not only saves time and effort but also promotes healthier plant growth by maintaining consistent soil moisture levels.

The core components of an Automatic Plant Watering System include soil moisture sensors, a microcontroller, a water pump, a water reservoir, and a relay module. The soil moisture sensor is a critical element that measures the moisture content in the soil and sends this data to the microcontroller. The microcontroller, often an Arduino or similar device, acts as the brain of the system. It processes the data received from the sensor and determines whether the soil moisture level is below a predefined threshold. When the soil moisture level drops below this threshold, the microcontroller activates the relay module, which acts as a switch to turn on the water pump. The water pump then draws water from the reservoir and delivers it to the soil, ensuring that the plants receive the necessary hydration. Once the soil moisture reaches the desired level, the sensor detects this change and signals the microcontroller to deactivate the relay module, turning off the water pump. This feedback loop ensures that the plants are neither overwatered nor under watered.

One of the significant advantages of an Automatic Plant Watering System is its ability to conserve water. By delivering water only when necessary and in the right amount, the system reduces water wastage, making it an environmentally friendly option. This is particularly important in regions facing water scarcity or where water conservation is a priority. Additionally, the system can be programmed to water plants at specific times of the day, such as early morning or late evening, to minimize evaporation and further enhance water efficiency. The convenience offered by this system is another noteworthy benefit. For busy individuals or those frequently away from home, the Automatic Plant Watering System ensures that plants are consistently cared for, preventing them from drying out. This is especially useful for maintaining indoor plants, balcony gardens, and urban landscaping where regular manual watering might be challenging. Moreover, the system's ability to maintain consistent moisture levels promotes healthier plant growth. Plants thrive in environments where they receive consistent care, and fluctuations in water availability can stress plants, affecting their growth and productivity. By providing a steady supply of water, the Automatic Plant Watering System helps plants develop stronger root systems, produce more foliage, and yield better fruits and flowers.

In addition to home gardening, the applications of this system extend to agricultural fields and greenhouses, where maintaining optimal growing conditions is crucial for crop yield. Farmers can benefit from reduced labour costs and improved crop management, while greenhouse operators can ensure that their plants receive precise watering tailored to their specific needs.

II. METHODOLOGY

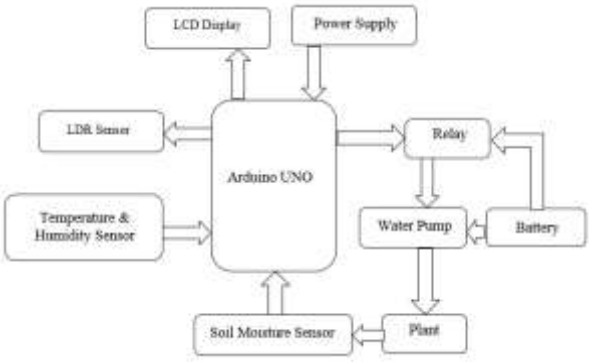

Fig 1.1: Block Diagram

When power supply is ON, the input module of three sensors (DHT22, moisture) start to activate. When sensors get ON it willread the data from soil and from surrounding. According to the values that are detected by sensors, motor will turn ON/OFF. If moisture OFF. If value, then motor is turn ON. If moisture level is high, then it will stop the motor and water supply will also stop. Temperature and Humidity sensor will collect the environmental weather conditions. As LDR sensor is used at the night time motor will turn off.

During the day time sensor gets activated, motor is ON and water supply is given to the plants. All the values that arecollected from sensors is send via Arduino UNO to the LCD display.

III. COMPONENETS USED

1. Water Pump

Fig 1: Water Pump

Water is used to perform a specific task of artificially pumping. It can be controlled by an electronic microcontroller. It can be on 1 triggered by sending the signal and turned off as needed. Artificial process is called Water Pumping. Station. There are many varieties of pumps. This project we would like to use a DC motor.

2. LCD Display

This is I2C interface 16x2 LCD display module, a high-quality 2 line 16-character LCD module with on-board contrast control adjustment, backlight and I2C communication interface. For Arduino beginners, no more cumbersome and complex LCD driver circuit connection. The real significance advantages of this I2C Serial LCD module will simplify the circuit connection, save some I/O pins on Arduino board, simplified firmware development with widely available Arduino library

Fig 2: LCD Display

3. Arduino Uno

Fig 3: Arduino Uno

The Arduino UNO R3 is the perfect board to get familiar with electronics and coding. This versatile development board is equipped with the well-known ATmega328P and the ATMega 16U2 Processor.

4. Humidity Sensor

Fig 4: Humidity Sensor

DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness.

5. Software Requirements

1. Arduino IDE: Arduino Integrated Development Environment (IDE) is an open source IDE that allows users to write code andupload it to any Arduino board. Arduino IDE is written in Java and is compatible with Windows, macOS and Linux operating systems.

Key Features:

- Code Editor: A simple, intuitive editor for writing code in C/C++.
- Compiler: Compiles code into machine language for Arduino boards.
- Uploader: Uploads compiled code to Arduino boards.
- Serial Monitor: Displays serial data from Arduino boards.
- Library Manager: Manages libraries for added functionality.
- Board Manager: Supports various Arduino boards and configurations.

6. Hardware Requirements

- **Arduino Uno/ Node MCU**: The central microcontroller that processes input data from various sensors and controls theoutput devices.
- **Temperature & Humidity Sensor**: Measures the temperature and humidity levels of the environment. This data helpsin maintaining optimal conditions for plant growth.
- **Soil Moisture Sensor:** Measures the moisture level in the soil to ensure plants receive the right amount of water.
- **DC Water Pump:** Controlled by the Arduino via the motor driver to water the plants based on the soil moisture sensor readings.
- **LCD Display**: An LCD consists of a layer of liquid crystals sandwiched between two transparent electrodes. When an electric current is applied, the crystals align to control the amount of light passing through them, creating the image you see on the screen.
- **Battery:** An electric battery is a source of electric power consisting of one or more electrochemical cells with external connections for powering electrical devices.
- **Relay:** A relay is an electrically operated switch. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals.
- **LDR Sensor:** LDR is an acronym for Light Dependent Resistor. LDRs are tiny light-sensing devices also known as photo resistors. An LDR is a resistor whose resistance changes as the amount of light

falling on it changes. The resistance of the LDR decreases with an increase in light intensity, and vice-versa.

IV. IMPLEMENTATION

Soil Moisture Sensor is Buried in the soil near the plant's roots, this sensor continuously measures the moisture content. If the soil is too dry, it's time for action. Temperature & Humidity Sensor positioned in the surrounding of the plant, this sensor monitors the local environment. After all, plants have preferences, some like it warm and humid, while others prefer cooler conditions. The Arduino UNO is placed in the middle of the system. It's like the plant's personal assistant. The Arduino receives data from the sensors. When it senses that the soil is dried or the environment isn't ideal, it springs into action. The Arduino processes the sensor data. If the soil moisture in the soil drops it knows it's time to water the plant. The relay works as a digital switch. When the Arduino gives the signal, the relay flips. This action connects the water pump to the power source. When the relay activates, the pump springs to life, delivering water to the plant's roots. The system runs on a trusty battery. Even during power outages, it ensures our plant does not stop it work. The systems include an LCD display. It's like the plant's status board. The display shows soil moisture levels temperature and humidity and the status of the pump. The whole setup exists for this little green wonder. The plant receives timely water doses and enhances for its growth.

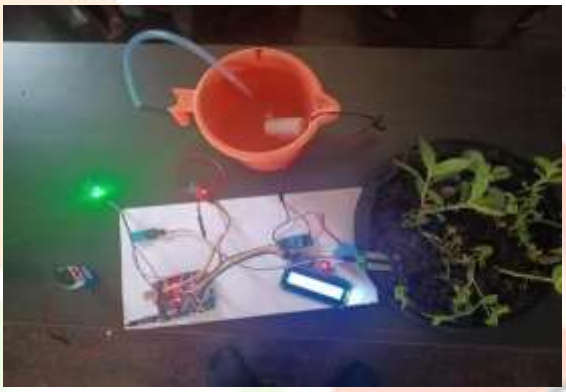

Fig 5: Model of automatic plant watering system

V. RESULT AND DISCUSSION

The Moisture-less soil is taken as a sample. The soil moisture sensor connected to the 6V DC motor pump and to the Arduino is placed on the surface of the soil firmly. The 12V external power supply is supplied to Arduino and 6V DC pump is placed submerged on a pool of water. The Arduino setup is mounted to Arduino case separately. The switch is turned ON, the moisture sensor instantly detects the moisture of the soil and compares with the pre-defined values. The estimated value of the moisture allows watering the plant ideally considering the soil type. The moisture content of the soil is checked continuously and this makes it an ideal plant watering prototype. If the moisture level of soil is more then the motor is off and displayed on LCD display.

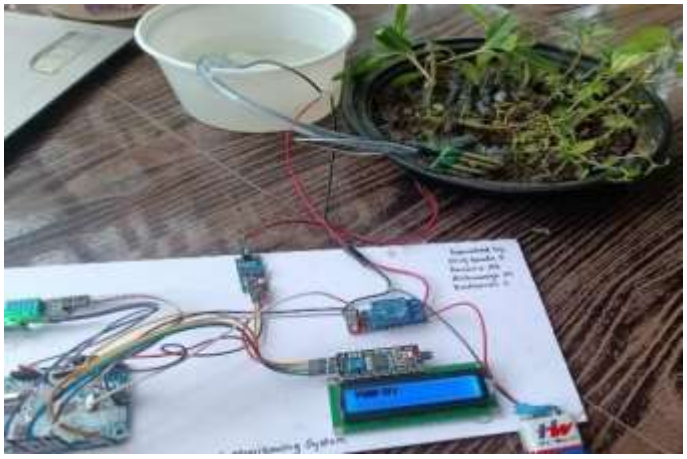

Fig 6: Pump Off state

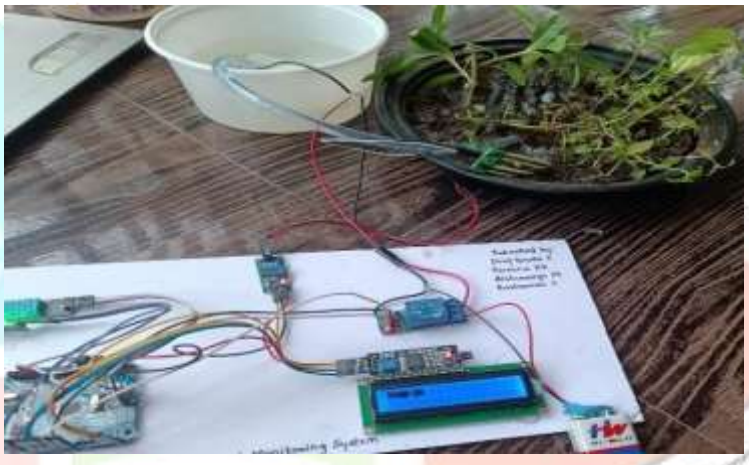

Fig 7: Pump ON state

VI. ADVANTAGES

- The system is quite affordable and feasible.
- This system is also helpful in the region where there is scarcity of water and improves their sustainability.
- Reduces water consumption
- Reduces manpower

VII . APPLICATIONS

- In house gardening.
- For growing medicinal plants.
- Plant nursery

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VIII. CONCLUSION

The intelligent plant monitoring system using Arduino Uno has been successfully designed and implemented, enabling real- time monitoring and automated control of soil moisture, temperature, and humidity levels to ensure optimal growing conditions for plants. This efficient and sustainable solution improves plant growth and health, conserves water, reduces manual labour, and increases crop yields, making it suitable for various applications including greenhouses, agricultural fields, indoor gardens, urban farming, and environmental monitoring. With potential enhancements such as integrating additional sensors, machine learning algorithms, and cloud-based data storage, this system demonstrates the potential of IoT technology in improving plant care and agriculture, making it a valuable contribution to the field of precision agriculture.

A system to monitor temperature, humidity, moisture levels in the soil is designed and the project provides an opportunity to study the existing systems, along with their features and drawbacks. Agriculture is one of the most water-consuming activities. The proposed system can be used to switch the motor (on/off) depending on favorable condition of plants that is sensor values, thereby automating the process of irrigation which is one of the most time efficient activities in farming, which helps to prevent over irrigation or under irrigation of soil thereby avoiding crop damage. The farm owner can monitor the process through a LED display. Though this project it can be concluded that there can be considerable development in farming with the use of IOT and automation.

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