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SMART IRRIGATION SYSTEM WITH REAL TIME WEATHER MONITORING

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INTRODUCTION

Traditional irrigation systems are not the most efficient method of irrigation in this technologically evolving era and they lead to excessive or deficit watering to the soil. Smart irrigation systems address these issues by providing farmers with real-time data on soil moisture levels and weather conditions, allowing them to irrigate only when necessary and in the right amount.

A smart irrigation system is an automated watering system that utilizes advanced technologies such as the Internet of Things (IoT), sensors, and machine learning algorithms to optimize water usage and improve crop yields. This system provides farmers with accurate and up-to-date information about soil moisture levels and weather conditions, enabling them to make data-driven decisions about when and how much water to use for irrigation.

IoT sensors and machine learning algorithms play a critical role in smart irrigation systems. Soil moisture sensors continuously monitor soil moisture levels and transmit the data to the main Arduino processor, where machine learning algorithms analyze the data to predict crop water requirements and optimize irrigation schedules. The system also incorporates weather data to adjust irrigation schedules based on real-time weather conditions.

Smart irrigation systems have benefits such as optimized water usage, great crop growth soil conditions and also decreases the manpower required. These systems can also reduce the environmental impact of agriculture by reducing water waste and promoting sustainable practices.

Overall, smart irrigation systems represent a significant advancement in agricultural technology that has the potential to improve water management, increase crop yields, and promote sustainable agriculture practices.

HARDWARE COMPONENTS

- *Arduino UNO*
- *Temperature and Humidity sensor*
- *Soil Moisture sensor*
- *Relay Module*
- *Water Pump*
- *LCD Display*
- *Arduino IDE*

ARDUINO UNO:

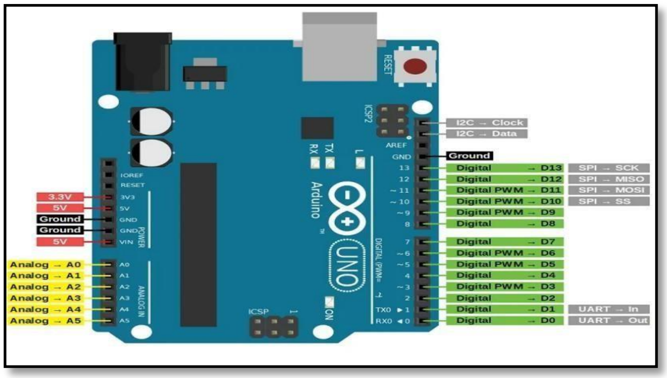

FIG 1. ARDUINO UNO

Open source microcontroller Arduino UNO is based on the chip ATmega328P. The typical connection for this board's 14 digital I/O pins and 6 analog I/O pins is a Type B cable. This Arduino module can be programmed using the Arduino IDE Software. It usually operates on 5V. 6 to 20 volts are the range of the input voltage. On board, 3.3V can be created, and the maximum current draw is 50mA. The memory of the ATMega328P consists of 32KB and 0.5KB memory, as well as SRAM-2KB and EPROM-1KB.

WATER PUMP:

FIG 2. WATER PUMP

A mechanical tool called a water pump is used to carry water from one place to another. Numerous applications, such as irrigation, plumbing, and wastewater treatment, frequently use water pumps. In a smart irrigation system, the water pump is automated using an Arduino UNO, which can be programmed to turn the pump on and off based on soil moisture levels and weather conditions. By ensuring that the pump only runs when required and for the right length of time, this method can maximize water utilization and decrease water waste.

LCD Display:

A smart irrigation system can use an LCD (liquid crystal display) to provide farmers with real-time data regarding soil moisture levels, weather forecasts, and irrigation-schedules.

The LCD display can be programmed to show different information, such as:

1. **<u>SOIL MOISTURE LEVELS</u>:** The soil moisture sensors in the field can measure current soil moisture levels, which can be seen on the display. These details can be used by farmers to decide whether irrigation is required.
2. **<u>IRRIGATION SCHEDULES</u>:** The irrigation schedules that have been programmed into the microcontroller can be viewed on the screen. Farmers have easy access to the system's irrigation schedule and can make any necessary modifications.

FIG 3. LCD DISPLAY(16X2) WITH I2C

3. **<u>WEATHER CONDITIONS</u>:** Real-time weather data from weather sensors, including temperature, humidity, and rainfall, may be shown on the display. These details can be used by farmers to modify irrigation plans in accordance with the weather at the time.
4. **<u>SYSTEM STATUS</u>:** The display can show thecurrent status of the irrigation system, such as whether thewater pump is on or off, or whether valves are open or closed. This information can help farmers to monitor the system and quickly identify any issues.

In general, a smart irrigation system's LCD display may give farmers crucial information about existing weather, soil moisture levels, and irrigation schedules. With the use of this knowledge, farmers can optimize water utilization and make data-driven decisions that will encourage sustainable agricultural practices and higher crop yields.

RELAY:

A relay is an electromechanical switch that operates on the electromagnetic induction principle. This relay guarantees adequate watering and is also used to prevent issues like under- and over-irrigation.

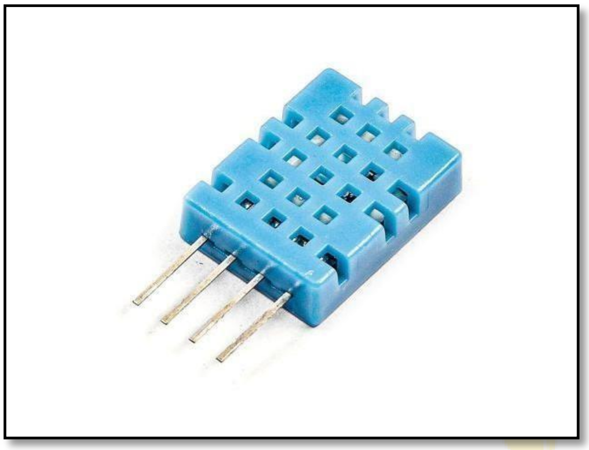

FIG 4.RELAY MODULE

The microcontroller and relay in a smart irrigation system can be used to operate the water pump or valve dependingon information from soil moisture sensors and weather sensors. For instance, the microcontroller can instruct the relay to activate the water pump, which would begin the flow of water to the plants if the soil moisture sensor detects that the soil moisture level is low. The microcontroller can also send a signal to the relay to turn off the water pump or valve, which will stop the flow of water to the plants if the weather sensor detects that it has recently rained.

Relays can also be used as security tools to guard against irrigation system damage. For instance, if the water levelin a well or reservoir is too low, the microcontroller can send a signal to the relay to shut off the water pump, saving the pump from running dry and inflicting damage.

TEMPERATURE AND HUMIDITY SENSOR:

Using a DHT11 temperature and humidity sensor, a smart irrigation system can keep track of the environmental factors affecting plant growth. The sensor offers precise and reliable measures of temperature and humidity, which are necessary to guarantee the best possible growing conditions for plants.

DHT11 can be used to gauge the temperature and humidity of soil, air, and water in a smart irrigation system. The timing and amount of plant watering can then be determined using this information. To maintain ideal growing conditions, the system can be configured to water the plants more regularly if, for instance, the temperature is too high and the humidity is too low. DHT11 can also be used to track the arrival of frost or other environmental factors that might harm plants.

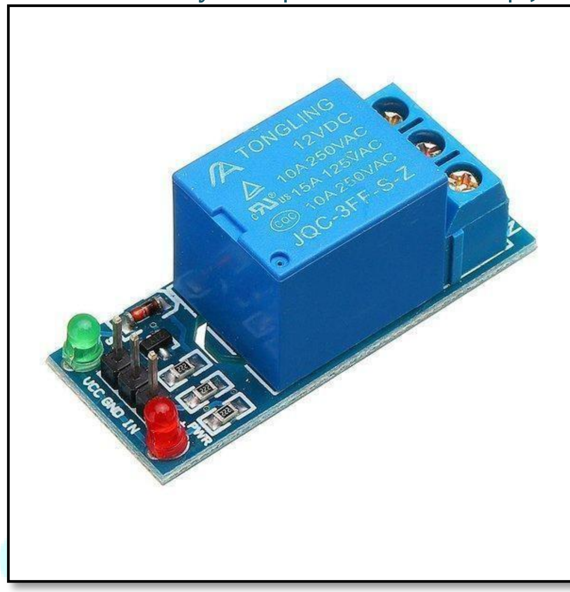

FIG 5. DHT 11- TEMPERATURE AND HUMIDITY SENSOR

The DHT11 sensor may be readily connected to an Arduino board using a straightforward circuit and a library that offers the required functionality for reading the temperature and humidity data. The information is then processed and shown on an LCD screen. In conclusion, the incorporation of DHT11 into a smart irrigation system can aid in the efficient use of water resources and enhance crop quality and output.

SOIL MOISTURE SENSOR:

An essential part of a smart irrigation system is a soil moisture sensor. In order to decide when and how much water should be applied to the crops, it is necessary to measure the moisture content of the soil. Two probes are put into the soil to make up the sensor, which detects the electrical resistance between them.

When the soil is moist, it conducts electricity better, and the resistance between the probes is lower. The resistance between the probes is greater in dry soil because it conducts electricity poorly. By measuring the resistance between the probes, the sensor can determine the moisture content of the soil.

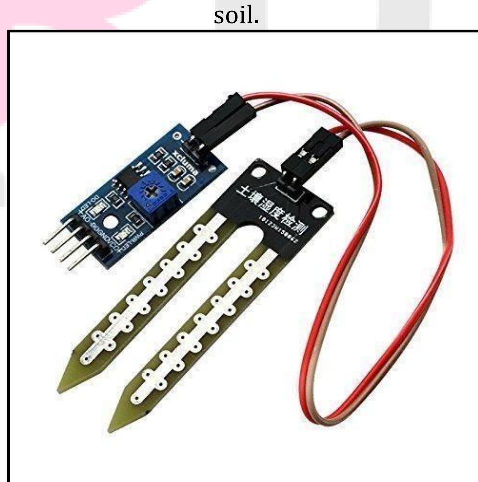

FIG 6. SOIL MOISTURE SENSOR

Typically, a microcontroller, such as an Arduino, receives the information from the soil moisture sensor and uses it to run an irrigation system or water pump.

The soil moisture sensor can be utilized in a smart irrigation system to improve watering schedules and save water. For instance, the system can be set up to water only when the soil moisture falls below a predetermined level and to change the amount of water applied depending on the moisture content of the soil at the time. By doing this, it is possible to avoid over- and under-watering, both of which can result in crop damage and water waste.

Overall, the soil moisture sensor is an essential part of a smart irrigation system since it offers useful data on the soil's moisture content and aids in the efficient use of water for sustainable agriculture.

ARDUINO IDE:

For writing, assembling, and uploading code to the Arduino board, the Arduino IDE offers a straightforward user interface. It also comes with a text editor, a serialmonitor, and a library manager, making it simple to use example code and pre-built libraries.

FIG 7. ARDUINO IDE LOGO

The IDE is user-friendly for those with little to no programming knowledge because it employs a condensed version of the C++ programming language. It has a large range of built-in libraries and functions that may be used to manipulate the microcontroller's actions and communicate with sensors and other parts.

The Arduino IDE's extensive and vibrant development and user community are two of its main benefits. The community offers assistance, guidance, and a variety of open-source projects and programs that can be utilized as a jumping-off point for developing new applications.

The Arduino IDE is an all-around strong and flexible platform that offers a simple user interface for creating programs for Arduino microcontrollers and other embedded systems.

PROPOSED METHODOLOGY:

Our main objective of the assembling of the Arduino based smart irrigation system is to optimize water usage in agriculture and promote sustainable water management practices. The system utilizes Arduino UNO, sensors such as soil moisture sensor, temperature and humidity sensor and also relay operated actuators to automate the irrigation process and provide real-time data on soil moisture levels and weather conditions.

By continuously monitoring soil moisture levels and analyzing data using machine learning algorithms, the system can accurately predict crop water requirements and optimize irrigation schedules. This approach minimizes water waste by only irrigating when necessary and in the right amount, thereby reducing overall water consumption.

Additionally, the system aims to improve crop yields by providing crops with the correct amount of water at the right time. This can enhance crop growth and improve the quality of the harvest.

BLOCK DIAGRAM:

Here is the block diagram for the smart irrigation system using arduino and this diagram helps in explaining the process involved in the irrigation process.

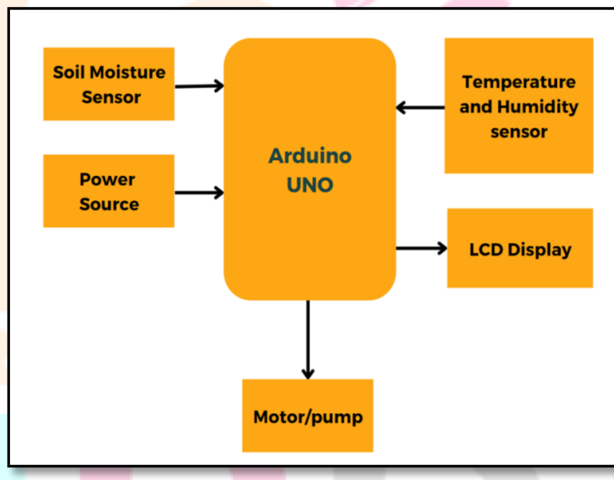

FIG 8. BLOCK DIAGRAM FOR SMART IRRIGATION SYSTEM USING ARDUINO UNO

HOW IT WORKS:

The smart irrigation system using Arduino works by continuously monitoring the soil moisture level, temperature, and humidity of the environment, and using this data to make decisions about when and how much to water the plants. The system uses a microcontroller board such as Arduino to control the water pump and other actuators, and to read sensor data from the soil moisture sensor and temperature and humidity sensor.

Here is a step-by-step explanation of how the system works:

1. The soil moisture sensor measures the moisture level of

the soil and sends this information to the Arduino board.

2. The Arduino board processes the data from the soil moisture sensor and decides whether or not the plants need to be watered.
3. If the plants need to be watered, the Arduino board activates the water pump to deliver water to the plants.
4. The DHT11 sensor measures the temperature and humidity of the environment, and sends this information to the Arduino board.
5. The Arduino board uses the temperature and humidity data to adjust the watering schedule and amount of water delivered to the plants. For example, if the temperature is high and the humidity is low, the system may increase the frequency or duration of watering to compensate for the dry air.
6. The LCD display shows the current status of the system, including the moisture level of the soil, the temperature and humidity of the environment, and the status of the water pump.

Overall, the smart irrigation system using Arduino automates the process of watering plants and ensures that they receive the right amount of water at the right time, while conserving water resources and minimizing waste.

CIRCUIT DIAGRAM:

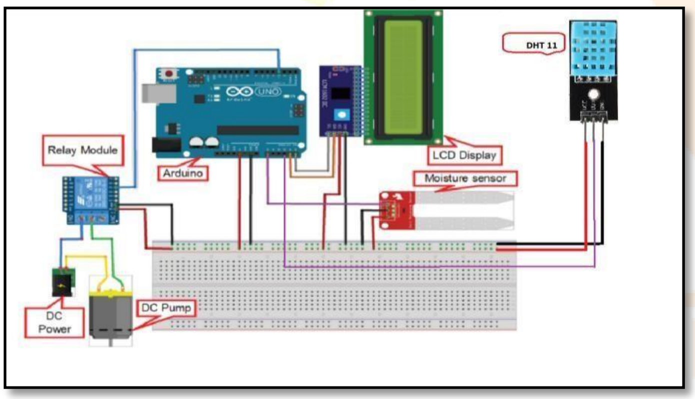

FIG 9. CIRCUIT DIAGRAM FOR SMART IRRIGATION SYSTEM

Program :

```
#include <LiquidCrystal.h>
// Include the LiquidCrystal library for the LCD display #include <DHT.h>
// Include the DHT library for the temperature and humidity sensor
// Define the pins for the water pump and the sensors
const int waterPumpPin = 10;
const int soilMoisturePin = A0;
const int dhtPin = 2;
// Initialize the LCD display
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);
// Initialize the temperature and humidity sensor
DHT dht(dhtPin, DHT11);
void setup() {
pinMode(waterPumpPin, OUTPUT);
// Set the water pump pin as an output
lcd.begin(16, 2);
// Set up the LCD display
dht.begin();
// Set up the temperature and humidity sensor
}
void loop()
{
int soilMoisture = analogRead(soilMoisturePin);
// Read the soil moisture sensor
float temperature = dht.readTemperature();
// Read the temperature from the DHT11 sensorfloat humidity = dht.readHumidity();
// Read the humidity from the DHT11 sensor
// Display the readings on the LCD display
lcd.setCursor(0, 0);
lcd.print("Soil:        ");
lcd.print(soilMoisture);
lcd.print("             ");
lcd.setCursor(0,       1);
lcd.print("Temp:       ");
lcd.print(temperature);
lcd.print("C ");
lcd.print("Hum:         ");
lcd.print(humidity);
lcd.print("%             ");
// Check the soil moisture level and turn on the waterpump if necessary
if (soilMoisture < 500)
{
// Set the threshold for turning on the water pump digitalWrite(waterPumpPin, HIGH);
// Turn on the water pump
delay(1000);
// Wait for one second digitalWrite(waterPumpPin, LOW);
// Turn off the water pump
}
delay(5000);
// Wait for five seconds before taking another reading
}
```

This program reads data from the soil moisture sensor and the DHT11 sensor and displays the readings on the LCD display. If the soil moisture level is below a certain threshold (in this case, 500), it turns on the water pump for one second to irrigate the soil. The program then waits for five seconds before taking another reading.

RESULTS:

The above bar graph is the observed data obtained through different times in a day. The soil's moisture level must be maintained at 500 because it is roughly 200 degrees dry in the morning.

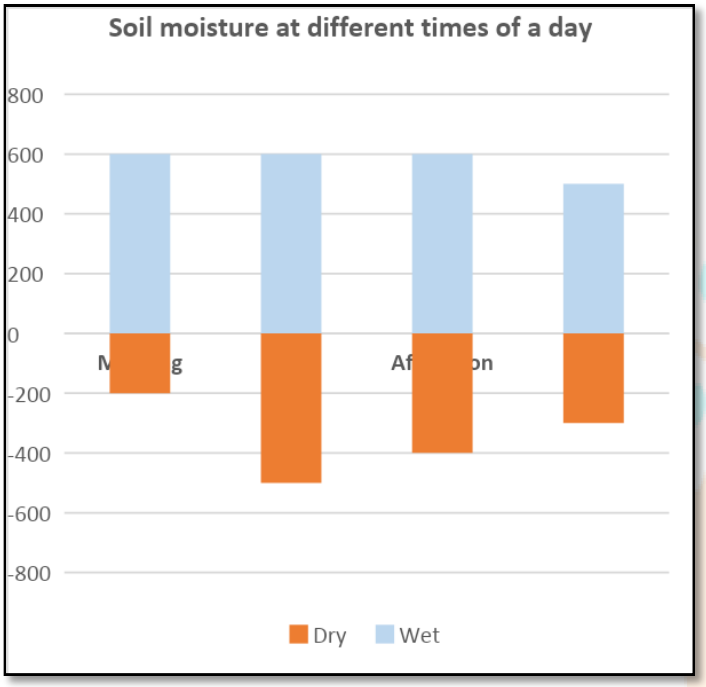

FIG 10. BAR GRAPH DEPICTING THE MOISTUREOF SOIL IN A DAY

Henceforth, by irrigating the soil through 600 is necessary for optimal plant growth. Similar to how the dryness level in the area reaches about 500 and even 900 during hot days, the dryness should be decreased by raising the soil's moisture content. When the sun is out, the moisture level needs to be kept at 600. Additionally, the soil's moisture level should be kept at 500 during the night.

CONCLUSION:

Using Arduino, Internet of Things sensors, and machine learning algorithms, a smart irrigation system offers a promising approach for enhancing the utilization of water in agriculture. The technology optimizes irrigation schedules and water usage by continually monitoring soil moisture levels and analyzing data using machine learning algorithms, which conserves water resources, lowers costs, and boosts agricultural yields. The integration of weather data and real-time monitoring further enhances the accuracy and efficiency of the system.

Smart irrigation systems have numerous advantages for farmers and gardeners as well as for the environment, such as reduced water and energy use. Additionally, the system's automation saves time and eliminates the need for manual work, making it a cost-effective and sustainable solution for managing water resources in agriculture.

The adoption of smart irrigation systems can be vital for improving water management and sustainability in agriculture as the issue of water scarcity becomes more urgent. Further research and development in this field can lead to even more advanced and efficient smart irrigation systems, providing a possible response to one of the most important concerns of today's society.

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