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Sensor Based Smart Irrigation System

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Abstract - Due to the scarcity of water in today's world, smart irrigation methods are becoming increasingly important. Sensors and microcontrollers can be used to automatically water the plants. Automation entails increasing production speed, lowering costs, and making efficient use of resources. The main goal of this project is to create a Microcontroller system that will automatically irrigate the plants and send the data to the farmers. The user's mobile phone will receive all of this data.

Key Words: Smart Irrigation, IoT, Soil moisture sensor, DC motor, Temperature and humidity sensor.

1. INTRODUCTION

Farmers and agriculture are prevalent in India. Agriculture provides food for approximately 70% of the total population. And, as the country's population grows, the total amount of land under cultivation must grow as well. As the total amount of cultivation grows, so does the total amount of water used. Agriculture currently accounts for 83 percent of the country's total water usage. As a result, a system must be devised to reduce water waste and relieve pressure on farmers.

The most important aspect of agriculture is irrigation. When doing agriculture, two things must be kept in mind: acquiring information about soil fertility and measuring the moisture content of the soil. This paper proposes not only measuring the soil content in the soil, but also automatically providing the required water to the soil when the moisture content falls below a certain threshold.[1] Because there is a limited amount of fresh water available on Earth, the majority of it is used for agriculture. As a result, there is a need to develop a system that conserves water while also providing adequate water to crops.

There are two parts to the smart agricultural monitoring and irrigation system. The first component is the system's hardware structure, and the second component is the development of an IoT platform for monitoring and controlling the system.[2] A smart agricultural monitoring and irrigation system is being developed, which will provide a more convenient irrigation process as well as water conservation. The primary purpose of a smart agricultural monitoring and irrigation system is to conserve water and provide the appropriate amount of water to farmers.

To irrigate the plants in our traditional farming method, a greater number of laborers are required. Many sensors, such as soil moisture sensors and temperature sensors, are used to reduce farmer intervention and convert this process into an automated one, and the output of these sensors is connected to the microcontroller.[4] Every day, technology advances, reducing the complexities and risks associated with the process. Many problems can be solved using embedded and microcontroller systems. Using a sensor-based Microcontroller system, this system automatically controls the water system for irrigation land. This can be accomplished by placing sensors in agricultural land to monitor the soil temperature and soil moisture sensor, which then sends the data to the microcontroller. The soil moisture sensor is used to automatically supply the water flow.

[1] This paper uses wireless sensor networks to implement a sensor-based irrigation system that uses renewable energy as a source. Wireless sensor networks are used to irrigate the plants in this project.[5]The goal of this Smart Irrigation System is to create an entirely automated irrigation system that detects the moisture content of the agricultural land using a soil moisture sensor and turns the motor on and off without the need for direct human intervention. Automation irrigation system using an ESP8266 board and a remotely controlled operating system via the internet. This Smart Irrigation System project turns on and off the irrigation system and sends a message to the user. This irrigation system aids in the efficient use of water as well as precise irrigation of the land.

2. PROBLEM STATEMENT

Agriculture is India's economic backbone. Agriculture, on the other hand, uses more water than it receives each year. Improving farm yield is critical to meeting the world's rapidly growing food demand due to population growth. To optimize water use for agricultural crops, an automated irrigation system is required. The technique can be used to apply a precise amount of water to a surface. A good monitoring of water regulation in agriculture can be achieved by forming a sensor network. Farm yields can be increased with the use of advanced tools and technology. The relay switching unit and the watering subsystem are controlled by the microcontroller in the node.

3. PROPOSED MODEL

Water scarcity is causing a lot of problems in the agricultural field these days. Smart irrigation systems have been used to assist farmers in overcoming their challenges. Sensors such as soil moisture are connected to the Arduino microcontroller's input pins in this system.

If the sensed value exceeds the program's threshold values, the relay circuit automatically switches the pump ON/OFF, and it is connected to the driver circuit, which helps to switch the voltage. Through the GSM module, the farmer will be informed

of the current field condition. The farmer can control the field system from anywhere and at any time by using this system.

A. ARDUINO UNO

The microcontroller used in this project is an Arduino UNO. The ATMEGA 328P-based UNO is a microcontroller board. For storing code, the ATMEGA 328P has 32kB of flash memory. The board has 14 digital input and output pins, 6 analogue inputs, a quartz crystal with a frequency of 16 MHz, USB, an ICSP circuit, and a reset button. The Arduino software can be used to programme the UNO.

FIG -1. Arduino UNO

B. GSM MODULE

The European Telecommunication Standards Institute (ETSI) developed the GSM (Global System for Mobile Communication) standard to describe protocols for second-generation (2G) digital cellular networks used by mobile phones. GSM refers to a digital, circuit-switched network that was designed for full duplex voice telephony but has since been expanded to include other services. In practice, the GSM specification allows for a maximum distance of 35 kilometers.

FIG -2. GSM Module

C. SOIL MOISTURE SENSOR

Soil Moisture sensor is used to measure the moisture content present in the soil. When the soil moisture value read by the sensor is above the threshold value, low level (0V) will be the digital output and if it is below the threshold level, high level (5V) will be the digital output. The digital pin is used to directly read current soil moisture value to see if it is above threshold or not. The threshold voltage can be regulated with the help of a potentiometer.

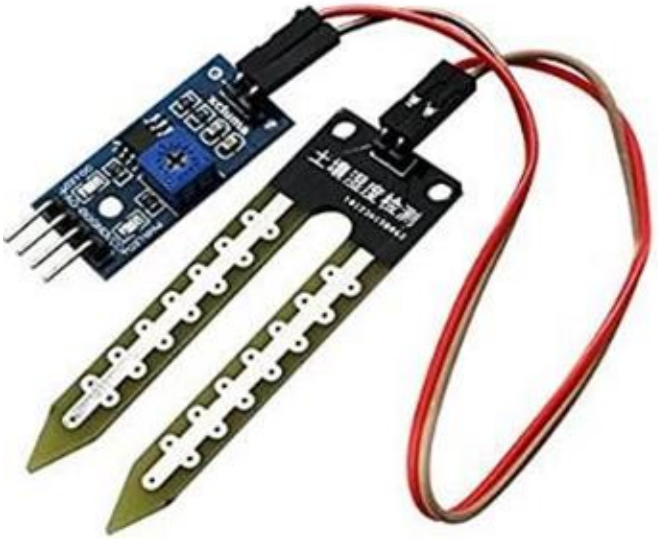

FIG -3. Soil Moisture Sensor

D. TEMPERATURE AND HUMIDITY SENSOR

The DHT11 sensor, utilized to gauge the humidity and temperature in the environment. It measures the temperature and water vapor present in the surrounding air which is in gaseous state.

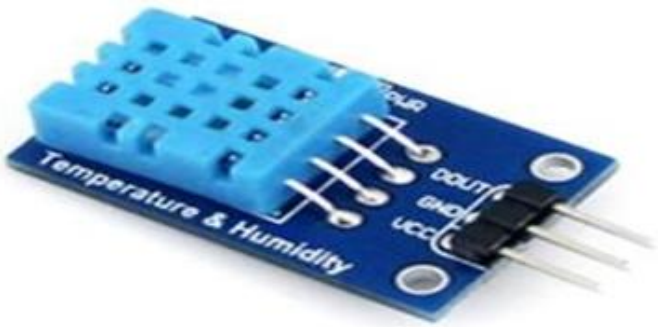

FIG -4. Temperature and Humidity Sensor

4. PROPOSED MODEL METHODOLOGY

Working of proposed model Algorithm:

It specifies the steps to be taken by the proposed system.
Step 1: Start the operation.
Step 2: GSM is supplied with initializing power.
Step 3: Humidity test (less or more than) and checking the moisture level of the soil.
Step 4: Unless the amount reaches a specified threshold, no irrigation will be required.
Step 5: When humidity and soil moisture is lower than a specified threshold, the irrigation will be initiated.
Step 6: Pump and rain gun startup.

Step 7: It returns to the original state after the cycle is completed. Stop the Process

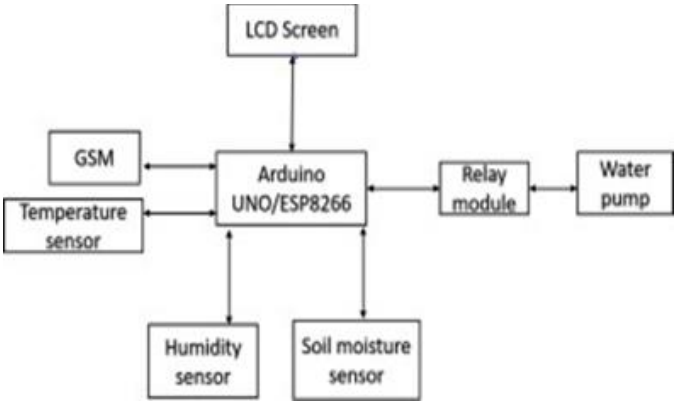

FIG -5. A Block Diagram of Proposed Model

5. SYSTEM ARCHITECTURE

The Arduino Nano microcontroller, which serves as the system's brain and heart, is at the center of the system's architecture [1]. It is the system control unit that reads data from various upload programmes and sends it to the Arduino microcontroller, which is written in the advanced C++ programming language. The SIM900/A GSM module is used, which is a small and wireless module with 6 pins for hardware connections to the Arduino Nano and wireless communication using AT commands.

When the water level is low, it sends SMS to farmer mobile devices about the status of the water content like - "field is dry, Switch on the motor" or "Field is wet, Switch off the motor". The relay module is a two channels electrically operated switch integrated with Arduino Nano pins and is directly connected with the motor that lets the current go through or not which is controlled with low voltage like 5V. [1] The Soil Moisture Sensor LM393 is used to test the volumetric soil water content.

The soil's dielectric permittivity is measured, and precise measurements are made with the complete system calibration to determine the soil's moisture level, as well as the serial output data at 9600bps. The DHT11 Humidity and Temperature Sensor includes a capacitive sensor and thermistor, as well as an NTC temperature measuring component that measures air and outputs digital signals on the data pin, all of which are connected to a high- performance 8-bit microcontroller. With a humidity range of 20% to 80%, DHT11 has a 5% accuracy.

This architecture, which implements an improvised version of Traditional Irrigation methods and allows farmers to check the status of their farm even from remote locations, can be implemented at a low cost.

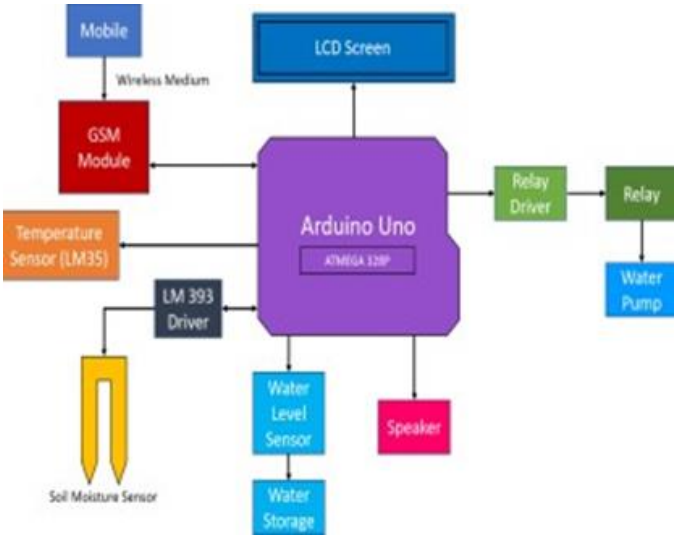

FIG -6. System Architecture

6. RESULT AND DISCUSSION

A smart irrigation system is being implemented in agricultural lands. The moisture sensor is placed in the soil and sends an analogue signal to the Arduino, as do the analogue signals from the water level sensor, temperature, and humidity sensors. The analogue signals are converted to digital signals, and the motor is turned on. The message signals are sent to the user as a message, and the user knows whether the motor is turned on or off.

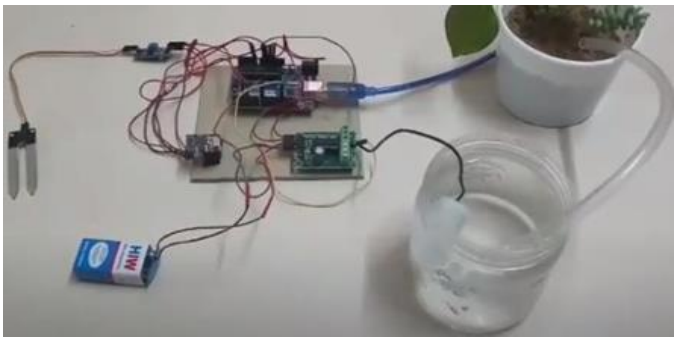

FIG -7. Experimental Setup

7. CONCLUSION

This smart irrigation system's main goal is to make it more innovative, user-friendly, time-saving, and efficient than the current system. The system includes an intruder detection system as well as measuring parameters such as soil moisture and humidity values. This system will allow farmers to automatically irrigate their crops based on the amount of soil or water required by the crop.

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