ARDUINO BASED SMART FARM IRRIGATION SYSTEM

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Abstract: *Agricultural sector is considered as the backbone of the Indian economy which is the most essential aspect of human life. Suitable atmospheric conditions are needed for desired plant growth, enhanced agricultural fields, and effective use of water and other resources. Conventional irrigation systems, such as surface, sub-surface, drip and overhead sprinklers irrigation methods are being unproductive which gave way for the emergence of an optimized method to irrigate the agricultural fields. Many innovative ideas are being explored to assist agricultural automation prosper and reach its full potential. Extended periods of dry weather condition caused by fluctuations in average annual precipitation may dramatically change agricultural productivity.*

The expenditures of cultivating many of these crops, along with their relative drought tolerance, necessitate the use of an adequate irrigation infrastructure for efficient and effective performance. In this article, we will share with you how to make a smart irrigation system. This irrigation system is useful for watering the plants as it calculates the amount of moisture present in the soil and then proceeds to the further commands. We are using a relay module to control the water pump. This system can work automatically and there is no need for interference. We are using two soil moisture sensors that can sense the moisture content of the soil and send the output data to the Arduino. Place the soil moisture sensors in the soil. If the soil is dry that means the plants need some water so the sensor sends the signals to the Arduino. The Arduino sends the signals to the relay module and the water pump is turned on for some time. You can change the time by modifying the code. If all the water from the water pump will stay in a specific position/place then there is a chance that crops may destroy. To overcome this problem we are using a servo motor that can rotate the pipe from one position to other in a loop.

Keywords—Arduino UNO board, Moisture Sensor, Relay, Arduino IDE Software, Water Pump (DC, 12V)

1. INTRODUCTION

Water is a precious resource not only in dry areas but also in many parts of the world. So, it must be used carefully and with maximum efficiency. Although there are many proposed solution regarding irrigation systems, there is still a waste of water with consequences on power consumption. Many researchers have tried to address the issue. In [1] it is presented a smart irrigation system that uses information from environment to determine when and where irrigation is needed. The efficiency of the solution is given by the transmission of water to dry locations of the field. In [3] it is presented a system which prioritizes irrigation operation by determining the number of pumps to be operated at any instance as well as their locations. As a result, specific crops can be watered in dependence on their water necessity.

R. Subalakshmi et.al. [2] has used as solutions Programmable Logic Controller and Raspberry Pi, 16F877 PIC microcontroller, Atmega 382 on the Arduino Uno [3]. Other solutions are presented in [4] - [8]. This paper proposes a solution for water management using a cost-effective smart irrigation system based on microcontroller. A microcontroller, humidity sensors, relays block and water pump are the main components of the system. Different parameters, i.e. humidity, make it possible to adjust the system according to the requirements of a particular place. When the humidity drops below a preset value on zone 1, the humidity sensor 1 transmits the information to the microcontroller, opens the solenoid valve 1 and starts the water pump until the humidity reaches the set value. If humidity decreases in the mean time on zone 2 the information received from the humidity sensor 2 leads to the solenoid valve 2 to open and the pump starts until the desired humidity is attained while the entire system is operating. When the humidity is over the threshold humidity, the system is in "stand-by" until the sensors send new information to the microcontroller and thus the system resumes its operating cycle.

2. SYSTEM ARCHITECTURE

Arduino UNO board: Arduino is a single card microcontroller designed to make the application more appreciable that is interactive objects and the surrounding environment. The UNO board of Arduino is a microcontroller based on ATmega328. It has 14 digital input and output pins in which 6 can be used as PWM outputs, a 16 MHz ceramic resonator, an ICSP header, a USB connection, 6 analog inputs, a power connector and a reset button. Contains the entire necessary support controller required. It is presented by ATmega16U2 programmed as USB serial converter. It is a simple USB interface system. This allows the interface. This allows the USB interface since it is like a series. The chips on the card connect directly to the USB port and are compatible with the computer as a virtual serial port. The advantage of this configuration is that serial communication is an extremely simple protocol that has been proven over time and that USB connects to modern computers and makes it comfortable.It is easy to find the microcontroller brain that is the Atmega328 chip. It is an open source project and there is an advantage to be open source, since it has a large community of people who use it and solve it. This facilitates the help in debugging projects. It is very convenient to manage the energy inside and has an integrated voltage regulation function. This can also be powered directly from a USB port without an external power supply. It is connected to an external power supply up to 12 V and adjusts the digital pins of the 5v and 3.3v.13 and 6 analog pins. This type of pin allows you to connect the hardware to the UNO board of Arduino externally. Simply connect the electronic devices and sensors to the plugs that correspond to each of these pins and are ready to work.

Fig 1: Arduino UNO

Moisture Sensor: The humidity sensor is used to measure the water content (moisture) of the soil. This sensor reminds the user to irrigate their plants and also controls the moisture content of the soil depicted in fig 2. It has been widely used in agriculture, irrigation and the land botanical garden. The ground moisture operating voltage is 5 V, the current required is less than 20 mA, and the interface is an analog type sensor and operates between 10 and 20. The soil moisture sensor uses capacitance to measure the dielectric permittivity of the surrounding soil. In the soil, dielectric permittivity is a function of water content. The sensor creates a voltage proportional to the dielectric permittivity and, therefore, to the water content of the soil. The sensor calculates the average water content over the entire length of the sensor. The soil moisture sensor is used to measure the loss of moisture over time due to evaporation and plants. Monitor soil moisture content to control irrigation in greenhouses and improve bottle biology experiments. The hardware and software needed for the soil moisture sensor is Arduino IDE humidity sensor software, and the Arduino Uno board.

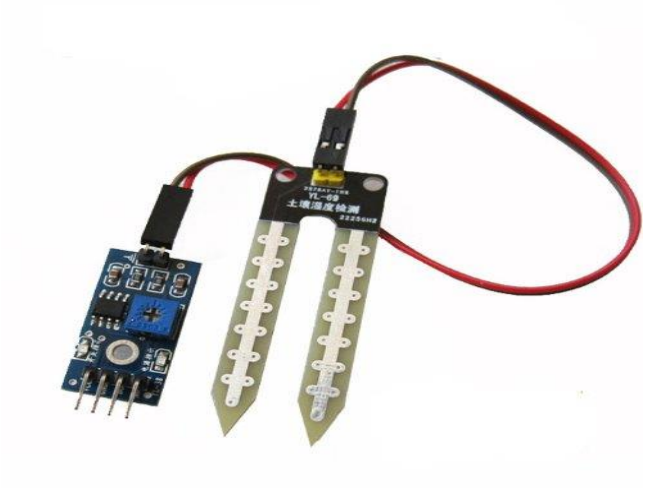

Fig 2: Moisture Sensor

Relay: A relay is an electrical main voltage switch. This means that it can be turned on or off, letting the current flow or not. Controlling a relay with Arduino is as simple as controlling an output like a motor. There are many types of modules, such as single channels, double channels, four channels and eight channels as shown in fig 3. A type of relay able to handle the high power required to directly control an electric motor or other loads called contractors. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overloads or failures. In relation to the mains voltage, the relays have 3 possible connections. There is a common pin (COM), usually a pin (NO) and a normally closed pin (NC). There is no contact between the common pin and the normally open (NO) pin. We activate the relay to connect the COM pin and the power supply is supplied to a load. There is a contact between the COM pin and the NC pin. A connection between the COM and NC pins is always required, even when the relay is switched off. When we activate the relay, the circuit opens and there is no power supply for a load. The connection between the relay module and the arduino is really simple. The GND of the relay goes to ground. IN1 relay port connected to the Arduino digital pin.

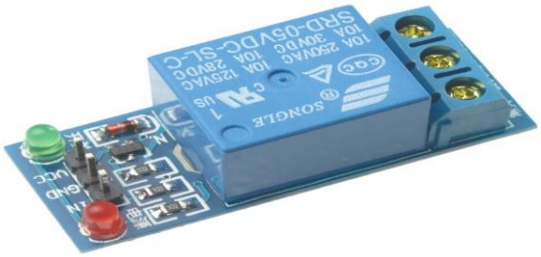

Fig 3: Relay

Arduino IDE Software: In the proposed work, the Arduino IDE Software is used for smart irrigation system to be performed uninterrupted.

Jump Wire: A jump cable is used to connect the test plate, the prototype or the internal circuit with other non-joined instruments as shown in fig 4.

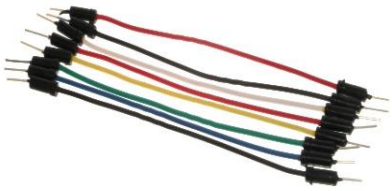

Fig 4: Jump Wire

Water Pumps (DC, 12V): For this study a water pump is required, which must be DC, 12V. The DC motor is the commonly used motor and has DC power distribution systems. Some rotors carry magnets and the stator grabs the conductors. The supports are used to allow the rotor to rotate continuously towards its axis.

3. WORKING

The working of this project as shown in fig 5 is like using a Soil Moisture sensor for measuring the moisture of Soil according to which water valves are controlled. When the moisture level gets below a threshold value, valves will open with the help of a relay or solenoid till the soil is well moisturized. The main thing, we will use an Arduino UNO microcontroller as the brain of the project. In a used case, when the moisture level gets below a threshold value, valves will open with the help of a relay or solenoid for a required time interval.

Fig 5: Real time irrigation system

Simulation Diagram and Code Used: The simulation diagram is shown in fig 6 and the code used for performing the irrigation system smartly observing the soil moisture by the sensor is written below:

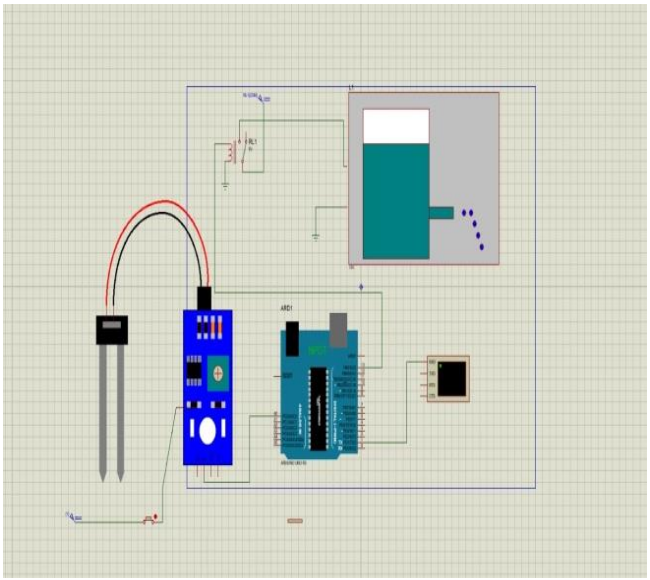

Fig 6: Simulation Diagram for irrigation System

```
 void setup()
{pinMode(13,OUTPUT);
Serial.begin(9600);}
void loop() {
  int y =analogRead(A0);
  int u=map(y,0,1023,0,255);
Serial.println(u);
  if(u>200)  {digitalWrite(13, HIGH);
delay(1000);  }
  if(u<200)  {digitalWrite(13, LOW);
delay(1000);
 }}
```

4. TEST CASE ANALYSIS

This solution based on microcontroller ensures that water is adequately managed in the process of irrigation. It uses the humidity sensor to determine the value of humidity in the ground and transmits the information to the Esp8266 module. Having this information the microcontroller decides when the pump will be ON. In order to test the proposed solution for water management, as shown in table 1, tests were made on different soil samples with a moisture content of 38% and 55%, setting a threshold of 40 % for dry soil and 52 % for wet soil.

Table 1: Testing the Functionality of the System

Soil Condition	Humidity Preset Value [%]	Humidity Measured Value [%]	Relay Status	Water Pump Status
Dry	< 40	38	ON	ON
Wet	> 52	55	OFF	OFF

5. CONCLUSIONS AND FUTURE SCOPES

The proposed work aims to save time, money and water consumption, by providing smart control irrigation system using friendly solar power. This is an important study in energy and environmental sector. The irrigation control system was designed, executed, and have achieved the research aims: 2. Sense the moisture of the soil through the soil moisture (humidity) sensors. 3. Display the humidity data provided by the sensors in LCD screen. 4. To contact the user via mankind smart phone when the soil is dry or moist to automatically turn ON and OFF the water pump in order to irrigate the plants land. This smart control irrigation system is beneficial in places where there are shortage of water, absence of electrical grid and huge farming lands.

Water level sensors could be added to irrigate the land with the suitable amount of water. The noise sensor could also be used to protect the farm field from the animals or even human get closer to the farm by producing a noisy sound as an alarm or buzzer. Even adding an electronic gate valves is preferred in order if there are multi farms need to be irrigated individually at different times controlled by one system. Seeding, ploughing and fertilizing functions could be implemented automatically whether using Arduino or PLC as a controller. Solar Energy can be used in the side of supply to the system in order to reduce the dependency upon Conventional sources of energy.

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