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Smart Irrgation System Using Moiture Sensor And Its Live Monitoring Using IoT

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ABSTRACT

Our project smart irrigation system is based upon moisture sensors and the use of microcontrollers to control the volume of water to be poured into the soil for the purpose of irrigation. Also in advancement to this, we also included a facility that users can have an observation of their field from wherever they want as in our system we used a wifi module which enables the feature of sending the data to the clouds and in our project's case its think speak website using the data connection provided with any mobile hotspot or wifi router. This feature is optional depending upon the need of the consumer. Apart from this online data, there are two LCDs provided which are used to observe the moisture content of the soil manually without an internet connection but this feature requires the manual visiting of the field and checking the system for the purpose.

Keywords: LCD-Liquid Crystal Display, NODEMCU ESP8266, Arduino Uno, Soil moisture, Irrigation, IoT.

1. INTRODUCTION

The artificial application of water in the field is known as irrigation. Irrigation comes in many forms. Many kinds of efficient water supplying technology is replacing rapidly the old ones and applying them to the soil. Depending on how water is distributed throughout the eld there are many different types of irrigation systems.

The usage of this particular technique makes the field irrigation system & its soil monitoring system independent of human intervention, and thus the establishment of an automatic irrigation system and soil monitoring system that is known as the smart irrigation and soil monitoring system for this reason. In this project we have tried to:

1. reduce the wastage of water in name of irrigation
2. Reduce manual efforts in irrigation of the fields
3. Increase the crop yielding of the field with a proper well-calculated way of irrigation rather than the commonly used assumption method

In this report a system has been developed to solve the problem of real time monitoring and stored data monitoring to investigate the soil condition at any time to take decision what types of crops should be grown and what should be done with the soil to get better and best production of the crops and also makes the whole system wirelessly automatic control over the mobile phone which can reduce the cost of the labor, water cost as well the effort of a farmer and make agriculture a little more profitable by reducing the above costs.

2. METHODOLOGY

1.1.1 Materials Used: A smart irrigation system is composed of various crucial components are given as follows:-

- NODEMCU ESP8266
- Soil Moisture Sensor
- Breadboard

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- NODEMCU ESP8266
- Soil Moisture Sensor
- Breadboard
- Connector wires
- laptop
- Single channel relay module
- Mini submersible pump
- LCD Display MODULE
- A Mobile phone As a portable hotspot
- Some of the software which we are using in our project are the ThingSpeak website, Arduino IDE application for coding of NODEMCU, and Arduino board.

2.1.1 NODEMCU ESP8266:-

NODEMCU is a PC unit, which is an open-source device that arranges the component units by the programming language and amalgamates the operation with the client group to produce microcontroller packets. These micro-controlled packets are used as a smart agent which was programmed to determine and to command the working of the system in the real-life Sample NODEMCU is shown in Fig. 1. Generally, NODEMCU boards are cheaper in price point and used in different types of operating systems. It is

easy and flexible for beginners. It is well suited to various languages such as C++ and JAVA .

ESP-8266 also works as a Wi-Fi module unit. It has dual capabilities, it can carry and drive the entire application and can control other micro-controllers. Its working power range is 3.0 to 3.6 volts. It has a built-in TCP/IP stack.

Fig. 2.1.1 Node MCU esp8266

2.1.2 AURDINO UNO

Arduino Uno is a PC unit, that is open-source which arranges the constituents by the programming language and integrates the enterprise with the client group to produce microcontroller packs. These micro-controlled packs are used as an intelligent agent which was programmed to detect and to control the working of the system in the real-life Sample Arduino Uno is shown in Fig.1. Generally, Arduino boards are also cheaper and used in various operating systems. It is easy and flexible for beginners. It is well suited to various languages such as C++ and JAVA .

Fig.2.1.2 Arduino Uno

2.1.3 SOIL MOISTURE SENSOR

FIG. 3.1 and 3.2 show the figures of the Capacitive soil moisture sensor. It contains two tests by methods for which current will reach to the dirt, at that point inspects the barrier of the soil, which will read the moisture level. We know the proximity of the water makes the dirt more inclined to guide the power without any effort, which means R(resistance) is lesser in such kind of soil, while dry soil has poor conductivity of intensity, in this way dry soil verify with more surety than the wet soil. The sensor is assembled on this property of intensity. There should be a point that supports the obstacle into voltage, this is done by making use of a circuit that shows us the inside of the sensor, which changes over the opposition into voltage.

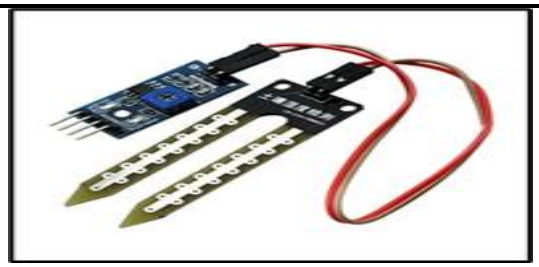


Fig 2.1.3 Moisture sensor

Fig 2.1.3 Moisture Sensor

2.1.4 BREADBOARD AND JUMPER WIRES:-

A Breadboard is a device without any more solid joint to add a temporary model with test circuit designs. A bounce wire (generally called jumper, jumper wire, jumper interface, DuPont wire, or DuPont interface – named after the who created them) is an electrical wire in a connection with a connector or stick at each end (or from time to time without them– essentially "tinned"), which is commonly used in the interconnections in the sections of a breadboard or other model or test circuit, inside or with other hardware units or parts, without joining them through soldering. Single jump wires are connected by inserting their "end connectors" into the starting way which is given in a breadboard, the header connector of a circuit board, or a touch of the test circuit.

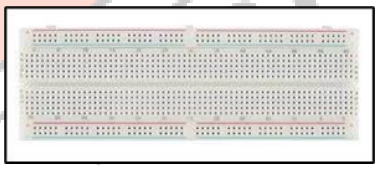


Fig 2.1.4 Breadboard

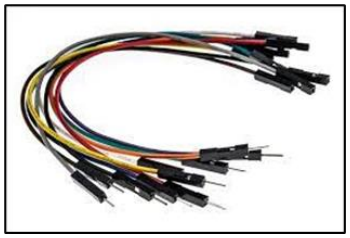


Fig 2.1.4 jumper wires

2.1.5 5V SINGLE CHANNEL RELAY MODULE:-

5v relay module is perfect for single-chip microcontroller and family apparatus control applications. It has a triode drive that builds transfers curls and high impedance controller pins. The module's draws-down current maintains a strategic distance from the glitch and there are control supply and control pointer LEDs on the board. And some of all this device can turn off-on the motor by the command of NODEMCU

Fig. 2.1.5 Relay Module

2.1.6 MINI SUBMERSIBLE PUMP:-

A mini submersible pumps a water pump that is fully submerged in the water and pumps the water to the place wherever required. In our project, we are using this mini pump as a prototype or the replica of the Pump which is actually used in irrigating the fields.

Fig 2.1.6 mini submersible pump

2.1.7 LCD display MODULE:-

This device is generally utilized to display data and the message is known as LCD with 16x2 digits. As the name indicates, it includes 16 Columns & 2 Rows so it can display 32 characters (16×2=32) in total & every character will be made up of 5×8 (40) Pixel Dots. In our project, this LCD display will function as an output unit that will display The data like the moisture percentage value, the status of motor, and the devices connection status with mobile hotspot

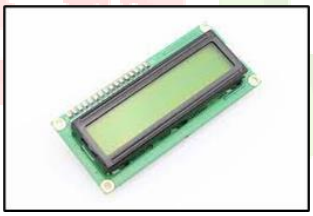


Fig. 2.1.7 LCD DISPLAY

2.1.8 A MOBILE PHONE AS A PORTABLE HOTSPOT:-

Phone with portable hotspot connectivity features so that our system can connect to the THINKSPEAK servers and data can be viewed and stored to the think speak servers.

2.1.9 Laptop:-For coding the microcontroller (NODEMCU) and to view the stored And live data a laptop or any pc is required.

2.1.10 THINK SPEAK SERVER:-

It is an application designed for the IoT. it grants us to create that type of application that collects the data from various sensors which are lined up with ThinkSpeak. At the ThingSpeak website, we can create the ThingSpeak Channel. A channel is that place in the server where our data is to be stored. Each channel contains 8 fields for any kind of data, 3 location fields, and 1 status field. Once we create our ThingSpeak Channel we can publish the desired data to this channel, and let the ThingSpeak process our sensed data from the sensors, and then let the server store the data and display it in final form.

Fig 2.1.10 Thinspeak Site

2.1.11 ARDUINO IDE:-

Arduino IDE is the application that is used for coding our microcontrollers NODEMCU ESP8266, ARDUINO, etc. THE status of our sensors and their output data can also be viewed on this application.

FIG 2.1.11 AURDINO IDE

3. COST ESTIMATION

The cost estimation of the project are as follows

TABLE NO. 3.1

S.No.	Item Name	Specifications	Unit	Cost/Piece (in Rs)	Total cost (In Rs)
1	NODEMCU ESP8266	Tensilica - 32 bit RISC CPU Xtensa LX106	1	500	500
2	CAPACITIVE SOIL MOISTURE SENSOR 2.0	PH2.54-3P	2	280	560
3	BREADBOARD	-	1	150	150
4	Jump Wire	-	29	3	87
5	SINGLE CHANNEL RELAY MODULE	5V switch	1	250	250
6	MINI SUBMERSIBLE PUMP	6v DC PUMP	1	240	240
7	LCD DISPLAY MODULE	16*2 DIGIT WITH GREEN	2	380	760

		BACKGROUND			
8	ARDUINO	UNO	1	500	800
9	Rainbow wires	-	1 mtr	80	80
10	Water pipe	-	1.5 feet	60	60
11	Acrylic Sheet	-	1 sq ft	250	250
12	Tub	-	1*1.5 sq ft	180	180
13	miscellaneous	-	-	700	700

TOTAL Rs 4617.00/-

4. METHODOLOGY-

4.1 Connection Part:-

The connection part includes the connections of the circuit using a breadboard and other types of equipment through jump wires etc. This connection is done as follow-

Node 1 is mounted with a capacitive soil moisture sensor, Arduino Uno & Esp8266 wifi module. There are a total number of 3 pins in each capacitive soil moisture sensor that are directly connected with our microcontroller i.e. Arduino Uno. The pins of ESP8266 which we are using as a wifi module is connected with the Arduino Uno board.

The way in which the pins are connected with each other is given below:

- ESP8266 ⟶ Arduino Uno
- Pin CE ⟶ Pin 7
- Pin CSN⟶ Pin 8
- Pin SCK ⟶ Pin 13
- Pin MISO ⟶ Pin 12
- Pin MOSI⟶ Pin 11
- Pin VCC⟶ Pin 3.3V
- Pin GND ⟶ Pin GND
- Soil Moisture Sensor⟶ Arduino Uno
- Pin VCC⟶ Pin 5V
- Pin GND ⟶ Pin GND
- Pin Analog Reading ⟶ Pin A1
- Pin Analog Reading – Pin A2

Node 2 is installed with LCD module, Arduino Uno, ESP8266 wifi module, and ESP8266 Wifi -Module. So, the pins are connected to each other in this way:

- ESP8266 ⟶ Arduino UNO
- LCD Pin SCL-Pin 1
- LCD Pin SLA-Pin 2
- LCD Pin 3v-VU of wifi module
- LCD Pin GND to GND
- Pin CE ⟶ Pin 7
- Pin CSN⟶ Pin 8
- Pin SCK ⟶ Pin 13
- Pin MISO ⟶ Pin 12
- Pin MOSI⟶ Pin 11
- Pin VCC⟶ Pin 3.3V
- Pin GND ⟶ Pin GND
- DHT11 Sensor⟶ Arduino UNO
- Pin VCC⟶ Pin 5V
- Pin GND Pin GND
- Pin DATA⟶ Pin 4
- ESP8266 WiFi Module⟶ Arduino UNO
- Pin VCC⟶ Pin 3.3V
- Pin GND ⟶ Pin GND
- Pin CH_PD ⟶ Pin 3.3V

Node 3 is mounted with NodeMCU and Relay module. So, the pins are connected to each other in this way.

- Relay Module⟶ NodeMCU
- Pin EN⟶ Pin D8
- Pin VCC⟶ Pin Vin
- Pin GND ⟶ Pin GND

Node 3 is mounted with Nodemcu & Relay module. There are 38 pins in Nodemcu & 6 pins for the Relay module.

4.2 DATA TRANSFER PART :-

Now the analog reading is taken from both the soil moisture sensor and sent to the aurdino board through Coding and jump wire the data is now shown in the LCD Screen and the data is also sent to thinks app server through the coding which is mentioned below.

```
#include <SPI.h>
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27, 16, 2);
const int AirValue = 790;   //you need to replace this value with Value_1
const int WaterValue = 390;  //you need to replace this value with Value_2
const int SensorPin = A0;
const int SecondPin = A2; // Second Sensor Pin
int soilMoistureValue = 0;
int soilmoisturepercent=0;
int soilMoistureValue2 = 0;
int soilMoisturepercent2 = 0;
int relaypin = D2;
void setup() {
Serial.begin(115200);
lcd.init();
lcd.backlight();
lcd.clear();
lcd.setCursor(0, 0);
lcd.print("IRRIGATION");
lcd.setCursor(0, 1);
lcd.print("SYSTEM IS ON ");
lcd.print("");
delay(3000);
lcd.clear();
}
void loop()
{
soilMoistureValue = analogRead(SensorPin);  //put Sensor insert into soil
soilMoistureValue2 = analogRead(SecondPin);
Serial.println(soilMoistureValue);
```

```
Serial.println(soilMoistureValue2);
soilmoisturepercent = map(soilMoistureValue, AirValue, WaterValue, 0, 100);
soilMoisturepercent2 = map(soilMoistureValue2, AirValue, WaterValue, 0, 100);
if((soilmoisturepercent >=0 && soilmoisturepercent <= 30) || (soilMoisturepercent2 >=0 && soilMoisturepercent2 <= 30))
{
digitalWrite(relaypin, HIGH);
lcd.print("Motor is ON");
 }
else if ((soilmoisturepercent >45 && soilmoisturepercent <= 100) && (soilMoisturepercent2 >45 && soilMoisturepercent2 < 100) )
{
digitalWrite(relaypin, LOW);
lcd.print("Motor is OFF");
}
```

4.3 Relay Part:-

Now in this part, it is said in code that when moisture sensor will sense the value of moisture content more than the desired value it will indicate the aurdino to switch the NO port of the Relay to NC port which means Normally open and normally closed when the switch of the relay is at normally open it starts to flow the current through it and the current starts the motor is turned on and when the switch turns to Normally Closed the motor turns off

4.4 Working Principle of controlling System:-

Three major parts are involved here,

1. IoT (internet of Things) part: Data are sent from Node 1 to Node

2. Node 2 receives the data from the sensors & transfers it to the Thingspeak cloud server through the internet.

These data are received by node 3 via the internet.

a)This is real-time data monitoring.

b) WSN (Wireless Sensor Network) Part: Data is sent from node 1 to node 2 wirelessly.EP8266 wifi is mounted with it.

c). Automatic/Manual Control Of the Pump through Mobile App(Blynk): The pump will be turned on-off automatically without any external interference.

4.5 Powering the system

The system starts by powering the main unit with a 5-volt adapter or directly by battery.the water pump must be powered with a separate or external power source in case of higher hp of motors are used

Fig.4.5- 5 V Power adapter supply

Fig. 4.5 External Rechargeable Batteries for Motor

4.6 Initiation of the system

As the switch is turned on, the LEDs on the aurdino, moisture sensor, and relay will also glow assuring the correct connection and also indicating the power is reached to those devices or not.

In our project, the project is initiated by connecting to WiFi Using a hotspot provided by any kind of router. When the model turns on the LCD is displayed as "**Connecting WiFi..**"

And search for the SSID provided in the coding as soon as the Wifi is connected the system completes its initiation stage and initiates its process to detect the moisture content by both the sensors.

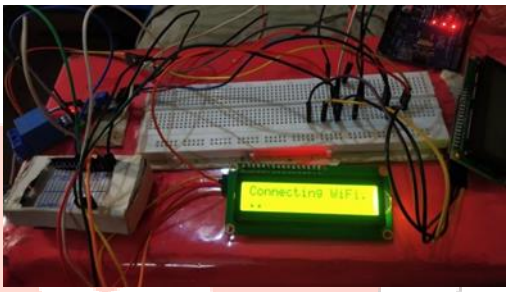


Fig.4.6 Connecting wifi output on the LCD display

4.7 Output on the LCD display

As the system is turned on the following output we will get in order

IRRIGATION SYSTEM IS TURNED ON SEARCHING FOR WIFI-The hotspot of the phone should be turned on and at the same time the internet connection must also be on so that the system will search for it and connect to the Thinkspeak server WIFI IS CONNECTED SUCCESSFULLY- this indicates the successful connection the cellphone's hotspot SHOWS THE MOISTURE PERCENTAGE AND THE STATUS OF MOTOR IF ITS ON OR NOT

4.8 Dual Sensor's application their working and reading from the field

Initially, when the sensors are not deployed on the field The LCD display will show. The status of the motor that it is on and it will also display that the moisture percentage is lesser than 40 % after reading the zero values from both the sensors but as the sensors are once deployed on the field, the sensors will read the moisture values from different location of the field and if the combined values from the sensors are lesser than 40% this statement will be displayed as" moisture <40%" and the motor will be remained on and the status of the motor will also be displayed on LCD that "Motor is on" and as the moisture on the field and the combined moisture value-form both the sensors are more than 70% in LCD the statement will be displayed like "moisture >70%"

And the motor will be automatically turned off without any external effort from any individual.

The status of the motor that it is off will be displayed on the LCD like "motor is turned off"

Fig. 4.7 Shows water pump on status and moisture level <40%

Fig. 4.8 Shows water pump off status and moisture level >70%

4.9 Reason for using Dual moisture sensor

The 2 different moisture sensors can be deployed on the two different locations on the same agricultural field.

And it is more beneficial and practical than the single sensor because lets us suppose a condition on the field. we know this system can only be applied during the non-monsoon season and in the non-monsoon season, the field is irrigated by stored water resources like dam from that the water is brought to the field the pumps and our project will regulate the pump (switch on-off) automatically according to the moisture content and moisture required on the field.

Fig. 4.7 Sensor 1 Moisture Sensor

Fig. 4.8 Sensor 2 (Soil Moisture Sensor)

4.10 Location of application of sensor on field

Out of two sensors one will be deployed at any desirable place which should be near the pump throwing water another sensor will be placed at the farthest place on the field so as the water reaches to first sensor its moisture lever will increase to max level but the motor will not be switched on because the other sensor did not cross the desired level of moisture, so as the water reaches to another sensor with is deployed at the farthest place and its moisture value exceeds the required level then the motor pump will be switched off automatically. Without any human intervention and the field will be prevented from being over irrigated.

Fig. 4.9 Sensors application on the field

4.11 Data collection and its monitoring on ThinkSpeak Webserver

The LCD displays very limited data. Our system is connected to the internet via a mobile phone's hotspot and the exact moisture content its level in percentage with respect to date and time is stored on the website and it can be monitored from around the on the ThinkSpeak web server. And the data can views in the form of Graphs, excel sheet format for better data viewing and its storage. And current moisture content value is also shown on the website separately from two different Sensors in the form of a percentage

The water requirement data can be observed by The Government before designing the Dam and other water storage facilities in that area in order to know the exact figures of water requirement in that area without actually visiting the field. These the methodology of working of Our System and this is how it is supposed to work

5. RESULTS AND DISCUSSIONS

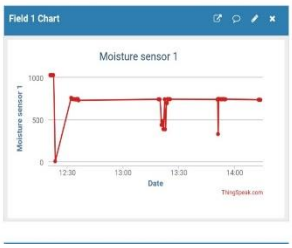
The experiment was carried out by receiving the input data from the soil moisture sensors 1 and 2. The moisture sensor 1 gives an analog output that can be read through the Arduino Uno analog pin A1 and another moisture sensor is connected to another analog pin A2.

we are using a 5v relay module to drive the mini submersible motor pump. The data collected from various sensors are listed in the table given below. Table.1 contains the data from, humidity sensor, Soil moisture sensor 1&2 Indicated as attributes as A1, A2 respectively which denotes the moisture value in percentage.

Table 5.1 Sample Datasheet:-

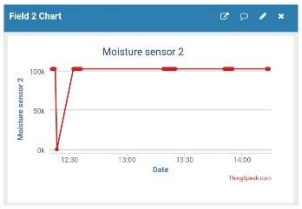
DATE & TIME OF ENTRY	entry_id	A1	A2
2021-12-03T19:36:32+05:30	1	0	
2021-12-04T19:26:28+05:30	2	732	1023
2021-12-04T19:26:44+05:30	3	732	102314
2021-12-04T19:27:05+05:30	4	733	102314
2021-12-04T19:27:20+05:30	5	732	102314
2021-12-04T19:27:35+05:30	6	730	102314
2021-12-04T19:27:58+05:30	7	730	102314
2021-12-04T19:28:17+05:30	8	732	102314
2021-12-04T19:28:34+05:30	9	732	102314
2021-12-04T19:29:12+05:30	10	734	102314
2021-12-04T19:29:32+05:30	11	734	102314
2021-12-04T19:29:48+05:30	12	730	102314
2021-12-04T19:30:19+05:30	13	734	102314
2021-12-04T19:31:11+05:30	14	730	102314
2021-12-04T19:31:28+05:30	15	732	102314
2021-12-04T19:31:44+05:30	16	730	102314
2021-12-04T19:32:01+05:30	17	732	102314
2021-12-04T19:32:17+05:30	18	734	102314
2021-12-04T19:32:53+05:30	19	730	102314
2021-12-04T19:33:09+05:30	20	734	102314
2021-12-04T19:33:24+05:30	21	732	102314

Here the graph is plotted between moisture value with time. The graph of the moisture sensor I am shown below:-



Graph. 5.1

The graph for moisture sensor II is shown below:-



Graph. 5.2

The LCD display shows the status of the pump (i.e. on) when moisture is lesser than a particular percent. The status is shown in the following figure.

Fig. LCD output when moisture <40%

And the LCD display shows the status of the pump (i.e. off) when moisture is more than the threshold percentage. The status is shown in the following figure:

Fig. LCD output when moisture>70%

Hence we can conclude that the above data are capable to interpret the aim of our project.

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