Smart Agriculture and Drip Water Flow System

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Abstract
In recent days, everything depend on smart technology. Irrigation system is also becoming smart by using modern technologies, which are more advantageous than the traditional methods. With this paper, a smart irrigation system is developed that automates the irrigation process with the help of solar power. This proposed system can optimize the use of water based on different data, such as soil moisture. It will also notify its owner about the current condition of the soil and motor through GSM technology. This proposed model can automatically turn ON and OFF the motor pump by sensing the moisture content of the soil depending on the demand of water in the field. A moisture sensor is used to collect data (soil moister level) of a particular area. The motor will automatically turn OFF after fulfilling the demand of water and gets turned ON again when the field becomes dry. GSM technology is used to send updates (ON/OFF) of a motor to the farmers. The whole proposed system is controlled by an Arduino. DC electric power is supplied from solar panels. All these features will make irrigation system much smarter and economical.

Keywords: Arduino, Charge Control Circuit, GSM Technology, Irrigation System, Moisture Sensor, Solar Panel, Water Pump

1. Introduction

1.1. Introduction

The agriculture field has higher contribution in the Indian economy. To achieve maximum utilization of man power and to obtain maximum profit in a given stipulation, there is a need in upgradation of various engineering techniques that are being used today.

Energy consumption all over the world is increasing swiftly with the growth of world population. In order to cope up with the increasing demand, energy generation needs to be increased. Conventional energy sources i.e. fossil fuel which is not environmentally friendly and will finish in near future.

Renewable energy sources can be the best alternate way for energy generation. Nowadays, solar energy is one of the most popular and reliable energy sources. It is considered as a green technology because it does not emit greenhouse gases.

This type of energy is capable of operating DC load smart irrigation system, etc. Irrigation system is the technique which controls the supply of water artificially through pipes, drains, etc. The main objectives of irrigation systems are to help the growth of a plant, landscape maintenance, reduce the effect of inadequate rainfall, etc.

This type of irrigation is very useful for farmers. It can be made with very low cost compared to existing system.

1.2. Existing System

- Among various methods suggested by researchers, one recent method is to improvement in the energy sources.
- In conventional irrigation system runs on the electricity, so a lot of conventional energy is wasted. Which can be easily replaced by the solar energy.
- In this block diagram, solar panel observes the photo voltaic energy. It transfers the energy to the converter and battery.
- The battery stores the energy to supply electric energy to the water pump to run.

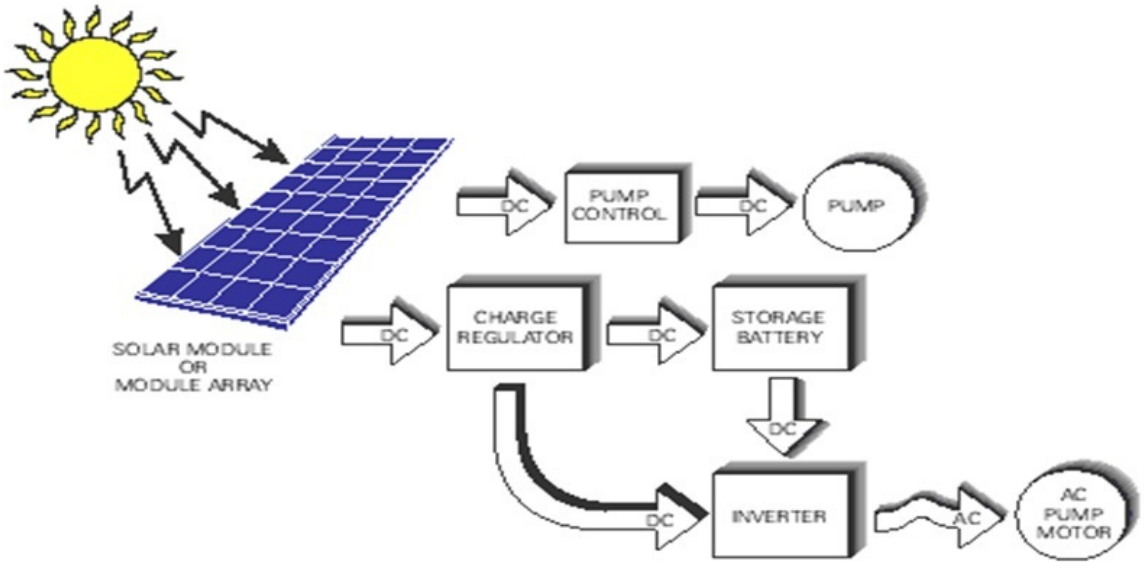

Figure 1.1: Solar Irrigation System

- The solar panel receives energy from the sun and it sends the DC voltage to the charge control and battery.
- The storage battery sends the DC voltage to the inverter. The inverter changes the AC voltage to the DC voltage and sends to the AC pump motor.

1.3. Drawbacks of the Existing System

- The primary disadvantage associated with this system is the expense.
- The existing system has flood method which may result in faster weed growth.
- Furthermore, portions of the lawn will have to be dug up to install pipework and attach it to the plumbing system of the home.

1.4. Proposed System

- In this system, we have proposed efficient usage of water in the agriculture. So, we decided to use drip irrigation in this system.
- The uses of drip irrigation in this system is to control usage of water and to reduce the weed growth in the land.
- We have designed the automated irrigation system with IoT.
- The GSM module has been used to establish a communication link between the farmer and the field.
- The main components of our project is soil moisture sensor, GSM and Arduino Uno.
- We proposed the solar power for the supply, so there is no need of external power supply.
- The proposed system has single phase power supply.

1.5. Drip Irrigation

- Drip irrigation is a type of micro-irrigation system that has the potential to save water and nutrients by allowing water to drip slowly to the roots of plants, either from above the soil surface or buried below the surface.
- The goal is to place water directly into the root zone and minimize evaporation.
- Drip irrigation systems distribute water through a network of valves, pipes, tubing and emitters.
- Depending on how well designed, installed, maintained, and operated it is, a drip irrigation system can be more efficient than other types of irrigation systems, such as surface irrigation or sprinkler irrigation.

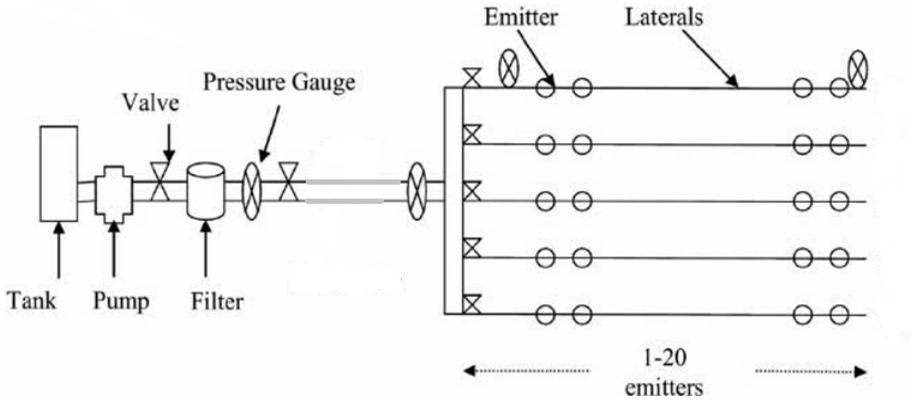

Figure 1.2: Circuit Diagram of Drip Irrigation

1.6. Merits and Application

- Minimal usage of water.
- Lesser manpower.
- Saving of electricity.
- Increase in yield.
- Saving of fertilizer.
- Reduced weed growth.

1.7. Application

- It may also used in rural-remote areas where electrical supply isn't available.
- It can be implemented in modern irrigation system.

- It may be implement by small agriculturists.

2. Literature Survey

"Development of Smart Drip Irrigation System using IoT" by Anushree Math, Layak Ali, U. Pruthviraj. 2018 IEEE Distributed Computing, VLSI, Electrical Circuits and Robotics.

- In this conference paper is based on smart irrigation by using webpage.
- When the water level is reduced in the land it can be detected by the soil moisture sensor and send to the webpage.

"Solar Powered Smart Irrigation System using IoT" by Kshirod Kumar Rout, Samuchita Mallick, Sivkumarn Mishra. 2018 IEEE Conference on Data Science and Business Analystics.

- In this conference paper is based on solar power smart irrigation.
- The required electricity of this system is taken from the solar power.

"Smart Agriculture using Internet of Things with Raspberry Pi" by Zuraida Muhammad, Muhammad Azri Asyraf Mohd Hafez, Nor Adni Mat Leh, Zakiah Mohd Yusoff, Shabinar Abd Hamid. 2020 IEEE International Conference on Control System, Computing and Engineering (ICCSCE).

- This conference paper is based on smart agriculture by using IoT.
- The information of the system is sent to the controller Raspberry Pi.

"IoT based Smart Agriculture Monitoring System" by Dr. N. Suma, Sandra Rhea Samson, S. Saranya, G. Shanmugapriya, R. Subhashri. SNS College of Engineering, Coimbatore, India.

- In this journal paper, the PIR sensor is used to collect the data and send to the controller with the use of webpage.

"A Digital Model for Monitoring Soil and Crops using Internet of Things (IoT)" by O. Pandithuraj, S. Aishwarya, B. Aparna, K. Kavitha. 2017 Third International Conference on Science Technology Engineering & Management (ICONSTEM).

- The main aim of this paper is to propose a wireless sensor network technology in agronomy.

"Solar based Smart Irrigation system Using IoT" by Prachi Subash Kulkarni, Jitendra Rajendra. 2020 International Conference on Smart Innovations in Design, Environment, Management, Planning and Computing (ICSIDEMPC).

- This paper focused on improvement of water management practice in irrigation which are suffering from the various operational deficiencies like load shading.
- This paper will also review the comparison between solar based irrigation and the other energy based irrigation based on various parameters.

"Smart Irrigation with Embedded System" by K.K. Namala, Krishna Kanth Prabhu A.V., Anushree Math, Ashwini Kumari, Supraja Kulkarni. 2016 IEEE Bombay Section Symposium (IBSS).

- This paper proposes intelligent and smart Irrigation system which can be used for controlling the watering or irrigation of flowering plants.
- The system has a sensor which measures the moisture of the soil, and switches relay which controls solenoid valve according to the requirement.

3. Block Diagram and Description

3.1. Block Diagram

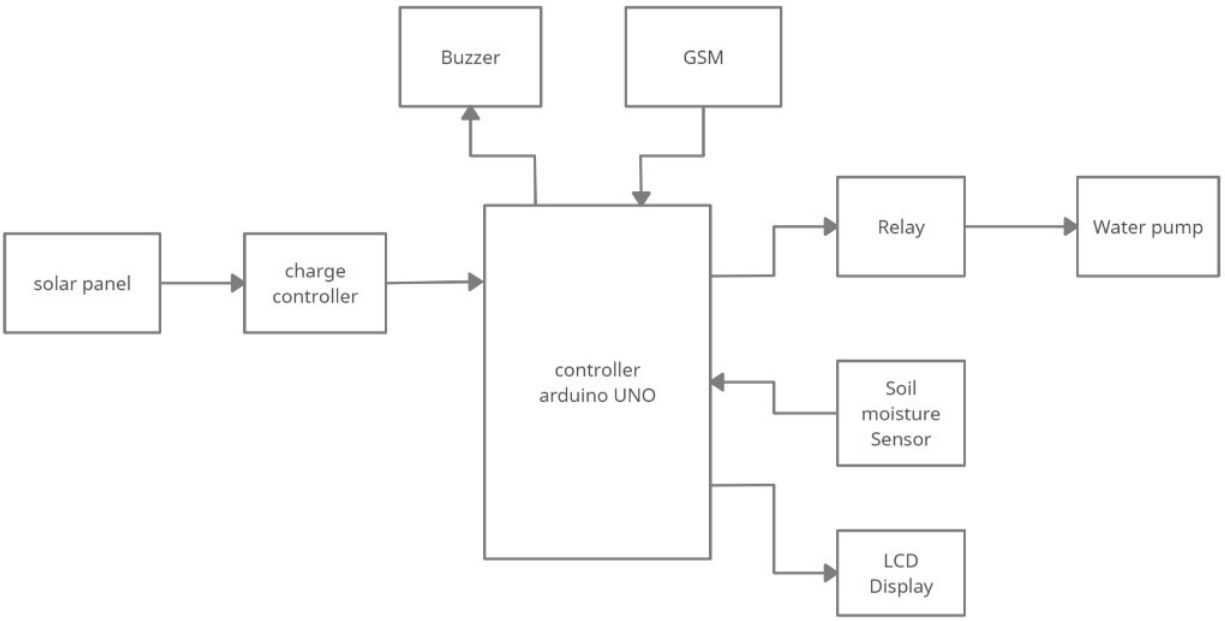

Figure 3.1: Block Diagram

- In this system, solar panel receives the solar power and sends to the charge controller and storage battery.
- The battery stores the energy and it gives to the controller Arduino board.
- When the moisture level is decreased in the land it can be detected by the soil moisture sensor and sends the data to the Arduino.
- The relay is connected to the Arduino board when there is no water in the land the relay will tripped and runs the motor.
- The values are displayed in the LCD display.
- The complete information of this process is sends to the farmer mobile by using the GSM module.

3.2. Hardware Description

- Arduino Uno
- LCD display
- Relay
- Water motor
- Soil moisture sensor
- Solar panel
- Battery
- Buzzer
- Buck converter
- 230 – 12V DC Adapter
- GSM Module

3.2.1. Arduino Uno

- Arduino is an open-source electronics platform based on easy-to-use hardware and software.
- Arduino boards are able to read inputs - light on a sensor, a finger on a button and turn it into an output - activating a motor, turning on an LED, publishing something online.
- You can control your board by sending a set of instructions to the microcontroller on the board.
- Arduino Uno is the most standard board available and probably the best choice for a beginner.
- We can directly connect the board to the computer via a USB cable which performs the function of supplying the power as well as acting as a serial port.

Vin: This is the input voltage pin of the Arduino board used to provide input supply from an external power source.
5 V: This pin of the Arduino board is used as a regulated power supply voltage and it is used to give supply to the board as well as on-board components.
3.3 V: This pin of the board is used to provide a supply of 3.3 V which is generated from a voltage regulator on the board.
GND: This pin of the board is used to ground the Arduino board.
Reset: This pin of the board is used to reset the microcontroller. It is used to reset the microcontroller.
Analog Pins: The pins A0 to A5 are used as an analog input and it is in the range of 0-5 V.
Digital Pins: The pins 0 to 13 are used as a digital input or output for the Arduino board.
Serial Pins: These pins are also known as a UART pin. It is used for communication between the Arduino board and a computer or other devices. The transmitter pin number 1 and receiver pin number 0 is used to transmit and receive the data resp.
External Interrupt Pins: This pin of the Arduino board is used to produce the External interrupt and it is done by pin numbers 2 and 3.
PWM Pins: This pin of the board is used to convert the digital signal into an analog by varying the width of the Pulse. The pin numbers 3, 5, 6, 9, 10 and 11 are used as a PWM pin.

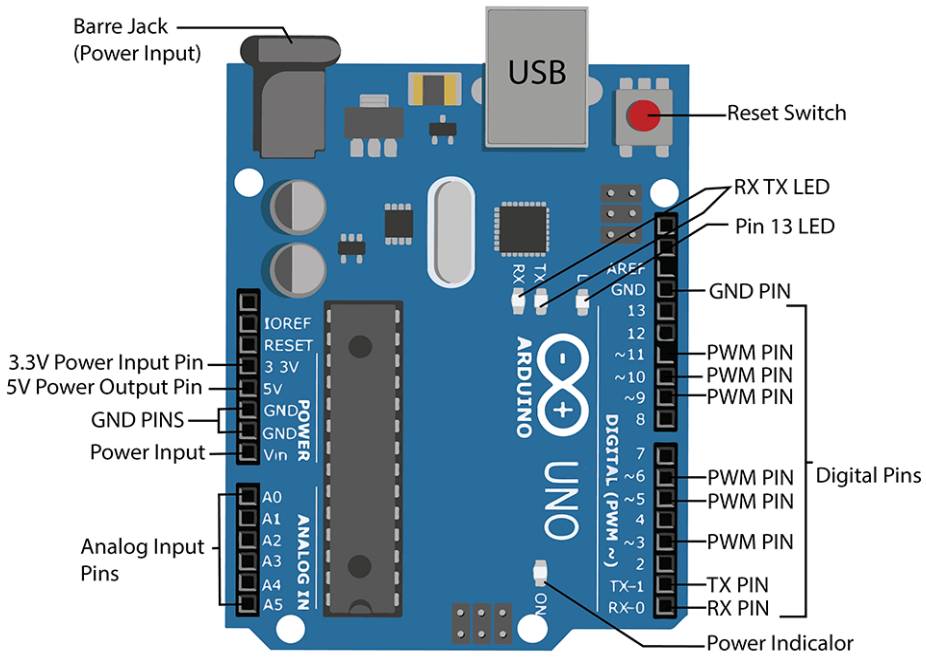

Figure 3.2: Arduino Uno

Types of Arduino Boards

- Arduino Uno (R3)
- LilyPad Arduino
- Red Board
- Arduino Mega (R3)
- Arduino Leonardo

LilyPad Arduino

- The Lily Pad Arduino is a microcontroller board designed for wearables and e-textiles.
- It can be sewn to fabric and similarly mounted power supplies, sensors and actuators with conductive thread.
- The Lily Pad Arduino was designed and developed by Leah Buechley and Spark Fun Electronics.

Red Board

- The Spark Fun Red Board is an Arduino-compatible development platform that enables quick-and-easy project prototyping.
- It can interact with real-world sensors, control motors, display information, and perform near-instantaneous calculations.

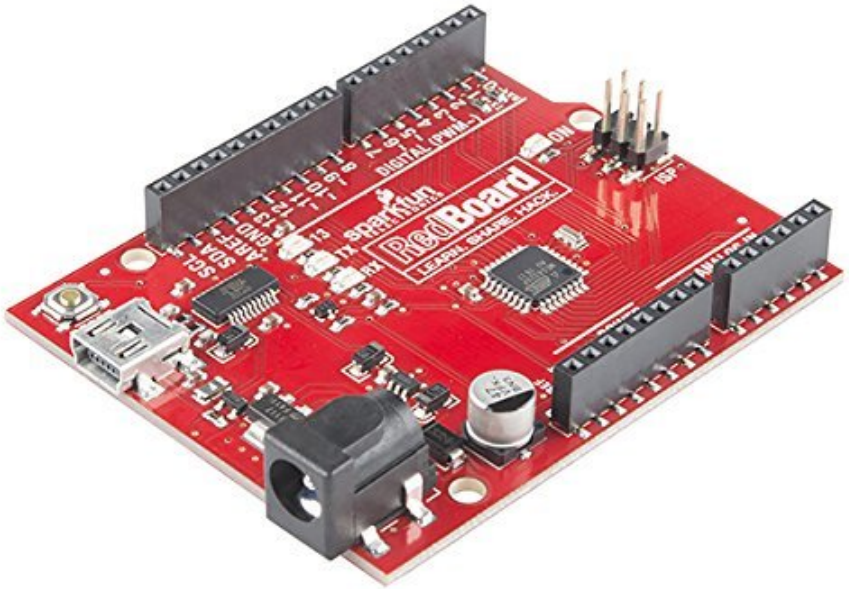

Figure 3.3: Red Board

Arduino Mega (R3)

- The Arduino Mega 2560 R3 is an opensource precise microcontroller board Successor to the Arduino Mega based on the ATmega2560 SMD chip.
- The Mega 2560 R3 also adds SDA and SCL pins next to the AREF.
- The Mega 2560 R3 works with all existing shields but can adapt to new shields which use these additional pins.

Arduino Leonardo

- The Arduino Leonardo is a microcontroller board based on the ATmega32u4 (datasheet).

- It has 20 digital input/output pins (of which 7 can be used as PWM outputs and 12 as analog inputs), a 16 MHz crystal oscillator, a micro USB connection, a power jack, an ICSP header, and a reset button.

3.2.2. LCD Display

- They work by using liquid crystals to produce an image.
- The liquid crystals are embedded into the display screen, and there's some form of backlight used to illuminate them.
- When the backlight is activated, it produces light that is somewhat obstructed by the liquid crystals.

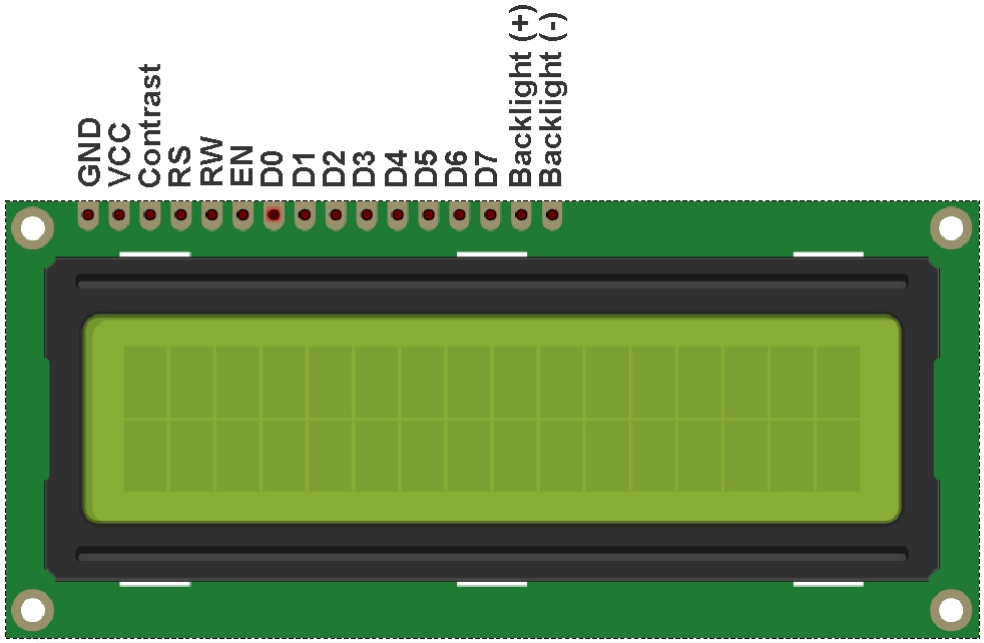

Figure 3.4: LCD Display

3.2.3. Relay

- A relay can be defined as a switch. Switches are generally used to close or open the circuit manually.
- Relay is also a switch that connects or disconnects two circuits.
- But instead of manual operation a relay is applied with electrical signal, which in turn connects or disconnects another circuit.
- 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.
- The switch may have any number of contacts in multiple contact forms, such as make contacts, break contacts, or combinations thereof.

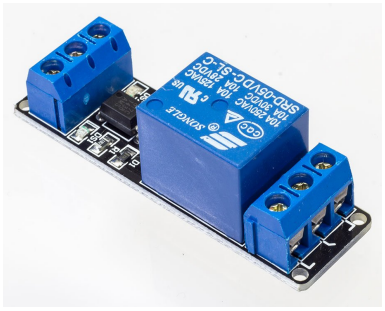

Figure 3.5: Relay

Types of Relay

- Reed Relay.
- Polarized Relay.
- Buchholz Relays.
- Inverse Definite Minimum Time Relays (IDMT Relays).
- Differential Relays.

Reed Relay

- A reed relay is a type of relay that uses an electromagnet to control one or more reed switches.
- The contacts are of magnetic material and the electromagnet acts directly on them without requiring an armature to move them. Sealed in a long, narrow glass tube, the contacts are protected from corrosion.

Figure 3.6: Reed Relay

Polarized Relay

- Polarized Relays use the magnetic flux of the permanent magnet in their electromagnetic sections.
- This means that the operating coil has polarity.

Buchholz Relays

- In electric power distribution and transmission, a Buchholz relay is a safety device.
- Mounted on some oil-filled power transformers and reactors, equipped with an external overhead oil reservoir called a "conservator".

Differential Relay

- The differential relay is one that operates when there is a difference between two or more similar electrical quantities exceeds a predetermined value.
- In the differential relay scheme circuit, there are two currents come from two parts of an electrical power circuit.

3.2.4. Water Motor

- The working principle of a water pump mainly depends upon the positive displacement principle as well as kinetic energy to push the water.
- These pumps use AC power, otherwise DC power for energizing the motor of the water pump, whereas others can be energized other kinds of drivers like gasoline engines or diesel.

Figure 3.7: Water Motor

3.2.5. Soil Moisture Sensor

- Soil moisture sensors measure the volumetric water content in soil.
- Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighing of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil.
- Such as electrical resistance, dielectric constant, or interaction with neutrons as a proxy for the moisture content.
- The relation between the measured property and soil moisture must be calibrated and may vary depending on environmental factors such as soil type, temperature or electric conductivity.
- Reflected microwave radiation is affected by the soil moisture and is used for remote sensing in hydrology and agriculture.
- Portable probe instruments can be used by farmers or gardeners.
- The Soil Moisture Sensor uses capacitance to measure dielectric permittivity of the surrounding medium.
- In soil, dielectric permittivity is a function of the water content.
- The sensor creates a voltage proportional to the dielectric permittivity, and therefore the water content of the soil.
- The sensor averages the water content over the entire length of the sensor. There is a 2 cm zone of influence with respect to the flat surface of the sensor, but it has little or no sensitivity at the extreme edges.
- The moisture of the soil plays an essential role the irrigation field as well as in gardens for plants.
- As nutrients in the soil provide the food to the plants for their growth. Supplying water to the plants is also essential to change the temperature of the plants.
- The temperature of the plant can be changed with water using the method like transpiration. And plant root systems are also developed better when rising within moist soil.
- Extreme soil moisture levels can guide to anaerobic situations that can encourage the plant's growth as well as soil pathogens.

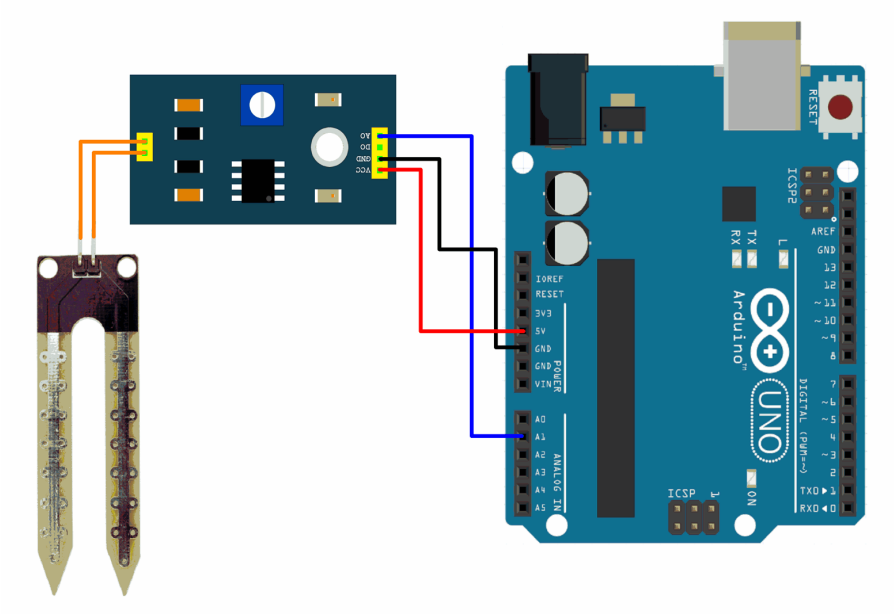

Figure 3.8: Soil Moisture Sensor

3.2.6. Solar Panel

- Solar panels work by absorbing sunlight with photovoltaic cells, generating direct current (DC) energy and then converting it to usable alternating current (AC) energy with the help of inverter technology.
- Excess electricity produced by solar panels is fed to the electric grid.
- Sunlight hits the solar panels, and creates an electric field.
- The electricity generated flows to the edge of the panel, and into a conductive wire.
- The conductive wire brings the electricity to the inverter, where it is transformed from DC electricity to AC, which is used to power buildings.
- Another wire transports the AC electricity from the inverter to the electric panel on the property (also called a breaker box), which distributes the electricity throughout the building as needed.
- Any electricity not needed upon generation flows through the utility meter and into the utility electrical grid. As the electricity flows through the meter, it causes the meter to run backwards, crediting your property for excess generation.
- The term Solar Panel is used colloquially for a photo-voltaic (PV) module.
- A PV module is an assembly of photo-voltaic cells mounted in a framework for installation.
- Photo-voltaic cells use sunlight as a source of energy and generate direct current electricity.

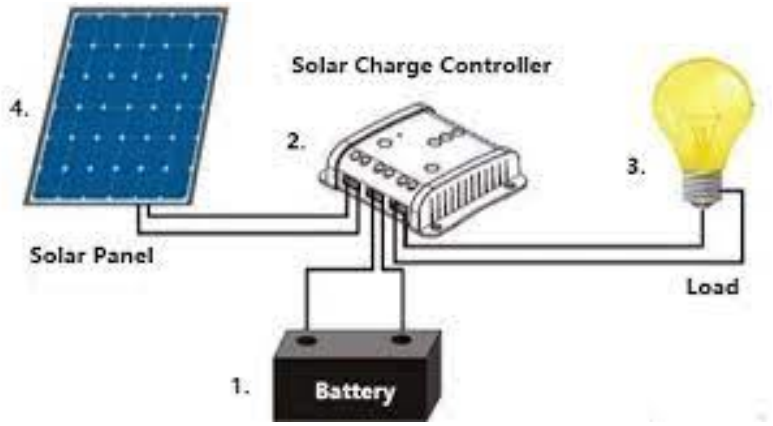

Figure 3.9: Solar Panel Connection

3.2.7. Battery

- A battery is a device that stores chemical energy and converts it to electrical energy.
- The chemical reactions in a battery involve the flow of electrons from one material (electrode) to another, through an external circuit.
- The flow of electrons provides an electric current that can be used to do work.

Battery Types

- Lead Acid battery
- Lithium Ion battery

Lead Acid Battery

- The lead acid storage batteries is formed by dipping lead peroxide plate and sponge lead plate in dilute sulfuric acid.
- A load is connected externally between these plates.
- In diluted sulfuric acid the molecules of the acid split into positive hydrogen ions (H^+) and negative sulfate ions (SO_4^{--}).

Figure 3.10: Lead Acid Battery

Lithium Ion Battery

- A Lithium Ion Battery or Li-Ion Battery is a type of rechargeable battery.
- Lithium-Ion batteries are commonly used for portable electronics and electric vehicles and are growing in popularity for military and aerospace applications.

Figure 3.11: Lithium Ion Battery

3.2.8. Buzzer

- The vibrating disk in a magnetic buzzer is attracted to the pole by the magnetic field.
- When an oscillating signal is moved through the coil, it produces a fluctuating magnetic field which vibrates the disk at a frequency equal to that of the drive signal.

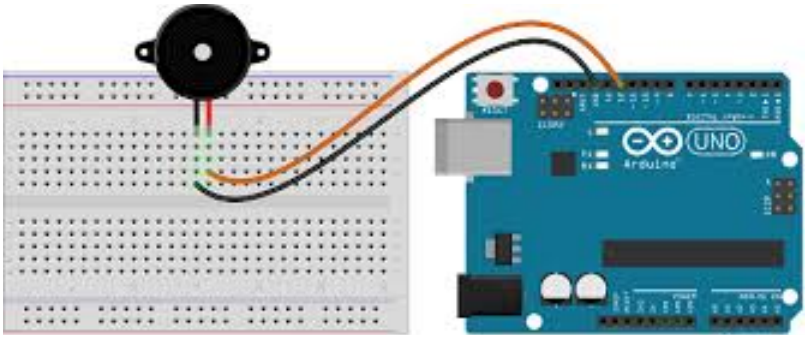

Figure 3.12: Buzzer Connection

3.2.9. Buck Converter

- A buck converter (step-down converter) is a DC-to-DC power converter which steps down voltage (while drawing less average current) from its input (supply) to its output (load).
- It is a class of switched-mode power supply (SMPS) typically containing at least two semiconductors (a diode and a transistor, although modern buck converters frequently replace the diode with a second transistor used for synchronous rectification) and at least one energy storage element, a capacitor, inductor, or the two in combination.
- To reduce voltage ripple, filters made of capacitors (sometimes in combination with inductors) are normally added to such a converter's output (load-side filter) and input (supply-side filter).

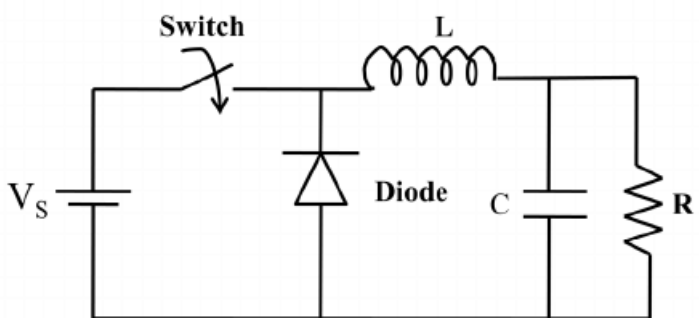

Figure 3.13: Buck Converter

3.2.10. 230-12 V DC Adapter

- Originally, most DC adapters were linear power supplies, containing a transformer to convert the mains electricity voltage to a lower voltage.
- A rectifier to convert it to pulsating DC, and a filter to smooth the pulsating waveform to DC, with residual ripple variations small enough to leave the powered device.

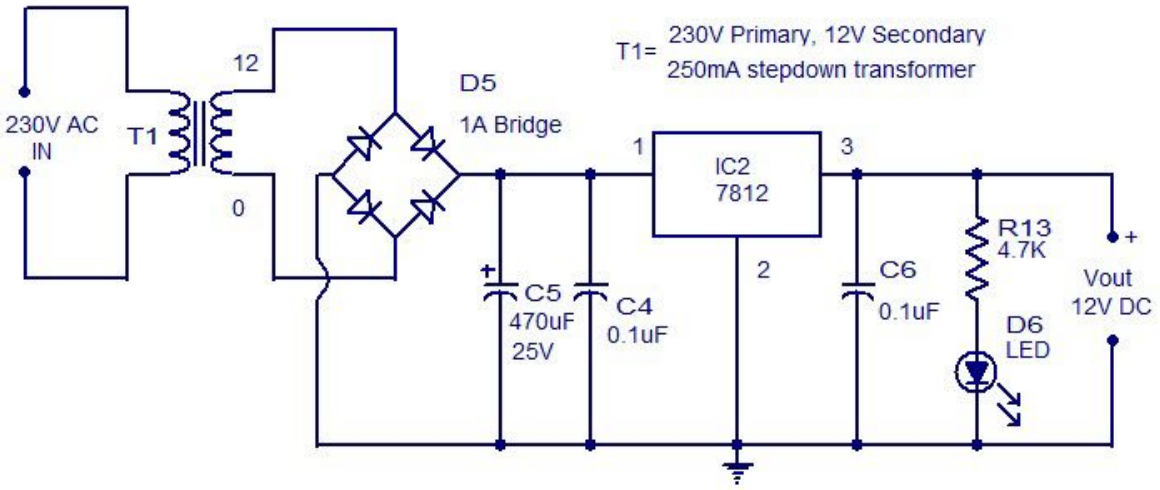

Figure 3.14: 12 V DC Adapter

3.2.11. GSM Module

- A GSM modem or GSM module is a hardware device that uses GSM mobile telephone technology to provide a data link to a remote network.
- From the view of the mobile phone network, they are essentially identical to an ordinary mobile phone, including the need for a SIM to identify themselves to the network.

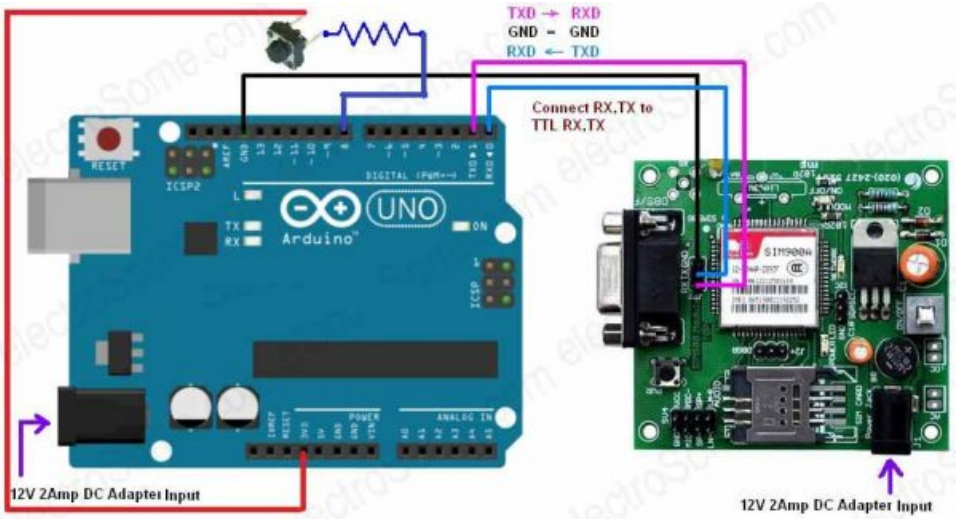

Figure 3.15: GSM Module with Arduino

4. Software Description

```
#include <SoftwareSerial.h>
#include "LiquidCrystal_I2C.h"
LiquidCrystal_I2C lcd(0x27, 16, 2);
SoftwareSerial k(2,3); // D5,D6,false,256
// Initialize the library by associating any needed LCD interface pin
#include "DHT.h"
#define DHTPIN 11 // Digital pin connected to the DHT sensor
// Feather HUZZAH ESP8266 note: use pins 3, 4, 5, 12, 13 or 14 --
// Pin 15 can work but DHT must be disconnected during program upload.
// Uncomment whatever type you're using
```

```
#define DHTTYPE DHT11 // DHT 11
DHT dht(DHTPIN, DHTTYPE);

void setup()
{
	Serial.begin(9600); // Setting the baud rate of GSM Module
	k.begin(9600);
	lcd.init();
	lcd.backlight();
	dht.begin();
	pinMode(2, OUTPUT);
	// Print a message to the LCD
	lcd.setCursor(0, 0); // Column and Row
	lcd.print("Welcome");
	delay(2000);
	//RecieveMessage();
}

int a, b;
int status_1, status_2;

void loop()
{
	delay(2000);
	float h = dht.readHumidity();
	float t = dht.readTemperature();
	// Compute heat index in Fahrenheit (the default)
	Serial.print(F("Humidity: "));
	Serial.print(h);
	Serial.print(F("% Temperature: "));
	Serial.print(t);
	Serial.println(F("°C "));

	delay(100);
	lcd.clear();
	lcd.setCursor(0, 1);
	lcd.print("Hum: ");
	delay(100);
	lcd.setCursor(0, 7);
	lcd.print(h);
	delay(100);
	lcd.clear();
	lcd.setCursor(1, 1);
	lcd.print("Tem: ");
	delay(100);
	lcd.setCursor(1, 7);
	lcd.print(t);
	delay(100);
	int sensorValue1 = analogRead(A0);
	float voltage1 = sensorValue1 * (5.0 / 1023.0);
	int sensorValue2 = analogRead(A1);
	float voltage2 = sensorValue2 * (5.0 / 1023.0);

	if(voltage1 < 2)
```

```
{
	lcd.clear();
	lcd.setCursor(0, 1);
	lcd.print("Motor 1 ON");
	delay(100);
	digitalWrite(10, HIGH);

	if(status_1 == 0)
	{
		sms1();
		Serial.println("SMS Sent");
	}

	status_1 = 1;
	delay(100);
}
else
{
	lcd.clear();
	lcd.setCursor(0, 1);
	lcd.print("Motor 1 OFF");
	delay(100);
	digitalWrite(10, LOW);

	if(status_1 == 1)
	{
		sms1();
		Serial.println("SMS Sent");
	}

	status_1= 0;
	delay(100);
}

if(voltage2 < 2)
{
	lcd.clear();
	lcd.setCursor(0, 1);
	lcd.print("Motor 2 ON");
	delay(100);
	digitalWrite(12, HIGH);

	if(status_2 == 0)
	{
		sms1();
		Serial.println("SMS Sent");
	}

	status_2 = 1;
	delay(100);
}
else
{
	lcd.clear();
```

```
            lcd.setCursor(0, 1);
            lcd.print("Motor 2 OFF");
            delay(100);
            digitalWrite(12, LOW);

            if(status_2 == 1)
            {
                  sms1();
                  Serial.println("SMS Sent");
            }

            status_2 = 0;
            delay(100);
      }
}

void sms1()
{
      k.println("ATD9xxxxxxxx8;"); // Sets the GSM Module in Text Mode
      delay(6000);
      k.println("ATH");
      k.println("AT+CMGF=1"); // Sets the GSM Module in Text Mode
      delay(1000); // Delay of 1000 milliseconds or 1 second
      k.println("AT+CMGS=\"+919xxxxxxxx8\"\r"); // Replace x with mobile number
      delay(200);
      k.println("Motor 1 ON"); // The SMS text you want to send
      delay(200);
      k.println((char)26); // ASCII code of Ctrl + Z
      delay(200);
}

void sms2()
{
      k.println("ATD9xxxxxxxx8;"); // Sets the GSM Module in Text Mode
      delay(6000);
      k.println("ATH");
      k.println("AT+CMGF=1"); // Sets the GSM Module in Text Mode
      delay(1000); // Delay of 1000 milliseconds or 1 second
      k.println("AT+CMGS=\"+919xxxxxxxx8\"\r"); // Replace x with mobile number
      delay(200);
      k.println("Motor 1 OFF"); // The SMS text you want to send
      delay(200);
      k.println((char)26); // ASCII code of Ctrl + Z
      delay(200);
}

void sms3()
{
      k.println("ATD9xxxxxxxx8;"); // Sets the GSM Module in Text Mode
      delay(6000);
      k.println("ATH");
      k.println("AT+CMGF=1"); // Sets the GSM Module in Text Mode
      delay(1000); // Delay of 1000 milliseconds or 1 second
      k.println("AT+CMGS=\"+919xxxxxxxx8\"\r"); // Replace x with mobile number
```

```
        delay(200);
        k.println("Motor 2 ON"); // The SMS text you want to send
        delay(200);
        k.println((char)26); // ASCII code of Ctrl + Z
        delay(200);
}

void sms4()
{
        k.println("ATD9xxxxxxxx8;"); // Sets the GSM Module in Text Mode; Replace x with
mobile number
        delay(6000);
        k.println("ATH");
        k.println("AT+CMGF=1"); // Sets the GSM Module in Text Mode
        delay(1000); // Delay of 1000 milliseconds or 1 second
        k.println("AT+CMGS=\"+919xxxxxxxx8\"\r"); // Replace x with mobile number
        delay(200);
        k.println("Motor 2 OFF"); // The SMS text you want to send
        delay(200);
        k.println((char)26); // ASCII code of Ctrl + Z
        delay(200);
}

void RecieveMessage()
{
        k.println("AT+CNMI=2,2,0,0,0"); // AT Command to receive a live SMS
        delay(1000);
}

/*
void smsNO(String name1, String status1)
{
        k.println("AT+CMGF=1"); // Sets the GSM Module in Text Mode
        delay(1000); // Delay of 1000 milliseconds or 1 second
        k.println("AT+CMGS=\"+919xxxxxxxx7\"\r"); // Replace x with mobile number
        delay(200);
        k.println("CHILD NAME : " + name1 + " STATUS : " + status1); // The SMS text you want
to send
        delay(200);
        k.println((char)26); // ASCII code of Ctrl + Z
        delay(200);
}
*/
```

6. Conclusion

- In this smart irrigation system, an automated mode of operation is designed for watering purposes.
- It works perfectly in the absence of the owner by detecting the soil condition through a moisture sensor.
- Arduino runs the irrigation system. It also notifies its user about current status of both soil and motor.
- Here solar power is used for electricity. This method of watering the soil is very helpful for farmers.

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