International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 03 | March - 2024 SJIF Rating: 8.176 ISSN: 2582-3930

IoT Based Smart Irrigation System

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Abstract:
Smart irrigation refers to an advanced agricultural and landscaping technique that leverages technology, data, and automation to optimize water usage for irrigation. It encompasses the use of sensors, weather forecasts, and automation systems to monitor soil moisture levels, weather conditions, and plant requirements. By employing real-time data and intelligent algorithms, smart irrigation systems aim to deliver precise amounts of water to plants, reducing water wastage, conserving resources, and improving crop yields or landscape health. This approach holds the promise of addressing water scarcity issues and enhancing sustainable agriculture and landscaping practices.

Keywords:
1.Arduino IDE program software.
2.Development board ESP8266.
3.Communication devices.
4.Sensors.
5.Watering devices.
6.Drip irrigation.

I. INTRODUCTION

Smart irrigation is an innovative approach to water management in agriculture and landscaping, leveraging technology to optimize the use of water resources. Traditional irrigation methods often result in inefficient water usage and can lead to overwatering or under watering, which can be detrimental to crops and landscapes. In contrast, smart irrigation systems use a combination of sensors, data analytics, and automation to make irrigation more precise, efficient, and environmentally friendly[1].

These systems typically employ sensors to monitor various environmental factors such as soil moisture, weather conditions, and plant health. The data collected from these sensors is then processed and analysed to determine when and how much water is needed.

By integrating weather forecasts and historical data, smart irrigation systems can make real-time decisions about irrigation scheduling, ensuring that water is applied only when necessary. This approach not only conserves water but also reduces energy costs associated with pumping and distributing water.

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Moreover, smart irrigation systems can be remotely controlled and monitored through mobile apps or web-based platforms, providing users with the flexibility to manage their irrigation systems from anywhere. This level of control and automation enhances convenience and allows for quick adjustments based on changing conditions.Overall, smart irrigation is a crucial advancement in water management, promoting sustainability and resource conservation in agriculture and landscaping while also contributing to increased crop yields and healthier plants.

COMPNENTS OF SMART IRRIGATION

1)Arduino IDE program software: Arduino IDE is an open-source software platform used for programming Arduino microcontroller boards.

1. Arduino IDE is a user-friendly integrated development environment.

2. It simplifies programming for Arduino boards using C/C++.

3. It offers a code editor with syntax highlighting and auto completion.

4. Libraries and examples are included to facilitate code development.

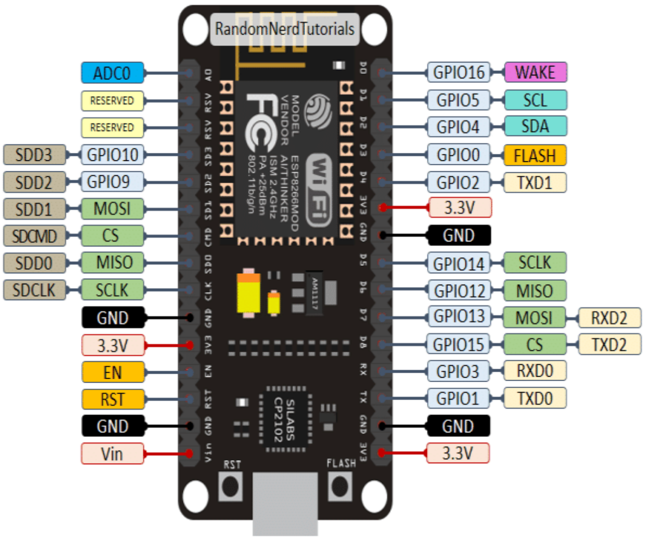
5. A simple interface uploads code to the connected Arduino hardware.

6. It supports various Arduino board models and compatible hardware.

7. Serial monitoring tools assist in debugging and data exchange.

8. Arduino IDE is free and available for Windows, macOS, and Linux.

Development board ESP8266:



Connectivity: The ESP8266 can connect to Wi-Fi networks and GSM, enabling the irrigation system to access the internet. This connectivity can be used for remote monitoring, control, and data exchange.

Sensor Integration: You can connect various sensors to the ESP8266, such as soil moisture sensors, DHT11, Soil pH sensor, or rain sensor. The ESP8266 can collect data from these sensors, providing real-time information about soil conditions and weather forecasts.

Automation: Using the data collected from sensors, the ESP8266 can implement automation rules to optimize irrigation. For example, it can trigger irrigation only when soil moisture levels drop below a certain threshold or when rain is not expected.

Power efficiency: Implement power-saving features to ensure the ESP8266 operates efficiently and conserves energy, especially if the system relies on battery power.

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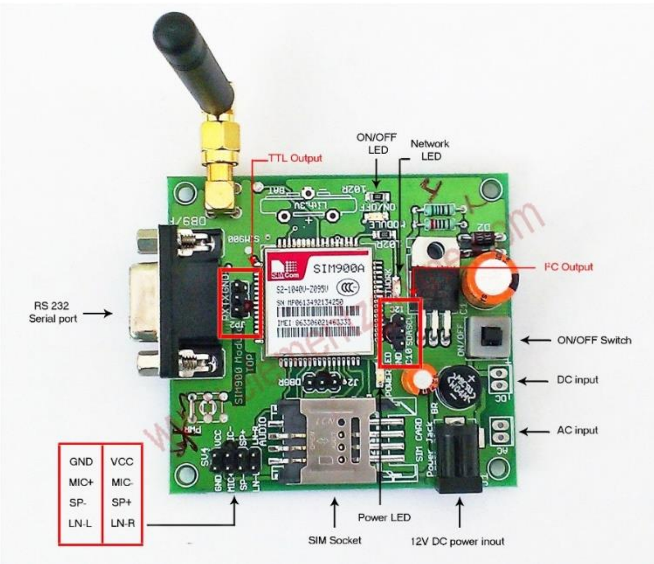
Scalability: The ESP8266 can be used in both small-scale and large-scale smart irrigation systems, making it versatile for various applications.

2.**Communication devices:**



Data Communication: The ESP8266 connects to a GSM module, typically via UART communication. The GSM module has a SIM card for cellular data access.

Internet Connectivity: Once connected, the ESP8266 can access the internet through the GSM module. It can send and receive data from a central server or cloud platform for real-time monitoring and control.

Remote Control: Smart irrigation systems can be controlled remotely via SMS or through a web interface hosted by the ESP8266. Users can change irrigation schedules, turn the system on or off, or receive system status updates.

Data Logging: The ESP8266 can log sensor data and upload it to a central server for historical analysis and decision-making. This data may include soil moisture levels, weather forecasts, and irrigation schedules.

Notifications: The system can send SMS or push notifications to users for alerts, such as low soil moisture or system malfunctions. Users can be informed of important events in real-time.

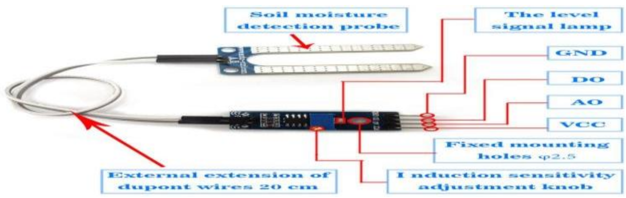
Energy Efficiency: To conserve power in remote areas, the ESP8266 and GSM module can be configured to enter sleep mode when not in use, reducing energy consumption.

Scalability: GSM connectivity makes smart irrigation systems more versatile and suitable for remote locations where Wi-Fi or wired internet access is not available.

We can control and monitor the smart irrigation system using GSM from all over the India.

4.SENSORS:

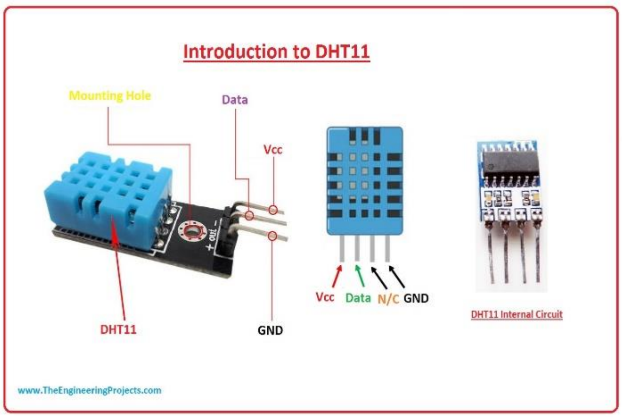
- SOIL MOISTURE SENSOR:



Soil moisture sensor using a measuring soil moisture level and get moisture level like a Dry or wet, normal.Dry: (520 430], Wet: (430 350],Water: (350 260] .Peak value of sensor 1024.

It commonly uses in Smart farming.

DHT11:



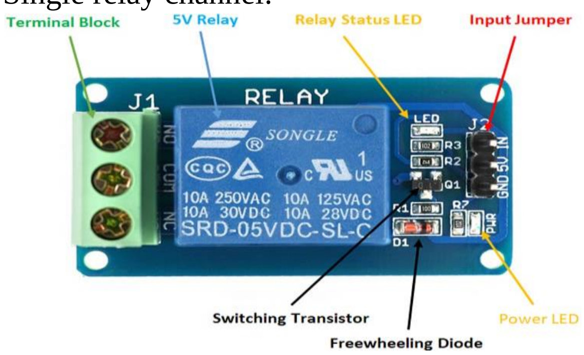
Using a DHT11 sensor we can detect the temperature and humidity level surrounding environment. GSM sends the notifications to the user about the temperature and humidity level in yield.

Watering devices:

Water pump:

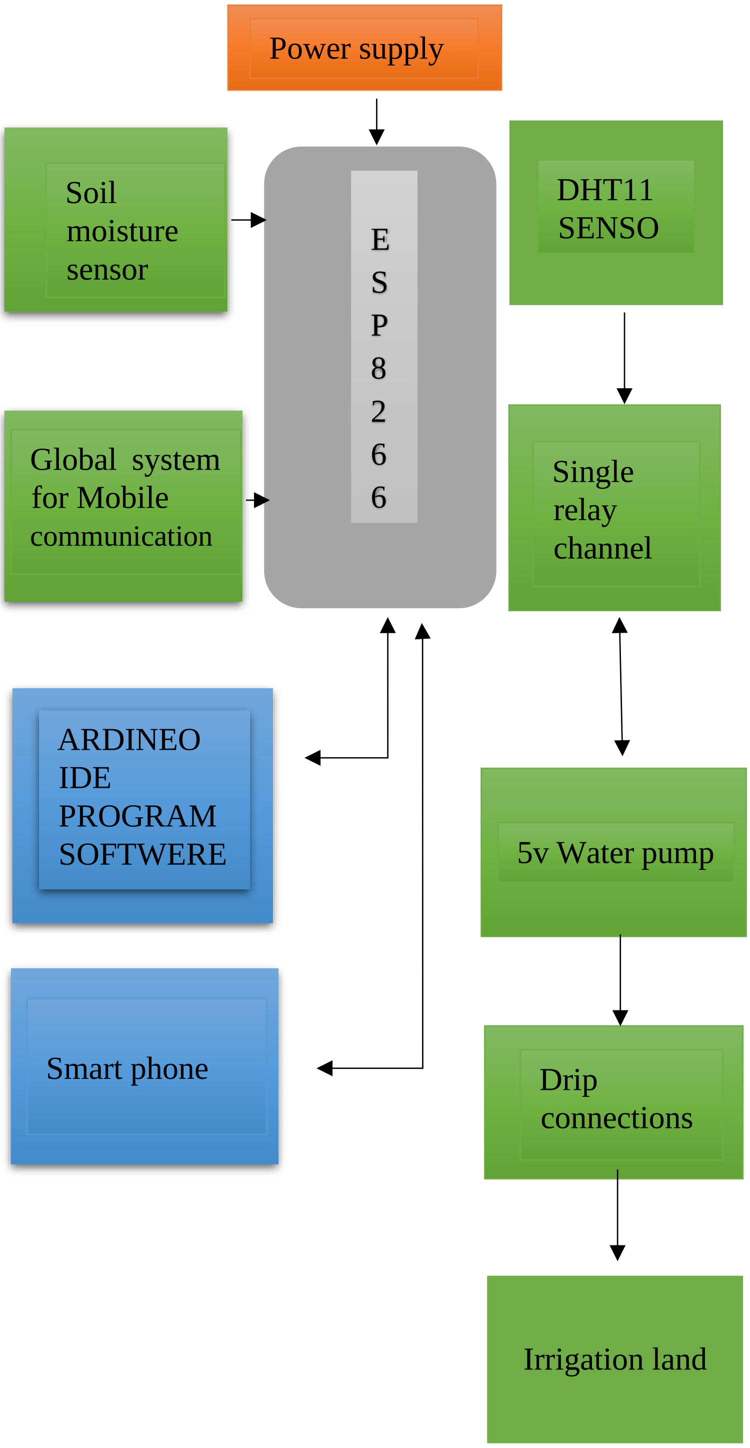
A water pump in a smart irrigation system is essential for efficiently delivering water to crops. It is controlled by sensors and automation technology to provide the right amount of water at the right time, conserving resources and optimizing plant growth. The system can adjust pump operations based on weather forecasts and soil moisture levels. This smart approach helps reduce water wastage and improve crop yields. ESP8266 controlled the motor and send the status of motor conditions with the support GSM.

Single relay channel:

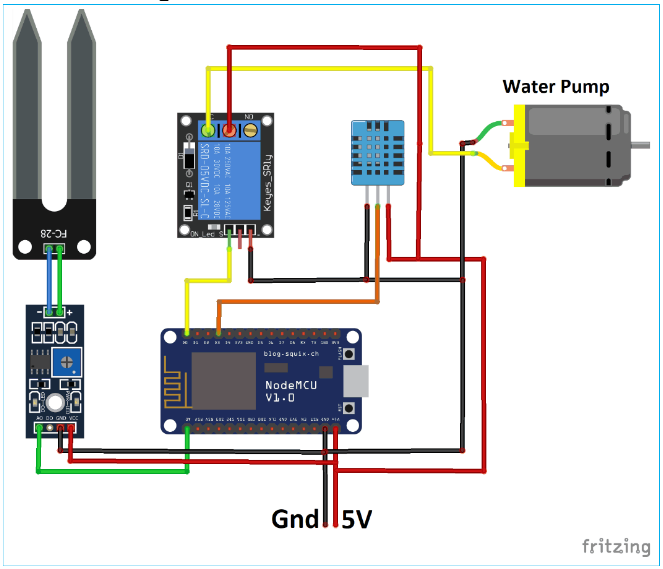


A relay channel in a smart irrigation system controls a water pump. It serves as a switch that can be remotely operated to start or stop the pump, allowing for efficient and automated irrigation. This technology enables precise control over water distribution in agricultural fields, conserving resources and optimizing crop growth.

BLOCK DIAGRAM:



Circuit Diagram:



Program:

```
#include <ESP8266WiFi.h>
#include <Wire.h>
#include <Adafruit_Sensor.h>
#include <DHT.h>
#include <GSM.h>

#define DHTPIN 2        // DHT11 data pin
#define DHTTYPE DHT11   // DHT sensor type

DHT dht(DHTPIN, DHTTYPE);

const int soilMoisturePin = A0;
const int moistureThreshold = 50; // Adjust this
threshold as needed

const char* ssid = "Your_SSID";
const char* password = "Your_Password";
const char* gsmAPN = "Your_GSM_APN";
const char* gsmUsername =
"Your_GSM_Username";
const char* gsmPassword =
"Your_GSM_Password";
GSM gsmAccess;
void setup() {
  Serial.begin(115200);
  dht.begin();
  // Connect to Wi-Fi
  WiFi.begin(ssid, password);
  while (WiFi.status() != WL_CONNECTED)
{
 delay(1000);
 Serial.println("Connecting to WiFi...");
 }
 Serial.println("Connected to WiFi");
// Initialize GSM
Serial.println("Connecting to GSM...");
  While
(gsmAccess.begin
(gsmAPN, gsmUsername,gsmPassword)
!=GSM_READY)
{
 delay(1000);
 Serial.println("Connecting to GSM...");
 }
 Serial.println("Connected to GSM");
 }
 void loop()
 {
  float temperature = dht.readTemperature();
  float humidity = dht.readHumidity();
  int soilMoisture = analogRead(soilMoisturePin);
  if (soilMoisture < moistureThreshold)
  {
    // Soil is too dry, activate irrigation
    // You can add your irrigation control logic here
    Serial.println("Soil is dry - Activate irrigation");
    // For demonstration, you can send a text
message   here via GSM
    sendSMS("Soil is dry - Activate irrigation");
  }
  Serial.print("Temperature: ");
  Serial.println(temperature);
  Serial.print("Humidity: ");
  Serial.println(humidity);
  Serial.print("Soil Moisture: ");
  Serial.println(soilMoisture);

 delay(60000); // Delay for one minute (adjust as
needed)
}
```

```
  void sendSMS(const char* message) {
  GSM_SMS sms;
  sms.beginSMS("Recipient_Phone_Number");
  sms.print(message);
  sms.endSMS();
}
```

Connections:

1. Sensors: Soil moisture sensors, DHT11connected NodeMCU to the system to gather data about soil conditions

2. Control Unit: A central control unit or controller ESP8266, GSM often connected to the internet, processes the sensor data and controls irrigation schedules.

3. Valves: Solenoid valves are used to control the flow of water to different zones. These valves can be connected to the control unit for remote operation.

4. Pumps: In some cases, water pumps are integrated into the system to ensure adequate water pressure for irrigation.

5. Communication: The system may use Wi-Fi, GSM, cellular, or other communication methods to connect to the internet, allowing remote control and monitoring via smartphone apps or web interfaces.

8. Mobile Apps: Users can connect to the system through mobile apps like GSM sends notification to monitor the system, adjust settings, and receive alerts.

8. Drip or Sprinkler System: The irrigation system itself, whether it's a drip system, sprinklers, or other irrigation methods, is connected to the valves for water distribution.

9. Power Supply: The various components may require electrical power, so connections to power sources are essential.

10. Data Storage and Analysis: Data collected by the system can be stored and analysed to improve irrigation efficiency over time.

Advantages:

1. Water conservation: Smart irrigation systems optimize water usage, reducing wastage.

2. Cost savings: Efficient water use lowers utility bills for homeowners and farmers.

3. Automation: Remote control and scheduling make irrigation convenient.

4. Improved plant health: Precise watering fosters healthier landscapes and crops.

5. Environmental benefits: Reduced runoff and pollution enhance ecosystems.

Disadvantages:

1. Initial cost: Smart systems can be expensive to install.

2. Technical complexity: Requires setup and maintenance skills.

3. Power dependency: Reliance on electricity or batteries can be a drawback.

4. Connectivity issues: Network problems may disrupt remote control.

5. Compatibility challenges: Integration with existing irrigation can be tricky.

Conclusion:

The conclusion of a smart irrigation system is that it offers numerous benefits, including efficient water usage, reduced maintenance, and improved crop yields. By using sensors and technology to monitor soil conditions and weather data, it can automatically adjust irrigation schedules, conserving water resources. Additionally, it provides real-time data and control through smartphone apps, making it convenient for farmers and gardeners. Overall, smart irrigation systems play a crucial role in sustainable agriculture and water conservation.

Reference:

1."Smart Irrigation Systems: A Comprehensive Review",John A. Smith, Sarah E. Johnson.
Water Resources Research.2019.