SMART IRRIGATION SYSTEM USING PRECISION FARMING

A PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

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Submitted for the Viva-Voce examination held on ……………….

INTERNAL EXAMINER **EXTERNAL EXAMINER**

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ABSTRACT

Agriculture 4.0, as the future of farming technology, includes several key enabling technologies towards sustainable agriculture. The use of state-of-the-art technologies, such as the Internet of Things, transform traditional cultivation practices, like irrigation, to modern solutions of precision agriculture. In this paper, we present in detail the subsystems and the architecture of an intelligent irrigation system for precision agriculture, the AREThOU5A IoT platform. We describe the operation of the IoT node that is utilized in the platform. Moreover, we apply the radiofrequency energy harvesting technique to the presented IoT platform, as an alternative technique to deliver power to the IoT node of the platform. To this end, we fabricate and validate a rectenna module for radiofrequency energy harvesting.

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CHAPTER 1

INTRODUCTION

1.1 GENERAL INTRODUCTION OF THE PROJECT:

The Smart Irrigation System using Precision Farming is an innovative approach that integrates advanced technologies, such as sensors, GPS, and data analytics, to optimize irrigation management. This system enables farmers to make data-driven decisions, reducing water waste, enhancing crop yields, and promoting sustainable agriculture practices.Agriculture is the backbone of many economies worldwide, and irrigation plays a vital role in crop cultivation. However, traditional irrigation methods often result in water wastage, reduced crop yields, and decreased farm profitability. To address these challenges, this project proposes the development of a Smart Irrigation System using Precision Farming techniques.

Precision Farming involves the use of advanced technology, such as sensors, GPS, and data analytics, to optimize crop yields and reduce waste. By integrating Precision Farming techniques with irrigation systems, farmers can make data-driven decisions to optimize water usage, reduce energy consumption, and enhance crop yields.Smart Irrigation Systems leverage real-time weather data to anticipate environmental conditions. By adjusting irrigation schedules based on upcoming weather patterns, farmers can adapt to changing circumstances, ensuring efficient water management

Smart irrigation technology uses weather data or soil moisture data to determine the irrigation need of the landscape. Smart irrigation technology includes: These products maximize irrigation efficiency by reducing water waste, while maintaining plant health and quality is the process of applying water to the crops artificially to fulfil their water requirements. Nutrients may also be provided to the crops through irrigation. The various sources of water for irrigation are wells, ponds, lakes, canals, tube-wells and even dams.

1.2 OBJECTIVES:

This paper presents a smart irrigation system that addresses the three mentioned challenges to pave the way for a solution to precision agriculture. The system will measure the water tank levels, soil moisture, humidity, temperature, rain levels and will fetch the weather forecast for temperature and rain levels and us-ing its algorithm it will decide when to start the irrigation process and for how long. The system will provide the farmers with a web portal that contains the system status that's includes water tank level, water pump status, weather fore-cast, sensors measurements. Agriculture is one of the main sources of income in the economy.

One of the key components in an agriculture system is its irrigation system. The efficiency and practicality of the irrigation system will have a direct impact on crops yield. One of the main challenges for an irrigation system is water scarci-ty. Another challenge is time, based on the used irrigation system the task of watering the field could be labor-intensive and time-consuming. To maximize crop yield, farmers must practice precision agriculture, and that is an another challenge

1.3 PROPOSED SYSTEM:

A smart irrigation system based on precision farming integrates advanced technologies like sensors, IoT, data analytics, and automation to optimize water usage and improve crop productivity. The system begins with a network of sensors strategically placed in the field to measure critical parameters such as soil moisture, temperature, humidity, pH levels, and nutrient concentrations. These sensors provide real-time, location-specific data that reflect the precise water and nutrient needs of the crops. Weather forecasts, rainfall predictions, and satellite imagery are integrated into the system to account for environmental conditions and variability. The data is transmitted via IoT devices, using communication protocols such as LoRa, ZigBee, or GSM, to a centralized platform where machine learning algorithms analyze it to determine the ideal irrigation schedule. Automated valves and drip irrigation systems are controlled based on this analysis, ensuring water is delivered only when and where it is needed, minimizing waste and runoff.

1.4 AIM OF THE PROJECT:

Modern agriculture faces several challenges, including water scarcity, inefficient irrigation practices, and the adverse effects of climate change. Traditional irrigation systems often result in water wastage, uneven distribution, and over-irrigation, which can harm crops and reduce productivity. At the same time, the growing global demand for food necessitates efficient and sustainable resource management. These challenges highlight the need for innovative solutions to optimize water usage in agriculture while ensuring high crop yields and environmental sustainability.

The primary aim of a smart irrigation system using precision farming is to enhance water management by using advanced technologies to deliver water precisely when and where it is needed. By incorporating real-time data from sensors, weather forecasts, and satellite imagery, the system tailors irrigation schedules to meet the specific needs of crops. This reduces water wastage, prevents over-irrigation, and improves overall crop health, leading to higher productivity and better resource utilization.

The system leverages technologies such as IoT, soil and environmental sensors, automated valves, and data analytics. Sensors monitor parameters like soil moisture, temperature, humidity, and nutrient levels, while IoT devices transmit this data to a centralized platform. The platform processes the information using algorithms to determine optimal irrigation patterns. Farmers can monitor and control the system remotely through a mobile or web application, ensuring flexibility and ease of operation.

A smart irrigation system based on precision farming not only addresses immediate agricultural challenges but also promotes long-term sustainability. It helps conserve water, reduce energy usage, and minimize operational costs for farmers. Additionally, it supports environmental goals by preventing soil degradation, reducing runoff, and lowering greenhouse gas emissions associated with water pumping. Ultimately, the system aims to ensure food security while preserving natural resources for future generations

CHAPTER 2
LITERATURE SURVEY

Precision agriculture focuses on optimizing agricultural inputs like water, fertilizers, and pesticides by using technology to make data-driven decisions. A study by W. He et al. (2020) highlights that integrating smart irrigation systems with precision farming can reduce water usage by up to 40% while maintaining or even enhancing crop yield. These systems utilize sensors, IoT, and machine learning algorithms to adapt irrigation based on real-time field conditions, providing a sustainable solution for modern agriculture.

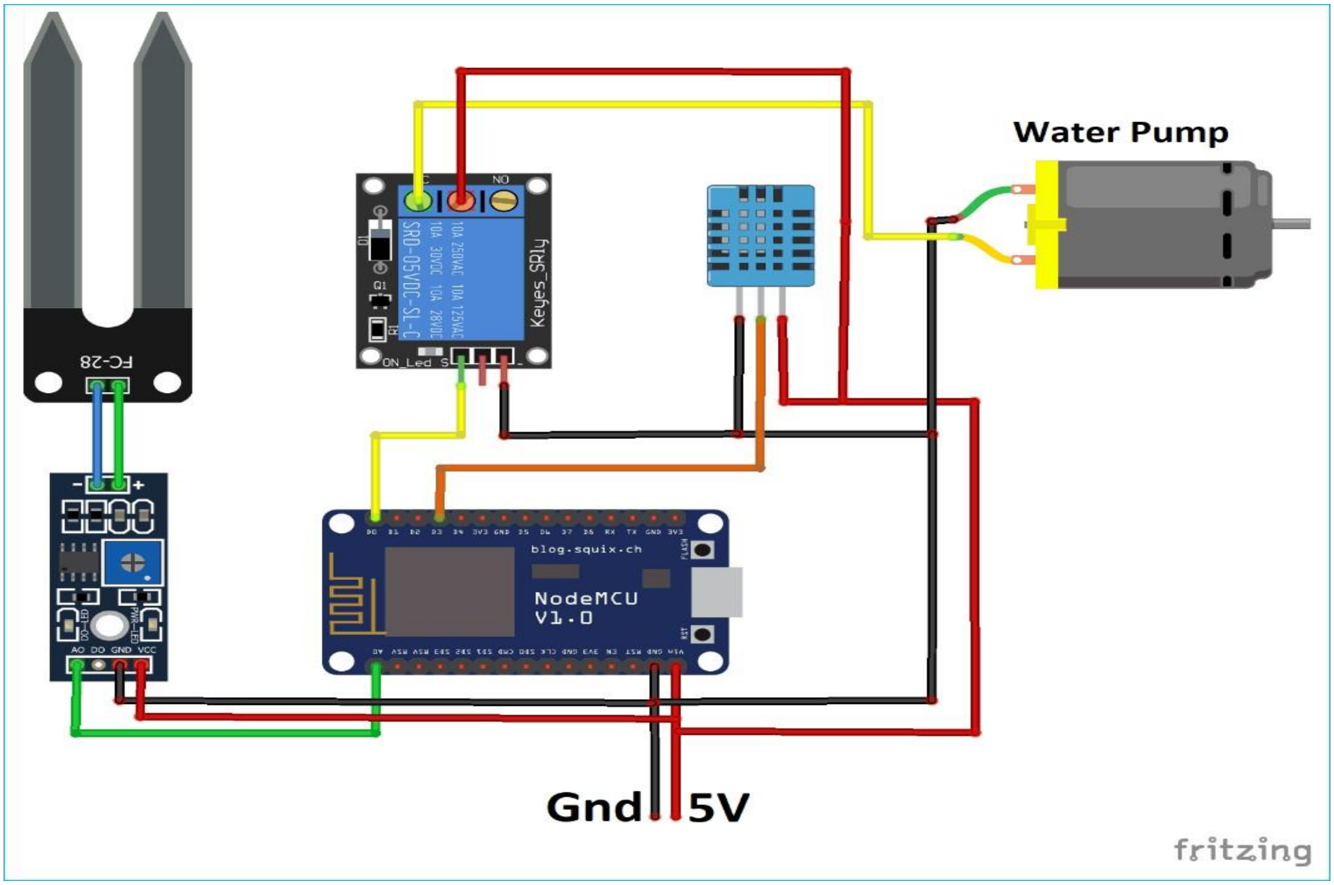
Research by Kumar et al. (2018) demonstrates that soil moisture sensors play a critical role in precision irrigation. By continuously monitoring soil water levels, these sensors enable irrigation systems to activate only when necessary. This reduces water wastage and prevents over-irrigation, which can lead to waterlogging and nutrient leaching. The study further emphasizes the importance of combining soil sensors with environmental data, such as temperature and humidity, for accurate irrigation decisions.

IoT-based systems have revolutionized irrigation practices by enabling real-time data collection, transmission, and analysis. According to Patil et al. (2019), IoT devices like microcontrollers and communication modules (e.g., LoRa, ZigBee) allow remote monitoring and control of irrigation systems. The study found that farmers could achieve better water management and reduce labor costs by using mobile or web applications to control irrigation schedules.

Weather forecasting plays a vital role in improving irrigation efficiency. A study by Jagtap and Jha (2021) demonstrated that combining weather data with AI algorithms can predict optimal irrigation times and water requirements. This approach minimizes water usage during rainy periods and avoids unnecessary irrigation, contributing to resource conservation and crop health.

CHAPTER 3

BLOCK DIAGRAM

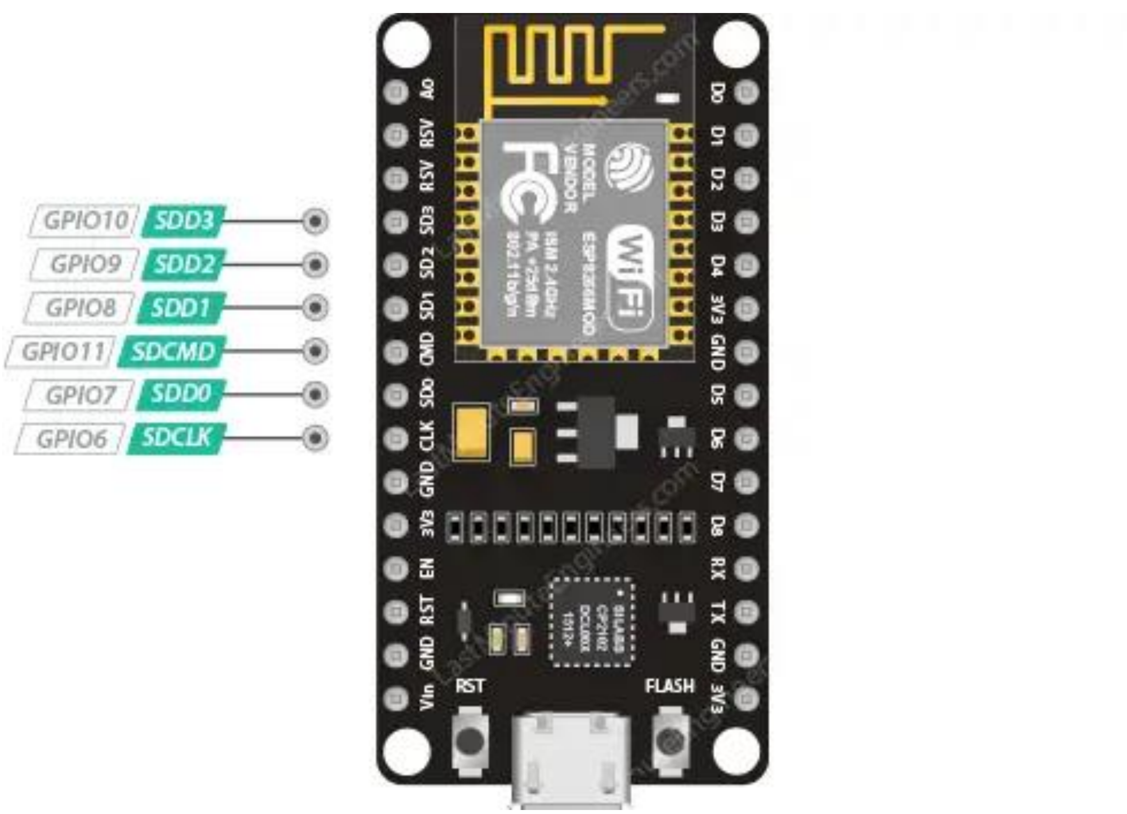


CHAPTER 4

COMPONENTS

4.1 NodeMCU ESP8266

The NodeMCU ESP8266 is a low-cost, open-source IoT platform that combines the features of a microcontroller and a Wi-Fi module, making it highly suitable for IoT applications. It is based on the ESP8266 chip, a 32-bit microcontroller with a clock speed of 80 MHz, and supports multiple communication protocols like I2C, SPI, UART, and PWM. With its built-in Wi-Fi capabilities, the NodeMCU ESP8266 can operate as a Wi-Fi station, access point, or both simultaneously, enabling seamless wireless connectivity. It offers 11 GPIO pins for interfacing with sensors and actuators and includes a 10-bit ADC for analog input.



4.1 NodeMCU ESP8266

The board can be programmed using the Arduino IDE or Lua scripting, with extensive libraries and community support for easy development. Its compact size, affordability, and versatility make it ideal for applications like smart irrigation systems, where it can collect data from soil moisture sensors, communicate with cloud platforms, and enable remote monitoring and control. Despite its limitations, such as operating at 3.3V and limited GPIO pins.

The ESP8266 is built around the Tensilica L106 32-bit microprocessor, running at 80 MHz (it can be overclocked to 160 MHz).Typically ranges from 1MB to 16MB, depending on the specific version of the NodeMCU.The ESP8266 has about 80KB of RAM available for user programs, which is quite limited compared to more powerful microcontrollers but sufficient for many IoT applications.

The NodeMCU ESP8266 offers 2.4 GHz Wi-Fi connectivity, supporting 802.11 b/g/n protocols.It can operate as a Wi-Fi station (STA), connecting to existing Wi-Fi networks, or an access point (AP), allowing other devices to connect directly to it.It is also capable of Wi-Fi Direct and Wi-Fi Protected Setup (WPS), making it easy to integrate into various networks.

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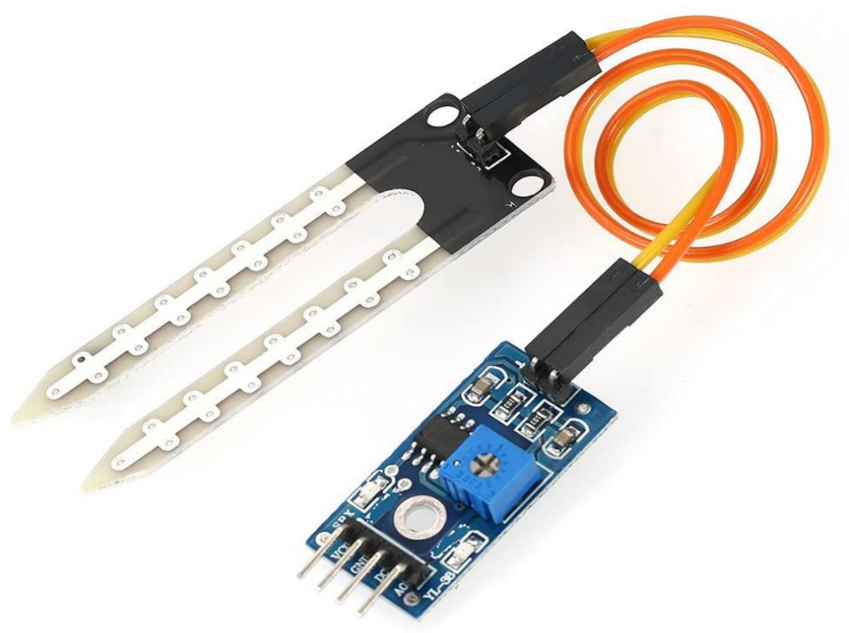
4.2 Soil Moisture Sensor Module

A Soil Moisture Sensor Module is a device used to measure the moisture content in soil, which is critical for optimizing irrigation systems, especially in precision farming and smart irrigation applications. The sensor helps in monitoring the water levels in the soil, ensuring crops receive the right amount of water without over-irrigation or water stress.

By providing real-time data about soil moisture, these sensors help automate irrigation processes, conserving water, reducing operational costs, and improving crop health.



4.2 Soil Moisture Sensor Module

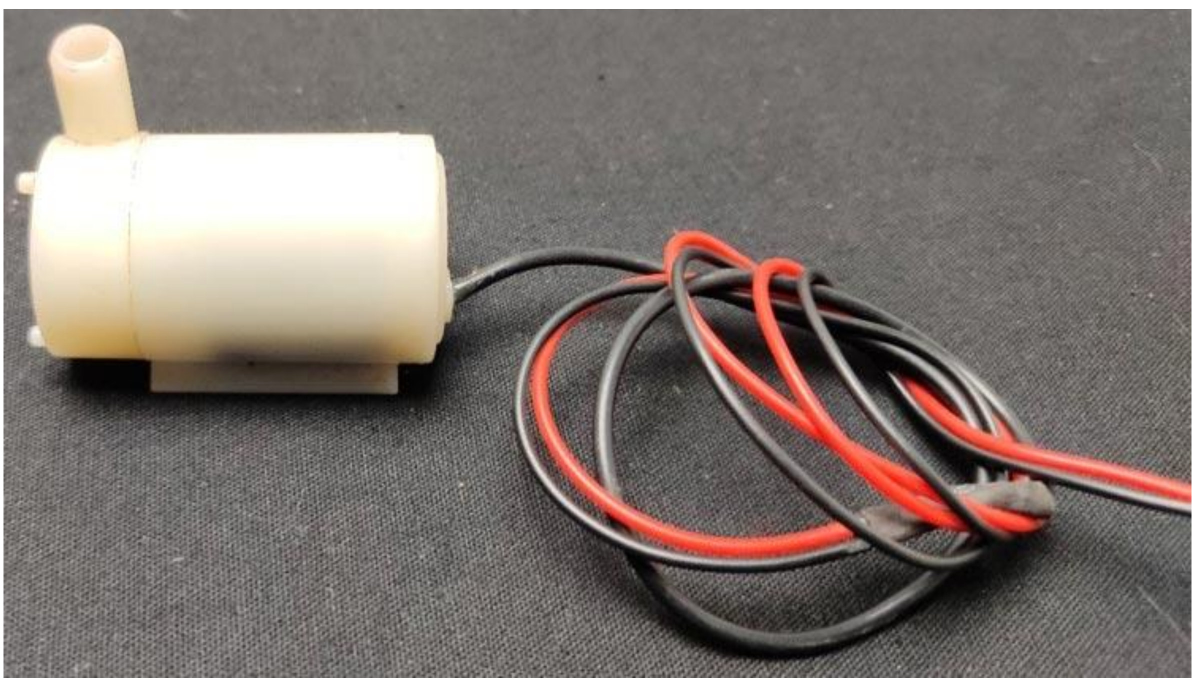
Measures the dielectric permittivity of the soil. The capacitance changes with the amount of water in the soil, providing a more accurate and stable reading compared to resistive sensors.Measures the resistance between two probes inserted into the soil. The resistance decreases as the soil moisture increases, and this value can be used to estimate the moisture content.

The sensor detects soil moisture levels and outputs either an analog signal or a digital signal based on the detected level.Analog output provides continuous data representing the moisture percentage, while digital output can signal when the soil is too dry or too wet (using a predefined threshold).The sensor is compatible with microcontrollers like Arduino, Raspberry Pi, and NodeMCU ESP8266, making it simple to integrate into IoT systems.

The Soil Moisture Sensor Module is an essential component in precision agriculture and irrigation systems. It is used to measure the moisture level in soil, providing real-time data that helps optimize water usage and maintain healthy plant growth. The sensor is widely used in applications such as smart irrigation systems, greenhouse monitoring, and agricultural automation.

4.3 Water Pump Module

A Water Pump Module is a device used in various applications where water needs to be moved from one location to another. In the context of smart irrigation systems and precision farming, it plays a critical role by enabling the automation of irrigation processes, where water is delivered to plants or crops based on soil moisture readings or other sensor data. Water pump modules are often integrated with microcontrollers (such as NodeMCU or Arduino) to create automated systems that can be controlled remotely or operate based on specific conditions like soil moisture or weather data.



4.3 Water Pump Module

The module is designed to pump water from a reservoir or source to the desired location, such as soil, plant pots, or irrigation pipes.Operates on a low DC voltage, typically 5V, 6V, or 12V, depending on the type of water pump, making it suitable for battery-operated or IoT-based systems.Many pump modules are small and portable, allowing for use in small-scale projects such as indoor gardening or hydroponics.Submersible pumps often produce minimal noise, making them ideal for quiet environments.The module can be easily controlled via microcontrollers like Arduino, Raspberry Pi, or NodeMCU ESP8266 using a relay or motor driver.

These pumps are placed directly into the water source, such as a well or tank, and pump the water from the bottom to the surface. They are widely used in irrigation systems due to their ability to move large volumes of water.These are used for precise fluid transfer and often used in applications like agricultural nutrient delivery systems. They work by squeezing a tube with rollers to push water through.These are typically used for moving small amounts of water in various systems and are known for their durability and reliability.

4.4 Relay Module

A Relay Module is an electronic component that acts as a switch to control high-voltage or high-current devices, such as water pumps, motors, lights, and other appliances, using low-voltage signals from a microcontroller or microprocessor. It allows microcontrollers like Arduino, NodeMCU, or Raspberry Pi to control devices that operate at higher voltages or currents than the microcontroller can safely handle. Relay modules are essential for creating automated systems, including smart irrigation systems, home automation, and industrial controls.

A relay consists of an electromagnet, a spring-loaded armature, and contacts. When a low-voltage current passes through the coil (electromagnet), it generates a magnetic field that pulls the armature, closing or opening the contacts to complete or break the circuit of a high-voltage device.

4.4 Relay Module

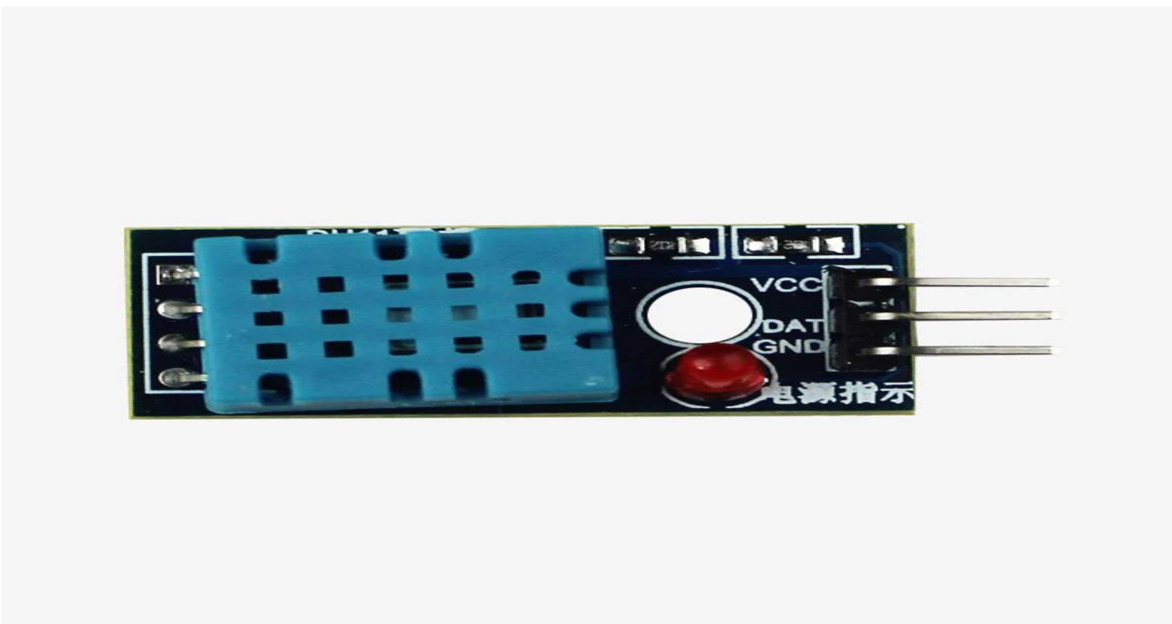
Relays provide complete electrical isolation between the control circuit (low voltage) and the load (high voltage), ensuring safety and protection.A low-power signal from a microcontroller can operate the relay, making it ideal for use with devices that operate at much higher voltages and currents.Available in various configurations, including single-channel, dual-channel, and multi-channel modules, allowing the control of multiple devices.Most relay modules include onboard LEDs to indicate the relay's status (ON/OFF), simplifying troubleshooting and monitoring.Typical relay modules can control loads of up to 250V AC or 30V DC with currents of up to 10A.

4.5 DHT11 Sensor

The DHT11 is a low-cost, digital temperature and humidity sensor widely used in electronics projects and IoT applications. It is an ideal choice for systems where monitoring environmental conditions such as temperature and humidity is required. The sensor is compact, easy to use, and provides reliable data, making it popular in smart irrigation systems, weather monitoring stations, and home automation projects.

Measures temperature in the range of 0°C to 50°C with an accuracy of ±2°C.Measures relative humidity in the range of 20% to 90% RH with an accuracy of ±5% RH.Provides a single digital signal output, making it easy to interface with microcontrollers without requiring an analog-to-digital converter (ADC).Small and lightweight, suitable for compact projects or portable devices.

The sensor uses a capacitive humidity sensing element. Changes in environmental humidity alter the capacitance of the element, and this change is processed to provide humidity readings.A thermistor inside the sensor detects temperature changes. The resistance of the thermistor varies with temperature, and the internal microcontroller converting this data.



4.5 DHT11 Sensor

DHT11 communicates with microcontrollers using a proprietary one-wire protocol.The microcontroller sends a start signal, and the DHT11 responds by sending temperature and humidity data as a digital signal. Used in smart thermostats or environmental monitoring systems to maintain comfortable indoor conditions. Tracks temperature and humidity to ensure optimal growing conditions for plants.

Operates only within a temperature range of 0°C to 50°C and humidity range of 20% to 90%, making it unsuitable for extreme environments.Can only provide one reading per second, which may not be sufficient for applications requiring rapid data updates.Temperature accuracy of ±2°C and humidity accuracy of ±5% RH may not meet the precision requirements of certain applications.

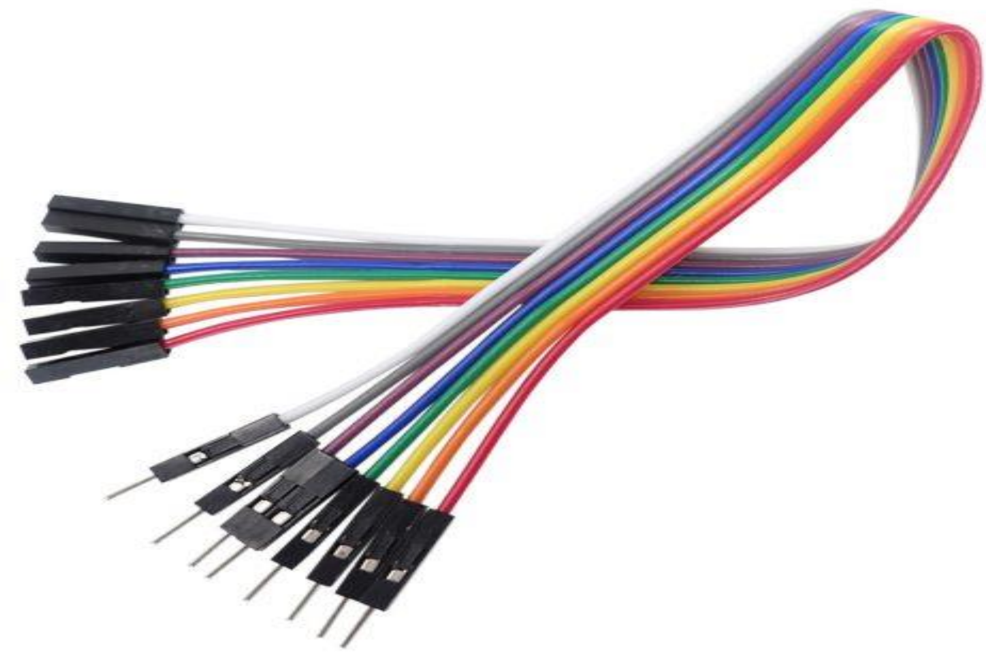
4.6 Connecting Wires

Connecting wires are essential components in any electronic or electrical system. They are used to establish connections between various components, ensuring the flow of electrical signals or power within the circuit. In projects such as smart irrigation systems, connecting wires play a crucial role in linking sensors, actuators, controllers, and power supplies to create a cohesive and functional system.

It is Made up of materials like copper or aluminum due to their high electrical conductivity and minimal resistance.Coated with insulating materials such as PVC, silicone, or rubber to prevent short circuits and protect users from electrical shocks.Available in flexible forms to allow easy routing and installation in compact spaces.Typically color-coded (e.g., red for positive, black for ground) to simplify identification during circuit assembly and troubleshooting.

Available in various thicknesses (measured in AWG, or American Wire Gauge) to handle different current capacities. Thicker wires are used for higher currents, while thinner wires are used for signal transmission. Deliver electrical power from the source to components like motors, water pumps, or sensors.

Most commonly used due to its excellent conductivity, resistance to corrosion, and flexibility. Copper wires ensure minimal power loss and are ideal for both power transmission and signal communication.Lightweight and cost-effective but less conductive than copper. Often used in specific applications where weight is a concern.



4.6 Connecting Wires

Connecting wires are a fundamental element of any electronic or electrical project, ensuring seamless integration between components. Their role in powering devices, transmitting signals, and grounding circuits makes them indispensable in systems like smart irrigation. By selecting the right type of wires and following best practices, users can ensure the reliability, safety, and efficiency of their setups.

CHAPTER 5
TRAINING

All subjects were split into one of four sets: training, validation, public test, or private test. The training and validation sets were released publicly, while the public and private test sets were not released, as they were used to rank the final scores of all submissions to the Kaggle contest. Not all possible pairs were trained. For example, an initial set of 857 subjects were selected into the training set, and there are over 360,000 potential pairings within this group.

Training all pairs would require almost 1,000 GPUyears, assuming that it takes one day to train a DFAE model on one GPU. Instead, within a set, subjects were paired with those with similar appearances, as this tended to give better results for models like the DFAE. Over 800 GPUs were used to train 6,683 pairwise models (which required 18 GPU-years), as well the more flexible models such as NODEMCU that only required a small amount of finetuning per subject.

Finally, a subset of 10 second clips were selected from the output of all models, and the overall distribution of gender and appearance was balanced across all sets and videos.

5.1 Post Processing

After inference, all methods produced a cropped image containing the face at 256x256 resolution. However, some methods do not infer details around the face, such as hair or background information. Therefore, we re-blended the face onto the original full-resolution raw frame using several steps, and combined the original raw frames and audio with ffmpeg. First, we created a face mask using detected landmarks. The mask produced by these landmarks included the forehead region - many off-the-shelf algorithms only use a mask that extends to the eyebrow region, but this can lead to blending artifacts where ”double eyebrows” appear in the final video.

Next, we blended the face using the mask onto the original frame using Poisson blending. However, we did not use Poisson blending over the entire mask, as this would often blend the two identities and create an ”average” face rather than a face that looks like the source subject

5.2 PROPOSED METHOD

The Smart Irrigation System utilizes a combination of sensors, GPS, and data analytics to optimize irrigation management. Soil moisture sensors measure the moisture levels in the soil, while temperature and humidity sensors monitor the ambient conditions. Rainfall sensors detect precipitation and adjust irrigation accordingly. This data is then transmitted to a central control system, where it is analyzed and used to determine the optimal irrigation schedule.

The system's irrigation scheduling algorithm takes into account factors such as soil type, crop type, and weather forecasts to ensure that crops receive the right amount of water at the right time. This approach not only conserves water but also reduces energy consumption and minimizes the environmental impact of irrigation.

One of the key benefits of the Smart Irrigation System is its ability to provide farmers with real-time data and insights. The system's user interface allows farmers to monitor soil moisture levels, temperature, and other parameters remotely, enabling them to make data-driven decisions about irrigation and crop management.

The Smart Irrigation System is also highly scalable and can be adapted to suit the needs of small, medium, or large-scale farms. Its modular design allows farmers to add or remove sensors and other components as needed, making it a flexible and cost-effective solution for irrigation management.

Overall, the Smart Irrigation System has the potential to revolutionize the way farmers manage irrigation, enabling them to conserve water, reduce energy consumption, and improve crop yields. By leveraging advanced technologies and data analytics, this system provides farmers with the insights and tools they need to optimize irrigation management and promote sustainable agriculture practices.

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CHAPTER 6
SOFTWARE REQUIREMENT

6.1 ARDUINO IDE

5.1

ARDUINO IDE

CHAPTER 7
WORKING PRINCIPLE

7.1 WORKING

The block diagram of the objectives irrigation system is shown in Above. The main advantage of an irrigation system is that it can send the information of a soil to the user through IOT network for irrigation. Power supply is given to the circuit in the form of voltage or current. Here soil moisture sensor measures the water content of soil and its output is fed to the amplifier, which is used to improve the gain value. And this measured value is given to the Arduino Uno as analog input. And second input of the Arduino comes from LDR and laser. These two analog inputs are converted to digital output values by Arduino Uno.

The smart irrigation system using precision farming operates on the principle of monitoring environmental and soil conditions in real-time and utilizing the collected data to automate water delivery based on the actual needs of crops. This approach minimizes water wastage, optimizes plant health, and enhances crop yield while reducing manual intervention. Here is a breakdown of its working.

Measures the soil's water content to determine if irrigation is required.Monitors environmental factors such as temperature and humidity, which influence water evaporation and plant transpiration.Detects rainfall to avoid unnecessary irrigation.The collected data from the sensors is transmitted to a microcontroller or microprocessor (e.g., NodeMCU ESP8266).

The microcontroller processes the sensor readings and compares them against predefined threshold values.If the soil moisture is below a set threshold, it signals the need for irrigation.Environmental data (temperature, humidity, and rainfall) helps refine the decision-making process by predicting evapotranspiration rates. If the soil moisture level is low and no rainfall is detected, the system activates the water pump.If the soil moisture is adequate or rainfall is expected, the system refrains from irrigation.

Smart irrigation systems rely on a variety of sensors and external data sources to collect real-time information about the environment and crop needs. These include soil moisture sensors to measure the water content in the soil, temperature and humidity sensors to monitor weather conditions, and rainfall sensors to detect current or forecasted rain. Additionally, the system may integrate with weather forecast services to predict upcoming rainfall or temperature changes. Crop-specific data is also used to determine the precise water requirements for different growth stages.

The collected data is sent to a microcontroller or central processing unit, which analyzes the information using pre-programmed algorithms. These algorithms compare real-time sensor readings with pre-set thresholds, such as minimum soil moisture levels or optimal temperature ranges. Based on this analysis, the system decides whether irrigation is needed, how much water should be supplied, and for how long the irrigation should run. This ensures that water is used only when necessary and in the right amount.

7.2 Innovative Working:

The Smart Irrigation System operates on the principle of precision farming, utilizing real-time data from various sensors to optimize irrigation management. The system begins by collecting data from soil moisture sensors, temperature and humidity sensors, and rainfall sensors, which is then transmitted to a central control system. The control system analyzes this data using advanced algorithms, taking into account factors such as soil type, crop type, and weather forecasts.

Based on this analysis, the system determines the optimal irrigation schedule and sends commands to the irrigation system to water the crops accordingly. The system continuously monitors the soil moisture and other parameters, providing feedback to the farmer and adjusting the irrigation schedule as needed to ensure that crops receive the right amount of water at the right time.

Once the system determines that irrigation is needed, it activates the irrigation components. Electrically controlled valves and pumps are used to deliver water to the crops. Depending on the irrigation method (e.g., drip irrigation or sprinkler systems), water is distributed efficiently to the plants. The system targets specific areas or zones to ensure that water is applied only where it is required.

Many smart irrigation systems are equipped with IoT (Internet of Things) technology, enabling users to monitor and control the system remotely. Through a smartphone app or web interface, users can view real-time sensor data, adjust irrigation schedules, and receive alerts about system performance. This feature adds convenience and flexibility, especially for large-scale or remote farming operations.

Smart irrigation systems are typically powered by electricity, but solar panels and batteries are also common options, especially in rural areas where grid power may not be available. Solar-powered systems ensure that the irrigation system can function sustainably and continuously without reliance on external power sources.

7.3 Code:

```
#include <DHT.h>

#include <ESP8266WiFi.h>

String apiKey = "X5AQ3EGIKMBYW31H";

// Enter your Write API key here const char* server = "api.thingspeak.com";

const char *ssid = "CircuitLoop";

// Enter your WiFi Name const char *pass = "circuitdigest101";

// Enter your WiFi Password #define DHTPIN D3

// GPIO Pin where the dht11 is connected DHT dht(DHTPIN,
DHT11);

WiFiClient client;

const int moisturePin = A0;

// moisteure sensor pin const int motorPin =D0;

unsigned long interval = 10000;

unsigned long previousMillis = 0;

unsigned long interval1 = 1000;

unsigned long previousMillis1 = 0;

float moisturePercentage;

//moisture reading float h;

// humidity reading float t;

//temperature reading

void setup()
{
  Serial.begin(115200);  delay(10);
  pinMode(motorPin, OUTPUT);
  digitalWrite(motorPin, LOW);
 // keep motor off initally  dht.begin();
```

```
 Serial.println("Connecting to ");

Serial.println(ssid);
WiFi.begin(ssid,pass);
while (WiFi.status() != WL_CONNECTED)
  {
   delay(500);
   Serial.print(".");
 // print ... till not connected  }
  Serial.println("");
  Serial.println("WiFi connected");
}
void loop()
{
  unsigned long currentMillis = millis();
 // grab current time
 h = dht.readHumidity();

// read humiduty  t = dht.readTemperature();

// read temperature

if (isnan(h) || isnan(t))

 {

  Serial.println("Failed to read from DHT sensor!");
return;  }

 moisturePercentage=(100.00-
((analogRead(moisturePin) / 1023.00) * 100.00 ) );

 if ((unsigned long)(currentMillis - previousMillis1) >=
interval1)

 {

Serial.print("Soil Moisture is = ");

Serial.print(moisturePercentage);
Serial.println("%");   previousMillis1 = millis();

 }
```

```
 if (moisturePercentage < 50)
{
 digitalWrite(motorPin, HIGH);
// tun on motor


}
if (moisturePercentage > 50 && moisturePercentage <
55)
{
 digitalWrite(motorPin, HIGH);
//turn on motor pump
}
if (moisturePercentage > 56)
{
 digitalWrite(motorPin, LOW);     // turn off mottor
}
if ((unsigned long)(currentMillis - previousMillis) >=
interval)
{
 sendThingspeak();
//send data to thing speak  previousMillis = millis();
client.stop();
}
void sendThingspeak()
{
  if (client.connect(server, 80))
  {
   String postStr = apiKey;
```

```
// add api key in the postStr string   postStr += "&field1=";
 postStr += String(moisturePercentage);
// add mositure readin   postStr += "&field2=";
  postStr += String(t);
// add tempr readin   postStr += "&field3=";
  postStr += String(h);
// add humidity reading postStr += "\r\n\r\n";   client.print("POST
/update HTTP/1.1\n");

client.print("Host:api.thingspeak.com\n");
client.print("Connection: close\n");
client.print("X-THINGSPEAKAPIKEY:"+apiKey+"\n");
client.print("Content-Type:application/x-www-form-urlencoded\n");
client.print("Content-Length: ");
client.print(postStr.length());
//send lenght of the string   client.print("\n\n");
client.print(postStr);
// send complete string
Serial.print("Moisture Percentage: ");
Serial.print(" C, Humidity: ");
Serial.print(h);
Serial.println("%. Sent to Thingspeak.");

}
```

CHAPTER 8

FUTURE WORK

Future work on the Smart Irrigation System will focus on integrating additional features and technologies to further enhance its efficiency and effectiveness. One potential area of exploration is the incorporation of artificial intelligence and machine learning algorithms to enable the system to learn and adapt to changing environmental conditions.

Additionally, the integration of satellite imaging and weather forecasting data could provide more accurate and reliable predictions of water requirements. Furthermore, the development of a mobile app for farmers to remotely monitor and control the system could improve user experience and accessibility. Finally, exploring the potential for integrating the Smart Irrigation System with other precision agriculture technologies, such as autonomous farming equipment and crop monitoring drones, could lead to even greater improvements in crop yields and resource efficiency.

Future Work of Smart Irrigation System

CHAPTER 9

9.1 CONCLUSION

In conclusion, the Smart Irrigation System is a cutting-edge technology that has the potential to revolutionize the way we manage irrigation in agriculture. By leveraging advanced sensors, data analytics, and precision farming techniques, this system enables farmers to optimize irrigation schedules, reduce water waste, and improve crop yields.

The system's ability to provide real-time monitoring and feedback allows farmers to make data-driven decisions, reducing the risk of over- or under-irrigation. Additionally, the system's automated irrigation scheduling feature ensures that crops receive the right amount of water at the right time, reducing the need for manual intervention.

The benefits of the Smart Irrigation System are numerous. Not only does it help to conserve water, a precious resource, but it also reduces energy consumption and minimizes the environmental impact of irrigation. Furthermore, the system's ability to improve crop yields and reduce waste can have a significant impact on farm profitability and sustainability.

While the Smart Irrigation System has the potential to bring about significant benefits, it is not without its challenges. The high upfront cost of the system may be a barrier for some farmers, and the need for reliable internet connectivity and technical support may also be a concern.

However, as the technology continues to evolve and become more widespread, it is likely that the costs will come down, and the benefits will become more accessible to farmers of all sizes and backgrounds. In the meantime, the Smart Irrigation System remains a promising solution for farmers looking to optimize their irrigation management and improve their bottom line.

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