AUTOMATED IRRIGATION USING WIRELESS SENSOR NETWORK AND GPRS MODULE

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ABSTRACT

The project's goal is to create an automated watering system using a wireless sensor network and GPRS module. The system is made up of many sensor nodes dispersed around the agricultural area that detect soil moisture and temperature conditions. These sensor nodes are linked via a wireless network and send sensed data to a central node, which processes the data and, if necessary, activates the irrigation system. The central node has a GPRS module, allowing the farmer to remotely monitor and control the irrigation system using a mobile smartphone. The technology saves water and improves irrigation efficiency by ensuring that crops receive the necessary amount of water at the appropriate time. The project uses low-cost hardware and software components, making it appropriate for small and medium-sized farmers.

To control water quantity, an algorithm including temperature and soil moisture thresholds was created and implemented into a microcontroller-based gateway. The system was powered by photovoltaic panels and had a bidirectional communication link based on a cellular-Internet interface that enabled data examination and irrigation scheduling via a web page.

An automated irrigation system was created to maximise water utilisation for agricultural crops. The system includes a distributed wireless network of soil moisture and temperature sensors located in the plants' root zones. In addition, a gateway unit processes sensor data, activates actuators, and sends data to a web application.

Our project intends to build an efficient and automated irrigation system using Raspberry Pi, wireless sensors, and a GPRS module. It is made up of a network of connected sensors that monitor and regulate the irrigation process, ensuring that water is used efficiently, and crops develop properly.

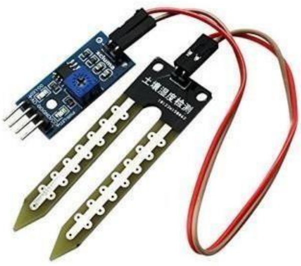
We employ soil moisture, water level, and weather detecting sensors. These function with wireless systems.

In addition to this, we use GPRS (General Packet Radio Services), a best-effort packet-switching protocol for wireless and cellular network connection. It is deemed best effort because all packets have the same priority and packet delivery is not guaranteed.

COMPONENTS REQUIRED:

Soil Moist Sensor

Soil moisture sensors measure the water content in the soil and can be used to estimate the amount of stored water in the soil horizon. Soil moisture sensors do not measure water in the soil directly. Instead, they measure changes in some other soil property that is related to water content in a predictable way.



Raspberry Pi Board

The Raspberry Pi is a very cheap computer that runs Linux, but it also provides a set of GPIO (general purpose input/output) pins, allowing you to control electronic component.ts for physical computing and explore the Internet of Things (IoT)

WATER LEVEL SENSOR

A level sensor is a device that is designed to monitor, maintain, and measure liquid (and sometimes solid) levels. Once the liquid level is detected, the sensor converts the perceived data into an electric signal.

MOTOR BOARD

DC MOTOR

WEATHER DETECTION SENSOR

GPRS MODULE

A GSM module or a GPRS module is a chip or circuit that use to establish communication between a mobile device or a computing machine and a GSM or GPRS system.

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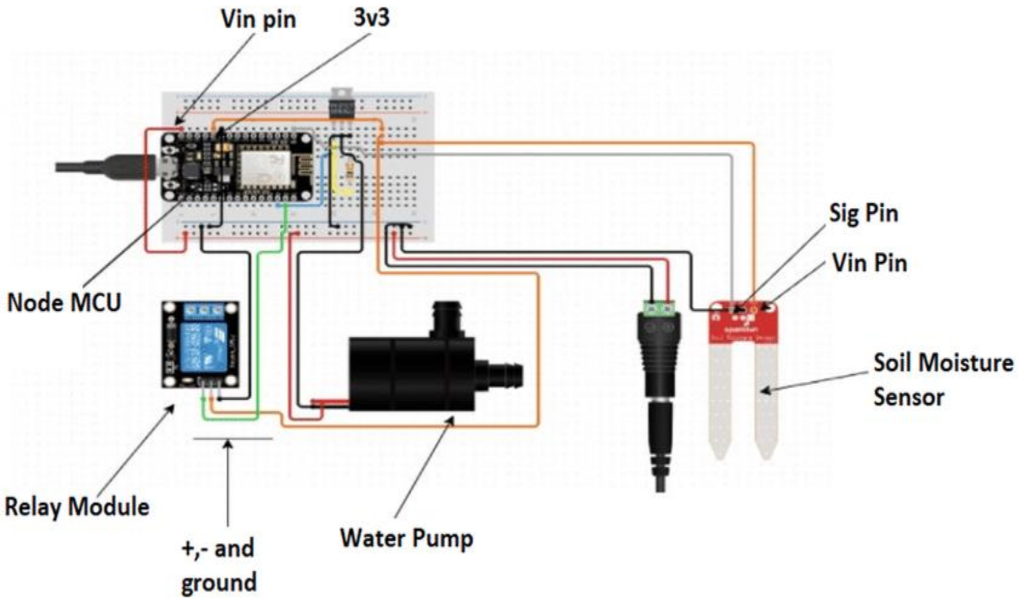
INTRODUCTION

Automated irrigation using a wireless sensor network (WSN) and GPRS module is a project that aims to improve the efficiency and accuracy of irrigation systems. In traditional irrigation systems, water is often wasted due to overwatering or mismanagement of the system. By utilizing a WSN and GPRS module, this project aims to monitor the moisture levels of soil and transmit data wirelessly to a central server or control unit. The WSN consists of a network of sensor nodes that are placed in the soil to measure the moisture levels. These nodes communicate with each other using wireless communication protocols, forming a network. The data collected by the nodes is then sent to a gateway node, which transmits the data to a central server or control unit using a GPRS module. The GPRS module uses the GSM network to send data over long distances.

The central server or control unit receives the data from the gateway node and processes it to determine the optimal irrigation schedule. The system can be configured to automatically turn on and off the irrigation system based on the moisture levels measured by the sensor nodes. This helps to prevent overwatering and ensures that the plants receive the optimal amount of water.

In the modern drip irrigation systems, the most significant advantage is that water is supplied near the root zone of the plants drip by drip due to which a large quantity of water is saved. At the present era, the farmers have been using irrigation technique in India through the manual control in which the farmers irrigate the land from time to time. This process sometimes consumes more water. There are different types of method for irrigating farm field for different types crop field. Basically Indian farmer use these three methods channel system, sprinkler system, drip system. Channel system is a traditional method of irrigation. But a smart irrigation system is a new technology to irrigating farm field automatically. Drip irrigation is one of the methods of irrigation that saves water and fertilizer. In drip irrigation method, water drips slowly to the roots of the plants either onto the soil surface or directly onto the root zone through a network of valves, pipes, tubing and emitters. The process is completed in narrow tubes so that water is given directly to the root of the plant. Drip irrigation is also termed as localized irrigation or micro irrigation

CIRCUIT DIAGRAM



BACKGROUND

Automated irrigation using wireless sensor network and GPRS module is a project that aims to optimize the use of water in agriculture. Traditional irrigation systems often rely on human intuition or manual labor to monitor and control the flow of water to crops, which can be time-consuming and inefficient.

This project proposes a solution that leverages wireless sensor networks (WSNs) and GPRS (General Packet Radio Service) technology to automate the irrigation process. WSNs are networks of small, low-power sensors that can detect changes in the environment and communicate wirelessly with each other.

The project will involve deploying a network of WSNs in a field to monitor various parameters such as soil moisture, temperature, humidity, and light intensity. The data collected by the sensors will be transmitted to a central controller using GPRS technology, which allows for real-time communication over a cellular network.

The central controller will use the data from the sensors to make decisions about when and how much water to deliver to the crops. This can help to reduce water waste by only irrigating when necessary and ensuring that the crops receive the optimal amount of water. Additionally, the system can be configured to send alerts to farmers if there are any issues with the irrigation system, such as leaks or malfunctions.

System has a soil moisture and temperature sensor. Each wireless sensor node was comprised of a soil moisture probe, a temperature sensor probe, a microcontroller for acquisition of data, and a radio transceiver. The receiver unit comprises a master microcontroller, radio transceiver, GSM and a pump. The communication link between the transmitter and receiver units is via the ZigBee protocol. Irrigation scheduling could be monitored using an Android Application.

Overall, this project has the potential to improve the efficiency of agriculture by automating the irrigation process and reducing water waste. It also has the added benefit of reducing the workload for farmers and enabling remote monitoring and control of the irrigation system.

PROBLEM STATEMENT

The agriculture sector is one of the largest contributors to the economy of many countries. Irrigation is a crucial factor in agricultural productivity, but traditional irrigation methods are inefficient and require significant amounts of water. Automated irrigation systems have been developed to optimize water usage, but their implementation is still limited due to high installation and maintenance costs.

To address this issue, this project proposes an automated irrigation system using a wireless sensor network and GPRS module. The system will consist of several sensor nodes placed in the field to monitor soil moisture, temperature, and humidity levels. These sensor nodes will be connected wirelessly to a central node, which will receive and process data from all sensor nodes.

The central node will use the data to determine the appropriate time and amount of water needed for irrigation. This information will be transmitted to a GPRS module, which will send commands to an irrigation system to turn on and off the water supply as per the requirements.

The proposed system will reduce water usage by providing accurate and timely irrigation to crops. The wireless sensor network will eliminate the need for manual monitoring, which will save time and resources. The GPRS module will ensure that the irrigation system can be controlled remotely, making it more efficient and reliable.

OBJECTIVES

Efficient water usage: The system should ensure that water is used efficiently by monitoring soil moisture, weather conditions, and other environmental factors that affect irrigation requirements.

Real-time monitoring: The system should provide real-time monitoring of soil moisture, weather conditions, and water levels to enable the farmer to make informed decisions about irrigation.

Automatic control: The system should be capable of controlling the irrigation system automatically based on the data received from the sensors.

Remote access: The system should allow remote access to the irrigation system, enabling the farmer to monitor and control the system from a remote location.

Reduced labor costs: The system should reduce the need for manual labor, as it will automate the irrigation process.

Cost-effective: The system should be cost-effective to implement and maintain, providing value for money for the farmer.

User-friendly interface: The system should have a user-friendly interface that is easy to understand and operate, even for non-technical users.

Increased crop yield: The system should ensure that the crops receive the appropriate amount of water, which will result in increased crop yield.

METHODOLOGY

Problem identification: Identify the need for an automated irrigation system that can optimize water usage and reduce manual labor.

Literature review: Conduct a literature review to gather information on existing irrigation systems, wireless sensor networks, and GPRS modules.

System design: Based on the literature review, design the system architecture, including the hardware and software components required for the automated irrigation system. The system should include sensors for measuring soil moisture, temperature, and humidity, a GPRS module for sending data to a central server, and a microcontroller for controlling the irrigation system.

Prototyping: Build a prototype of the automated irrigation system and test its functionality. Make any necessary modifications to the design.

System integration: Integrate the hardware and software components of the system to ensure that they work together seamlessly.

Field testing: Conduct field tests to evaluate the system's performance in realworld conditions. Measure the system's effectiveness in optimizing water usage and reducing manual labor.

Data analysis: Analyze the data collected from the system to determine its efficiency and effectiveness in managing irrigation.

Results and conclusion: Summarize the results of the project and draw conclusions about the system's effectiveness. Identify areas for future development and improvement.

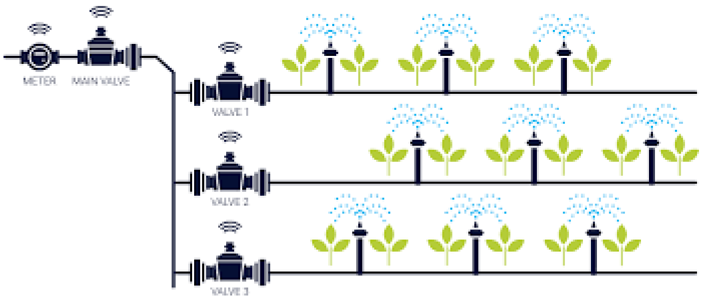
RESULTS

Automated irrigation systems have been designed to enhance the efficiency and effectiveness of agricultural practices. These systems are capable of monitoring the moisture levels in the soil and automatically irrigating crops when needed, thereby reducing water waste and improving crop yield.

Wireless sensor networks (WSNs) are an essential component of automated irrigation systems. They are used to gather data on soil moisture, temperature, and other environmental factors, which are transmitted wirelessly to a central control system. The GPRS module enables communication between the WSN and the central control system through the cellular network, allowing for remote monitoring and control of the irrigation system.

However, the implementation of these systems requires careful planning and design to ensure optimal performance. Factors such as the type of crops, soil type, and climate must be taken into consideration when designing the system. Maintenance and calibration of the sensors are also important to ensure accurate data collection.

In summary, automated irrigation systems using WSNs and GPRS modules have shown promising results in improving agricultural practices. However, careful planning, design, and maintenance are necessary to ensure optimal performance.



FUTURE WORKS

Integrate AI and Machine Learning: Implementing AI and machine learning algorithms can help optimize the irrigation process by predicting the amount of water required by crops and adjusting the irrigation system accordingly.

Implement a smart control system: A smart control system can be implemented to monitor and control the irrigation system from a remote location, using a mobile application or web interface.

Expand the system to cover a larger area: If the current project covers a small area, consider expanding the system to cover a larger area. This can be achieved by adding more sensors and GPRS modules.

Use alternative sources of energy: Consider using alternative sources of energy, such as solar power, to power the irrigation system. This can help reduce the system's dependence on electricity.

Improve the accuracy of sensors: The accuracy of sensors used in the project can be improved by upgrading them to more advanced sensors with higher accuracy and precision.

Implement a fault detection and notification system: Implementing a fault detection and notification system can help identify faults in the irrigation system and notify the user via email or SMS.

Implement a data analytics system: A data analytics system can be implemented to collect and analyze data from the sensors and GPRS module. This can help identify patterns and trends in the irrigation process, which can be used to optimize the system.

Consider adding a weather monitoring system: A weather monitoring system can be integrated with the irrigation system to automatically adjust the irrigation schedule based on weather conditions.

CODE

File Edit Sketch Tools Help

project_code

```
#include <SoftwareSerial.h>
SoftwareSerial gsm_Serial(16,17);
#include <LiquidCrystal.h>
const int rs =10, en =11, d4 =12, d5 =13, d6 =14, d7 =15;
LiquidCrystal lcd(rs, en, d4, d5, d6, d7);
const int pingPin = 5; // Trigger Pin of Ultrasonic Sensor
const int echoPin = 4; // Echo Pin of Ultrasonic Sensor
long duration;
int distance;
#include "DHT.h"
#define DHTPIN 3
#define DHTTYPE DHT11
DHT dht(DHTPIN,DHTTYPE);
int buz=13;
int m1=1;
int m2=2;
int m3=6;
int m4=7;
int ms=26;

void setup() {
 lcd.begin(16,2);
  lcd.print("  WELCOME");
  lcd.setCursor(0,1);
  lcd.print("INITIALIZING");
  delay(1500);
  lcd.clear();
  dht.begin();
Serial.begin(9600);
gsm_Serial.begin(9600);
gsm_Serial.println("AT");
  delay(1500);
gsm_Serial.println("AT+CMGF=1");
pinMode(pingPin,OUTPUT);
pinMode(echoPin,INPUT);
pinMode(ms,INPUT);
pinMode(m1,OUTPUT);
```

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project_code

```
pinMode(m1,OUTPUT);
pinMode(m2,OUTPUT);
pinMode(m3,OUTPUT);
pinMode(m4,OUTPUT);
pinMode(buz,OUTPUT);
}
void loop()
{
 delay(200);
int t = dht.readTemperature();
int h=dht.readHumidity();
int mval=analogRead(ms);
digitalWrite(pingPin, LOW);
delayMicroseconds(2);
digitalWrite(pingPin, HIGH);
delayMicroseconds(10);
digitalWrite(pingPin, LOW);
duration = pulseIn(echoPin, HIGH);
distance=duration*0.034/2;
Serial.println("D:");
Serial.println(distance);
Serial.println("T:");
Serial.println(t);
Serial.println("H:");
Serial.println(h);
Serial.println("M:");
Serial.println(mval);
delay(500);
lcd.clear();
lcd.setCursor(0,0);
lcd.print("L:");
lcd.setCursor(2,0);
lcd.print(distance);
lcd.setCursor(7,0);
lcd.print("T:");
lcd.setCursor(9,0);
lcd.print(t);
```

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project_code

```
lcd.print(t);
lcd.setCursor(0,1);
lcd.print("S:");
lcd.setCursor(2,1);
lcd.print(mval);
lcd.setCursor(7,1);
lcd.print("H:");
lcd.setCursor(9,1);
lcd.print(h);
if(distance>15)
{
  digitalWrite(m1,1);
  digitalWrite(m2,0);
  send_sms(1);
}
else
{
  digitalWrite(m1,0);
  digitalWrite(m2,0);
  // send_sms(4);
 }
 if(mval<400)
 {
  digitalWrite(m3,0);
  digitalWrite(m4,0);
  send_sms(2);
 }
 {
  digitalWrite(m3,1);
  digitalWrite(m4,0);
  //send_sms(3);

 }
}
void send_sms(int k)
{
gsm_Serial.println("Sending SMS...");
```

project_code | Arduino 1.8.19

File Edit Sketch Tools Help

project_code

```
gsm_Serial.println("Sending SMS...");
gsm_Serial.println("AT");
delay(1000);
gsm_Serial.println("ATE0");
delay(1000);
gsm_Serial.println("AT+CMGF=1");
delay(1000);
gsm_Serial.print("AT+CMGS=\"9885185546\"\r\n");// Replace x with mobile number
delay(1000);
gsm_Serial.println("ABNORMAL FIELD CONDITIONS ");
if(k==1)
gsm_Serial.print("TANK LEVEL IS LOW AT FIELD");
if(k==2)
gsm_Serial.print("MOISTURE CONTENT IS HIGH AT FILED");
if(k==3)
gsm_Serial.print("MOISTURE CONTENT IS LOW AT FILED");
if(k==4)
gsm_Serial.print("TANK LEVEL IS HIGH AT FIELD");
//gsm_Serial.println("https://www.google.com/maps/search/?api=1&query=" + String(16.4419)+ "," + String(80.6226));
delay(100);
gsm_Serial.println((char)26);// ASCII code of CTRL+Z
delay(6000);
gsm_Serial.println("AT");
delay(1000);
gsm_Serial.println("ATE0");
delay(1000);
gsm_Serial.println("AT+CMGF=1");
delay(1000);
gsm_Serial.print("AT+CMGS=\"8247699676\"\r\n");// Replace x with mobile number
delay(1000);
gsm_Serial.println("ABNORMAL FIELD CONDITIONS ");
if(k==1)
gsm_Serial.print("TANK LEVEL IS LOW AT FIELD");
if(k==2)
gsm_Serial.print("MOISTURE CONTENT IS HIGH AT FILED");
if(k==3)
gsm_Serial.print("MOISTURE CONTENT IS LOW AT FILED");
```

```
gsm_Serial.print("TANK LEVEL IS LOW AT FIELD");
if(k==2)
gsm_Serial.print("MOISTURE CONTENT IS HIGH AT FILED");
if(k==3)
gsm_Serial.print("MOISTURE CONTENT IS LOW AT FILED");
if(k==4)
gsm_Serial.print("TANK LEVEL IS HIGH AT FIELD");
//gsm_Serial.println("https://www.google.com/maps/search/?api=1&query=" + String(16.4419)+ "," + String(80.6226));
delay(100);
gsm_Serial.println((char)26);// ASCII code of CTRL+Z
delay(2000);
  }
```

CONCLUSION

The project's findings are a breath of fresh air for sustainable agriculture. Automated irrigation systems utilizing wireless sensor networks and GPRS modules show immense promise in revolutionizing water management practices.

These systems go beyond simple timers by precisely sensing real-time soil moisture levels. This translates to water being delivered only when and where plants need it, optimizing growth and potentially leading to increased crop yields. Additionally, reduced water stress on plants can minimize the risk of disease, further improving overall crop health.

The environmental benefits are undeniable. By using water with utmost precision, this technology promotes significant water conservation. This not only lessens the strain on local water resources but also contributes to a healthier environment for everyone.

Economically, these systems are a win-win. Automation significantly reduces labour costs associated with traditional irrigation methods. Farmers can also expect cost savings on water bills due to improved water efficiency. The potential for increased crop yields due to optimized irrigation translates to higher profits, making this technology an attractive investment.

Looking ahead, the future is bright for this irrigation system. Integration with advanced analytics platforms can allow for real-time adjustments based on weather forecasts and historical data. Machine learning can further optimize irrigation schedules by learning specific crop needs and soil conditions. Advancements in sensor technology hold promise for even more granular data on factors like soil moisture, temperature, and nutrient levels.

In conclusion, automated irrigation using wireless sensor networks and GPRS modules presents a significant leap forward in precision agriculture. This technology promotes water conservation, increased productivity, and economic benefits, paving the way for a sustainable future in how we manage water resources and ensure the continued success of agriculture.

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3. https://www.scirp.org/journal/paperinformation.aspx?paperid=83708

VIDEO LINK:

https://drive.google.com/file/d/1j96Fdz_1uduYtafIqOWUXDWkHepBsVsa/view?usp=sharing

THANK YOU