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INTELLIGENT CULTIVATION IRRIGATION BASED ON INTERNET OF THINGS

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ABSTRACT

Agriculture is a crucial sector of the economy in many countries. However, conventional irrigation systems are not efficient in terms of water usage and control. To overcome these issues, an IoT-based smart irrigation system is proposed in this project. The proposed system consists of a network of sensors and actuators that collect data on soil moisture, temperature, humidity, and weather conditions. This data is transmitted to a central control unit that uses algorithms to make decisions about when and how much water to be irrigated. The system is designed to be energy-efficient and cost-effective, using a regular power source to operate. The system provides several benefits over traditional irrigation systems. It reduces water wastage and conserves water resources, resulting in improved crop yields and reduced costs. The system is easy to install, operate, and maintain, and can be customized to suit specific crops and soil types. Additionally, the system is scalable and can be expanded to cover larger areas or multiple fields. Overall, the proposed IoT-based smart irrigation system is a significant improvement over traditional irrigation systems, providing a sustainable and efficient solution for agriculture. the system's scalability, energy-efficiency, and customizability make it a viable option for farmers looking to adopt new technology to improve their irrigation systems. first, it reduces water wastage and conserves water resources by only irrigating when needed. This, in turn, results in improved crop yields and reduced costs. Second, the system is easy to install, operate, and maintain

Keywords - *agriculture, irrigation, IoT, sensors, actuators, temperature, humidity, weather conditions, energy-efficient, cost-effective, water wastage, water resources, crop yields, scalability, customizability.*

1. INTRODUCTION

Plants not only add a natural beauty to our surroundings but also provide us with oxygen, which is essential for our survival. However, maintaining healthy plants requires proper care, including providing them with adequate water, sunlight, and nutrients. While plants require low maintenance, taking care of them becomes challenging when we are away from our homes for extended periods.

In such scenarios, plants may wither, die or become susceptible to diseases due to the lack of proper watering. To address this issue, we propose an automatic irrigation system that can water plants automatically and maintain their health, even when we are not around.

With the rise of urbanization and the increasing population density in cities, space for gardening

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is becoming scarce. People are opting for indoor plants as an alternative, which not only adds aesthetic value but also purifies the air and creates a relaxing ambiance. However, indoor plants require proper care, which can be challenging for those who are busy or travel frequently. The proposed automatic irrigation system can help address this issue, allowing people to take care of their indoor plants with ease and convenience, and ensure their healthy growth and longevity.

This project aims to design and implement an Arduino-based automatic irrigation system that uses a moisture sensor to maintain the optimal moisture level for plants. The system is not only suitable for outdoor gardens but can also be used to take care of indoor plants.

The proposed system consists of an Arduino Uno microcontroller that reads data from the moisture sensor and triggers the irrigation system when the moisture level falls below the set threshold. The system is designed to be low-cost, energy-efficient, and easy to operate and maintain.

Overall, this project presents a practical solution for plant enthusiasts and those who want to contribute to environmental conservation by efficiently using water resources.

1.1 AIM OF THE PROJECT

The motivation for this project came from the countries where economy is based on agriculture and the climatic conditions lead to lack of rains & scarcity of water. Our country mostly depends on agriculture. The farmers working in the farm lands are solely dependent on the rains and bore wells for irrigation of the land. Even if the farm land has a water-pump, manual intervention by farmers is required to turn the pump on/off whenever needed.

The project aim is to detect the dryness in soil using sensors and provide water to the plants appropriately. This project helps to maintain the plants quite easily. In this project we are detecting soil moisture and need for Irrigation.

The Aim of our project is to minimize this manual intervention by the farmer.

Automated Irrigation system will serve the following purposes:

1) As there is no un-planned usage of water, a lot of water is saved from being wasted.

The irrigation is done only when there is not enough moisture in the soil and the sensors decide when the pump should be turned on/off. This saves a lot time for the farmers. This also gives much needed rest to the farmers, as they don’t have to go and turn the pump on/off manually.

2. LITERATURE SURVEY

Automated irrigation systems have gained significant attention in recent years due to the need for water conservation and efficient irrigation methods. Various studies have been conducted on the development of automated irrigation systems for different applications.

One such study by Dang et al. (2020) proposed an automatic irrigation system using a wireless sensor network (WSN) and a decision-making algorithm based on the principle of fuzzy logic. The system was designed to reduce water consumption while maintaining optimal soil moisture levels for crop growth. The authors used fuzzy logic to build a decision-making algorithm that determined the amount of water to be applied based on the soil moisture levels

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and environmental factors. They also designed a WSN-based architecture that could monitor the soil moisture levels in real-time, enabling precise irrigation control.

Similarly, a study by Sandoval-Solis et al. (2018) presented an IoT-based irrigation system that used a low-cost microcontroller and a moisture sensor to control irrigation. The system was able to optimize water use by collecting real-time data on soil moisture and weather conditions, allowing for precise irrigation control. The authors developed a user- friendly interface that could be accessed through a web-based application. This interface allowed the user to monitor the system's performance and control irrigation remotely.

Furthermore, a study by Priyanka and Jain (2017) developed an automatic irrigation system using an Arduino microcontroller and a moisture sensor. The system was designed for small-scale irrigation and could be easily implemented by farmers to reduce labor costs and improve crop yields. The authors used a moisture sensor to detect the soil moisture levels and trigger the irrigation system when the levels fell below the desired threshold. They also used a mobile application to monitor the system's performance and control irrigation remotely.

Overall, the literature suggests that automated irrigation systems offer a promising solution for efficient water management and crop irrigation. The proposed system in this project, which uses an Arduino Uno microcontroller and a moisture sensor, rain sensor is aligned with these findings and offers a low-cost and practical solution for plant care. The use of an Arduino microcontroller allows for the development of a customized system that can be easily modified to suit different plant species and environments.

3. EXISTING SYSTEM

Currently, there are several commercially available automated irrigation systems that use various technologies and sensors to control irrigation. Most of these systems use a timer-based approach, which waters the plants at regular intervals, regardless of the soil moisture levels. This approach can lead to over-watering and waste of water resources.

Some existing systems use soil moisture sensors to determine the soil moisture levels and trigger irrigation when the levels fall below a certain threshold. However, these systems can be expensive and complex to install and maintain.

Another technology used in automated irrigation systems is the use of weather data to optimize irrigation. This technology uses weather forecasts and historical data to predict the water requirements of plants and adjust irrigation accordingly. However, this technology requires sophisticated sensors and weather forecasting models, making it costly and complex to implement.

In our project, we are proposing an automated irrigation system that uses a rain sensor and a moisture sensor to control irrigation. The rain sensor is used to detect the presence of rain and suspend irrigation to prevent over-watering, while the moisture sensor is used to determine the soil moisture levels and trigger irrigation when the levels fall below a certain threshold. Our system offers a low-cost and practical solution that can be easily installed and maintained by homeowners and small-scale farmers.

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Existing System Block Diagram

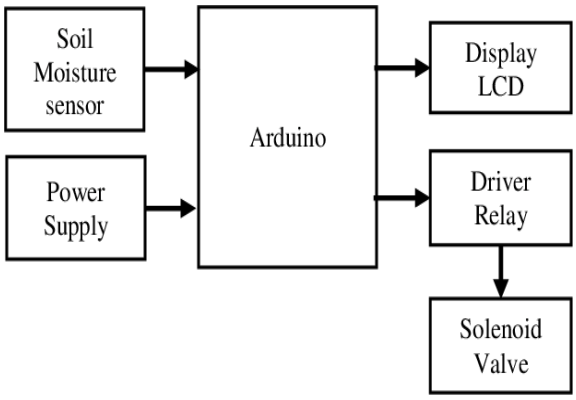

Fig 3.2: Block Diagram of Existing System

COMPONENTS USED:

- **Arduino**
- **Relay**
- **Motor**
- **Soil moisture sensor**
- **Lcd**

4. PROPOSED SYSTEM

Agriculture is a crucial sector of the economy in many countries. However, conventional irrigation systems are not efficient in terms of water usage and control. To overcome these issues, an IoT-based smart irrigation system is proposed in this project the proposed system for automatic irrigation using IoT is an intelligent and efficient system that utilizes various sensors, microcontrollers, and cloud technologies to monitor the moisture level of the soil, detect rainfall, and control the irrigation system.

The proposed system for automatic irrigation using IoT not only overcomes the drawbacks of traditional irrigation systems, but it also incorporates additional features to improve water usage efficiency.

One such feature is the use of a rain sensor to prevent over-watering and water wastage. The rain sensor detects the presence of rain and sends a signal to the microcontroller to stop the water pump, thereby preventing over-watering and water wastage. This feature ensures that water is only used when it is necessary and promotes efficient water usage.

Furthermore, the proposed system allows farmers to monitor their fields remotely through the Arduino IoT cloud platform. The sensor data collected by the system is uploaded to the cloud, and farmers can access the data using their mobile devices. This allows farmers to monitor the soil moisture level, temperature, humidity, and rainfall in real-time, enabling them to make informed decisions regarding irrigation and crop management.

Overall, the proposed system for automatic irrigation using IoT is an intelligent and comprehensive solution that not only overcomes the drawbacks of traditional irrigation systems but also incorporates additional features to promote efficient water usage and enable remote monitoring. With the help of this system, farmers can optimize their irrigation systems, reduce water wastage, and improve crop yields.

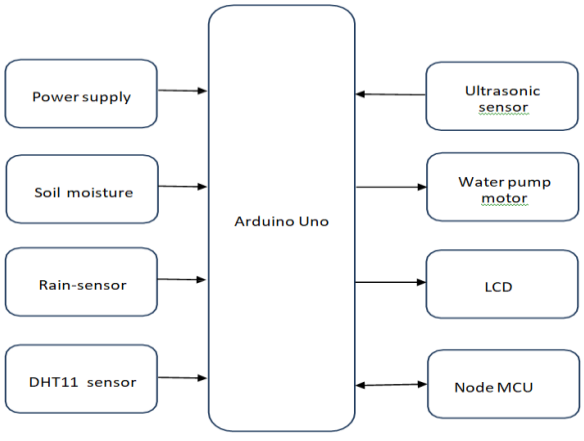

Fig 4.2: Block Diagram of Proposed System

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BLOCK DIAGRAM EXPLANATION:

The system starts by collecting data from the sensors installed in the soil. The soil moisture sensor measures the moisture level in the soil and sends the data to the Arduino Uno board. The rain sensor detects the presence of rain and sends a signal to the Arduino Uno board.

The Arduino Uno board processes the data from the sensors and decides whether to turn on or off the water pump. If the soil moisture level is below a set threshold value and there

is no rain detected by the rain sensor, the Arduino Uno board activates the relay connected to the water pump to supply water to the plants. The water pump continues to operate until the soil moisture level reaches the desired level. Once the desired moisture level is reached, the Arduino Uno board deactivates the relay and stops the water pump.

If rain is detected, the system turns off the water pump and stops the irrigation process. This helps to avoid over-watering the plants and prevent water wastage. The rain sensor is a crucial component of the proposed system, as it enables the system to automatically adjust the irrigation schedule based on the current weather conditions.

It also includes an ultrasonic sensor to detect the presence of animals in the garden or field. The ultrasonic sensor is placed at a suitable height and orientation to detect the animals when they come near the garden.

If the ultrasonic sensor detects the presence of animals, the system activates a buzzer to scare them away. This helps to prevent the animals from damaging the plants and the garden ensuring the health and safety of the plants.

In addition to controlling the water pump, the system also displays the sensor data on the LCD screen. The LCD screen shows the current moisture level in the soil, the temperature, and the humidity level in the environment. This information helps farmers to monitor the health of their crops and adjust the system settings as needed. The system also includes a NodeMCU module that connects the system to the internet and uploads the sensor data to the cloud. The NodeMCU module sends the data to the cloud using Wi-Fi and stores the data in a database. The data can be accessed by farmers remotely using a mobile device or a computer.

The cloud platform provides a user-friendly interface that displays the sensor data in real-time. This helps farmers to make informed decisions about their irrigation systems and promote efficient water usage.

Overall, the proposed system for automatic irrigation using IoT combines various technologies to provide an automate d and optimized irrigation system for agricultural fields, gardens, and other areas where plants are grown. The system can help farmers, gardeners, and other plant enthusiasts optimize their irrigation systems for healthier plants and more efficient resource usage.

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5. RESULTS

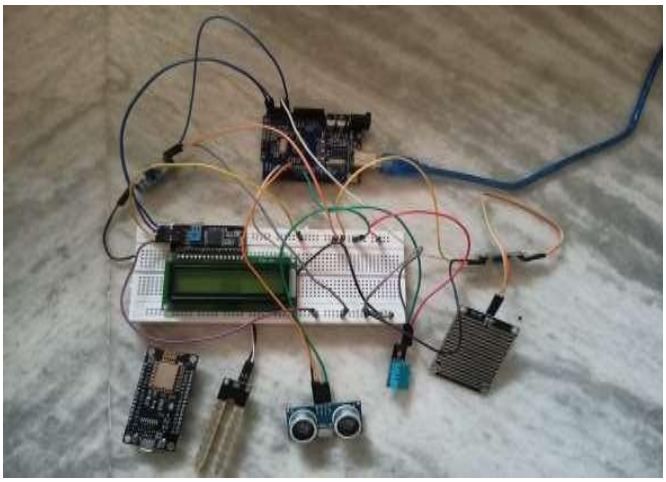

FIG 5.3.1: Hardware Implementation with all Sensor

FIG 5.3.2: Hardware Implementation with soil sensor in sand

FIG 5.3.3: Hardware Implementation with complete assembly

ARDUINO IOT CLOUD OUTPUT

FIG 5.4.1: TEMP AND HUMIDITY READINGS

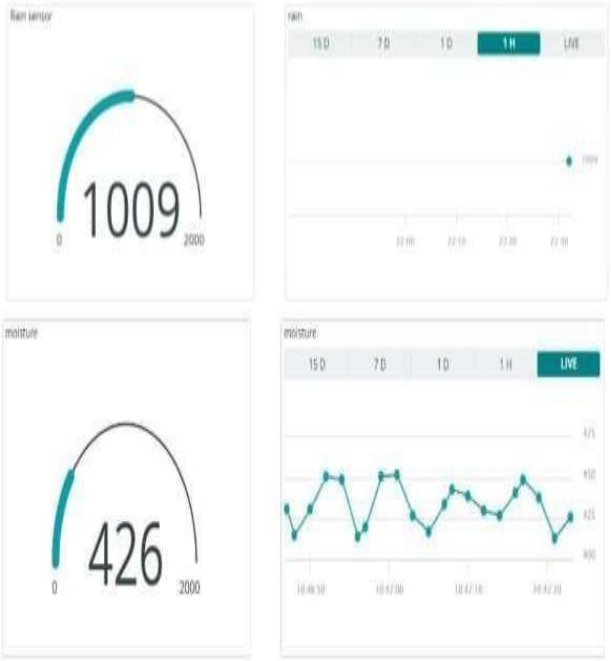

FIG 5.4.2: MOISTURE SENSOR AND RAIN SENSOR READING

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ARDUINO IDE OUTPUT

```
------------------------------------------------------------
              AUTOMATIC IRRIGATION USING IOT
Distance: 219.06 cm
Humidity: 51.00%
Temperature: 32.80C
Moisture Level : 1016
rain sensor value :: 1015
MOTOR ONN
============================================================
              AUTOMATIC IRRIGATION USING IOT
Distance: 0.00 cm
Humidity: 51.00%
Temperature: 32.80C
Moisture Level : 1016
rain sensor value :: 1015
MOTOR ONN
============================================================
              AUTOMATIC IRRIGATION USING IOT
Distance: 46.23 cm
Humidity: 51.00%
Temperature: 32.80C
Moisture Level : 1015
rain sensor value :: 295
MOTOR OFF
============================================================
              AUTOMATIC IRRIGATION USING IOT
Distance: 222.57 cm
Humidity: 51.00%
Temperature: 32.80C
Moisture Level : 1023
rain sensor value :: 325
MOTOR OFF
============================================================
              AUTOMATIC IRRIGATION USING IOT
Distance: 29.88 cm
Humidity: 51.00%
Temperature: 32.80C
Moisture Level : 1023
rain sensor value :: 337
MOTOR OFF
============================================================
```

FIG 5.5: ARDUINO IDE OUTPUT

6. CONCLUSION

The proposed IoT-based smart irrigation system is an innovative and intelligent solution that addresses the inefficiencies of traditional irrigation systems. With the use of sensors, microcontrollers, cloud technologies, and other components, the system ensures that water is used efficiently and effectively, promoting healthier plants and a more sustainable approach to agriculture. The system provides real-time monitoring of the soil moisture level, temperature, humidity, and rainfall, enabling farmers to make informed decisions about their irrigation systems and improve crop management. With the help of the cloud platform, farmers can access the sensor data remotely and adjust the system settings as needed.

The proposed system also incorporates additional features such as the use of a rain sensor and ultrasonic sensor to prevent over-watering and protect plants from animals. These features enhance the efficiency and effectiveness of the system, promoting optimal plant growth and yield.

Overall, the proposed IoT-based smart irrigation system is an excellent example of how technology can be used to address real-world problems and promote sustainability in agriculture.

FUTURE SCOPE:

1. The proposed IoT-based smart irrigation system has a lot of potential for future advancements and improvements. Some possible areas for future research and development include:
2. **Integration with other IoT systems**: The smart irrigation system can be integrated with other IoT systems, such as weather stations, crop monitoring systems, and precision farming systems, to create a comprehensive smart farming solution.
3. **Use of AI and Machine Learning**: The system can be enhanced by incorporating AI and machine learning algorithms to provide more precise and accurate control of the irrigation system based on real-time sensor data.
4. **Wireless Sensor Networks:** Wireless sensor networks can be implemented to reduce wiring complexity and provide better coverage of the field. This would eliminate the need for wiring and improve the flexibility of the system.
5. **Use of Solar Power**: Solar power can be integrated into the system to reduce energy

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consumption and provide a more sustainable solution.

6. **Use of Drones and Robotics:** Drones and robots can be used to automate the irrigation process and enable more efficient water usage.
7. Overall, the future scope of the IoT-based smart irrigation system is vast and promising. With continued research and development, the system can be further optimized and enhanced to provide a more efficient and sustainable solution for agricultural irrigation.

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