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Real Time Soil Moisture Monitoring & Irrigation Optimization for Agriculture via IOT

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Abstract: ***In smart irrigation, access to sustainable energy services acts as a catalyst for development. Enabling facility of internet connection for the new possibilities of increasing agricultural cultivation with proper information and guidance, access to clean water, sanitation and nutrition, the growth of productive enterprises to boost farmer's income. The development of a country depends on the village's development. Most of the agriculture productivity suffer greatly with unforeseen change in climate. Therefore, farmers need to get appropriate information's if any sudden climatic disruption occur, it should notify on time to avoid any major damage in agricultural field. As part of the smart irrigation concept, an intelligent system is designed that may help a farmer to get basic facilities/infrastructure by agricultural development. Here an intelligent system is proposed on the fact of farmers getting all relevant details about the improvement in fertilization of soil and agriculture by delivering climate change information's through an IOT (Internet of Things) devices. These information's could be handled through website and mobile phones. To ease for farmer understandings all the facts and information related to soil fertilization and climatic alerts are delivered as per their native language / language of their interest. This system may help its members to collaborate and take it to another level of requirement in improving their production capacity. These IOT devices are operated either through solar panel or electric supply appropriately to balance the power requirement across the field.***
Indexed Terms- Internet of Things, Data Collection

I. INTRODUCTION

Efficient irrigation is crucial for sustainable agriculture, particularly in regions with scarce water resources. The Smart Irrigation Control and Monitoring System using IoT aims to address the limitations of traditional manual irrigation methods by providing an automated and remote-control solution.

Leveraging IoT technology, the system uses sensors to monitor environmental conditions and an LCD display to provide real-time data on soil moisture, temperature, and humidity. The integration of GSM technology enables communication without internet access, making it suitable suitable for areas with limited connectivity. This system empowers farmers with the ability to optimize irrigation schedules, conserve water, and improve crop productivity.

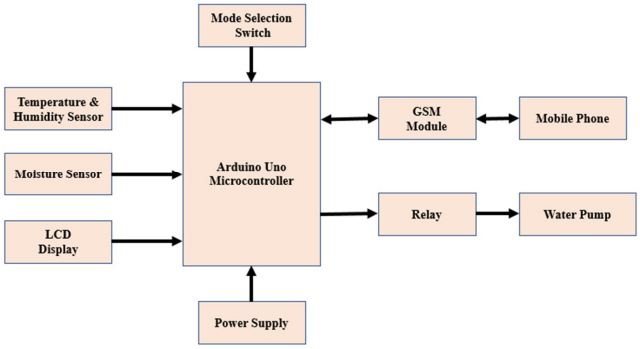
II. LITERATURE SURVEY

This paper elucidates the research and implementation of IOT based smart village . IOT (Internet of Things) is a structure which provides an exclusive identity and ability to relocate the data over a network without requiring two way handshaking from human-to-human. It enables the path to connect anytime, anywhere, with anything and anyone ideally using any network topology with a specify service. Hence the divergence on the scenario of a Smart Globe" has emerged to mean many things to many people. Meaning of "Smart" utilizes sensitive information and communications technology (ICT) remains consistent with the Internet Technologies to address rural challenges. To bifurcate the ideal scenario on the basic occupation of agriculture, the ecosystem control technology and system becomes mature having high level of intelligence. This puts precise significance on efficiency, high quality, secure and sustainable production of facility agriculture. That makes a glance of a smart irrigation as a smart farming, ultimately converging into a „Smart Village". This is all about the outsourcing application, technology and wonders of IoT (Internet of Things).

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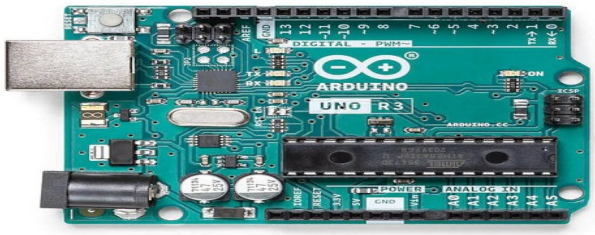
III. METHODOLOGY



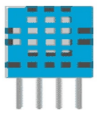
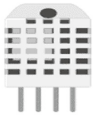
1) Sensor Integration: Connect the soil moisture sensor and DHT11 temperature and humidity sensor to the Arduino Uno for environmental monitoring.
2) Pump Control: Use a relay module to control the water pump based on input from the microcontroller.
3) Mode Selection: Implement a mode selection switch to choose between automatic and manual operation.
4) Automatic Mode Operation: The microcontroller activates the pump when soil moisture falls below a certain threshold.
5) Manual Mode Operation: Users control the pump by calling the GSM module's SIM card number; the system starts/stops the pump based on the number of calls.
6) LCD Display: Real-time sensor data and pump status are displayed.
7) GSM Communication: Send SMS notifications to the registered mobile phone with pump status and environmental data.

A. Arduino

The R3arduino uno is a microcontroller development committee that functions on the Atmega-328p. Arduino delivers results with a variety of functions, including microcontroller area units, computer circle units, and small computers that run mainly small simple software package programs. The Board is an Italian organization that has configured and sold microcontrollers to make them easy to use, and there are various types of Arduinos that shape the leave these circuit.



B. DHT11 and DHT22 sensor

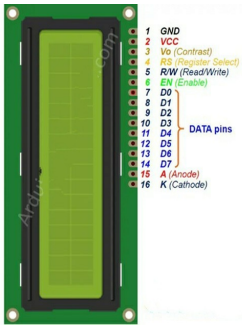



	DHT11	DHT22
Operating Voltage	3 to 5V	3 to 5V
Max Operating Current	2.5mA max	2.5mA max
Temperature Range	0-50°C / ± 2°C	-40 to 80°C / ± 0.5°C
Humidity Range	20-80% / 5%	0-100% / 2-5%
Sampling Rate	1 Hz (reading every second)	0.5 Hz (reading every 2 seconds)
Advantage	low cost	More Accurate

This sensor is used in various applications such as measuring humidity and temperature values in heating, ventilation and air conditioning systems. Weather stations also use these sensors to predict weather conditions. The humidity sensor is used as a preventive measure in homes where people are affected by humidity.

C. LCD (Liquid Crystal Display)

LCD stands for Liquid Crystal Display .The 16x2 LCD is one of the easiest and most cost-effective way to include a native display capability to your IoT projects. 16x2 refers to the two rows with 16 characters on each row, each character is made up of 5x8 pixel matrix. The 16x2 LCD can be interfaced using its 16 pins or via an I2C connector module.



D. Relay

Relays are essential components of electrical engineering and electronics, and act as switches that control circuits with electromagnets. In many different types, the 5V relay stands out as a wide range of components due to its compatibility with microcontrollers and compatibility with low performance applications. This comprehensive guide will address the subtlety of a 5V relay and explore the construction, working principles, applications, benefits, limitations and tips for using it.



Fig.Relay

IV. RESULT

The working of system is that it will collect real data from different sensors connected to the system regarding to moisture and weather condition and check about rain. If the desired data is not match with collected data then identified whether it required irrigation or not level is low Now if it required the irrigation, turning on the pump and checking the actual data with desired data after some finite interval. If data is match, the system will stop irrigation by turning off pump. In rainy day most of time irrigation is not needed but in winter most of time system will turn on and off the irrigation. While in summer it required more water so most of time system is on.

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Fig. Model

V. APPLICATIONS AND ADVANTAGES

1) This sensor is used in various applications such as measuring humidity and temperature values in heating, ventilation and air conditioning systems. Weather stations also use these sensors to predict weather conditions. The humidity sensor is used as a preventive measure in homes where people are affected by humidity.

2) Traditional irrigation systems in agriculture are predominantly manual, requiring farmers to physically turn water pumps on and off. This approach is labour-intensive, time-consuming, and inefficient, often leading to over-irrigation or under-irrigation. Existing automated systems that depend on internet connectivity may not function effectively in areas with limited network coverage.

3) Additionally, the lack of real-time monitoring and status notifications makes it difficult for farmers to optimize water usage and maintain crop health. Therefore, there is a need for a smart irrigation system that can operate autonomously, as well as through remote control, while providing real-time feedback on environmental conditions and system status.

VI. CONCLUSIONS

The Smart Irrigation Control and Monitoring System Using IoT offers a practical and innovative solution for modern agriculture, especially in regions where water management and network connectivity are significant challenges. By combining automated irrigation with manual remote control, the system optimizes water use, improves labour efficiency, and supports sustainable farming practices. Through real-time monitoring and status updates via SMS, it empowers farmers with the information needed to make informed decisions, thereby enhancing agricultural productivity and resource conservation.

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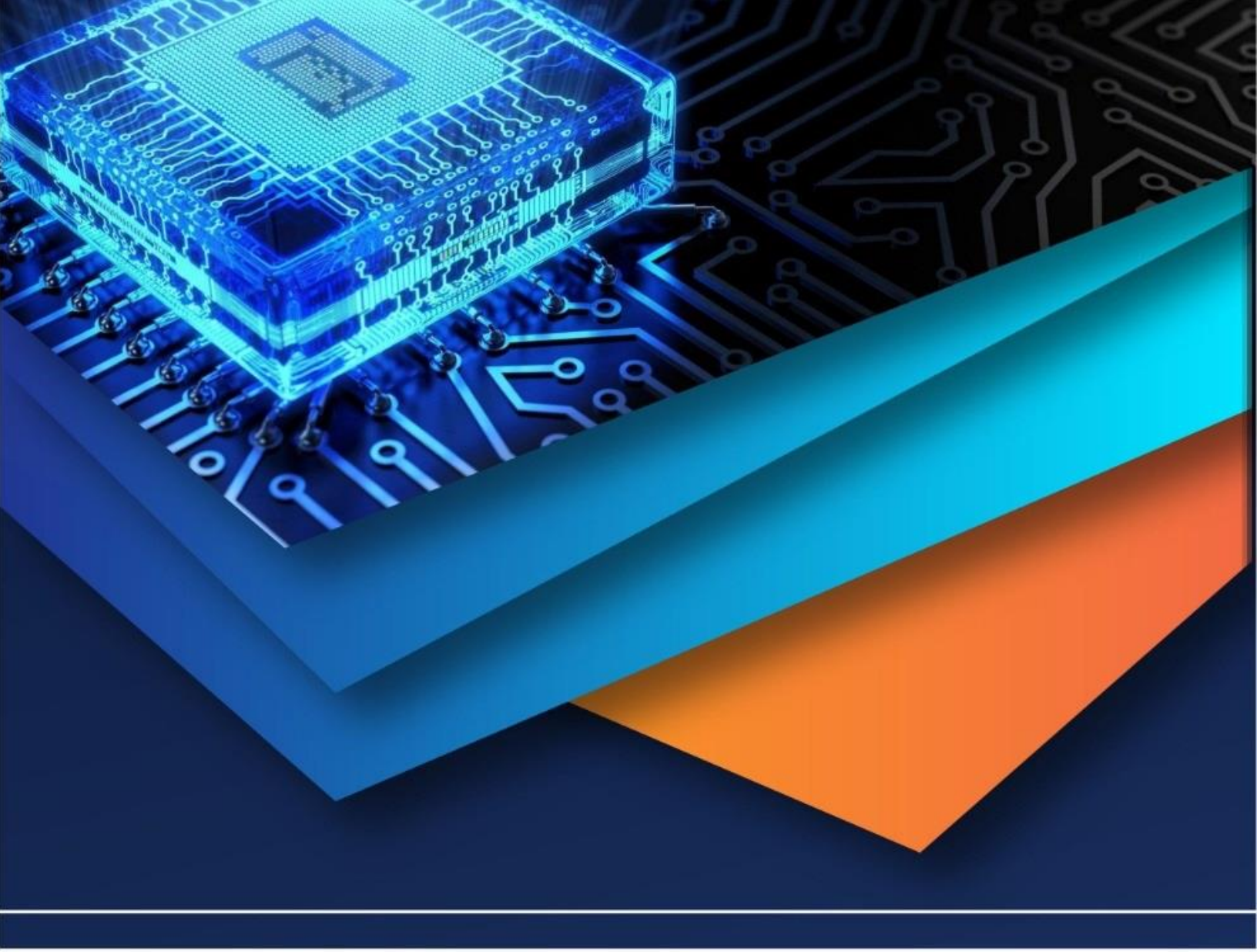
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