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IOT-Powered Automatic Irrigation System and Soil Monitoring

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Abstract: ***There will be a severe food shortage in 25 to 30 years due to India's population of over 1.2 billion people and its daily population growth, necessitating the development of agriculture. Because there isn't enough rain, farmers now face the challenge of water scarcity. Giving farmers access to an automated irrigation system that saves them time and money is the primary goal of this project. The Traditional farmland irrigation methods necessitate human involvement. Irrigation technology that is automated can reduce the need for human intervention. Using a widely used technology known as the "Internet of Things," the sensor detects changes in the soil's humidity and automatically irrigates the field. The project is affordable and uses basic IoT technology, making it possible even in underdeveloped areas.***
Index Terms: Wi-Fi, Display, Board, Microcontroller, Scrolling, Program

I. INTRODUCTION

Ever imagined a world where machines or things communicate with each other. Imagine a network of physical objects-devices, vehicles, buildings and other items embedded with electronics, software, sensors and network connectivity that enable these objects to collect and exchange data. Machine to machine, machine to infrastructure, internet of intelligent things, intelligent system and that is Internet of Things (IoT) and its potential is huge.

IoT describes a world where just about anything can be connected and communicate in an intelligent fashion. In other words, with the Internet of Things, the physical world is becoming one big information system. IoT being one of the blooming technologies in today's world has various real time applications which prove to be really useful. The scope of the technology is vast promising to be one of the technologies of recent times. With the water requirements in irrigation being large, there is a need for a smart irrigation system that can save about 80% of the water. This prototype aims at saving time and avoiding problems like constant vigilance. It also helps in water conservation by automatically providing water to the plants or gardens depending on their water requirements. It can also prove to be efficient in Agricultural fields, lawns and parks. As technology is advancing, there is always a chance of reducing risks and making work simpler. Embedded and micro controller systems provide solutions for many problems. This application precisely controls water system for gardens by using a sensor micro controller system. It is achieved by installing sensors in the field to monitor the soil temperature and soil moisture. Smart irrigation systems estimate and measure diminution of existing plant moisture in order to operate an irrigation system, restoring water as needed while minimizing excess water use.Intelligent automatic plant irrigation system concentrates watering plants regularly without human monitoring using a moisture sensor. The circuit is build around a comparator Op-amp (Operating Amplifier) and a timer which drives a relay to switch on a motor. The system uses a hardware component, which is subjected to variation with the environmental conditions. One may wonder why Smart irrigation is required. During manual irrigation, the water requirement of plants or crops is not monitored. Even when the soil is moist enough, water is still provided. This water is not absorbed by the plants and thus is wasted. Hence a system is used to monitor the water requirements.

This prototype monitors the amount of soil moisture and temperature. A predefined range of soil moisture and temperature is set, and can be varied with soil type or crop type. In case the moisture or temperature of the soil deviates from the specified range, the watering system is turned on or off. In case of dry soil and high soil temperature, it will activate the irrigation system, pumping water for watering the plants.

This technology is recommended for efficient automated irrigation systems and it may provide a valuable tool for conserving water planning and irrigation scheduling which is extendable to other similar agricultural crops. Maximum absorption of the water by the plant is ensured by spreading the water uniformly using a servo motor. So there is minimal wastage of water. This system also allows controlling the amount of water delivered to the plants when it is needed based on types of plants by monitoring soil moisture. This project can be used in large agricultural area where human effort needs to be minimized. Many aspects of the system can be customized and fine-tuned through software for a plant requirement. The system used a number of components which on the other hand are easy to operate or use.

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II. LITERATURE REVIEW

1) *Danish Inamdar, Vishal Raut, Akash Patil, Nayan Patil(2016), 'Smart Drip Irrigation System', International Research Journal of Engineering and Technology (IRJET) Volume- 03, Issue- 02, pp 100- 103*

The automation process is integrated to control devices to operate autonomously and interact with smart technologies and devices that perform many tasks without human hands. Thus, this work Arduino-Powered Smart Irrigation System based on smart sensors that can be rationally and economically used to monitor a mint or any facility by integrating some connected electronic devices and other useful tools commonly used in the IoT field. This system includes a soil moisture sensor placed in the root zone of the plant, a temperature sensor and a water flow sensor connected to the valve of the water pump motor. These sensors are integrated with Arduino UNO microcontroller, relay module, DC pump motor and batteries. In other words, the behaviour of this automated system is encapsulated in detecting soil moisture and temperature levels and automatically starting the pump motor based on soil moisture. In general, such an automatic watering system can be easily implemented in small gardens, nurseries or greenhouses. Recently, innovative solutions have been introduced to reduce costs, save time and optimize the use of resources. The proposed system ensures optimal watering by automatically switching the pump motor through the relay module according to the soil moisture and temperature threshold. The system is quite functional and the results observed are very encouraging. there are many systems dedicated to the conservation of irrigation water for the cultivation of various crops, from the rudimentary to the technologically advanced. For example, an automatic irrigation system using a wireless sensor network and a GPRS module was created to optimize water use for crops. Temperature sensors and a gateway unit for processing sensor data, controlling actuators and transferring data to a mobile application.

2) *Lakshmiprasad C N , Aashish R , Syed Muzaffar J(2014),'Smart Irrigation in Agriculture',IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE) Volume- 09, Issue- 06, pp 34-40*

Fresh water irrigation in the agricultural land is of raising importance. Since there is a heavy demand for the fresh water, reduced and optimal usage of resources is encouraged which can be provided by the usage of automation technologies and its apparatus like irrigation, sensors and remote operation. Emerging trends in agriculture aims at ensuring more productivity and less damage to the land which led to soil nutrient management, where the fertilizers can be met based on local requirements with go green technology. Providing latest technologies in nutrient management along with sophisticated sensor control will mentor in getting more productivity and profitability.

Non destructive and efficient sensors are used to track the utility. Also the developed irrigation method removes the need for workmanship for irrigation and maintaining farm or field. The purpose of this paper is to provide more facility in agriculture field by using wireless sensor network along with linear programming and monitoring system. Paper describes an application of a wireless sensor network for low-cost wireless controlled and monitored irrigation solution.

Real time monitoring of temperature, moisture, humidity and nutrient facts of soil and atmosphere can correctly guide the agriculture and improve crop production. Precision agriculture is an agricultural system that can contribute to the sustainable agriculture concepts.

3) *S. Darshna, T. Sangavi, Sheena Mohan, A. Soundharya, Sukanya Desikan (2015)',Smart Irrigation',IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) Volume- 10, Issue- 03, pp 32-36*

With the water requirements in irrigation being large, there is a need for a smart irrigation system that can save about 80% of the water. This prototype aims at saving time and avoiding problems like constant vigilance. It also helps in water conservation by automatically providing water to the plants/gardens depending on their water requirements. It can also prove to be efficient in Agricultural fields, Lawns & Parks. As technology is advancing, there is always a chance of reducing risks and making work simpler. Embedded and micro controller systems provide solutions for many problems. This application precisely controls water system for gardens by using a sensor micro controller system. It is achieved by installing sensors in the field to monitor the soil temperature and soil moisture which transmits the data to the microcontroller for estimation of water demands of plants. In the present era one of the greatest problems faced by the world is water scarcity and agriculture being a demanding occupation consumes plenty of water. Therefore a system is required that uses water judiciously. Smart irrigation systems estimate and measure diminution of existing plant moisture in order to operate an irrigation system, restoring water as needed while minimizing excess water use.

4) *Shwetha (2016),'Automated Irrigation System using wireless sensor networks',International Research Journal of Engineering and Technology (IRJET) Volume- 03, Issue- 4, pp 1586-1588*

Irrigation is the artificial application of water to the soil. There are various technological improvements in irrigation including automated irrigation. Automated irrigation implies operation of the system without any manual intervention. An automated system utilizes technologies like timers, sensors, computers, mechanical appliances, etc. Here we are presenting a comparative study of optimizing irrigation using remotely monitored embedded system, zigbee or hotspot, using wireless sensor networks particularly for drip irrigation and a micro controller based optimization that uses cellular internet interface which allows data inspection and irrigation scheduling to be programmed through web page. Implementation of these systems can be potentially used in water limited geographical areas. Indian agriculture contributes to 16% of the nation's GDP and 10% of export earnings. Clearly agriculture contributes to the economic development and it is necessary to optimise the yield by utilizing available science and technology. Obtaining good yield depends on various factors such as irrigation, soil pH level, humidity level. Any factor affecting these parameters leads to the diseased and improper growth of plants. This paper provides a review on the automated irrigation by comparing the two papers, using wireless sensor networks and a GPRS module [1] and automated drip irrigation and monitoring of soil by wireless [2]. Automated irrigation implies the artificial application of the water to the soil, without the intervention of human. The proposed systems helps in reducing the farmer's workload by irrigating the land based on the water requirements. It has sensors embedded which helps in monitoring the soil moisture content, humidity and the temperature. It is also possible to apply water soluble fertilizers along with drip irrigation, and thereby minimizes the water and fertilizers usage, as it directly applies fertilizers and water to the root zone due to which large quantity of fertilizers and water is saved.

III. COMPONENTS

1) Node MCU ESP8266 Board
2) LCD(Liquid Cristal Display)
3) Jumper wires
4) Bread board
5) micro-USB data cable

A. Arduino

Arduino is an open source, computer hardware and software company, project, There are various types of arduinos. all the type of arduinos we are using

Fig1. Arduino board

NodeMCU10 in this project. This Node arduino consist of 12pins.It also has an in-built wiFi module in it.It has a storage of 32kb of memory.

NodeMCU10 NodeMCU is an open source IoT platform. It includes rmware which runs on the ESP8266 Wi-Fi The term " NodeMCU & quot; by default refers to the ESP8266 is Wi-Fi enabled system on chip (SoC) module developed by Espressif system. It is mostly used for development of IoT (Internet of Things) embedded applications[14-16].

Fig 2, Node MCU10

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IV. BLOCK DIAGRAM

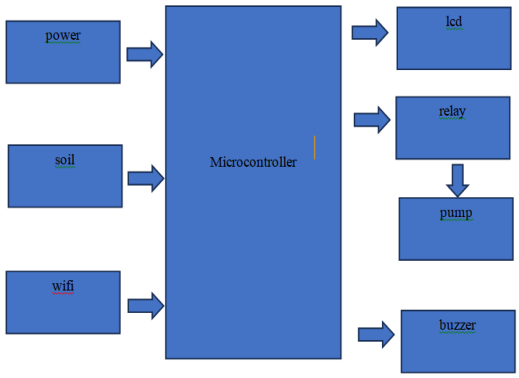

Fig3. Block Diagram

V. WORKING

The Arduino microcontroller UNO is used in an automatic plant watering system that is configured to send interrupt signals to the motor through the motor driver module. The Arduino board's A0 pin is connected to a soil sensor, which measures the soil's moisture content. The sensor detects a change in humidity whenever the soil moisture content values decrease, and it sends a signal to the microcontroller to turn on the pump (motor). An automatic system for watering plants can use this idea. An Arduino UNO board, a soil moisture sensor, a 5V motor pump, a motor driver L293D, and a motor driver IC are all part of the circuit that powers the water pump. The Arduino board can be powered by a 5V to 9v.

VI. OPERATIVE BENEFITS

1) IoT system monitor soil moisture levels in real-time, ensuring water is applied only when necessary, significantly reducing water waste.
2) By optimizing water usage, farmers can lower their water bills and reduce costs associated with manual irrigation methods.
3) Consistent and precise irrigation promotes better plant growth and health, leading to higher yields and improved crop quality.
4) Easy to operate.
5) Low Cost.

VII. RESULT

The results analysis shows how well IoT-based watering systems work to maintain the ideal soil moisture levels for plant growth. These systems offer better irrigation, conserve water, and flexibility, data-driven insights, plant health and growth, remote monitoring and control, and resource efficiency. Plant owners, farmers, and gardeners can use IoT technology to implement accurate and efficient watering practices, which will produce stronger and healthier plants.

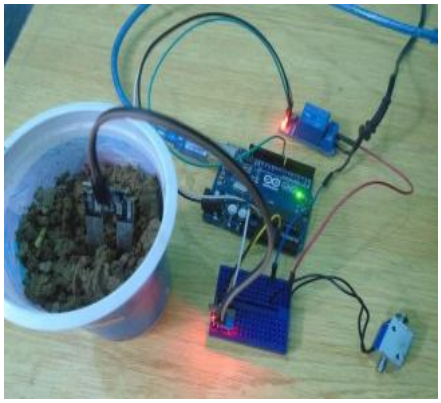

Fig 6. Experimental setup

VIII. CONCLUSION

In the present era, the farmers use irrigation technique through the manual control, in which the farmers irrigate the land at regular intervals. This process seems to consume more water and results in water wastage. Moreover, in dry areas where there is inadequate rainfall, irrigation becomes difficult. Hence, we require an automatic system that will precisely monitor and control the water requirements in the field. Installing Smart irrigation system saves time and ensures judicious usage of water. Moreover, this architecture uses Arduino which promises an increase in system life by reducing power consumption. It also reduces the human intervention therefore less energy of the farmer of the farmer is required.

Our project can be improvised by adding a Webscaper which can predict the weather and water the plants or crops accordingly. If rain is forecasted, less water is let out for the plants. Also, a GSM module can be included so that the user can control the system via smart phone. A water meter can be installed to estimate the amount of water used for irrigation and thus giving a cost estimation. A solenoid valve can be used for varying the volume of water flow. Furthermore, Wireless sensors can also be used. Monitoring of other growth or soil parameter can also be included just by connecting the sensors and modifying the source code of the project. This integration can also reduce the number of other hardware components used in the system thereby reducing the total cost of the system. The system will continuously send the data on the cloud. These data can also be accessed using Bluetooth on Android App. If there is no internet present, the farmer can control the system through the App that is the Semiautomatic system. The plant's growth can be detected earlier by measuring the pH content of the soil which can help the farmers in numerous ways. The farmer gets to know earlier that what crops can be grown in the field.

IX. FUTURE SCOPE

The integration of Internet of Things (IoT) technology into agriculture, particularly in automatic irrigation systems, represents a significant advancement in the quest for efficient water management. As global populations grow and climate change intensifies, the need for sustainable agricultural practices becomes increasingly urgent. The future scope of automatic irrigation soil moisture control using IoT is promising, driven by technological advancements, data analytics, and a growing emphasis on sustainability.

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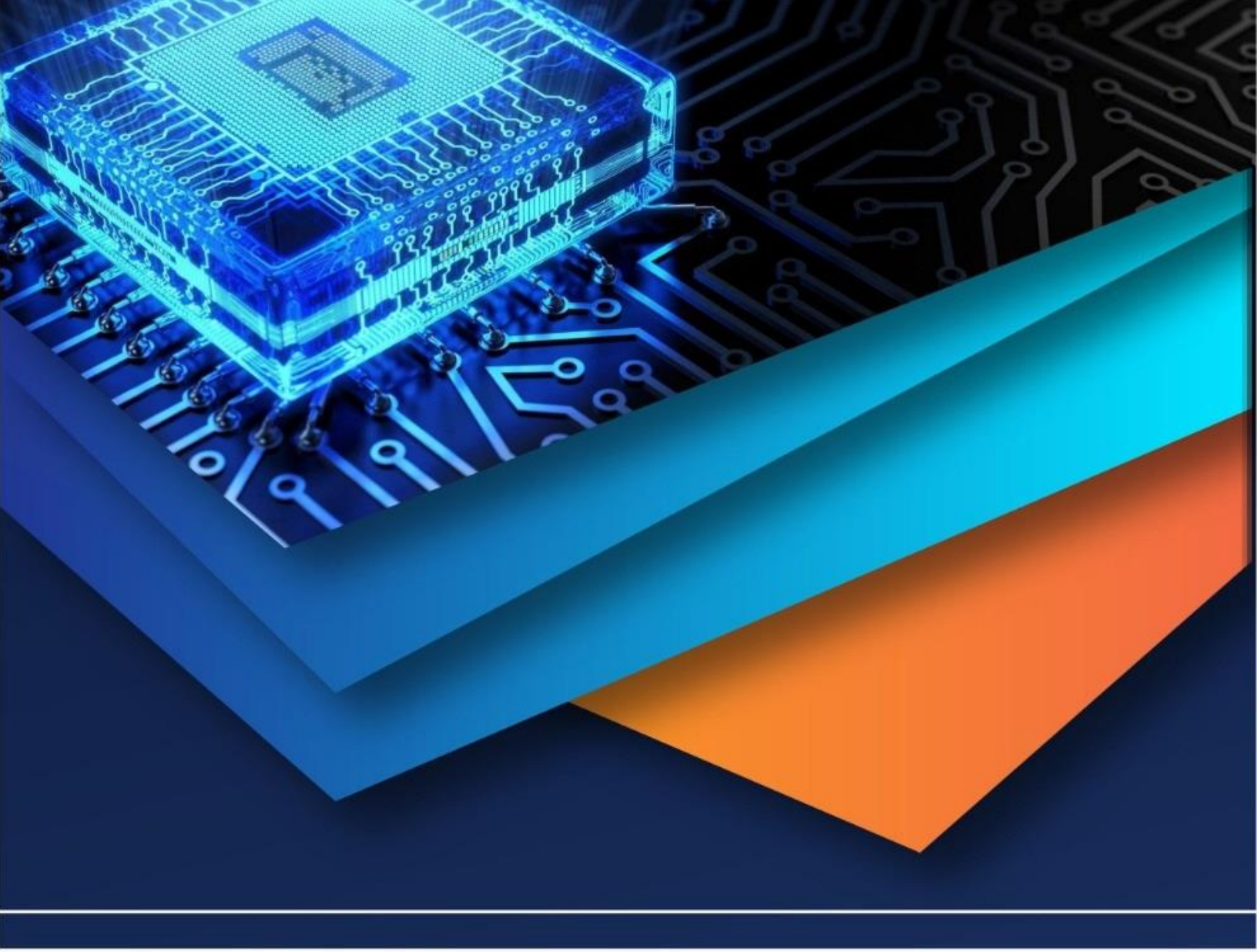

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