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A Novel Design Approach towards Next-Generation Smart Irrigation System for Agricultural Enhancement

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Abstract: *Smart irrigation systems represent a transformative solution to enhance agricultural sustainability and productivity. By integrating advanced sensor technology, artificial intelligence, and IoT connectivity, these systems optimize water usage, adapt to changing environmental conditions, and minimize resource wastage. This paper explores the current state of smart irrigation technology, highlighting its potential to revolutionize farming practices. Additionally, future research directions and opportunities for further innovation are discussed, emphasizing the role of smart irrigation in promoting sustainability and resilience in agriculture. As technology continues to evolve, the adoption of smart irrigation systems offers promising prospects for improving efficiency and ensuring food security in the face of environmental challenges.*

Keywords: Smart irrigation systems, agriculture, sustainability, water efficiency, crop yield, sensor technology, artificial intelligence, IoT connectivity, environmental impact, resilience, innovation

I. INTRODUCTION

In the domain of modern agriculture, the integration of advanced technologies has become increasingly essential to address the challenges posed by climate change and population growth. One such technological innovation with profound implications for sustainable agriculture is smart irrigation systems. These systems leverage cutting-edge sensors, artificial intelligence (AI), and Internet of Things (IoT) connectivity to optimize water usage and enhance crop yield while minimizing environmental impact. As global water resources become increasingly scarce and unpredictable weather patterns intensify, the development and implementation of smart irrigation systems have emerged as a critical strategy to ensure efficient water management and food security. This paper provides an overview of the current state-of-the-art in smart irrigation technology, highlighting its potential to revolutionize agricultural practices and mitigate the adverse effects of climate change. Furthermore, it explores future research directions and opportunities for innovation in this rapidly evolving field, aiming to contribute to the advancement of sustainable agriculture and resilience in the face of environmental challenges.

Irrigation is the application of providing controlled amounts of water to plants at needed intervals. It helps to grow agricultural crops, maintain landscapes, soil, consolidation and revegetate disturbed soils in dry areas and during periods of less than average rainfall. The objective of our project is to design an automated irrigation system which is cost effective and time saving using Node microcontroller. The NodeMCU (Node MicroController Unit) is an open source software and hardware development environment that is built around a very inexpensive System-on-a-Chip (SoC) called the ESP8266.The proposed system will automatically water the plants when the soil moisture sensor detects insufficient amount of moisture in soil using as the centrecore. We also aim to connect the system with internet so that it can also manually be operated by smartphone app from anywhere-anytime.

The concept of this project is to allow the owners of fields to control and observe the growth of their plants in their farms. This is achieved by using a smart platform of IoT and solenoid valves to control the flow of water based on the moisture of the soil and gives real time surveillance to the owners who stay far away from the farms. This project also allows surveillance on the personnel and their crops so as to not occur losses. It is easy to use for anyone with a Smartphone and doesn't require maintenance once set up. This project has been designed for surveillance of irrigation

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systems in farms without the need of manual checking of irrigation systems. For example, if you are staying in Bangalore, and have your farm in Andhra Pradesh or elsewhere and it is not possible for you to go to the farms every time to keep a tab on the plants. Instead, this project allows you to check up on your plants using a simple IoT system. The positive part of this project is that, the node used to connect the system to your smart device, also controls the flow of water from the pump and also the timing intervals in between the irrigation cycles. In this paper we will be discussing all about the project as to how it is constructed and how it works.

II. LITERATURE SURVEY

1. "Smart Irrigation Systems: A Review"

Smith et al. conducted a comprehensive review of existing smart irrigation systems, offering valuable insights into the various technologies and methodologies employed in this field. By analyzing a wide range of studies and practical applications, the authorsprovide a thorough overview of the capabilities and limitations of smart irrigation systems. This review serves as a foundational resource for understanding the evolution of smart irrigation technology and its potential impact on agricultural practices.

2. "Advancements in Sensor Technologies for Smart Irrigation Systems"

Garcia et al. focused on the recent advancements in sensor technologies and their implications for smart irrigation systems. By examining the latest developments in sensor design, accuracy, and affordability, the authors highlight the potential for sensors to provide real-time data on soil moisture, temperature, and crop health. This review underscores the importance of sensor technology in improving the efficiency and effectiveness of smart irrigation systems.

3. "Integration of Data Analytics in Smart Irrigation Systems"

Patel et al. explored the integration of data analytics techniques in smart irrigation systems to enhance performance and efficiency. By leveraging data from sensors and other sources, such as weather forecasts and crop models, data analytics can optimize irrigation scheduling and water management strategies. This review highlights the role of data analytics in maximizing crop yields while minimizing water usage and environmental impact.

4. "Automation and Control in Smart Irrigation Systems"

Lee et al. delved into the automation and control mechanisms employed in smart irrigation systems to optimize water management. By automating irrigation scheduling and adjusting water delivery based on real-time data, these systems can minimize human intervention while maximizing efficiency. This review discusses various automation technologies and their potential impact on improving crop yields and resource conservation.

5. "User Interface Design for Smart Irrigation Systems"

Wang et al. examined the user interface design considerations for smart irrigation systems to enhance usability and accessibility. A user-friendly interface is crucial for enabling farmers to interact with and control irrigation systems effectively. This review discusses various interface design principles and technologies, such as mobile applications and web-based platforms, aimed at improving user experience and adoption of smart irrigation systems.

III. MATERIALS AND METHODOLOGY

Development of soil moister analyzer

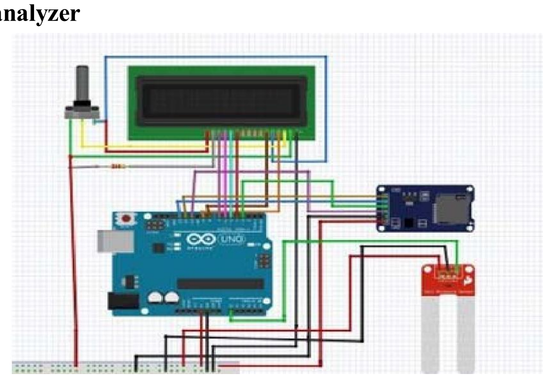

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Figure 1 Prepared Gadget

In order to monitor the soil moisture content an Arduino based soil moister analyzer was prepared. For the soil moister analyzer Arduino UNO board, 16*2 LCD, SD card module, Yl-69 soil moisture sensors, were connected.
Figure 1 shows the final diagram that was made to analysis the soil moisture and for data logging

Calibration of soil moister sensor

As the soil moister sensor is only will only measure resistance between the two probes, it has to be calibrated with soil moister meter in order to make the sensor to show the direct soil moister measurements. So, for that the soil moister meter readings were noted in different levels of soil moister along with the corresponding resistance readings of moister analyzer and by plotting a graph, a linear equation was obtained.
Then the developed soil moister analyzer was utilized at different measured root depth to maintain the field capacity of root zone to find out the crop water requirement and to store the obtained data.

Plant selection

For this research purpose, eggplant (Plastic variety) was selected as it is medium rooted and drought tolerant, so that water saving will be more efficient without crop damage.

Field preparation and Preliminary investigation

A field was selected in Department of Agriculture farm, Thirunelvely. According to the Agriculture department spacing recommendation, drip system was developed in the field and some preliminary investigations such as infiltration rate, field capacity level of the soil, emitter discharge, emission uniformity coefficient and finally the measurement of quantity of water being irrigated by the farmers in different stages of eggplant were carried out.

Field planting

Plants were planted according to the recommended spacing in two adjacent drip irrigation fields. Each field was allowed to have 6 columns and 13 rows. Planting was carried out in two different times. First field was planted 31 days prior to the planting of second field (test field). First field was used for the root investigation and the second field was used to calculate the crop water requirement.
For field planting 23 days old, disease free plastic variety eggplant seedlings were planted in the field manually in the basis of 1 seedling per planting holes. Then the plants were covered by glyricidia plant branches in order to facilitate temporary shading.

Root investigation

The first field was irrigated according to the recommendation of Department of Agriculture training center. From each column of field one, 4 plants were randomly selected and uprooted according to the monolith method and roots were investigated for vertical and horizontal lengths in 18 days after planting, 38 days after planting, 58 days after planting, 78 days after planting and 108 days after planting.

Estimation of crop water requirement

According to the investigated length of the root, the soil moisture sensors were inserted as shown in the Figure 2 into the soil and plants were irrigated up to the field capacity of soil in the test field. Finally the time needed to irrigate the eggplant in different stages and the time needed between two consecutive irrigation were calculated.

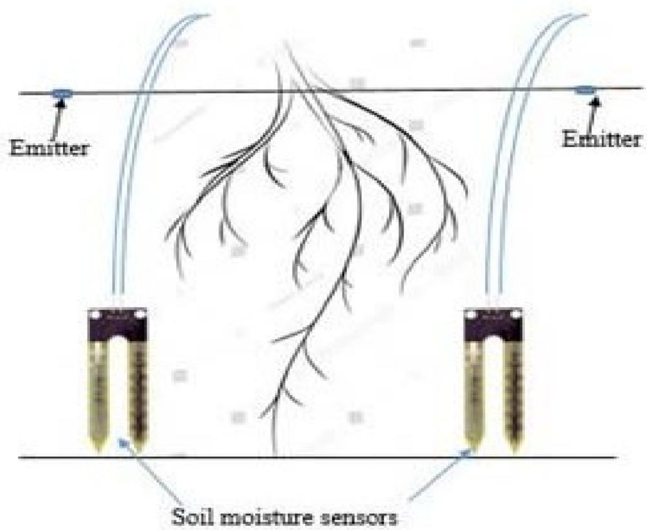
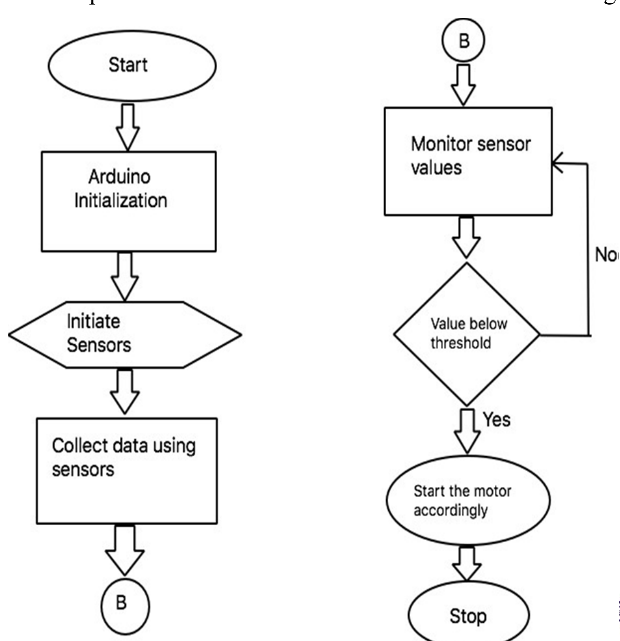


Figure 2 Soil moisture sensor insertion pattern

III. SOFTWARE IMPLEMENTATION

Arduino Integrated Development Environment (IDE) [7] is used to write the program. The Arduino IDE is a cross platform application (for Windows, macOS , Linux) which is used to write and upload programs to Arduino compatible boards and also with development boards such as NodeMCU. It is derived using C and C++.



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IV. HARDWARE DESIGN

- Atmega 328 Microcontroller
- 12V DC motor
- Relay module
- Jump wire
- Power Supply

Fig 3. ATmega 328 microcontroller

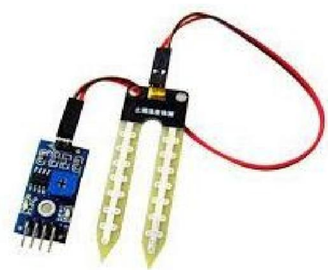

Fig 4. Moisture sensor

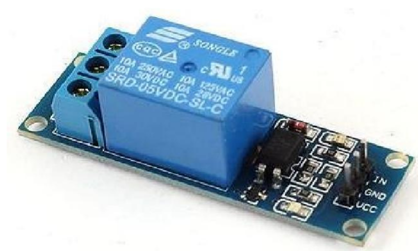

Fig 5. Relay module

VI. CONCLUSION

In conclusion, smart irrigation systems offer a promising solution for enhancing agricultural practices by improving water efficiency and crop yield while reducing environmental impact. As technology continues to advance, further research and innovation in this field hold the potential to revolutionize farming, making it more sustainable and resilient in the face of climate change. With ongoing development and adoption of these systems, we move closer to achieving a more efficient and sustainable future for agriculture.

REFERENCES

[1]. IOT based Smart Irrigation System "Srishti Rawal" presented at International Journal of Computer Applications, volume 159-No 8, February 2017.

[2]. Design and Implementation of Automatic Plant Watering System "Archana and Priya" presented at International Journal of Advanced Engineering and Global technology, vol- 04, Issue-01, Jan-2016.

[3]. Sensor Based Automated Irrigation System with IOT "Karan Kansara and Vishal Zaweri," presented at International Journal of Computer Science and Information Technologies, vol-06, 2015.

DOI: 10.48175/568

[4]. C.H.Chavan and V.Karnade, “ Wireless Monitoring of Soil moisture, Temperature and Humidity using Zigbee in Agriculture” presented at International Journal of Engineering Trends and Technology (IJETT), vol-11, May- 2014.

[5]. Asian Journal of Science and Technology Vol. 10,Issue 0 6, pp.9756-9768, June, 20.

[6]. Measurement of Temperature and Humidity by using Arduino Tool and DHT11 “Deeksha Srivastava, Awanish Kessarwani, Shivani Dubey”, International Research Journal of Engineering and Technology (IRJET), volume5, Issue 12, Dec 2018

[7]. The working principle of an Arduino “Yusuf Abdullahi Badmasai” published in 2014 11th International Conference on Electronics, Computer and Computation (ICECCO).