iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 **Issue:** V **Month of publication:** May 2025

DOI: https://doi.org/10.22214/ijraset.2025.70691

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue V May 2025- Available at www.ijraset.com

IOT Based Irrigation System

Amit Singh[1], Naimish Kumar Verma[2], Saurabh Verma[3], Shubham[4], Asst. Prof. Mr. Vikas Porwal[5]
[1, 2, 3, 4, 5] Department of Computer Science And Engineering, Babu Banarasi Das Northern India Institute Of Technology, Lucknow, Uttar Pradesh, India.

Abstract: In the context of increasing population and diminishing water resources, the need for efficient and automated irrigation systems has become crucial for sustainable agriculture. This paper introduces an IoT-enabled smart irrigation system aimed at automating the irrigation process while integrating security features to protect field equipment from theft. The system is built around a Node MCU ESP8266 microcontroller, which interfaces with sensors that monitor soil moisture, temperature, and humidity in real time. When the soil moisture level falls below a predetermined threshold, the irrigation system activates automatically. Furthermore, a PIR (Passive Infrared) sensor is included to detect unauthorized movement near the equipment, sending alerts to users via the Blynk IoT platform. This innovative dual-purpose system not only enhances water efficiency but also provides protection for equipment situated in open agricultural areas. Designed to be cost-effective, scalable, and easy to use, this system offers a practical and secure solution for contemporary farming practices.

This dual-purpose design—combining water management and security—makes the proposed system particularly valuable for modern agricultural operations. It is engineered to be accessible and easy to deploy, prioritizing a low-cost design that can be scaled according to the size and needs of different farms. The user-friendly interface provided by the Blynk platform allows farmers to monitor soil conditions, control irrigation schedules, and receive real-time alerts remotely from their smartphones or computers, thus increasing convenience and operational efficiency.

Keywords: IOT (Internet of Things), Sensors, Blynk, Humidity, Temperature, Irrigation, Crop Yields.

I. INTRODUCTION

Agriculture serves as a fundamental pillar for numerous economies worldwide and is essential for maintaining food security. However, conventional irrigation techniques frequently result in inefficient water usage, leading to resource wastage and diminished agricultural productivity. As global concerns regarding water scarcity intensify, there is an urgent need for innovative solutions that can automate and optimize irrigation practices. The emergence of Internet of Things (IoT) technologies has created significant opportunities for the development of intelligent agricultural systems. IoT-enabled irrigation systems facilitate real-time monitoring of soil and environmental conditions, allowing for precise management of water application. This capability not only conserves water resources but also promotes healthier crops and increases overall yield. In this study, we introduce a cost-effective smart irrigation system that leverages IoT technology to monitor key parameters such as soil moisture, temperature, and humidity, thereby automating the irrigation process. The system is built around the Node MCU ESP8266 microcontroller, which serves as the core processing unit. It is equipped with various sensors that continuously gather data on soil conditions and environmental factors. This information is then transmitted to the Blynk IoT platform, enabling farmers to monitor and control the irrigation system remotely through a user-friendly mobile application. The design of this smart irrigation solution prioritizes simplicity and scalability, making it accessible to farmers, particularly those in rural areas. By providing an easy-to-implement system, we aim to empower agricultural practitioners to adopt modern technologies that enhance their productivity while promoting sustainable practices. The ability to automate irrigation based on real-time data not only reduces water consumption but also ensures that crops receive the optimal amount of moisture needed for growth. Moreover, this IoT-based irrigation system is designed to be cost-effective, making it a viable option for a wide range of agricultural operations. By minimizing the need for manual intervention and optimizing water usage, farmers can achieve better crop yields without incurring significant expenses. This is particularly important in regions where water resources are limited, and efficient management is crucial for sustaining agricultural activities.

II. LITERARTURE REVIEW

The automation of irrigation systems has emerged as a significant area of research, driven by the growing demand for efficient water management practices in agriculture. Numerous studies have highlighted that automated irrigation systems can greatly minimize manual labour and reduce water wastage when compared to traditional irrigation methods, which often rely on less precise techniques.

For instance, Dang et al. (2020) introduced an innovative irrigation system that utilizes a wireless sensor network combined with fuzzy logic algorithms. This system optimizes water application by taking into account real-time soil moisture levels and weather conditions, thereby ensuring that crops receive the appropriate amount of water precisely when needed. This approach not only enhances water efficiency but also contributes to improved crop health and yield.

In a similar vein, Sandoval-Solis et al. (2018) developed an IoT-based irrigation system that employs cost-effective microcontrollers and real-time monitoring tools. Their system allows for better management of water resources by providing farmers with the ability to monitor soil conditions and adjust irrigation schedules accordingly. This real-time feedback loop is crucial for optimizing water usage and ensuring that crops are adequately hydrated without unnecessary waste.

Additionally, Priyanka and Jain (2017) designed an automatic irrigation system controlled by Arduino technology, specifically tailored for small-scale farms. Their work emphasizes the importance of creating low-cost solutions that are accessible to farmers in rural areas, where resources may be limited. By focusing on affordability and ease of use, such systems can empower smallholder farmers to adopt modern agricultural practices that enhance productivity and sustainability.

Despite the advancements made in automated irrigation systems, several challenges remain. Many existing solutions still grapple with issues such as high initial deployment costs, complexities in maintenance, and limited accessibility for small-scale farmers who may lack the technical expertise or financial resources to implement sophisticated systems. These barriers can hinder the widespread adoption of automated irrigation technologies, particularly in developing regions where they are most needed.

This innovative approach not only focuses on reducing costs but also emphasizes user-friendliness, ensuring that farmers can easily operate and maintain the system without requiring extensive technical knowledge. By leveraging IoT technology, the proposed system will enable real-time monitoring and control of irrigation processes, allowing farmers to optimize water usage based on current soil conditions and environmental factors.

III. EXISTING SYSTEM

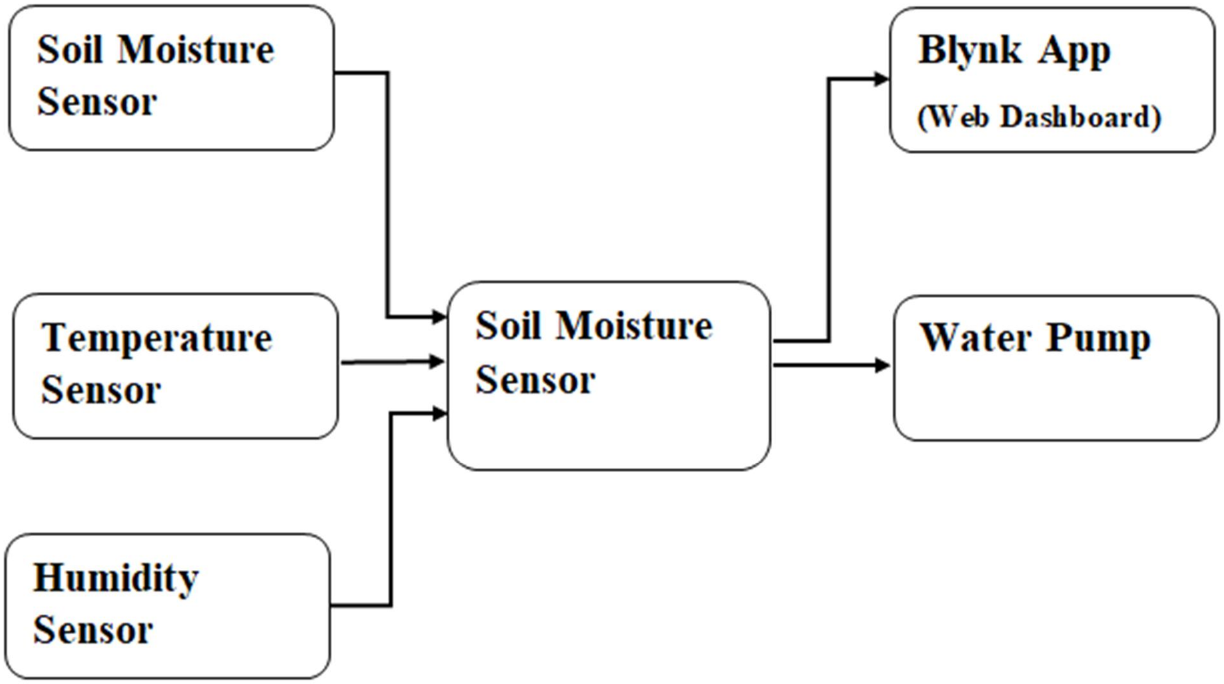
Traditionally, agriculture has relied heavily on manual labour, which has made it difficult for farmers to accurately forecast weather conditions, often resulting in inefficient water usage. However, advancements in technology have introduced various sensors that can measure essential factors such as soil moisture, humidity, and temperature, all of which are critical for effective irrigation management. These sensors are typically integrated with irrigation systems, including sprinklers and water pumps, and the data they collect is often displayed through microcontrollers or LED indicators. Despite their effectiveness, this conventional setup faces several challenges, particularly in rural and urban areas where internet connectivity may be unreliable and power supply can fluctuate. To tackle these issues, newer technologies have been integrated into irrigation systems to enhance their performance. For instance, modern soil moisture sensors can automatically activate irrigation systems when moisture levels drop below a specified threshold. Consequently, there is an increasing demand for more accessible and user-friendly solutions that can deliver the advantages of automated irrigation without the high costs and complexities associated with traditional systems.

IV. PROPOSED SYSTEM

The proposed system is an innovative IoT-based smart irrigation solution that automates the watering of agricultural crops by utilizing real-time data on soil moisture levels and environmental conditions. This system incorporates a variety of sensors and a microcontroller to continuously monitor critical parameters such as soil moisture, temperature, and humidity. When the moisture content in the soil falls below a specified threshold, the system automatically activates a water pump or solenoid valve to irrigate the crops effectively. At the heart of this system is the Node MCU ESP8266 microcontroller, which processes the data collected from the sensors and executes the necessary control actions. This microcontroller is known for its efficiency and connectivity capabilities, making it an ideal choice for IoT applications.

Designed with user-friendliness and energy efficiency in mind, the system seamlessly integrates with the Blynk IoT platform. This integration allows farmers to monitor field conditions remotely through a mobile application, providing them with real-time notifications and updates about soil conditions and irrigation status. Such features empower users to make informed decisions, reducing the need for manual labor and optimizing water usage, which is crucial in areas facing water scarcity. Ultimately, this leads to improved crop yields and sustainable farming practices.

Furthermore, the system can be expanded with additional features, such as weather forecasting integration, which would allow for predictive irrigation scheduling based on upcoming rainfall or temperature changes. This would further optimize water usage and ensure that crops receive the right amount of water at the right time. Additionally, incorporating machine learning algorithms could enable the system to learn from historical data, improving its efficiency and effectiveness over time.



V. SYSTEM COMPONENTS

A. Node MCU ESP8266 Microcontroller

A Wi-Fi-enabled microcontroller that acts as the brain of the system. It collects data from sensors and controls the water pump based on pre-programmed logic.

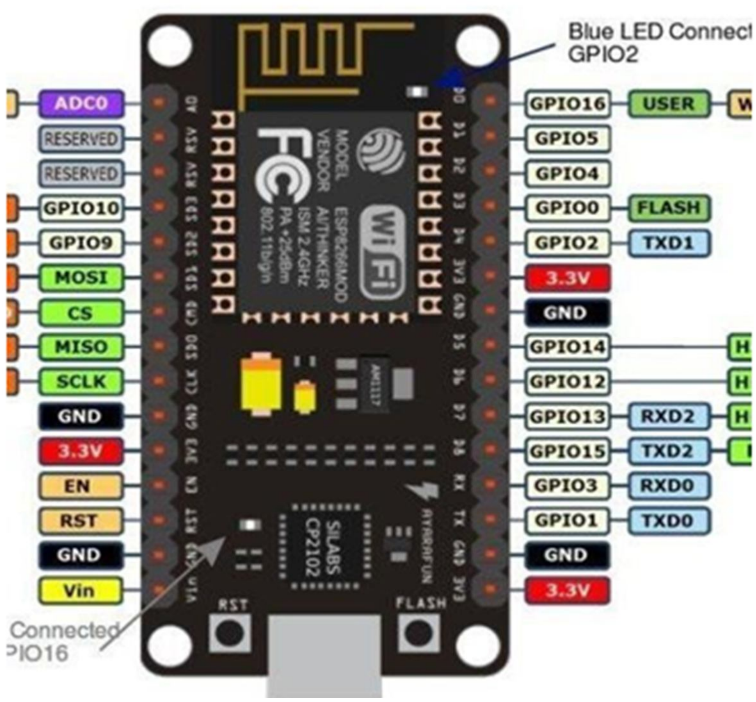


Fig. 1: Node MCU ESP8266

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue V May 2025- Available at www.ijraset.com

B. Soil Moisture Sensor

Soil Moisture sensor is designed to assess the volumetric water content present in the soil. It delivers real-time data on soil moisture levels, which is essential for determining the necessity of irrigation.

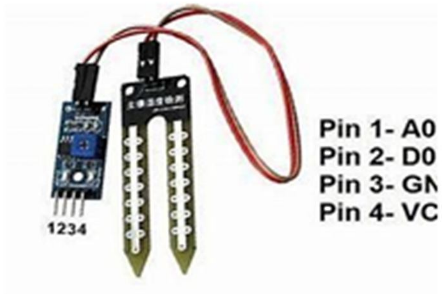


Fig. 2: Soil Moisture Sensor

C. Temperature and Humidity Sensors

Temperature and humidity sensors (e.g., DHT11 or DHT22) can be used to complement the system with more environmental data. These sensors gather data on surrounding environmental conditions, enabling the system to make better-informed irrigation choices, particularly in response to severe weather events. This ensures that irrigation practices are adapted to changing climatic circumstances.

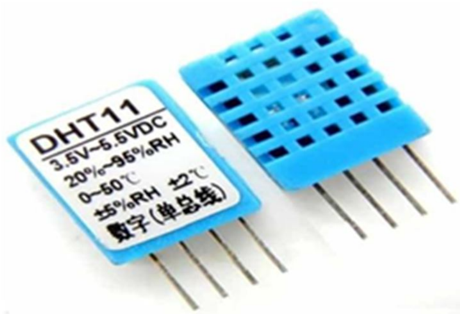


Fig. 3: DHT11 Humidity Sensors

D. Relay Module

The relay module acts as a switch, allowing us to control water pumps or valves that manage the irrigation process.

Fig. 4: Relay Module

E. PIR Motion Sensor

This sensor detects movement in the surrounding area of the system. It helps monitor unauthorized access or intrusion attempts around critical components like the Node MCU, water pump, and sensors. When motion is detected, a notification is sent via the Blynk app, allowing the user to take timely action. This enhances the security of the system, especially when deployed in open fields.

F. LCD Screen
The LCD screen, connected through an I2C module, displays real-time information such as soil moisture levels and irrigation status.

G. I2C Module
This module simplifies the communication between the Node MCU and the LCD screen, enabling efficient data display.

H. Water Pump
The pump or valve is activated to deliver water when the soil moisture falls below the required level.

I. Power Supply
A standard DC power supply (5V or 12V) is used. For remote areas, battery backups or small solar panels can also be incorporated for uninterrupted operation.

J. Mobile Application/Web Dashboard
The Blynk application serves as the primary user interface for the system, providing a comprehensive platform for farmers to interact with their smart irrigation setup. It presents real-time sensor readings, allowing users to monitor soil moisture levels, temperature, and humidity at a glance. Additionally, the app sends notifications to users regarding irrigation events, ensuring they are promptly informed when watering occurs or when soil conditions require attention.

VI. WORKING METHODLOGY

A. Data Collection
The sensors are engineered to monitor vital parameters like soil moisture, surrounding temperature, and humidity levels at all times. The measurements are relayed in real-time to the Node MCU microcontroller, the brain of the system, to be processed for further analysis.

B. Decision-Making
Upon acquiring the soil moisture reading, the microcontroller compares it with a set threshold. When the level of moisture in the soil is discovered to be lower than the set threshold, the system determines the requirement of irrigation, thus prompting the following steps in the procedure.

C. Irrigation Activation
After the irrigation requirement has been determined, the Node MCU sends a control signal to turn on the solenoid valve or water pump. This kicks off the irrigation process, supplying water to the plants until the moisture content in the soil is at the required level, providing the best level of hydration for plant growth.

D. Remote Monitoring and Control
The system continuously transmits sensor data and operation status to the Blynk app through a Wi-Fi connection. Farmers can track real-time field conditions using their mobile devices. They get notifications when irrigation starts or stops and can also control the system manually if needed, offering flexibility and convenience.

E. Energy Efficiency
The energy efficiency of the irrigation system is planned with power-saving programming, which ensures optimal use of electricity. This makes it an ideal choice for areas that have limited availability of consistent power supply. Through maximum utilization of power, not only is efficient irrigation ensured but also eco-friendly farming practices.

F. Security Monitoring
A PIR sensor is deployed alongside the system to detect motion in its vicinity. If any unauthorized movement is detected, the Node MCU sends an alert to the user through the Blynk app. This feature enhances the security of the irrigation setup and protects it from potential theft or tampering, particularly when left unattended in remote agricultural fields.

VII. RESULT

The IoT-based smart irrigation system was successfully designed and tested, demonstrating its effective functionality. The system was capable of monitoring real-time environmental conditions and automating the irrigation process efficiently.

During the testing phase, the soil moisture sensor accurately tracked variations in soil water content. When the moisture level dropped below the predetermined threshold, the system automatically activated the water pump to irrigate the field. Once the desired moisture level was achieved, the system deactivated the pump to prevent over-irrigation and conserve water.

The Blynk smartphone application provided real-time updates on soil moisture, temperature, and humidity levels. This feature enabled users to remotely monitor field conditions, receive notifications during irrigation events, and manually control the system as needed. The wireless functionality ensured that farmers could manage irrigation from virtually anywhere, enhancing convenience and efficiency.

In summary, the results indicate that the proposed system is user-friendly, reliable, and highly effective in conserving water while maintaining optimal soil moisture levels for crops. It presents a practical solution for improving agricultural productivity, especially for small and medium-sized farms.

Fig. 5: Dashboard Page

VIII. CONCLUSION

This paper presents the design and development of a low-cost, energy-efficient IoT-based smart irrigation system aimed at optimizing water usage in agricultural fields. By utilizing soil moisture, temperature, and humidity sensors connected to a Node MCU microcontroller, the system automates irrigation based on real-time data, ensuring that crops receive adequate water only when necessary. The integration with the Blynk IoT platform allows for remote monitoring and control, adding flexibility and convenience for farmers. The results of the system testing confirm that the smart irrigation system successfully reduces water wastage, saves labor costs, and promotes sustainable agricultural practices. Given its simple design, affordability, and scalability, the proposed system is particularly beneficial for rural farmers and can contribute significantly towards achieving more efficient water management in agriculture.

IX. FUTURE SCOPE

While the current system successfully addresses the core needs of smart irrigation, several enhancements can be considered for future development:

1) Weather Forecast Integration: Incorporating real-time weather prediction APIs can help the system decide whether to irrigate based on upcoming rainfall forecasts.
2) Fertilizer Management: Future versions of the system could include nutrient sensors to automate fertigation along with irrigation.
3) Solar-Powered Operation: Integrating solar panels can make the system completely self-sustainable, especially in remote agricultural regions with limited access to electricity.
4) Advanced Data Analytics: Collecting historical sensor data and applying machine learning algorithms could enable predictive irrigation scheduling for even better water optimization.
5) Multi-Field Scalability: Expanding the system to manage multiple fields simultaneously through a centralized dashboard can improve large-scale farming operations.

X. ACKNOWLEDGEMENT

We would like to extend our heartfelt gratitude to the project coordinator and Assistant Professor, Mr. Vikas Porwal, for his genuine counseling, continuous support, and encouragement throughout the project. His professionalism and recommendations guided us in a vast manner to complete this successfully. Additional thanks also to our project partners who brought this project to life. The ideas and efforts of everyone were crucial in designing the Apparel Recommendation System. Finally, we acknowledge our gratitude to the materials and services provided to us, that assisted us in fulfilling this project as anticipated

REFERENCES

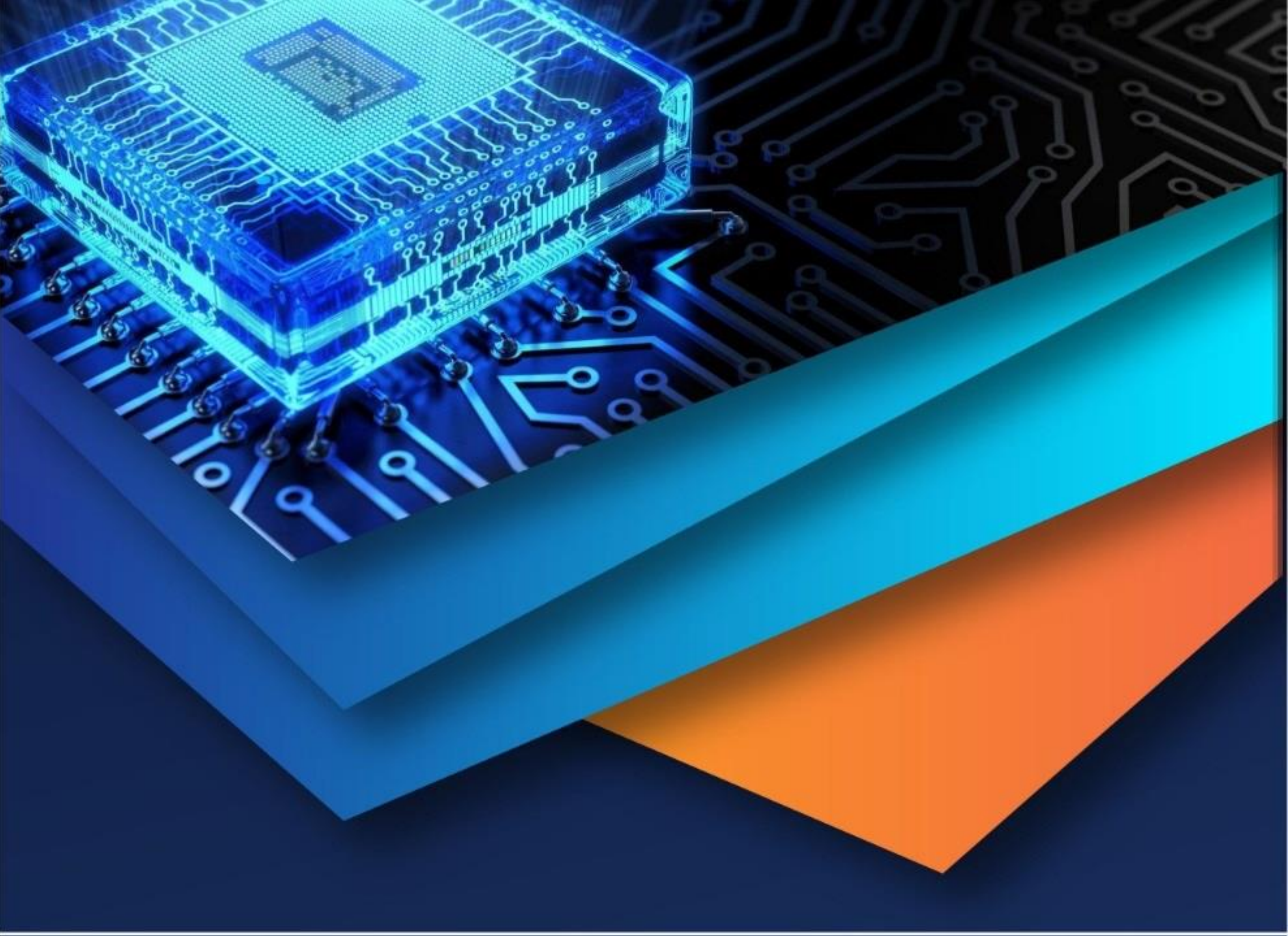
[1] Dang, Q. V., Park, S., & Kim, S. (2020). A Fuzzy Logic-Based Automatic Irrigation System Using Wireless Sensor Networks. Sensors, 20(18), 5273. https://doi.org/10.3390/s20185273

[2] Sandoval-Solis, S., Giraldo, F., & Torres, A. (2018). Smart Irrigation System Using IoT. International Journal of Advanced Research in Computer Science, 9(5), 40–45.

[3] Priyanka, P., & Jain, D. (2017). Automated Irrigation System Using Arduino and Soil Moisture Sensor. International Research Journal of Engineering and Technology (IRJET), 4(7), 1635–1638.

[4] Blynk. (n.d.). Blynk IoT Platform. Retrieved from https://blynk.io/

[5] ESP8266 Community. (n.d.). NodeMCU ESP8266 Documentation. Retrieved from https://www.espressif.com/en/products/socs/esp8266 .



10.22214/IJRASET

INDEX COPERNICUS
45.98

IMPACT FACTOR:
7.129

TOGETHER WE REACH THE GOAL
IMPACT FACTOR:
7.429