ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14831456

Automated Irrigation System with AI Based

Dr. Chetan Marol[1] ; Supriya Khanapur[2]; Jyoti Rathod[3];
Salauddin Mulla[4]; Rakshita Bajantri[5]

[1] (Prof. Dept of Civil Engineering SIET Vijayapura)
[2,3,4,5] (Department of Civil Engineering Secab Institute Engineering Technology Vijayapura)

Publication Date: 2025/02/08

Abstract: New ideas to lessen human labour in agriculture have been made possible by technological advancements, especially in the areas of IoT, AI, and machine learning. Inefficient irrigation techniques are frequently the result of farming in areas with unpredictable rainfall and high temperatures, which presents difficulties for the sustained production of crops. Using IoT-based sensors, including soil moisture sensors, DHT11 sensors, and a NodeMCU microcontroller, this study aims to develop an autonomous and reasonably priced irrigation system. The system uses a fuzzy logic model to optimise water use based on weather forecasts, temperature, humidity, and soil moisture data. Incorporating solar energy also minimises carbon footprints, guarantees sustainability, and lessens reliance on traditional energy sources. The suggested system tackles the twin goals of effective water management and ecological.

Keywords: *ESP8226, Humidity Sensor, DHT11 Sensor, Moisture Sensor.*

How to Cite: Dr. Chetan Marol; Supriya Khanapur; Jyoti Rathod; Salauddin Mulla; Rakshita Bajantri (2025). Automated Irrigation System with AI Based. *International Journal of Innovative Science and Research Technology*, 10(1), 1917-1922. https://doi.org/10.5281/zenodo.14831456

I. INTRODUCTION

Agriculture is essential to the growth of the human population. After some people started growing one type of crop and depended on others for supplementary food, clothing, shelter, and knowledge, even the first civilisation emerged swiftly. India's economy depends heavily on agriculture, which employs more than 60% of the workforce and contributes around 17% of the nation's GDP. A growing population means that more food is constantly needed. However, our farmlands are already being used to their maximum capacity, thus a shift to more efficient irrigation and farming practices is required. Our study suggests a method for harnessing sunlight to irrigate crops at the right times based on a variety of climate factors and precipitation projections, encouraging wise water management and increasing crop output.

II. METHODOLOGY

An irrigation system powered by AI is designed for efficient agricultural management, enabling farmers to address challenges. Numerous AI applications address major challenges like soil moisture detection, water conservation management, agricultural growth monitoring, and more. This technology provides enhanced and more intelligent watering by utilizing a network of sensors for temperature, humidity, and other factors that engage with the user. Through the implementation of affordable, simple-to-install sensors and an abundance of valuable data, the Internet of Things has provided remarkably effective methods for farmers and gardeners to care for soil. Water held in the spaces between soil particles is known as soil moisture. The water available to plants in the root zone soil moisture is commonly considered to be within the top 200 cm of soil. Moisture is essential for many hydrological, biological, and biogeochemical processes. The central component of the suggested system is measuring soil moisture. Field irrigation and user satisfaction rely on the soil's water content. Electrical conductivity (EC) quantifies how well a dissolved substance in an aqueous solution can carry electric current, measured in siemens per unit area. The more dissolved substances present in the soil, the greater the EC. The soil's pH, similar to EC, evaluates its acidity by measuring the concentration of hydrogen ions present. The soil pH varies between 1 and 14, where pH values of 1-6 indicate acidity, pH 7 is neutral, and pH levels of 8-14 are basic. The ideal pH range for most plants is between 5.5 and 7. The pH value can be used to determine the nutrient level in the soil. The aim of this project is to build an automated irrigation system that turns the pump motor on and off according to the

A. Materials Used

- Soil Moisture Sensors: Measure soil water content to determine irrigation needs.
- Weather Sensors: Include temperature, humidity, and rainfall sensors to account for environmental conditions.. Arduino, Raspberry Pi, ESP836 Handle sensor data and control the irrigation system.
- Relay Modules: Switch pumps and valves on and off .

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14831456

- Valves: Electric solenoid valves for controlling water flow.
- Pumps: Deliver water to plants based on system commands.
- Solar Panels: Provide renewable energy, particularly for remote areas.
- Battery Packs: Store energy to power the system during the night or cloudy conditions.
- Bylank app; To determine the moisture and humidity temperature of soil.

B. AI And Control Software

- Machine Learning Models: Predict water requirements based on historical and real-time data.
- IoT Platforms: Manage sensor data, send alerts, and allow remote monitoring. Examples: AWS IoT, Google IoT Core, Thingspeak.
- Mobile Apps/Web Dashboards: User interfaces to control and monitor the system.

C. Experimental Setup

The experimental setup for an automated irrigation system integrated with AI involves the strategic deployment of hardware components and software integration to achieve efficient water management. The system includes soil moisture sensors embedded in the soil to monitor real-time water content, complemented by weather sensors measuring temperature, humidity, and rainfall, and light sensors tracking sunlight intensity. These sensors are connected to a central microcontroller, such as an Arduino or Raspberry Pi, which serves as the system's brain, processing the data. Electric solenoid valves, controlled by relay modules, regulate water flow through drip irrigation tubes or sprinklers, ensuring precise water delivery to plants. The entire setup is powered by solar panels with battery storage for sustainable and uninterrupted operation. Communication modules like Wi-Fi remote monitoring and control via IoT platforms, while machine learning algorithms hosted on cloud or edge computing devices predict irrigation schedules based on historical and real-time data. A user-friendly mobile app or web dashboard provides a seamless interface for system management. To ensure reliability, waterproof enclosures protect sensitive electronics, and structural supports like mounting poles secure the sensors and solar panels. This experimental setup replicates real-world agricultural conditions, allowing for testing and optimization of the AI-driven irrigation system's performance in conserving water and enhancing crop yields.

Fig 1 :-Experimental Setup for an AI-Driven Automated Irrigation System.

III. RESULT AND DISCUSSION

In order to optimise water consumption based on crop requirements, ambient circumstances, and historical data, an AI-integrated automated irrigation system frequently makes use of sensors, machine learning models, and decision-making algorithms. A graph is usually included in such a system to show the irrigation's effectiveness, performance, or outcomes. Farmers would be able to increase agricultural yield and preserve water by using this gadget model. Begonia plants in Kanchipuram, Tamil Nadu, have their 24-hour temperature, humidity, rainfall pattern, and soil moisture data regularly monitored. Since the moisture level drops the highest during this time, the engine is only turned on once, at 3:30 pm and 5:30 am, to water the plant.

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14831456

A. Environmental Factor

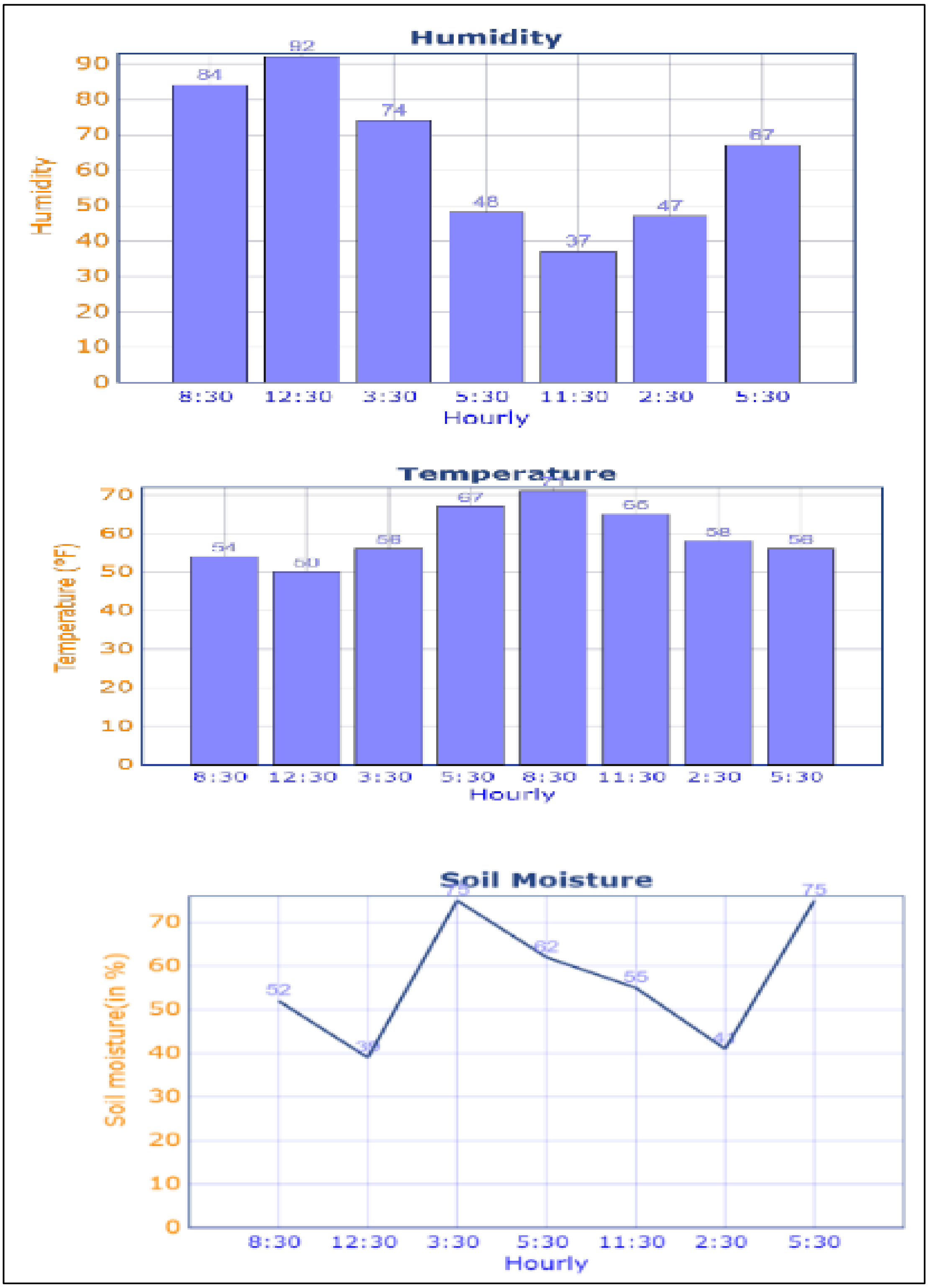

Fig 2 (a) Graph Representing Humidity of the Region Taken Using DHT11 Sensor (b) Graph Representing Temperature of the Region Taken using DHT11 Sensor (c) Graph Representing soil Moisture from the Plant Taken using Soil Moisture Sensor.

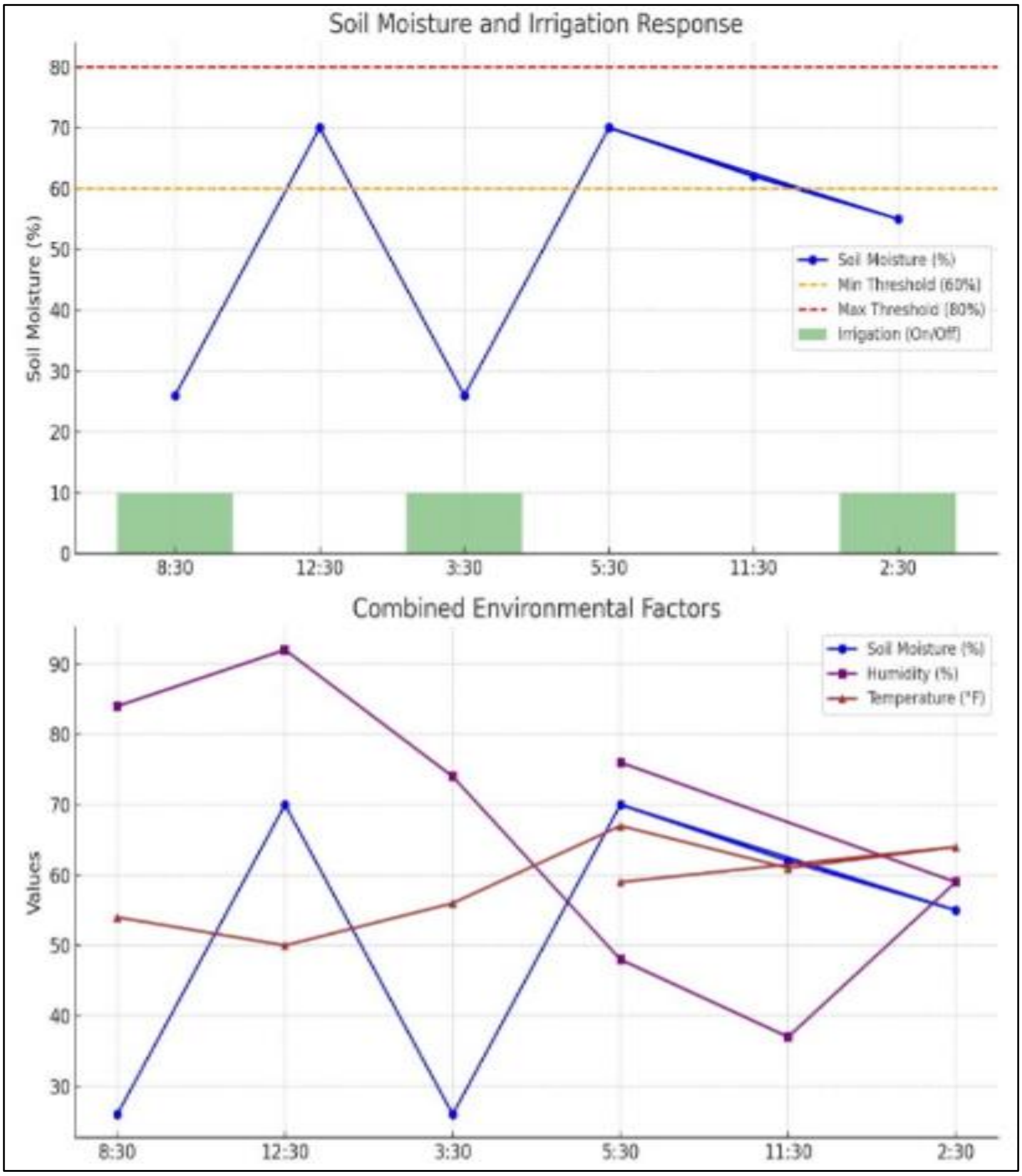

Fig. 3 The Visualizations for the Automated Irrigation System

B. Soil Moisture and Irrigation Response

The blue line shows soil moisture levels throughout the day. The orange and red dashed lines represent the minimum (60%) and maximum (80%) thresholds for soil moisture. Green bars indicate when irrigation is active (soil moisture below 60%).

C. Combined Environmental Factors

This graph shows how soil moisture, humidity, and temperature vary together over time

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14831456

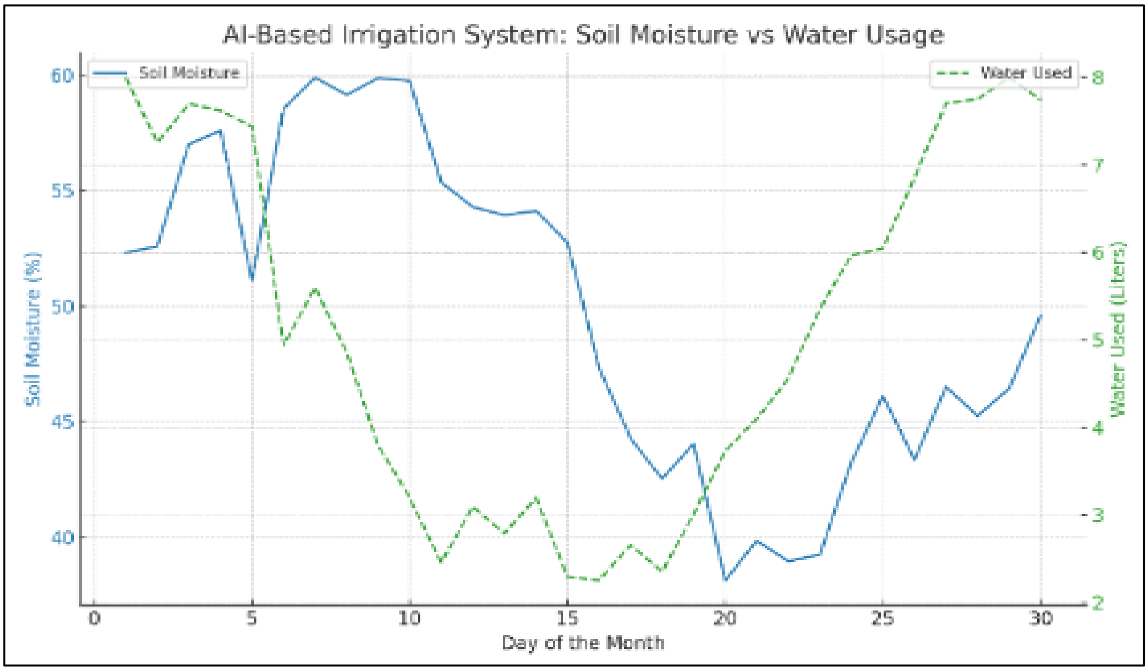

Fig. 4 Analysis of Soil Moisture and Water Usage in AI-Based Irrigation

➢ *Blue Line*

Represents the soil moisture percentage over the days of a month. It demonstrates how irrigation events maintain moisture within an optimal range.

➢ *Green Dashed Line*

Indicates water usage in liters over the same period, reflecting varying needs based on soil and environmental conditions.

The graph illustrates the relationship between soil moisture levels and water usage in an AI-based irrigation system over 30 days. The blue line represents soil moisture as a percentage, showing fluctuations influenced by irrigation events and natural conditions. The system maintains soil moisture within an optimal range (approximately 30% to 70%) to ensure healthy crop growth. Peaks in moisture levels correspond to irrigation or rainfall events, while gradual declines reflect water absorption and evaporation The green dashed line shows water usage in liters, indicating the amount of water applied daily by the irrigation system. Water usage varies based on soil moisture requirements, demonstrating the system's ability to adapt to changing environmental conditions. For instance, less water is used on days when soil moisture is higher or when rain is forecasted. This adaptive approach highlights the efficiency and precision of the based system in conserving water while ensuring adequate hydration for crops.

IV. CONCLUSION

The AI-driven automated irrigation system demonstrates a significant advancement in precision agriculture, combining real-time sensor data, machine learning algorithms, and IoT connectivity to optimize water usage. The experimental setup highlights the system's ability to monitor environmental and soil conditions, predict irrigation requirements, and execute controlled water delivery efficiently. By integrating renewable energy sources like solar panels, the system ensures sustainability and adaptability for remote applications. The results indicate that such a setup not only conserves water but also enhances crop health and productivity, offering a scalable and eco-friendly solution to modern agricultural challenges**.**

FUTURE SCOPE

The future scope of AI-driven automated irrigation systems lies in their potential to revolutionize sustainable agriculture through advanced integration and scalability. Future developments could include the incorporation of advanced AI models for predictive analytics, leveraging real-time satellite imagery and big data to refine irrigation strategies further. Enhanced IoT connectivity using 5G and edge computing could improve system responsiveness and enable broader deployment in remote and resource-constrained areas. Integration with autonomous robotics for precision planting, fertilization, and weeding could create fully automated agricultural ecosystems. Furthermore, these systems can be adapted for diverse crops and climates, addressing global food security challenges while minimizing environmental impact. The inclusion of blockchain technology for secure data sharing and resource tracking offers additional avenues for innovation.

REFERENCES

[1]. https://www.worldbank.org/en/topic/water in agriculture.
[2]. Akhrs, G, "Smart Materials and Smart systems for the Future", Canadian Military Journal, 08/2000.
[3]. Gubbi, J., Buyya, R., Marusic, S., Palaniswami, M., 2013. Internet of things (IoT): a vision, architectural

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14831456

elements, and future directions. Futur. Gener. Comput. Syst. 29,1645–1660
[4]. Janani M and Jebakumar R. A Study on Smart Irrigation Using Machine Learning. Cell Cellular Lif Sci J 2019, 4(2): 000141.
[5]. LiakosKG,BusatoP,MoshouD,PearsonS,BochtisD(2018)Machine Learning in Agriculture: A Review. Sensors (Basel) 18(8): 2674
[6]. Viani F, Bertolli MG, Salucci M, Polo A (2017)Low-Cost Wireless Monitoring and Decision Support for Water Saving in Agriculture. IEEE Sensors Journal. .
[7]. Radadiya BL, T hakkar RG, T humar VM, Chaudhari BD (2016) Cloud computing and agriculture, International Journal of Agriculture Sciences 8(22): 1429-1431
[8]. Gupta A, Krishna V, Gupta S, Aggarwal J (2016) Android based Solar Powered Automatic Irrigation System. Indian Journal of Science and Technology
[9]. Gupta, A.; Krishna, V.; Gupta, S.; Aggarwal, J. Android based solar powered automatic irrigation system. Indian J. Sci. Technol. 2016,9. 1– 5.