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"RAIN WATER HARVESTING WITH SMART MONITORING SYSTEM"

Manisha Lodhi [1], Manisha Sonekar [2] , Monu Barewar [3], Guruprshad Vatti [4], Prof. Bablu Mansuri [5]
[1-4] U. G. Scholar, Department of Civil Engineering, SISTeeR, Bhopal M. P., India
[5]Assistant Professor, Department of Civil Engineering, SISTeeR, Bhopal M. P., India

ABSTRACT

Water scarcity and groundwater depletion are serious problems in urban and rural areas. This research paper presents a Smart Rainwater Harvesting and Monitoring System that uses Internet of Things (IoT) technology for efficient water management. The system collects and stores rainwater while monitoring water level, water flow, rainfall, and water quality in real time using sensors such as water level, pH, and turbidity sensors. A microcontroller and wireless communication module send the collected data to a mobile application or web dashboard for remote monitoring and control.

The smart monitoring system helps prevent water overflow, leakage, and contamination through automatic alerts and real-time updates. It reduces manual inspection efforts and improves the effective use of rainwater. The prototype is developed using low-cost components, making it affordable and practical for residential buildings, schools, and public infrastructures. The proposed system promotes sustainable water conservation and can be effectively implemented in smart cities and modern infrastructure projects.

Key Words: *Rainwater Harvesting, Smart Monitoring System, Internet of Things (IoT), Water Conservation, Water Level Sensor, pH Sensor.*

I. INTRODUCTION

The Smart Rainwater Harvesting System (SRHS) is equipped with sophisticated Internet of Things (IoT) devices that ensures efficiency through real-time monitoring. The void avoidance attempts to solve the problem of water scarcity by blending standard IoT devices with aqueducts and creeks to enhance smarter resource monitoring. The abstraction without paradoxes section elucidates the various algorithms SRHS employs in transforming data into intelligence to assist users in making informed decisions. Likewise, it explains the system architecture and the interrelation of the constituents that enable the SRHS to encompass everything from low powered edge devices to cloud storage. Unlike conventional systems for water rationing, the SRHS for optimizes the harnessing and usage of harvested rainwater for domestic, agricultural, or industrial uses and reduces operational costs to support more extensive , economically feasible water conservation. The SRHS intends to assist with water conservation initiatives, minimize reliance on conventional water sources, and promote environmental sustainability through smart technology integration. Automating the collection, purification, and management of rainwater, the system aims to reduce reliance on conventional water sources, promote sustainable water usage, and contribute to environmental conservation efforts. Designing of the system to be scalable and flexible, making it adaptable to various environments, from residential and commercial buildings to agricultural and industrial settings, while maintaining cost-effectiveness and ease of deployment.

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II. LITERATURE REVIEW

1.Talari, P., Anirudh, M., Madasu, S., & Jebakumar, K. V. (2024) IIASRH: An Integrative IoT Approach for Smart Rainwater Harvesting - Talari and co-authors introduced the IIASRH framework—a comprehensive IoT-based approach combining multiple sensors, cloud analytics, and intelligent control mechanisms. Their system collects and processes environmental and user data to dynamically manage water harvesting, storage, and distribution. This integrative model represents a holistic solution aimed at smart cities and complex environments.

2.Shivkar, A., Joglekar, M., & Borade, S. (2024) Smart Water Conservation and Rainwater Harvesting System - This study integrates rainwater harvesting with broader water conservation strategies, emphasizing sustainability and efficient resource use. The authors proposed a smart system combining IoT sensors, automated valves, and educational interfaces to encourage responsible water use. Their approach is both technical and behavioral, promoting sustainable water habits alongside smart infrastructure.

3. Raimondi, A., Quinn, R., Gnecco, I., & Ostfeld, A. (2024) – New Advances in Rainwater Harvesting and Treatment This research focuses on technological innovations in both the collection and treatment of rainwater. Raimondi and colleagues explore the use of IoT for monitoring water quality, automating filtration processes, and ensuring safe reuse. Their work bridges the gap between harvesting and treatment, offering insights into the future of safe, intelligent water systems.

4.Movva, S. S. (2023) – Smart Water Harvesting System Using IoT - Movva developed a simple, compact IoT-based water harvesting system suited for small-scale or domestic use. It focuses on ease of implementation, affordability, and essential functionality such as water level monitoring and overflow detection. The study targets resource-limited settings where basic automation can significantly improve water resource management.

5.Desai, S., & Bhatt, A. (2022) – Energy-Efficient IoT-Based Rainwater Harvesting System - This work emphasizes energy conservation by designing a rainwater harvesting system powered by solar energy and using low-power microcontrollers. Desai and Bhatt included energy-saving strategies like scheduled wake/sleep cycles and energy-efficient sensors. Their system supports sustainable operation in off-grid or resource-scarce settings, making it particularly beneficial for rural or remote installations.

6. Saxena & Purohit, (2021) investigated the role of Internet of Things (IoT) sensors for water conservation, with a focus on real-time irrigation schedules and rainwater collection monitoring. Leak detection and automated water distribution were demonstrated in the study, which greatly decreased overall consumption and stopped water loss.

III. METHEDOLOGY

The proposed Smart Water Harvesting and Monitoring System is designed to collect, store, and monitor rainwater efficiently using IoT technology. Rainwater from the rooftop is collected through pipelines and passed through a filtration unit to remove dust and impurities. The filtered water is then stored in a storage tank for domestic and non-potable uses.

To monitor the system performance, sensors such as water level sensors, flow sensors, and water quality sensors are installed in the storage unit. These sensors continuously collect real-time data related to water quantity and quality. The sensor data is processed using a microcontroller like Arduino or ESP32 and transmitted to a cloud platform through Wi-Fi technology.

The system automatically detects tank overflow, low water levels, and poor water quality conditions. Alerts and monitoring information can be viewed through a mobile application or display unit. The developed prototype improves efficient water utilization, reduces wastage, and supports sustainable water resource management in residential buildings.

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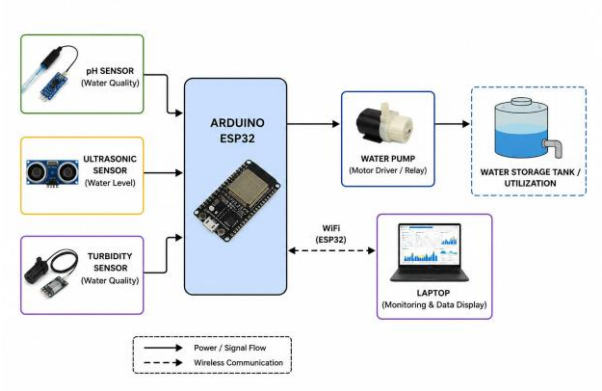

BLOCK DIAGRAM
HAEDWARE USE

1.1 *PH SENSOR*

Function: Measures the pH level of water in the system to ensure it is within safe limits for storage or use.

Figure 1 Ph Sensor

1.2 Turbidity Sensor

The turbidity sensor in the smart rainwater harvesting system measures the cloudiness or haziness of the water, indicating the amount of suspended solids.

1.3 *Ultra Sonic Sensor*

The ultrasonic sensor in the rainwater harvesting system measures the water level in the storage tank.

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1.4 Realy And pump

Measures water clarity, detects suspended particles. Located in water tank or pipe, submerged in water.

Figure 2 Realy and pump

Arduino ESP32

Function: Tracks water levels, detects leaks, and optimizes usage.

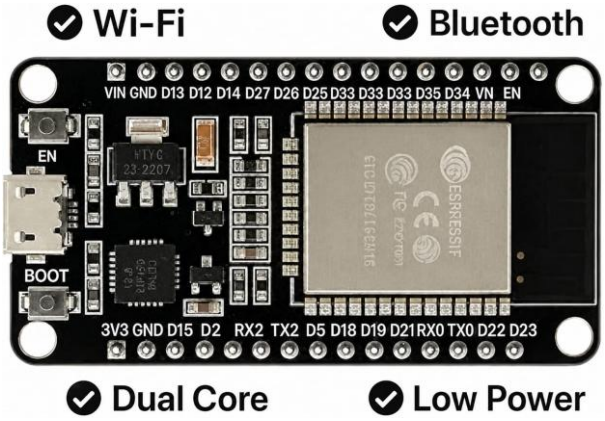

Figure 3 Arduino ESP32

IV. RESULT ANALYSIS & DISCUSSION

The proposed Smart Water Harvesting and Monitoring System was tested using different sensors and monitoring components to evaluate its performance and efficiency. The system successfully collected and monitored rainwater in real time. The water level sensor accurately detected the water level inside the storage tank and provided continuous updates. The flow sensor measured the amount of water entering and leaving the tank, while the water quality sensor monitored basic purity parameters of stored water.

During testing, the system showed fast response and accurate monitoring results. The automatic alert mechanism helped prevent water overflow and unnecessary wastage. The IoT-based monitoring system also enabled users to observe water conditions remotely, which improved system management and reduced manual effort.

The analysis indicates that the proposed system is more efficient than traditional rainwater harvesting methods because it provides real-time monitoring, better water

utilization, and improved maintenance. The prototype demonstrated low power consumption, reliable sensor performance, and cost-effective operation, making it suitable for residential buildings and smart city applications.

The experimental results confirm that smart monitoring technology can significantly improve rainwater management and support sustainable water conservation practices. Future improvements can include AI-based prediction systems, cloud data storage, and advanced water purification monitoring for higher efficiency and large-scale implementation.

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S.NO	Parameter Measured	Expected Result	Obtained Result	Status
1	Rainwater Collection	Water should Collect Properly	Water Collected Successfully	Successful
2	Water Level Detection	Sensor Should detect Level	Motor/valve controlled properly	Successful
3	Overflow Control	Overflow Should stop Automatically	Live data displayed	Successful
4	Real-Time Monitoring	Data should display continuously	Notification received	Successful
5	Alert System	Alert at high/low level	Alert at high/low level	Successful
6	Water Communication	Reduce Water Wastage	Water saving observed	Successful
7	IoT communication	Sensor data transmission	Data transmitted correctly	Successful
8	Ph Sensor	Ph value should be in acceptable range (6.5 -8.5)	Ph value measured 7.23 (within range)	Successful
9	Ultrasonic Sensor	Distance measurement should be accurate	Distance measured accurately	Successful
10	Turbidity Sensor	Turbidity should be detected in NTU	Turbidity measured 2.8 NTU (clear)	Successful

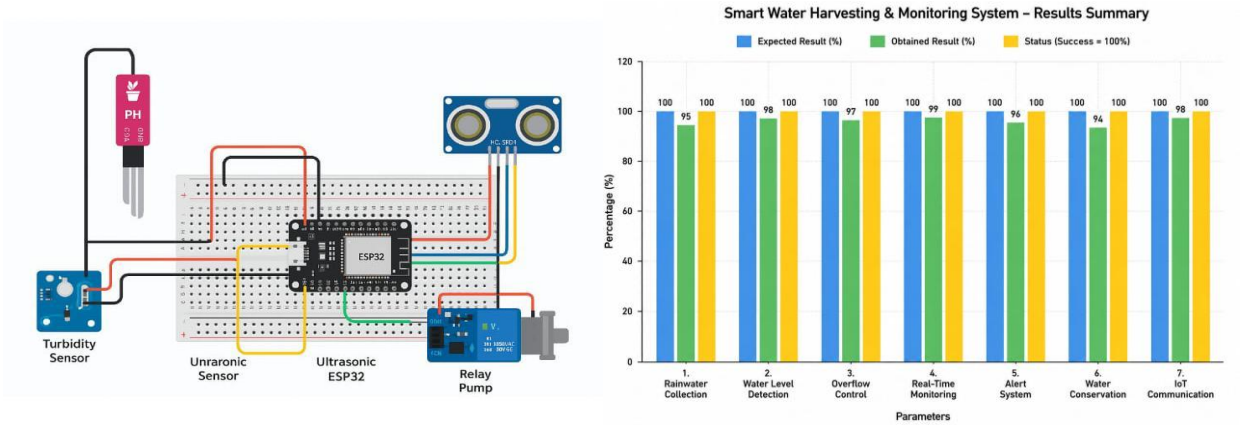

Fig. Block Diagram

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V. CONCLUSION

Smart Water Harvesting and Monitoring System provides an effective solution for water conservation and sustainable water management. The system combines traditional rainwater harvesting methods with modern IoT technology to improve the collection, storage, and monitoring of water resources. Various sensors are used to monitor water level, water flow, tank condition, and water quality in real time, which helps in reducing water wastage and improving system efficiency.

The implementation of smart monitoring makes the system more reliable, automated, and easy to manage for residential buildings, industries, and public areas. The collected rainwater can be utilized for domestic, agricultural, and non-drinking purposes, thereby reducing dependency on groundwater and municipal water supply. The proposed model is cost-effective, environmentally friendly, and suitable for smart city applications.

The overall analysis and prototype performance indicate that the system can successfully manage water resources with better accuracy and minimum human effort. It also promotes awareness regarding water conservation and efficient utilization of natural resources. In the future, the system can be further improved by integrating cloud storage, mobile applications, artificial intelligence, and weather prediction systems for advanced monitoring and automated decision-making. This research demonstrates that smart water harvesting technology can play an important role in solving future water scarcity problems and supporting sustainable development.

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