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IOT+Camera Based Water Tank Level and Quality Monitoring System

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Abstract

Water is one of the most critical natural resources, and its efficient management is essential for sustainable living. Traditional methods of monitoring water levels and quality are often manual, time-consuming, and prone to human error. This project presents an IoT-based Smart Water Tank and Quality Monitoring System that enables real-time tracking of water levels and water quality parameters such as pH, turbidity, and temperature. The system uses sensors integrated with a microcontroller (ESP32 or Arduino) to collect and transmit data to cloud platforms like Blynk or ThingSpeak for visualization and analysis. Additionally, the system can trigger alerts or automatic motor control when water levels reach predefined thresholds, ensuring optimal utilization and conservation. By leveraging IoT, cloud computing, and computer vision technologies, this project offers a low-cost, scalable, and automated solution for efficient water management in residential, agricultural, and industrial applications.

Index Terms—Smart Water Management, Water Level Mon- itoring, Water Quality Analysis, Real-Time Monitoring, Sensor Integration.

1. Introduction

Water is one of the most essential natural resources, and its efficient management is crucial for sustainable living. In many residential, industrial, and institutional settings, manual monitoring of water levels and quality often leads to wastage, overflow, or contamination going unnoticed.

The IoT and Camera-Based Water Tank Level & Quality Monitoring System aims to automate the process of monitoring both water levels and quality parameters using sensors and a camera module. The system employs an ultrasonic sensor to measure water levels, a turbidity sensor to assess clarity, and an ESP32-CAM module to capture images for visual analysis. All data is transmitted to a cloud platform such as Blynk or ThingSpeak for real-time visualization and alert generation. This integration of IoT with image processing provides an innovative, low-cost, and reliable approach to ensure safe and efficient water management.

2. Literature Survey

A brief overview of existing work in various papers, which have been referred for implementation:

In S. Karthik et al. (2020) presented an IoT-based solution utilizing ultrasonic sensors and the Blynk platform for real-time water level monitoring. The NodeMCU micro- controller transmits data to the

cloud, enabling users to receive notifications when water levels exceed predefined limits. How- ever, it does not include water quality monitoring.

In A. Sharma et al. (2019) introduced an IoT-driven framework for monitoring key water quality parameters such as pH, turbidity, and temperature. While effective, it lacks integration with level monitoring.

In S. Singh and N. Gupta (2021) combined IoT and machine learning for predictive contamination detection, but required higher computational resources.

3. Existing System

The existing water management system largely depends on manual inspection methods where individuals physically check water levels and quality in tanks. This traditional approach leads to inefficiency, delayed responses, and frequent issues such as overflow, dry-run conditions, and water contamination. Although some systems use basic electronic sensors or timers, these are not integrated with IoT or cloud monitoring, making real-time supervision difficult. Water quality testing is mostly performed manually using chemical kits or laboratory meth- ods, which are time-consuming and unsuitable for continuous monitoring. Additionally, the lack of remote access and alert mechanisms leads to wastage and inconsistent water supply. The absence of data analytics or automated controls further limits optimization and reliability.

4. Proposed System

The proposed system introduces an intelligent and cost- effective solution for automated water management by inte- grating Internet of Things (IoT), image processing, and cloud computing technologies. It utilizes multiple sensors and an ESP32-CAM module to monitor both the water level and water quality in real time. Ultrasonic sensors are used to measure the tank's water level with high accuracy, while turbidity sensors assess water clarity to determine quality. The ESP32-CAM captures images of the water surface, enabling visual verification and analysis through OpenCV-based image processing. IoT connectivity is achieved through the ESP32 microcontroller, which collects sensor readings and transmits them to the Blynk cloud platform for real-time visualization, historical tracking, and alerts.

A. Ultrasonic Sensor

Ultrasonic Sensor is used to measure the water level in the tank by emitting ultrasonic waves and calculating the distance based on the time taken for the echo to return. It provides precise level measurements and helps prevent overflowor dry- run condition

Fig. 1. Ultrasonic Sensor Module

B. Turbidity Sensor

The Turbidity Sensor measures the cloudiness or haziness of water, indicating the amount of suspended particles. It helps determine water purity levels and detects contamination or sediment buildup.

Fig. 2. Turbidity Sensor

C. ESP32-CAM Module

The ESP32-CAM is a low-cost microcontroller board in- tegrated with a camera module and Wi-Fi capabilities. It captures images of the water surface for visual quality analysis and sends them to the cloud.

5. System Architecture

The system architecture illustrates how IoT, image pro- cessing, and cloud integration work together for smart water management. Ultrasonic and turbidity sensors continuously measure the water level and quality, while the ESP32-CAM captures real-time images of the tank. All data and images are transmitted via Wi-Fi to the Blynk cloud platform, where

Fig 3. ESP32-CAM Microcontroller Board

can visualize readings and receive instant alerts. The cloud stores sensor data and processed results for monitoring and analysis. Image processing using OpenCV is performed to validate water clarity and detect impurities. Users can access the live status, historical data, and notifications through the Blynk mobile app, ensuring efficient, automated, and reliable water management.

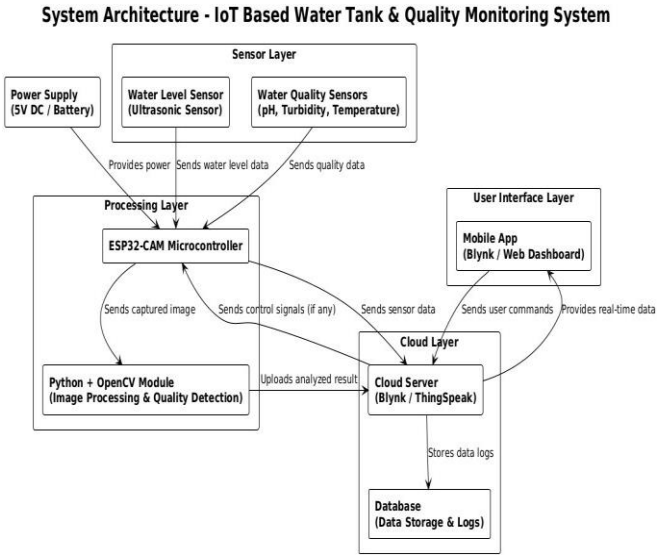

Fig. 4. System Architecture of Smart Water Monitoring System

6. Conclusion

The project "IoT and Camera-Based Water Tank Level & Quality Monitoring System" provides an efficient and intelli- gent solution for real-time water management by integrating IoT sensing technology, image processing, and cloud con- nectivity. Through the use of ultrasonic and turbidity sensors along with ESP32-CAM, the system effectively monitors water levels and quality while transmitting live data to the Blynk cloud for visualization and alerts. This innovation minimizes manual intervention, prevents water wastage, and ensures safe and efficient usage of water resources. The combination of sensor-based data with visual validation enhances reliabil- ity and accuracy in monitoring. Furthermore, the system's scalable design and potential for automation open doors for future improvements such as AI-based impurity detection, pump control, and multi-tank monitoring. Overall, this project demonstrates a sustainable, low-cost, and smart approach to modern water management.

References

1. S. Karthik, R. Priya, and M. Nithya, "Smart Water Tank Monitoring System using IoT," IJERT, vol. 9, no. 5, pp. 1–5, 2020.
2. A. Sharma, P. Patel, and R. Mehta, "IoT-Based Water Quality Monitoring System," IJARCS, vol. 10, no. 2, pp. 45–50, 2019.
3. S. Singh and N. Gupta, "Real-Time Water Quality Analysis Using IoT and Machine Learning," IJCA, vol. 183, no. 20, pp. 30–35, 2021.
4. R. Verma and A. Deshmukh, "Camera-Based Water Quality Detection Using Image Processing," IJSTR, vol. 11, no. 4, pp. 12–18, 2022.

5. M. Jain and D. Rathore, “IoT and Computer Vision Integrated System for Water Management,” J. Environ. Informatics, vol. 36, no. 1, pp. 55–63, 2023.
6. H. S. Bhattacharjee, “IoT Applications in Smart Water Management,” IEEE IoT J., vol. 7, no. 6, pp. 5402–5415, 2020.
7. A. N. Kumar, “ESP32-CAM Based Real-Time Monitoring System,” Int.
8. J. Eng. Technol., vol. 9, no. 2, pp. 100–104, 2021.
9. R. C. Gonzalez and R. E. Woods, Digital Image Processing, 4th ed., Pearson, 2018.
10. D. P. Kothari and K. C. Singal, Water Quality Monitoring and Manage- ment, McGraw-Hill, 2019.
11. Blynk Inc., “Blynk IoT Platform,” [Online]. Available: https://blynk.io/
12. ThingSpeak, “IoT Analytics and Visualization Platform,” [Online].
13. Available: https://thingspeak.com/
14. OpenCV Library, “Open Source Computer Vision Library,” [Online]. Available: https://opencv.org/