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Project Synopsis

on

Smart wireless water meter with Web DB.

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ABSTRACT

The Smart Wireless Water Meter with Web Database is an innovative project designed to optimize water management through intelligent monitoring and control systems. This project integrates real-time data collection and analysis with a web-based interface such as ThingSpeak for remote monitoring and control. The system tracks water levels to ensure efficient preservation and prevents wastage, alerts users about water contamination to prompt cleaning actions, and provides remote control over water flow for user convenience. By leveraging IoT technology, this solution ensures a sustainable, user-friendly approach to water conservation, quality assurance, and efficient water usage management, all accessible via an interactive web database for enhanced decision-making and system oversight.

Keywords: IoT, ESP-32 Wi-Fi module, Ultra-sonic Sensor, TDS Sensor, FS400 Sensor, Relay, ThingSpeak IoT.

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1 INTRODUCTION

The Smart Wireless Water Meter with Web Database project is designed to monitor and control water management systems efficiently. It involves measuring real-time water flow and storing the readings in a database for record-keeping and analysis. The system can remotely control water pumps, automatically turning them on or off when the tank is either full or empty, optimizing water usage and preventing overflow. Additionally, it measures the contamination levels in water to ensure quality. All data, including flow rate, tank status, and contamination levels, are displayed on the ThingSpeak IoT platform, enabling remote monitoring and analytics for improved water resource management.

2 LITERATURE SURVEY

Mustaq Shaikh *et al.*, [1] The literature on water quality testing underscores its essential role in protecting public health, particularly by identifying contaminants that pose risks to communities. Studies consistently highlight that poor water quality is linked to various health problems, from acute waterborne illnesses to long-term conditions, due to contaminants like coliform bacteria, nitrates, and heavy metals. Effective water quality testing involves both chemical and bacteriological analyses to monitor parameters such as pH, turbidity, TDS, and microbial content. Advanced methods and technologies are increasingly utilized in laboratories, enhancing the accuracy and reliability of results. However, challenges in infrastructure, sample transportation, and consistent testing methods remain significant. Research emphasizes the need for robust community engagement, suggesting that empowering residents through awareness programs leads to better participation in water quality monitoring efforts. Furthermore, the literature recommends adopting innovative technologies and strengthening collaborations as critical future steps for improving water quality monitoring, especially as climate change poses additional risks to water sources.

Waheb A. Jabbar *et al.*, [2] The literature on real-time water quality monitoring systems emphasizes the growing need for reliable, cost-effective, and sustainable solutions, especially in remote and rural areas with limited infrastructure. Recent advancements in IoT, including wireless networks like LoRa WAN, have enabled continuous monitoring of essential water quality parameters, such as pH, turbidity, temperature, and TDS. Solar-powered IoT devices have gained attention due to their energy efficiency and suitability for remote deployments. Studies show that IoT-based systems equipped with microcontroller boards and sensor arrays can accurately capture and transmit real-time data, which can then be analyzed on web-based platforms like ThingSpeak for remote access. Compared to traditional water quality testing, these systems offer several benefits, including reduced response time, improved accessibility to data, and minimized need for manual sampling. However, challenges remain in ensuring data reliability, waterproofing, and system durability in varying environmental conditions. Nonetheless, evidence supports that such IoT-enabled solutions provide actionable insights that closely match laboratory results, indicating their potential as effective alternatives for decentralized water quality monitoring.

Anupma Thakur *et al.,* [3] The literature on water quality monitoring highlights a shift from traditional laboratory methods to innovative, portable, and user-friendly approaches aimed at real-time and on-site testing. Traditional techniques, though accurate, rely on complex, costly, and labor-intensive processes that hinder widespread field use and community participation. Emerging sensor-based technologies offer alternatives, leveraging optical (e.g., absorbance, fluorescence), electrochemical (e.g., voltammetry, impedance), electrical, and biological sensing methods. These technologies aim to meet the ASSURED criteria—affordable, sensitive, specific, user-friendly, rapid, equipment-free, and deliverable to end-users—making them suitable for broader adoption. Integrating these sensing platforms with IoT solutions can enhance data accessibility and drive user engagement, aligning with Industry 4.0’s goals for environmental monitoring. However, technical challenges remain, including material durability, sensor sensitivity, and device calibration, which require continued research to fully realize their market and societal potential.

Mr. Rajshekar G *et al.,* [4] The literature on IoT-based water quality monitoring emphasizes the need for efficient, real-time solutions to address global water scarcity and enhance water management in industrial and economic applications. Traditional water testing methods are often resource-intensive and slow, prompting the adoption of IoT technologies for continuous, remote monitoring. Studies show that IoT-enabled systems equipped with sensors for parameters such as pH, temperature, turbidity, TDS, flow rate, and water level provide timely, accurate data for decision-making. By uploading sensor data to platforms like ThingSpeak, these systems facilitate online monitoring, making it easier to track water quality trends and respond swiftly to changes. This approach offers a robust, scalable solution for sustainable water management, supporting improved resource utilization and protection against contamination.

Rohith M *et al.*, [5] Water usage monitoring has become a significant challenge due to rapid population growth and urbanization. The advent of Internet of Things (IoT) technology has enabled the development of smart water meters to efficiently control and analyze water consumption in buildings and cities. While IoT-based smart meters are promising, one limitation is the battery life of sensor nodes, which are critical for continuous data transmission. Several studies have highlighted this issue, with a focus on extending battery life by optimizing data collection and transmission processes. This project aims to address this challenge by implementing an efficient data collection algorithm (EDCDWM) to reduce the number of packet transmissions, thus conserving energy and extending the battery life of IoT-based smart water meters. The system uses a PIC microcontroller, Wi-Fi ESP8266, and water flow sensors, with implementation carried out using Arduino and performance analyzed through hardware simulation.

3 PROBLEM FORMULATION

The project addresses the need for efficient, real-time water management by developing a smart wireless water meter system that tracks water usage, manages automated refilling, and monitors water quality. Traditional systems lack real-time data and automation, resulting in unmonitored consumption, manual refilling, and limited quality checks, which lead to waste and health risks. This system integrates with a web database, utilizing the ThingSpeak cloud to provide users with continuous access to water usage, quality, and system status. By automating refilling and enabling proactive monitoring, this solution aims to enhance resource efficiency, promote sustainable water use, and ensure water safety.

4 OBJECTIVES

1. To design a system that continuously monitors water usage in real-time.
2. To provide precise, automated tracing of water usage in real-time.

3. To determine the water quality of precised container for the usage of water.
4. To provide a web dashboard that is easy for users to navigate, showing detailed usage statistics.

5 METHODOLOGY

The Smart Wireless Water Meter system uses sensors to monitor flow rates, tank levels, and water quality, sending real-time data to a microcontroller and a web database via IoT protocols. Accessible through ThingSpeak, users can view live data, receive alerts, and track trends. Automated controls manage pumps based on tank levels, while contamination sensors ensure water safety, optimizing water management and resource conservation.

5.1 Block diagram

The diagram shows a Smart Water Meter System using an ESP32. It includes sensors like FS400 for flow rate, Ultrasonic for tank level, and TDS for water quality. A Relay controls the pump, and data is sent to a Cloud Server for remote monitoring.

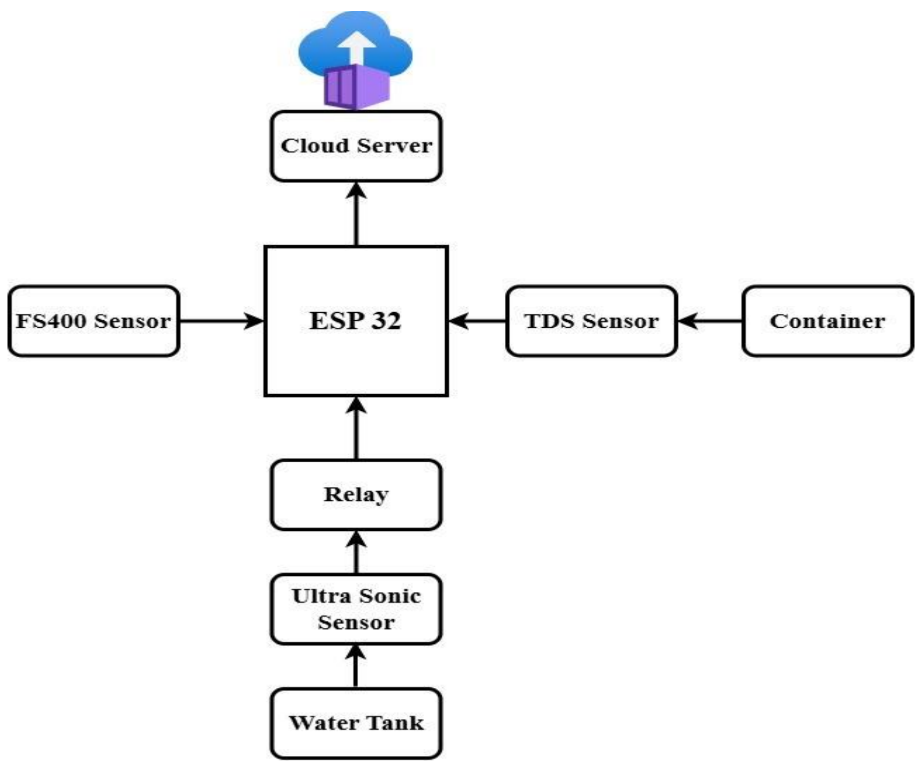

Figure 1: Block diagram for smart wireless water meter with web DB

The Smart Wireless Water Meter System uses an ESP32 microcontroller to monitor and control water management. It integrates the FS400 flow sensor, TDS sensor, and ultrasonic sensor to measure flow rate, water quality, and tank levels, respectively. A relay controls water pumps based on tank status. Sensor data is sent to a cloud server, enabling remote monitoring and management via IoT platforms like ThingSpeak for efficient water resource management.

5.2 Flow diagram

This flowchart outlines an automated water management system. It controls water flow based on container capacity, water quality, and threshold levels. The system starts by filling a container, checks purity, and directs water accordingly while displaying data on a dashboard.

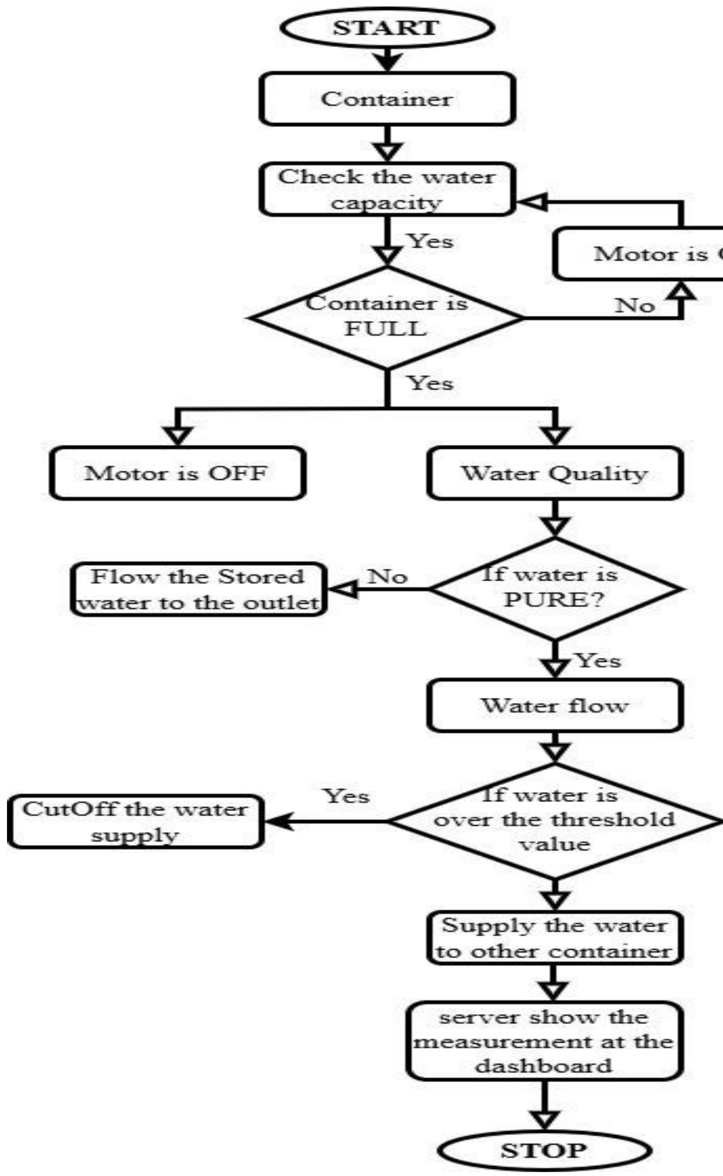

Fig.2: Flow diagram for smart wireless water meter with web DB

i. Start the process by checking the water capacity of the container.
ii. If the container is not full, turn on the motor to fill it.
iii. Once the container is full, turn off the motor.
iv. Check the water quality; if it is pure, allow the water to flow.
v. If the water level is above the threshold, cut off the water supply.
vi. If the water is below the threshold, supply it to another container.
vii. Display the measurements on the dashboard and stop the process.

6 COMPONENTS REQUIRED

These are hardware components and software requirements for Smart wireless water meter with Web DB.

6.1 Hardware Requirements

- ESP32: A versatile and powerful microcontroller with built-in Wi-Fi and Bluetooth capabilities, ideal for IoT projects. It has multiple GPIO pins for connecting sensors and actuators. The ESP32 is commonly used for wireless communication and real-time control.
- FS400 Sensor: The FS400 is a flow sensor used for measuring the rate of liquid flow. It detects the movement of liquids using a rotor, providing an electrical output proportional to the flow rate.
- TDS Sensor: A Total Dissolved Solids (TDS) sensor measures the concentration of dissolved solids in water, typically to assess water quality. It works by measuring the electrical conductivity of the water. Commonly used in water filtration and purification systems, it helps ensure water safety.
- Relay: A relay is an electrically operated switch that allows you to control high-voltage devices with a low-voltage signal. It isolates different circuits and is often used in automation systems to control lights, motors, or other appliances. Relays help ensure the safe operation of high-power devices.
- Ultrasonic Sensor: The ultrasonic sensor measures distance by emitting sound waves and calculating the time taken for the waves to return. It is widely used in robotics and automation for object detection, distance measurement, and obstacle avoidance. It provides accurate distance measurements in various environments.

6.2 Software Requirements

- Arduino IDE

The Arduino Integrated Development Environment (IDE) is an open-source application used to write programs, called sketches, in C language. Sketches are saved with a .ino extension. The IDE includes an editor, a text console, toolbars for saving, verifying, uploading code, and serial monitoring, as well as a message area for displaying status and errors. The Arduino's bootstrap allows sketches to be uploaded without additional hardware.

Figure 3: Arduino integrated development environment (IDE)

- ThingSpeak IoT

ThingSpeak is an open-source Internet of Things (IoT) platform for collecting, analyzing, and visualizing sensor data. It allows users to send and receive data from devices, store it in the cloud, and display it on custom dashboards. ThingSpeak supports integration with MATLAB for advanced data analysis and visualization.

7 ADVANTAGES AND APPLICATIONS

Below the several advantages and real time applications

7.1 Advantages

- Real-time water usage, quality, and level monitoring.
- Automated filling system reduces wastage and ensures supply.
- Active water quality tracking for safe distribution.
- Accessible data on ThingSpeak cloud for transparency.
- Cost-effective and resource-saving through automation.

7.2 Applications

- Residential water usage and quality monitoring.
- Industrial water system management.
- Automated irrigation for agriculture.
- Smart water distribution for municipalities.
- Remote monitoring in rural or underserved areas.

8 EXPECTED OUTPUT

The proposed system will address the highlighted issues by providing a scalable, user-friendly solution that enhances water management efficiency, supports sustainability, and promotes safe water usage practices through real-time monitoring, automation, and data accessibility.

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