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Smart Water Distribution Monitoring System: A Review

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ABSTRACT— Water is an essential resource for human survival and the well-being of the environment. Despite numerous government initiatives and efforts to conserve water, efficient water management remains a critical challenge, especially in urban settings. This review focuses on the need for smart water distribution and monitoring systems, particularly in large residential complexes, to promote sustainable water usage. The project aims to address the issue of water scarcity by implementing a system that continuously monitors water levels, ensuring proper distribution and reducing wastage. By utilizing embedded systems and IoT technology, the proposed solution enables real-time tracking and management of water resources, thus enhancing efficiency and conserving water for future generations. This review examines the current technologies used in smart water management, the challenges faced in large-scale implementations, and the future potential of IoT-based water distribution systems.

I. INTRODUCTION-

Water distribution in urban areas is a critical yet often overlooked issue, especially in large residential complexes. In many apartment buildings, disputes over water allocation frequently arise as residents struggle to acquire sufficient water to meet their individual needs. These challenges stem from inefficient water management systems that lack real-time monitoring and proper regulation of supply.

This review paper introduces a solution aimed at addressing these challenges by implementing a smart water distribution and monitoring system. The system is designed to channel water efficiently to each apartment block, ensuring equitable distribution from the first to the last user. Utilizing a Raspberry Pi-based embedded system, the model is cost-effective and highly adaptable to various urban environments. The Raspberry Pi controller regulates water supply intervals and flow rates, preventing excessive usage through a solenoid valve that controls flow when it exceeds predetermined limits. In addition to ensuring proper distribution, the system includes a billing mechanism that charges residents based on their water usage. This encourages water conservation, as saving water directly translates to saving money. The system also accommodates occasional higher water demands, allowing users to request additional water based on available storage. Real-time updates on water usage and storage are accessible through a cloud-based platform via the Internet of Things (IoT). This information can be monitored and managed through a mobile application, which also allows users to communicate their water requirements, monitor usage, and manage billing. The proposed solution is not only cost-effective but also provides a sustainable way to manage water resources in urban settings. Through continuous monitoring, proper flow control, and user engagement.

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1.1. Block Diagram

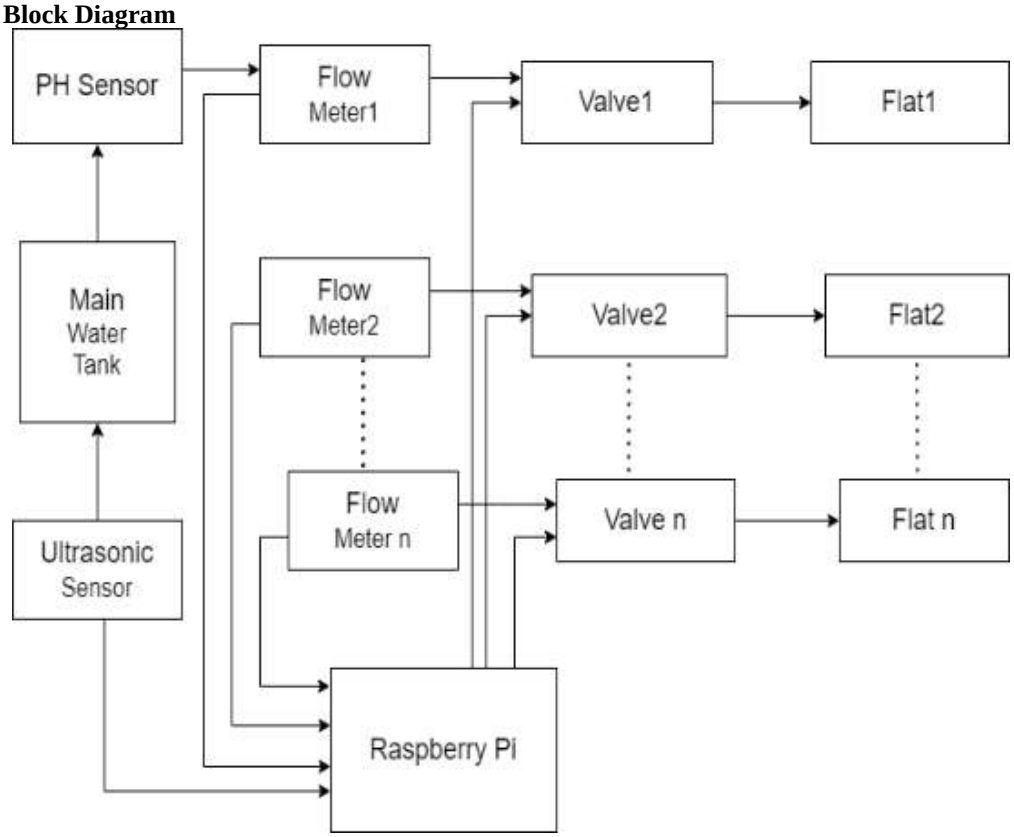

Fig.1 Block Diagram

- **Main Water Tank**: Central water source for the system.
- **Ultrasonic Sensor**: Monitors the water level in the tank.
- **Flow Meters**: Measure water usage for each flat.
- **Valves**: Control water flow to each flat, automated by the Raspberry Pi.
- **Flats**: Individual units receiving water.
- **Raspberry Pi**: Central controller that processes data and manages valves.
- **Wi-Fi Module**: Enables remote control and monitoring via mobile devices.
- **Mobile**: User interface for monitoring and controlling water distribution remotely.

II. SYSTEM ARCHITECTURE

2.1. Raspberry Pi

Raspberry Pi acts as the core controller, managing data from sensors and executing control operations. Its affordability and compatibility with IoT make it ideal for real-time water monitoring and distribution systems.

2.2. Ultrasonic Sensor

The ultrasonic sensor measures the water level in tanks by emitting sound waves and calculating the time for them to return. It ensures accurate monitoring of water levels to prevent shortages or overflows.

2.3. pH Sensor

The pH sensor measures the acidity or alkalinity of water to ensure it meets safety standards. This real-time monitoring helps maintain water quality for safe usage.

2.4. Dissolved Oxygen (DO) Sensor

The DO sensor monitors the oxygen levels in water, an important indicator of water quality. It ensures that the water being supplied is not stagnant and meets environmental health standards.

2.5. Flow Meters

Flow meters measure the rate of water flow through the pipes in the system. They help regulate distribution and detect anomalies such as leaks or excessive usage.

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2.6. Electronically Controlled Valves (Solenoid Valves)

Solenoid valves automatically open and close to control water flow based on real-time data. They prevent wastage by ensuring water is only supplied when needed and within set limits.

2.7. Wi-Fi Module

The Wi-Fi module enables communication between the Raspberry Pi and cloud servers for real-time data upload and remote access. It allows users to monitor and control the system through a mobile application.

2.8. Mobile Devices

Mobile devices provide a user-friendly interface for monitoring water usage, billing, and sending additional water requests. The app ensures transparency and convenience by allowing residents and administrators to manage the system remotely.

III. BENEFITS OF SMART WATER DISTRIBUTION MONITORING SYSTEM

3.1. Efficient Water Management

The system ensures optimized and equitable water distribution, preventing overconsumption and reducing wastage. This efficient management helps conserve water, addressing the critical challenge of water scarcity in urban areas.

3.2. Real-Time Monitoring

Real-time monitoring of water levels, quality, and flow allows for immediate detection of issues such as leaks or overuse. The integration with IoT enables remote control and timely updates via mobile devices, ensuring the system runs efficiently and issues are resolved quickly.

3.3. Cost-Effectiveness

By using affordable components like Raspberry Pi and solenoid valves, the system offers a budget-friendly solution for water management. The pay-per-use billing mechanism encourages water conservation, leading to financial savings for users based on their water consumption.

IV. OBJECTIVE

Develop an IoT-enabled system for smart water distribution in residential complexes.

Ensure real-time monitoring of water levels, flow, and quality.

Enable users to track consumption and manage water usage through a mobile application, promoting water conservation**.**

V. CONCLUSION

The Smart Water Distribution Monitoring System effectively addresses the challenges of managing and monitoring water usage in residential complexes. By utilizing sensors, flow meters, and Raspberry Pi, the system provides real-time insights into water levels and consumption for each flat. Automated valve control ensures efficient water distribution, while remote monitoring via a mobile app allows users to track usage, detect leaks, and manage water flow. This smart solution not

only promotes water conservation but alsoenhances the convenience and accountability of water usage, making it a valuable tool for sustainable resource management.

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