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Digital Mapping and Monitoring of Water Networks Using Web Interface

Prof. Ashwini Deokate[1], Yashshree Mendhe[2], Nidhi Bhoyar[3] , Samiksha Juwar[4] , Shivani Sawarkar[5], , Indrajeet Charde[6], Ankit Mourya[7]

[1,2,3,4,5,6,7] *Artificial Intelligence , Priyadarshini JL College of Engineering*

Abstract - The project aims to develop an intelligent water supply monitoring system integrated with GPS- based pipeline mapping for real-time tracking and management. The system dynamically updates the status of water distribution to both main and peripheral areas, ensuring accurate delivery tracking. It includes advanced leakage detection capabilities, identifying leakage locations and sending immediate notifications for swift intervention. Additionally, the system manages water distribution timing with a programmable timer to regulate supply duration in specific areas and can automatically manage tap operations based on these schedules. In cases of irregular water supply absence of water for 15- 20 min, the system generates alerts to prompt timely rectifications. A comprehensive water quality assessment module is included to monitor parameters like water quality and density before supply, ensuring safety and sustainability. The system's preventive measures also aim to minimize water wastage and contamination, enhancing efficiency and resource conservation across the supply chain.

***Key Words*: Intelligent water supply monitoring, GPS-based pipeline mapping, Real-time tracking, Leakage detection, Notifications .**

1. INTRODUCTION

The ongoing project focuses on the development of an advanced web and mobile-based mapping tool for real- time monitoring, management, and control of water supply networks. Utilizing GPS-enabled pipeline mapping technology, the system empowers municipal bodies and utility providers with enhanced visibility and control across the entire water distribution infrastructure from primary supply lines to the most remote areas ensuring no part of the network is left unmanaged.

Central to the system is its real-time status monitoring, which enables the quick identification and resolution of inefficiencies or disruptions within the distribution network. A key highlight is the intelligent leakage detection module, which processes data from integrated sensors and employs robust algorithms to accurately identify and localize leakages. Immediate notifications are automatically generated, allowing maintenance teams to take swift action, thus minimizing water loss and operational delays.

The system also incorporates a programmable scheduling feature that governs the timing of water distribution in different zones. This is complemented by automated tap control, allowing the system to dynamically regulate water flow based on local demand and set supply intervals. Such functionality is especially beneficial in regions facing water scarcity or where conservation measures are critical.

An integrated water quality assessment module enhances the platform's utility by continuously analyzing key parameters such as purity levels, pH, and potential contaminants. Alerts are issued instantly if any deviation from safety standards is detected, ensuring that only safe and clean water reaches end users and maintaining compliance with health regulations.

Designed for accessibility on both web and mobile platforms, the tool features an intuitive interface that simplifies operational workflows. Its combination of real- time analytics, automation, and intelligent alerting makes it a powerful solution for promoting sustainability, reducing water wastage, and improving the reliability and safety of water distribution in both urban and rural settings.

2. OBJECTIVE

The primary objective of a web or mobile-based tool for water supply network management is to enhance the efficiency, reliability, and sustainability of water distribution systems. This tool enables real-time monitoring of water flow, pressure, and quality through GPS-based pipeline mapping and sensor technology, offering comprehensive visibility into the infrastructure. By detecting leaks promptly using advanced algorithms and triggering automated notifications, it minimizes water loss and ensures swift maintenance responses. Additionally, the system supports optimized water distribution by using programmable schedules and automated controls, ensuring water is supplied efficiently based on demand. It integrates water quality monitoring capabilities to evaluate safety parameters like pH and turbidity, enabling proactive responses to anomalies. By providing actionable insights through data analysis and visualization, the tool empowers stakeholders to make informed decisions, allocate resources effectively, and anticipate operational challenges. Its user-friendly web and mobile interfaces ensure accessibility, while its focus on minimizing wastage and contamination underscores its role in promoting sustainability and environmental conservation .

1. **Real-Time Monitoring:** Develop a platform to monitor water flow and distribution across the pipeline network in realtime using GPS technology**.**
2. **Leakage Detection and Alerts:** Implement a system to detect leakages in the supply network, identify the exact location, and send alerts for immediate action.

3. Automated Supply Control: Introduce timer-based controls to regulate water supply durations in specific areas, ensuring efficient usage.

4. Outage Alerts: Provide timely alerts if an area has not received water for an extended period (1-2 days), enabling quicker problem resolution.

5. Water Quality Monitoring: Integrate tools for real- time water quality checks to ensure the supply of clean and safe water, preventing contamination risks.

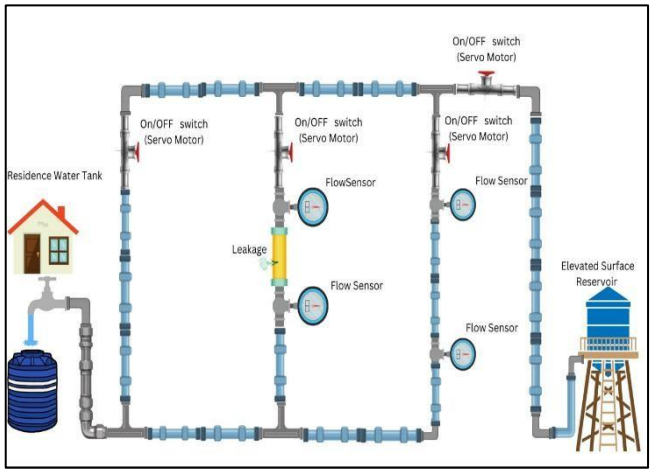
3. METHODOLOGY

Components of a Water Supply Monitoring and Mapping System

- **GIS Mapping (Geographic Information System):** Utilizes GIS software for mapping and spatial analysis. Helps create maps that display water-related data, topography, and infrastructure.
- **WaterHaltSensor:** Detects the presence or absence of water and triggers an alert when flow stops unexpectedly.
- **FlowSensors:** Measure the rate of water flow in pipes, rivers, and streams to monitor usage and detect anomalies.
- **PressureSensors:** Monitor changes in water pressure within pipelines, helping maintain a stable and efficient water supply.
- **Alerting and Notification Systems:** Provide real-time alerts to enable quick responses to issues such as leaks, blockages, or abnormal readings.
- **Communication Systems:** Facilitate remote monitoring and control of the water supply network, integrating with IoT devices and centralized dashboards.
- **Historical Data and Trend Analysis:** Analyzing past data helps in understanding patterns, improving decision-making, and optimizing future water management strategies.

Fig 3.1 Work Flow diagram of sensor network's map

4.



PROJECT IMPLEMENTATION

- Peoples are facing issues after some days they can share our issues in feedback form.
- In information stack we can see information about what we deployed in water pipelines like Flow meter , Servo meter, and etc.
- Reading Of flow meter.
- In tables we can see who send the feedback.

Fig 4.1 Dashboard

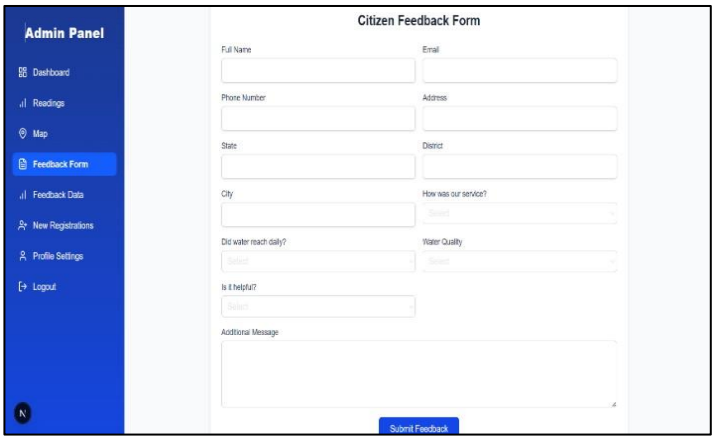


Fig 4.2 : Feedback Form

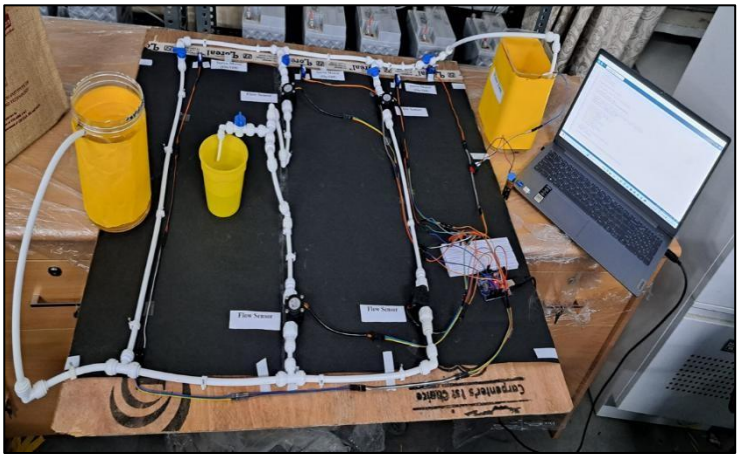


Fig 4.3 : Prototype of our Project

5. PLATFORM, TOOLS & TECHNIQUES

5.1 Backend:

- **Node.js:** Handles server-side logic, API development, and data management, ensuring seamless communication between the frontend, backend, and IoT devices. FastAPI is preferred for high-performance applications.
- **MongoDB:** Provides a NoSQL alternative for storing unstructured or semi-structured data, enabling real-time syncing and instant updates for mobile and web applications, particularly useful for push notifications and live sensor data monitoring**.**

5.2 Frontend :

- **Next.js:** Builds an interactive and responsive web interface with real-time visualization of the water network, integrating dynamic dashboards, GIS-based mapping, and real-time alerts for efficient monitoring and management. Next.js enhances performance with server-side rendering (SSR) and static site generation (SSG).
- **React Native:** Enables cross-platform mobile app development for Android and iOS, providing a seamless user experience with real-time updates on water supply status, leakage alerts, and interactive mapping features. Flutter offers high-performance UI rendering, while React Native ensures better integration with existing web technologies.

6. CONCLUSION

In conclusion, a web and mobile-based tool for mapping water supply networks significantly enhances real-time monitoring, leak detection, and overall system optimization. By integrating GIS technology, IoT sensors, and data analytics, the system ensures efficient water distribution and proactive maintenance. Mobile accessibility empowers field teams, increasing operational efficiency, minimizing water loss, and promoting sustainability in modern water supply management.

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