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Smart Tank Water Monitoring System

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ABSTRACT: In this paper, we present a smart tank water monitoring system that uses Internet of Things (IoT) technology to provide real-time monitoring and automated notification of water level, quality, quantity and leaks. The system is made up of a GSM module, a microcontroller, and advanced sensors that work together. The system analyses the data to detect anomalies and sends notifications to the user via SMS, enabling timely corrective action. The system's goals are to minimize maintenance costs, prevent contamination, real-Time monitoring, better water Quality, effective resource management leak detection and prevention and reduce water waste. It is designed to overcome the drawbacks of traditional water tank monitoring methods, which are frequently labour-intensive, time-consuming, and prone to errors.

KEYWORDS: Arduino, pH, Sensors ,Turbidity, Water quality, water leakage, IoT, Automated Notification, GSM.

I. INTRODUCTION

A. Overview:

Numerous developments in the twenty-first century have reduced human labour and saved time. An innovative solution to the common issue of water waste that would help society is a Smart Tank Water Monitoring System. Water quality, quantity, leak detection, and level monitoring systems are currently in place. Also it carried out by hand, adding the contemporary touch of automation to lessen the issue of water waste .It prevents water waste and saves electricity. Additionally, it stops water pollution. By detecting water leaks and quality, it saves the user time when storing water in a tank and avoids water waste.

B. Proposed system functions:

This project is based on IOT. The circuit is designed using an Arduino Uno. In order for them to function as intended, it also ultrasonic sensors to track the water level. Water quality is also measured using temperature, turbidity, and pH sensors. An LCD is used to show the output and notifications are sent to the user via a GSM module by alert messages, while water sensor prevent the identification of water leaks.
In this project required following component for this smart water monitoring system are:
Includes,

- Arduino Uno
- Ultrasonic sensor
- PH sensor
- Turbidity sensor
- Temperature sensor
- LCD 16X2
- Water sensor
- GSM Module

C. Advantage of Smart tank monitoring system

1. Real-Time Monitoring: The system continuously and instantly delivers information on the quality and levels of the water. This eliminates the need for manual checks and allows users to monitor the condition of their water supply at any time.
2. Better Water Quality: The system keeps an eye on vital water quality indicators like temperature, turbidity, and pH. This contributes to maintaining the water's safety for use and consumption. The system can identify contamination

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early and notify users to take appropriate action, like purifying the water or ceasing its usage, by continuously monitoring the quality of the water.

3. Effective Resource Management: Helps users better manage their water resources by giving them accurate information on water levels and quantity. Users can find patterns and optimise their water usage by examining data on water usage.
4. Leak Detection and Prevention: The system can identify a tank leak by detecting anomalous dips in water level or constant flow. gives users prompt notifications of possible leaks so they can take action before there is a substantial loss of water.

II. SYSTEM ANALYSIS

A. Problem Definition:

The development of smart water monitoring systems is fraught with difficulties. It necessitates financial backing, sustainability, and challenges in attaining security. The primary goal of this project is to use the Internet of Things to develop and deploy an automated, controllable smart monitoring system in order to address this issue. The difficulties and problems encountered during the creation or deployment of new technology that the system is attempting to resolve or address may be connected to the problem definition in a smart water monitoring system. The following are a few possible problem definitions that a smart water monitoring systems might be made to address:

- **Water Wastage:** Water wastage due to overflows or leaks, resulting in financial losses and environmental damage. Our smart water tank monitoring system uses ultrasonic sensors to measure water levels and detect leaks, sending automated notifications to prevent water wastage.
- **Contamination:** Contamination of water due to poor quality or leaks, posing a risk to human health and safety. Our system uses pH, turbidity, and temperature sensors to monitor water quality, detecting any anomalies and sending notifications to ensure prompt action.
- **Damage to Surrounding Area:** Damage to the surrounding area due to leaks or overflows, resulting in costly repairs and potential environmental hazards. Where our system's water sensor detects leaks, sending notifications to prevent damage to the surrounding area.
- **Increased Maintenance Costs:** Increased maintenance costs due to frequent repairs and replacements, resulting in financial burdens. Where our system's real-time monitoring and automated notifications enable prompt maintenance, reducing the need for costly repairs and replacements.
- **Inaccurate Water Level Readings:** Inaccurate water level readings, leading to inefficient water usage and potential water wastage. Where our system's ultrasonic sensor provides accurate water level readings, enabling efficient water usage and reducing waste.

B. Implementation:

We designed a circuit for a smart tank water monitoring system using an Arduino Uno. The ultrasonic sensor in the system measures the water level, allowing it to determine the tank's water level and display it on an LCD, as well as send notifications to the user via a GSM module. The water quality parameters are measured to assess the water quality. The concentration of hydrogen ions is measured by pH, which indicates whether the water is alkaline or acidic. The pH of pure water is 7, with values below 7 indicating acidity and values above 7 indicating alkalinity. The pH range is 0 to 14, with the ideal range for drinking water being 6.5 to 8.5.Turbidity, which measures the large quantity of invisible suspended particles in water, is also monitored. Higher turbidity increases the risk of cholera and diarrhoea, while cleaner water is characterized by reduced turbidity. A temperature sensor is used to determine the water temperature, which helps assess whether the tank water quality is acceptable or not. The results are displayed on an LCD, and notifications are sent to the user via a GSM module to alert them when the tank needs to be cleaned. A water leak detection system is also integrated into the smart tank, using a water sensor to identify leaks. The system works by identifying if there is any leakage by sensing the water on the surface using water sensor. If a leak is detected, a message is displayed on the LCD, and a notification is sent to the user via a GSM module. The results are displayed on the LCD, and notifications are sent to the user via a GSM module, ensuring that the user is informed about the tank's water level and quality at all times.

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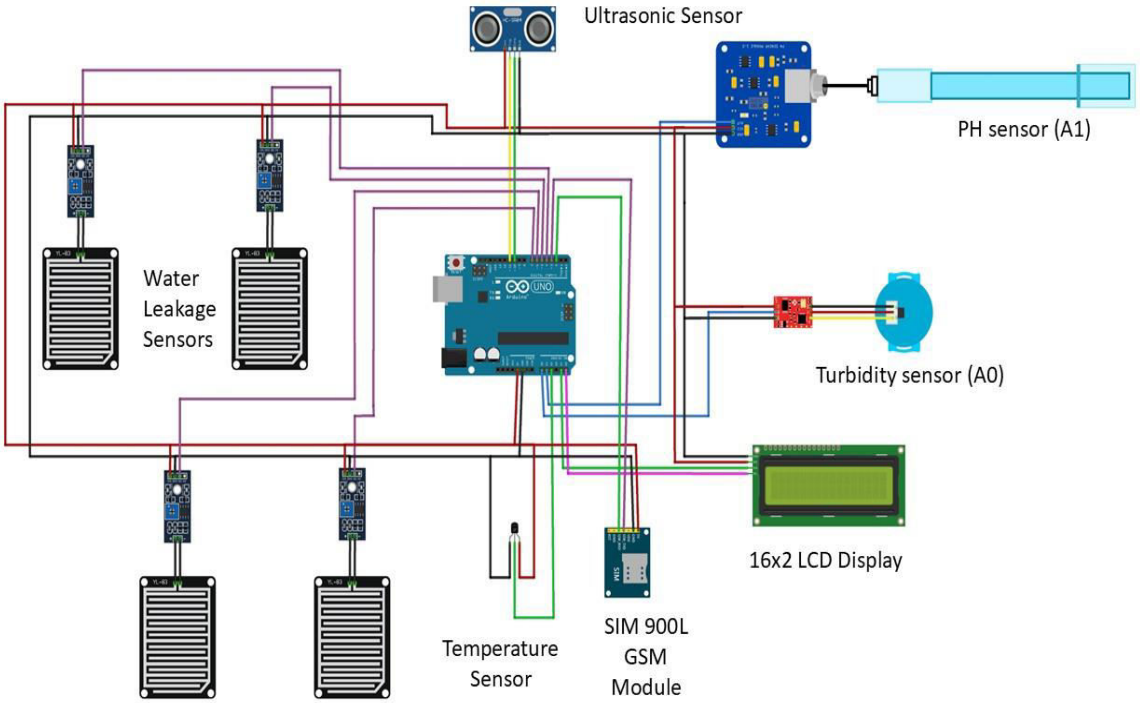
C. Circuit diagram of smart tank water monitoring system using Arduino Uno :



- The Water Leakage Sensors (Water Droplet Sensors) are connected to pin 3, 4, 5 and 7 of Arduino Uno
- The Ph Sensor is connected to pin A0 of Arduino Uno
- The Turbidity sensor is connected to pin A1
- The 16x2 LCD display with I2C connection is connected to VCC and GND for power supply and pins A4 and A5 of Arduino Uno for communication
- The Ultrasonic Sensor is connected to pin 10 and 11 of Arduino Uno
- The Temperature sensor is connected to pin A2 of Arduino Uno

III. DISCUSSION

A. Interpretation of results:

Based on the project description, it can be inferred that the implementation of a Smart Tank Water Monitoring System project using Arduino Uno is successful. The water level in the tank may be determined by the ultrasonic sensor, which can also detect movement in the tank. The sensor for pH shows the water's acidity or alkalinity based on its pH level. It can be dangerous to use or consume water whose pH is higher than what is considered safe. sensor for turbidity determines the water's cloudiness, which may be a sign of pollutants or suspended particles. Since high temperatures can degrade water quality and reveal the existence of bacteria or other problems, temperature sensors keep an eye on the water's temperature. The ultrasonic continuously deliver real-time information on Continuous real-time information on the tank's current water level is provided by the ultrasonic sensor. The user can see exactly how much water is available at any given time because this is usually shown as a percentage of the tank's entire capacity. In leakage detection water sensor sense the water on the surface and if the water is found then SMS is sent.

B. Comparison with previous research:

Our Smart Tank Water Monitoring System using Arduino Uno expands upon prior research by integrating a broader set of functionalities and leveraging GSM communication for real-time updates. Previous studies typically focused on individual aspects such as water level monitoring or basic water quality assessment. In contrast, our system combines water level measurement using an ultrasonic sensor, water quality analysis through pH, turbidity, and temperature sensors, and water leakage detection using water sensors. Additionally, the use of pH sensors in our system provides a

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precise evaluation of water acidity or alkalinity within the ideal drinking range of 6.5–8.5, which was less emphasized in earlier designs. The turbidity sensor identifies risks associated with suspended particles, addressing health concerns like cholera and diarrhoea, an improvement over systems that overlooked such detailed quality parameters. Temperature monitoring adds another dimension by ensuring water suitability for various applications, an aspect rarely addressed in past systems. Leak detection in our system introduces a novel approach by analyzing flow vibrations, correlating them to leak-induced variations. Finally, our system integrates ultrasonic sensors for precise water quantity measurements, with real-time results displayed on an LCD and communicated and notifications are sent to the user via a GSM module. This integration of comprehensive monitoring with remote notifications marks a significant advancement over earlier research, which often lacked such cohesive and user-friendly reporting mechanisms.

C. Limitations of the study:

When there are failures, it requires specialized knowledge and skills to troubleshoot. Any components that fail (e.g., the connectivity or sensors) can disrupt the process. It will be not able to move automatically. Automated systems require a stable power supply to operate effectively. Power outages or electrical failures can disrupt operations and affect user experience.

D. Suggestions for future research:

Future research for an IoT smart tank water monitoring system using Arduino can enhance water level monitoring through adaptive calibration and sensor fusion for greater accuracy. In water quality monitoring, advancements in detecting contaminants, self-calibrating sensors, and AI for trend analysis can improve performance. For water quantity monitoring, predictive models and optimized sensor placement can refine resource management. Water leakage detection can benefit from acoustic sensing, AI-based analysis, and networked systems for precise localization. These innovations will create smarter, more reliable water management solutions.

IV. CONCLUSIONS AND FUTURE WORK

A. Conclusion:

The Smart Tank Water Monitoring System, which is based on the Internet of Things, has been successfully tested and deployed. In conclusion, a key factor in converting residential environments into effective, sustainable, and user-friendly spaces is the incorporation of smart technologies such as tank water level monitoring, tank water quality monitoring, tank water leak detection, and tank water quantity monitoring. While water tank quality monitoring helps determine whether the water is of good quality or not by measuring the water's turbidity, temperature, and pH, tank water level monitoring measures the water's level in the tank, reducing water waste from overflowing. Water waste is decreased by implementing leak detection systems, and tank water quantity monitoring gauges the amount of water in the tank. When taken as a whole, these advances make the community more sustainable, connected, and better for future generations.

B. Future work:

Technology-driven smart tank water monitoring system solutions will be part of the future of smart tank water monitoring technology. Data indicating any structural changes can be transmitted by the smart sensors. People's capacity to analyse pertinent infrastructure data will help them plan more effectively, allowing for proactive maintenance and better demand forecasting. Our smart tank water monitoring system uses technologies that support sustainability, water management, energy efficiency, and an overall higher standard of living to assist individuals in planning their water management. Certainly, here are some potential future works for this IoT-based smart tank water monitoring system:

- **Predictive Maintenance:** To anticipate possible issues with the water tank or its related parts (such as sensors, valves) before they arise, apply machine learning techniques.
- **Smart Home System Integration :** For voice control and automation, seamlessly integrate the system with smart home ecosystems such as Apple HomeKit, Google Home, or Amazon Alexa. Depending on the availability of water, automate household tasks like watering systems.
- **Real-Time Alerts for anomalous Conditions:** These alerts identify and alert users to anomalous conditions such as sensor malfunctions, abrupt changes in tank pressure, or excessive water usage.
- **Management of Rainwater Harvesting :**Using sensors to track inflow and utilisation, monitor and control rainwater harvesting systems. Offer up-to-date information on harvested water levels and consumption effectiveness.
- **Advanced Reporting and Analytics :** Provide analysis of past usage data together with trends, visual dashboards, and suggestions for water-saving measures. Provide a mobile app that allows users to select settings and access analytics.

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- **Automation and Remote Control :**Give users the ability to remotely operate pumps or water valves through online interfaces or mobile apps. When levels drop below a predetermined threshold, external sources are automatically refilled.
- **Integration with Municipal Water Systems:** To keep an eye on and improve water distribution and avoid shortages, work with nearby water suppliers.
- **Multi-Tank Synchronisation:** Oversee several tanks in a single system, arranging water use and refills according to availability and priority.
- **Water Purity Insights:** Offer comprehensive evaluations of water pollutants such as pathogens, nitrates, or heavy metals, along with practical recommendations for water treatment.

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