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# Cloud-based IoT Architecture for Monitoring Water Quality Leveraging Sensor Data for Environmental Insights

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**ABSTRACT:** This paper presents a real-time water quality monitoring system based on IoT using Arduino Uno. It integrates sensors for turbidity and TDS to monitor water quality. The system displays data on a 16x2 LCD screen and sends SMS alerts via a GSM module for remote monitoring. Data is uploaded to ThingSpeak Cloud and a website, providing real-time insights. The alert message includes a link to the website, where users can view the monitoring parameters. The system is compact, low-cost, and suitable for urban and rural applications.

**KEYWORDS:** Water Quality, IoT, Arduino Uno, Turbidity Sensor, TDS Sensor, GSM Module, LCD Display, Real-time Monitoring, ThingSpeak Cloud, Website Integration, SMS Alerts, Remote Monitoring, Water Quality Parameters.

## I. INTRODUCTION

Water pollution is a pressing issue affecting ecosystems and human health globally. The increasing contamination of water sources due to industrial waste, agricultural runoff, and urbanization necessitates the development of efficient water monitoring systems. Traditional

methods involve manual sampling and laboratory testing, which are time-consuming and unsuitable for real-time monitoring. This paper introduces a low-cost, IoT-based water quality monitoring system using widely available electronic components. The system integrates turbidity and TDS sensors with an Arduino Uno, displaying real-time data on an LCD screen. Additionally, a Sim Com GSM module is used to send real-time alerts via SMS to a mobile phone, including a link to a website. The website displays the monitored water quality parameters, providing an accessible, automated monitoring solution. Data is also uploaded to Thing Speak Cloud, enabling remote access to real-time water quality information without manual intervention.

## II. LITERATURE SURVEY

Several studies have explored water quality monitoring using embedded systems. In [1], the authors introduced a system for pH and temperature sensing based on microcontrollers. While effective for environmental monitoring, this system lacked remote alert capabilities. Similarly, the work in [2] focused on agricultural applications, where a GSM-based system was used to provide real-time weather data but did not incorporate water quality parameters like turbidity

and TDS. Another study by [3] utilized a microcontroller to monitor water quality but was limited to local data display without cloud integration or remote alert systems. In contrast, GSM-based systems, such as in [4], have shown significant potential for integration into water quality monitoring by sending SMS alerts to mobile phones, providing users with real-time notifications.

The integration of turbidity and TDS sensors has been proven reliable in water monitoring applications. In [5], the SEN0189 turbidity sensor was used for measuring water clarity, while the MW-TDS101 sensor in [6] provided accurate real-time TDS data for similar applications. Both sensors have demonstrated consistent performance and are widely recognized for their precision in water quality assessment. Additionally, the use of ThingSpeak Cloud for data storage and remote access was explored in [7], which enabled seamless integration with IoT systems, offering enhanced capabilities for continuous monitoring and analysis of water quality parameters.

The work in this paper builds on these prior studies by incorporating GSM alert systems, cloud integration, and a website interface, allowing for a fully automated, remote water quality monitoring solution. This integration eliminates manual intervention, offering users the ability to monitor water quality in real time through both an LCD display and a cloud-based platform.

### **III. METHODOLOGY**

#### **A. System Architecture Overview**

The proposed water quality monitoring system integrates both hardware and software components to provide real-time data acquisition, processing, and communication. The architecture consists of:

- **Power Supply:** A 0–12V transformer with a 7805 voltage regulator supplies a stable 5V to all modules.
- **Microcontroller:** An Arduino Uno manages sensor data collection and communication.
- **Sensors:**
  - **Turbidity Sensor (SEN0189)** – Measures suspended particles in water by analyzing light scattering.
  - **TDS Sensor (MW-TDS101)** – Detects the concentration of total dissolved solids.
- **Display Module:** A 16x2 LCD shows real-time sensor values locally.
- **Communication Module:** A SIM800 GSM module sends SMS alerts when sensor values exceed safe thresholds. The alert includes a direct link to the live monitoring website.

#### **B. Software and Remote Monitoring Integration**

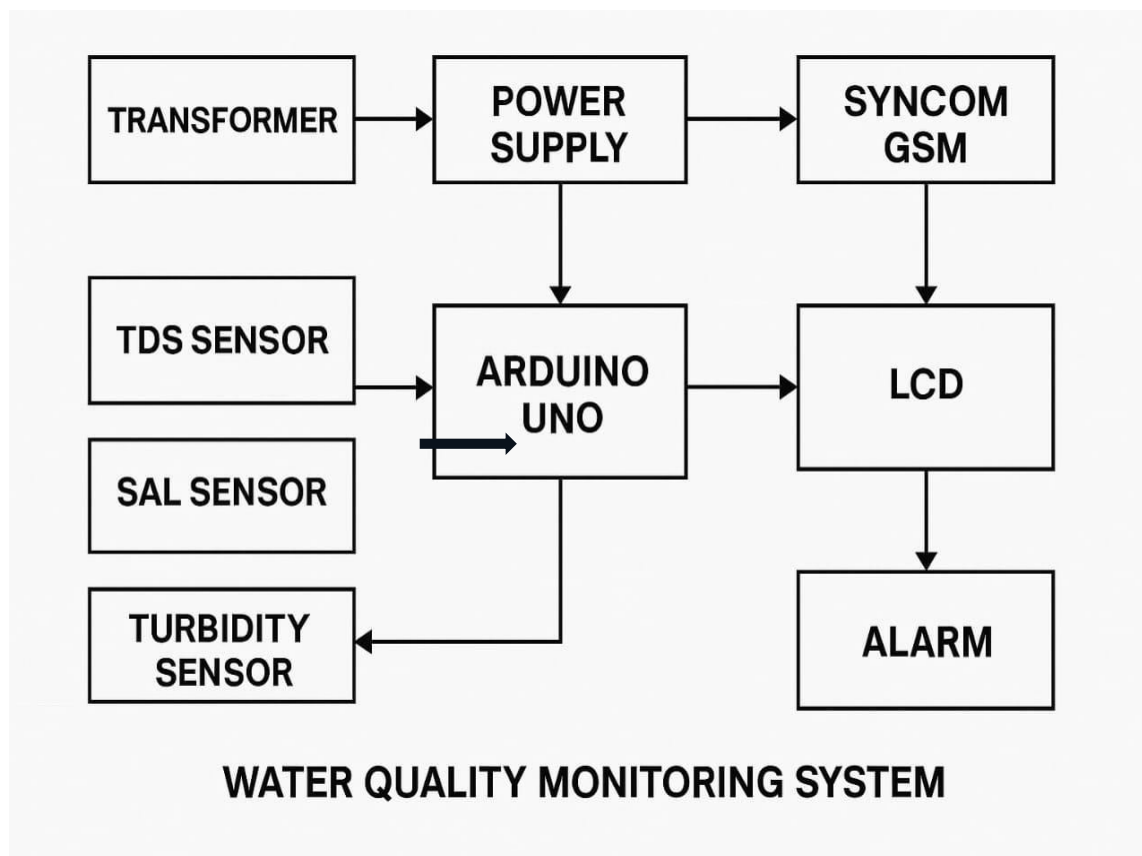
- **Website Integration:**
  - A custom website was developed to display real-time measurements of turbidity, TDS, and salinity.
  - The system updates the website data automatically every 30 seconds, eliminating the need for user login or manual cloud access.
  - Users can access the website directly from the SMS alert link, providing a seamless experience for remote monitoring.
- **ThingSpeak Cloud:**
  - Sensor data is also uploaded to ThingSpeak Cloud for advanced analytics and visualization.
  - This adds redundancy and allows historical data tracking with graphical representations of the parameters.

#### **C. Operational Flow**

1. Sensors continuously monitor water quality.
2. Arduino reads sensor outputs and processes the data.
3. Every 30 seconds, new readings are:
  - Displayed on the LCD,
  - Sent to the ThingSpeak Cloud,
  - Updated on the monitoring website.
4. If readings cross safety thresholds, an SMS alert is automatically triggered via the GSM module, including a direct link to the website for instant access.



Fig(1)



#### IV. EXPERIMENTAL RESULTS

The system was tested with tap water and slightly polluted water to monitor TDS, turbidity, and salinity in real-time.

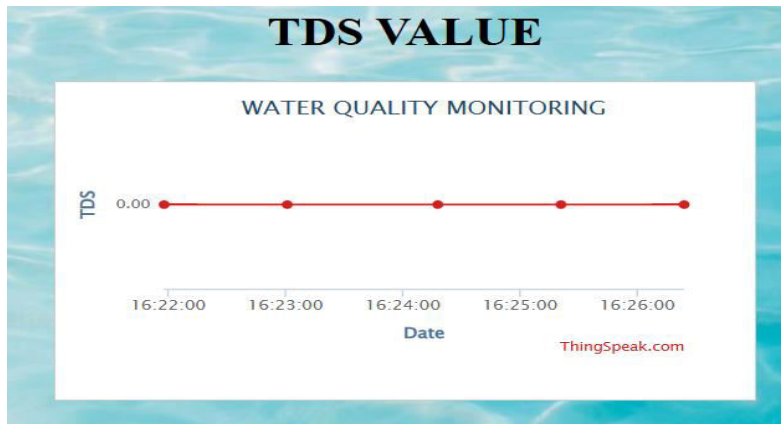
Observations:

Sample Type	TDS (ppm)	Turbidity (NTU)	Salinity (ppt)	Alert Triggered
Clean Water	200	0.8	0.2	No
Polluted Water	750	3.5	1.5	Yes

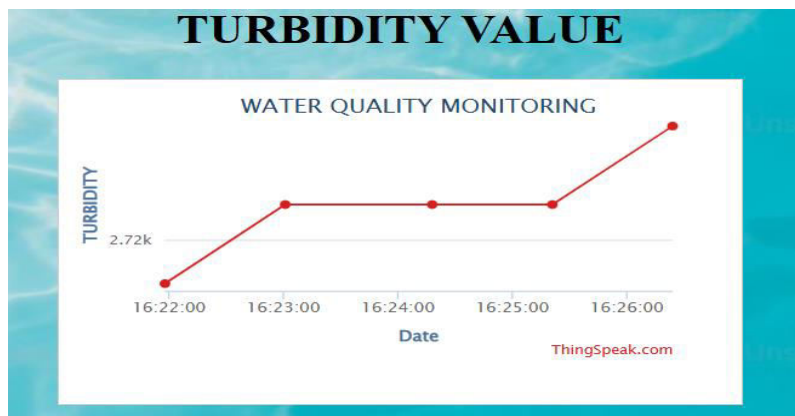
- Sensor values were updated every 30 seconds.
- Real-time data was displayed on a 16x2 LCD, uploaded to ThingSpeak Cloud, and shown on a custom website.
- The SIM800 GSM module sent alert messages for polluted samples with a link to the website.
- The system achieved a sensor response time under 2 seconds, ensuring timely alerts and monitoring.

The graphs below illustrate the expected real-time trends of TDS, turbidity, and salinity values as monitored by the system. These visual outputs are generated through ThingSpeak Cloud and represent how the system tracks changes in water quality parameters over time.

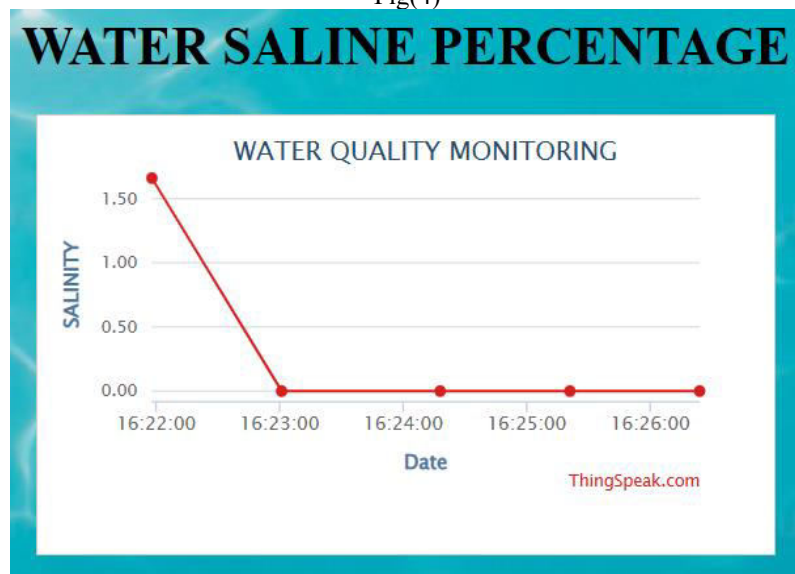
Fig(2)



Fig(3)



Fig(4)



### V. CONCLUSION

The developed system successfully monitors key water quality parameters—turbidity and total dissolved solids (TDS)—in real-time using an Arduino Uno-based IoT architecture. With its compact design, low cost, and minimal manual intervention, the system is well-suited for both urban and rural water monitoring applications. Real-time values are displayed on a 16x2 LCD and simultaneously uploaded to ThingSpeak Cloud for remote data access. In addition, the integration of the SIM800 GSM module enables automatic alert messages to be sent to predefined mobile numbers. These messages include a direct link to a custom-built website, allowing users to instantly view the current water quality status and sensor readings through their mobile devices. Future enhancements may include cloud-based data storage, the integration of additional sensors such as pH and temperature, and automated threshold-based analysis for predictive alerts and deeper environmental insights.

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