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A Water-Quality Monitoring System Based on Web-Server-Embedded Technology

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ABSTRACT: Efficient management and continual monitoring of water quality hold paramount importance across industrial and economic sectors. Addressing the global water scarcity crisis demands sustainable solutions that optimize water usage. Harnessing the potential of the Internet of Things (IoT) provides a resilient and economical solution for real-time monitoring of diverse water parameters. This paper aims to deploy an intelligent water quality monitoring system utilizing IoT technology. The devised system has been effectively deployed to ascertain the levels of turbidity, pH and temperature within a given water sample. Collected sensor data are seamlessly uploaded to the ThingSpeak dashboard, facilitating online monitoring capabilities. Furthermore, the system is designed to issue SMS alerts to users whenever parameter values surpass predefined threshold limits indicative of optimal water quality.

KEYWORDS: Web Server, Internet of Things, ESP32, Sensor parameters, ThingSpeak platform.

I. INTRODUCTION

In today's context, access to clean drinking water stands as a fundamental necessity for humanity. The real-time operation of drinking water utilities presents management with unprecedented challenges. These challenges stem from various factors such as limited water resources, population growth, and aging infrastructure. Consequently, there is an urgent need for advanced methodologies to monitor water quality effectively.

Hence, there exists an urgent requirement for the continuous online monitoring of water quality. Such a system would offer timely and comprehensive insights into water quality parameters, facilitating proactive measures to ensure the safety and sustainability of drinking water resources.

Advancements in online water monitoring technologies have undoubtedly progressed, facilitating enhanced surveillance of source water and operational management of water treatment plants. However, the widespread adoption of these technologies is often hindered by the substantial costs associated with installing and calibrating an extensive network of monitoring sensors. Furthermore, algorithms designed for such technologies may not always be adaptable to specific geographic areas or conducive to large-scale systems.

In light of these challenges, our paper aims to create and implement a cost-effective system for real-time water quality monitoring within an IoT framework. Our system architecture centers around the utilization of the ESP32 microcontroller as the core controller. Utilizing a dedicated IoT module, our design streamlines the access of sensor data from the core controller to the cloud. This data can then be easily viewed on the cloud platform through a dedicated IP address. Additionally, the IoT module offers Wi-Fi connectivity, enabling users to access and monitor the data via mobile devices.

II. LITERATURE REVIEW

The research paper titled [1] "Intelligent Water Quality and Water Supply Management System for Smart City using ARM" by Mr. D.B. Rane et al. addresses the pressing need for efficient water quality monitoring and management systems in the context of smart cities. The literature review likely explores previous studies on water quality monitoring systems, emphasizing the importance of real-time data collection and analysis for ensuring safe and sustainable water supply. Researchers have investigated various sensor technologies, communication protocols, and data analytics

methods to develop intelligent water management systems capable of detecting contaminants, predicting water quality trends, and optimizing water distribution networks. Additionally, studies on smart city initiatives have highlighted the role of IoT (Internet of Things) and ARM-based microcontrollers in integrating sensor networks, cloud computing

platforms, and decision support systems for effective water resource management. By synthesizing insights from previous research, the paper lays the groundwork for the development of an innovative water quality and supply management system tailored to the needs of smart cities.

The research paper titled [2] "The Real-Time Monitoring of Water Quality in IoT Environment" by N. Vijayakumar and R. Ramya, presented at the IEEE Sponsored 2nd International Conference on Innovations in Information, Embedded, and Communication Systems (ICIIECS) 2015, contributes to the growing body of literature on water quality monitoring in the context of IoT (Internet of Things) environments. The literature review is expected to delve into prior research on real-time water quality monitoring systems, emphasizing the importance of IoT technologies in improving data collection, analysis, and dissemination procedures. Researchers have investigated the integration of sensor networks, wireless communication protocols, and cloud computing platforms to develop scalable and cost-effective solutions for monitoring various parameters such as pH, turbidity and temperature in water bodies. Additionally, studies on IoT-based environmental monitoring have emphasized the importance of sensor calibration, data validation, and system reliability in ensuring accurate and timely information for decision-making purposes. By synthesizing insights from previous research, the paper aims to advance the understanding of IoT-enabled water quality monitoring systems and propose innovative approaches for addressing the challenges in this domain.

The research paper titled [3] "Water Quality Monitoring System Implemented with IoT" by Kartik Maheshwari and Adrija Chakraborty, presents a significant contribution to the literature on water quality monitoring systems leveraging IoT (Internet of Things) technologies. The literature review likely explores previous studies on IoT-based water quality monitoring systems, emphasizing the importance of real-time data collection, analysis, and visualization for ensuring the safety and sustainability of water resources. Researchers have investigated various sensor technologies, communication protocols, and cloud-based platforms to develop scalable and cost-effective solutions for monitoring parameters such as pH, turbidity and temperature in water bodies. Additionally, studies on IoT-enabled environmental monitoring have highlighted the potential of sensor networks, data analytics, and machine learning algorithms in predicting water quality trends, detecting anomalies, and supporting informed decision-making processes. By synthesizing insights from previous research, the paper seeks to push the boundaries of IoT-based water quality monitoring systems and introduce inventive approaches to tackle the challenges within this field.

The research paper titled [4] "Water Management System using Dynamic IP based Embedded Webserver in Real Time" by Vaishali U. Patil and Avichal R. Kapur, presented at the 2015 International Conference on Nascent Technologies in the Engineering Field (ICNTE-2015), contributes to the literature on water management systems by proposing a novel approach leveraging dynamic IP-based embedded web servers for real-time monitoring and control. The literature review likely explores previous studies on water management systems, focusing on the integration of embedded systems, web technologies, and dynamic IP addressing to enable remote access and control of water-related infrastructure. Researchers have investigated various aspects of water management, including supply optimization, leakage detection, and quality monitoring, highlighting the importance of real-time data acquisition and analysis for efficient resource utilization and sustainable development. By synthesizing insights from previous research, the paper aims to advance the state-of-the-art in water management systems and propose innovative solutions for addressing the challenges in this domain.

The research paper titled [5] "Web Scraping for Automated Water Quality Monitoring System: A Case Study of PDAM Surabaya" by Rizqi Putri Nourma Budiarti et al., presents a comprehensive exploration of utilizing web scraping techniques to enhance online water quality monitoring systems. The literature review likely delves into the existing challenges faced by water utility companies in implementing real-time monitoring solutions and the significance of timely detection and response to water contamination events. Previous studies have highlighted the limitations of passive sensor devices in providing comprehensive data access and management, necessitating innovative approaches to data collection and analysis. The paper likely discusses the growing importance of web scraping as a tool for extracting data from online sources, enabling seamless integration with existing monitoring infrastructure. By proposing an application of data logger using Python and web scraping techniques, the paper contributes to advancing the capabilities of water quality monitoring systems, demonstrating high accuracy in data collection and real-time

performance. Additionally, the literature review may explore the potential applications of web scraping in other domains of environmental monitoring and data analytics.

III. METHODOLOGY

The methodology employed in the project involves several key steps aimed at developing and implementing a robust water quality monitoring system. Initially, thorough research and analysis were undertaken to comprehend the prevailing challenges in water quality monitoring and the potential of IoT (Internet of Things) technologies in mitigating these challenges. This involved reviewing literature, studying existing monitoring systems, and identifying the essential parameters to be monitored, such as pH, turbidity, temperature, and chlorine. Next, hardware components including sensors for measuring these parameters and microcontrollers, such as ESP32, were selected based on their compatibility, accuracy, and cost-effectiveness. The system architecture was designed to integrate these components, enabling real-time data acquisition, processing, and transmission.

Software development played a crucial role in the project, with programming languages like Python being utilized for data processing and analysis. Web scraping techniques were employed to collect data from the sensors, allowing for seamless integration with cloud-based platforms for storage and visualization. The implementation of a dynamic IP-based embedded web server facilitated remote access and control of the monitoring system, enhancing its usability and accessibility. Additionally, machine learning algorithms may have been explored to predict water quality trends and detect anomalies based on the collected data.

Throughout the project, rigorous testing and validation procedures were conducted to ensure the accuracy and reliability of the monitoring system. Field trials may have been performed to assess the system's performance under real-world conditions and validate its effectiveness in providing timely and accurate water quality information. Continuous monitoring and optimization of the system were carried out to address any issues and improve its functionality based on feedback and observations. Overall, the methodology adopted in the project aimed to develop an intelligent and cost-effective water quality monitoring solution that meets the needs of modern urban environments.

IV. SYSTEM ARCHITECTURE

The system architecture for our real-time water quality monitoring solution within an IoT environment comprises several interconnected components to ensure seamless data acquisition, processing, transmission, and visualization. Here's an overview of the system architecture:

1. Sensor Nodes:

- Multiple sensor nodes are deployed to gather data on different water quality parameters, including pH, turbidity, and temperature. Each sensor node is equipped with sensors for specific parameters.

2. ESP32 Microcontroller:

- The ESP32 microcontroller serves as the core controller within each sensor node. It interfaces with the sensors to collect data and manages data processing tasks.

3. IoT Module:

- A specialized IoT module is integrated into the system architecture to facilitate communication between the sensor nodes and the cloud platform. This module enables data transmission over Wi-Fi networks.

4. Cloud Platform:

- The cloud platform serves as the central repository for storing, processing, and analyzing the collected data. It provides a scalable and secure environment for data management.

5. Data Processing and Analysis:

- Within the cloud platform, data processing and analysis algorithms are employed to interpret the raw sensor data and extract meaningful insights. This may include identifying trends, anomalies, or correlations between different water quality parameters.

6. User Interface:

- A user-friendly interface is developed to enable users to access and visualize the water quality data in real-time.

This interface may be web-based or mobile-based, allowing users to monitor the system remotely.

7. Alerting Mechanism:

- An alerting mechanism is implemented to notify users of any deviations from predefined thresholds or abnormal conditions in water quality parameters. This ensures timely intervention in case of potential issues.

8. Security Measures:

- Robust security measures are integrated into the system architecture to safeguard sensitive data and prevent unauthorized access or tampering.

Overall, the system architecture is designed to be scalable, adaptable, and reliable, providing comprehensive insights into water quality parameters while ensuring ease of use and accessibility for users.

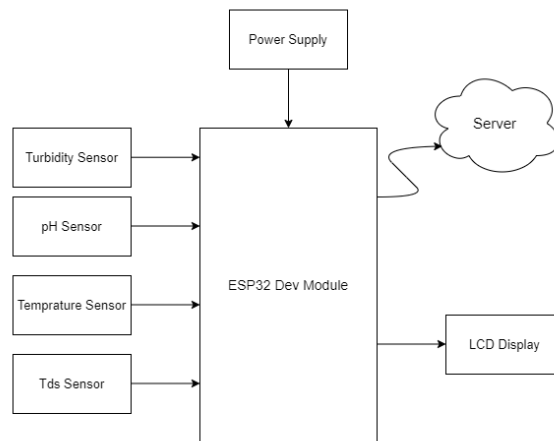


Fig 1. Overall block diagram

V. RESULT AND DISCUSSION

Utilizing IoT technology, the implemented system offers real-time monitoring capabilities, as demonstrated through the graphical representations provided by ThingSpeak. Turbidity, which refers to the clarity of water, serves as a crucial indicator of water quality. When water contains particles such as mud, silt, or sand, its quality may be compromised. According to water quality standards, normal water typically falls within the range of 0 to 5 Nephelometric Turbidity Units (NTU), with a maximum permissible value of 5 NTU. Nevertheless, when turbidity surpasses 6 NTU, escalating to levels as high as 3000 NTU, the water is designated as turbid or sediment-laden. The measurement of water turbidity is depicted in Figure.

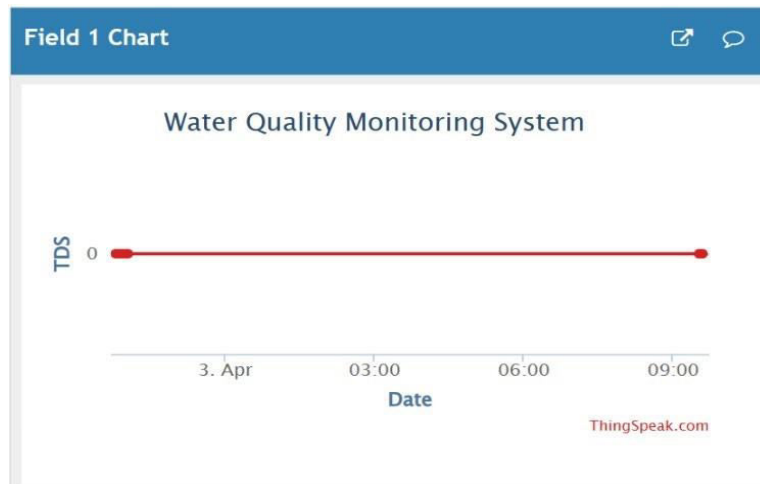


Fig. 2 Temporal Fluctuations in Turbidity: A Graphical Representation

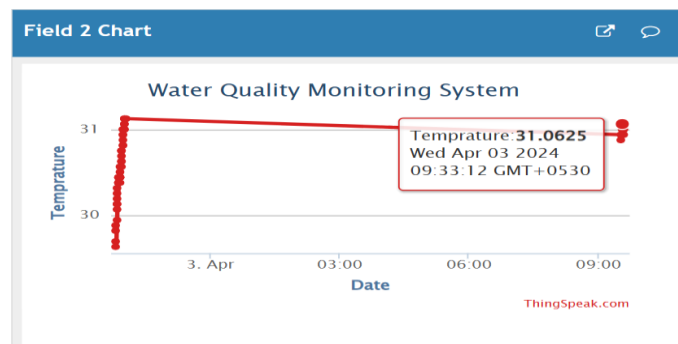


Fig. 3 Temporal Fluctuations in temperature: A Graphical Representation

VI. CONCLUSION

In conclusion, the implemented water quality monitoring system has demonstrated effectiveness in providing real-time insights into water parameters and facilitating informed decision-making. By leveraging ThingSpeak platform, the system successfully displayed the collected sensor data in a user-friendly format, allowing stakeholders to monitor water quality trends and deviations over time. Additionally, the system's ability to generate a CSV file in Excel format enhances its usability by enabling further analysis and reporting.

Moreover, the integration of Telegram bot functionality enables prompt notification to stakeholders whenever a sensor reading exceeds predefined threshold values. This feature ensures timely response to potential water quality issues, thereby enhancing the system's effectiveness in safeguarding public health and environmental sustainability.

Overall, the combination of data display in ThingSpeak, generation of Excel-compatible CSV files, and alert messaging via Telegram contributes to a comprehensive water quality monitoring solution. The system's capabilities empower stakeholders to proactively address water quality concerns, optimize resource management, and ensure compliance with regulatory standards. As such, the developed system represents a valuable tool for enhancing water management practices and promoting the sustainable utilization of water resources.

REFERENCES

1. `Vaishnavi V. Daigavane and Dr. M.A Gaikwad." Water Quality Monitoring System Based on IOT", Advances in Wireless and Mobile Communications. ISSN 0973-6972 Volume 10, Number 5 (2017),pp. 1107-1116
2. S. Sukaridhoto, R. Sudibyo, W. Sarinastiti, R. Dharmawan, A. Sasono, A. Saputro and S. Sasaki, "Design and

development of a portable low-cost COTS-based water quality monitoring system," in 2016 International Seminar on Intelligent Technology and Its Applications (ISITIA), 2016.

3. G. o. Surabaya, *Pengelolaan Kualitas Air dan Pengendalian Pencemaran Air*, 2004.
4. Deepak C.Karia, Vispi Adajania, Manisha Agrawal and Swapnil Dandekar, "Embedded Web Server Application Based Automation and Monitoring System", *Proceedings of 2011 International Conference on Signal Processing, Communication, Computing and Networking Technology*, pp.634-637, 2011.
5. Y. 600R, "'6-Series Multiparameter Water Quality Sondes User Manual," [Online]. Available: <https://www.ysi.com/>. [Accessed 1 July 2019].
6. MQTT, "Message Queue Telemetry Transport," [Online]. Available: <http://mqtt.org>. [Accessed 1 July 2019].
7. Alif Syarafi Mohamad Nor, Mahdi Faramarzi, Mohd Amri Md Yunus, and Sallehuddin Ibrahim "Nitrate and Sulfate Estimations in Water Sources Using a Planar Electromagnetic Sensor Array and Artificial Neural Network Method," *IEEE SENSORS JOURNAL*, VOL. 15, NO. 1, JANUARY 2015
8. T. P. Lambrou, C. G. Panayiotou, and C. C. Anastasiou, "A low-cost system for real time monitoring and assessment of potable water quality at consumer sites," in *Proc. IEEE Sensors*, Oct. 2012, pp. 1–4.
9. S. Zhuiykov, "Solid-state sensors monitoring parameters of water quality for the next generation of wireless sensor networks," *Sens. Actuators B, Chem.*, vol. 161, no. 1, pp. 1–20, 2012.
10. A. Aisopou, I. Stoianov, and N. Graham, "In-pipe water quality monitoring in water supply systems under steady and unsteady state flow conditions: A quantitative assessment," *Water Res.*, vol. 46, no. 1, pp. 235–246, 2012.



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