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Water Quality Monitoring System: Literature Survey and Design

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Abstract: Given the significant obstacles that water pollution poses to the principles of green globalisation, it is more important than ever to guarantee a reliable and safe source of drinking water. This research presents a practical and affordableapproach to meet this need by proposing a real-time waterquality monitoring system that makes use of the Internet ofThings (IoT). The proposed system effectively incorporates awide range of sensors that are specifically designed to monitor physical and chemical parameters that are critical for assessingthe quality of water. These parameters include temperature, pH,turbidity, and water flow. These sensors gather data, which isthen processed through a complex process made possible by anArduino-based core controller. As a result, the information thathas been processed is easily available online via a Wi-Fi system. This all-encompassing approach addresses the pressing need tosecure a dependable and safe drinking water supply in the faceof the complex challenges posed by water pollution to thefundamental tenets of green globalisation. It also offers an effective and financially feasible solution for the ongoingmonitoring of water quality.

I. INTRODUCTION

Numerous inventions have evolved in the twenty-first century, but so have challenges like pollution and global warming, resulting in a global scarcity of safe drinking water. These days, issues like population growth, scarce water supplies, and global warming make real-time water quality monitoring difficult. As a result, it is imperative to create better techniques for the continuous monitoring of water quality parameters. pH is a measure of hydrogen ion concentration that determines the acidity or alkalinity of water, making it one of the most important water quality indicators. A pH of seven indicates pure water; an acidic value is less than seven, while an alkaline value is greater than seven. The pH scale goes from 0 to 14, with 6.5 to 8.5 being the ideal range for drinking water. The measurement of turbidity determineswhether water contains suspended particles that are invisible to the unaided eye. Lower turbidity levels imply cleaner water, while higher turbidity levels raise the danger of illnesses like cholera and diarrhoea. Temperature sensors detect the water's temperature, giving important details about its surrounding surroundings. Conversely, flow sensors assess the speed at which water passes through them. Unlike the manual techniques of gathering water samples from different areas, more modern procedures are needed to handle the complexity brought about by environmental issues and human activity.

A. Research Questions

The current study is focused to answering the research questions depicted in table1.The motivation for these research questions is also listed.

TABLE 1. RESEARCH QUESTIONS AND MOTIVATION

No.	Research Question	Motivation
RQ1	How may the accuracy and efficacy of water quality monitoring systems be improved by using cutting-edge sensor technologies?	By investigating more sophisticated sensors, it will be possible to get beyond the present water quality monitoring systems' speed and precision constraints and provide more precise, real-time data to remedy their weaknesses..

RQ2	How can patterns in water quality data from monitoring systems be predicted and identified using machine learning algorithms?	By using machine learning, predictive models for early anomaly identification in water quality may be developed, providing proactive insights and completely changing the way that water quality management is done.

The remaining paper is organized as: the 2nd section outlines the literature review,the 3rd section presents systematic mappingresults and discussion, the 4th section highlights future research trends and the 5th section presents conclusion of the study.

II. LITERATURE REVIEW

Author: Nikhil Kedia entitled, Published in 2015 1st International Conference on Next Generation Computing Technologies (NGCT-2015) Dehradun, India.
Title: "Water Quality Monitoring for Rural Areas-A SensorCloud Based Economical Project."
The entire process of monitoring water quality, sensors, embedded design, and information dissipation are the main topics of this study. The function of the government, network operator, and villages in ensuring sufficient information dissipation is also covered. It investigates the Sensor Cloud domain as well. Although improving water quality automatically is not currently possible, water quality and public awareness can be raised withthe clever application of technology and cost-effective techniques.

Author: Jayti Bhatt,Jignesh Patoliya entitled
Title: "Real Time Water Quality Monitoring System".
This study outlines a novel approach to water quality monitoring—IOT (Internet of Things) based monitoring—that aims to guarantee the safe supply of drinking water by monitoring the quality in real time. In this research, we discuss the architecture of an Internet of Things (IoT)-based system for real- time water quality monitoring. The water quality parameters, including pH, turbidity, conductivity, dissolved oxygen, and temperature, are measured by a number of sensors in this system. Through the use of the Zigbee protocol, the microcontroller processes the measured values from the sensors and sends the processed values remotely to the Raspberry Pi, which serves as the core controller. Finally, cloud computing can be used to see sensor data on an internet browser application.

Author: Michal Lom, Ondrej Pribyl, Miroslav Svitek
Title: "Industry 4.0 as a Part of Smart Cities".
This article discusses the Smart City Initiative and the idea of Industry 4.0. The phrase "smart city" has been popular in recent years, especially since the global financial crisis of 2008.
The creation of a sustainable urban model and the preservation of the standard of living of its citizens are the primary driving forces behind the creation of the Smart City Initiative. Smart city concepts need to take into account a number of legal, humanitarian, and economic factors in addition to technical ones. Under the Industry 4.0 idea, the Internet of Things (IoT) will be used in the development of so-called smart products.
Subcomponents of the product have their own intelligence built into them. Enhanced intelligence is employed in the process of creating products as well as in their handling afterward, all the way up to ongoing lifecycle monitoring (smart processes). The Internet of Services (IoS), which encompasses intelligent transport and logistics (smart mobility, smart logistics), and the Internet of Energy (IoE), which regulates the efficient use of natural resources (oil, water, and electricity, among others), are two more key components of Industry 4.0.
It is possible to think of IoT, IoS, IoP, and IoE as componentsthat can link the
Industry 4.0 and the Smart City Initiative: Industry 4.0 is apart of smart cities.

Author: Sokratis Kartakis, Weiren Yu, Reza Akhavan, andJulie A.
Title:"Adaptive Edge Analytics for Distributed NetworkedControl of Water Systems"
This study presents a burst detection and localization approach for water distribution networks that leverages graph topology analytics along with lightweight compression and anomaly detection. We show that our method effectively localises water burst events by leveraging the difference in arrival times of vibration variations reported at sensor sites, while alsosignificantly reducing the amount of communication between sensor devices and back end computers. Our results can save up to 90% of communications when compared to typical periodical reporting settings.

III. METHODOLOGY

Establishing the parameters for evaluating water quality and determining allowable limits is the first step in developing a water purity testing system using IoT and an Android application. After that, select the right sensors to detect these variables and link them to a microcontroller to ensure compatibility with the preferred IoT platforms. Set up the microcontroller to communicate with the Internet of Things platform via Wi-Fi or other communication protocols in order to read sensor data. Create an Android application to connect to the IoT platform and enable users to monitor historical and real-time water quality data via an intuitive interface. Configure the platform to receive, store, and visualise the data. Put in place user authentication, permission, and an alert system to let users know if the quality of the water drops below acceptable bounds. To guarantee that the water purity testing system is used properly, comprehensive testing of the entire system is necessary before deployment. This is followed by ongoing maintenance, updates,documentation preparation, and user training.

IV. PROPOSED SYSTEM

The recommended Internet of Things (IoT)-based Arduino Uno-based water purity testing system is made to track and evaluate significant water quality indicators.
The Arduino Uno will be integrated with water quality sensors, including pH, turbidity, temperature, and dissolved oxygen, for the purposeof data collecting. The Arduino Uno will be set up to read sensor data and use a wireless connection module to send it to an Internet of Things platform like ThingSpeak or Blynk. To interface with the IoT platform and provide users with historical and real-time data on water quality, an Android application will be developed. The system will provide threshold-based alerts that will alert users to any deviations from acceptable water quality levels, along with user identification that will permit secure access to the Android app. Extensive testing, calibration, and implementation, together with routine.Updating and maintaining the system will ensure its effectiveness and dependability for ongoing water quality monitoring. To guarantee the system's seamless operation, comprehensive documentation and user training will be provided.

V. DESIGN

Fig 1. Sample Implementation of the system design

There are two steps in the suggested operation for the IoT system. The block diagram of the proposed IoT system forwater tests as a case study is shown in Fig 1. The first step inthe IoT system is the collecting of sensing data from sensors connected to the IoT control. In this work, two types of sensors are employed to collect data from water. These sensors areknown as (TDS) and (pH metre). In the second level, these sensors are linked to control (ESP32), which controls data collection. After all information is delivered to the unique web application in the third phase, it can save information in the website. Before transferring the obtained data to the IoT server, the proposed IoT was applied to it. Figure 1. illustrates the proposed IoT system (using component of IoT). It is shown that the steps of the IoT system operations, all parameters, and initial values will determine between the two sides (sender side, and IoT server-side). Figure 1. illustrates the proposed IoT system (using component of IoT). It is shown that the steps of the IoT system operations, all parameters, and initialvalues will determine between the two sides (sender side, and IoT server- side).

VI. CONCLUSION

The first stage is the gathering of sensory data made possible by sensors connected to the Internet of Things controller. Total Dissolved Solids (TDS) and pH metres are the two types of sensors used in this investigation to collect data. In the next step, these sensors communicate with the ESP32 controller, which manages the data gathering procedure. The final stage involves sending all of the collected data to a specific web application, which then posts the information on a webpage. The suggested IoT system is used to examine the gathered data before sending it to the IoT server.

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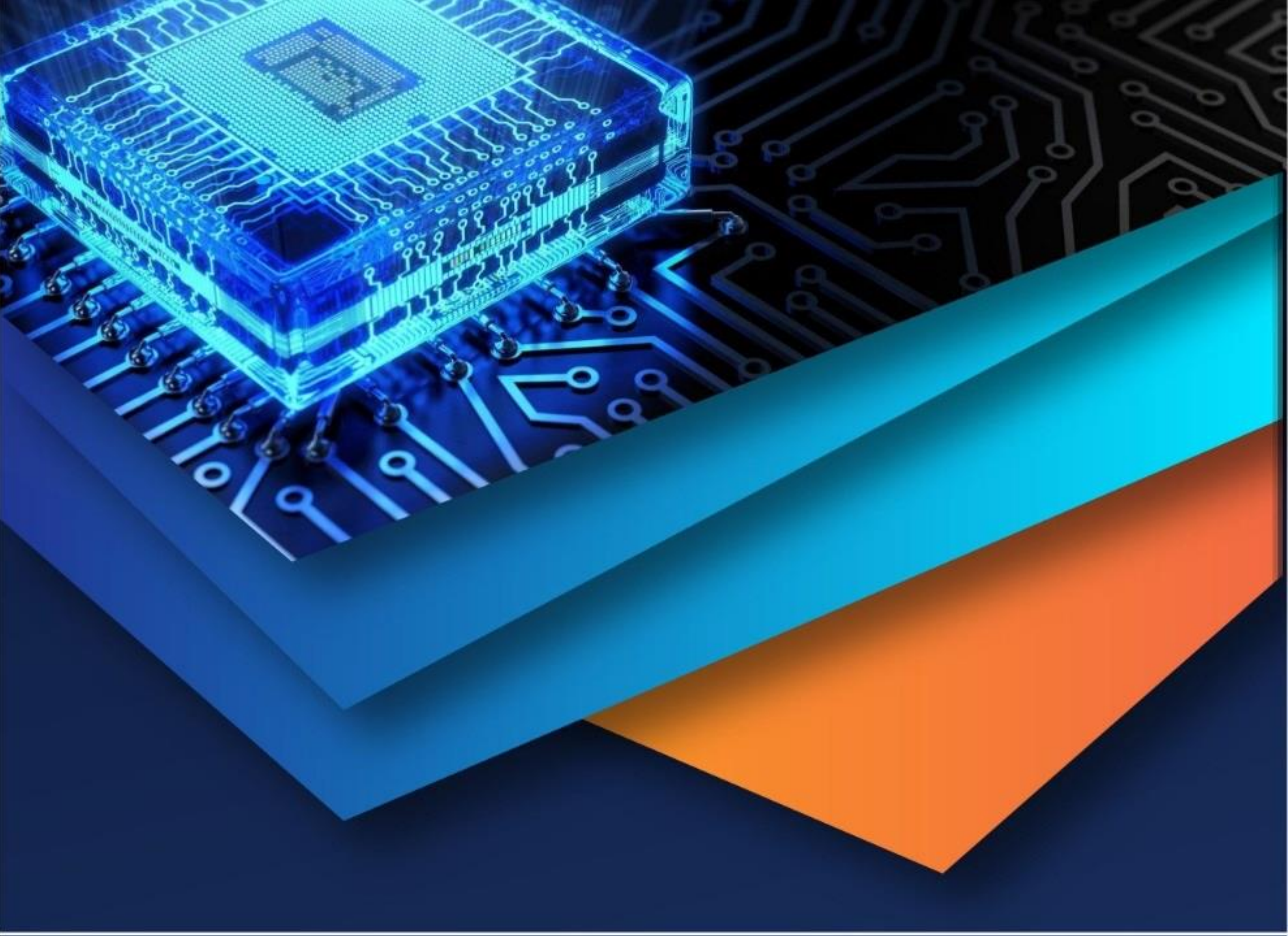

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