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Cloud Based Water Pollution Monitoring System

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***Abstract*: In India, 70% of surface and groundwater resources are contaminated by several pollutants, including biological, poisonous, organic, and inorganic ones. This poses a significant environmental challenge. In India, untreated sewage causes water contamination. The other causes of contamination are unregulated small-scale industries and agricultural runoff. The majority of our nation's rivers, lakes, and surface waters are contaminated by industries, untreated sewage, and solid waste. The result of this enormous issue is the rising socioeconomic cost of low-quality water. A very small portion of the nearly 40 million litres of effluent that enter rivers and other water bodies each day is appropriately treated. The weaker portions of society are the class most severely affected by water contamination. The majority of this society's members live close to India's major waterways. The first step in locating the source of water pollution is to identify it and to address the challenges associated with both static and dynamic pollution source detection. in the undertaking. The source detection techniques are tried in this research. The outcomes show how the high detection accuracy in the network for pollution source detection is related to the number of sensors utilised and the extent of the values being monitored. In addition, pollution source detection can be done with high detection accuracy if a sufficient number of samples can be guaranteed.**

***Keywords*: water pollution monitoring.**

1. Introduction

Water safety is a concern since there are so many causes of pollution, the majority of which are man- made. The primary reasons of issues with water quality are overuse and abuse of the earth's resources. Water contamination has been greatly exacerbated by the quick speed of industrialization, increased emphasis on agricultural growth, modern technological advancements, agricultural fertilizers, and lax enforcement of laws. The issue can occasionally be made worse by the uneven distribution of rainfall. The quality of water is also influenced by individual practices (Central Ground Water Board, 2017). Both point and non-point sources of pollution, such as sewage discharge, industrial discharge, runoff from agricultural areas, and urban runoff, have an impact on water quality. In order to maintain the quality of water resources, users must be involved in preserving water quality and considering other factors including hygiene, environmental sanitation, storage, and disposal.

Poor water quality promotes sickness, results in death, and obstructs socioeconomic development. Worldwide, waterborne diseases claim the lives of almost 5 million people each year (Water Resource Information System of India, 2017). Farmers' usage of pesticides and fertilizers might wash through the soil and end up in waterways when it rains. Additionally, industrial waste is washed into rivers and lakes. These toxins penetrate the food chain and build up until they are toxic levels, which finally result in the death of fish, birds, and mammals. Waste is also disposed of in the water by chemical plants. River water is used in factories to cool down or power equipment. Lowering the amount of dissolved oxygen in the water and upsetting the balance of life in the water are two effects of increasing water temperature (Central Ground Water Board, 2017). The aforementioned reasons make monitoring water quality crucial.

According to Neil et al. (2016) and Muinul et al. (2016), water quality monitoring is the process of gathering data at certain places and intervals in order to develop trends, define current conditions, etc. Jianhua et al. (2015); 2014). The main goals of online water quality monitoring include measuring crucial water quality parameters like microbiological, physical, and chemical characteristics in order to spot deviations from the norm and provide early warning of potential dangers. Additionally, the monitoring system offers real-time analysis of the data gathered and recommends appropriate corrective actions.

This initiative has two objectives. The first is to offer a thorough overview of recent work in the field of smart water quality monitoring, taking into account application, communication technology used, types of sensors used, etc. The second goal is to propose a smart water quality monitoring system that is less expensive and complex and uses a controller with an integrated Wi-Fi module to track variables like pH, turbidity, and conductivity. The device also has a warning feature that notifies the user when certain water quality parameters are out of the ordinary.

2. System Overview

The suggested block design in Fig. 1 includes a number of sensors connected to the core controller, including pH, TDS and PNP sensor (Metal Detector). A Wi-fi module is used by the core controller to retrieve the sensor values and process them

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before sending the data over the internet. The sensor data is viewable online on a cloud.

The main components are divided into two categories: hardware and software. In the hardware, sensors are used to measure values in real time. The ADC i.e., Analog to digital converter is a device that converts analogue values to digital values and then sends it to raspberry pi to displays sensor data. The connection between hardware and software is provided by the Wi-Fi module.

We created a software program based on the Python language.

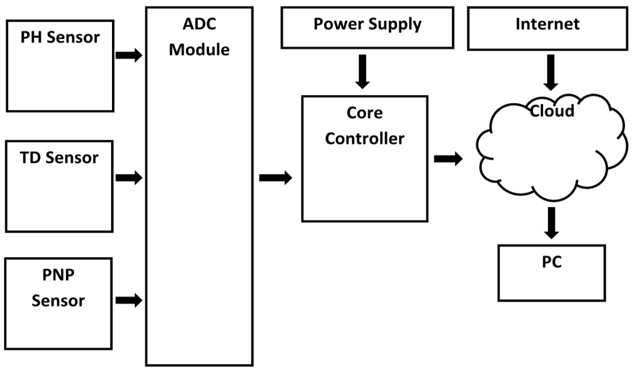

Fig. 1. Block diagram

A. Hardware System Design

A straightforward block diagram like the one in Fig. 1 can be used to explain the project's fundamental idea. The sensors, the analogue to digital converter (ADC), the microcontroller, and the SD storage make up the entire system.

The gathered data can either be transferred to a File Transfer Protocol (FTP) server or a cloud server, or it can be saved locally on the device using an SD card. For this project, a complete sensor bundle that includes the sensors, microcontroller, and Internet connection was used.

B. Sensors

Controller (Raspberry Pi 3): The Raspberry Pi3 Model B, as depicted in Fig. 3, is a fantastic platform for creating automation systems. It is obvious that the Raspberry Pi3 model B board is ideal for connecting to other open-source hardware components like sensors and serving as a hub for automation systems. The Raspberry Pi3 Model B is a small single- board computer that can do all of the functions of a typical desktop computer, including spreadsheets, word processing, the internet, programming, games, and more. It transforms into the ideal IoT-ready solution with built-in WiFi and Bluetooth connectivity. It has a 1.2GHz quad-core Broadcom BCM2837 64-bit ARMv8 processor, built-in Bluetooth Low Energy (BLE), 1GB RAM, 4 USB 2 ports, 40-pin extended GPIO, HDMI, and RCA video output. Operating systems built on the Linux kernel power Raspberry Pi3Model B devices. It uses the SD card to boot and operate. Other than the ROM, it has no internal memory. It features a slot for SD cards that can read up to 32 GB. The Python programming language is used to programme the Raspberry Pi3 Model B's GPIO pins. When necessary, GPIO pins are assigned to I/O devices like sensors.

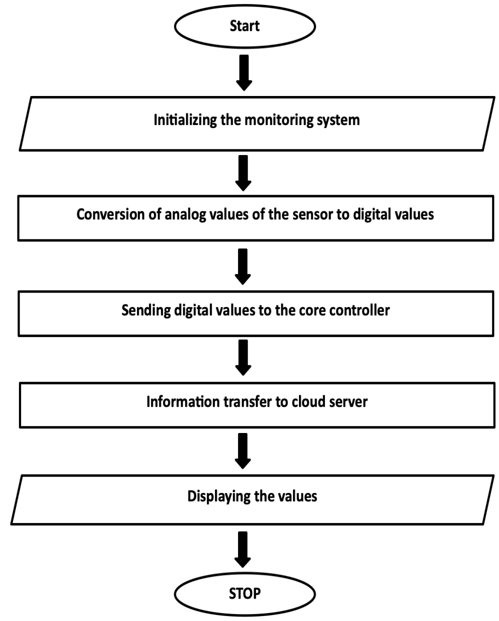

Fig. 2. Flow Chart

Water pH Sensor: Should the pH of an aqueous solution be measured? Yes, the Grove - pH sensor (as depicted in fig. 5) can assist you in doing so. The output signal from this sensor reflects the hydrogen ion concentration as determined by the pH electrode. Because it may be immediately attached to a controller, you can always see the pH level. For pH readings in situations like waste water, sewage, and others, this gadget can be utilized.

PNP Sensor: An active HIGH output is provided by PNP proximity sensors. The output of the sensor is linked to +24V when an object enters its detection range. This is recognised by the device as a logic HIGH signal when connected to a PLC input. 39; Sourcing39; sensors are another name for PNP proximity detectors.

TDS Sensor: A TDS sensor (shown in fig. 7) is essentially an electrical charge (EC) metre that measures charge in water by inserting two electrodes that are similarly spaced apart. The TDS metre interprets the result and converts it to a ppm value.

If the water is pure and free of any soluble elements, it won't conduct a charge and will have a 0-ppm. On the other hand, if the water is heavily dissolved, it will conduct a charge, and the resulting ppm value will be proportionate to the number of dissolved solids. This is due to the fact that all dissolved materials contain an electrical charge, allowing electrical charge to conduct across the electrodes.

Ethernet: Ethernet functions by dividing data being delivered to or from devices like a personal computer into brief segments of various types of frames are sized units of information. These frames provide standardised data that aids in frame routing through a network, such as the source and destination addresses.

Cloud: The term cloud describes the software and databases that run on servers that may be accessed via the Internet. Data centres all throughout the world have cloud servers. Users and businesses can avoid managing physical servers or running software on their own computers by utilizing cloud computing. Thingspeak is the cloud that we are deploying for this project.

Thingspeak: Data is stored in Thingspeak channels. Send data from devices or from the web to a ThingSpeak channel. Use of Thingspeak helps us to alter data, visualize it, or start a process.

C. Software System Design

Figure 2 depicts the full software system's flow. The above flow diagram serves as the foundation for the proposed system's operation, which guarantees effective implementation. As a result, it requires less time and labour to run and maintain the system. Additionally, it offers ongoing water quality monitoring and makes taking essential action simple. Additionally, if the quality exceeds the limit, an alarm is given.

3. Results

The outcomes we anticipate getting from this study are as follows:

- The identification of pollution levels within water resources.
- Post the information online.
- The information is accessible from anywhere in the world at any time.

The values shown above correspond to optimum and drinkable water under WHO (World Health Organisation) standards. Our model determines the water quality and plots graph of the values vs. time as shown in fig. (3, 4, 5). It also displays the results on the local monitor as it being stored on an SD card, which is then uploaded on a cloud platform online.

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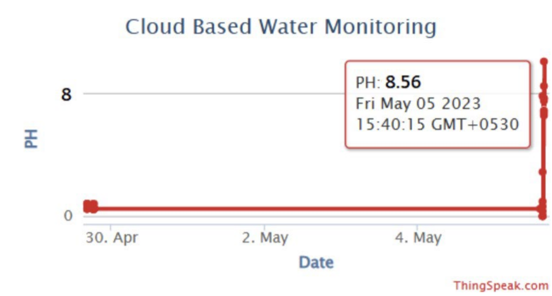

Fig. 3. pH Value plot

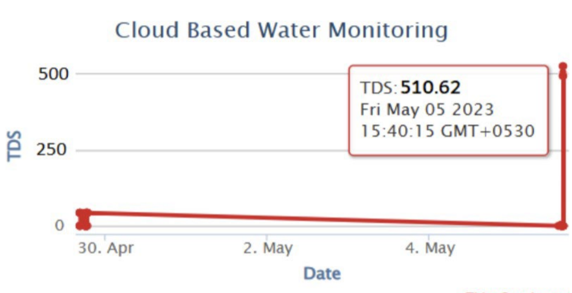

Fig. 4. TDS plot

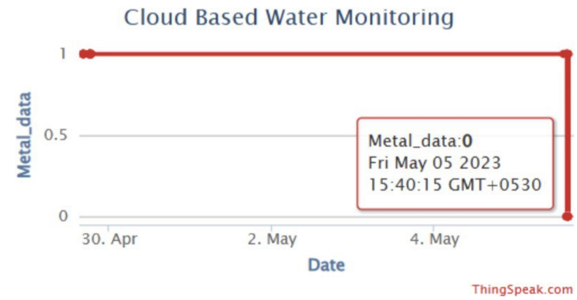

Fig. 5. PNP plot (presence of any metal, 0 indicates no metal is present)

4. Applications

A. Using an IoT water quality monitoring system, maintain a consistently healthy water supply

Apart from the Legionella risks connected to reopening after protracted closures, it's critical for residents to keep a sufficient supply of drinking water. Some building managers collect samples and analyze the water once or twice a year, but that approach just offers a momentary glimpse of the water's quality. After testing, a significant contaminant can emerge and be unreported for months, leaving residents susceptible to sickness.

You are always kept updated about the water quality in your building by an IoT water quality monitoring system. Using laser beams, turbidity sensors installed inside your pipes gauge the water's quality (whether it is clear or opaque).

High turbidity is a warning indicator that your water needs to be checked because it denotes the presence of particles. You may get a sense of the typical turbidity level in your build- ing through ongoing water quality monitoring; if conditions change, the data will be immediately visible. If that occurs, you can either use another sensor to search for particular chemicals or send a water sample for laboratory analysis.

B. Achieve LEED and/or WELL certification

In order to further their sustainability objectives and healthy building initiatives, a rising number of commercial build- ings are working to earn LEED and/or WELL certification. (Read more here about LEED, WELL, and the advantages for commercial buildings.) While WELL certification focuses on building elements that affect inhabitants39; health and wellness, LEED certification concentrates on sustainability-related topics. In addition to helping the environment and your employees, working for one or both of these certifications can help you save money by cutting down on inefficiencies.

An IoT water monitoring system can be used to address the water-related standards in both certifications. In order to track consumption in real time and identify water use, LEED encourages water submetering. It also gives points for installing devices that encourage water use reduction both indoors and outdoors.

WELL water quality guidelines are designed to assist buildings preserve water while also enhancing its quality so that it is safe for inhabitants. Whether your building is new or an existing one, an IoT water quality monitoring system can assist you in meeting all necessary water-related LEED and WELL criteria.

5. Conclusion

Water pollution is a serious challenge to any nation since it harms people's health, the economy, and biological variety. An effective IoT-based strategy for water quality monitoring has been detailed in this study, along with a thorough assessment of the various ways of monitoring water quality and the causes and effects of water pollution. Even if there are many great smart devices for monitoring water quality, the research field is still difficult. This work provides an overview of recent research efforts to develop intelligent, energy efficient, and highly effective water quality monitoring systems that will allow for continuous monitoring and the transmission of alerts and notifications to the appropriate authorities for follow-up action. The created model is easy to use and economical (flexible). The water samples are examined, and based on the findings, it is possible to determine if the water is fit for consumption or not. The recommendation for the future is to use cutting-edge sensors to detect various other quality parameters, wireless communication standards to improve communication, and IoT to create a better system for monitoring water quality and making water resources safe through quick action.

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