DESIGN AND IMPLEMENTATION OF AN IOT-BASED WATER QUALITY MONITORING SYSTEM WITH CLOUD SUPPORT

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ABSTRACT: Degradation and contamination of drinking water have recently intensified water pollution problems. The green globalization movement views water contamination as a major concern. Various scientific disciplines are currently using the Internet of Things (IoT) and related technologies for remote data collecting, monitoring, and analysis. Keeping a consistent supply of drinkable water available requires real-time monitoring of water quality. This research suggests a user-friendly approach to measuring water quality in real-time. The most recent innovations in intelligent water pollution monitoring devices are thoroughly reviewed. An IoT-based smart water quality monitoring system that continuously assesses quality indicators is proposed in the research. It works well and doesn't cost a fortune. The established model is tested with water samples, and the parameters that are generated are sent to a server in the cloud for additional research.

Keywords:*Internet of Things, pH sensor, Turbidity sensor, Temperature sensor, ESP32, WI-FI module.*

1. INTRODUCTION

Water is a gift from nature that humans really appreciate. Beverages have a major impact on the health of animals and humans alike. Polluted water threatens ecosystems by upsetting the delicate balance of life on Earth and causing illnesses in both people and other creatures. A large amount of drinkable water comes from rivers and lakes. However, due to the rapid population growth, new sources of water contamination and danger emerged.

The most common types of contaminants in water include viruses, microbes, pesticides, fertilizers, parasites, medicines, phosphates, nitrates, radioactive materials, including plastics. In order to monitor the purity and quality of the water, the Central Pollution Control Board set up a number of observation sites.Before taking any kind of management action, it is crucial to conduct an accurate assessment of the water contamination levels.

The collection of samples from a variety of locations and the subsequent in-depth analysis of those samples in a laboratory are both components of the standard operating procedure (SOP) for monitoring water quality. It is difficult to put traditional methods of communication and detection quality assurance into reality since they are time-consuming, prone to errors, and provide a challenge to implement. Measurements of turbidity, temperature, pH, total suspended solids (TSS), and other parameters are taken into account by the Water Quality Monitor in order to guarantee that the user has access to water that is suitable for consumption.

The laborious and time-consuming operation of manually rowing a canoe around a reservoir or lake in order to check the entire body of water for contamination

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makes the monitoring of water pollution more challenging. Therefore, we developed this technology in order to facilitate the speedy evaluation of the quality of the water in huge bodies of water. The entire process of construction was carried out using the utilization of an ESP32 Internet of Things device, in addition to a pH, turbidity, and temperature sensor. ESP32 is going to be outfitted with sensors that measure temperature, turbidity, and pH, according to the plan.

2. LITERATURE REVIEW

Gaikwad, Dr. M. A. The title of the paper is "IoT-Based Water Quality Monitoring System." In this research, a flow sensor was used to measure turbidity, pH, and flow rate. By utilizing the existing GSM network to send sensor data, this academic research proposes a practical and economically viable technique for water quality monitoring.

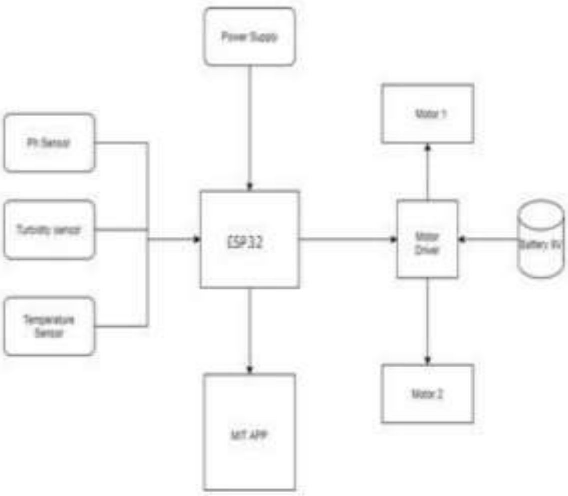
Atif A, Wasai Shadab, Mohammad Hassan, Shamim, Alelaiwi, and Anwar Hossain Defining "IoT Ecosystem: Real-Time Water Quality Surveillance"Thisresearch presents a cost-effective Internet of Things (IoT)-based method for real-time water quality monitoring. Various sensors designed to measure dissolved oxygen, temperature, pH, turbidity, and conductivity were integrated into their model. A primary controller for a Raspberry Pi B+ managed the sensor data. Subsequent to processing, the data was conveyed by cloud computing over the internet.

Nikhil Kedia's "A Survey on Sensor-Cloud: Architecture, Applications, and Approaches" examines the various data exchanges involved in sensor-cloud communication.

Pradeepkumar M, Monisha J, Pravenisha R, Praiselin V, and Suganya Devi K's work "Water Quality Monitoring for Rural Areas: An Economical Project Utilizing Sensor Cloud-Based Technology" makes perfect sense. Within the scope of this article, the subject of embedded sensor technology is explored in great detail. Additionally, the research investigates the potential for commercial application of this technology, potential barriers, and the support it receives from mobile network providers and the government. This device is equipped with the capability to connect directly with the government in the event that there is a severe concern with the product's quality.

M. Chandra Mohan, S. Vengateshapandiyan, M. Mathan Kumar, R. Eswaran, and R. Kartik Kumar came up with the acronym "IoT Environment: Monitoring of Water Quality in Real-Time." Throughout the course of this paper, the architecture of cloud computing, which enables sensor-based systems and makes sensor data accessible on a global scale, will be analyzed and discussed.

3.PROPOSED SYSTEM



The name is "Advanced water quality monitoring system powered by solar energy and wireless sensor network." The

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wireless sensor network, powered by the solar node, makes use of graphical user interfaces developed in Matlab.

HARDWARE DESCRIPTION

An IoT-based system capable of real-time water quality monitoring is laid forth in this article. In this paper, we analyze the proposed method's generic block diagram in detail. Extensive information is provided for each component of the system.

pH Sensor

The acidity or basicity of a solution can be determined using the pH scale. Any value between zero and fourteen is possible, according to the logarithmic pH scale. Acidity is indicated by a result lower than seven. A pH greater than seven indicates an alkaline or basic environment. Water with a detrimental effect on materials has a pH of 7. This component is compatible with Arduino and operates on 5V power.A typical pH ranges from six to eight and a half.

After connecting the pH sensor to the Arduino board, calibration is necessary to obtain a precise result. Before the sensor may be used, it must be calibrated by submerging it in clean water. Pin the analogue-to-digital converter in a different way if the sensor reading is too high, too low, or too close to seven. The typical analog readings from the sensor were transformed into digital values using an analog-to-digital converter. The sensor's ability to monitor water pH improved significantly during calibration.

Turbidity

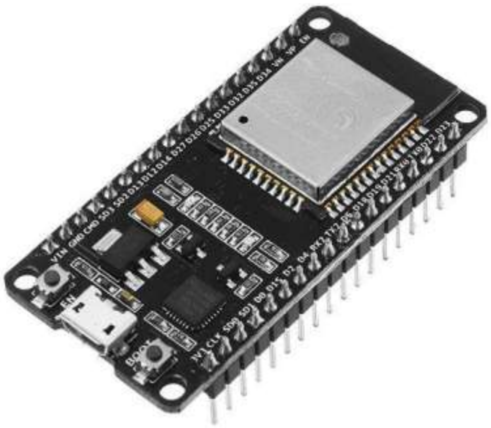
The term "cloudiness" describes the degree of cloudiness in a body of water. The less transparent the water is, the higher the turbidity. The general public seems to accept that it provides a reliable indicator of water purity. It is possible to quantify the amount of light scattered by particles in a given body of water using turbidity sensors. The amount of particle debris that sinks to the ocean floor is influenced by turbidity. To determine whether water contains silt, a turbidity sensor is used. The increased absorption of heat by suspended particles upon reaching the surface causes the water's surface temperature to rise.

Temperature sensor

The water's temperature is determined by scientists using temperature sensors. The experiment employed a DS18B20 temperature sensor. The temperature of the water is a good indicator of its temperature. The operating temperature range of the DS18B20 sensor is -55 to +125 degrees Celsius. The precision of the temperature reading is due to the digital sensor.

L293D

A decent DC and stepper motor driver, the L293D Motor Driver Module is a decent choice, regardless of its medium power rating. One famous example is the L293 motor driver integrated circuit. It has the ability to modify the speed and direction of two of the four DC motors in addition to turning them on and off.



ESP32

The ESP32 boasts a 2.4GHz operating frequency and is a 40 nm TSMC semiconductor. Not only is it energy efficient, but it also includes Bluetooth and Wi-Fi integrated. Optimal for a variety of power profiles and applications, it boasts excellent RF performance, practicality, longevity, and adaptability.

4. IMPLEMENTATION

The Arduino IDE allows you to program the ESP32. The Arduino Integrated Development Environment (IDE) needs to be installed on your computer before you can proceed with this. In order for the ESP32 to establish a connection, it is necessary to physically attach it to the computer and configure the interface that will receive data. The software is written in Lua, a scripting language.

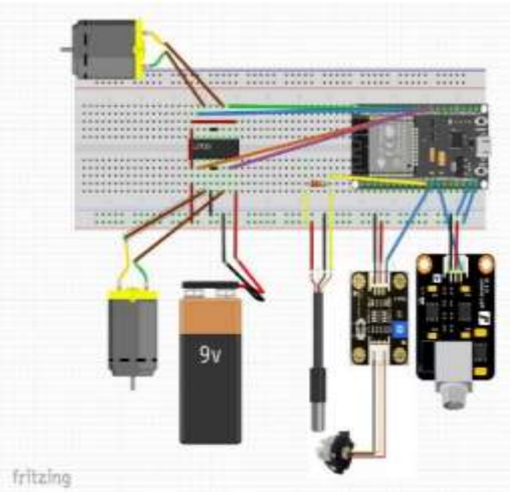
The sensors can be linked to the ESP32 once it has been properly configured. Sensors for temperature, turbidity, and pH should all be linked to the ESP32. The pH indicator measures the water's acidity level, which can range from zero to fourteen.

The turbidity of water can be measured with a turbidity meter. The device is able to determine the temperature of the water thanks to an integrated temperature sensor. Many sensors will be linked to various ESP32 ports. Until then, we will not have access to data from the various sensors. Connecting the sensors and the ESP32 via jumper wires allows them to communicate with one another. The sensors are linked to the correct terminals using jumper wires. The pH disables the functionality of any connected ESP32 pin. This is how the board is now linked to every single device.

The ESP32 is configured to analyze sensor data through the Arduino IDE. Errors in the code it generates are caught by the Integrated Development Environment (IDE). After compilation, the ESP32 receives the code. The ESP32 can read sensor data when the protocols have been uploaded. The data could be inaccurate if there is a mismatch between the schematic and the connection architecture of the sensor. To prevent this issue, be sure to thoroughly inspect the board's design and pins. For the sensor to collect data, it must be submerged in water. When they detect water, they connect to the ESP32. These numerical values will show you the exact degree of water haze. The numbers should be straightforward to get if everything is in line.

The ability to gather and display sensor data is crucial for the ESP32 module to establish an internet connection. Two distinct varieties of WiFi and Bluetooth are integrated within the ESP32 chip. The ESP32 communicates with the cloud to transmit the data. Data collection in this case takes place in the Thingspeak cloud. Information retrieved from the device is shown on the Thingspeak cloud.

By integrating Thingspeak's data with the accompanying analytical findings, an application can be created. To create an app, we will collaborate with the same developer that built the MIT app. With this software, the ESP32's sensors may collect data and measurements, which can then be accessed by the user.



An illustration of the "IoT Based Real Time Water Quality Monitoring System" project's components.

The system is built on top of the new idea of the Internet of Things, which is a concept in software development. There are two primary components: software and hardware. The hardware's built-in sensors make numerical measurements feasible in real time.The sensors can only provide accurate data if the connections adhere to the specified circuit design.

5. CONCLUSION AND FUTURE SCOPE

An inexpensive Internet of Things solution for quick water quality detection is suggested in this research. An operator is not necessary for the automated water quality testing performed by the low-cost apparatus. Many find this approach to water quality testing to be more practical, less expensive, and less complicated. This approach can be used in multiple ways.After the correct software package updates and sensor replacements have been performed, this system will be able to monitor new water quality indicators.

The method is simple to understand and implement. Expanding the system's capabilities could allow it to monitor a wider range of variables, including water levels, air pollution, and agricultural and industrial production.It is good for a number of reasons. Additional pertinent domains, such as environmental monitoring, cleanup, and wastewater treatment, will be added to the effort as it develops. There are a lot of potential applications for this strategy. The system's adaptability allows it to be tailored to fulfill the unique requirements of every user. To further improve the efficiency of PC data monitoring, it may be simply integrated with Lab View.

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