ENSURING CLEAN WATER: IOT-BASED SMART WATER QUALITY MONITORING SYSTEM WITH CLOUD INTEGRATION

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ABSTRACT: The "Internet of Things" (IoT) is a network of physical objects, such as cars, appliances, and household items, that have been outfitted with connectivity, actuators, software, and sensors to facilitate communication and information sharing. The quality of water is currently India's greatest environmental concern. Sewage provides a huge amount of clean water in India. Uncontrolled small-scale industrial and agricultural discharges pollute the majority of rivers, lakes, and surface waterways. Pollution from various sources also contributes to this. In traditional systems, the first stage of the monitoring procedure is the manual collection of water samples from various sites, followed by analysis and grading. It was easier to identify and view the water parameters with a desktop program after connecting the sensors to an Arduino Uno in a disassembly-friendly method. Water quality must be regularly checked to guarantee that all bodies of water and water resources provide a safe supply of drinkable water. The use of IoT devices to continuously monitor water quality can improve the quality of life and health of all living creatures.
KEYWORDS: Internet of Things (IoT), Cloud computing, Cloud storage

I. INTRODUCTION

The twenty-first century brought many new ideas, but it also introduced pollution, global warming, and other issues. Pollution has made it difficult to find clean water around the world. Monitoring water quality in real time is difficult due to factors such as population growth, global warming, and a scarcity of water supplies. The tools for monitoring real-time water quality metrics need to be improved [1. The pH and other quality parameters of water determine the amount of hydrogen ions present. It tells you whether the water is acidic or basic. Water with a pH of 7 or higher is alkaline, while water with a pH below 7 is acidic. pH levels range from 0 to 14, with 6.5 to 8.5 being the ideal range for humans to drink. It is impossible to express in words how water affects all living things. Water management is becoming increasingly important as the world's population grows rapidly, particularly in the industrial, agricultural, and other sectors. Many people around the world do not have access to clean water. It is estimated that many people die each year from dangerous diseases spread by contaminated water. According to studies, contaminated drinking water is the leading cause of death for approximately 5 million people each year. According to World Health Organization studies, providing children with access to clean water could prevent more than 1.4 million child deaths. The primary goal of this project is to connect an intelligent water quality monitoring device to an IoT platform. This technology will enable machines to monitor the various physical properties of drinking water, eliminating the need for humans to do so. The Internet of Things can also be viewed as a network of devices capable of sending and receiving data over a network. Effective wastewater management is not a luxury in today's world; it is a necessity. A stream with excessive basic or acidic H+ or OH- ion activity can harm or kill stream creatures by disrupting their biochemical processes. pH is a critical chemical limit for aquatic life. The Internet of Things (IoT) requires a controller, sensors, actuators, and a physical object. The Internet of Things is a critical component of Industry 4.0. Actuators and sensors are devices that collect data from their surroundings and interact with real-world objects. Actuators and sensors generate movements that can be observed by interpreting electrical impulses. Internet of Things (IoT) devices generate massive amounts of valuable and important data that must be analyzed, organized, and stored. Thus, using IoT technology would alert the user to the possible presence of a water pollutant through a steady stream of unusual readings. The goal of this project is to use the Internet of Things to intelligently monitor water quality. Temperature, pH, conductivity, and other physical properties of various water samples can be measured using these different devices, each equipped with an Arduino Uno and a NodeMCU. As part of the.NET framework, a desktop program is developed to determine whether the water samples being examined are safe to drink.

II. LITERATURE SURVEY

R. Kumar and several others. and S. Singh. "IoT-Based Water Quality Monitoring System: A Review" (2021) examines the field of IoT-based water quality monitoring systems to determine what is new, what the issues are, and

where it is likely to go in the future. These systems' transmission protocols, sensor technologies, and data analysis methods are examined in detail.

Park, H., Lee, S., and Kim, J. wrote the research paper "Development of an IoT-Based Water Quality Monitoring System for Sustainable Water Management" (2020). describes the development of an Internet of Things-based water quality monitoring system to promote environmentally friendly water management practices. Because it includes wireless communication and sensor modules, the system is capable of performing real-time parameter analysis and water quality monitoring.

Singh A., Gupta R., and Mishra S. The 2019 "Design and Implementation of a Low-Cost IoT-Based Water Quality Monitoring System" project aims to develop and build a water quality monitoring system that uses few resources and is inexpensive. The system makes use of low-cost sensors and open-source Internet of Things tools to ensure its widespread use.

The 2018 article "Wireless Sensor Network-Based IoT System for Real-Time Water Quality Monitoring" by Patel D., Shah D., and Patel R. provides an overview of an IoT system that uses a wireless sensor network to monitor the quality of water in real time. The system uses cloud-based analytics to make real-time decisions, while distributed sensor nodes collect data on a variety of water quality indicators.

The 2017 publication "Integration of IoT and Machine Learning for Autonomous Water Quality Monitoring System" by Zhang, L., Wang, Y., and Li, X. examines how machine learning and the Internet of Things (IoT) can be combined to create an autonomous system for monitoring water quality. The system employs advanced analytics to predict water quality trends and outliers, allowing for more effective proactive management methods.

Chen Y, Wu Q, and Liu Z. "IoT-Based Smart Water Quality Monitoring and Management System" (2016) This study paper discusses a system that uses the Internet of Things to improve water resource management by increasing its effectiveness and efficiency. Sensor networks, cloud computing, and data display tools are used by the system to monitor and analyze events in great detail.

Gupta, P., Sharma, A., and Kumar, V.'s 2015 paper "Development of a Scalable IoT Platform for Water Quality Monitoring" describes how to create a large-scale IoT platform that can be used to measure water quality in multiple locations. The platform employs peripheral computing and cloud technology to process and analyze data in real time.

M. M.Islam Hasan and M. Rahman's 2014 paper "An IoT-Based Water Quality Monitoring System for Aquaculture Industry" describes a system that uses the Internet of Things to monitor water quality in the aquaculture industry. The system consists of monitors that monitor critical aspects of water quality in aquaculture ponds. This provides fish farmers with valuable information for improving the health and productivity of their fish.

S. Ghosh, T. Saha, & S. Das. (2013). The goal of the study paper "Design and Implementation of a Remote IoT-Based Water Quality Monitoring System" is to use the Internet of Things to create a system that can monitor water quality from a distance or in difficult-to-access locations. By combining satellite connectivity with solar power, the technology enables remote areas to function independently.

Li, Zhang, and Wang authored the 2012 academic paper "IoT-Enabled Water Quality Monitoring System for Urban Infrastructure Management". describes an Internet of Things-based water quality tracking system designed to simplify urban infrastructure management. The system includes geographic information systems (GIS) and sensor networks, allowing for real-time tracking and spatial analysis of water quality measures. This enables people to make better decisions.

III. SYSTEM ANALYSIS
EXISTING SYSTEM

Modern water quality monitoring systems primarily rely on traditional methods that require collecting and analyzing water samples in a lab, which is time-consuming. The current systems are not very good at monitoring and responding in real time. Sensor technologies, such as those developed by Xylem and Hach, are frequently used in commercial water quality monitoring devices. However, they may not be as user-friendly or smooth as systems based on the internet of things. The IoT-based Smart Water Quality Monitoring System may be superior to traditional methods due to its efficiency and constant monitoring. The proposed project aims to address these issues by leveraging Internet of Things (IoT) technologies to facilitate real-time data collection, processing, and display. This will allow the team to be more adaptable and dynamic when dealing with water quality issues.

DRAWBACKS

Limited Real-Time Monitoring: Existing water quality monitoring systems relying on manual sample collection and laboratory testing lack the capability for continuous, real-time monitoring, which may result in delayed detection of water quality issues.

Lack of Connectivity and Accessibility: Traditional monitoring approaches often lack seamless integration and accessibility, making it challenging to remotely access and analyze water quality data, hindering timely decision-making and responses to emerging environmental challenges.

Restricted Real-Time Monitoring: Current methods of monitoring water quality cannot always provide real-time monitoring because they rely on people collecting samples by hand and testing them in a lab. As a result, water quality issues may go unnoticed for an extended period of time. 2. Poor Connectivity and Accessibility: Older tracking methods frequently struggle with connectivity and accessibility, making it difficult to collect and analyze water quality data from a distance. This situation makes it difficult to respond to new environmental risks and make quick decisions.

PROPOSED SYSTEM

The proposed IoT-based Smart Water Quality Monitoring System looks at water quality in a new and dynamic way, addressing issues with existing systems. The system under consideration uses Internet of Things (IoT) technology to constantly monitor water factors. This is accomplished by combining sensors with an Arduino-uno, as opposed to traditional methods that require samples to be collected manually and analyzed in a laboratory. The data is sent and viewed via a desktop program, making it simple and quick to gain an overview of the factors influencing water quality. Using this method ensures a more proactive response to potential problems, allowing you to act quickly to protect water resources. The methodology addresses the issues with traditional monitoring systems while also recognizing the importance of having a consistent connection and being easy to use. Using the Internet of Things, the proposed system provides an automatic and effective smart solution for managing water quality, thereby protecting the environment and improving people's health.

BENEFITS

1. The proposed Internet of Things (IoT)-based Smart Water Quality Monitoring System allows for continuous, real-time monitoring, ensuring that any changes in water factors are detected and addressed quickly.

2. The addition of Internet of Things (IoT) technologies to the system improves access to information about water quality. This enables people to evaluate data and make decisions from a distance, ultimately improving water resource management.

BLOCK DIAGRAM
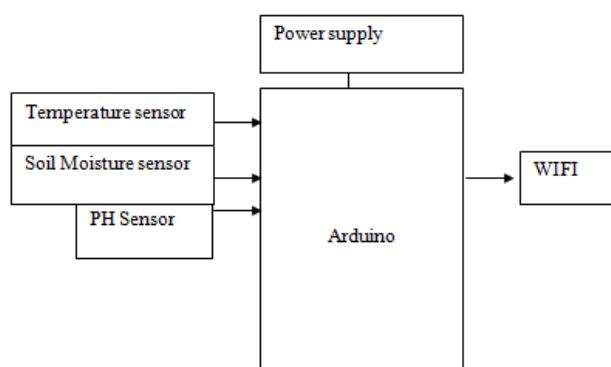
This block diagram depicts three important devices. Using IoT technology, it is possible to guess whether the water is safe to consume. The device is comprised of sensors that detect temperature, pH, and soil moisture. This system relies heavily on its sensors.

1. **Test for Pure Water**

In the first step, a water sample is collected from the sensor tank and placed in the tank. This is done tensure that the sample's pH value is within an acceptable range of 7. If this happens, the water can be used to drink and clean food. This is when the number will appear in the web browser.

2. **Test for Salt water**

A sample of river water is taken and a pH tester is placed in it. After converting the data from the pH conversion board to a pH scale, the result is entered into an Arduino Uno. The pH number is shown next to the temperature in degrees Celsius.

3.Test for Plant Pot Water

The results of the evaluation conducted after water was withdrawn from plant containers were displayed in a web browser. A wide range of sensors, including soil moisture, pH, and temperature, were used to evaluate the sample. The moisture content of the soil indicates the amount of water present, whereas temperature monitoring is used to protect the plant's nutrients.

IV. HARDWARE TOOLS
- ARDUINO UNO
- TEMPERATURE SENSOR
- SOIL MOISTURE SENSOR
- PH SENSOR
- LCD
- WIFI (ESP8266)
- RPS

1. ARDUINO UNO:

The Arduino Uno is the most popular version of the platform. Most people understand that the term "Ardunoid" refers to this particular board. The Uno is popular, and it is an excellent choice for those who are new to Arduino. The following section discusses the latest version of the Arduino Uno, known as Rev3 or R3.

The ATmega328 processor powers the microcontroller platform Arduino Uno. It includes a 16-MHz ceramic resonator, a USB connector, a power port, an ICSP header, six analog inputs, fourteen digital input/output pins (six of which can be used to generate PWM outputs), and a stop button. Because it includes everything you need to function as a microprocessor, all you have to do to get started is plug it into a computer or power it with a USB cable.
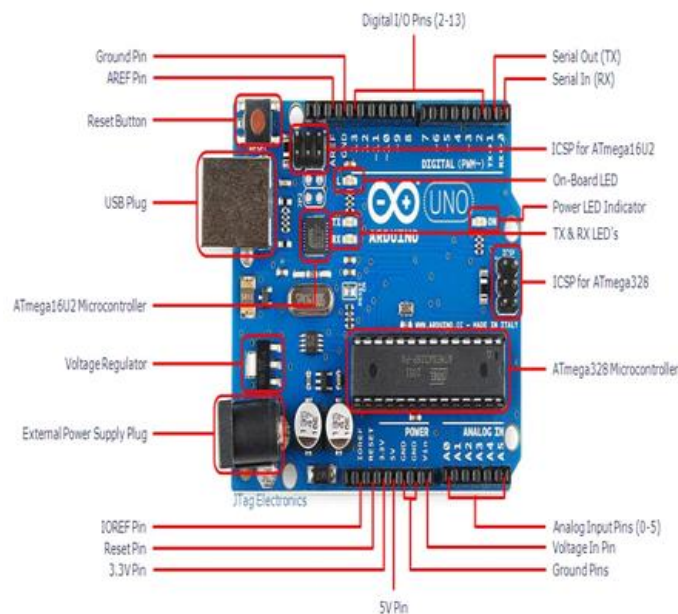
Arduino Uno Board

2. Temperature sensor:

Temperature is the most frequently measured environmental variable. Given that temperature affects the vast majority of mechanical, chemical, electrical, and biological systems, this is understandable. Temperature ranges work best for specific chemical reactions, biological processes, and electrical circuits. Given that temperature is one of the most frequently monitored variables, the presence of multiple monitoring methods is not surprising. Temperature can be sensed remotely via radiant energy, eliminating the need for direct contact with the thermal source or the source itself. Currently, a wide variety of temperature sensors are commercially available. These include RTDs, thermoistors, thermocouples, infrared sensors, and
semiconductor sensors.
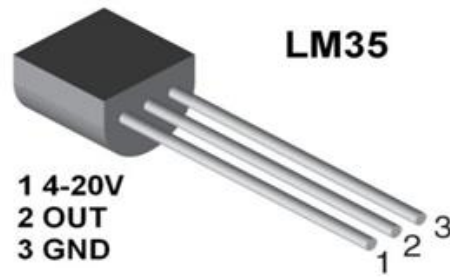
3. SOIL MOISTURE SENSOR:

Soil moisture sensors measure the volumetric water content of the soil. Soil moisture monitors use a soil parameter, such as electrical resistance, dielectric constant, or neutron interaction, to estimate moisture content and indirectly measure volumetric water content. This is because, in order to determine free soil moisture using direct gravimetric methods, a sample must be removed, dried, and weighed.

The relationship between the measured property and soil moisture must be calibrated, as it can change depending on environmental factors such as soil type, temperature, and electric conductivity.

The moisture level in the soil has a significant influence on the reflected microwave radiation.

Sensing is used in both hydrology and agriculture. Gardeners and farmers alike can use portable probing tools. Soil moisture sensors are also known as volumetric water content monitors. Gypsum blocks and tensiometers are two examples of a distinct type of sensor used to measure water potential or another moisture-related feature in soil. The common term for these sensors is "soil water potential sensors."
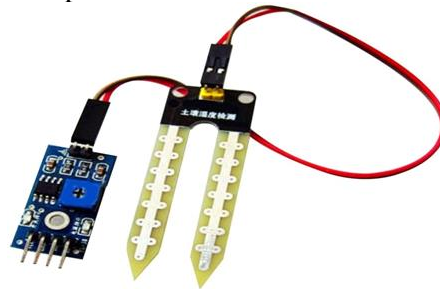
PH SENSOR:

pH sensors, which are commonly used in water quality surveillance, are among the most important instruments for determining pH. These sensors monitor the acidity and alkalinity levels of water and other liquids. When used properly, pH sensors help to ensure the quality and safety of products and operations in effluent treatment plants and manufacturing facilities.

The standard pH range is commonly represented by the number 14. A substance is considered neutral if its pH is 7. Acidic substances have a pH of 7 or lower, whereas alkalinity increases with a pH of 7 or higher. For example, the pH of toothpaste is typically between 8 and 9. However, stomach acid has a pH of 2.

Companies that use furnaces, cooling towers, pool control, manufacturing processes, or other environmental monitoring equipment must be fully aware of the distinction between alkaline and acidic materials. Normal physiological function requires a pH of 7.4, which is found in the human body. An excessively acidic or alkaline pH level in the body seeks to return to neutral.

4 TYPES OF PH SENSOR

The pH sensor allows for the maintenance of the process's optimal pH level, regardless of the application. This could be a very strong acid or a caustic base. Liquid measurement applications can make use of a variety of pH sensors, including differential, combination, laboratory, and process pH.

1.Combination pH monitors use a measuring electrode in addition to a reference electrode. The measurement electrode detects pH variations, whereas the reference electrode provides a consistent signal.

2.A differential sensor has three electrodes, one of which is a metal ground electrode. They are distinguished by their ability to prevent reference contamination.

Lab sensors can be made by combining sensors encased in plastic housings and glass with a diameter of 12 mm. These sensors are designed for less demanding applications like environmental sampling and pool monitoring.

4.Process pH sensors are housed in a large, durable housing with process connections to enable continuous pH monitoring. They originate from composite sensor components.

A wide range of pH sensors find use in a variety of applications, with pH assessments accounting for more than 25% of all quality-related metrics used in process control. Reliable pH transmitters and sensors are critical for maintaining process safety and optimizing plants. Our diverse product line includes solutions for hazardous environments, water treatment applications, viscous media, consistent processes, and media compositions that change frequently. Click the icons below to learn more about our transmitters, meters, calibration, and system solutions for plastic and glass pH monitors.

5. WIFI (ESP8266):

This ESP8266 lesson will teach you how to control an LED from a distance using an ESP-01 module. The ESP8266 is a low-cost yet extremely useful internet-based communication tool. It is also simple to put into action using an Arduino. This ESP8266 tutorial will teach you everything you need to know to control any electrical device from anywhere in the world using the internet.
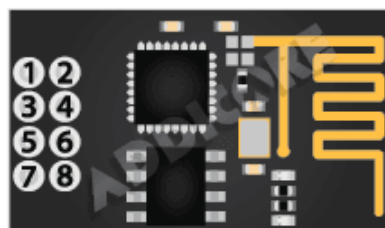

The web server for remote LED control will be built using the Arduino IDE, and the ESP8266 ESP-01 module will be programmed with a USB-to-TTL converter. If you have recently purchased your module, you can also refer to my previous ESP8266 lesson to learn how to use the ESP-01 WiFi module. The video also demonstrates how to configure the ESP8266 and ensure that a link can be established with another device without the use of a USB-to-TTL converter.

6. RPS:
POWER SUPPLY:
Every digital circuit requires a power source that can be controlled. This article will describe how to obtain a controlled positive supply from the main supply.
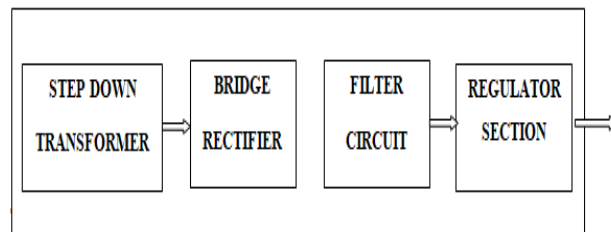
In addition to a gas sensor, this investigation used a thorough analysis of temperature, moisture, adhesive concentration, and light strength as fundamental sensors. In child care facilities, it is common to monitor environmental conditions using a suitable smartphone app. The NodeMCU esp8266 communicates information between the desktop and the phone. This mechanism reduces physical activity levels. This tool is useful in home stores, nurseries, and plant fields.

V. CONCLUSION
The greenhouse control and power system based in Arduino is master mind. DHT11 sensor Gas sensor and the fundamental sensors used in this experiment include a thorough assessment of temperature, dampness, adhesive content and light strength. This method is popular in children's nurseries to monitor and monitor ecological parameters using a reasonable smartphone application. NodeMCU esp8266 is used for sending the phone information and desktop information. This procedure decreases physical activity. In plant fields, nurseries, and homecenters, this machine can be used.

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