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WATER QUALITY MANAGEMENT SYSTEM USING ESP32

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ABSTRACT

This project presents the development of an embedded system for water quality management utilizing the ESP32 microcontroller platform. The system integrates multiple water quality sensors to monitor essential parameters such as pH, Turbidity, NH3 Ammonia gas level, and Water Level in real-time, the system ensures the safety and quality of water in real-time, suitable for both industrial and domestic applications. The collected data can be transmitted to a central server or displayed locally for analysis and visualization. The embedded nature of the system allows for compact and efficient deployment in various environments, facilitating continuous monitoring of water quality. Through this project, we aim to provide a cost-effective and scalable solution for water quality assessment and management, contributing to sustainable water resource management practices.

Keywords: **Water Quality Management, Water Level, Wi-Fi, Cloud, Water parameters**

I INTRODUCTION

Water plays a vital role in the creation of human beings and other natural phenomena. About 80% of diseases in the developing country are caused by the consumption of polluted water. As we all know, water is not only used for drinking purposes, it has other uses too such as; economic aspects, industrial sites, agriculture, fishing, and other constructive activities. The quality of water is mainly affected by physical, chemical, and biological aspects.

The main sources of water are lakes, rivers, glaciers, groundwater, rainwater, etc. Water is available in every part of the earth whether it is polluted or not. About 80 percent of Earth's land is covered by water. In our day-to-day life water plays one of the most important roles for living beings on earth. Quality of water is getting very serious attention in our generation. So, to live a healthy and prospective life, checking the water quality is very important.

In the past, water quality has been measured by taking the water samples and sending them to the laboratories, and examining them, which is very costly, time-consuming, and involves more human resources. This process will not provide real-time data and lead us to the impure quality of water. The proposed water quality monitoring systems consisting of a microcontroller with common sensors are compact and very useful for pH, turbidity, conductivity, water level detection, temperature and humidity of the atmosphere, continuous and real-time data.

This thesis aimed to design the water quality monitoring system using smart sensors, microcontrollers, and wireless systems. Although any definite result was not obtained due to the constraints of the environment, the possibility to get good quality measurement data wirelessly to any system was realized. ATmega2560 and NodeMCU ESP32 are the components that can build the theoretical water quality monitoring system.

II LITERATURE SURVEY

A. Jayti Bhatt, Jignesh Patoliya, Iot Based Water Quality Monitoring System, IRFIC, 21feb,2016.

Jayti Bhatt, Jignesh Patoliya entitled "Real Time Water Quality Monitoring System". This paper describes to ensure the safe supply of drinking water the quality should be monitored in real time for that purpose new approach IOT (Internet of Things) based water quality monitoring has been proposed. In this paper, we present the design of IOT based water quality monitoring system that monitor the quality of water in real time. This system consists some sensors which measure the water quality parameter such as pH, turbidity, conductivity, dissolved oxygen, temperature. The measured values from the sensors are processed by microcontroller and these processed values are transmitted remotely to the core controller that is raspberry pi using Zigbee protocol. Finally, sensors data can view on internet browser application using cloud computing.

B. Nikhil Kedia entitled "Water Quality Monitoring for Rural Areas-A Sensor Cloud Based Economical Project."

Published in 2015 1st International Conference on Next Generation Computing Technologies (NGCT-2015) Dehradun, India. This paper highlights the entire water quality monitoring methods, sensors, embedded design, and information dissipation procedure, role of government, network operator and villagers in ensuring proper information dissipation. It also explores the Sensor Cloud domain. While automatically improving the water quality is not feasible at this point, efficient use of technology and economic practices can help improve water quality and awareness among people.

III EMBEDDED SYSTEMS

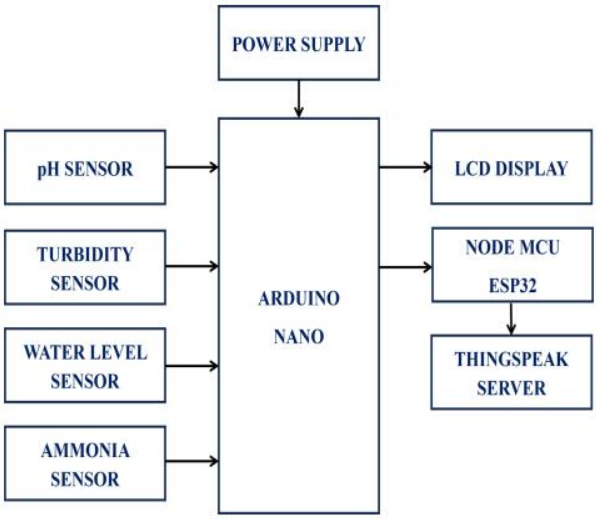
An embedded system is a microprocessor-based computer hardware system – a combination of a computer processor, storage medium (eg: RAM) and input/output peripheral devices – which form part of an independent or larger mechanical or electrical system, device or machine.

Within these products, an embedded system contains sequentially executed software that is designed to perform a dedicated function, a limited number of tasks or group of specific tasks such as: sampling sensor values, registering a button press or communicating with a PC. Its purpose is to control a device and allow a user to interact with it.

At the core of an embedded system is an integrated circuit (IC) designed to carry out computation for real-time operations. Complexities range from a single microcontroller to a suite of processors with connected peripherals and networks; from no user interface to complex graphical user interfaces. The complexity of an embedded system varies significantly depending on the task, application and environment for which it is designed.

IV PROPOSED SYSTEM

The main components that the proposed system consists of are transformer, Rectifier, voltage regulator, pH sensor, turbidity sensor, water level sensor, ammonia sensor, LCD and ESP32 (node MCU).



A water quality management system using ESP32 typically works by integrating sensors to measure various parameters of water quality, such as pH level, turbidity, NH3

ammonia and water level. The microcontroller then collects data from these sensors and processes it to assess the quality of the water. Here's a general overview of how such a system might work:

1. Sensor Integration: Various sensors are connected to the microcontroller. These sensors may include pH sensors, turbidity sensors, NH3 ammonia sensors, etc. Each sensor is responsible for measuring a specific parameter of water quality.

2. Data Acquisition: The Arduino Nano reads data from these sensors at regular intervals. It may use analog or digital inputs, depending on the type of sensor and its interface.

3. Data Processing: Once the sensor data is acquired, the Arduino Nano processes it to ensure accuracy and reliability. This may involve calibration (if required) and conversion of raw sensor readings into meaningful units.

4. Data Analysis: The processed data is then analyzed to determine the quality of the water. This analysis may involve comparing the measured values against predefined thresholds or standards set for different water quality parameters.

5. Communication: Based on the analysis, The ESP32 can be equipped with communication modules such as Wi-Fi module to transmit the data to a remote server i.e., ThingSpeak or display it on a local interface i.e., LCD. This enables real-time monitoring and remote management of the water quality.

6. User Interface: A user interface, which could be a web dashboard, a mobile app, or an LCD display, allows users to view the real-time data and system status. They can also configure settings and receive alerts if any parameter deviates from the acceptable range.

Overall, the ESP32-based water quality management system provides an efficient and cost-effective solution for monitoring and maintaining the quality of water in various applications such as drinking water supply, aquaculture, environmental monitoring, and industrial processes.

V CASE STUDY

The project is performed on the various cases like outside water, drinking water and mud water. The results are as follow:

Case 1: Test results of Outside Water

Case 2: Test results of Drinking Water

Case 3: Test results of Mud Water

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ThingSpeak Data Storage:

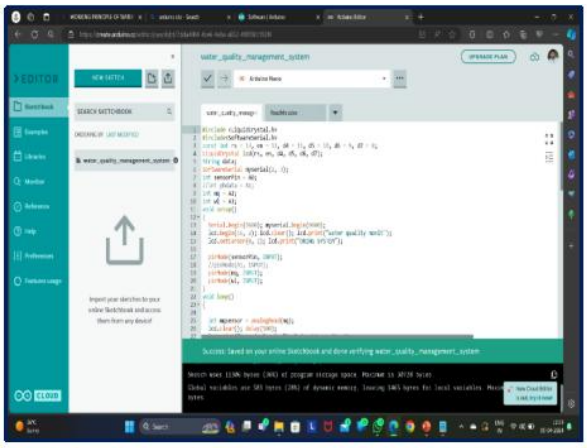
Fig: ThingSpeak Server Test Results Data Storage

be equipped with communication modules such as Wi-Fi module to transmit the data to a remote server i.e., ThingSpeak (or) Arduino Nano will display it on a local interface i.e., LCD. This enables real-time monitoring and remote management of the water quality.

VI SOFTWARE USED

After learning about the main parts of the Arduino UNO board, we are ready to learn how to set up the Arduino IDE. Once we learn this, we will be ready to upload our program on the Arduino board.

1. **Download and Install Arduino IDE:** If you haven't already, download and install the Arduino IDE (Integrated Development Environment) from the official Arduino website: https://www.arduino.cc/en/software.



2. Connect your Arduino Nano: Plug your Arduino Nano into your computer using a USB cable. Make sure the cable is firmly connected to both the Arduino Nano and your computer.

3. Select Board and Port: Open the Arduino IDE. In the Tools menu, under the Board

Fig: Arduino IDE Setup in PC

submenu, select "Arduino Nano." Then, under the Port submenu, select the port that your Arduino Nano is connected to. If you're not sure which port to choose, you can check in the Device Manager (Windows) or System Information (Mac).

4. Test Connection (Optional): To make sure everything is set up correctly, you can upload a simple sketch to your Arduino Nano. Open the "Blink" example sketch (File -> Examples -> 01. Basics -> Blink). This sketch will make the onboard LED on pin 13 blink on and off. Click the "Upload" button (the right arrow icon) in the Arduino IDE toolbar. If the upload is successful, you should see the LED on your Arduino Nano blinking.

5. Start Programming: Now you're ready to start writing your own Arduino sketches! You can find plenty of tutorials and examples online to help you get started with different projects and components.

VII CONCLUSION

In conclusion, water quality management plays a crucial role in environmental management by providing information on the chemical, physical, and biological characteristics of water bodies. It is critical for ensuring the safety of water for human consumption and for the preservation of aquatic ecosystems. There are various methods, such as chemical analysis, physical analysis, biological analysis, remote sensing, and citizen science, are used to monitor water quality, each with its own strengths and limitations. However, the use of a combination of methods is necessary to get a comprehensive understanding of water quality and its changes over time. Despite the challenges and limitations, it is important to continue improving and developing these methods for accurate and reliable water quality measurement. This information is essential for effective water management policies, public health protection, and preservation of ecosystems.

In the past, water quality has been measured by taking the water samples and sending them to the laboratories, and examining them, which is very costly, time-consuming, and involves more human resources. Through this project, we aim to provide a cost-effective and scalable solution for water quality assessment and management, contributing to sustainable water resource management practices. The embedded nature of the system allows for compact and efficient deployment in various environments, facilitating continuous monitoring of water quality.

VIII FUTURE SCOPE

We can add more sensors to cover the water quality more extensively.

- **Chlorine Sensor:** Monitoring free chlorine, chlorine dioxide, total chlorine, and free bromine in various water sources.
- **Conductivity Sensors**: Indicate the water's ability to conduct electricity.
- **Dissolved Oxygen Sensors:** Quantify the amount of oxygen dissolved in the water.

Also, we can add the feature to control the water supply to each flat depending upon user water usage.

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