International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 05 | May - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

Smart Remote Control for Water Pollution Monitoring

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ABSTRACT

Water pollution is a serious environmental issue which is mainly caused by industrial waste, harmful chemicals, and other contaminants. The good quality of water is essential for the survival of plants, animals, and humans. Traditional water quality monitoring methods involve manual sample collection and laboratory analysis, which are time- consuming and inefficient. To overcome these limitations, we propose an **IoT-based water quality monitoring system** for real-time assessment of water bodies.

The proposed system measures various parameters like pH, turbidity, temperature, and humidity using sensors and determines whether the quality of water is good or polluted. It also provides recommendations on suitable aquatic flora and fauna based on the recorded values. The sensors are mounted on a self- navigating boat, which moves over the water surface to collect real-time data. A propeller system enables forward motion, while a servo motor mechanism allows directional control via a joystick-controlled mobile application.

Key Words: Arduino Nano, pH, turbidity, temperature, humidity, flora, fauna, Adafruit.

I. INTRODUCTION

Water is a fundamental resource that sustains life, supports ecosystems, and drives economic and social development. It is essential for agriculture, industry, and daily human activities. However, increasing pollution from industrial waste, agricultural runoff, and chemical contaminants poses a significant threat to water quality. Excessive use of fertilizers, pesticides, and poor waste management practices further degrade aquatic ecosystems, affecting both human health and biodiversity. Additionally, rapid urbanization and climate change have intensified water pollution challenges. Ensuring clean and safe water requires effective monitoring and proactive measures.

II. LITERATURE SURVEY

Water quality monitoring of the water bodies requires a lot of effort as operators need to get in a boat with all sensors and manually check the entire lake. So we here design a solution for easy water quality checking of vast water bodies with ease. This RC boat will help to measure the pH level and turbidity level. This will further helpus to maintain the water clean. This project is remote-operated and controlled by an RC remote using which it can be accordingly, a motorized propeller system to provide the forward propulsion and servo motor arrangement to provide with the steering using a rudder. Additionally, we have two sensors to determine water quality, we include PH sensors as well as turbidity sensor. These sensors will detect the presence of suspended particles in the water.

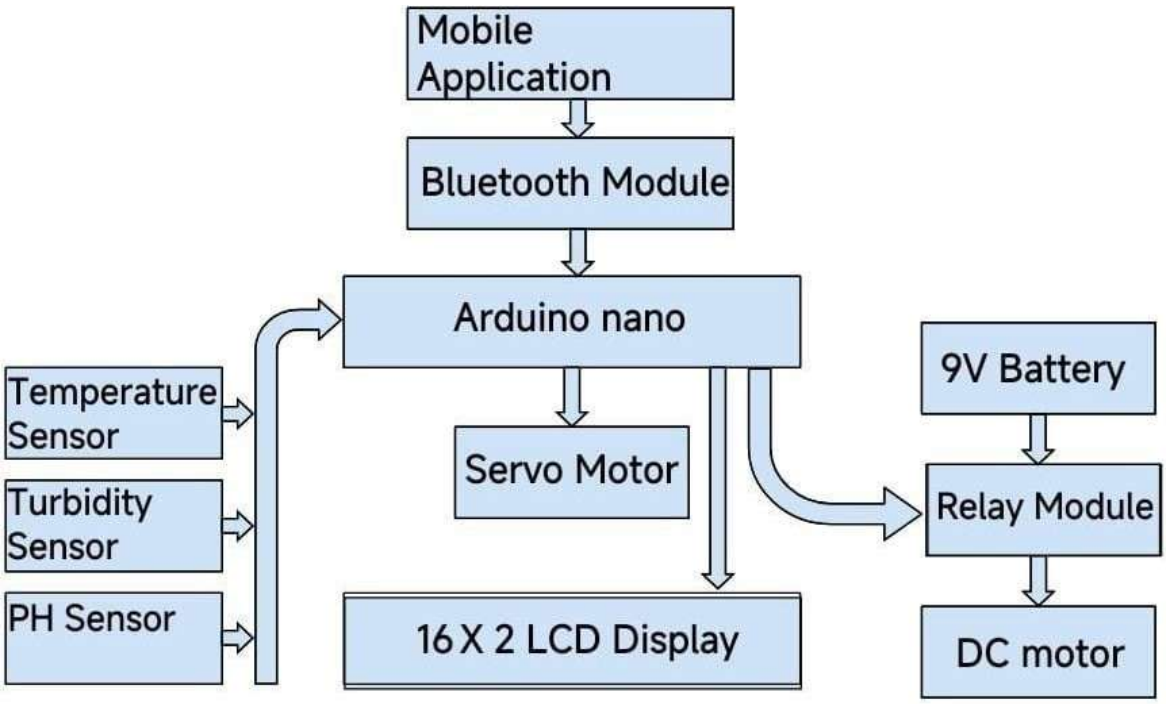
III. METHODOLOGY

This section outlines the fundamental principles of real-time IoT-based water quality monitoring. The system is designed to measure key water parameters, process the collected data, and provide real-time insights using IoT technology.

Section 3.1 presents the general block diagram of the proposed system, illustrating the overall architecture, sensor integration, and data flow from sensor nodes to the IoT platform.

Section 3.2 provides a detailed explanation of each component, including sensors, microcontrollers, wireless communication modules, and the cloud-based data storage and visualization system.

3.1 Block Diagram



In the proposed system, the sensors such as pH, turbidity, temperature and humidity are connected to the core controller as shown in figure 1. To transfer the data over the internet, the core controllers access the sensor values and process them. The Arduino Nano is used as a core controller. The sensors are also connected to the ESP8266 Wi-Fi module to display the data on the IOT Adafruit server.

The proposed system is subdivided into two parts Water Quality Monitoring System
Remote Navigation System

3.2 Water Quality Monitoring System

The first phase of implementation includes the monitoring of water parameters by using sensors such as pH sensor, turbidity sensor, temperature and humidity sensor. The sensors and GPS module are interfaced with the Arduino Nano and ESP8266 Wi-Fi module. The L298N motor driver is connected to the Arduino Nano. This whole setup is interfaced in the boat. Because the characteristics that the sensors are reading from the water bodies are analogue, they must be

transformed into digital form before the processor can process the data. After being processed, the data may be viewed on the IOT Adafruit website. Figure shows the implementation of water quality monitoring system using RC boat.

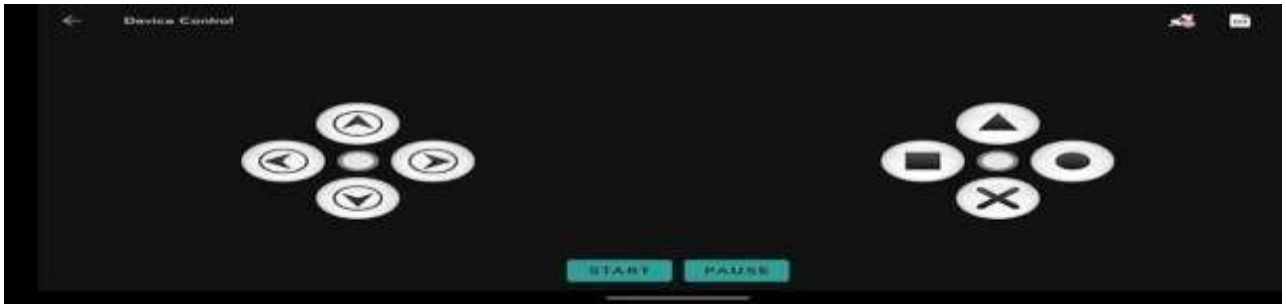
3.3 RC Boat

Here design a solution for easy water quality checking of vast water bodies with ease. This RC boat will help to measure the pH level and turbidity level. This will further help us to maintain the water clean. This project is remote-operated and controlled by an RC remote using which it can be maneuvered accordingly, a motorized propeller system to provide the forward propulsion and servo motor arrangement to provide with the steering using a rudder. As per the commands received by the RC receiver the controller operates the DC motor which

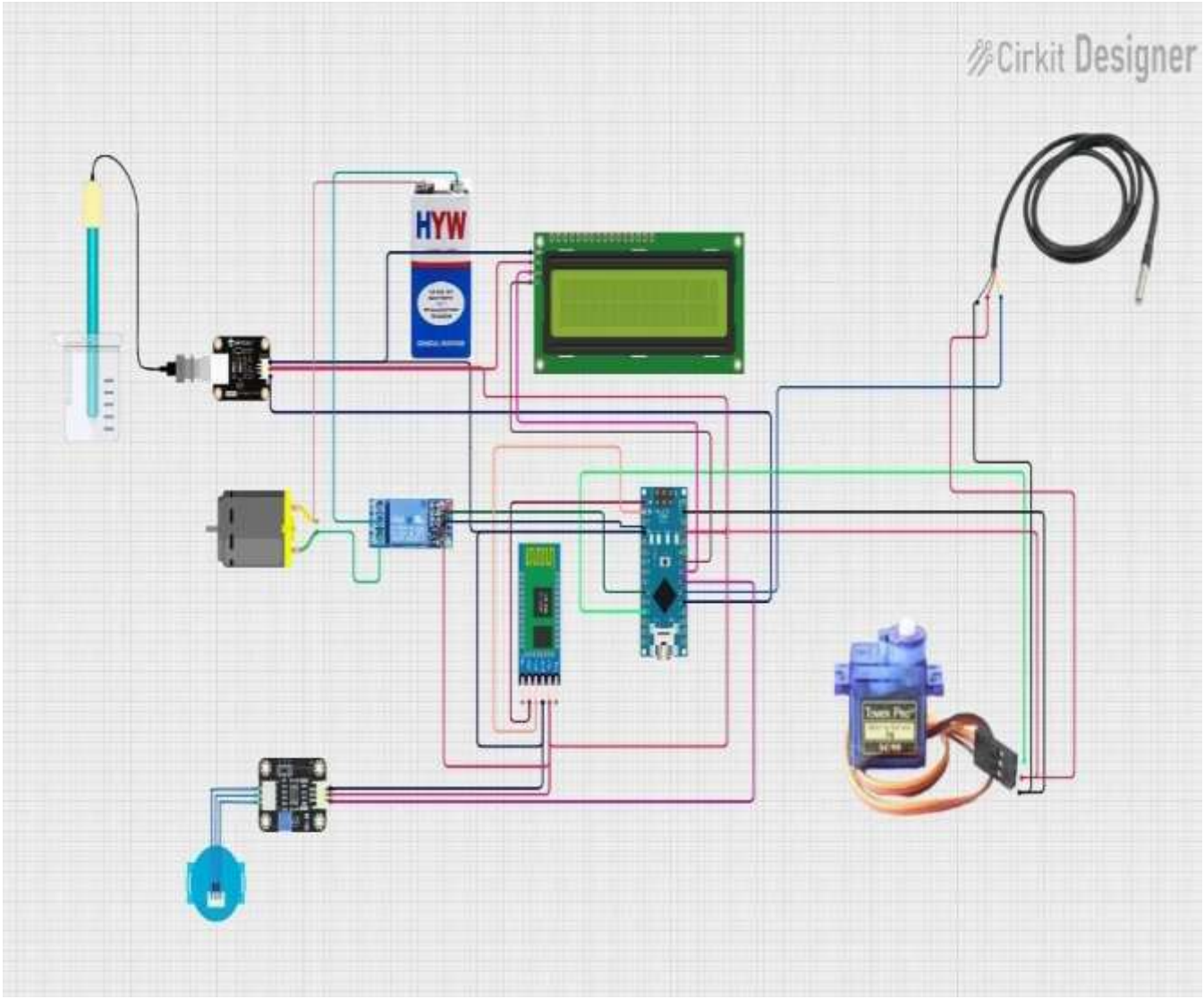
rotates the propeller through a flexible bearing and shaft. Now we have an a rudder attached to a servo motor used to steer the boat as per controller instructions.

3.4 Remote Navigation System

The second phase of implementation includes connecting the boat to the Bluetooth module and then interfacing it with the mobile application. Then the boat is controlled using the mobile application. The values of the water quality parameters and the graphs are displayed on the IOT Adafruit web server. Also, the position of the boat is obtained on the web server by using the GPS module. Based on the sensor values, the quality of the water is determined and classified as fresh water, slightly polluted water, or polluted water.



3.5 Circuit Diagram



3.5 Components :

Arduino Nano:- The Arduino Nano is a small, breadboard-friendly microcontroller board based on the ATmega328P or ATmega168. It's designed for electronics enthusiasts and hobbyists, offering a compact and versatile platform for a variety of projects, including prototyping, DIY projects, and robotics.

Relay Module:- A relay module is an electronic switch that allows a low-power circuit to control a higher-power circuit. It acts as an interface, receiving a low-power control signal and switching on a higher-power device. This enables things like controlling a large motor with a small microcontroller signal.

pH Sensor: Measures the acidity or alkalinity of the water.

Servo Motor Arduino:-A servo motor is a type of motor that allows for precise control of rotation, typically to a specific angle, using a feedback system with a built-in potentiometer. With an Arduino, you can send a signal to the servo motor, telling it to move to a specific position (angle), and it will move smoothly and accurately to that positio

Turbidity Sensor: Measures water clarity by detecting suspended particles.

Temperature Sensor: Monitors the water temperature.

16x2 LCD Blue with I2C :- A 16x2 LCD screen, especially when paired with an I2C module, simplifies displaying data on a small, character-based display for Arduino projects. The I2C module acts as a bridge, converting the

I2C protocol (two wires, SDA and SCL) into the commands the LCD needs

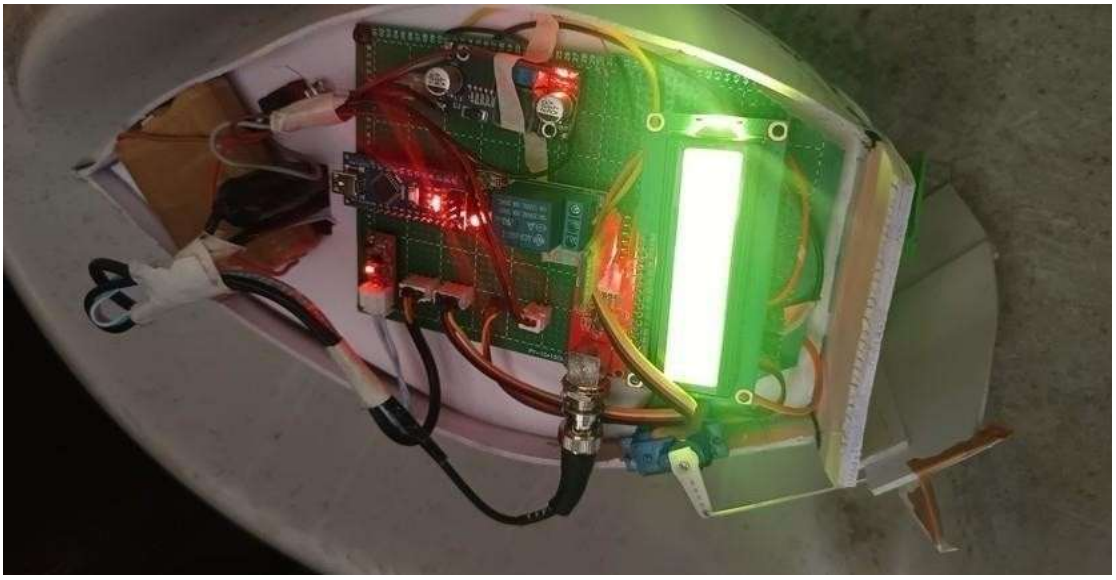
HC-05 Bluetooth Module:-The HC-05 is a popular and versatile Bluetooth module used for wireless serial communication, offering a simple way to connect microcontrollers and other devices over Bluetooth**.**

Battery: Typically a **Li-Ion** or **Li-Po** battery pack to power the motors, sensors, and electronics. Function: Supplies power to the entire system. For extended operation, especially useful for longterm monitoring missions.

Dc Motor:- A DC motor is an electrical machine that converts direct current (DC) electrical energy into mechanical energy, typically rotary motion.

IV. WORKING

When we switch on the toggle switch and place it in water, the sensors, such as the pH sensor and the turbidity sensor, get initialized. Then, by turning on Bluetooth on the mobile phone, the mobile application gets connected to the RC boat with the help of the Bluetooth module. Then the boat is controlled using the joystick module present in the Arduino Bluetooth Controller application. When the boat is moving in the
water, the real-time data gets displayed on the Adafruit webpage with the help of the ESP8266 Wi-Fi module that is connected to the MQTT server. The Arduino Nano and the ESP8266 Wi-Fi module are connected with the help of an API key regenerated on the IOT Adafruit server. Now, the water quality is determined with the help of PyCharm using the logistic regression algorithm. Based on the water quality and the sensor values,
the aquatic flora and fauna will be displayed using the same logistic regression algorithm. The username of the Adafruit server and the regenerated API key are given to the Arduino IDE as well as the PyCharm IDE.
Also, the realtime location (latitude and longitude) and the graphs obtained on the web server.



V. RESULT

In the proposed system we have used a pH sensor to calculate the pH value of different water samples. The Ph values range between 0 and 14. The pH range of 5.5-6.5 is ideal for plant development because of the accessibility of supplements. Then, we used a turbidity sensor with the supporting module to calibrate the turbidity of the water as well as determine the total suspended solids in the water. The presence of high
turbidity levels limits the amount of light that can penetrate the water's surface. Plant growth is impacted because their capacity for photosynthesis is decreased. Hence, turbidity is an important factor.
Also, the DS18B20 temperature and humidity sensor is used to calculate the surrounding temperature as well as the water temperature. Aquatic life is influenced by water temperature, which also regulates the rate of metabolic and reproductive processes. The solubility of oxygen decreases as the water temperature rises.

VI. CONCLUSION

Proposed water quality monitoring RC boat system is economical and fast as it can monitor water quality automatically and doesn't require any human on duty other than controlling the boat. This system has been
proven to be capable of showing these physicochemical parameters as well as properly displaying these results through a variety of experiments in reservoirs, lakes, and personal water storage tanks.

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