Tinkering Lab Project

Water Monitoring Through Turbidity and pH Sensor

Group-7

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Introduction:

Water quality monitoring is essential for ensuring access to safe and clean water for human consumption and environmental sustainability. Two crucial parameters for water quality monitoring are Turbidity and pH. Turbidity is the measure of relative clarity of a liquid. It is an optical characteristic of water and is a measurement of the amount of light that is scattered by material in the water when a light is shined through the water sample. The higher the intensity of scattered light, the higher the turbidity, pH on the other hand is a measure of the acidity or basicity of water. In this report, we will discuss the importance of water monitoring through Turbidity and pH measurement, the methods used for their measurement, and their significance in water quality assessment.

Objectives:

Our project's main aim is to create a system in which we will be measuring the pH and Turbidity levels of water properly. According to those levels, we can segregate usage of water for different purposes.

- **Access water quality:** The quality of water can be determined by measuring the turbidity and pH levels in order to determine the level of pollutants and potential health risks.
- **Detects changes in water quality:** Helps to maintain and improve the quality of water by detecting changes in the turbidity and pH levels which helps us to take corrective actions as needed.

Materials Required:

- ESP32
- Turbidity sensor
- pH sensor
- pH electrode probe BNC connector
- Jumper wires
- Bread board
- LCD Display

- Distilled water - 250ml
- pH buffer powder (for calibration of pH sensor)

Turbidity sensor:

A turbidity sensor is a device that measures the amount of suspended particles, such as sediment or organic matter, in a liquid. Turbidity is a measure of the clarity of the liquid.

To convert turbidity readings into ppm (parts per million), you would need to know the specific gravity of the suspended particles in the liquid. This is because ppm is a measure of the mass of the particles per unit volume of liquid.

Assuming you know the specific gravity of the particles, you can use the following equation to convert turbidity in NTUs to ppm:

ppm = NTUs x (specific gravity of particles) / 1,000

pH sensor:

A pH sensor is a device used to measure the acidity or alkalinity of a solution. The pH of a solution is a measure of the concentration of hydrogen ions (H+) in the solution. pH is expressed on a scale from 0 to 14, where 0 is the most acidic, 14 is the most alkaline, and 7 is neutral.

A pH sensor typically consists of a pH-sensitive electrode and a reference electrode. The pH-sensitive electrode contains a glass membrane that is sensitive to changes in the concentration of hydrogen ions in the solution. The reference electrode provides a stable reference voltage against which the pH-sensitive electrode can measure the pH of the solution.

To use a pH sensor, you would typically immerse the pH-sensitive electrode in the solution and allow it to equilibrate. The voltage difference between the pH-sensitive electrode and the reference electrode is then measured and converted to a pH value using a calibration curve.

pH sensors are commonly used in a variety of applications, including water and wastewater treatment, food and beverage production, chemical processing, and environmental monitoring.

Working of the Model:

Here, in this project, we will collect different samples of water from different places and measure the values of their pH and ppm with the help of pH sensor and Turbidity sensor.

Sensor Setup: The first step is to connect pH and turbidity sensors to the ESP32s.From this, we will take analog input i.e input is given by the turbidity and pH sensor.

Calibration: The pH sensor must be calibrated to ensure accurate readings. The calibration process is like initially we make pH buffer solutions then we will measure the analog input values using the pH probe. Then we will calculate the voltage at that analog values then we will make calculations to obtain the correct voltage.

Data acquisition: The ESP32 reads the data from the sensors and processes it using the built-in microcontroller.

Data Transmission: The ESP32 can log the pH and turbidity value onto the LCD display.

Code:

```
#include <Wire.h>

#include <LiquidCrystal_I2C.h>


#define I2C_ADDR 0x27 // I2C Address of the I2C Serial Interface Adaptor Module


LiquidCrystal_I2C lcd(I2C_ADDR, 16, 2); // Initialize the LCD with the I2C address and size

const int turbidityPin = 26; // Analog input pin for the turbidity sensor

const int pHpin = 33; // Analog input pin for the pH sensor

const float VREF = 3.3; // Reference voltage for the ADC

const float VPERPH = 0.059; // Volts per pH unit for the pH sensor
```

```
const float basevalue=130;
// Calibration values for pH sensor
const float pH4Voltage = 1.23; // Voltage reading at pH 4
const float pH7Voltage = 1.65; // Voltage reading at pH 7

void setup() {
  Wire.begin(); // Initialize the I2C bus
  lcd.init(); // Initialize the LCD
  lcd.backlight(); // Turn on the LCD backlight
  Serial.begin(9600); // Initialize serial communication
}

void loop() {
  int turbidityValue = analogRead(turbidityPin)-basevalue; // Read the analog input value
  int pHraw = analogRead(pHpin); // Read the analog input value
  float pHvoltage = VREF * pHraw / 4095.0; // Convert the raw value to voltage
  float pHvalue = 7.0 + (pHvoltage - pH7Voltage) / ((pH4Voltage - pH7Voltage) / 3.0); // Convert the voltage to pH units using calibration values
  lcd.clear(); // Clear the LCD screen
  lcd.setCursor(0, 0); // Set the cursor to the first row, first column

  lcd.print("PPM : "); // Print the message on the LCD
  lcd.print(turbidityValue);

  lcd.setCursor(0, 1); // Set the cursor to the second row, first column
  lcd.print("pH : "); // Print the message on the LCD
  lcd.print(pHvalue, 2); // Print the pH value with two decimal places
```

```
  delay(1000); // Wait for a second
}
```

Applications:

Environmental Monitoring: Water Monitoring through Turbidity and PH Measurement can be used to monitor water quality in various environmental settings such as rivers, lakes, and oceans. This application can help scientists and environmentalists understand the health of aquatic ecosystems and identify potential pollution sources.

Drinking Water Quality Assurance: Turbidity and PH measurements can be used to monitor the quality of drinking water in residential and commercial settings. This application can help ensure that drinking water is safe for consumption and meets regulatory standards.

Industrial Process Control: Water Monitoring through Turbidity and PH Measurement can be used to monitor industrial processes that involve water. By measuring turbidity and PH, industries can ensure that their processes are operating within the desired parameters, which can improve product quality and reduce waste.

Agriculture: Turbidity and PH measurements can be used to monitor water quality in agriculture. This application can help farmers understand the health of their crops and identify potential issues related to soil fertility and nutrient availability.

Aquaculture: Turbidity and PH measurements can be used to monitor water quality in aquaculture settings such as fish farms. This application can help fish farmers maintain optimal water conditions for fish growth and survival, which can improve production and reduce the risk of disease outbreaks.

Waste Water Treatment: Turbidity and PH measurements can be used to monitor water quality in waste water treatment plants. This application can help plant operators ensure that the treatment process is effective in removing contaminants from the water and producing safe effluent for discharge.

Conclusion:

In conclusion, water monitoring through turbidity and pH measurement is crucial for ensuring the quality of water for various purposes. Turbidity and pH are important indicators of water quality, and monitoring them regularly can help identify changes in water quality and potential contamination. The use of advanced technology and equipment for water monitoring has made it easier and more accurate to measure these parameters. Through regular monitoring and analysis of turbidity and pH levels, appropriate measures can be taken to maintain the quality of water and ensure it is safe for consumption, irrigation, industrial processes, and aquatic life. Overall, water monitoring through turbidity and pH measurement plays a critical role in preserving and protecting our valuable water resources.