REAL TIME WATER QUALITY MONITORING AND ANALYSIS SYSTEM ESP8266

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AIM:

To develop a real-time water quality monitoring and analysis system using an ESP8266 microcontroller. The system uses a turbidity sensor to measure water clarity, an OLED display to show the results in a digital format, and LEDs as visual indicators for water quality.

Tools/Hardware Required

Turbidity sensor
LED
Resistor
OLED(SSD1306)
ESP8266
Breadboard
Jumper Wires

THEORY

Turbidity sensor – A turbidity sensor is used to measure the clarity of a liquid, or how cloudy it is. It works on the principle of light scattering. The sensor has an infrared (IR) LED on one side and an IR phototransistor on the other. When suspended in a liquid, the amount of light that passes from the LED to the phototransistor decreases as the number of suspended particles (and thus turbidity) increases. The sensor provides an analog voltage output that is inversely proportional to the clarity of the water.

ESP8266 - The ESP8266 is a low-cost Wi-Fi microchip with a full TCP/IP stack and microcontroller capability. It is the central processing unit in this system, responsible for reading data from the turbidity sensor, controlling the LED, and displaying information on the OLED screen. Its built-in Wi-Fi makes it ideal for projects that require internet connectivity, though this particular setup uses it for local processing.

OLED Display(SSD1306) - An OLED (Organic Light Emitting Diode) display is a type of screen that uses an organic compound to emit light in response to an electric current. The SSD1306 is a common driver chip for these displays. In this project, the OLED display is used to show the measured turbidity level in a clear, digital format, providing real-time feedback to the user.

Circuit Components (LED, Resistor, Breadboard, Jumper Wires)

LED (Light Emitting Diode): An LED is a semiconductor light source. In this project, an LED can be used as a simple visual indicator. For example, it could light up when the turbidity level exceeds a certain threshold, alerting the user to poor water quality.

Resistor: A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. It is crucial for protecting the LED from excessive current, which would cause it to burn out. The resistor limits the flow of current to the LED.

Breadboard: A breadboard is a solderless construction base used for prototyping electronic circuits. It allows for quick and easy assembly and modification of the circuit by connecting components with jumper wires.

Jumper Wires: These are flexible wires used to make temporary connections on a breadboard, linking all the components together to form a complete circuit.

PIN DIAGRAM

Components	ESP8266
Turbidity Sensor VCC	3.3V
Turbidity Sensor GND	GND
Turbidity Sensor OUT	A0
LED 1	D1(GPI05)
LED 2	D2(GPI04)
OLED SDA	D2(GPI04)
OLED SCL	D1(GPI05)
OLED VCC	3.3V
OLED GND	GND

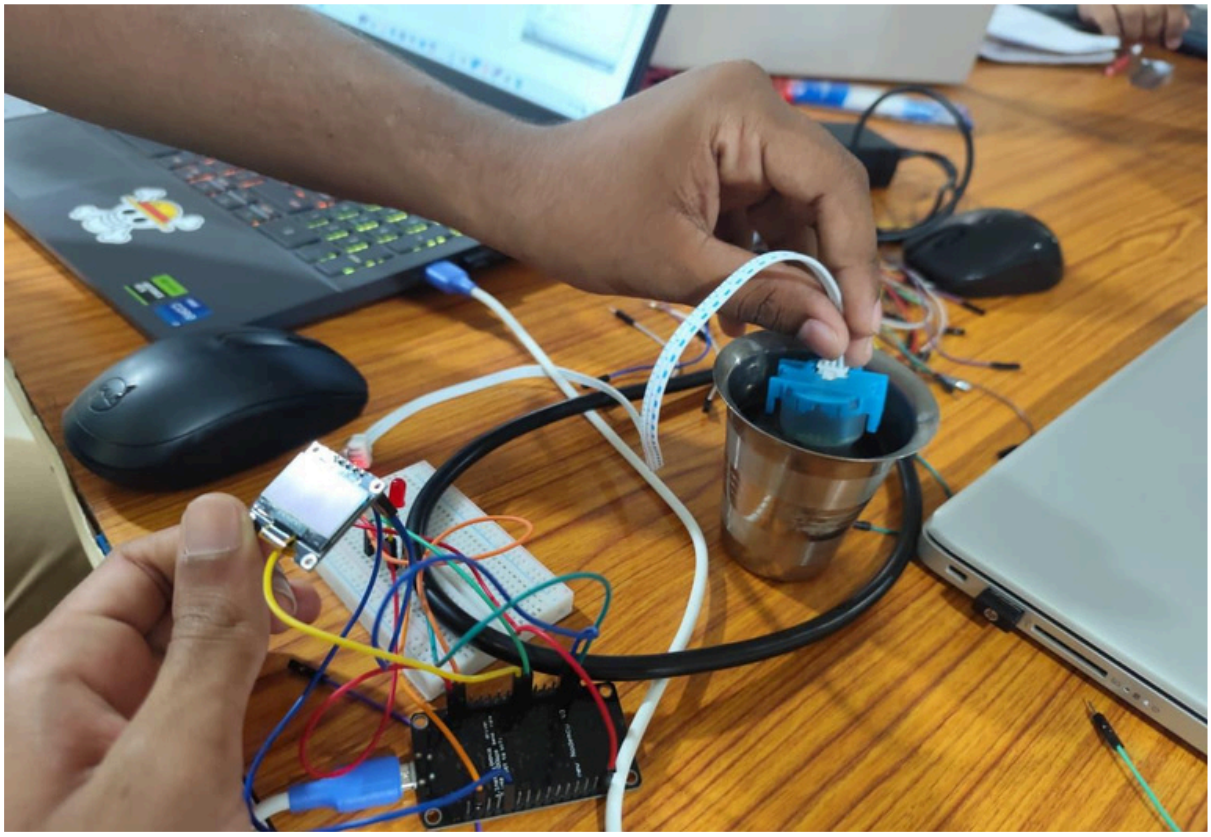
CODE:

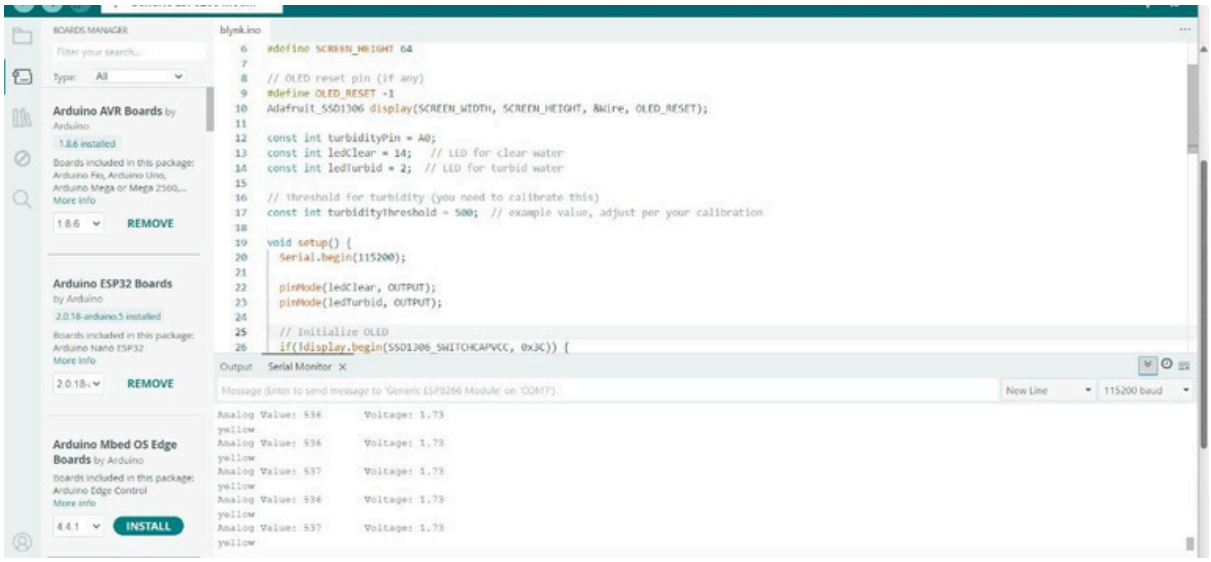
```
#include <Wire.h>

#include <Adafruit_GFX.h>

#include <Adafruit_SSD1306.h>

#define SCREEN_WIDTH 128

#define SCREEN_HEIGHT 64

// OLED reset pin (if any)

#define OLED_RESET -1

Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, &Wire, OLED_RESET);

const int turbidityPin = A0;
```

```
const int ledClear = 14; // LED for clear water
const int ledTurbid = 2; // LED for turbid water
// Threshold for turbidity (you need to calibrate this)
const int turbidityThreshold = 500; // example value, adjust per your calibration
void setup() {
  Serial.begin(115200);
  pinMode(ledClear, OUTPUT);
  pinMode(ledTurbid, OUTPUT);
  // Initialize OLED
  if(!display.begin(SSD1306_SWITCHCAPVCC, 0x3C)) {
    Serial.println(F("SSD1306 allocation failed"));
    while(1);
  }
  display.clearDisplay();
  display.setTextSize(1);
  display.setTextColor(SSD1306_WHITE);
  display.setCursor(0,0);
  display.println("Water Quality Monitor");
  display.display();
  delay(2000);
  display.clearDisplay();
}
void loop() {
  int sensorValue = analogRead(turbidityPin);
  float voltage = sensorValue * (3.3 / 1023.0);
  Serial.print("Analog Value: ");
  Serial.print(sensorValue);
  Serial.print("\tVoltage: ");
  Serial.println(voltage);
```

```
  //Display data on OLED
  display.clearDisplay();
  display.setCursor(0,0);
  display.println("Water Quality Monitor");
  display.print("Turbidity: ");
  display.println(sensorValue);
  display.display();
  //Turn on LEDs based on turbidity threshold
  if(sensorValue < turbidityThreshold) {
    digitalWrite(ledClear, HIGH);
    digitalWrite(ledTurbid, LOW);
    Serial.println("RED");
  }else {
    digitalWrite(ledClear, LOW);
    digitalWrite(ledTurbid, HIGH);
    Serial.println("yellow");
  }
  delay(1000); // 1-second delay
}
```

DEMONSTRATION





EXECUTION

1. Component Collection Collected the following components: ESP8266 NodeMCU Turbidity sensor (MJKDZ module with VCC, OUT, GND) SSD1306 OLED display (I2C) 2 LEDs (for clear and turbid water indication) 2 × 1 kΩ resistors Jumper wires and breadboard USB cable for ESP8266 2. Circuit Design and Wiring Turbidity Sensor: VCC → 3.3V (ESP8266) GND → GND (ESP8266) OUT → A0 / ADC0 (ESP8266 analog input) OLED SSD1306 Display: VCC → 3.3V (ESP8266) GND → GND (ESP8266) SDA → D2 (GPIO4) SCL → D1 (GPIO5) LED 1 (Clear Water Indicator): Anode (long leg) → 1 kΩ resistor → GPIO14 (D5) Cathode (short leg) → GND LED 2 (Turbid Water Indicator): Anode (long leg) → 1 kΩ resistor → GPIO12 (D6) Cathode (short leg) → GND 3. Library Installation in Arduino IDE Installed the following libraries via Library Manager: Adafruit GFX Library

Adafruit SSD1306

Wire (comes pre-installed)

4. Writing and Uploading the Code

Wrote the code to:

Read turbidity sensor values using analogRead(A0)

Compare the value against a threshold (e.g., 500)

Control two LEDs based on water clarity

Display the turbidity reading on OLED

Used Adafruit_SSD1306 to control the OLED display

Initialized Serial. Begin (115200) for serial debugging.

5. Uploading Code to ESP8266

Faced Error:

A fatal esptool.py error occurred: could not open port 'COM7': Permission Error(13, 'Access is denied.')

Resolved by:

Closing Serial Monitor

Unplugging and replugging ESP8266

Re-selecting correct COM port from Tools > Port

Running Arduino IDE as Administrator

Ensuring no other program was using the COM port

Final Upload:

Successfully uploaded the code after resolving the port issue.

Verified functionality via Serial Monitor and OLED display.

6. Testing and Calibration

Placed sensor in clean and dirty water samples

Adjusted turbidity Threshold value based on real readings

Verified:

LED1 lights up for clear water

LED2 lights up for turbid water

OLED shows live turbidity values

7. Final Outcome

Real-time water quality monitoring achieved.

Visual indicators (LEDs and OLED) functioned as expected.

System suitable for basic water turbidity analysis using ESP8266 and turbidity sensor.