Measuring Water Quality using Arduino and Turbidity Sensor

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ABSTRACT
Turbidity a key idea in the context of liquids since it is an important part of liquid dynamics and is also used to determine the calibre of water. The degree to which a liquid is cloudy or opaque is referred to as turbidity. This happens because as air is compressed, it is filled with countless small invisible particles that resemble white smoke. A liquid's turbidity is directly inversely correlated with the amount of free suspended particles, which means that as the number of particles rises, so will the turbidity. Light waves scatter when they travel through liquids because of these microscopic particles. So let's talk about what turbidity is and how to use an Arduino to test the turbidity of a liquid in this lesson. It is possible to connect an Arduino to a pH metre and to further evaluate the water's purity, check its pH-level. The evaluation of amount of the transparency loss brought on by water's suspended particles. The TSS (Total Suspended Solids) could be estimated using a measurement of turbidity. The Arduino turbidity sensor measures the amount of turbidity to assess the water's quality. The rate of light scattering and transmission, that can be used to evaluate whether there are suspended particles in water, are influenced by the concentration of TSS.

Keywords
Arduino, Turbidity module, Water Quality Measurement

1. INTRODUCTION
Water is a basic necessity that cannot be replaced and is utilized for a number of things, including drinking, making it essential for human survival. Depending on this, water can either be a source of life and wellness or a source of illnesses and fatalities for people. Drinking water services in metropolitan areas and water delivery to consumer taps face significant issues in protecting water sources from contamination, whether intentional or unintentional. Additionally, 3.4 million people worldwide perish annually from diseases associated with water; the majority of them are children, according to the World Health Organization (WHO) [1]. There is a need for a system to check the water quality in the distribution system as a result. An indicator of how foggy the water is called as turbidity. Water with low turbidity typically has great clarity, whereas water with high turbidity typically has low clarity. Fine particles like silt, sludge, and organic matter can reduce water clarity; therefore the Arduino with turbidity sensor detects the turbidity level to determine the quality of the water. By monitoring the changes in light transmittance and scattering rate caused by the amount of TSS in the water, particles that are suspended in the water can be seen. As a result, the water is measured by the turbidity sensor, and the LCD panel shows the results of the measurement, including the water's clarity, cloudiness, and dirtiness.

2. MATERIALS AND EQUIPMENT

2.1 ArduinoUNO
Arduino UNO can be used in a wide range of electronic projects, a microcontroller board that can be programmed that is open-source, inexpensive, and user-friendly was created by Arduino.cc. The Microchip ATmega328P microcontroller serves as its central component. A variety of expansion boards and other devices can be connected to the board's sets of digital and analogue input/output pins [2]. This board connects to other Arduino boards, Arduino shields, and Raspberry Pi boards and has the ability to operate relays, LEDs, servos, and motors as output devices.

Fig1: ArduinoUNO

2.2 Turbidity Sensor
Light scattering from suspended particulates in water is measured using turbidity sensors [6]. Together with the turbidity level, the total suspended solids (TSS) content of water rises (and cloudiness or haziness).

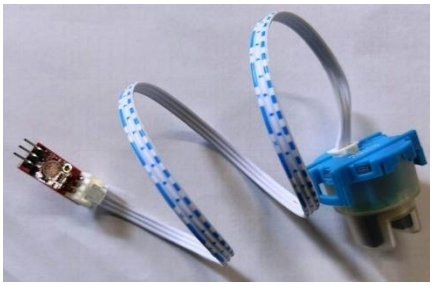

Fig 2: Turbidity Sensor

2.3 16*2 I2C LCD
It is an I2C interface with 16x2 LCD display. With white characters on a blue background, it can display 16x2 characters on 2 lines. Projects that call for the display of text, data, or any form of ASCII character are utilized to test this LCD's cost-effectiveness. Connect to the SDL (serial data line), Gnd, Vcc, and SCL (serial clock line). Projects for LCD panels on Arduino frequently run out of pin resources rapidly, especially with ArduinoUno.

Fig 3: 16*2 I2C LCD

2.4 Common cathode RGB-LED

The typical cathode for RGB-LEDs, which the three LEDs all possess, is connected negatively (cathode). The three LEDs in a common anode RGB LED are positively connected to one another (anode). As a result, the LED has four pins total—one for each LED and either one common cathode or anode.

Fig 4:Common cathode RGB LED

2.5 Breadboard

Building temporary circuits requires the use of a breadboard, often known as a plug block. Because components can be removed and replaced with ease, it is helpful to designers. The ability to design a circuit, demonstrate how it works and then reuse the components in another circuit is helpful.

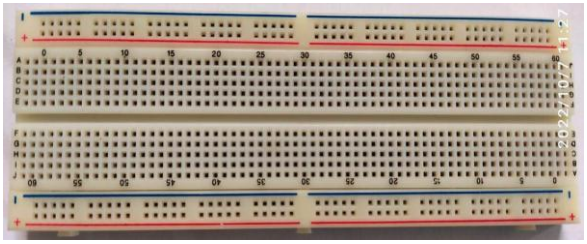

Fig 5:Breadboard

2.6 Jumper wires

Jump wires are cables made up of several electrical wires that have connectors or pins at either end. It's typically used to attach pieces of a prototype or test circuit inside or to other machinery or components without soldering a breadboard or other prototype or test circuit.

Fig 6: Jumper wires

3. SYSTEM TESTING

Calibration is carried out to check the measurement accuracy of the system's sensor. According to the values entered into the application, the output is presented. The actions taken to test the sensor are listed below:

Procedure

1) Gather some samples of clean, hazy, and dirty water.
2) Properly insert the sensor into the water samples.
3) Run the Arduino Software application in parallel.
4) Write down the value that the sensor read.
5) Compare the recorded value to the values listed in the programme.
6) If the turbidity of the water is (turbidity < 15), show it as clear water.
7) Display water as cloudy if the turbidity is ((turbidity> 15) && (turbidity<50)).
8) Display water as unclean if the turbidity is (turbidity > 50).
9) The turbidity of the water is tested when samples are delivered, and the results are shown on an LCD.

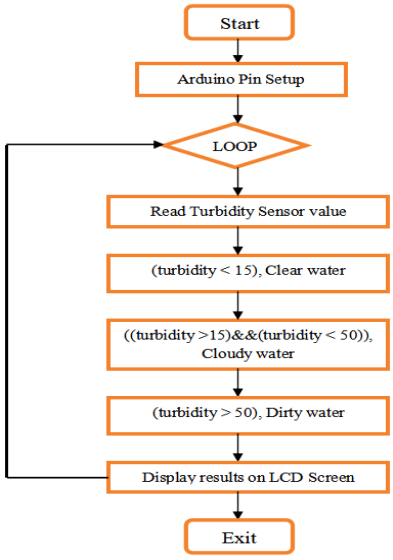

Fig 7: Flowchart demonstrating how hardware operates

3.1 System Architecture

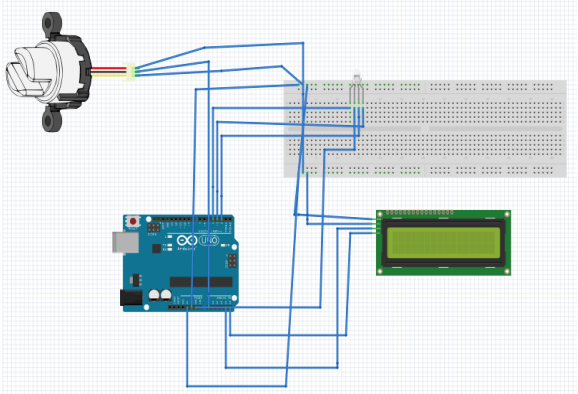

Fig 8: Connection Diagram

4. METHODOLOGY

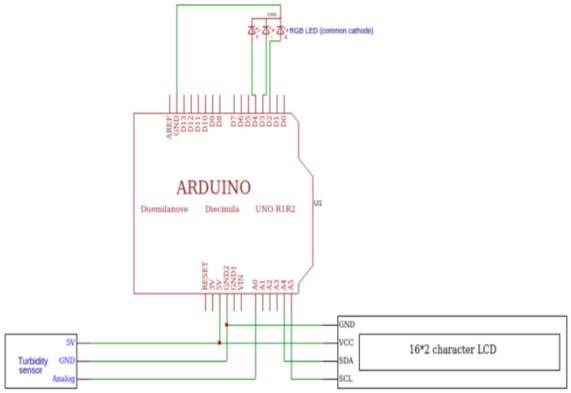

Fig 9:Schematic Diagram [16]

The SCL to A5 and SDA to A4 I2C pins of the Arduino are used to connect the I2C LCD to the Arduino. The turbidity sensor output is analogue, thus it is tied to the Arduino's A0 pin. Digital pins D2, D3, and D4 were next used to connect the RGB LED. After connecting ground to ground, connect the sensor's VCC to the Arduino's 5volt supply. The sensor's output pin to Arduino's analog 0 pin. Connect the LCD module's VCC and ground to the Arduino's 5v and ground next. Pins A4 and A5 on the Arduino I2C pins are used for SDA and SCL, respectively. Green, blue, and red are connected to D2, D3, and D4, respectively, with the ground of the RGB LED eventually being connected to the Arduino's ground.

5. RESULT AND DISCUSSION

Fig 10:Water Samples with different mixtures

After taking a water sample, the turbidity sensor is utilized to assess the water's quality [7]. The Arduino board was used to process the sensor readings. The water's suitability for human consumption was determined using these numbers. Regular checks are made to the water's quality to determine if there have been any changes; even a small adjustment will have an impact on the outcomes. The outcomes are then shown on the LCD.

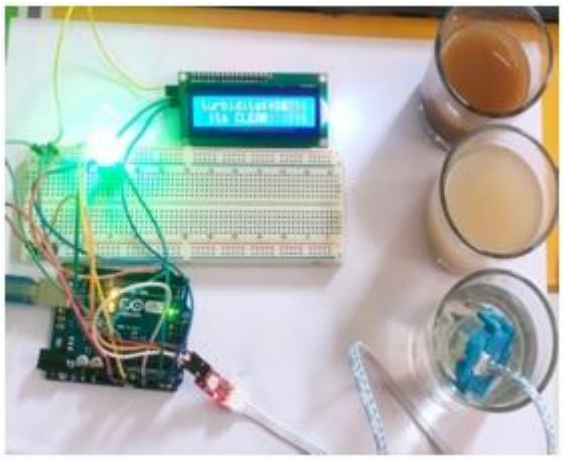

Fig. 11 Result of Clear Water

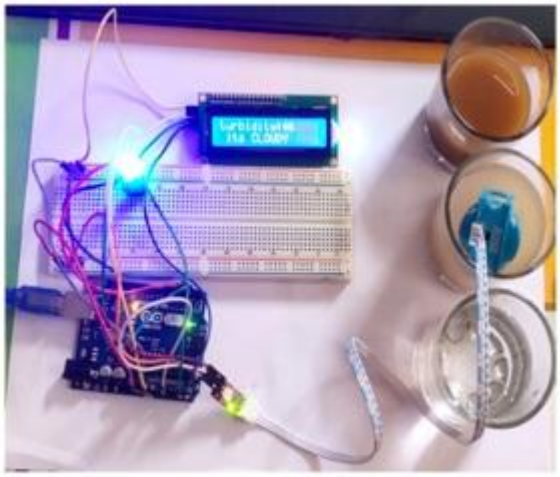

Fig 12: Result of Cloudy Water

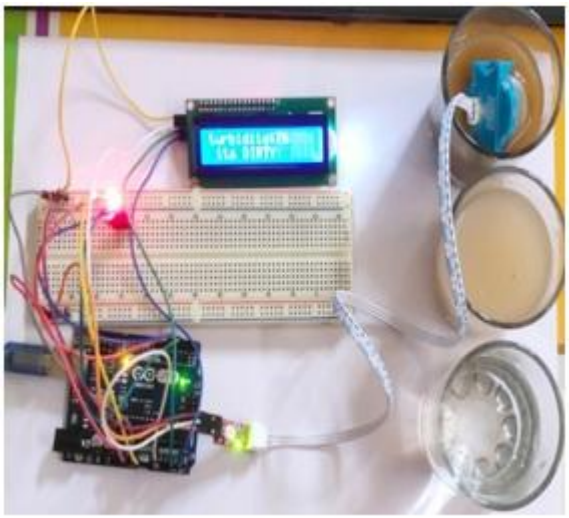

Fig 13: Result of Dirty Water

6. CONCLUSION

The "Measuring Water Quality Using Arduino and Turbidity Sensor" project has been built and tested successfully. System that tracks water quality in real time at the water sources.Researchers can forecast natural processes in the environment, gain knowledge from them, and identify how humans affect an ecosystem by using the Water Quality Monitoring (WQM). In addition to helping with restoration

projects, these measurement efforts can guarantee that environmental regulations are being met. The WQM, which makes use of IoT technologies, must be a practical and effective system for tracking drinking water quality.

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