Water Monitoring System Using Arduino

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***Abstract*—Water is very important for everyone. To survive on the earth every living being need water but this water is being polluted every day. The first step in preventing pollution is to identify the contaminant. This system is designed to develop, implement, monitor, and control water parameters such as pH, temperature, and salinity, turbidity. Our suggested system is prepared as a low-cost, real- time water quality testing device that can be used in remote rivers, lakes, coastal areas, and other bodies of water.**

Index Terms— Water quality, Arduino uno, sensors, LED

I. INTRODUCTION

A. Background information

Water is very important for everyone. To survive on the earth every living being need water. When the water is polluted, it is not only devastating to the environment, but also human body. Constant testing of water can prevent this pollution. The water quality measuring system is difficult. Each water body can comprise intensely different level of pollution. Water quality measures the physical, chemical, biological and microbiological characteristic of water. Keeping track of water quality in current era is big challenge because of the large amount of chemical use in day-to-day activities. Clean water is very important for the health of human as well as for aquatic animals. Also, the utilization of water health issues is growing intensively.

B. Project Objectives

The main objective of our project is from testing water, we can measure temperature, O2 level, pH level and turbidity. We aim to implement sensors remotely monitors and control of water quality parameters. Our objectives also range from detecting violations of water quality standards to determining the state of the ecosystem and analyzing temporal water quality trends. Our suggested system is prepared as a low-cost, real- time water quality testing device that can be used in remote rivers, lakes, coastal areas, and other bodies of water.

C. A brief outline of the report

This paper is structured as follows-To implement our idea first of all we identify the problems that we have to solve. Then we review some papers to find out the probable solutions. While finding the solutions we also keep in mind for the cheapest and effective one. For this we have come up with the sensors that are required for our water quality testing system. The basic working process of our proposed system are also stated here.

II. LITERATURE REVIEW

The paper by Yuda Irawan et. al. [1] tried to implement water quality measurement and filtering tools. In this project Arduino Uno, Hydrogen Potential Sensor (PH), and a Total Dissolved Solids (TDS) Sensor is used. The value of PH and TDS content in the water is received successfully in this paper which aims for people to know whether the water is drinkable or not. Total five samples were taken and the result showed that TDS ranged from 171 ppm to 212 ppm with an average of 186.4 ppm and a pH ranging from 7,152 to 8.336 with an average of 7,711 [1].

S.Gokulanathan et. al. [2] proposed a water quality monitoring system through a wireless sensor network. This system can detect water-borne diseases and measure the quality of water by using a PH sensor, Electric Conductivity (EC) sensor, a temperature sensor, and Arduino. The GSM module will show the data that is collected by the Arduino to the webpage.

The paper by Vaishnavi V. Daigavane et. al. [3] developed a low-cost system for real-time monitoring of the water quality in IoT (internet of things). With the help of several sensors, the physical and chemical parameters of the water are measured successfully. The parameters such as temperature, PH, turbidity, flow sensor of the water can be measured [3]. The Arduino model is used as a core controller. In this project, after collecting and analyzing the water samples, the sensor data can be viewed on the internet by using a WI-FI system.

In a research paper by I M Hakimi [4], it was shown that regular water quality monitoring of water bodies is essential to ensure it is within the allowing standard limits. The development of a simple and low-cost water quality measurement device for real time monitoring using Internet of Things (IoT) technology is presented in this study. Kolora meter is an alternative to the existing commercial monitoring devices. It was developed using the open-source platform

Arduino UNO model and NodeMCU board as the microcontroller and Wi-Fi connection respectively. Two sensors such as temperature and turbidity were selected to be installed in the early stage of Kolora meter development. The physical parameters (temperature and turbidity) of water were measured and the measured data collected are able to be viewed and monitored on the mobile phone using Kolora Mobile Application via Wi-Fi connection. Therefore, this surface water quality device has potential to be applied in real time monitoring for early pollution detection and during COVID-19 pandemic spread due to limited movement.

In the paper by K. Saravanan [5], he and his team proposed a new Supervisory Control and Data Acquisition (SCADA) system that integrates with the Internet of Things (IoT) technology for real-time water quality monitoring. It aims to determine the contamination of water, leakage in pipeline, and also automatic measure of parameters (such as temperature sensor, flow sensor, color sensor) in real time using Arduino Atmega 368 using Global System for Mobile Communication (GSM) module. The system is applied in the Tirunelveli Corporation.

III. Methodology and Modeling

A. Introduction

The system built with Arduino UNO as the main controlling unit. The function of the temperature sensor is to measure the temperature of water and send the data to Arduino UNO. The Arduino UNO use as Controller unit is read the analog values from the sensors and converted into the voltage form then calibrate. After taking input from all the sensor Arduino Uno calculate what is the condition of the water. The calculation will be done as we program it to do.

B. Working principle of the proposed project

We will be using Arduino Uno and four sensors for this project. The sensors are pH sensor, oximeter sensor, temperature sensor, turbidity sensor. The Arduino UNO use as Controller unit is read the values from the In this project Arduino UNO interface with LabVIEW. LabVIEW is used as a Display unit in the system. This Data can be Access Remotely on the Web. Table 1 show that the specification of parameter to monitoring the system. The water quality will be determined by the parameter of the following table. Arduino Uno collect the reading from the four sensors. Then it will compare with the table. The quality will be displayed on the monitor based on the code and the table.

Parameters	Unit	Range	Quality Range
Temperature	Degree Celsius	0-100	More than 18 degree Celsius and less than 35 degree Celsius
Turbidity	NTU	0-100	0-5
PH	PH	0-14	6.5-8.5
Oxygen level	ml/L		6-9 ml/L

Table 1: Water quality monitoring parameter

C. Description of the important component

We will use an Arduino Uno, a temperature sensor, a turbidity sensor, an oxygen sensor, a PH meter, and a LCD display in this project.

Arduino Uno: The Arduino Uno is an open-source microcontroller board designed by Arduino.cc. It is based on the Microchip ATmega328P microprocessor. The board has a variety of digital and analog input/output pins that may be used to communicate with expansion boards and another circuitry.

Temperature sensor: A temperature sensor is a device that is used to determine the ambient temperature. This might be the temperature of the air, a liquid, or a solid. There are several kinds of temperature sensors available, and each one measures temperature using a distinct set of technologies and principles.

Turbidity sensor: Water quality testing and management, river monitoring, stream measurement, reservoir water quality testing, groundwater testing, water and wastewater treatment, and effluent and industrial control are all applications for turbidity sensors.

Oxygen sensor: This is a kit for measuring dissolved oxygen that is compatible with Arduino microcontrollers. This product is used to determine the amount of dissolved oxygen in water, which serves as a proxy for the water's quality. It is extensively used in a broad variety of water quality applications, including aquaculture, environmental monitoring, and natural science

PH sensor: pH sensors are intended to test the acidity or alkalinity of a solution and display the results on a digital readout. In a variety of applications such as agriculture, wastewater treatment, industries, environmental monitoring and other similar areas of usage, it is widely employed.
LCD display: The LCD (Liquid Crystal Display) is a kind of show that operates by using liquid crystals in order to display information. In this section, we will take serial input from the PC and upload the program to the Arduino board. It will be possible to see all of the characters on the LCD screen.

D. Implementation

Turbidity sensors:
The turbidity of water is a measurement of its clarity. Muddy water has a high turbidity value, whereas clear water has a low turbidity value. Suspended soils and plankton suspended in the water column induce cloudiness. Turbidity has the effect of decreasing water transparency, lowering photosynthetic rates, and raising water temperature. Water that is extremely turbid can be harmful to an aquatic habitat. Nephelometric Turbidity Units [NTU] are a unit of turbidity. Surface water is likely to have turbidity between 1 and 50 NTU, according to USGS standards. If the turbidity of the water is less than 1.0 NTU, it is considered safe to consume. It should not exceed 5.0 NTU and ideally should be less than 1.0 NTU. The turbidity sensor measures the amount of light dispersed by a suspended material in water.

DO (Dissolved Oxygen) sensor:
One of the most important markers of water quality is dissolved oxygen (DO). It is necessary for fish and other aquatic species to survive. The aerating action of winds causes oxygen to dissolve in surface water. Aquatic plant photosynthesis releases oxygen into the water as a byproduct. Fish and other aquatic species cannot survive when dissolved oxygen levels fall too low. The more oxygen a body of water can hold, the colder it is. The amount of oxygen that may be dissolved in water decreases as the temperature rises. The amount of oxygen a body of water can store is also determined by salinity; fresh water may absorb more oxygen than salt water. Oxygen level between 6-9 is suitable for the water.

Temperature Sensors:
Temperature of water is one of most important property because of other parameter depend on temperature for accuracy. The DS18S20's primary function is to deliver immediate digital temperature measurements. The temperature sensors (DS18S20) have resolutions of 9, 10, 11 and 12 bits, which correspond to increments of 0.5o C, 0.25o C, 0.125o C, and 0.625o C, respectively. Temperature should be measured between -55 and +125 degrees Celsius with no extraneous components. The master converts the T command to begin temperature measurements and analog to digital conversion.

pH sensor:
The pH of water is a critical characteristic. It's used to determine if water is acidic or alkaline. The relative hydrogen ions h+ or relative hydroxyl ions OH- present in the water determine the acidity or alkalinity. Acidic solutions have a higher amount of hydrogen ions in the water, whereas alkaline solutions have a higher number of hydroxyl ions. pH can be expressed on a scale of 1 to 14. The scale from 0 to 6.0 indicates that the solution is acidic, the scale from 7.0 to 8.0 indicates that the solution is neutral, and the scale from 8.0 to 14.0 indicates that the solution is alkaline.

E. Experimental Setup

Firstly, we took the Arduino Uno board then we connected the sensor to the port of the Arduino uno board. pH sensor is connected to A0 port. To get the accurate result we connected a LC module with the output of the pH sensor. Temperature Sensors is connected to the A1. DO sensor is connected to the A3 and the turbidity is connected to the A2 sensor. A display is connected to 8,9,10,11,12,13. After calculate the result of each sensor the result is shown on the display.

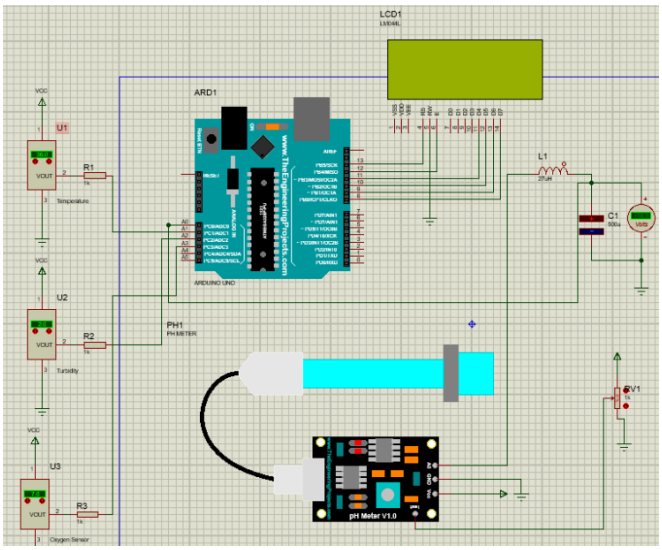
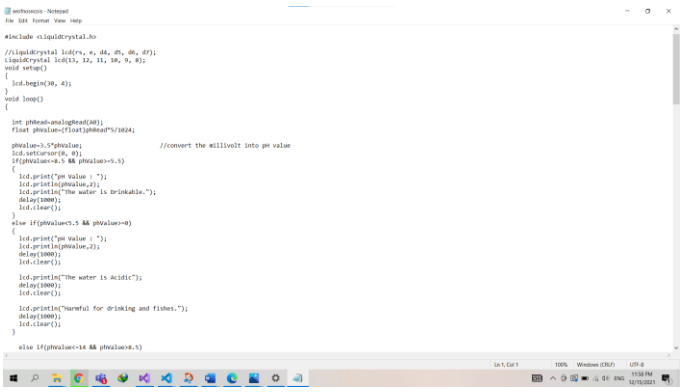


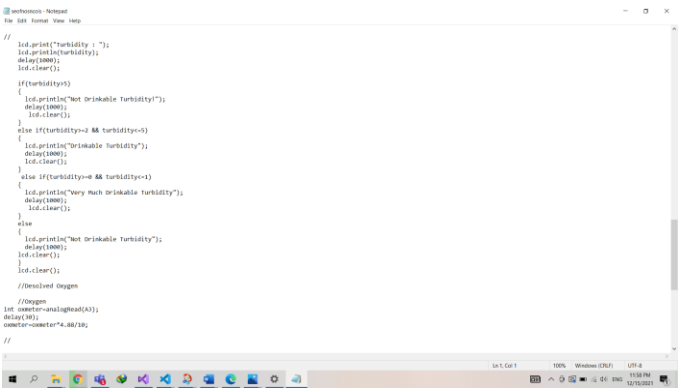
Figure 1: Experimental setup

We programed code to run the system. Code do the work as per instruction is given. There are mainly four condition in the code. First part detects if the pH value of the water is suitable or not. Second part detect if oxygen level is right or not. The other two part is for other two sensors.



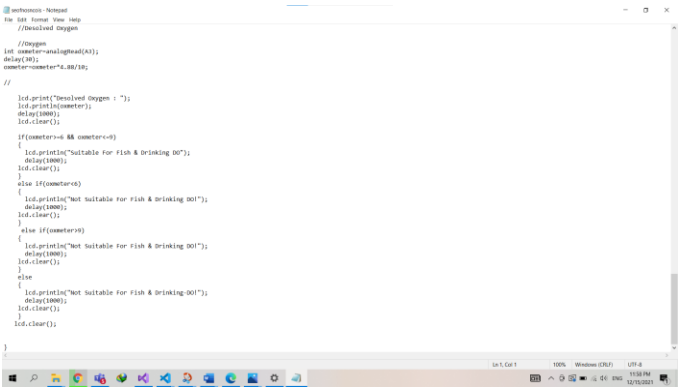
```
#include <LiquidCrystal.h>

//LiquidCrystal lcd(rs, e, d4, d5, d6, d7);
LiquidCrystal lcd(13, 12, 11, 10, 9, 8);
void setup()
{
  lcd.begin(30, 4);
}
void loop()
{

  int pHRead=analogRead(A0);
  float pHValue=(float)pHRead*5/1024;

  pHValue=3.5*pHValue;                  //convert the millivolt into pH value
  lcd.setCursor(0, 0);
  if(pHValue<=8.5 && pHValue>=5.5)
  {
    lcd.print("pH Value : ");
    lcd.println(pHValue,2);
    lcd.println("The water is Drinkable.");
    delay(1000);
    lcd.clear();
  }
  else if(pHValue<5.5 && pHValue>=0)
  {
    lcd.print("pH Value : ");
    lcd.println(pHValue,2);
    delay(1000);
    lcd.clear();

    lcd.println("The water is Acidic");
    delay(1000);
    lcd.clear();

    lcd.println("Harmful for drinking and fishes.");
    delay(1000);
    lcd.clear();
  }

    else if(pHValue<=14 && pHValue>8.5)
```

Figure 2: Code



```
//
    lcd.print("Turbidity : ");
    lcd.println(turbidity);
    delay(1000);
    lcd.clear();

    if(turbidity>5)
    {
      lcd.println("Not Drinkable Turbidity!");
      delay(1000);
        lcd.clear();
    }
    else if(turbidity>=2 && turbidity<=5)
    {
      lcd.println("Drinkable Turbidity");
      delay(1000);
      lcd.clear();
    }
    else if(turbidity>=0 && turbidity<=1)
    {
      lcd.println("Very Much Drinkable turbidity");
      delay(1000);
       lcd.clear();
    }
    else
    {
      lcd.println("Not Drinkable Turbidity");
      delay(1000);
    lcd.clear();
    }
    lcd.clear();

    //Desolved Oxygen

    //Oxygen
int oxmeter=analogRead(A3);
delay(30);
oxmeter=oxmeter*4.88/10;

//
```

Figure 3: Code



```
    //Desolved Oxygen

    //Oxygen
int oxmeter=analogRead(A3);
delay(30);
oxmeter=oxmeter*4.88/10;

//

    lcd.print("Desolved Oxygen : ");
    lcd.println(oxmeter);
    delay(1000);
    lcd.clear();

    if(oxmeter>=6 && oxmeter<=9)
    {
      lcd.println("Suitable For Fish & Drinking DO");
      delay(1000);
    lcd.clear();
    }
    else if(oxmeter<6)
    {
      lcd.println("Not Suitable for Fish & Drinking DO!");
      delay(1000);
    lcd.clear();
    }
      else if(oxmeter>9)
    {
      lcd.println("Not Suitable For Fish & Drinking DO!");
      delay(1000);
    lcd.clear();
    }
    else
    {
      lcd.println("Not Suitable For Fish & Drinking DO!");
      delay(1000);
    lcd.clear();
    }
   lcd.clear();

}
```

Figure 4: Code

F. Cost Analysis

The Arduino Uno cost 650 taka, and our temperature sensor cost 75 tk. The turbidity sensor cost 1000 taka, the pH sensor cost 3500 taka, the oxygen sensor cost 1200 taka, and additional transistors and wire cost around 100 tk. In all, we will need 6525 taka for this project.

IV. Results and Discussion

A. Simulation analysis

In order to create the water quality testing device, we have used Arduino UNO, pH meter, temperature sensor, turbidity sensor, Oxygen sensor and LCD screen. A voltage supply of 5 volts have been used to power the pH meter. The code portion is written on the Arduino IDE with the necessary conditions to determine from the sensor results if the water quality is safe for drinking and fishing.

Sensor	Range	Safe or Harmful
pH meter	5.5 to 8.5	Safe & Drinkable
	0 to 5.5	Harmful and Acidic
	8.5 to 14	Harmful and Alkalic
Temperature	Less than 34 °C	Safe
	More than 34 °C	Harmful
Turbidity	0 NTU to 1 NTU	Very safe
	2NTU to 5 NTU	Safe
	More than 5 NTU	Harmful
Oxygen	6 mg/L to 9 mg/L	Safe
	Less than 6 mg/L or more than 9 mg/L	Harmful

Table 2: Simulation analysis

B. Simulation Results

The pH meter, temperature, turbidity and oxygen sensors are simulated in a way to show results on the LCD screen. If the pH meter sensor has detected pH of 5.5 to 8.5 then the LCD screen will show that the water is safe and drinkable. If the pH is lower than 5.5 and more than 8.5 then it will show acidic and alkalic accordingly and harmful for drinking and fishes. If the Temperature sensor detects a temperature less than 34 °C, the LCD screen will show that it's suitable for water living creatures but if the temperature is more than 34 °C, the LCD screen will show that the temperature is not suitable for water

living creatures. Turbidity is the measure of haziness because of particles mixed onto it and it is measured in a unit called NTU. The lower the turbidity, the better it is for the living creatures and drinking. If the turbidity is 0 NTU or 1 NTU, then the LCD screen will show that the water is very much drinkable, if the turbidity is 2 NTU to 5 NTU then the LCD screen will show that the water is drinkable. If the turbidity is more than 5 NTU, then the LCD screen will show that the water is not drinkable. For the Dissolved oxygen sensor, if the oxygen is between 6 mg/L and 9 mg/L, the LCD screen will show that the water is suitable for fish and drinking. If the dissolved oxygen amount is Less than 6 mg/L or more than 9 mg/L, the LCD screen will show that the water is not suitable for drinking and fishes. Four of the sensors together will give a result about if the water is drinkable or safe for living creatures underwater or not.

V. Limitations

The limitations of the project are the device only tests the pH value, turbidity, temperature and dissolved oxygen but not any sensor to measure or detect the germs. Also, we could not find the sensors for turbidity and dissolved oxygen, so we reused the temperature sensor to act as also the turbidity and dissolved oxygen sensors and wrote the codes in that way so it will give the desired results from the simulation.

VI. Conclusion

This water quality testing system is a low-cost, real-time water testing technology that may be implemented in a range of environments, including drinkable water, distant lakes, rivers, coastal areas, and other similar environments, amongst many others. The system keeps track of a variety of water parameters, including temperature, oxygen levels, pH level, and turbidity. Maintaining healthy water for human consumption and for natural purposes may be a challenging task at times. Therefore, monitoring water quality is a difficult process. As a result of these considerations, this approach may be quite useful for evaluating all of the parameters.

VII. References

[[1] Yuda Irawan, Anita Febriani, Refni Wahyuni, Yesica Devis, “Gesture Controlled Laptop Using Arduino & Ultrasonic Sensor”, Journal of Robotics and Control (JRC) Volume 2, Issue 5, September 2021 ISSN: 2715-5072 DOI: 10.18196/jrc.25107

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