Project Name: pH Indicator with Auto Draining System

Introduction: pH Indicator with Auto Draining System is an automated system that indicates the pH value of stagnant water and drains the water with the motor as pH value. There are three draining motor which drains water respectively below pH 5 as acidic, upper pH 10 as base, and from pH 5.1 to pH 9.5 as neutral. It is mainly developed for agricultural uses as Bangladesh is an agrarian country. It is used for Fisheries and Cultivation of Crops because the acidic and base water is harmful to plants and animal.

Principle Behind the Project:

The pH Indicator with Auto Draining System operates based on several key scientific principles and technological components, which together ensure the efficient monitoring and management of water quality in agricultural settings. Here's a breakdown of these principles:

1. pH Measurement

- **Chemical Principle**: The pH scale measures the acidity or alkalinity of a solution, with values ranging from 0 to 14. A pH below 7 indicates acidity, a pH above 7 indicates alkalinity, and a pH of 7 is neutral. This scale is logarithmic, meaning each unit change represents a tenfold difference in hydrogen ion concentration.
- **Technological Application**: The system uses pH sensors that are capable of detecting the hydrogen ion concentration in water. These sensors generate a voltage corresponding to the pH level, which is then read and processed by a microcontroller.

2. Microcontroller and Data Processing

- **Technical Principle**: Microcontrollers are compact integrated circuits designed to execute specific tasks, such as reading sensor data, processing it, and controlling outputs based on predefined conditions.
- **Application in the System**: The microcontroller in this project receives the voltage signal from the pH sensors. It is programmed to categorize the water's pH value into three ranges: acidic (pH < 5), neutral (pH 5.1 to 9.5), and basic (pH > 10). Based on the pH value, the microcontroller activates the appropriate draining motor.

3. Automated Draining Mechanism

- **Implementation**: The system includes three draining motors, each connected to separate outlets. When the microcontroller identifies the pH value of the water, it triggers the corresponding motor: one for acidic water, another for basic water, and a third for neutral water.

4. Environmental and Agricultural Impact

- **Biological Principle**: Water pH significantly impacts the health and growth of plants and aquatic life. Most crops and fish species thrive in water with a neutral pH range. Acidic or basic water can hinder nutrient availability, harm biological processes, and increase toxicity.
- **Agricultural Application**: By continuously monitoring and regulating the pH of water, this system helps maintain optimal conditions for agriculture and aquaculture. It prevents the use of harmful water, thereby protecting plants and animals from adverse effects and promoting healthy growth and productivity.

5. Automation and Efficiency

- **Operational Principle**: Automation in agricultural systems reduces manual labor, enhances precision, and increases efficiency. Automated systems can continuously operate without the need for constant human supervision.
- **System Benefits**: The automated draining system ensures timely and accurate response to changes in water pH. This reduces the risk of human error and ensures consistent water quality management, crucial for sustainable agricultural practices.

Objective:

The objective of the pH Indicator with Auto Draining System is to enhance agricultural productivity and sustainability by ensuring optimal water quality through automated pH monitoring and management. This system aims to continuously measure the pH levels of stagnant water in agricultural settings and automatically drain water that falls outside the optimal pH range for crops and aquatic life. Ultimately, the system is designed to support sustainable agricultural practices, specifically tailored to the needs of Bangladesh, an agrarian country, thereby contributing to the long-term health of soil, crops, and aquatic ecosystems while improving food security in the region.

List of Equipment (In Detail)

1. Arduino Uno

- **Description**: A microcontroller board based on the ATmega328P. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header, and a reset button.
- **Usage**: Acts as the central control unit, processing inputs from the pH sensor and controlling the water motors and other components.

2. pH Sensor

- **Description**: A device that measures the hydrogen-ion activity in water-based solutions, indicating its acidity or alkalinity.
- **Usage**: Detects the pH level of the water and sends an analog signal corresponding to the pH value to the pH sensor module.

3. pH Sensor Module

- **Description**: An interface board that connects the pH sensor to the Arduino. It conditions the sensor signal and provides an easy connection to the microcontroller.
- **Usage**: Converts the analog signal from the pH sensor into a format that can be read by the Arduino.

4. 6V Water Motor

- **Description**: An electric motor that operates at 6 volts, typically used for pumping or draining water.
- **Usage**: Drains water when activated by the Arduino based on the pH reading.

5. Motor Driver

- **Description**: An electronic device that controls the direction and speed of electric motors.
- **Usage**: Interfaces between the Arduino and the water motors, allowing the Arduino to control the motors' operations.

6. LED

- **Description**: A light-emitting diode used as an indicator.
- **Usage**: Provides visual feedback, indicating the status of the system (e.g., when a motor is activated).

7. Resistor

- **Description**: An electronic component that limits or regulates the flow of electrical current in a circuit.
- **Usage**: Used in conjunction with the LED and other components to ensure proper current flow and prevent damage.

8. Power Supply Converter

- **Description**: A device that converts the main power supply voltage to a suitable level for the system.
- **Usage**: Ensures the components receive the correct voltage required for operation.

9. Power Supply

- **Description**: The source of electrical power for the system, which can be a battery or an AC-DC adapter.
- **Usage**: Provides the necessary power for the Arduino, sensors, motors, and other components.

10. Buck Converter

- **Description**: A DC-DC converter that steps down voltage from a higher level to a lower level.
- **Usage**: Used to efficiently reduce the voltage from the power supply to the appropriate level for different components.

11. 10k Potentiometer

- **Description**: A variable resistor with a resistance range of 0 to 10,000 ohms.
- **Usage**: Allows for manual adjustment of parameters within the circuit, such as tuning sensor sensitivity or setting threshold values.

12. Switch

- **Description**: An electronic component that can open or close an electrical circuit.
- **Usage**: Used to manually control the power to the system or specific components, enabling or disabling the system as needed.

13. PCB board

- A printed circuit board, or PCB, is used to mechanically support and electrically connect electronic components using conductive pathways, tracks or signal traces etched from copper sheets laminated onto a non-conductive substrate.

Application of the Project

The pH Indicator with Auto Draining System has a range of practical applications, particularly in the agricultural sector, where water quality is crucial for the health and productivity of crops and aquatic life. Here are the primary applications of this project:

1. Agriculture

- **Crop Cultivation**: Ensures that the water used for irrigation has an optimal pH level. Water that is too acidic or too basic can harm plant roots, affect nutrient availability, and ultimately reduce crop yields. By maintaining water pH within a neutral range, this system supports healthy plant growth and maximizes agricultural productivity.
- **Soil Management**: Prevents soil degradation caused by the use of water with unsuitable pH levels. Consistently using water with the right pH helps maintain soil health, fertility, and structure, which are essential for sustainable farming practices.

2. Aquaculture

- **Fish Farming**: Monitors and maintains the pH of water in fish ponds and tanks. Fish and other aquatic animals are sensitive to pH changes, and extreme pH levels can lead to stress, disease, and death. This system helps create a stable environment that supports the health and growth of fish and other aquatic species.
- **Water Quality Control**: Ensures that water in aquaculture systems is regularly refreshed and maintained at a pH level that promotes optimal living conditions, thereby enhancing the efficiency and yield of fish farming operations.

3. Greenhouses

- **Controlled Environment Agriculture**: Supports the precise control of water quality in greenhouse environments where plants are grown under controlled conditions. Proper pH levels in irrigation water are essential for nutrient uptake and overall plant health in these settings.

4. Water Resource Management

- **Reservoir and Pond Management**: Helps in managing the pH levels of water bodies used for irrigation or aquaculture. By preventing the accumulation of water with harmful pH levels, it ensures the availability of safe and suitable water resources.
- **Flooded Fields**: In areas prone to flooding, this system can be used to monitor and manage the pH of floodwater that might be used for irrigation, ensuring that it does not harm crops or soil.

5. Environmental Protection

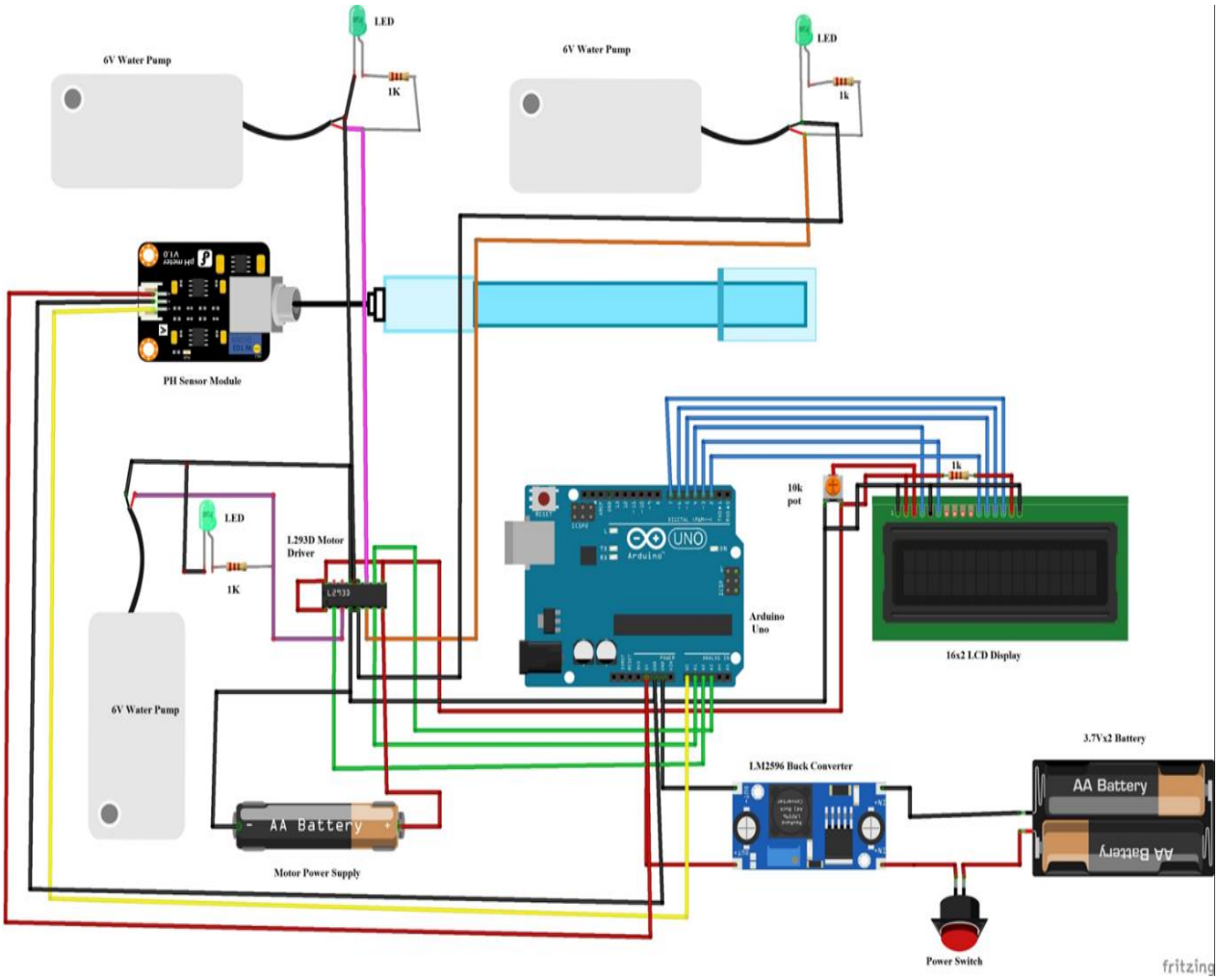
- **Pollution Control**: Assists in monitoring and mitigating the effects of acid rain or industrial pollutants that can alter the pH of water bodies. By automatically draining and replacing water with inappropriate pH levels, it helps protect local ecosystems.
- **Sustainable Practices**: Encourages the adoption of sustainable agricultural and aquaculture practices by ensuring that water quality is consistently monitored and managed, reducing the environmental impact of these activities.

6. Educational and Research Purposes

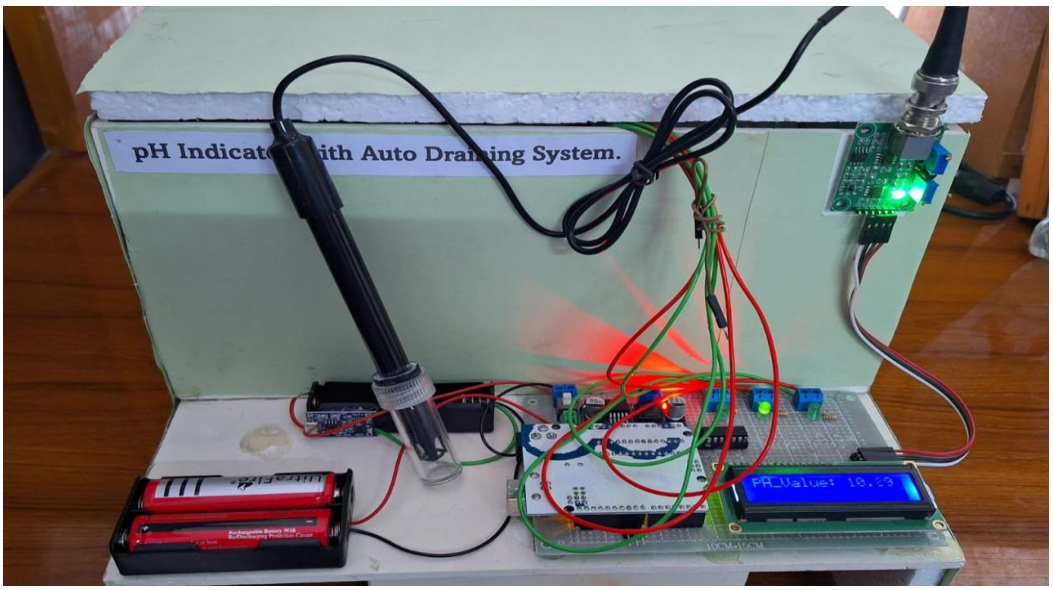
- **Demonstration and Training**: Serves as a practical tool for demonstrating the importance of pH management in water for students and researchers in agricultural sciences, environmental studies, and engineering.
- **Research and Development**: Provides a platform for experimenting with different pH levels and their effects on various crops and aquatic species, contributing to the development of more efficient and sustainable agricultural practices.

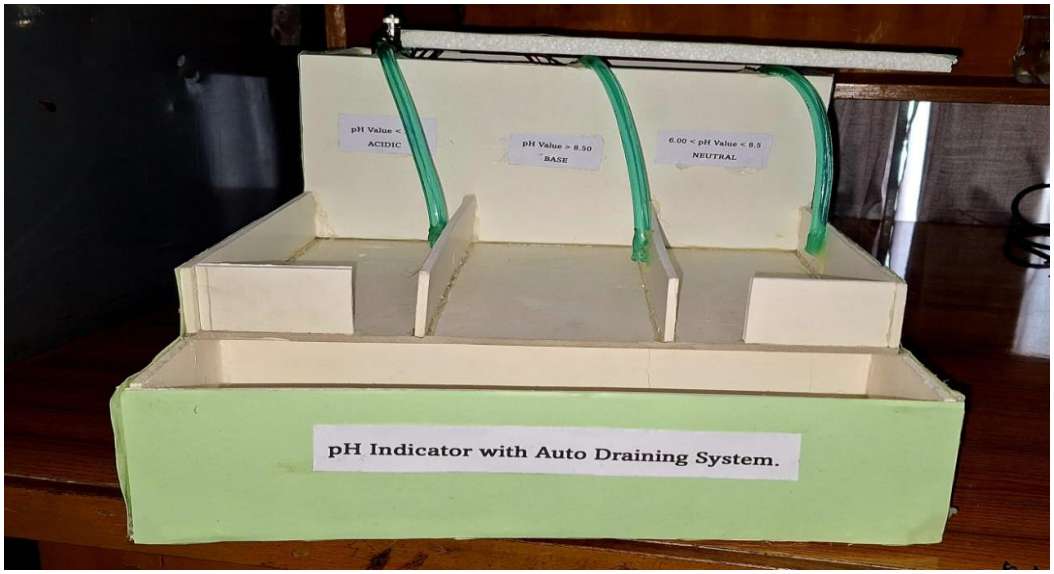
Design of the Project:

- **Diagram**



- **Project Photo**





Arduino Code:

```
// include the library code:
#include <LiquidCrystal.h>

// initialize the library by associating any needed LCD interface
pin
// with the arduino pin number it is connected to
const int rs = 4, en = 3, d4 = 2, d5 = 5, d6 = 6, d7 = 7;
LiquidCrystal lcd(rs, en, d4, d5, d6, d7);

#define ph_Pin A0
#define relayPin1 A1
#define relayPin2 A2
#define relayPin3 A3

float calibration = 21.34 + 5.20;  //change this value to calibrate
int sensorValue = 0;
unsigned long int avgValue;
float b;
int buf[10], temp;

float phValue;
int count = 0;

void setup() {
  Serial.begin(115200);
  lcd.begin(16, 2);
  lcd.setCursor(0, 0);
  lcd.print("PH Sensor");

  pinMode(relayPin1, OUTPUT);
  pinMode(relayPin2, OUTPUT);
  pinMode(relayPin3, OUTPUT);

  for(int i = 0; i < 30; i++)
  {
     ph_Sensor();
     delay(1000);
  }

}

void loop() {
  count++;
  ph_Sensor();
  delay(1000);

  if(count > 30)
{
    digitalWrite(relayPin1, LOW);
    digitalWrite(relayPin2, LOW);
```

```
    digitalWrite(relayPin3, LOW);
    count = 31;
  }
  else if(count )

  if (phValue < 5.00) {
    digitalWrite(relayPin1, HIGH);
    digitalWrite(relayPin2, LOW);
    digitalWrite(relayPin3, LOW);
  } else if (phValue > 6.0 && phValue < 8.5) {
    digitalWrite(relayPin1, LOW);
    digitalWrite(relayPin2, HIGH);
    digitalWrite(relayPin3, LOW);
  } else if (phValue > 8.50) {
    digitalWrite(relayPin1, LOW);
    digitalWrite(relayPin2, LOW);
    digitalWrite(relayPin3, HIGH);
  }

}

void ph_Sensor() {
  for (int i = 0; i < 10; i++) {
    buf[i] = analogRead(ph_Pin);
    delay(10);
  }
  for (int i = 0; i < 9; i++) {
    for (int j = i + 1; j < 10; j++) {
      if (buf[i] > buf[j]) {
        temp = buf[i];
        buf[i] = buf[j];
        buf[j] = temp;
      }
    }
    avgValue = 0;
    for (int i = 2; i < 8; i++)
      avgValue += buf[i];
    float pHVol = (float)avgValue * 4.8 / 1023.0 / 6;
    phValue = -5.70 * pHVol + calibration;

   if(phValue < 6.5 )
   {
    phValue = phValue * 0.6;
   }
   else if(phValue > 6 && phValue < 7.8)
   {
    phValue = phValue * 1.03;
   }
   else if(phValue > 7.8)
   {
    phValue = phValue * 1.3;
```

```
    }

     Serial.print("phValue    : ");
     lcd.setCursor(0, 0);
     lcd.print("PH_Value: ");
     lcd.print(phValue);
     lcd.print("  ");
     Serial.println(phValue);
   }
}
```

Future Work:

- We will work on if the water is dirty or not usable for normal work then it will be usable.
- Add water depth measuring machine.
- Add iron measuring machine.
- Make a fully AI based software for this project.

Conclusion:

The pH Indicator with Auto Draining System represents a significant advancement in agricultural and aquaculture water management. By integrating automated pH monitoring with precise water drainage controls, this system ensures that only water with optimal pH levels is used for irrigation and fish farming, thus protecting plants and aquatic life from the harmful effects of inappropriate pH levels. This project addresses critical challenges faced by farmers and aquaculture practitioners in Bangladesh, an agrarian country where water quality is pivotal for productivity and sustainability.

END