A Mini Project Report on

MODERN FISH FARMING AQUA RESOURCE MANAGEMENT USING IoT

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రాజీవ్ గాంధీ వైజ్ఞానిక సాంకేతిక విశ్వవిద్యాలయం - ఆంధ్రప్రదేశ్, శ్రీకాకుళం క్యాంపస్
Catering to the Educational Needs of Gifted Rural Youth of Andhra Pradesh

CERTIFICATE

This is to certify that the mini project work titled "Modern Fish Farming Aqua Resource Management Using IoT" was successfully completed by **V.Durga poojitha(s180373), J.Rama(s180036), R.Karuna Kumari(s180880)**, in partial fulfillments of the requirements for the mini project in Computer Science and Engineering of Rajiv Gandhi University of Knowledge Technologies under the guidance and output of the work carried out is satisfactory.

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DECLARATION

I declared that this thesis work titled **"Modern Fish Farming Aqua Resource Management System"** is carried out by us during the year 2022-23 inpartial fulfillment of the requirements for the Mini Project in **Computer Science and Engineering.**

I further declare that this dissertation has not beensubmitted elsewhere for any Degree. The matter embodied in thisdissertation report has not been submitted elsewhere for any otherdegree.The work contained in the project report is original and has been done by ourselves under the guide. Furthermore, the technical details furnished in various chapters of this thesis are purely relevant to the above project andthere is no deviation from the theoretical point of view for design,development and implementation.

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ABSTRACT

“Modern Fish Farming Aqua Resource Management Using IoT”

Andhra Pradesh is in 1st rank in the production of fish in india which is rich source of vitamins, minerals, protein, nutrients and micronutrients. Farmers found it difficult to manage aqua farms and achieve good yields since we were unable to foresee the water conditions. As a result, an IoT-based solution has been presented that will provide farmers with the real-time, accurate information they need to monitor and maximize their production level. Utilizing water flow control sensors, the architecture of a contemporary aquaculture management system examines water quality and modifies water parameters in real-time. This system comprises of many sensors that gauge temperature, turbidity, pH, and other aspects of the water quality. A microcontroller processes the measured sensor readings and displays changes in Arduino Cloud.

Key Words:

- IoT(Internet of Things)
- pH(Potential of Hydrogen)
- Microprocessors
- Turbidity
- Dissolved oxygen

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1. INTRODUCTION

1.1. Introduction:

The fisheries industry plays a significant role in the Indian economy by creating income, exports and ensuring nutritional and food security. Fish farming, sometimes referred to as aquaculture, is a growingly significant sector of the economy that involves breeding fish in managed environments. Fish are delicate creatures, though, and poor water quality can cause stress, illness, and even death. Low amounts of oxygen, high levels of ammonia or nitrite, and high levels of turbidity are common problems with water quality in fish farming. Furthermore, the discharge of nutrients and garbage into nearby waters can result in pollution and eutrophication, which can have detrimental effects on the ecosystem and general well-being.

Modern technology, including IoT and sensors, can be used to enhance fish farming practices to overcome these difficulties. In order to maintain the best circumstances for fish health and growth, these technologies can help monitor and regulate water quality parameters like oxygen levels, pH, temperature, and turbidity levels in real-time. Additionally, by proactively identifying and addressing water quality issues, fish producers might potentially lower the likelihood of disease outbreaks and death.

1.2 Statement of the problem

The problem statement of the aqua resource management include challenges such as increase in turbidity level of water, fluctuations in pH level, decrease of dissolved oxygen level, fluctuations in temperature and lack of real-time information of the above parameters to the aqua farmers. Addressing these problems require different bio sensors to detect water quality parameters, microprocessors to process the data collected from sensors and an IoT cloud platform to store the data from sensors.

1.3 Objective

- Aqua farmers can remotely monitor the water quality parameters such as ph, temperature, dissolved oxygen and turbidity
- Automation of aerators based on dissolved oxygen level
- Automation of water flow using flow control sensors and turbidity sensor

1.4 Goals

- Increase the yield of fish production
- Maintaining good fish health
- Water wastage management
- Aqua farmers friendly

1.5 Scope

The scope of aqua resource management in fish farming includes water quality management, disease control, sustainability practices, data analytics, automation, and regulatory compliance to enhance productivity, minimize environmental impact, and ensure the sustainable development of the industry.

1.6 Applications

1. **Commercial Fish Farms:** Aqua resource management is widely applied in commercial fish farming operations, including the production of various fish species for food consumption or ornamental purposes.

2. **Educational and Training Facilities:** Aqua resource management concepts and technologies are taught and implemented in educational institutions and training centers to train future aquaculturists and promote sustainable fish farming practices.

3. **Urban Aquaculture**: Aqua resource management techniques can be utilized in urban aquaculture systems, such as rooftop or indoor fish farming, to maximize limited space and ensure efficient resource utilization.

1.7 Limitations

- Depending on the type of fish the threshold values has to be adjusted.
- Proper care has to be taken for hardware devices.
- In remote areas or locations with limited internet connectivity.
- High implementation costs and scalability issues.
- Compatibility and integration difficulties.
- Power consumption and battery life constraints.

2. LITERATURE SURVEY

2.1 Collect Information

We have collected the information from the internet and various research papers about the water quality measures in aqua culture and how they define fish health. We restricted our survey with only Andhra Pradesh state as it is the top in fish production in India and researched about various fish species produced by Andhra Pradesh and applied average threshold values to the water quality parameters.

2.2 Study

Key Features:

- Automation of aerators.
- Maximize the fish production.
- User friendly interface
- Node Mcu with ESP8266 wifi module
- Real-Time Monitoring
- Remote Access and Control

2.3 Benefits

- **Improved Production Efficiency**: Aqua resource management optimizes feeding schedules, water quality parameters, and environmental conditions, resulting in improved fish growth rates, feed conversion ratios, and overall productivity.
- **Enhanced Fish Health and Welfare**: By continuously monitoring water quality and implementing appropriate measures, aqua resource management helps maintain optimal conditions for fish health, reducing the risk of diseases and promoting better fish welfare. Maintain the accuracy, integrity and consistency of the data.
- **Remote Monitoring and Control**: Aqua resource management systems often provide

remote access capabilities, allowing fish farmers to monitor the water conditions from anywhere. This flexibility improves convenience, enables timely response to alerts or issues, and facilitates better farm management. Security of data.

- **Knowledge Sharing and Collaboration:** Aqua resource management encourages the exchange of knowledge, best practices, and collaboration among fish farmers, researchers, and industry stakeholders. This promotes innovation, continuous learning, and the advancement of fish farming practices.Ensure data accuracy.
- **Market Competitiveness:** Implementing efficient aqua resource management practices enhances the quality, consistency, and traceability of fish products. This can improve market competitiveness and meet the demands of consumers seeking sustainably produced fresh water fishes.

2.4 Summary

Aqua resource management in fish farming involves the application of technologies and practices to optimize water quality, disease control, and overall resource utilization. It enables real-time monitoring, data analysis, automation, and remote access, leading to improved production efficiency, fish health, sustainability, and market competitiveness. By promoting responsible resource management and leveraging advanced tools, aqua resource management supports the growth of a sustainable and efficient fish farming industry.

3. ANALYSIS

3.1 Existing system

Some of the existing technologies used in aquaculture include:

- **Environmental Monitoring Systems:** These systems incorporate sensors to continuously monitor water quality parameters such as temperature, pH, dissolved oxygen, and turbidity. The collected data is analyzed to maintain optimal conditions for fish health and growth. Examples include the use of multi parameter probes, water quality monitoring stations, and automated data logging.
- **Automated Feeding Systems:** These systems utilize sensors and feeding algorithms to automate the distribution of fish feed based on predetermined schedules or real-time monitoring of fish behavior and appetite. They ensure accurate and efficient feed delivery, reducing waste and optimizing feed conversion ratios.
- **Recirculating Aquaculture Systems (RAS):** RAS systems recirculate and treat water, allowing for better control of water quality parameters and reduced water usage compared to traditional flow-through systems. These systems often incorporate monitoring and automation technologies for water filtration, aeration, and waste management.

3.2 Disadvantages

- Highly expensive
- Less accurate.
- Not user friendly.
- Less efficient.

3.3 Proposed System

The proposed system is made for fishermen to monitor the quality of water for a healthy environment for fish to live in. Healthy water is essential for aquatic animals. Water quality is decided by some factors like pH level, oxygen level, temperature etc. Some sensors have been integrated with the proposed system to collect the values of some parameters from the water. For this purpose, pH sensor, temperature sensor, oxygen and turbidity have been used. This system was created by connecting a pH sensor, a temperature sensor, and some other equipment.

3.4 Advantages

- Farmers can accurately monitor and maintain optimal water quality levels, leading to higher yields and better quality fish.
- **Real-time monitoring:** The system continuously monitors the water quality parameters and sends alerts to the farmers in real-time if there is any deviation from the desired conditions. This helps farmers to take corrective actions promptly and prevent any adverse effects on fish health.
- **Improved yield:** By maintaining optimal water quality conditions, the system can help farmers achieve better yields and maximize their profits.
- **Environmentally friendly:** The system helps to minimize the impact of aquaculture on the environment by preventing pollution and eutrophication

3.5 System Requirements

Software Requirements:

- Tinkercad
- Thingspeak or Arduino cloud

Hardware Requirements:

- Node MCU microprocessor or Arduino UNO
- Sensors: pH, Temperature, Turbidity, Dissolved Oxygen, Water level sensor, Water flow control sensor
- DC motors along with Fans
- Connecting wires and resistors

4. Materials and Methods

4.1 Hardware Equipment for the Development of the System

The temperature sensor and pH sensor measure the properties of the water and transmit those properties to the server via the Wi-Fi module. To view values, a mobile application was created. Fish need a certain pH level. Maintaining the pH level is crucial to growing a healthy fish. Thus, a pH sensor (Fig. 1) was employed . The pH of natural freshwater ponds ranges from 6 to 8. Low pH levels indicate acidic water, whereas high pH levels indicate alkaline water. Fish can suffer harm to their skin, eyes, and other exterior surfaces if pond water gets overly alkaline. Fish cannot reproduce in acidic water. Low pH levels can cause fish to perish.

The temperature of the water has been tracked using a temperature sensor (Fig. 3; reference 29). It's critical to maintain the proper temperature because fish activity levels are influenced by temperature. It is crucial for fish because hot water cannot hold adequate oxygen. Fish require more food to thrive because they are more active in hotter water. They require less food since they are relatively less active in cold water.

Not all varieties of fish prefer the same temperature. The DS18B20 temperature sensor was employed here. A programmable digital temperature sensor is the DS18B20. It functions with a single cable for communication.

For fish, oxygen is a crucial component. Water quality will be impacted by dissolved oxygen levels that are either too high or too low. So, the concentrations of dissolved oxygen in the water have been measured using Dissolved oxygen sensor. A concentration of 5 mg/L DO is recommended for optimum fish health. Sensitivity to low levels of dissolved oxygen is species specific, however, most species of fish are distressed when DO falls to 2-4 mg/L. Mortality usually occurs at concentrations less than 2 mg/L. Hence if the oxygen levels falls to certain threshold value aerators automatically turned on and when it reaches to normal conditions the aerators will turned off.

Turbidity is a water parameter that affects its transparency due to fine dispersion of the light beam passing through it. This phenomenon is directly associated with suspended solids in water. The suspended solids are a combination of clay, salts as well as organic and inorganic matter. Higher turbidity results may cause decease of fishes hence by using turbidity sensor we can know the quality of water and if the turbidity is higher valves automatically open and old water is replaced with fresh water using water flow control sensors.

Fig 1.Temparature Sensor

Fig 2. pH Sensor

Fig 3. Dissolved Oxygen Sensor

Fig 4. Turbidity Sensor

Fig 5.Water Flow Control Sensor

Fig 6. Water Level Sensor

Fig 7. Arduino UNO

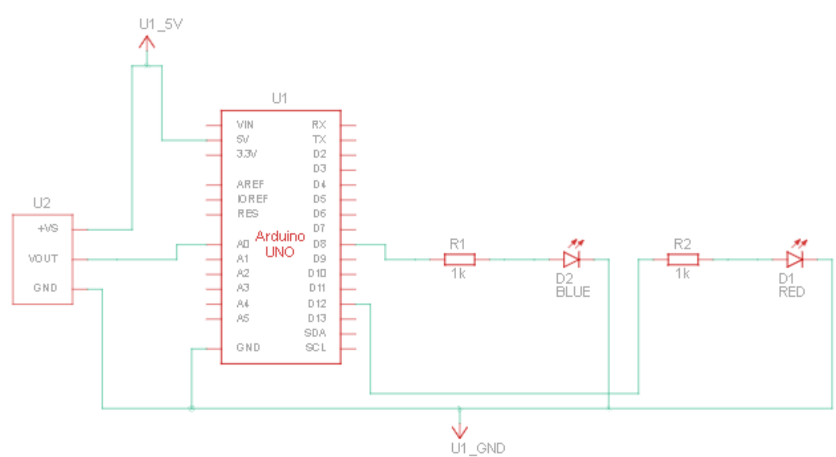
5. SYSTEM IMPLEMENTATION

5.1 Implementation of sensors using Tinkercad Software

We can employ a broad variety of electronic components from Tinkercad in our Designs. These parts include sensors, resistors, capacitors, LEDs, motors, and microcontrollers (such as Arduino boards). We may link these components to our systems in order to detect things like pH level, temperature value, dissolved oxygen level, and water turbidity level.

5.1.1 Temperature Sensor Working

Name	Quantity	Component
U1	1	Arduino Uno R3
U2	1	Temperature Sensor [TMP36]
D1	1	Red LED
D2	1	Blue LED
R1 R2	2	1 kΩ Resistor



Circuit diagram of temperature sensor

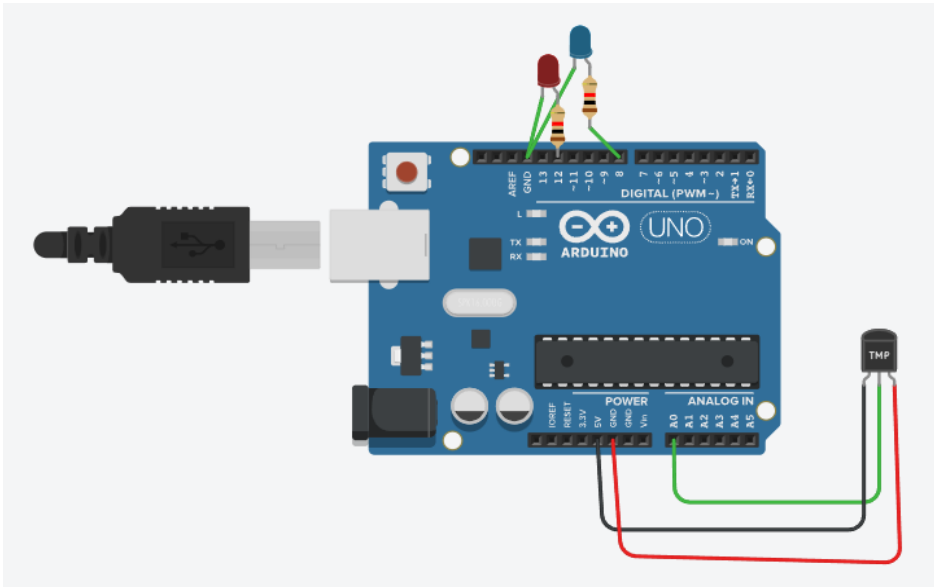


Fig. Temperature at Normal Level (25°c - 30° c)

The Temperature Sensor[TMP36] having 3 inputs

- Analog pin(A0) connected to the temperature sensor(Vout)
- Power pin is connected to the 5V
- Last pin connected to Ground

There are two LEDs are connected to digital pins (output)

Whenever the connections are completed then we can write the code as per our conditions and simulate it.

Condition:1 If the temperature level is high($>30^{\circ}$c) then the Red LED is glow

Condition:2 If the temperature level is low($<25^{\circ}$c) then the Blue LED is glow

After Simulation:

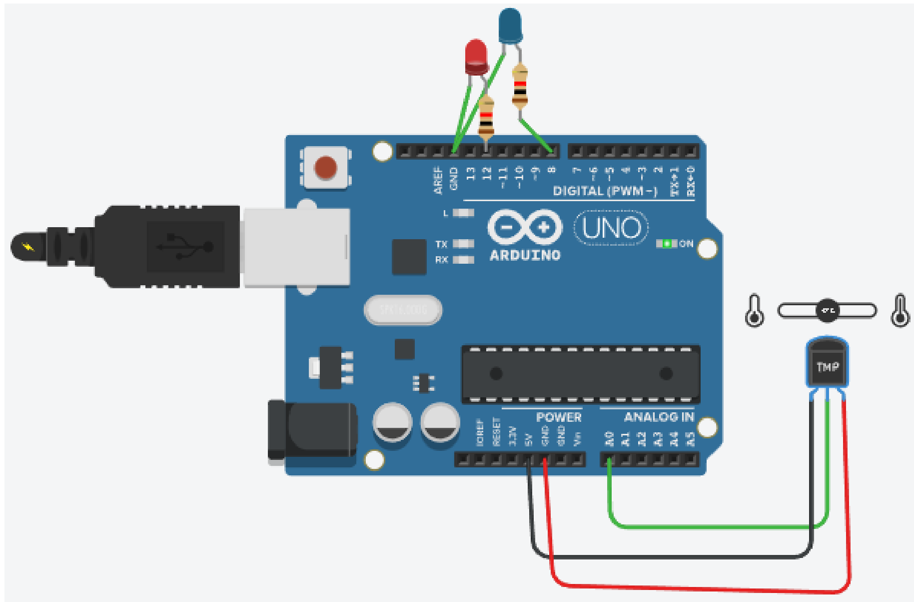


Fig. Temperature at High Level (63.4º c)

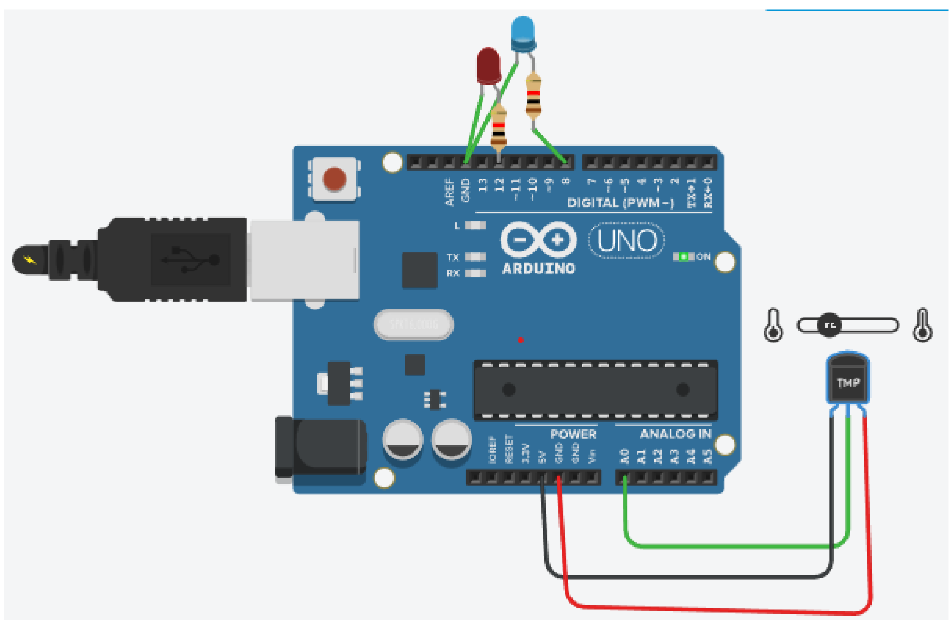
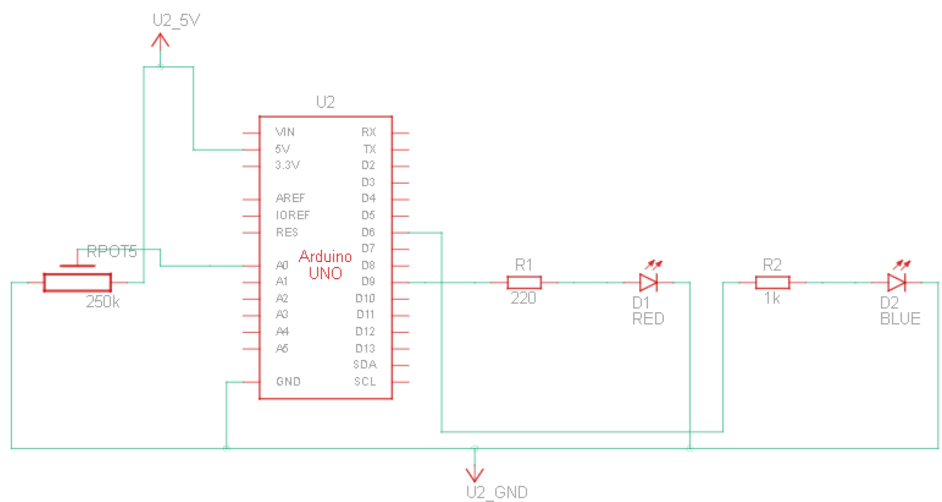


Fig. Temperature at Low Level (18.2º c)

5.1.2 Potentiometer Working (instead PH sensor)

Name	Quantity	Component
U2	1	Arduino Uno R3
Rpot5	1	250 kΩ Potentiometer
R1	1	220 Ω Resistor
D1	1	Red LED
D2	1	Blue LED
R2	1	1 kΩ Resistor



Circuit diagram of ph sensor

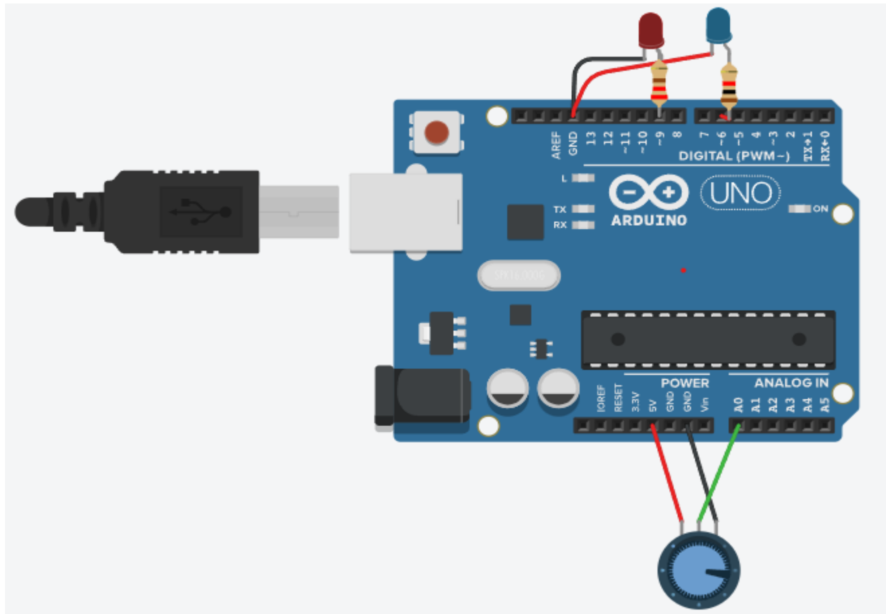


Fig. PH value at Normal (6.0 to 8.5)

- Potentiometer connected to analog pin 0.
- Center pin of the potentiometer goes to the analog pin.
- Side pins of the potentiometer go to +5V and ground
- LEDs connected from digital pin 9,6 to ground

Whenever the connections are completed we may write the code to simulate the situation according to our conditions.

Condition:1 If the Ph level is high(>8.5) then the Red LED is glow

Condition:2 If the Ph level is low(<6.0) then the Blue LED is glow

After Simulation:

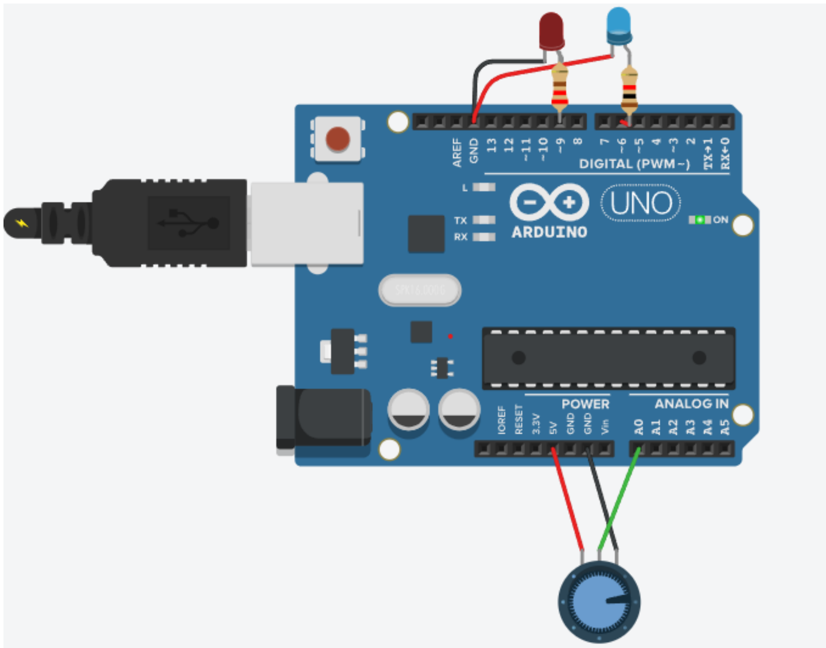


Fig. pH level is Low (3.2)

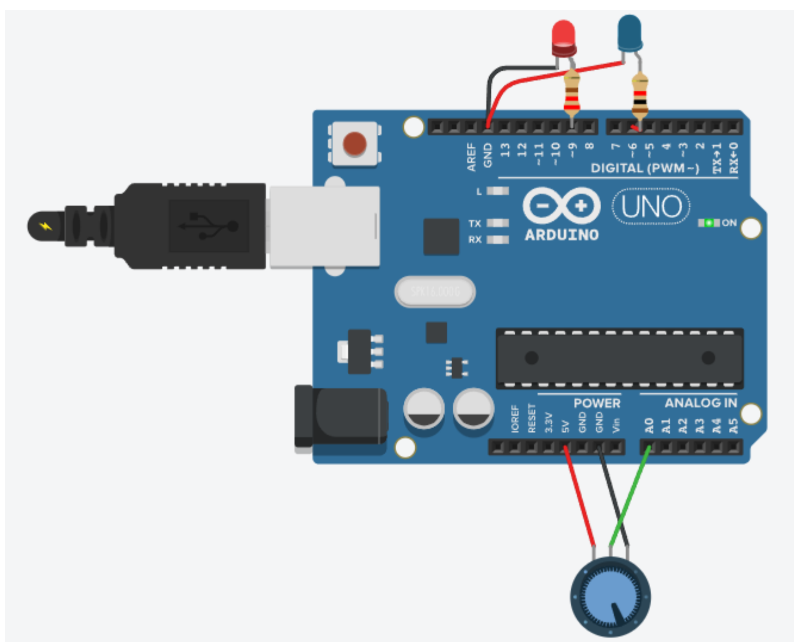
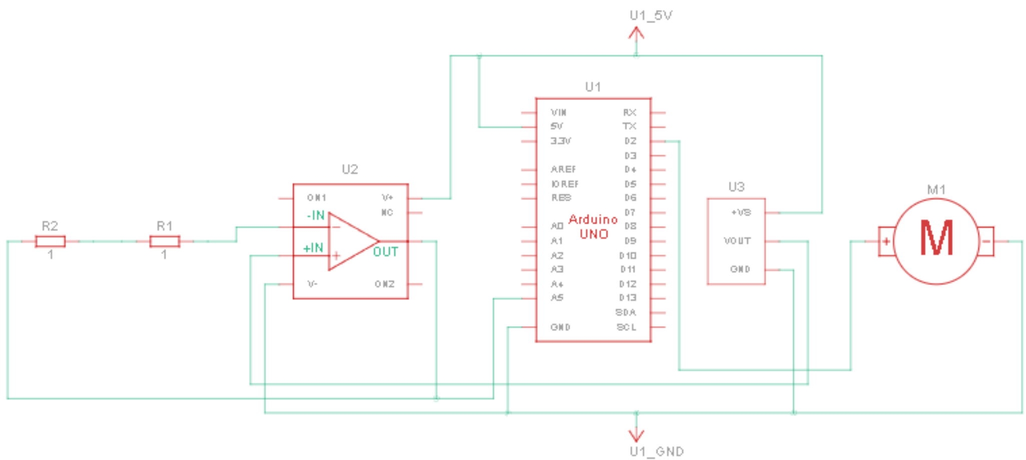


Fig.pH level is High (10.5)

5.1.3 Dissolved Oxygen sensor Circuit Working

Name	Quantity	Component
U1	1	Arduino Uno R3
R1 R2	2	1 Ω Resistor
U3	1	Temperature Sensor [TMP36]
M1	1	DC Motor
U2	1	741 Operational Amplifier



Circuit diagram of dissolved oxygen

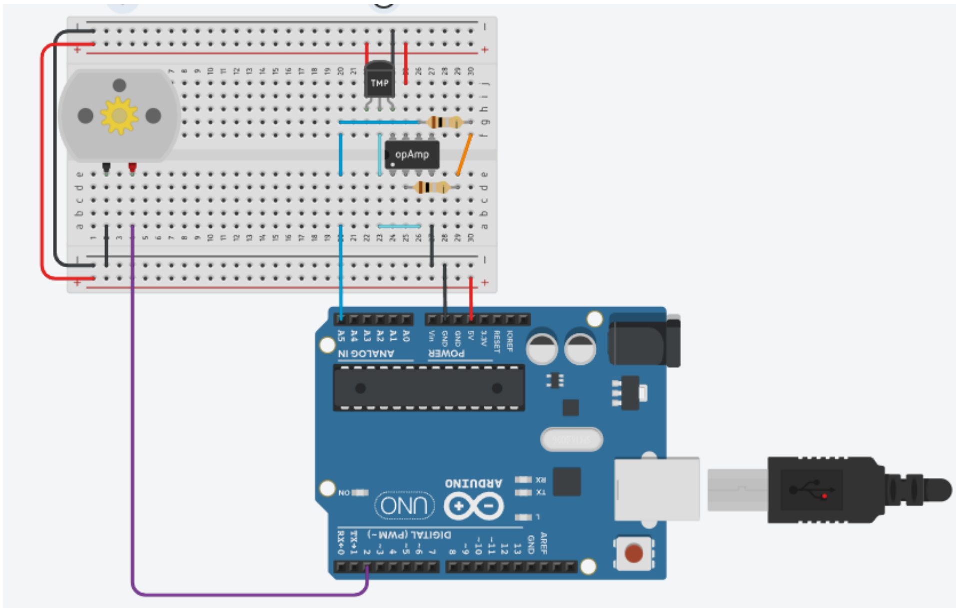


Fig. Dissolved oxygen level

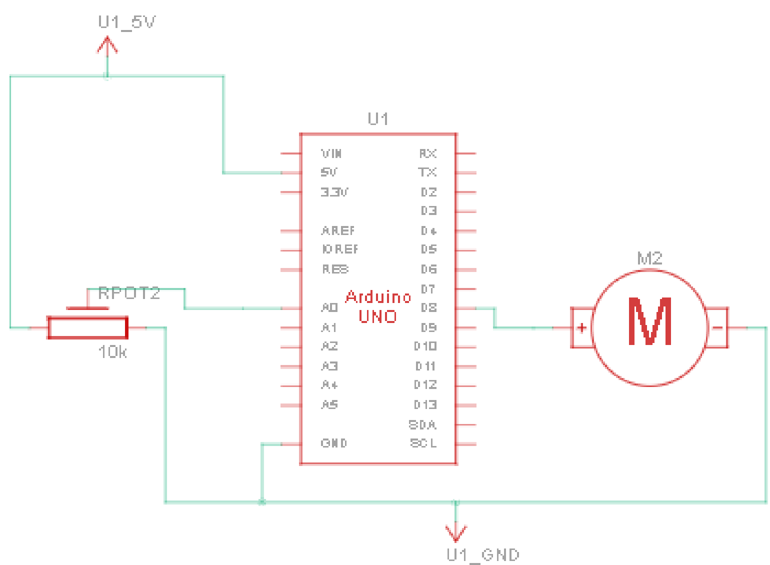
- Connect the VCC pin of the dissolved oxygen sensor to the 5V pin on the Arduino.
- Connect the GND pin of the dissolved oxygen sensor to the GND pin on the Arduino
- Connect the TX pin of the dissolved oxygen sensor to a digital pin on the Arduino (e.g., pin 2 or any other available digital pin).
- Connect the RX pin of the dissolved oxygen sensor to a digital pin on the Arduino (e.g., pin 3 or any other available digital pin).

Whenever the connections are complete, we may write the code to simulate the situation according to our conditions.

Condition: if currentO2Level < wanted02Level then DC Motor ON

5.1.4 Turbidity Sensor Circuit Working

Name	Quantity	Component
U1	1	Arduino Uno R3
Rpot2	1	10 kΩ Potentiometer
Meter2	1	Voltage Multimeter
M2	1	DC Motor



Circuit diagram of turbidity sensor

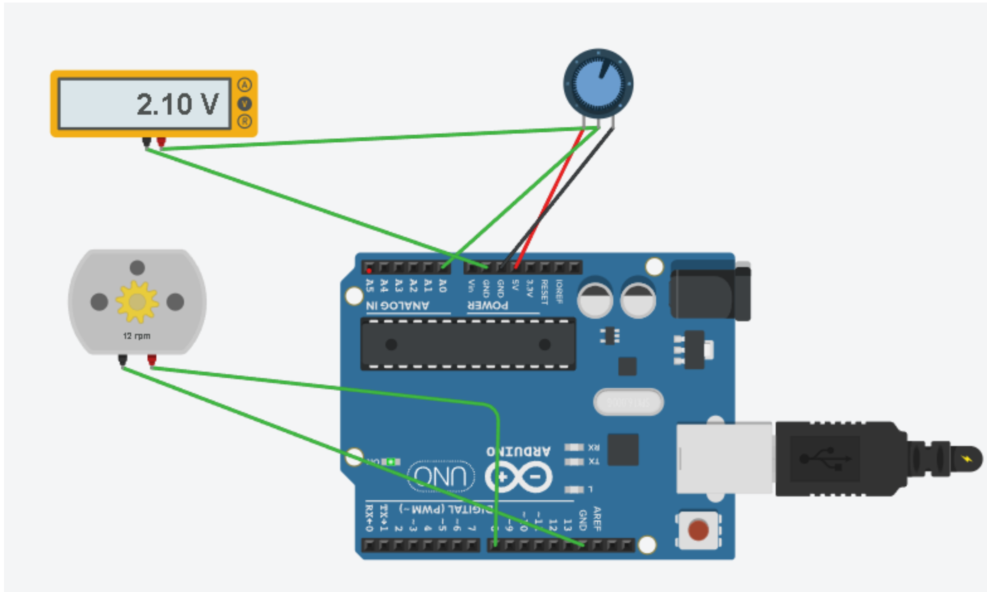


Fig: Turbidity level

- Connect the VCC pin of the turbidity sensor to the 5V pin on the Arduino.
- Connect the GND pin of the turbidity sensor to the GND pin on the Arduino.
- Connect the analog output pin of the turbidity sensor to an analog input pin on the Arduino (e.g., A0 or any other available analog input pin).

Whenever the connections are complete, we may write the code to simulate the situation according to our conditions.

Condition: If Turbidity value > some_value_given then automatic pipes open water flows out and pump is ON (for new Water)

6. SOURCE CODE

6.1 Temperature Sensor

```
const int analogPin = A0; // Analog pin connected to the temperature sensor
void setup() {
  pinMode(A0, INPUT);
  pinMode(12, OUTPUT);
  pinMode(8, OUTPUT);
  Serial.begin(9600);        // Initialize serial communication
}

void loop() {
  int sensorValue = analogRead(analogPin);  // Read analog value from the temperature sensor
  float voltage = sensorValue * (5.0 / 1023.0);  // Convert analog value to voltage
  float temperature = (voltage - 0.5) * 100;  // Convert voltage to temperature in degrees celsius

   if (temperature > 30) {
    digitalWrite(12, HIGH);
    digitalWrite(8, LOW);
  } else if (temperature < 25) {
    digitalWrite(12, LOW);
    digitalWrite(8, HIGH);
  } else {
```

```
    digitalWrite(12, LOW);
    digitalWrite(8, LOW);
   }
  Serial.print("Analog Value: ");
  Serial.print(sensorValue);
  Serial.print(", Voltage: ");
  Serial.print(voltage);
  Serial.print("V, Temperature: ");
  Serial.print(temperature);
  Serial.println("°C");
  delay(100);  // Delay for stability
```

6.2 pH Sensor

```
int sensorValue = 0;
int outputValue = 0;
void setup()
{
  pinMode(A0, INPUT);
  pinMode(9, OUTPUT);
  pinMode(6, OUTPUT);
  Serial.begin(9600);
}
```

```
void loop()
{
  sensorValue = analogRead(A0); // read the analog in value
  outputValue = map(sensorValue, 0, 1023, 0, 255); // map it to the range of the analog out
 // change the analog out value:
 if (outputValue > 85) {
   digitalWrite(9, HIGH);
   digitalWrite(6, LOW);
 } else if (outputValue < 65) {
   digitalWrite(9, LOW);
   digitalWrite(6, HIGH);
 } else {
   digitalWrite(9, LOW);
   digitalWrite(6, LOW);
 }
  // print the results to the serial monitor:
 Serial.print("sensor = ");
 Serial.print(sensorValue);
 Serial.print("\t output = ");
 Serial.println(outputValue);
 // wait 2 milliseconds before the next loop for the
 // analog-to-digital converter to settle after the
 // last reading:
 delay(2); // Wait for 2 millisecond(s)}
```

6.3 Dissolved Oxygen Sensor Circuit

```
int currentO2Level = 0;

int wanted02Level = 0;

void setup()

{

  Serial.begin(9600);

  pinMode(A5, INPUT);

  pinMode(2, OUTPUT);

}

void loop()

{

  wanted02Level = 155;

  Serial.println(currentO2Level);

  currentO2Level = analogRead(A5);

  if (currentO2Level < wanted02Level) {

   digitalWrite(2, HIGH);

  } else {

    digitalWrite(2, LOW);

  }

  delay(10); // Delay a little bit to improve simulation performance

}
```

6.4 Turbidity sensor circuit

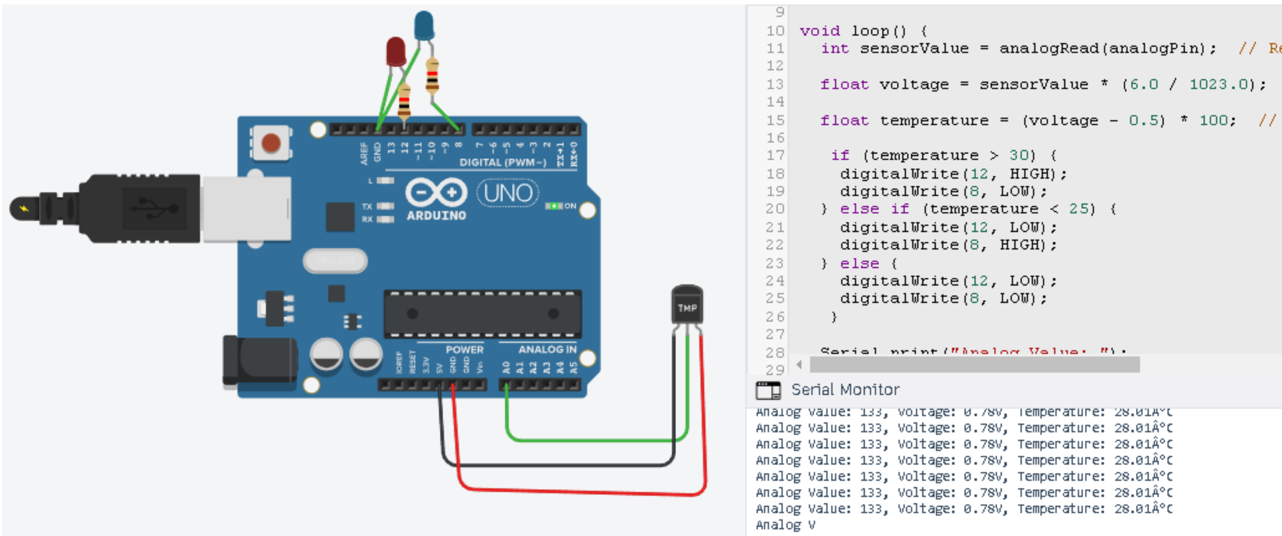
```
float adc = 0;

float U = 0;
```

```
float a = 0;
float b = 0;
float c = 0;
float Turbidity = 0;
void setup()
{
  pinMode(A0, INPUT);
  Serial.begin(9600);
}
void loop()
{
  adc = analogRead(A0); // How to declare adc
  U = ((5 * adc) / 1023);
  a = (5742.3 * U);
  b = (1120.4 * (U * U));
  c = 4352.9;
  Turbidity = (a - (b + c));
  Serial.println(Turbidity);
  delay(10); // Delay a little bit to improve simulation performance
if (Turbidity>2000)
{ digitalWrite(8, HIGH);
}
  else {
    digitalWrite(8, LOW);
  }}
```

7. OUTPUT

7.1 Temperature sensor Output



When the temperature is high or low, the LEDs glow; otherwise, the ouput indicates that the temperature is normal. In this case, the LEDs are not glow. Serial monitor, it keeps track of sensor/Analog value, voltage and Temperature information. Based on formulas the sensor value is converted to voltage and voltage is converted to temperature value which are stored in voltage and temperature.

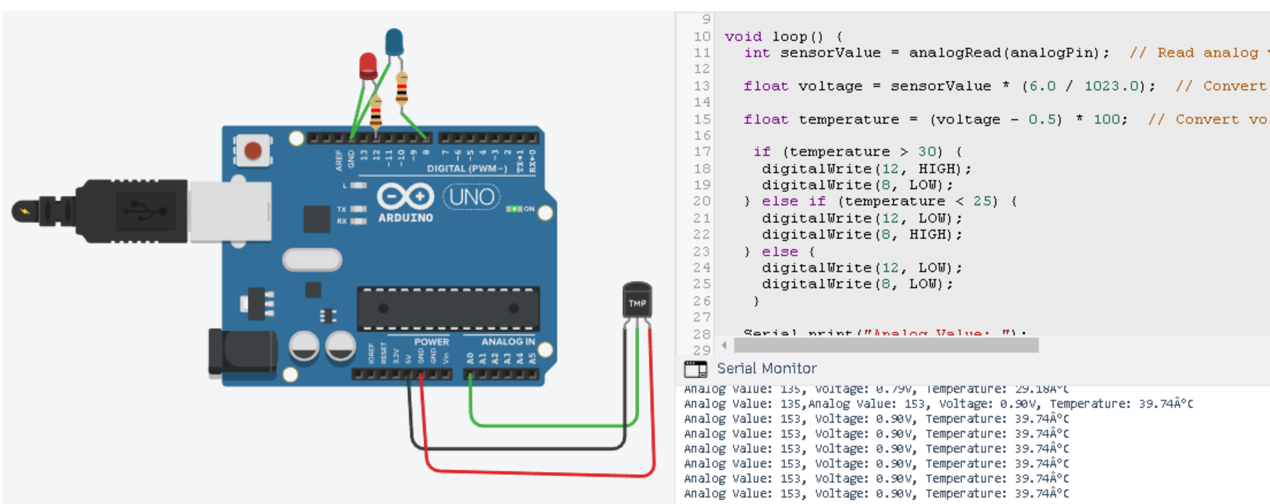


Fig.This output indicates that the temperature level is high(>30)

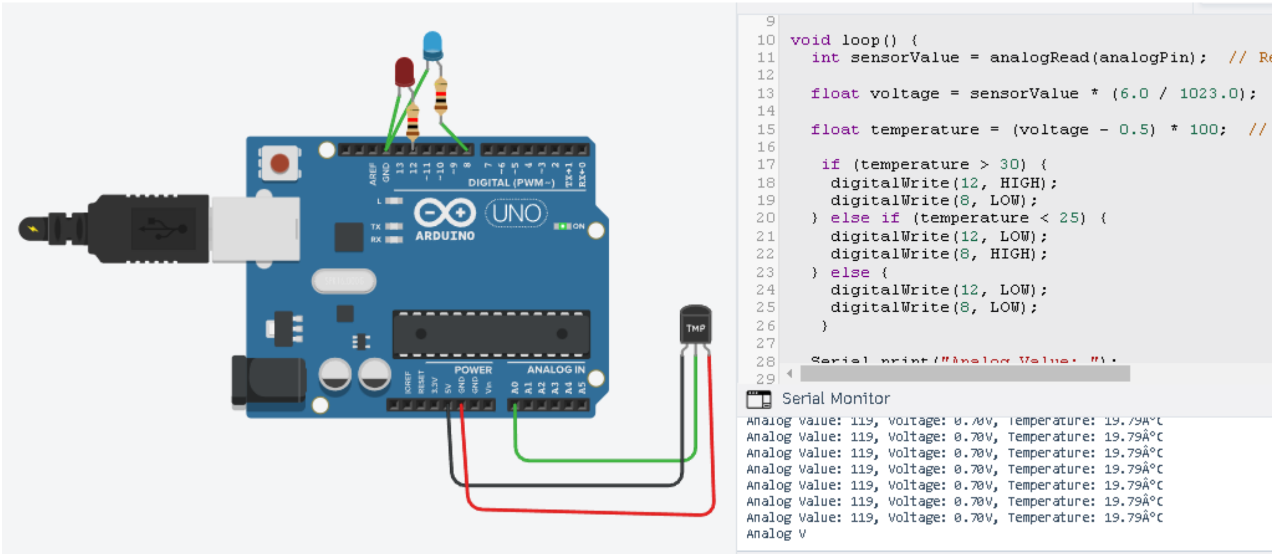
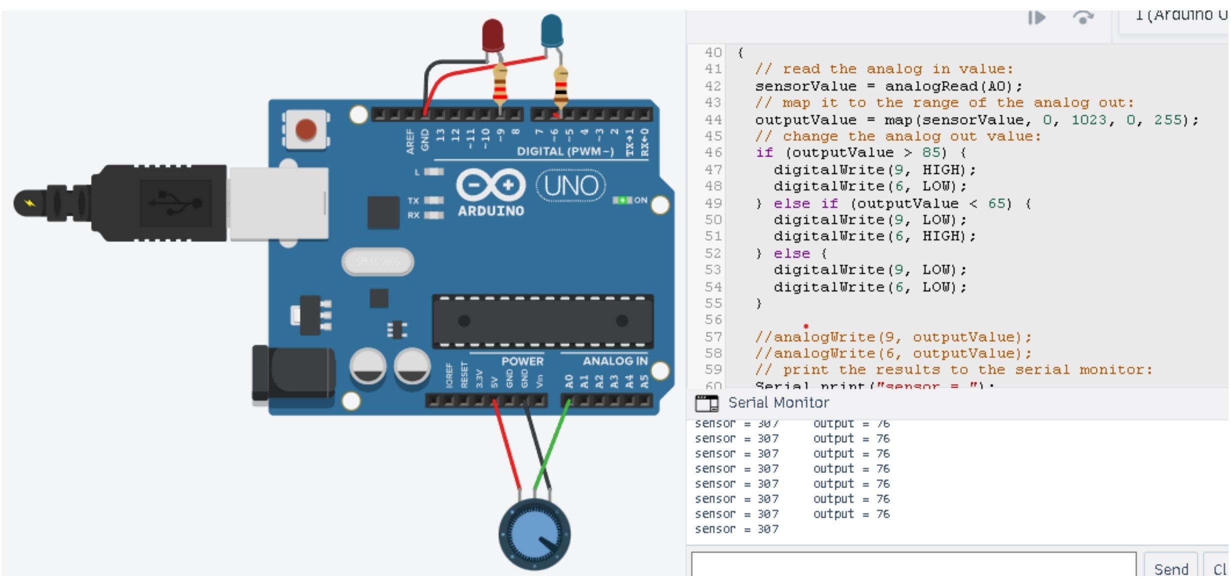


Fig.This output indicates that the temperature level is low(<25)

7.2 Ph sensor Output



We can programme the code to light the LEDs whenever the pH level is high or low and not do so otherwise, this output indicates that the ph level is normal. Serial monitor, it keeps track of output and sensor information. The analogRead(A0) function maps potentiometer values to sensor values, which are then saved in output values.

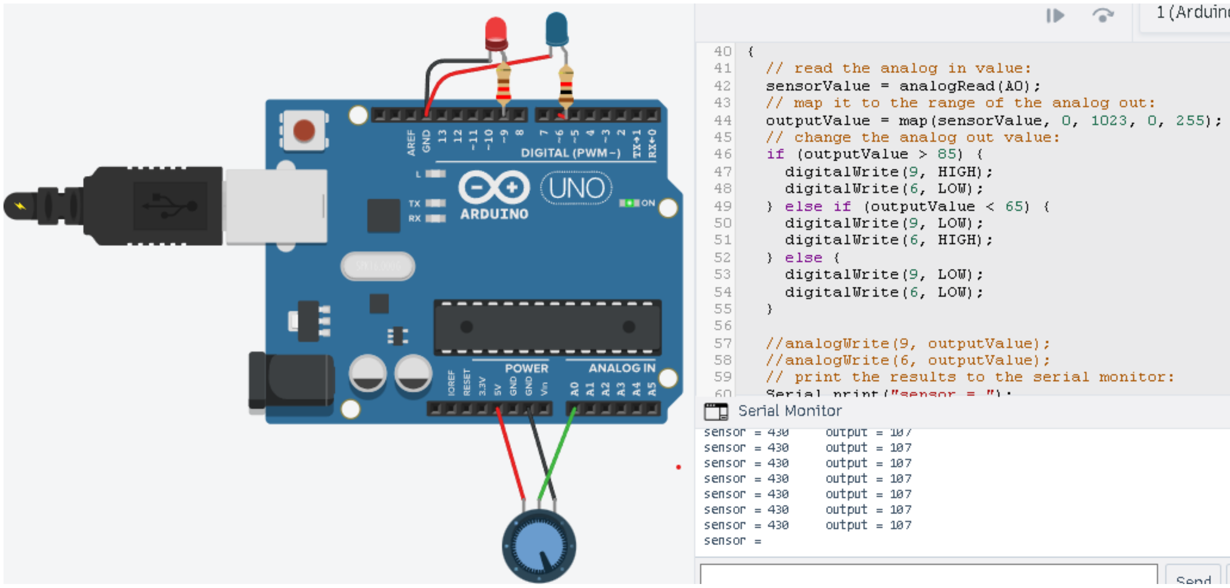


Fig.This output indicates that the ph level is high(>85)

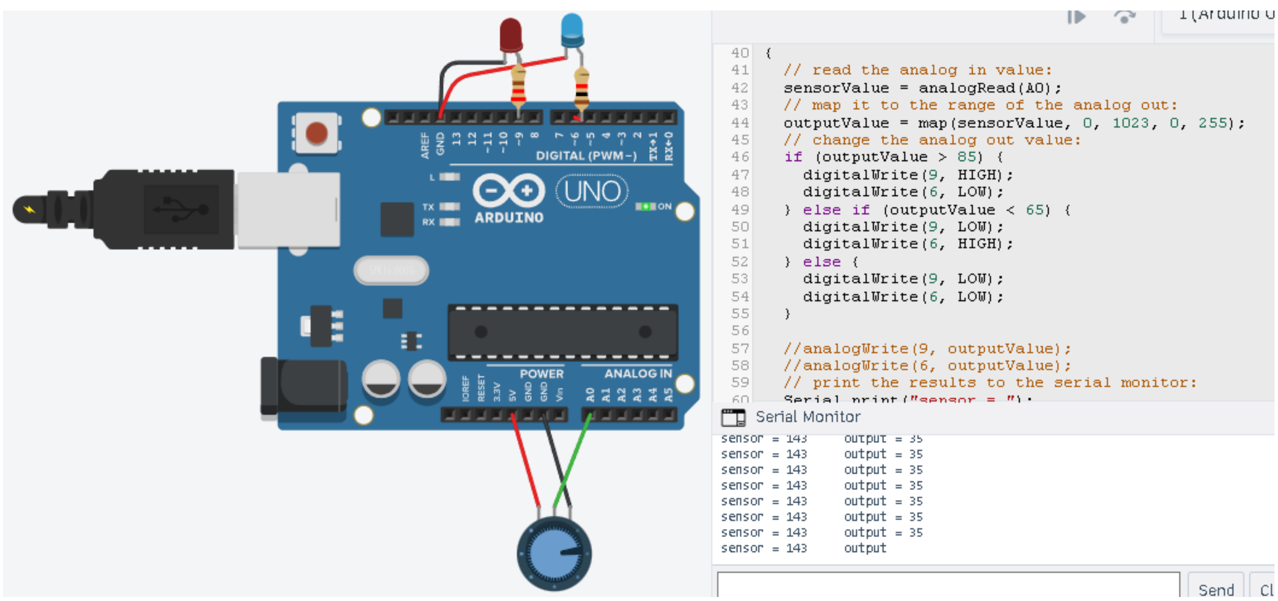
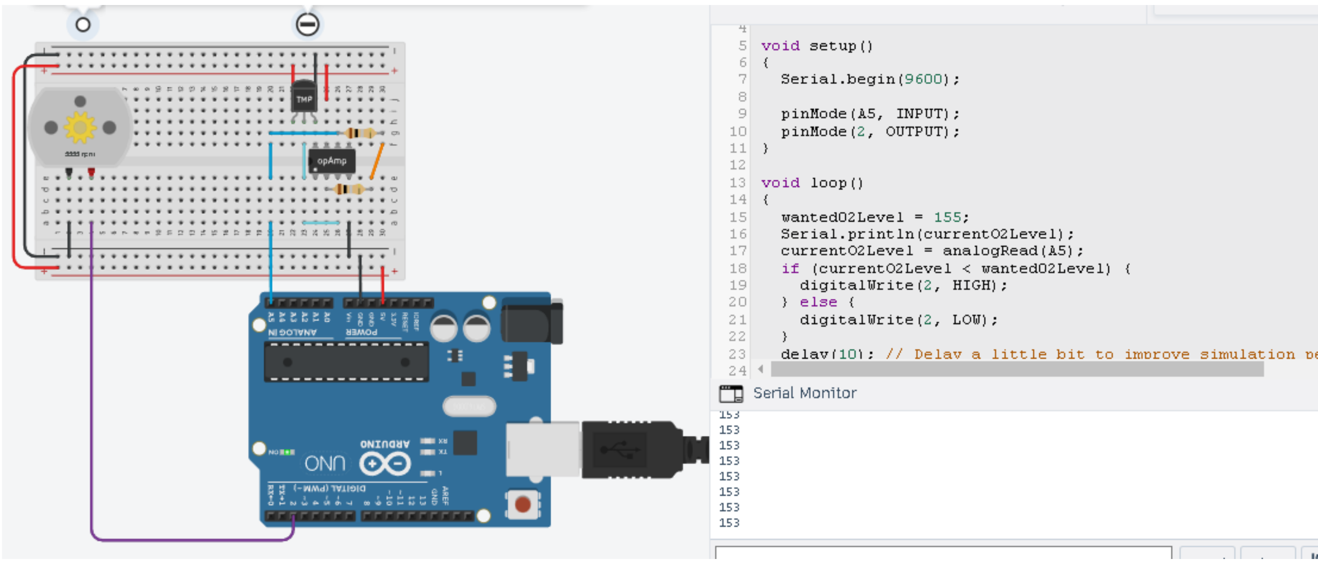


Fig. This output indicates that the ph level is low(<65)

7.3 Dissolved Oxygen sensor circuit Output



DC motor operates when the oxygen level is low which means the current oxygen level is lower than desired amount. This output indicates oxygen level is low Dc motor is ON.

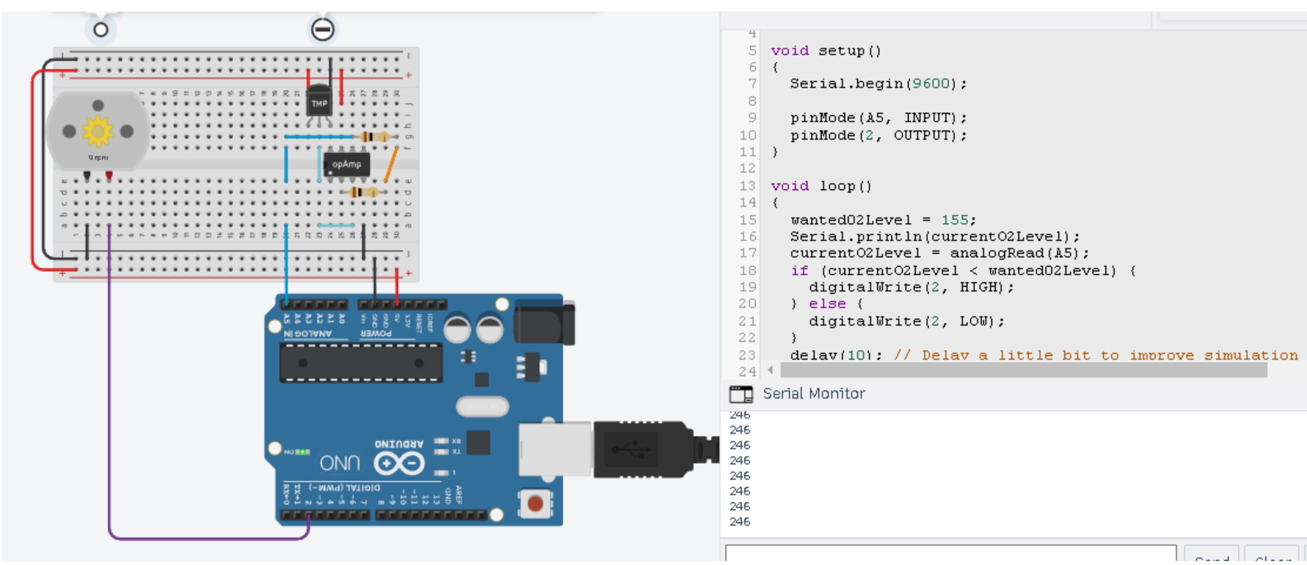
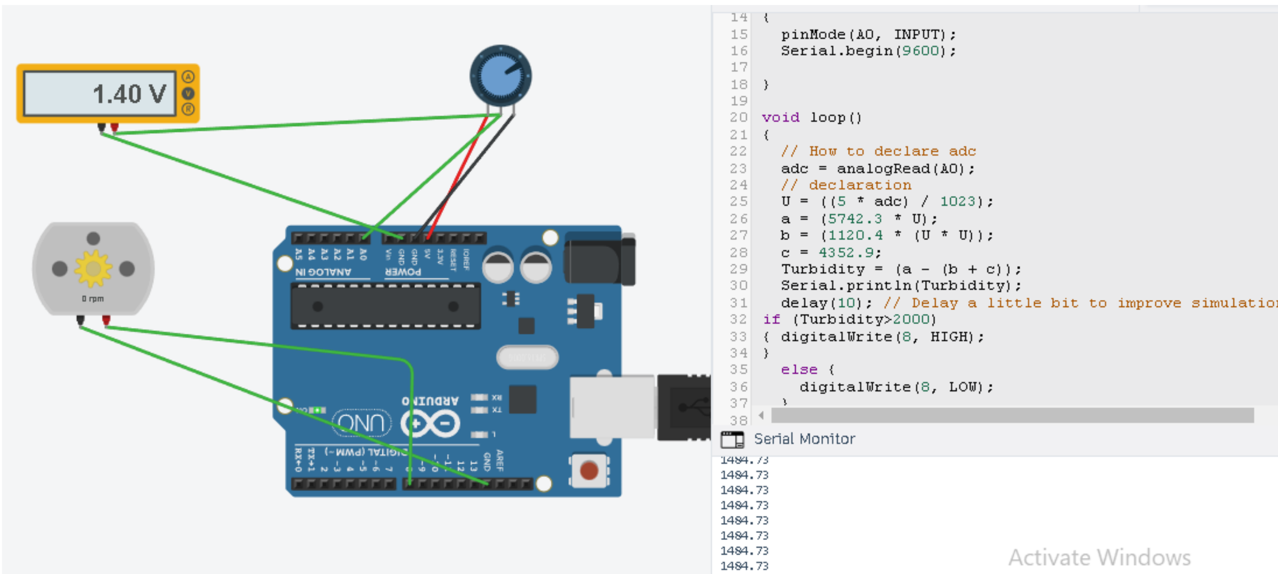


Fig.This output indicates oxygen level is normal Dc motor is OFF.

7.4 Turbidity sensor circuit Output



In this , potentiometer divides the voltages into turbidity values based to formula and some research calibrating values. If the turbidity value is high, an automatic water flow sensor this turbidity water flows out from tank from one pipe and dc motor turn on to fresh water enter into the tank from another pipe, respectively. And we can use the water level sensor to resist the water level of tank . This output indicates the turbidity is low therefore dc motor OFF.

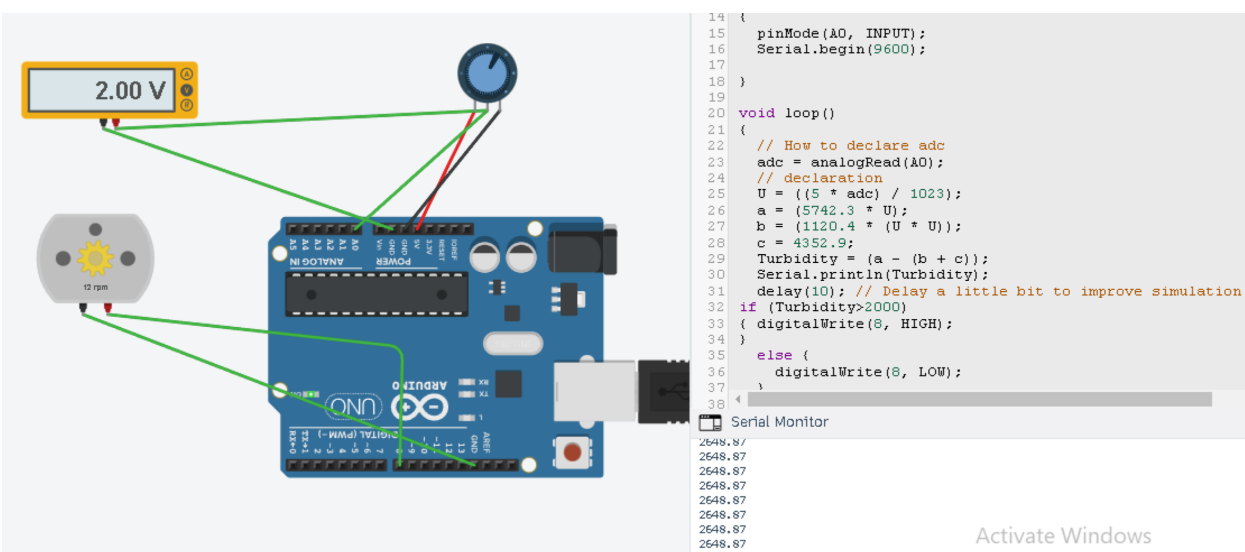


Fig. This output indicates the turbidity is high, dc motor ON.

CONCLUSION

In conclusion, aqua resource management plays a crucial role in enhancing the efficiency, sustainability, and productivity of fish farming operations. By integrating technologies such as sensors, automation, data analytics, and remote monitoring, aqua resource management systems enable real-time monitoring of water quality, disease control, and resource optimization. These systems offer numerous benefits, including improved production efficiency, enhanced fish health and welfare, reduced environmental impact, and data-driven decision making. However, it's important to address potential challenges such as initial investment costs, technical complexity, data security, and user acceptance. With proper planning, training, and ongoing support, aqua resource management systems can drive the growth of a sustainable and profitable fish farming industry.

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