IoT Based Smart Biofloc Monitoring and Maintenance System

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A Final Year Design Project (FYDP) submitted to the Department of Electrical and Electronic Engineering in partial fulfillment of the requirements for the degree of B.Sc. in Electrical and Electronic Engineering

Department of Electrical and Electronic Engineering
Brac University
September 2022

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Department of Electrical and Electronic Engineering
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September 2022

Declaration

It is hereby declared that

1. The Final Year Design Project (FYDP) submitted is our own original work while completing degree at Brac University.
2. The Final Year Design Project (FYDP) does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. The Final Year Design Project (FYDP) does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
4. We have acknowledged all main sources of help.

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Approval

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of Summer, 2022 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of B.Sc. in Electrical and Electronic Engineering on 1st September, 2022.

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Ethics Statement

We hereby confirm that this project "IoT Based Smart Biofloc Monitoring and Maintenance System" has met the requirements of the Final Year Design Project (FYDP) and has been written with our own efforts. However, in case of any supporting materials from other sources have been properly cited. The contents of this project have been implemented by us, with support from our supervisor and the university.

Abstract/ Executive Summary

Water quality has a great impact on the quality and quantity of fish production, and since Biofloc systems are designed for utilizing fish waste with the help of microorganisms. Hence, water quality monitoring and management (is vital in improving production quality and efficiency of Biofloc technologies). In this project, we developed an internet of things (IoT) system that gathers relevant information of the Biofloc environment with the help of sensors, this data is stored and processed in a cloud server, and relevant actuators are controlled for maintaining a suitable water quality. In addition, a mobile application is developed for providing a real time monitoring system.

Keywords: Biofloc Technology; IoT; Aquaculture Engineering.

Acknowledgement

We would like to express our gratitude towards our committee chair and professor Dr. AKM Abdul Malek Azad, who provided massive support and actively reviewed the project. In addition, we are also grateful to Afrida Malik, Lecturer, Brac University and Mohammad Thushar Imran, Lecturer, Brac University for providing guidance and suggesting different conventions for making the project better. Lastly, we extend our appreciation to Md. Nahid Haque Shazon who also supported us in the initial stages of the project.

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List of Acronyms

ADC	Analog-to-Digital Converter
AWS	Amazon Web Service
BFT	Biofloc Technology
CAD	Computer-Aided Design
CAE	Computer-Aided Engineering
CAM	Computer-Aided Manufacturing
COMPIM	Communication Physical Interface Model
CPU	Central Processing Unit
DO	Dissolved Oxygen
EPS	Electrical Power System
GPIO	General-Purpose Input/Output
GSM	Global System for Mobile communication
IoT	Internet of Things
IT	Information Technology
MCU	Microcontroller Unit
NodeMCU	Node Microcontroller Unit
PCB	Printed Circuit Board
PWM	Pulse Width Modulation

RAM	Random-Access Memory
ROM	Read-Only Memory
SIM	Single Inline Module
SMS	Short Message Service
SoC	System-on-a-Chip
TAN	Total Ammonia Nitrogen
TDS	Total Dissolved Solids
UART	Universal Asynchronous Receiver/Transmitter

Chapter 1

Introduction- [CO1, CO2, CO3, CO10]

1.1 Introduction

The world population is rising rapidly and this in turn increases food consumption. Traditional fish farming techniques requires larger water bodies like ponds or swamps and the amount of fish production in each pond/swamp is limited. Biofloc is the new modern fish farming technique where extensive amount of fish production is made possible in smaller areas compared to traditional fish farming. Furthermore, the fish feed cost in Biofloc is reduced to around 33% in comparison to traditional fish farming. Biofloc fish farming process requisite substantial water quality monitoring for faster growth and development of the fish. Water quality surveil and maintenance is a great challenge for Biofloc fish farmers as this is the ultimate activity for fish growth. In this project the different water quality parameters are monitored in real time and adjustment of certain parameters are done to maintain the desired aquaculture environment for the fish.

1.1.1 Problem Statement

Biofloc is a fish farming technology in which the recycling and reuse of fish waste are accomplished by microorganisms, algae, bacteria, and protozoa. The principal approach is to culture suitable microorganisms and aquatic species to produce a sustainable system, benefited by the minimum or zero water exchange. Biofloc systems need great attention for maintaining fish and water quality because these microorganisms require certain nutrients and environments for growth and their metabolic functions. Furthermore, as large amounts of fish are stored in comparatively small quantities of water, maintenance of water quality is essential for fish growth and disease prevention. Consequently, parameters such as DO (Dissolved Oxygen), pH, temperature, water level, ammonia factor, TDS (Total Dissolved Solids), and water turbidity should continuously be monitored. These parameters vary depending on different species of fish. However, measuring all these parameters on a continuous basis requires constant human intervention, requiring the need of a specialized workforce to monitor the system. Consequently, the cost of maintenance will rise.

1.1.2 Background Study

Biofloc technology was expanded to enhance environmental control over production in aquaculture. Biofloc technology, a fish farming method that recycles and reuses fish waste, employs microorganisms, algae, bacteria, and protozoa. The primary approach is to breed suitable microorganisms and aquatic creatures to build a long-term system that requires little or no water exchange. It also makes culture more feasible by lowering feed conversion ratios and costs.

Operational cost and investments are the major drawbacks in modernizing Biofloc technology; otherwise, Biofloc is profitable. A small-scale farmer with a few Biofloc systems cannot afford to hire workers to manage the day-to-day operations of monitoring water level, temperature, and concentration of oxygen. An analysis concluded that Biofloc systems are optimal for species that can withstand high sediment concentrations in water and can tolerate poor water quality in general [1]. Therefore, not all fish species can be cultivated in Biofloc system.

The fish are fed and cultivated in clean water during the primary stage, and the water is then changed and replaced constantly until the fish weighs 40g and afterwards they are released in the Biofloc tank [1]. A proper control of water quality must be maintained because this can affect the growth of the fish and hamper fish health. In the conventional method, the fish feed is deployed by hand in the Biofloc and pH of the Biofloc fish tank is manually adjusted by adding baking soda to raise it and molasses to lower it. Moreover, the Biofloc water tank temperature was regulated by regulating the room temperature, which consumed more power [2]. Saha et al. devised a method in which Arduino collected sensor data and uploaded it to a Raspberry Pi database. The operators were then given suggestions for necessary activities instead of autonomously maintaining water quality [3]. For these reasons, our primary focus is to inaugurate a solution for maintaining water quality and monitoring the parameters remotely with significantly less human intervention. Numerous research and analysis have been done regarding these problems and each has a different method of solution to the issue. The research work done by Sharma et al. was about the effect of temperature on Biofloc formation [4].

Hargreaves claims to maintain water quality and prevent incoming disease into a farm from incoming water; a Biofloc system was developed for shrimp, exchanging water 10% per day. Reducing water exchange could be the best approach for improving farm biosecurity [5]. In the study done by Phulia et al. stated that settling properties in flocs are unsatisfactory at low DO levels (0.5 mg/L - 2.0 mg/L), with an index of sludge volume 250 mL/g, and at higher DO levels (2.0 mg/L - 5.0 mg/L), with an index of sludge volume roughly 100 mL/g [6]. Additionally, in their study, it is found that at low water temperature 18°C – 20°C, microbial activity decreases, causing less sludge formation, and at high water temperature 30°C - 35°C, there is excessive production of sludge with a sludge volume index greater than 500 mL/g [6]. Further, TDS depends on pH, temperature, and dissolved oxygen concentration. TDS induces toxicity and causes long-term effects on the growth and development of fish [7]. Furthermore, the research work done by Devi et al. mentioned that when temperature increases, it causes a decrease in dissolved oxygen and an increase in carbon dioxide concentration in water [8].

The objective of Manan et al. was to check the effect of Biofloc treatment on white shrimp. This whole experiment was conducted in a closed hatchery, and no water was exchanged for 105 days except for refilling the tank with water, which was reduced due to waste removal. In this experiment, six tanks were used, where three used Biofloc technology, and the other 3 followed the conventional method. DO was measured from 5.95 mg/L to 9.53 mg/L, salinity from 31.60 ppt to 36.11 ppt, pH from 6.1 to 8.2, temperature from 26 ºC to 28.66 ºC, and TDS from 31.59 mg/L to 35.5 mg/L in the three tanks that used Biofloc Technology. Biofloc microorganisms successfully eliminated nitrogenous waste from the treatment tanks, ensuring that the nutrients and quality of water were safe for the shrimp [9]. Therefore, Biofloc aids in reducing the environmental harm caused by aquaculture, reducing water usage, reducing feed costs, and the effective use of energy.

Africa et al. developed a system that estimated the ammonia factor[1] based on pH and water temperature sensor input but did not use any actuators to control water quality parameters [10]. Moreover, Huang mentioned the harmful prospects of ammonia for aquaculture and studied the way for managing it in Biofloc technology system [11]. Chowdury et al. used sensors that were submerged in water and the collected data was sent to the cloud server through wireless medium [12]. In their research, they did not compare the sensor data with any threshold values. Moreover, a system designed by Zougmorc et al. that can store data for agricultural fish farmers in Africa using the IoT (Internet of Things), and users can only view real-time parameters and graphs based on the stored values [13]. Nevertheless, there is no guidance for standard pH, turbidity, and other water level parameters. In another paper, author Raju et al. proposed a system that worked with several sensors. Also, they used a customized website and mobile application to analyze the data [14]. However, here the authors did not mention any actuators. Additionally, Teja et al. built a smart pond monitoring system based on NodeMCU and AWS cloud for monitoring in real time using a variety of sensors [15]. However, they did not use any actuators to control the water parameters. Similarly, Ahamed et al. also designed a smart Biofloc system, which is controlled and monitored through a mobile application, but it does not keep track of the DO parameters and ammonia factors [16]. The system also lacks proper

[**1** - Check Appendix section]

control of actuators. Furthermore, Salih et al. introduced real-time water quality monitoring via sensors, which was perceived in the dedicated mobile application [17]. However, the system had no facility to give emergency notifications, which may arise due to changes in the water quality parameters.

1.1.3 Literature Gap

Biofloc technology (BFT) is becoming popular nowadays. Researchers are also interested in this technology. As different methods are followed for monitoring and managing the water quality for Biofloc, automatizing the full system requires different types of research. Some of the parameters that are constantly tracked are temperature, dissolved oxygen (DO), pH, TAN (Total Ammonia Nitrogen), nitrite, orthophosphate, alkalinity, and many more. However, the researchers have only focused on a few important parameters mainly concentrated on temperature, pH, and dissolved oxygen. Furthermore, IoT is currently playing a noteworthy role in smart fish farming, it allows remote monitoring and control of various parameters. For resolving the critical problems in the Biofloc system IoT is an excellent solution. Though automatization can help to cherish the farming procedure, few researchers ignored about. A study done by Ahmed et al. showed that real-time water quality monitoring was possible. However, they did not implement the system to measure factors affecting water quality in real-time. Furthermore, the water quality factors were estimated and approximated from other open sources rather than performing experiments [16].

1.1.4 Relevance to Current and Future Industry

Not long ago, ACI, the largest conglomerate in Bangladesh developed a system that automatically feeds the fish in a Biofloc fish tank. It is programmed in such a way that after a particular period it spreads the fish feed in the whole fish tank. Moreover, the product is very costly and Biofloc fish farmers find it difficult to use as it’s a concept product. The future industry that leads to any automation in BFT (Biofloc Technology) will be helpful to anyone who is willing to start Biofloc fish farming. More and more automated Biofloc systems can be developed and implemented according to customer's needs. In contemplation of fish farming business, our project illustrates the essentials in automation of BFT.

1.2 Objectives, Requirements, Specification and Constraint

1.2.1 Objectives

The objective of this project is to develop a smart system that continuously collects data using appropriate sensors to monitor and maintain parameters.

We intend to accomplish the following goals:

- Collecting consecutive data from the sensors, which will then be transferred to the cloud server.
- Developing a mobile phone application to keep track of data collected by the sensors.
- Alerting the operators via a mobile application for any anomalies in the Biofloc system.
- Pre-setting algorithm to perform required action when sensor readings are out of range.
- Minimizing maintenance and labor expense by automating the system to control water quality parameters.

1.2.2 Functional and Nonfunctional Requirements

Functional requirements

- Various environmental factors for different types of fish.
- Real-time monitoring via a mobile application.
- Relevant actuators will be triggered if the water quality parameter changes.
- Removal of sludge using a pipe.
- Constant power supply.

Non-functional requirements

- Waterproof sensors.
- Sludge collection drain.
- Fish feeding system.
- Cloud data storage.

1.2.3 Specifications

System Specification

- ✓ Size Chart

Diameter (Meters)	Height (Meters)	Capacity (Liters)
2	1.5	4700
2.5	1.5	7300
3	1.5	10600
4	1.5	18800
5	1.5	29400

Table 1. Size Chart For the Biofloc Tank

- ✓ Material – PVC
- ✓ Slanted bottom end of Biofloc tank for sludge collection
- ✓ Test kits for measuring pH, turbidity, and dissolved oxygen.

- **First Approach**

Subsystem	Requirements	Components	Technical Specifications	Component Description
Monitoring System	Central Processing Unit (CPU)	Arduino Uno	• Microcontroller Chip: ATmega328P • Operating Voltage: 5V • Flash Memory: 32KB • SRAM: 2KB • EEPROM: 1KB • Clock Speed: 16MHz	Arduino Uno is a micro-controller board designed by Arduino.cc, which is based on the Microchip ATmega-328P microprocessor. Several digital and analog input/ output pins on the board allow it to be connected to expansion boards and other devices.
	Sensor Data Acquisition	Analog Dissolved Oxygen Sensor	• Operating Voltage: 3.3V~5.5V • Type: Galvanic Probe • Range: ≤ 20 mg/L • Pressure Range: (0~50) PSI	Dissolved oxygen sensors analyze water quality using electrodes that measure the oxygen concentration in the water.
		pH Sensor	• Supply Voltage: 5V • Current: 5mA-10mA • Power Consumption: ≤ 0.5W • Operating temperature: 10℃ - 50℃	A pH sensor, with a value ranging from 0 to 14, aids in measuring the acidity or alkalinity of water.
		Waterproof Ultrasonic Sensor	• Operating Voltage: DC 3.0V~5.5V • Probe Frequency: 40 kHz • Measuring Angle: 75 degrees • Measurement Range: 25cm - 450cm	The ultrasonic sensor head emits an ultrasonic pulse, which the target reflects to it. It computes the distance to the target by measuring the duration between emission and reception.
		Waterproof Temperature Sensor	• Operating Voltage: DC 3.0V~5.5V • Temperature Range: -55°C to +125°C • Accuracy: ±0.5°C	A temperature sensor detects and measures heat and cold, then converts the data into an electrical signal.
		TDS (Total Dissolved Solids) Sensor	• Operating Voltage: DC 3.0V~5.5V • Measurement Range: 0 ppm - 1000 ppm • Measurement Accuracy: +/- 10% F.S. (25°C)	A TDS sensor is a device that detects the concentration of Total Dissolved Solids (TDS) in a solution, most often water. As dissolved ionized solids, such as salts and minerals, increase the conductivity of a solution, the TDS is estimated using that value.

		Turbidity Sensor	• Operating Voltage: DC 5V • Response Time: < 500ms • Operating Temperature: -30°C to 80 °C • Storage Temperature: -10°C to 80 °C	The amount of light scattered in water by suspended particles is determined by turbidity sensors. The turbidity level (cloudiness or haziness) of the water increases as the amount of total suspended solids (TSS) in the water increases.
	Cloud Upload	NodeMCU DevKit_v1	• Number of Cores: 2 (dual) • Wi-Fi: 2.4 GHz up to 150 Mbits/s • Operating Voltage: 3.3V DC • RAM: 512 KB • Architecture: 32 bits • Clock Speed: up to 240 MHz	The Arduino development board sends data to the ESP32 using UART communication, which is decoded and uploaded to the cloud for further reference.
Cloud Computing	Database	Firebase	• Backend-as-a-Service • HTTP calls for syncing data • Realtime data • Node level built in security	We are using Firebase for storing and monitoring data. And it also acts as a data sending bridge between the sensors and actuators.
Actuator Control System	Central Processing Unit (CPU) and Data Acquisition	Arduino Mega 2560 Rev3	• Microcontroller: ATmega2560 • Operating Voltage: 5V • Flash Memory: 256 KB • SRAM: 8 KB • EEPROM: 4 KB • Clock Speed: 16 MHz	The Arduino receives data from the NodeMCU and activates the actuators to keep the environment of the Biofloc under balanced conditions.
	Data collecting form Cloud	NodeMCU DevKit_v1	• Number of Cores: 2 (dual) • Wi-Fi: 2.4 GHz up to 150 Mbits/s • Operating Voltage: 3.3V DC • RAM: 512 KB • Architecture: 32 bits • Clock Speed: up to 240 MHz	NodeMCU is a development board with ESP32 Wi-Fi SoC (System-on-a-Chip). It is an open source IoT platform. This MCU receives data from the cloud and forwards it to the Arduino.
	Threshold control	DC Air pump	• Voltage: 12V DC • Current: ≤ 350 mA • Maximum Air flow: 3.2LPM • Maximum Vacuum: <420mmHg • Noise Level: ≤ 65 dB	A 370 micro dc motor-powered tiny air pump. It is ideal for providing oxygen for the small system such as an aquarium.

			• Inflation Time: ≤ 3s • Life Test: ≥ 600 hours	
		Mini Submersible Pump	• Working voltage: 2.5V ~ 6V • Operating current: 130 mA ~ 220 mA • Maximum lift: 40 mm ~ 110 m • Flow rate: 80 L/H-120 L/H	It is a compact, low-cost pump motor that runs on 2.5V to 6V. With a current usage of only 220mA, it can process up to 120 liters per hour.
		DC Water Pump	• Voltage: 12V DC • Current Rating: 1.2A • Power: 8W • Maximum Flow Rate: 10 L/Min • Maximum Water Head: 5M	A small centrifugal pump that can deliver 10 liters of water per minute.
		Solenoid Valve	• Working Temp: 1℃ - 75℃ • Supply Voltage: 12V DC • Resistance coil: 4.75KΩ (20℃) • Working Environment: Water	An electro-mechanical valve to control the flow of liquid in the system.
		Heating Rod	• Power: 500 watts • Temperature: 12°C - 34°C	Heating element transforms electrical energy into heat via the resistivity process. Resistance is encountered by an element while an electric current passes through it, and this results in the production of heat.
		VNH2SP30 Motor Driver	• Maximum Voltage: 16V • Maximum Current: 30A • Drain-Source Resistance: 19mΩ • Maximum PWM frequency: 20 kHz	A DC motor is controlled by a full-bridge motor driver. The device includes a dual monolithic high side driver as well as two low side switches. The speed and di-rection of motor rotation are regulated by the INA, INB, and PWM pins.
		Relay	• Operating Voltage: 12V • Current Rating: AC250V 10A; DC30V 10A • Driver Current: 15-20mA	Relays use electromagnets to transform small electrical impulses into greater currents. These transitions occur when electromagnets are engaged by electrical inputs to build or break existing circuits.

Table 2. Specification of First Approach

- **Second Approach**

Subsystem	Requirements	Components	Technical Specifications	Component Description
Monitoring System	Central Processing Unit (CPU)	Raspberry Pi 4	• Microcontroller Chip: Broadcom BCM2711 SoC • Operating Voltage: 5V • Flash Memory: 2MB • Clock Speed: 1.8GHz	Raspberry Pi is a miniature Linux-based single-board computer. It also includes a set of GPIO (general-purpose input/output) pins for operating electronic components and exploring the IoT. In our project, Raspberry Pi is used to carry out tasks, like collecting.
	Sensor Data Acquisition	Analog Dissolved Oxygen Sensor	• Operating Voltage: 3.3V~5.5V • Type: Galvanic Probe • Range: ≤ 20 mg/L • Pressure Range: (0~50) PSI	Dissolved oxygen sensors analyze water quality using electrodes that measure the oxygen concentration in the water
		pH Sensor	• Supply Voltage: 5V • Current: 5mA-10mA • Power Consumption: ≤ 0.5W • Operating temperature: 10℃ - 50℃	A pH sensor, with a value ranging from 0 to 14, aids in measuring the acidity or alkalinity of water.
		Waterproof Ultrasonic Sensor	• Operating Voltage: DC 3.0V~5.5V • Probe Frequency: 40 kHz • Measuring Angle: 75 degrees • Measurement Range: 25cm - 450cm	The ultrasonic sensor head emits an ultrasonic pulse, which the target reflects to it. It computes the distance to the target by measuring the duration between emission and reception.
		Waterproof Temperature Sensor	• Operating Voltage: DC 3.0V~5.5V • Temperature Range: -55°C to +125°C • Accuracy: ±0.5°C	A temperature sensor detects and measures heat and cold, then converts the data into an electrical signal.
		TDS (Total Dissolved Solids) Sensor	• Operating Voltage: DC 3.0V~5.5V • Measurement Range: 0 ppm - 1000 ppm • Measurement Accuracy: +/- 10% F.S. (25°C)	A TDS sensor is a device that detects the concentration of Total Dissolved Solids (TDS) in a solution, most often water. As dissolved ionized solids, such as salts and minerals, increase the conductivity of a solution, the TDS is estimated using that value.

		Turbidity Sensor	• Operating Voltage: DC 5V • Response Time: < 500ms • Operating Temperature: -30°C to 80 °C • Storage Temperature: -10°C to 80 °C	The amount of light scattered in water by suspended particles is determined by turbidity sensors. The turbidity level (cloudiness or haziness) of the water increases as the amount of total suspended solids (TSS) in the water increases.
	Data Upload	GSM Module (SIM900A)	• Operating Voltage: 3.4V to 4.5V • Maximum Current: 400 mA to ~1 A • Data transfer: Upload - 42.8kbps Download - 85.6kbps • Operating frequency: EGSM900 and DCS1800S	GSM (Global System for Mobile Communication) can handle multiple AT commands to perform various tasks. In our second design, a GSM module is used so that an operator can send a message with the help of phones to control relevant actuators.
Actuator Control System	Central Processing Unit (CPU) and Data Acquisition	Raspberry Pi 4	• Microcontroller Chip: Broadcom BCM2711 SoC • Operating Voltage: 5V • Flash Memory: 2MB • Clock Speed: 1.8GHz	Raspberry Pi is a miniature Linux-based single-board computer. It also has a set of GPIO (general-purpose input/output) pins for controlling electronic components and exploring the Internet of Things. The Raspberry Pi is employed in our project to carry out tasks, like collecting.
	Threshold control	DC Air pump	• Voltage: 12V DC • Current: ≤ 350 mA • Maximum Air flow: 3.2LPM • Maximum Vacuum: <420mmHg • Noise Level: ≤ 65 dB • Inflation Time: ≤ 3s • Life Test: ≥ 600 hours	A 370 micro dc motor-powered tiny air pump. It is ideal for providing oxygen for the small system such as an aquarium.
		Mini Submersible Pump	• Working voltage: 2.5V ~ 6V • Operating current: 130 mA ~ 220 mA • Maximum lift: 40mm ~ 110 m • Flow rate: 80 L/H - 120 L/H	It is a compact, low-cost pump motor that runs on 2.5V to 6V. With a current usage of only 220mA, it can process up to 120 liters per hour.

		DC Water Pump	• Voltage: 12V DC • Current Rating: 1.2A • Power: 8W • Maximum Flow Rate: 10 L/Min • Maximum water head: 5M	A small centrifugal pump that can deliver 10 liters of water per minute.
		Solenoid Valve	• Working Temp: 1℃ - 75℃ • Supply Voltage: 12V DC • Resistance coil: 4.75KΩ (20℃) • Working Environment: Water	An electro-mechanical valve to control the flow of liquid in the system.
		Heating Rod	• Power: 500 watts • Temperature: 12°C - 34°C	Heating element transforms electrical energy into heat via the resistivity process. Resistance is encountered by an element while an electric current passes through it, and this results in the production of heat.

Table 3. Specification of Second Approach

1.2.4 Technical and Non-technical Consideration and Constraint in Design Process

Technical consideration

- Nitrate measurement is challenging and resolving the nitrate level is difficult since it affects other elements that must be considered sufficient.
- This project needs a 24/7 power supply.

Non- Technical consideration

- Sensors are not always available in the local market.
- The longevity of some sensors is low.

Constraints

- Nitrate measurement is complex and resolving the nitrate level is sophisticated as this alters other factors that we are trying to maintain.
- This project needs a 24/7 power supply.
- Sensors are not always available on the local market.

1.2.5 Applicable Compliance, Standards, and Codes

Name	Standard No.	Definition	How it affects the solution
Fisheries Management	FAO CCRF Article 7.4.1	When considering the adoption of conservation and management measures, the best scientific evidence available should be considered to evaluate the current state of the fishery resources and the possible impact of the proposed measures on the resources.	This process apprises us to follow the guidelines and previous collected threshold values when performing test in the Biofloc tank.
Fisheries Management	FAO CCRF Article 7.4.5	To ensure sustainable management of fisheries and enable social and economic objectives to be achieved, sufficient knowledge of social, economic, and institutional factors should be developed through data gathering, analysis, and research.	Before carrying out test cases for the Biofloc fish, the data and information gathered are through analysis and research.
Standard for Harmonization of Internet of Things (IoT) Devices and Systems	IEEE 1451-99	This method coordinates the development of Internet of Things (IoT) based devices and systems. It describes the security of data for sharing and operating over networks.	Our system focuses on data integrity and security. Each Biofloc user will have designated data access assigned to them, therefore the data security is maintained.

Table 4. Applicable Compliance, Standards, and Codes

1.3 Systematic Overview/Summary of The Proposed Project

The automation of the Biofloc technology is an IoT-based approach used to monitor and maintain a suitable environment for the system. However, the first design would benefit the Biofloc operators the most due to its efficiency, usability, and maintainability. This system will verify, check, and maintain the water quality parameter of Biofloc fish tank.

A. Collecting data from sensors

In this subsystem, the main motive is to collect data from the Biofloc fish tank using the appropriate sensors like DO (Dissolved Oxygen), pH, turbidity, TDS (Total Dissolved Solids), temperature and ultrasonic. These sensor data are collected and forwarded by the aid of a microcontroller Arduino. This subsystem is very crucial as all the next stages depends on the sensor readings.

B. Storing and comparing data in the cloud storage

In this stage the sensor data are transferred to the cloud server from the Arduino using a Wi-Fi module. Hence, the user can view and control all the data in the cloud server using the mobile application.

Data comparison with the threshold value is also done in this stage. This comparison is the pivotal step for the best aquacultural environment of the fish as it determines if the water quality parameters are within the strict range or not.

C. Controlling the actuators

Now, after the comparison part is done, commands are sent to the NodeMCU from the cloud server over Wi-Fi module. Here node MCU plays the vital role of controlling the actuators. By this the water quality of Biofloc is maintained for the fish automatically without human intervention.

1.4 Conclusion

The automation of the Biofloc technology is an IoT-based approach used to monitor and maintain a suitable environment for the system. However, the first design would benefit the Biofloc operators the most due to its efficiency, usability, and maintainability. After the completion of this project the Biofloc system will be monitored automatically and if any water quality parameters are out of range from the threshold values it will automatically resolve it by using designated actuators.

Chapter 2

Project Design Approach [CO5, CO6]

2.1 Introduction

We have developed two design strategies that will produce the necessary results. These two designs have different working methods, but they both produce the same results. While designing we have maintained the design standards and integrity.

2.2 Identify Multiple Design Approach

First Approach

The first design approach is based on Arduino UNO as the central processing unit, which would collect data from sensors and upload it to a cloud server through ESP32 NodeMCU. Afterwards, ESP32 NodeMCU is used for receiving the data from cloud to control the actuators with Arduino Mega to maintain the threshold values.

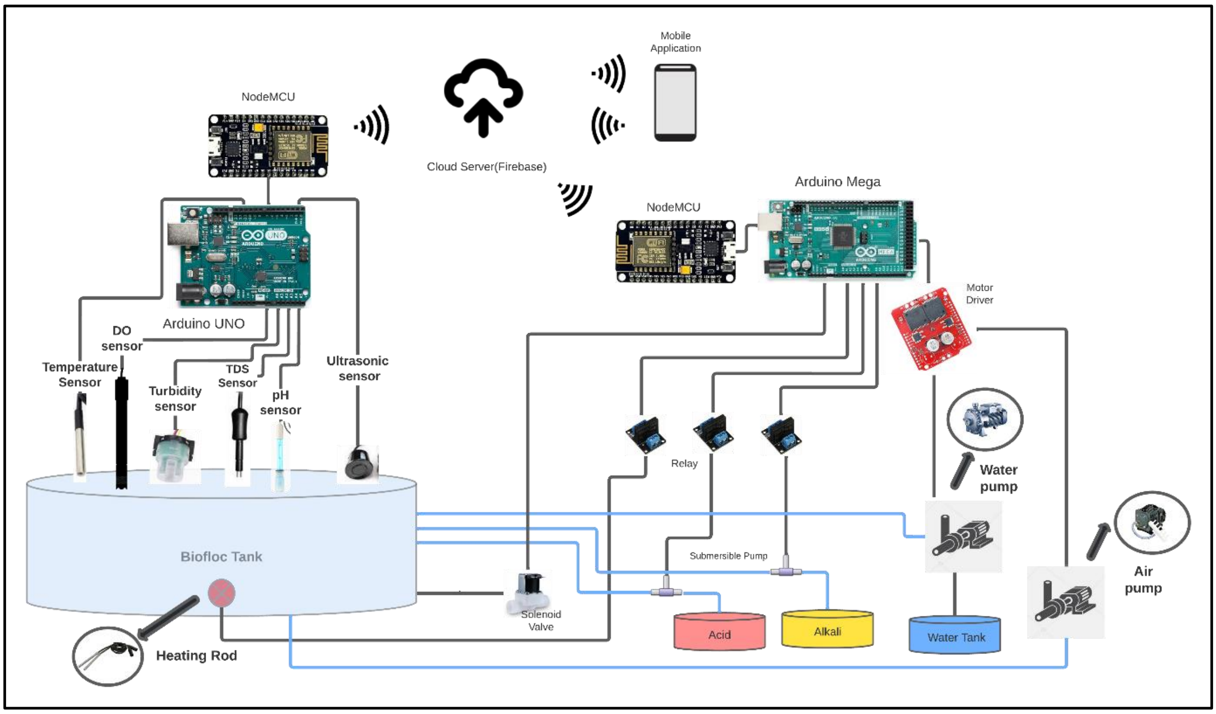


Figure 1. Design Overview of Design-1

Second Approach

In the second approach the central processing unit in use is Raspberry Pi 4 which collects data from the sensor and controls the actuators. On the other hand, instead of Firebase we have used GSM module for the transmitting and receiving data.

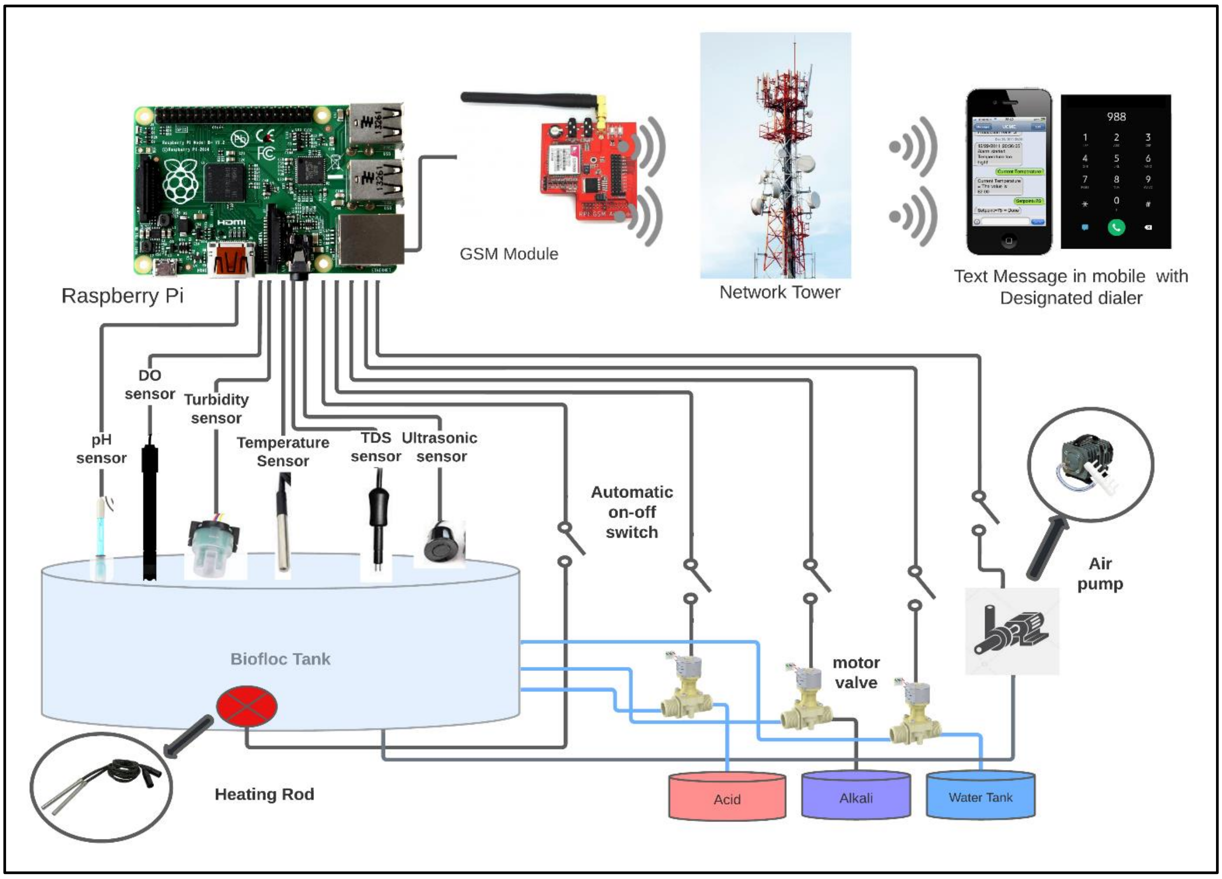


Figure 2. Design Overview of Design-2

2.3 Describe Multiple Design Approach

First Approach

In Figure 1, we propose a flexible and scalable design, which would support the operators in maintaining and monitoring several Biofloc systems containing different fish breeds.

The design is mainly divided into three categories. Firstly, the data collection system uses various sensors to observe the Biofloc environment, as shown in Fig-2. Here, the Arduino microcontroller is used to accumulate the data. he DO sensor measures the concentration of oxygen in the Biofloc environment. Similarly, pH and Temperature sensors are used to determine the corresponding parameters. In addition, the TDS sensor measures the accumulation of the dissolved solids, whereas the Turbidity sensor measures the cloudiness of the environment. Furthermore, to balance the level of water in the Biofloc tank an ultrasonic sensor is used.

After the parameters from the Biofloc are accumulated in the microcontroller, the parameters are sent to a cloud server using a NodeMCU, where information is processed and analyzed to make further decisions. In this phase, the parameters are compared to a pre-existing dataset where the DO level is above of 5.0 mg L^{-1} temperature between 28–30° (ideal for tropical species), pH of 6.8–8.0, nitrate less than 0.5–20 mg L^{-1} and TDS which is less than 500 mg L^{-1} are examined and checked if the parameters are within this range for the Biofloc [6], [8], [9]. If any discrepancies are found in the parameters, such as DO, temperature, pH, or water level, the cloud server sends a signal to the MCU, which is relayed to the appropriate relay. In the controlling system, the performance of the corresponding actuators, such as air compressor, water pump, and solenoid valves, is adjusted accordingly with the help of PWM (Pulse Width Modulation) using a feedback system until the sensor reads data that is within the appropriate threshold value. The processed data is also stored for future reference. Furthermore, with the help of a mobile application, the operators can check real-time data and generate customized graphs for better monitoring and maintenance of the system. Also, the operator can turn the actuators ON or OFF with the help of the mobile application.

Second Approach

Figure 2 represents the second design, where similar sensors, as design-1 is used to observe the parameters of the Biofloc system. However, we are using Raspberry Pi as central processing unit and for processing the parameters. Moreover, the Raspberry Pi would use switches to operate the actuators to balance the parameters, such as DO, temperature, or water level. If any discrepancies are found, the operators are alerted through SMS via the GSM module. This GSM module uses mobile networking services and network towers for transmitting and receiving the data. This method allows the operators to receive notifications even if they are outside the range of the Wi-Fi connection. Moreover, the Raspberry Pi would send signals to the corresponding switches for switching the actuators to keep the parameters of the Biofloc in a suitable range. In addition, the user can send specialized commands via a designated dialer to the GSM module which will allow the user to control any actuator. After receiving the commands, data would be processed by the Raspberry Pi, which would carry out the corresponding task like turning the actuators ON or OFF or changing the conditions of the Biofloc system. In this approach there is no use of relay for the controls of the actuators.

2.4 Analysis of Multiple Design Approach

	Design-1	**Design-2**
Cost	BDT. 52000	BDT. 70000
Efficiency	Tuning the actuators with the help of pulse width modulation to reduce the power loss of the system. As it can control the power that is delivered to the actuators.	Actuators cannot be controlled with precise values. Due to digital inputs from the sensors, accurate control of the actuators is difficult.
Usability	Real-time parameters can be monitored through the mobile application. Moreover, Arduino IDE is simple and user-friendly.	Only emergency alerts can be received through messages using the GSM module. However, it is not very easy to store dataset and integrate the system.
Manufacturability	The components are readily available, and easy to build the system. In addition, due to the presence of cloud storage, we can easily set datasets for different environments.	The system is based on Linux, for which it is not easy to store the dataset. Moreover, it requires digital sensors, and converting signals using ADCs can reduce the response rate of the system, which makes it complicated to maintain the system.
Maintainability	The system needs a constant internet connection as the data are being compared in the cloud server to maintain.	This system has onboard threshold comparison so the system would work seamlessly without any internet connection.

Table 5. Comparison Between the Multiple Designs

2.5 Conclusion

The most suitable and best design is determined by considering all the factors from the above table. Considering all the factors the most suitable approach is Design-1 and the implementation of this design will be more well-grounded, and serviceability will be exceptional.

Chapter 3

Use of Modern Engineering and IT Tool [CO9]

3.1 Introduction

To design, develop and validate the solution for the prototype of this project, we have used some modern engineering and IT tools. We have selected these tools as per our prototype requirements.

3.2 Select Appropriate Engineering and IT Tools

Hardware Tools	**Software Tools**
Arduino Uno	Arduino IDE
ESP32 (NodeMCU)	Proteus Design Suite 8.13
Arduino Mega	Autodesk Eagle
TDS sensor	Autodesk Fusion 360
Temperature sensor (DS18B20)	Firebase
Turbidity sensor	Android Studio
Dissolved oxygen sensor	
Waterproof ultrasonic sensor	
pH sensor	
Water heating rod	
Motor driver	
DC submersible pump	
12V Solenoid valve	
4 Channel 5V relay module	
DC Air pump	
DC Water pump	

Table 6. Appropriate Engineering and It Tools

3.3 Use of Modern Engineering and IT Tools

Proteus - It is essentially a suite of design software tools for automating electronic design. Electronic design engineers mostly use the software to generate schematics for simulating systems and designing PCBs (Printed Circuit Boards). In proteus, 2D design of electrical and electronic circuits and its simulation can be very helpful for building and implementing it physically. The circuit simulation will allow us to check its potential errors and problems before it is physically built. Some types of equipment can be expensive for test trying in real life, so simulation is necessary. In our case, the proteus software library had few sensors, and for some other sensors such as DO, TDS, and turbidity sensors, we had to use some custom libraries to get these sensors. Arduino works smoothly in proteus; therefore, simulation for our Design-1 came in handy.

Arduino IDE - Arduino is an open-source software, mainly developing hardware and software components. The Arduino development board, which contains the Microchip ATmega328P microcontroller, has several I/O pins to connect expansion boards, sensor modules or other digital or analog devices. It contains a CPU, RAM, ROM, Clock, Timers, Interrupts, and GPIOs that can-do numerous tasks simultaneously. We can use Arduino to work with a variety of sensors, modules, shields, and some different communication technologies. In our case, Arduino UNO will be deployed to collect the sensor data after specific intervals. Programming for Arduino UNO is done in Arduino IDE software which supports C/C++ programming language.

NodeMCU (ESP32) - It is a development board equipped with the ESP32 Wi-Fi SoC (System-on-a-Chip), which is mostly utilized in Internet of Things projects or systems. A Wi-Fi SoC from Espressif systems powers the ESP32 firmware. Furthermore, the hardware is built around the ESP-12 module. NodeMCU is a Wi-Fi enabled device that is used in our project to switch the appropriate solenoid valves or actuators using information from Firebase.

Firebase - Google Firebase is a platform for developing web and mobile applications. By giving secure access to the database directly from client-side code, Firebase Realtime Database enables the development of sophisticated, collaborative apps. Data is kept locally and can even be viewed offline. Furthermore, real-time events are continuously pushed into the database, providing the end-user with a responsive experience. In our project, Firebase is used to gather device-level information, evaluate them, and ensure that our mobile application has easy access to parameters. This allows us to make wise judgments.

Android Studio – It is an IDE from Google where one can develop the Android apps. In our project, we have used it to create an application where we can observe the values that are being read by the sensors. Moreover, we can check the Ammonia factor in the app.

Autodesk Fusion 360 – Fusion 360 is a cloud-based development software where one can develop 3D CAD, CAM, CAE, and PCBs. In our project, we have used this software to develop whole 3D overview of the system. Moreover, we developed and print some model which we have used for our project.

Autodesk Eagle – It is a software which give access to design PCB and work on electrical schematics. It has a vast number of libraries for the electronic circuit tools. We have used this software to design the PCB for the whole system.

3.4 Conclusion

We have covered the contemporary engineering and IT tools used in this project's prototype in this chapter. Additionally, all the tools we chose for the prototype are IEEE recommended and suitable for implementing the prototype to achieve the desired results.

Chapter 4

Optimization of Multiple Design and Finding The Optimal Solution [CO7]

4.1 Introduction

To accomplish the intended outcome, two design strategies have been developed. Although the two designs operate in distinct ways, they both achieve the same outcome. The first design is based on cloud-based data upload system and main processor is Arduino. In case of the second design, we have used GSM module for data transfer and the main processer is Raspberry Pi. Subsequently analyzing a large set of data, simulations, and practical test scenarios, we found the ideal design strategy we were looking for the foremost results

4.2 Optimization of Multiple Design Approach

Design-1

For this setup in Fig. 3, we have used Arduino, as it is cheaper and has a more user-friendly interface. Since NodeMCU is not available in Proteus, we have used another Arduino module to represent MCU. NodeMCU and Arduino Uno have a few similar functionalities. However, to control the actuators, which are different types of motor, we need PWM, and both boards have similar amounts of PWM pins. Furthermore, to represent the cloud server for communication between the subsystems, we have used COMPIM for serial communication, a substitute for the Wi-Fi module.

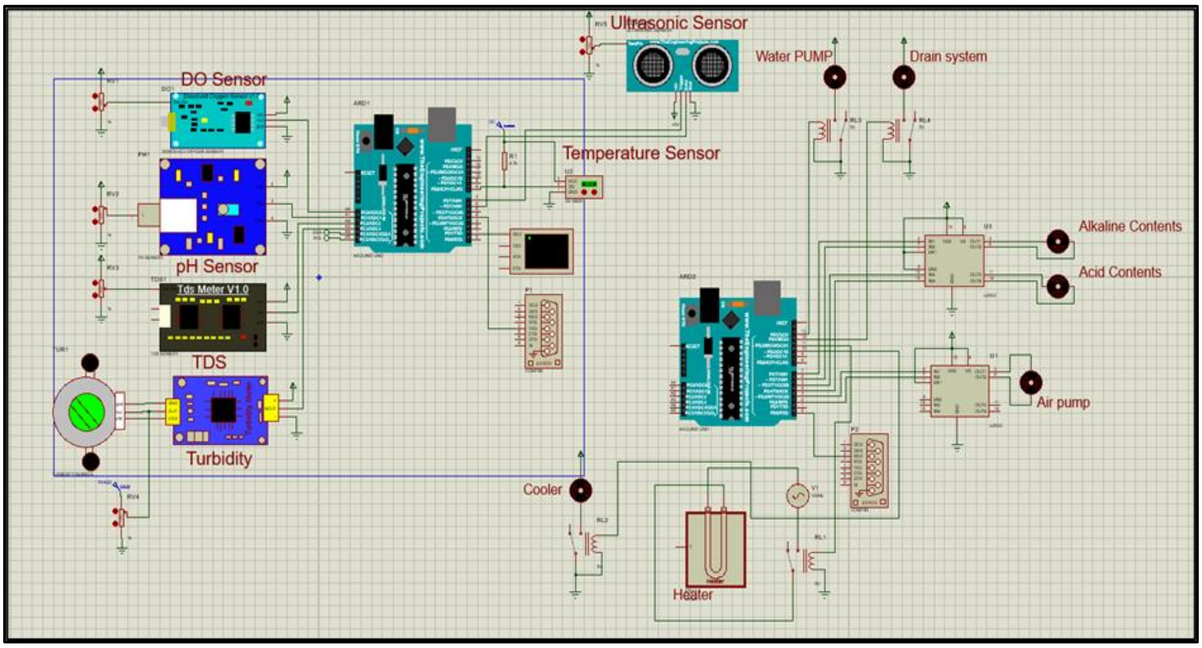


Figure 3. Simulation of Design-1

Dissolved Oxygen Measurement:

A DO sensor connected with Arduino UNO, which measure the concentration of oxygen of the water. Arduino reads sensor data and relies on data to the COMPIM. The COMPIM is used in place of the Wi-Fi module and the cloud server, as the server communication is not available in Proteus. Moreover, for representing the NodeMCU, we are using another Arduino module due to its unavailability in Proteus. The second Arduino acts accordingly to keep the oxygen concentration of the Biofloc in a suitable range by turning on the relay for the air compressor if the level reaches at or below 6 mg/L, as seen in Figure 4 and Figure 5.

Condition: DO level at 8 mg/L (Suitable Condition)

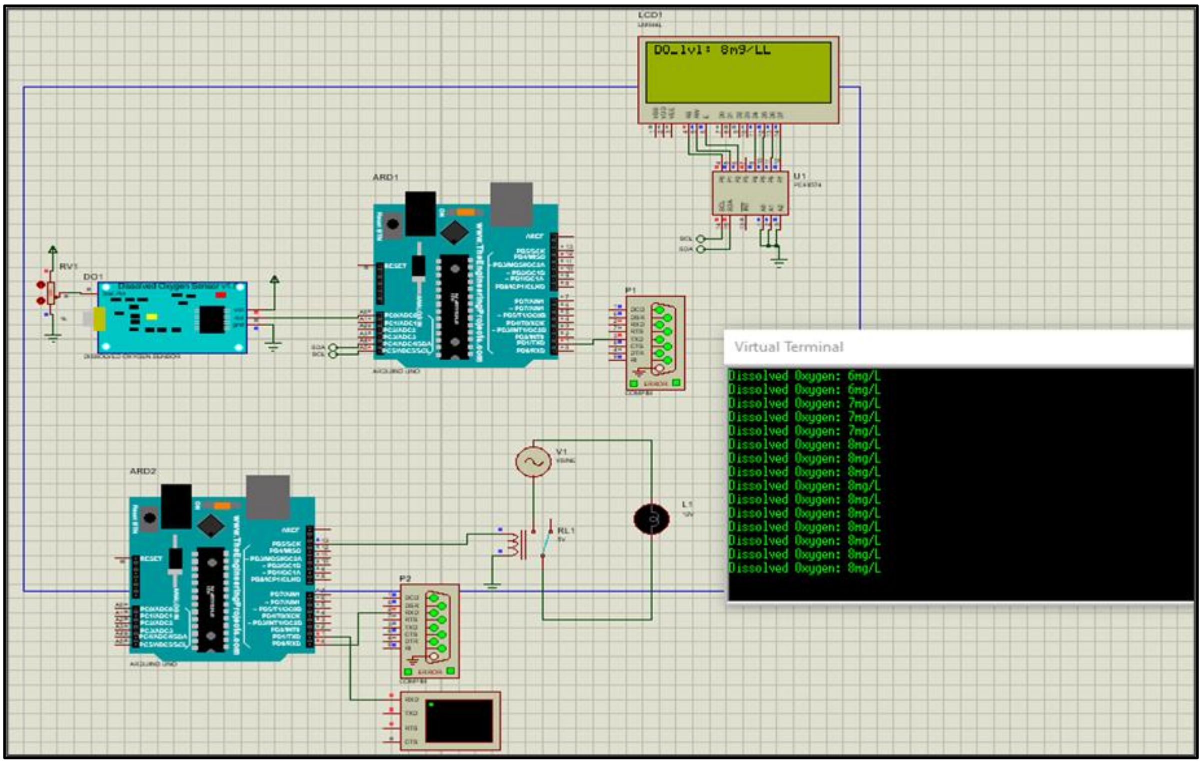


Figure 4. DO sensor and actuator simulation (Suitable Condition)

Condition: DO level at 6mg/L, DO level Low

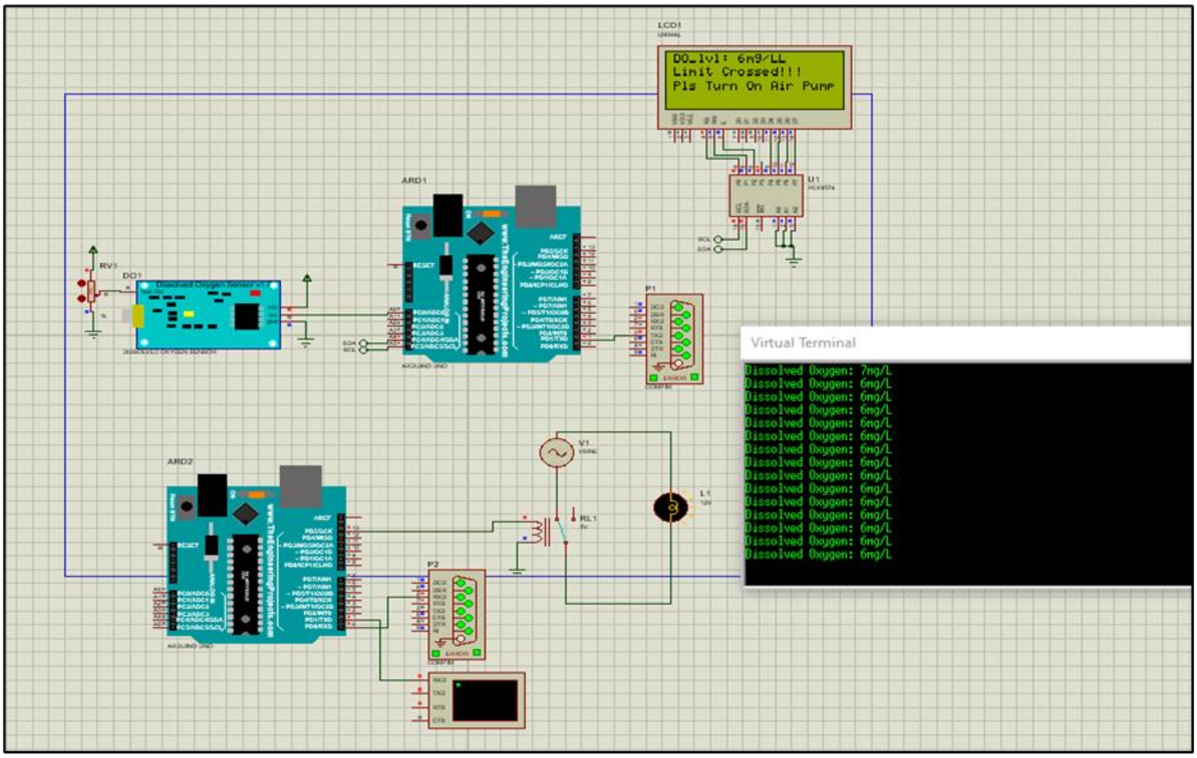


Figure 5. DO sensor and actuator simulation (Air Pump ON)

pH Level Measurement:

For maintaining a suitable pH condition, a similar approach is used as the DO sensor. Here, we have used a motor driver and two dc motors to add acid or alkaline contents according to the condition of the Biofloc system. In Figure 6, the actuators are turned OFF as the pH is within 6.50 - 8.00. However, when the pH level increases or decreases, the relevant actuator is turned ON, as shown in Figure 7 and Figure 8.

<u>Condition:</u> pH level within the threshold value, hence both actuators are turned OFF.

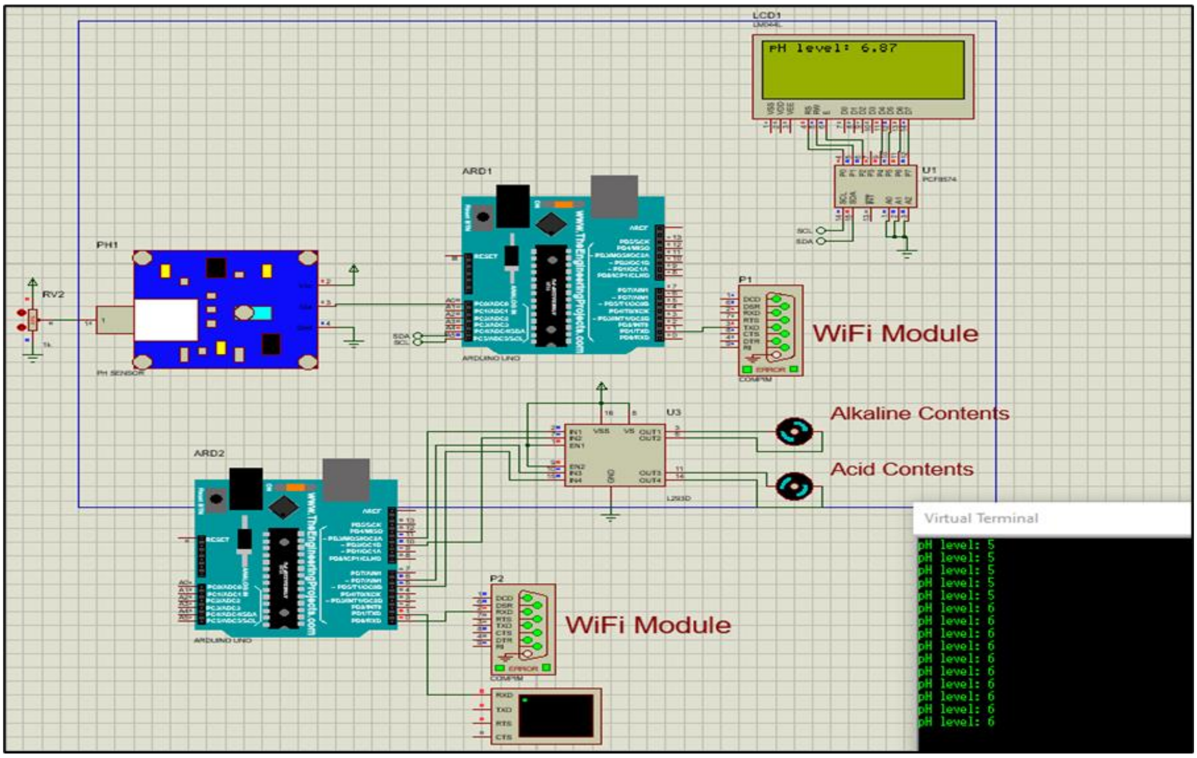


Figure 6. pH sensor and actuator simulation (pH within threshold value)

<u>Condition:</u> High pH value. Acid needs to be added.

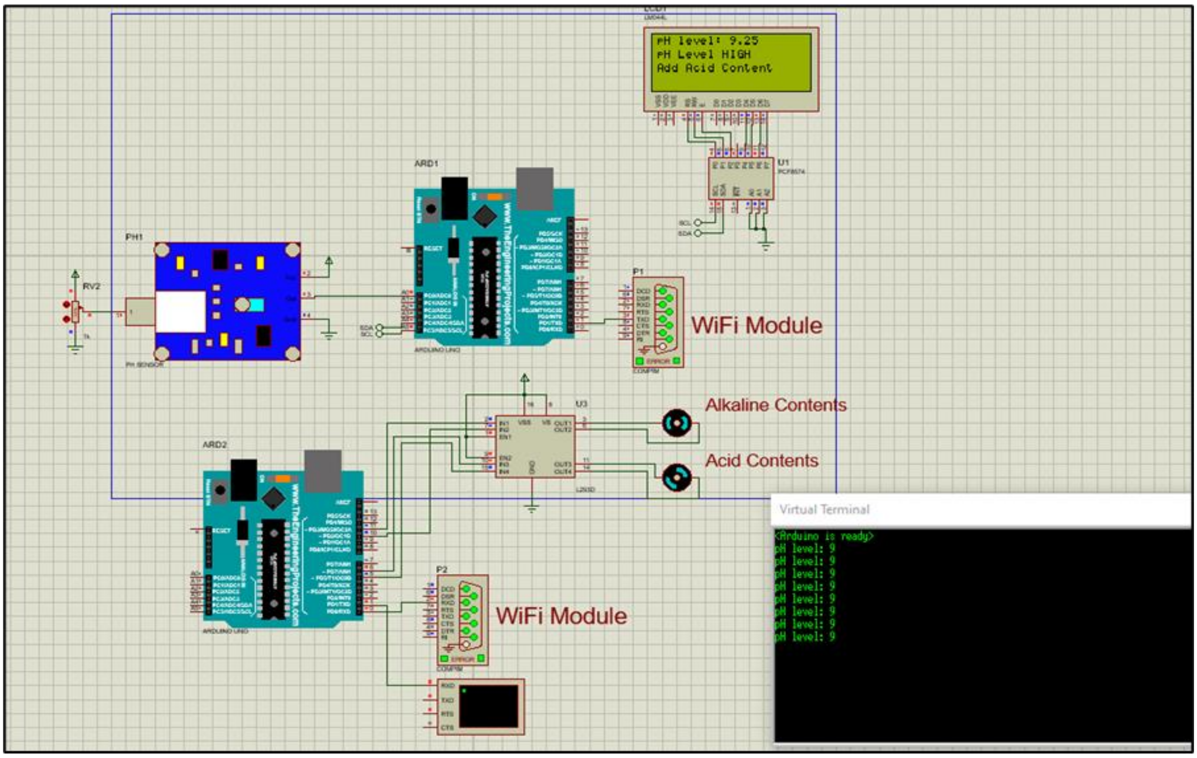


Figure 7. pH sensor and actuator simulation (pH level Exceed)

<u>Condition:</u> pH value at 5, which is low. Hence the relay corresponding to Alkaline contents is activated.

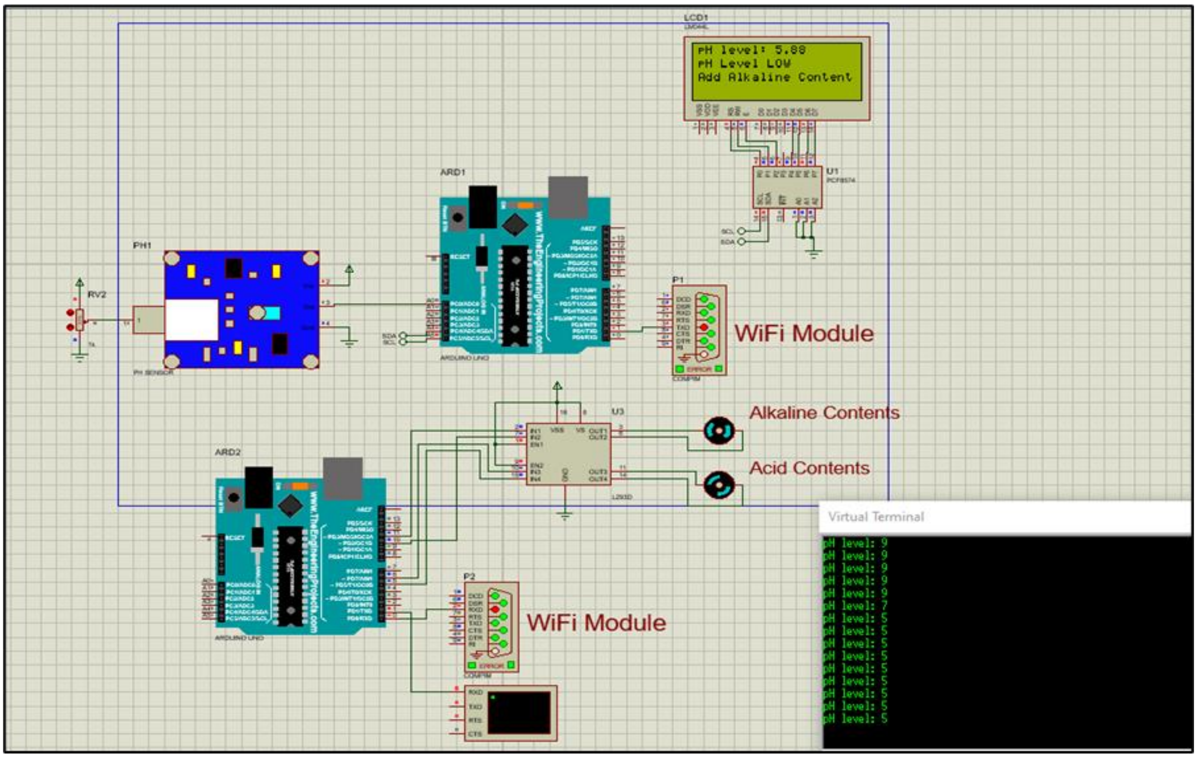


Figure 8. pH sensor and actuator simulation (pH under threshold level)

Temperature Measurement:

To observe the temperature of the Biofloc, we are using DS18B20, a waterproof temperature sensor. Moreover, to keep the parameters in a suitable range, we have used a heating element and a motor representing a cooler. In Figure 9, the temperature is within (25-30) °C, so the actuators are turned OFF. On the hand, the dedicated actuator is turned ON if the temperature level decreases or increases, as shown in Figure 10 and Figure 11.

Condition: Temperature in range, hence both the actuators are turned OFF.

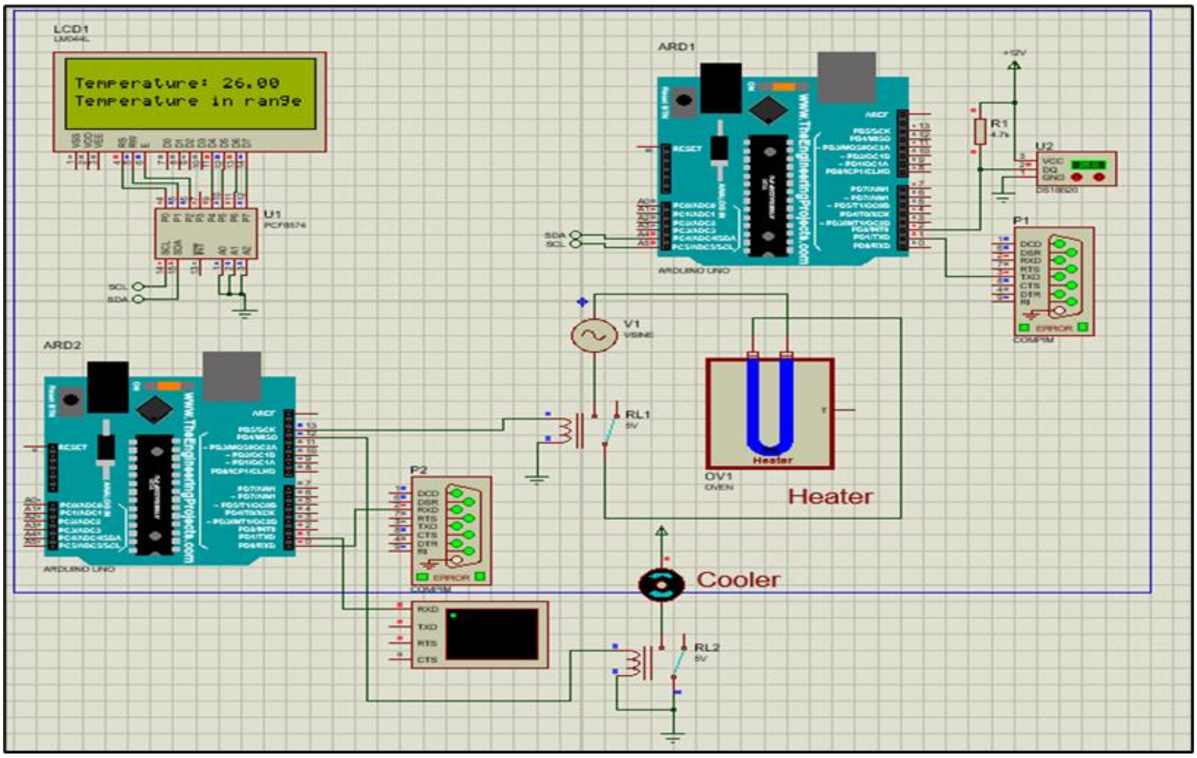


Figure 9. Temperature sensor and actuator simulation (Within threshold value)

<u>Condition:</u> When the temperature is below suitable value the heater is turned ON.

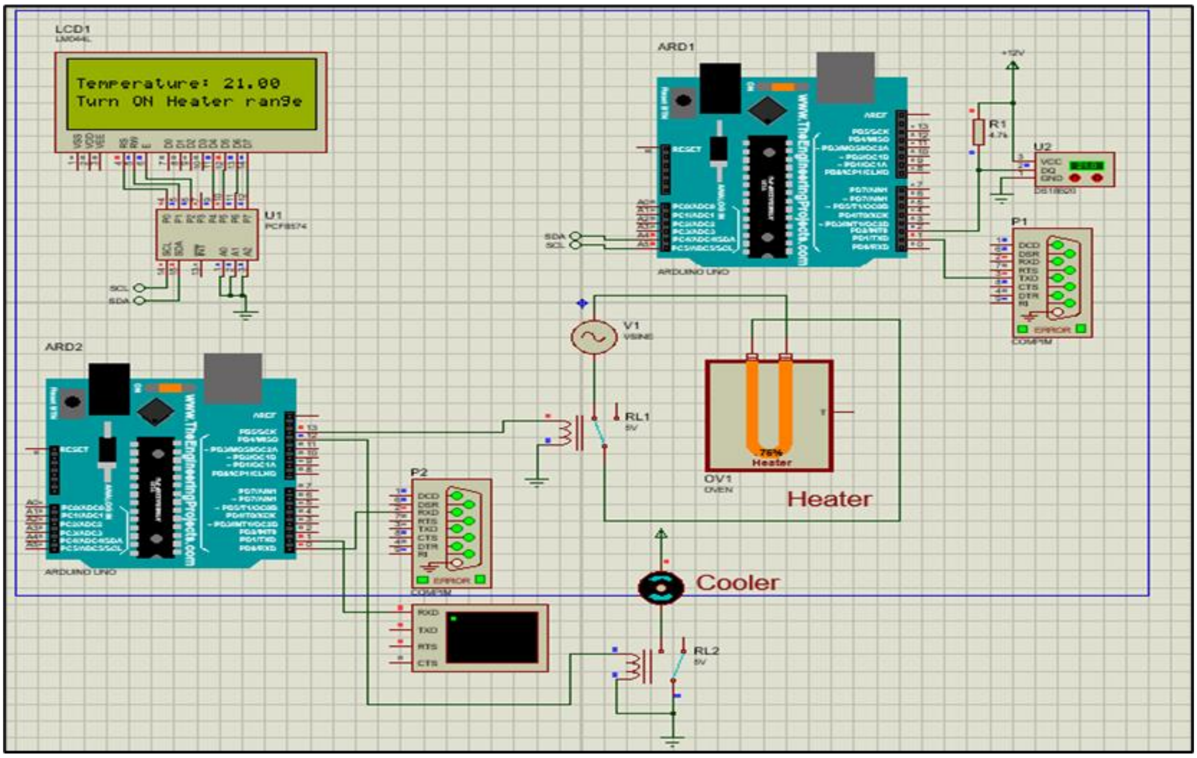


Figure 10. Temperature sensor and actuator simulation (Heater ON)

<u>Condition:</u> When the temperature is High, the cooler is turned ON.

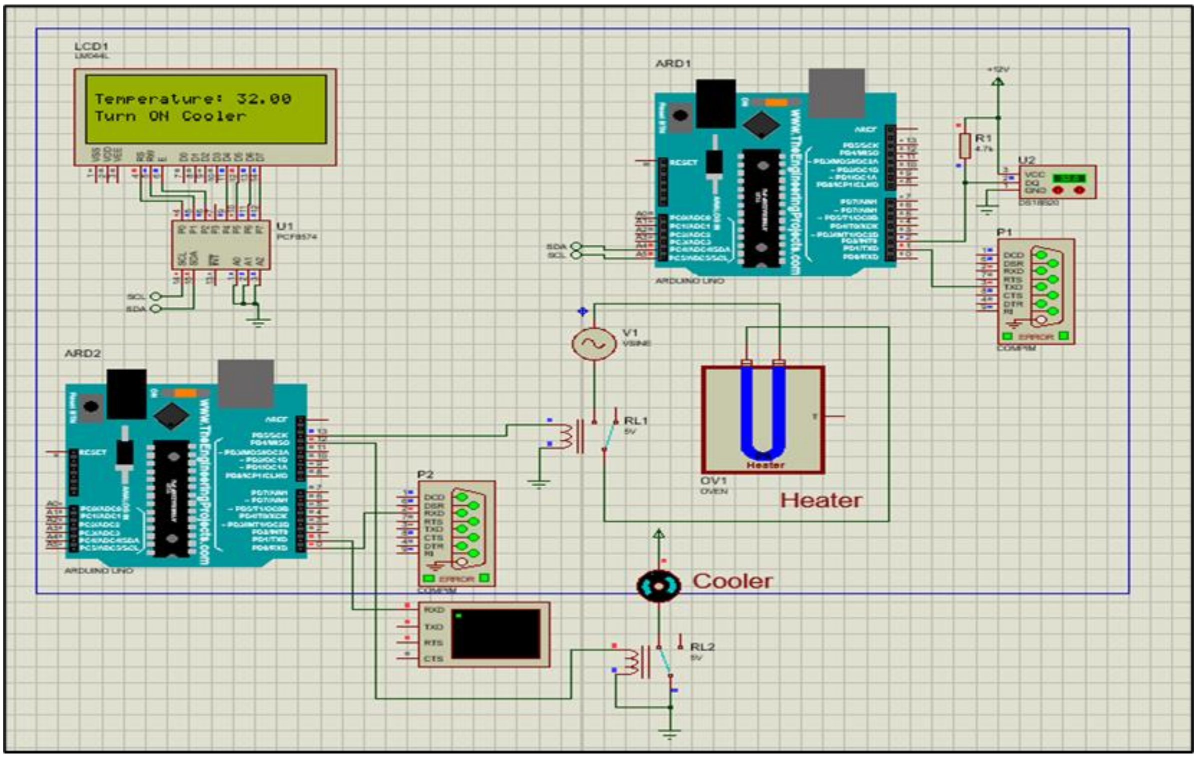


Figure 11. Temperature sensor and actuator simulation (Cooler ON)

Water Level Determination:

The water level in a Biofloc system needs to be monitored and maintained. However, we have used the HC-SR04 Ultrasonic sensor available in Proteus to verify this functionality. This module ranges from 2 cm to 400 cm, with a ranging accuracy of 3mm. When the water level of the Biofloc is low, water is added to the system with the help of the water pump (Figure 12). Moreover, Biofloc systems are often installed in outdoor environments, where during the rainy season, High water levels may be encountered; hence to keep the Biofloc from overflowing, the drain system is simulated in Figure 13.

Condition: Water Level is low; hence water pump is turned ON.

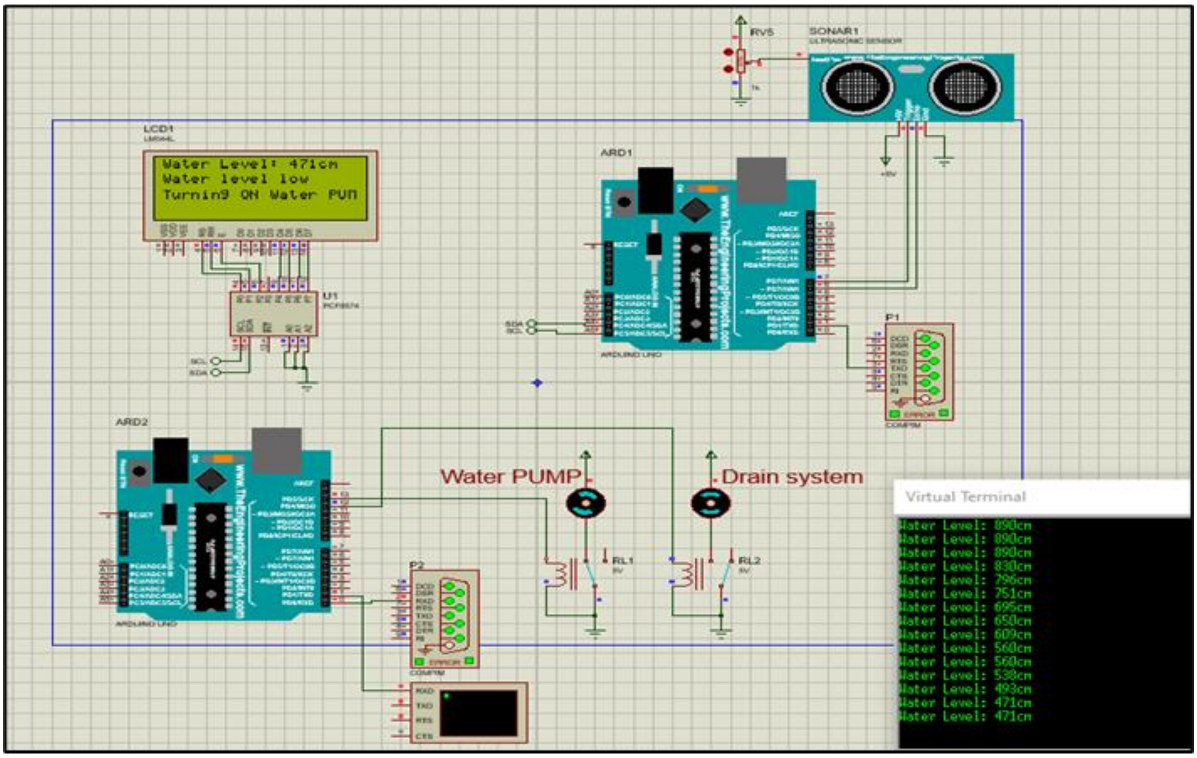


Figure 12. Ultrasonic sensor and actuator simulation (Water pump ON)

Condition: Water level is high; hence the drainage system is turned ON.

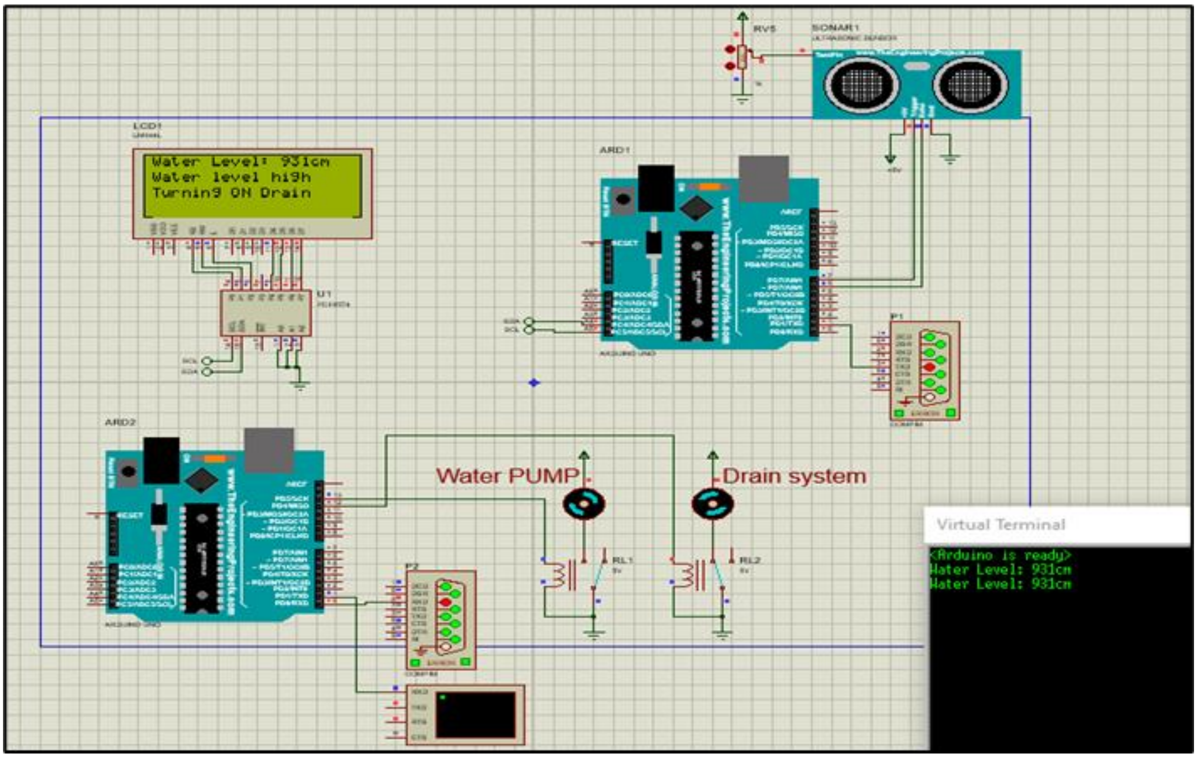


Figure 13. Ultrasonic sensor and actuator simulation (Drainage system ON)

Turbidity and TDS Measurement:

To observe the water quality in the Biofloc, we are using Turbidity and TDS sensors; these values are stored in the cloud, which can be analyzed and used for future references. It is shown in Figure 14 below.

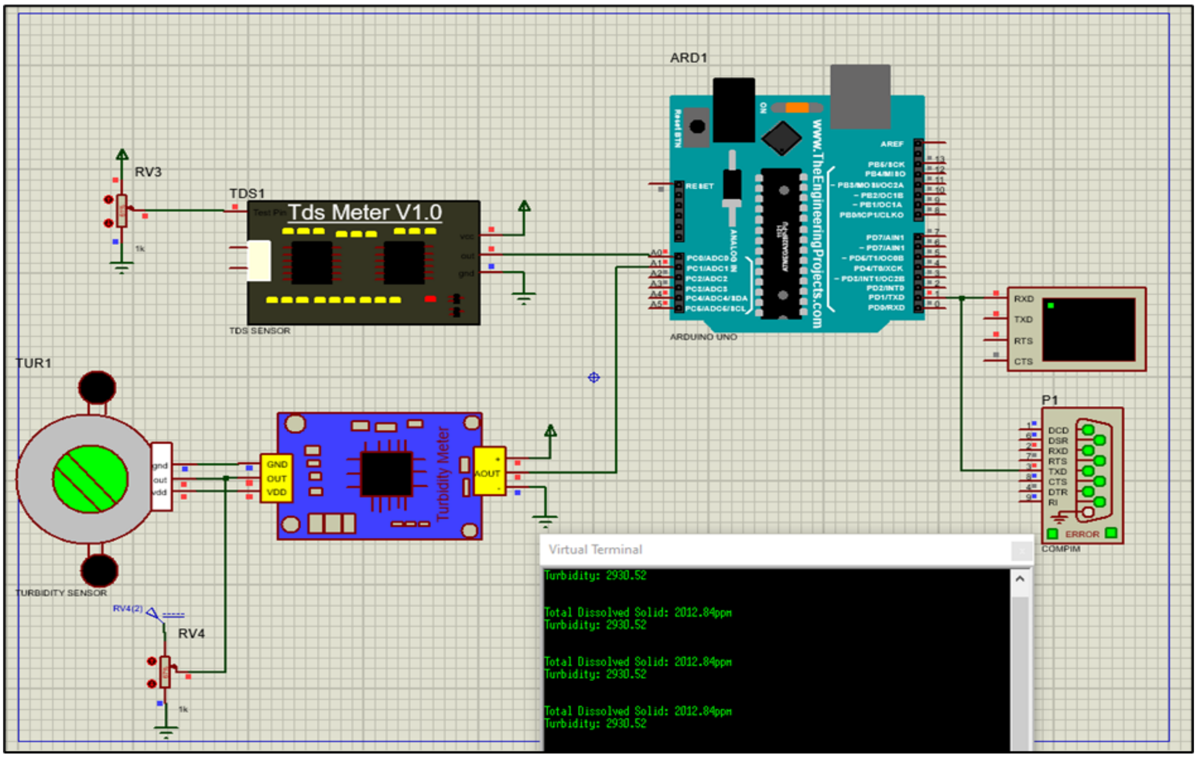


Figure 14. TDS sensor and Turbidity sensor simulation

Design-2

For the design shown in Figure 15, we have used Raspberry Pi, which only supports digital sensors. Moreover, the virtual terminal is used in the simulation for serial communication, as well as for displaying alert messages. In addition, LEDs are used to represent the switches of the actuators which are turned ON when any imbalance such as low temperature or unsuitable oxygen concentration is observed in the Biofloc system and are turned OFF when not necessary. We can observe the interface of the simulation in Figure 14.

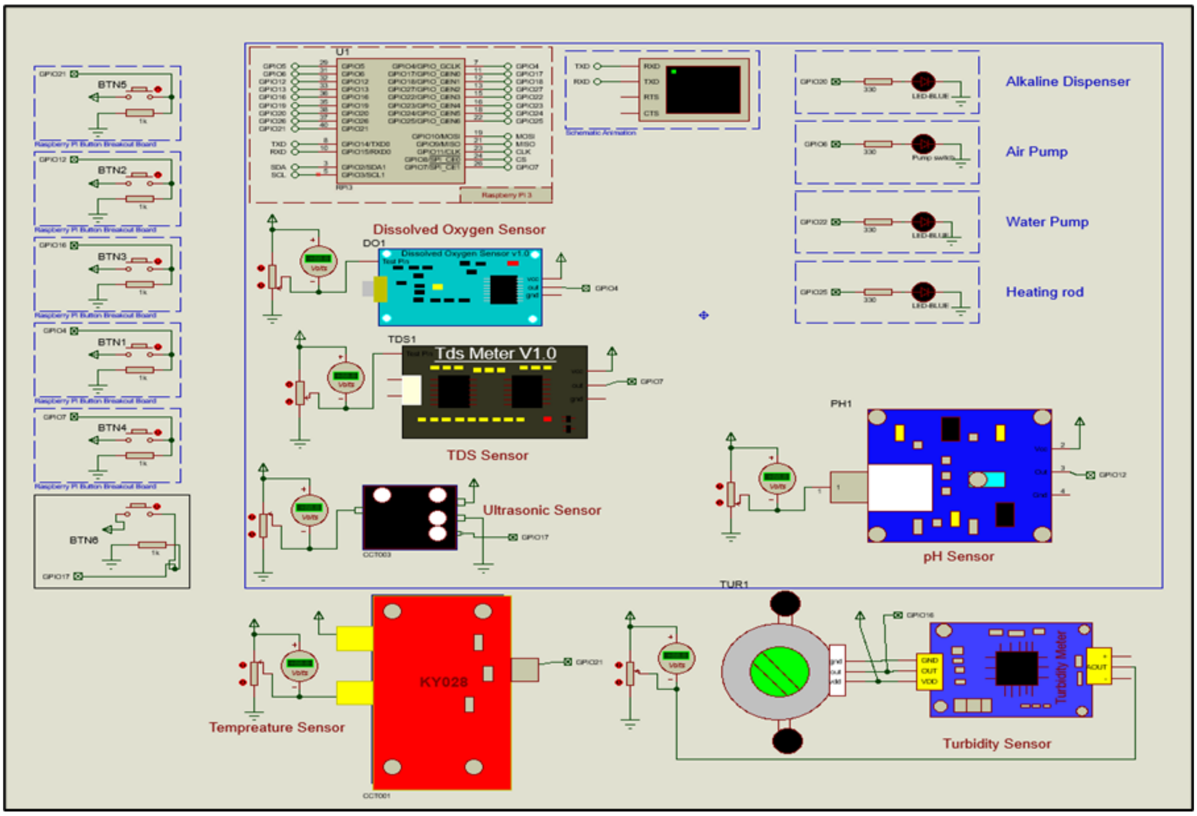


Figure 15. Simulation of Design-2

Dissolved Oxygen Measurement:

To monitor and maintain the oxygen concentration of the system, we are using a DO sensor. When the oxygen concentration level falls below 6.0 mg/L, the air pump is activated, represented by a DC motor, as shown in Figure 16. Moreover, the air pump remains idle in other scenarios, as shown in Figure 17.

Condition: DO level below 6 mg/L, Actuator ON.

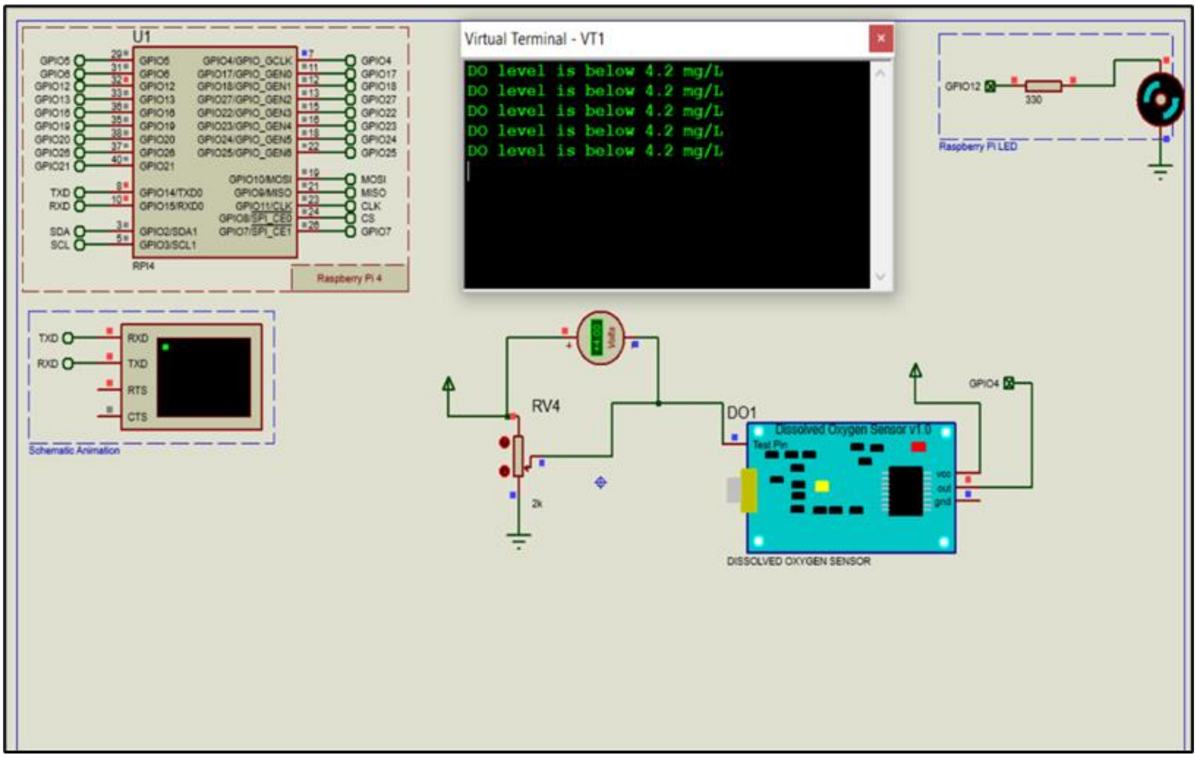


Figure 16. DO sensor and actuator simulation (Actuator ON)

Condition: DO Level at 6 mg/L, actuator OFF.

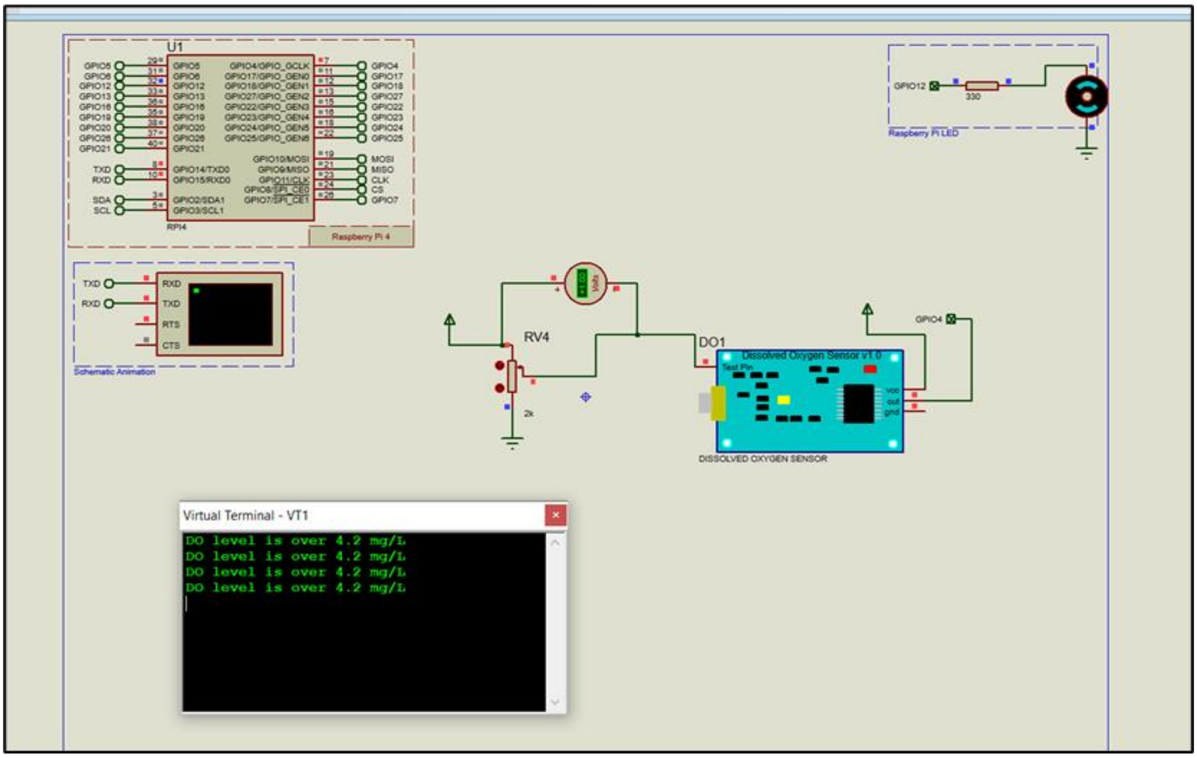


Figure 17. DO sensor and actuator simulation (Actuator OFF)

Temperature Measurement:

As Raspberry Pi cannot take a reading from analog sensors, the KY028 sensor, a digital temperature sensor, is used for simulation. An LED replaces the switch of the heating rod. This LED will remain OFF for any temperature over the suitable value and will be turned on for any temperature below the suitable value. Here, Figure 18. shows a condition where the temperature is in range, and in Figure 19. temperature is below the suitable value; as a result, the heater switch is turned ON.

<u>Condition:</u> Temperature in range, hence the actuator is turned OFF.

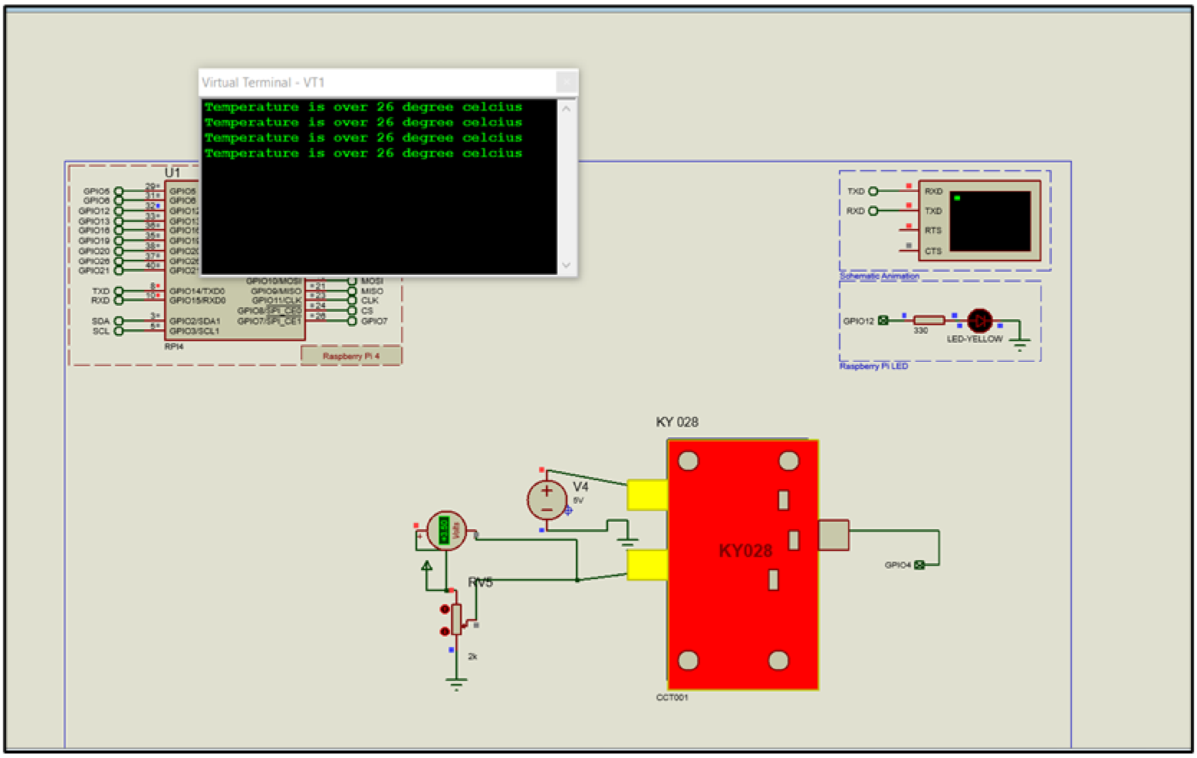


Figure 18. Temperature sensor and actuator simulation (Actuator OFF)

Condition: Temperature in range, hence the actuator is turned ON.

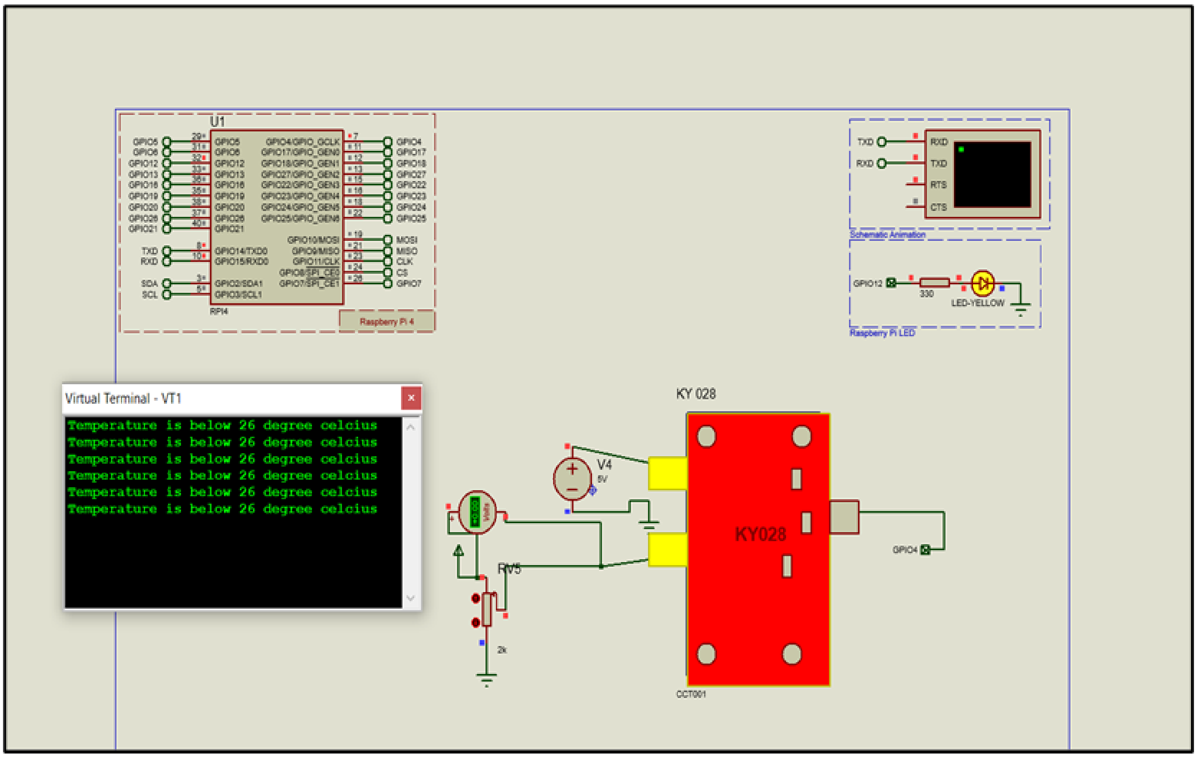


Figure 19. Temperature sensor and actuator simulation (Actuator ON)

pH Level Measurement:

For maintaining a suitable pH condition, a similar approach is used. However, two different simulations are used to add Acid contents to Alkaline contents according to the condition of the Biofloc. In Figure 20, pH value is between 6.50 – 8.00, so no Acid or Alkaline needs to be added. In Figure 21, the pH value is low, and the switch corresponding to Alkaline contents is turned on. On the other hand, Figure 22 shows a high pH value. Hence the switch corresponding to Acid contents gets turned on.

<u>Condition:</u> pH in range.

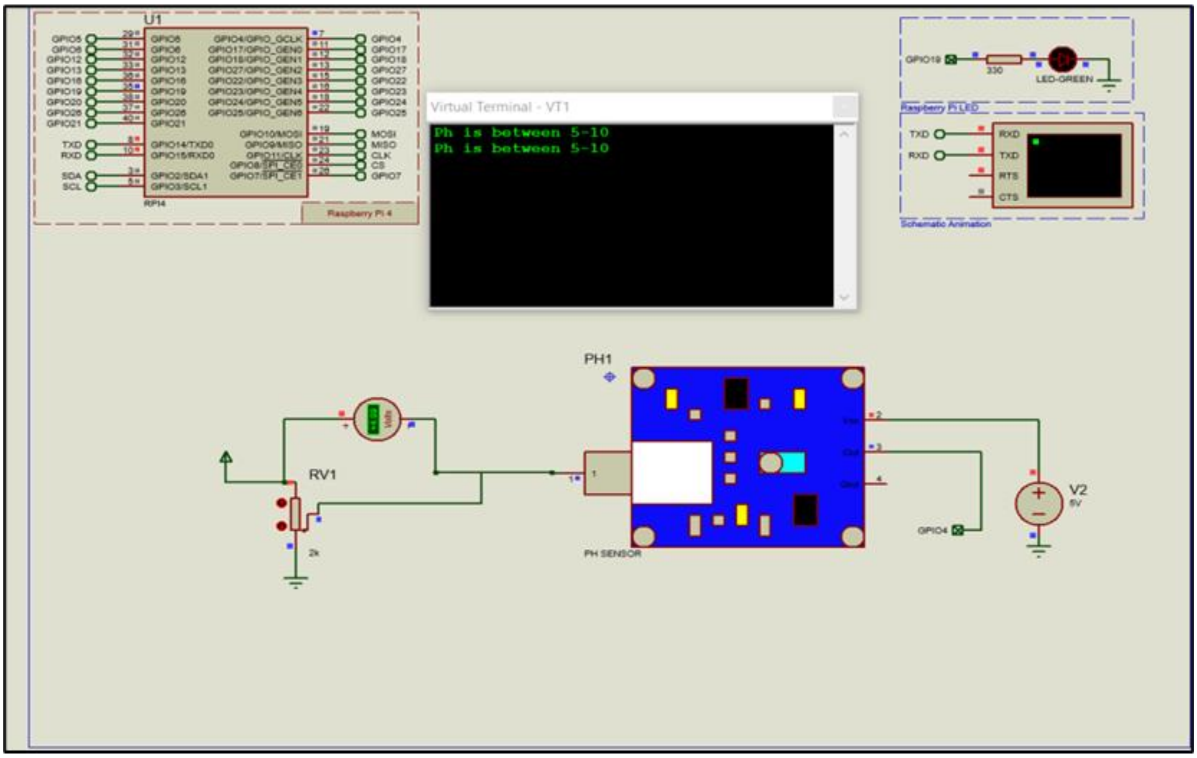


Figure 20. pH sensor and actuator simulation (Suitable condition)

<u>Condition:</u> pH is low, hence Alkaline added.

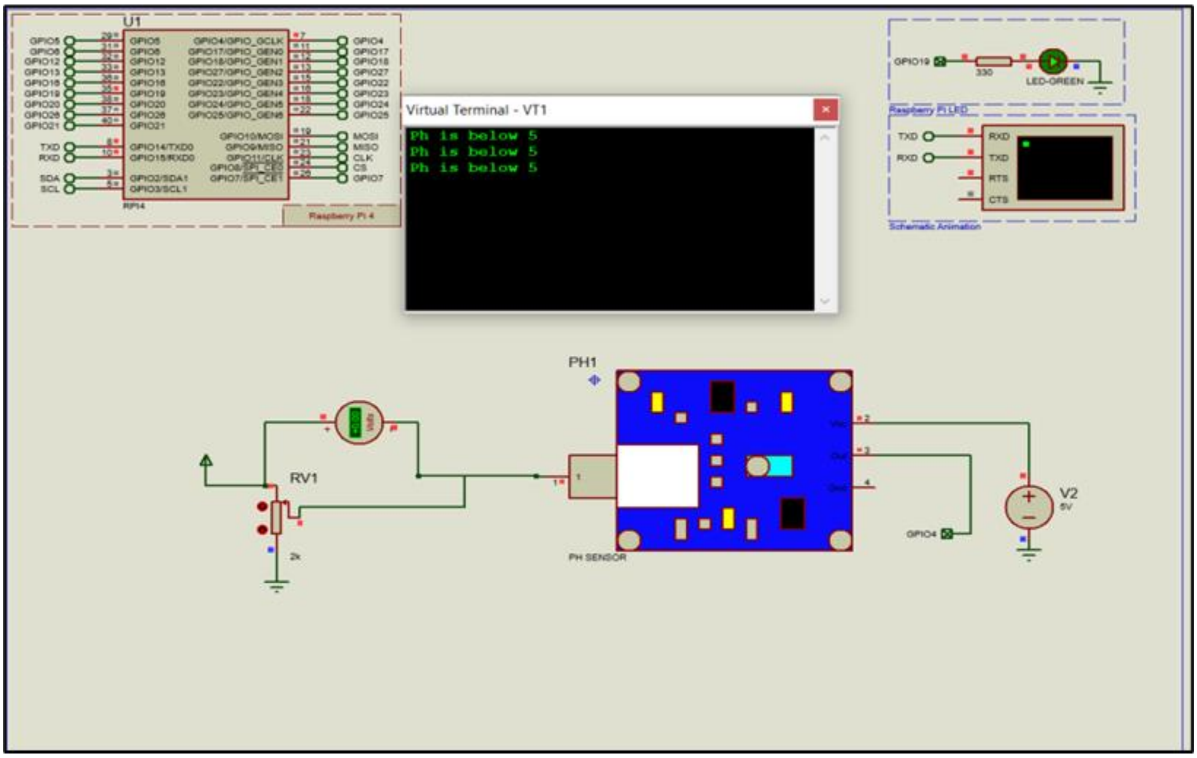


Figure 21. pH sensor and actuator simulation (pH level low)

Condition: pH is high, hence Acid added.

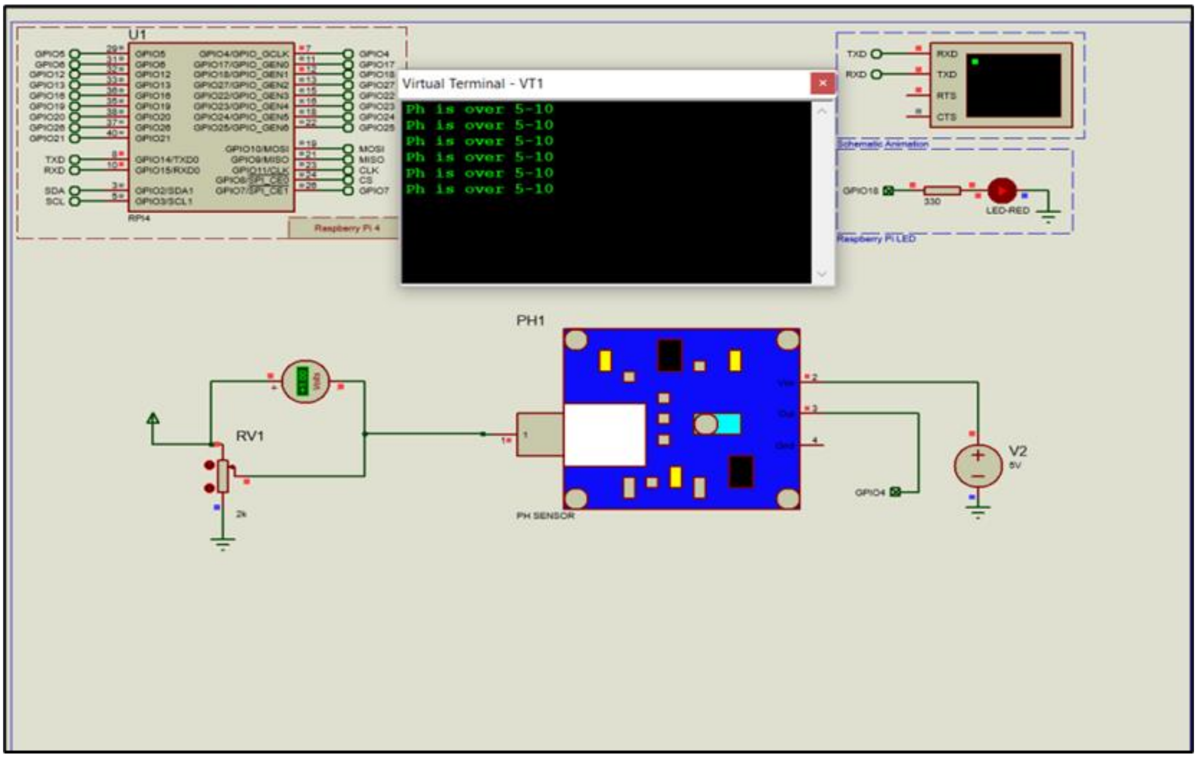


Figure 22. pH sensor and actuator simulation (pH level high)

TDS Measurement:

TDS value is observed using the TDS sensor and displayed in the virtual terminal as a notification message where Figure 23. shows the situation when the TDS value is over 600 mg/L, and Figure 24 shows the situation when the TDS value is below 600 mg/L.

Condition: TDS over 600 mg/L.

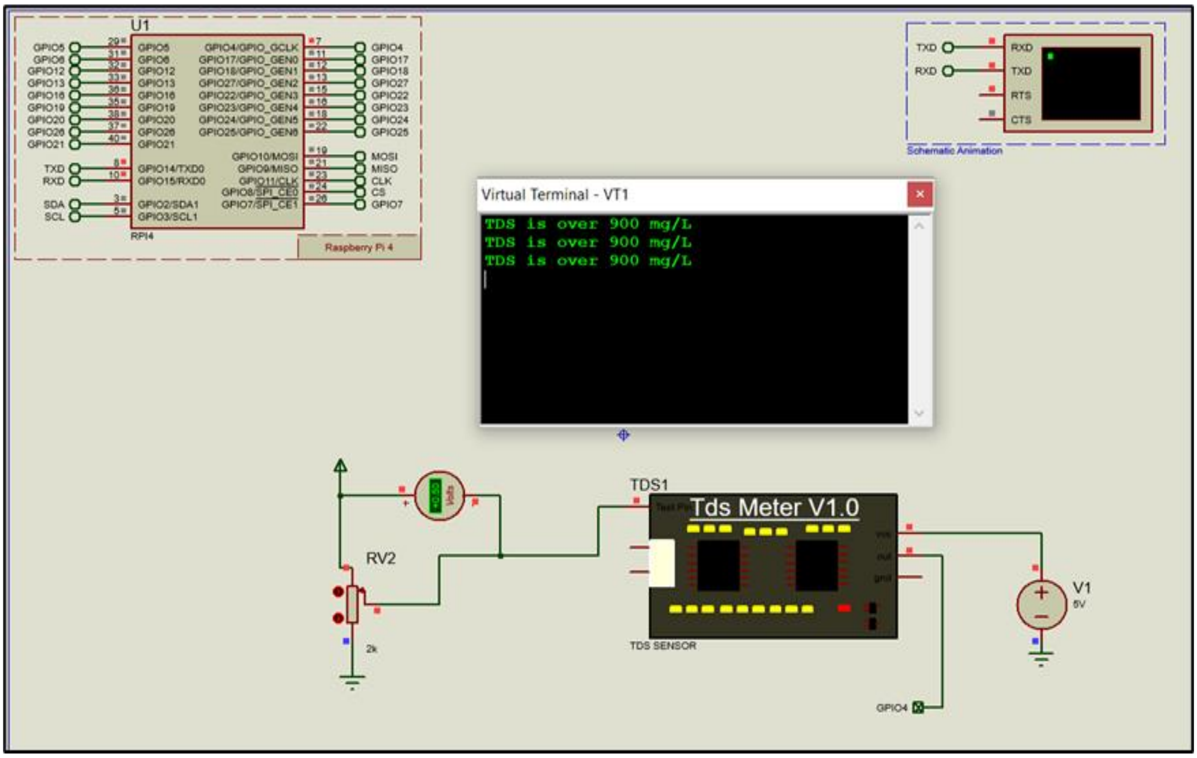


Figure 23. TDS sensor and actuator simulation (Over threshold value)

Condition: TDS below 600 mg/L.

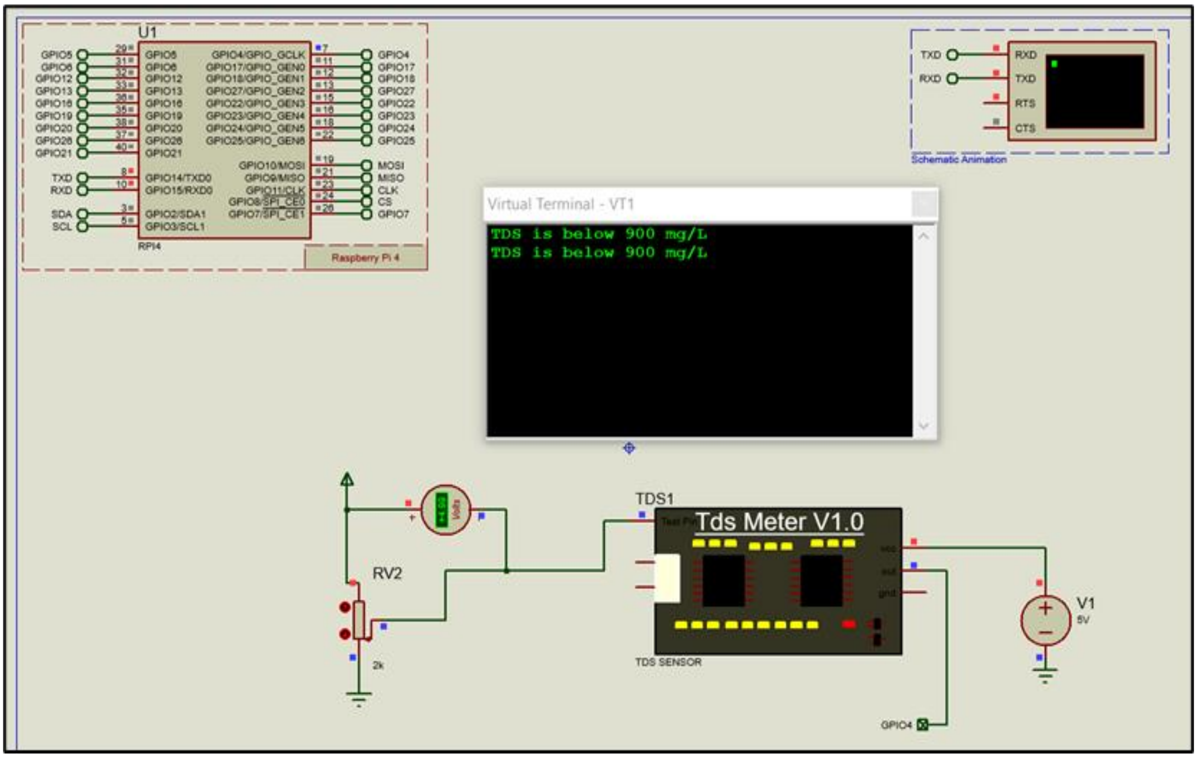


Figure 24. TDS sensor and actuator simulation (Below threshold value)

Turbidity Measurement:

To monitor the turbidity, a turbidity sensor is used. Figure 25 shows the notification received when turbidity is below 200 mg/L. On the other hand, Figure 26 shows the notification received when turbidity is over 200 mg/L

<u>Condition:</u> Turbidity below 200 mg/L.

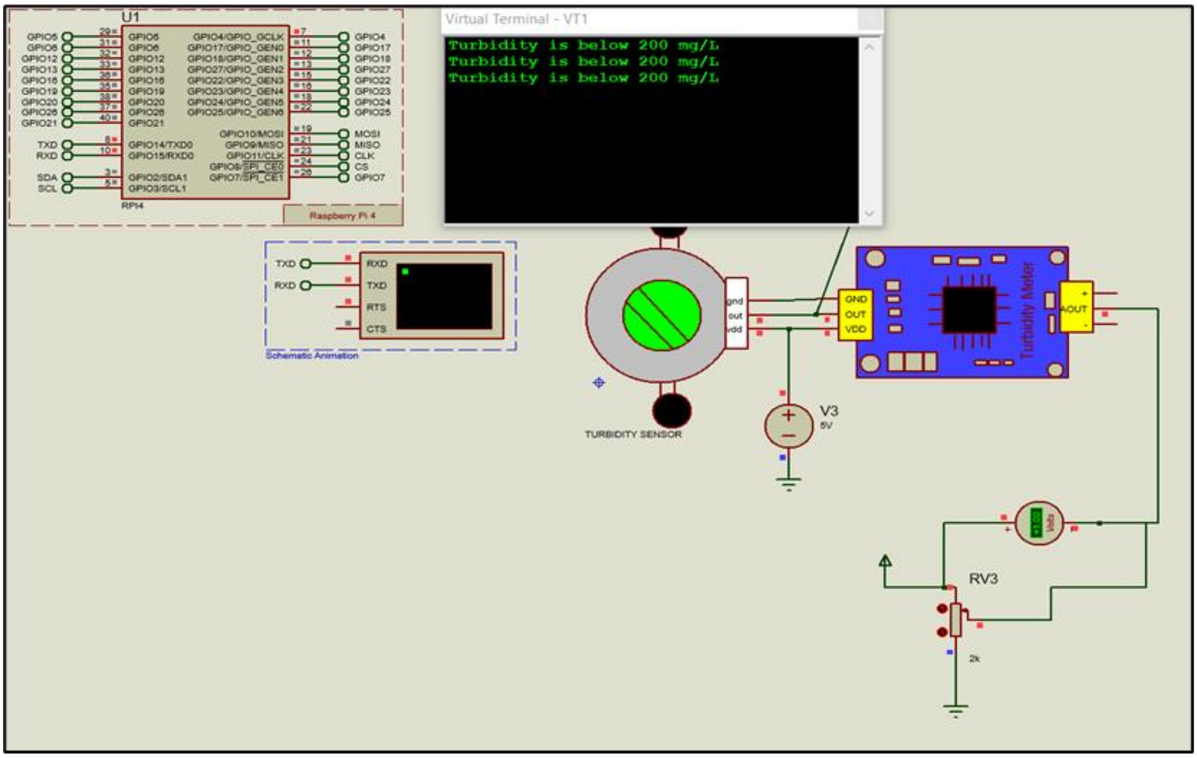


Figure 25. Turbidity sensor and actuator simulation (Below threshold value)

Condition: Turbidity over 200 mg/L.

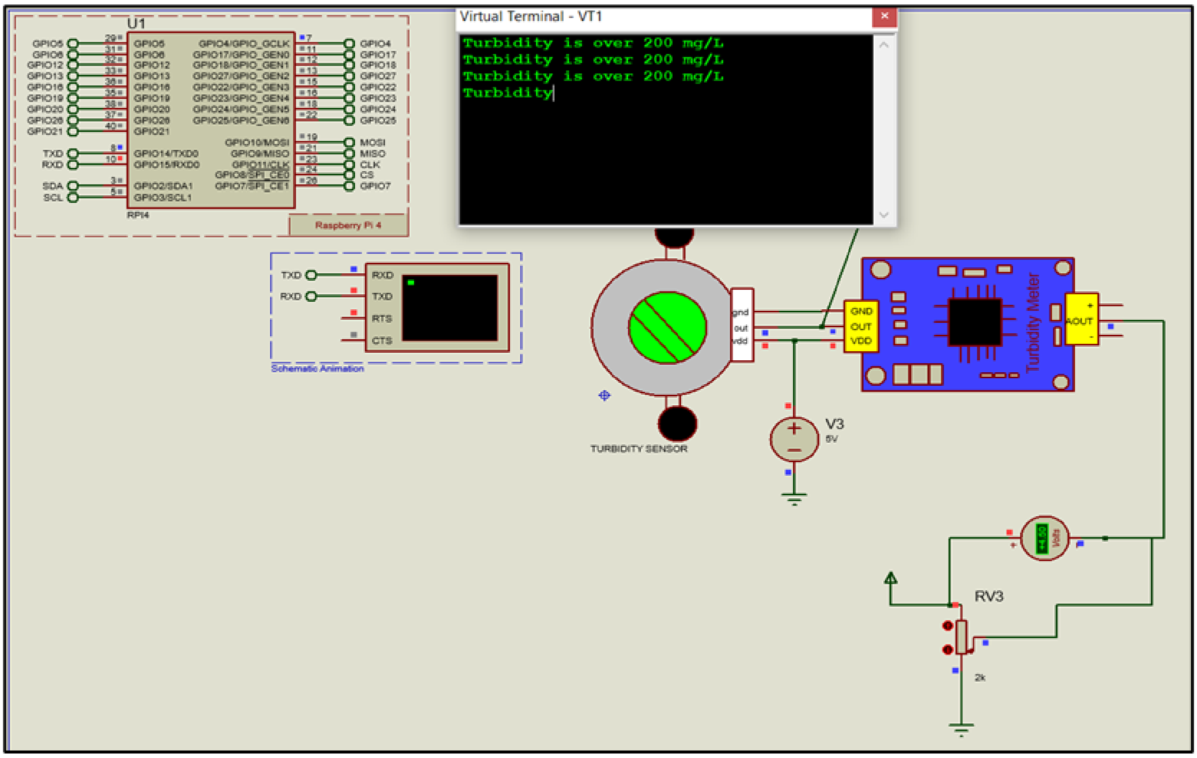


Figure 26. Turbidity sensor and actuator simulation (Over threshold value)

Water Level Measurement:

The water level is measured using a digital water sensor. Figure 27 depicts the scenario where the water level is above 0.8 m, and no actuator is turned ON as a result. Moreover, in Figure 28, when the height of water is below 0.8 m, the water pump is turned ON.

<u>Condition:</u> Water level over 0.8 m, actuators OFF.

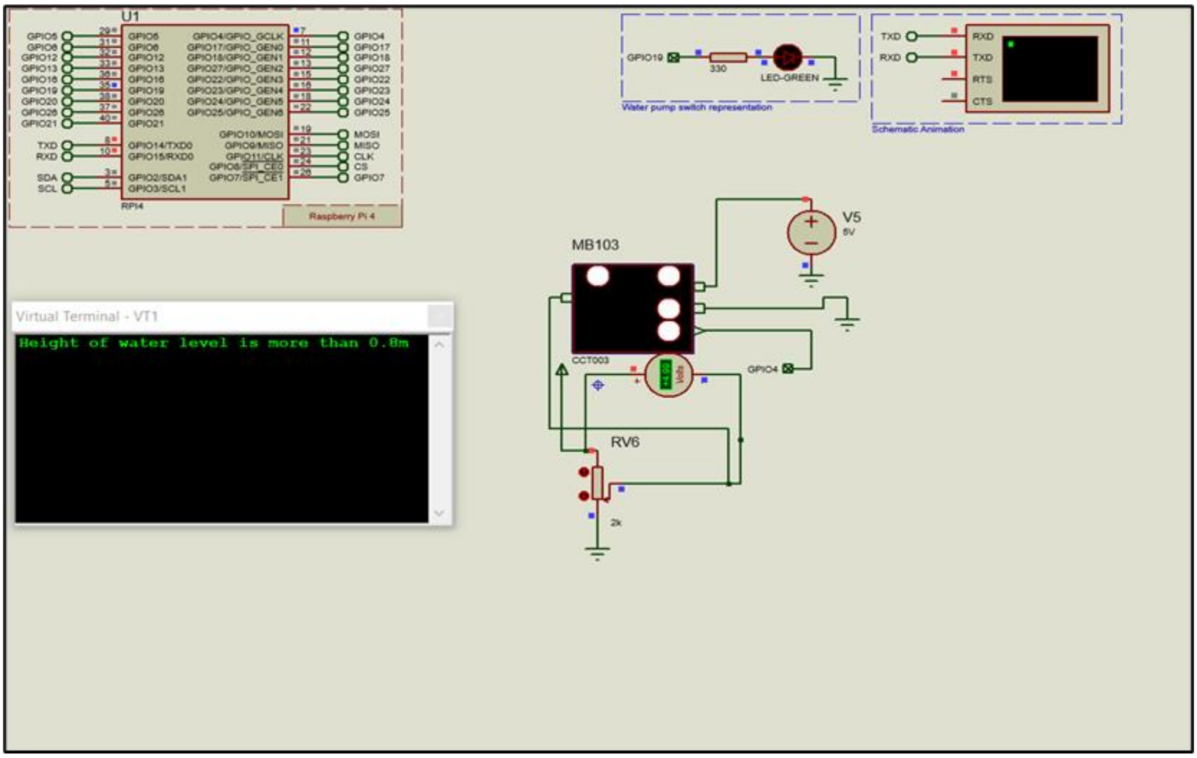


Figure 27. Ultrasonic sensor and actuator simulation (Actuator OFF)

<u>Condition:</u> Water level over 0.8 m, actuators OFF

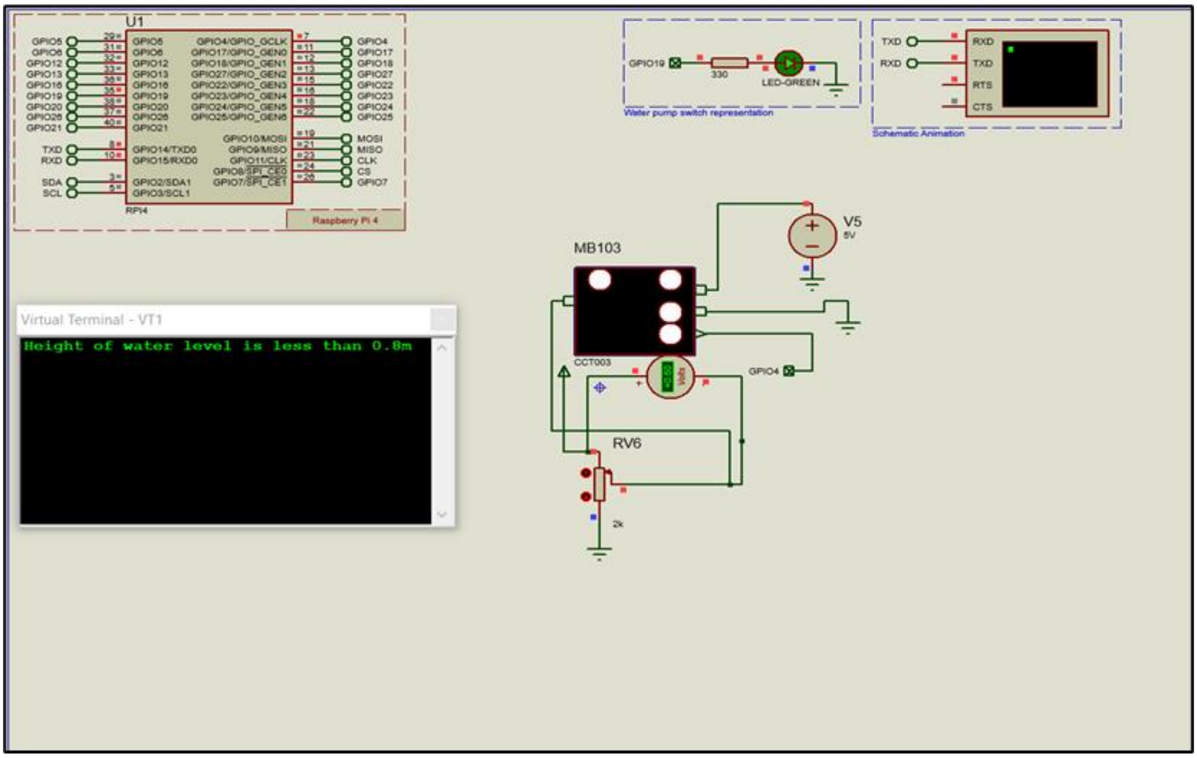


Figure 28. Ultrasonic sensor and actuator simulation (Actuator ON)

4.3 Identify Optimal Design Approach

In this section we have performed SWOT analysis and design simulation comparison to determine the optimal design approach for the project. The complete information is represented below with the necessary justification:

	Design-1	**Design-2**
Cost	BDT. 70000 (Low)	BDT. 88000 (High)
Efficiency	More efficient	Less efficient
Usability	High	Low
Manufacturability	Comparatively easy	Somewhat critical
Maintainability	Somewhat high	Low

Table 7. Comparison Between the Multiple Designs

- **SWOT Analysis for Design-1:**

Strengths:

1. **Efficient use of electric power**

   In this design, Pulse Width Modulation (PWM) is present, capable of controlling the power supplied to the actuators; hence it becomes energy efficient.

2. **Analog sensor**

   Analog sensors can represent the real-world scenario easily, and these sensors have better technical performance than digital sensors. Moreover, the implantation of analog sensors is easy compared to digital sensors.

3. **Cost**

   To complete the prototype of Design-1, it requires Taka 70000, which is Taka 18000 less than Design-2.

Weaknesses:

1. **Continuous need for internet connection**

   To compare the threshold values of water quality parameters and regulate actuators, this design heavily relies on the cloud server, which is challenging to operate without internet connectivity.

2. **IoT standardization**

   There is no specific IoT standard for our design that we can follow. So, making it standardized is quite challenging.

Opportunities:

1. **Involving cloud computing system**

   Cloud-based services such as storage and analysis play an essential role in the modern world, but unfortunately, in the fisheries sectors like Biofloc technology, these cloud-based services are still not appropriately used in countries like Bangladesh. This design has cloud storage and analysis features that will motivate people related to fisheries to know and use cloud computing more.

2. **Engaging wireless system**

   As the system is wireless, multiple Biofloc systems can be operated and maintained at a same time. Moreover, it has cloud comparison and a dedicated application.

Threats:

1. **Firmware update**

   Since, IoT is an emerging field, it is not regulated properly. Hence, most of the components or programs cannot be trusted solely for data protection. Thus, the system firmware needs to be updated regularly.

2. **Secure storage**

   A cloud server plays a vital role in this design as it stores and analyzes the data. In case of any problem with the cloud server, the system will face severe problems.

❖ **SWOT Analysis for Design-2:**

Strengths:

1. **No internet connection is required**

   This design does not contain any cloud system, so no internet connection is required for the system to run.

2. **User Interface**

   This design is based on Raspberry Pi, which is easy to program compared to Arduino.

Weaknesses:

1. **Cost**

   This system becomes more expensive than the Design-1 to implement.

2. **Interoperability**

   Raspberry Pi requires digital sensors to perform correctly. However, digital sensors are not available in the market vastly. However, analog sensors can be used with the help of ADC (Analog-to-Digital Converter). Additionally, unlike IoT, it cannot operate other systems that are implemented in different areas.

3. **Power loss**

   The power used in operating the actuators cannot be controlled efficiently in case of this design, as it is limited to turning the switches ON or OFF.

Opportunities:

1. **On-board encryption**

   This design is fully isolated as Raspberry Pi takes the sensor data, compares it with the threshold values, and controls the actuators.

Threats:

1. **Unavailability of sensors**

   Most of the sensors available in the market are analog. On the other hand, due to many issues like the Covid-19 pandemic, international situations can make sensors unavailable.

2. **Fault in switch connections**

   As this design turns ON and OFF the switches of the actuators based on sensor data, if there is any fault in switch connections, then the system will not be able to control the actuators.

After Performing all the simulations and critically observing all the criteria of using SWOT analysis, we can state that the Design-1 shows the superlative results.

4.4 Performance Evaluation of Developed Solution

Data table of test cases for different sensors.

Temperature Sensor

Trial	Temperature (Degree Celsius / °C)	Threshold Value (25 -30) °C	Result	Heater
1	29	Within	Good	OFF
2	21	Below	Increase Temp	ON
3	33	Above	Decrease Temp	OFF
4	27	Within	Good	OFF
5	20	Below	Increase Temp	ON

Table 8 .Performance Evaluation of Temperature Sensor

Table 8 shows how actuators behave based on different temperature values. When temperature value is below the threshold value the actuator (heater) is ON. Also, the actuator is OFF while the temperature is over the threshold value.

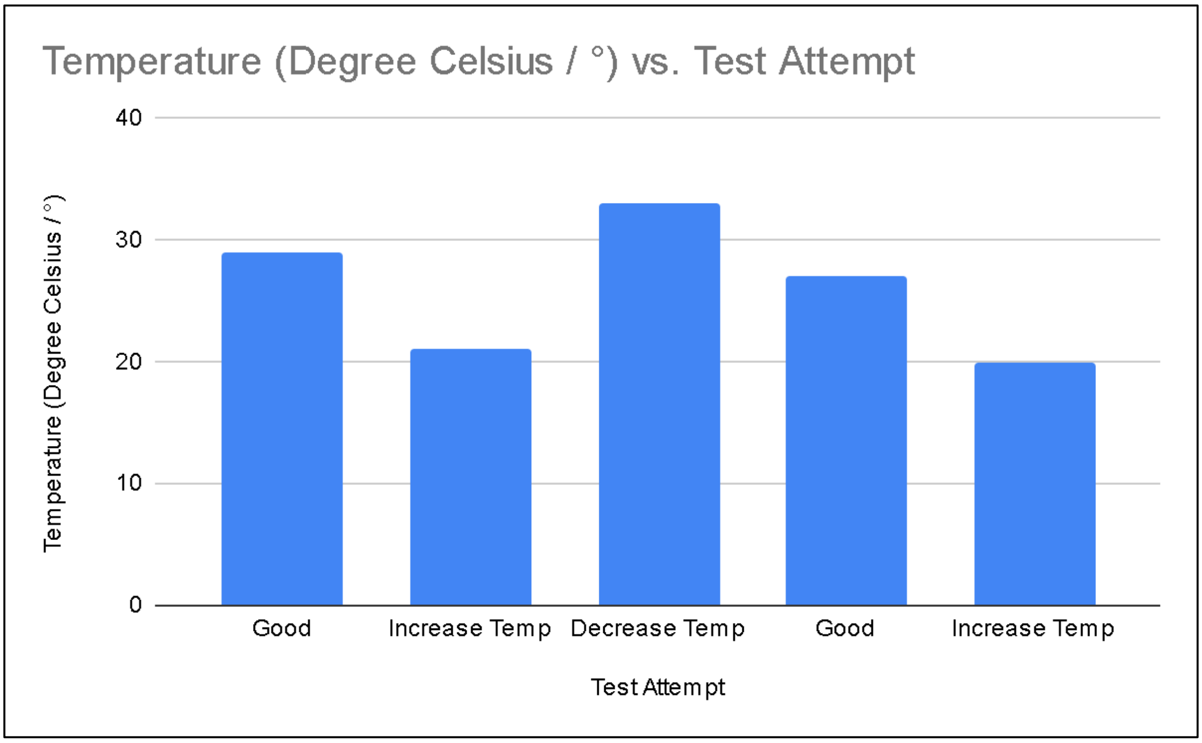


Figure 29. Column chart of Temperature sensor with result

In figure 29, the graph shows the temperature sensor readings and the output result from the sensor reading from Table 8. The threshold temperature value for a specific Biofloc tank container is always compared with the sensor readings and the output results are to operate the heater in the Biofloc tank.

Dissolved Oxygen Sensor

Trial	**Dissolved Oxygen (mg/L)**	**Threshold Value (7 mg/L - 9 mg/L)**	**Result**	**Air Pump**
1	8	Within	Suitable Condition	OFF
2	6	Below	Increase DO	ON
3	4	Below	Increase DO	ON
4	7	Within	Suitable Condition	OFF
5	5	Below	Increase DO	ON

Table 9. Performance Evaluation of Dissolved Oxygen Sensor

Table-9 shows when the oxygen level of water falls below than standard value, an air pump will increase the oxygen level by creating bubbles in the water. On the other hand, the pump is OFF when the DO level is over the threshold value.

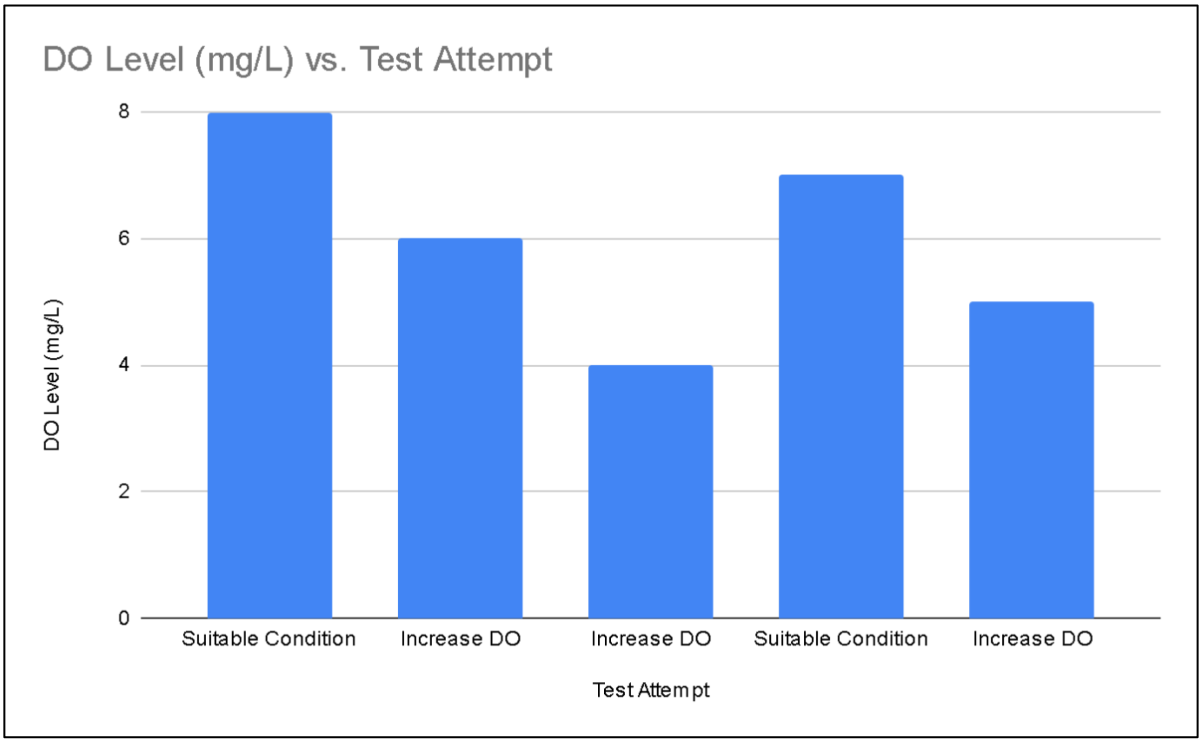


Figure 30. Column chart of Dissolved Oxygen Sensor with result

In figure 30, the graph shows the DO sensor readings and the output result from the sensor reading from Table 9. The threshold dissolved oxygen level for a specific Biofloc tank container is always compared with the sensor readings and the output results are to operate the air pump in the Biofloc tank to maintain the desired oxygen level.

pH Sensor

Trial	**pH**	**Threshold Value (6.5-7.5)**	**Result**	**Relay**
1	6.97	Within	Good	OFF (Both acid/alkali)
2	9.25	Above	Acid needs to be added	ON (Relay for acid)
3	5.88	Below	Alkali needs to be added	ON (Relay for alkali)
4	7.15	Within	Good	OFF (Both acid/alkali)
5	11	Above	Acid needs to be added	ON (Relay for acid)

Table 10, Performance Evaluation of pH Sensor

Table 10 shows when the pH value is within limit, no solution will be mixed with the tank water. However, if the pH value goes down, alkali solution will be added. In contrast, acid solution will be added to the water when the pH level is high.

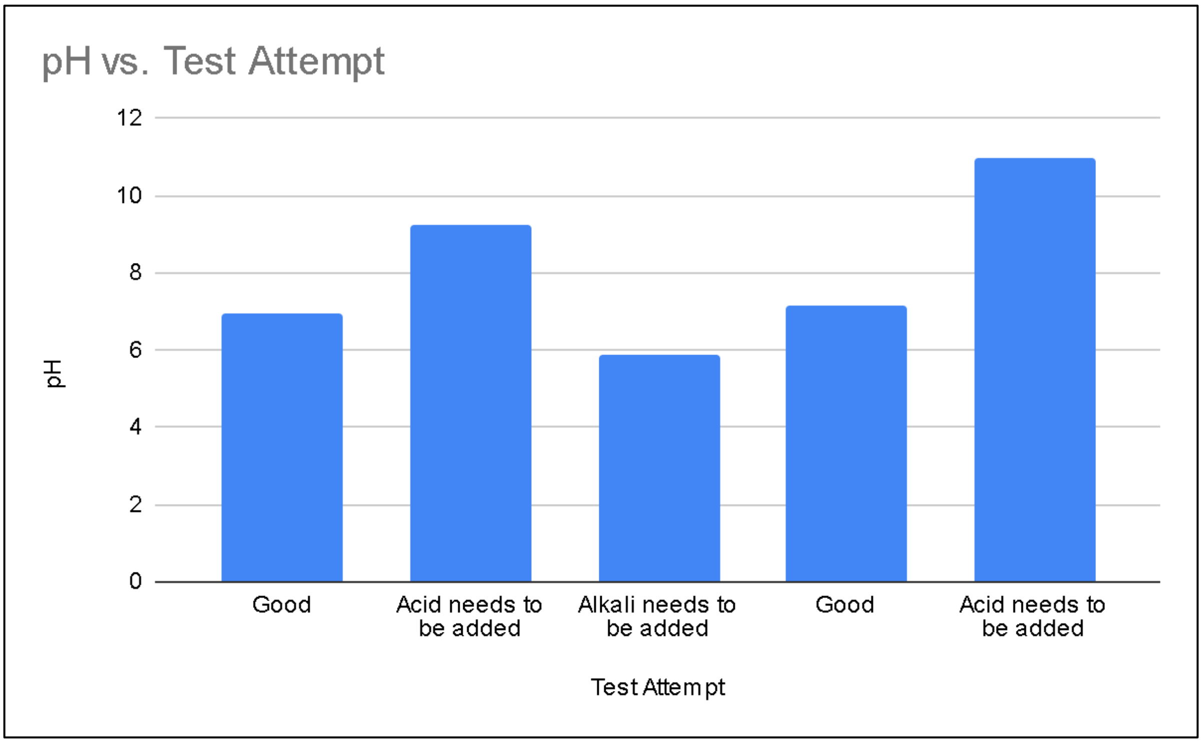


Figure 31. Column chart of pH Sensor with result

In figure 31, the graph shows the pH sensor readings and the output result from the sensor reading from table 10. The threshold pH level for a specific Biofloc tank container is always compared with the sensor readings and the output results signals either the acid or alkali actuator to turn ON.

Ultrasonic Sensor

Trial	Water Level (cm)	Threshold Value (600 cm -700 cm)	Result	Water Pump	Drainage System
1	471	Below	Increase water	ON	OFF
2	933	Above	Decrease water	OFF	ON
3	812	Above	Decrease water	OFF	ON
4	630	Within	Water in level	OFF	OFF
5	546	Below	Increase water	ON	OFF

Table 11. Performance Evaluation of Ultrasonic Sensor

Table 11 demonstrates how the water pump will turn ON when the water level drops below the threshold. On the other hand, when the water level beyond the threshold, the solenoid valve will drain the water from the tank. However, whenever the water level is within the threshold value, both the water pump and the drainage system would remain OFF.

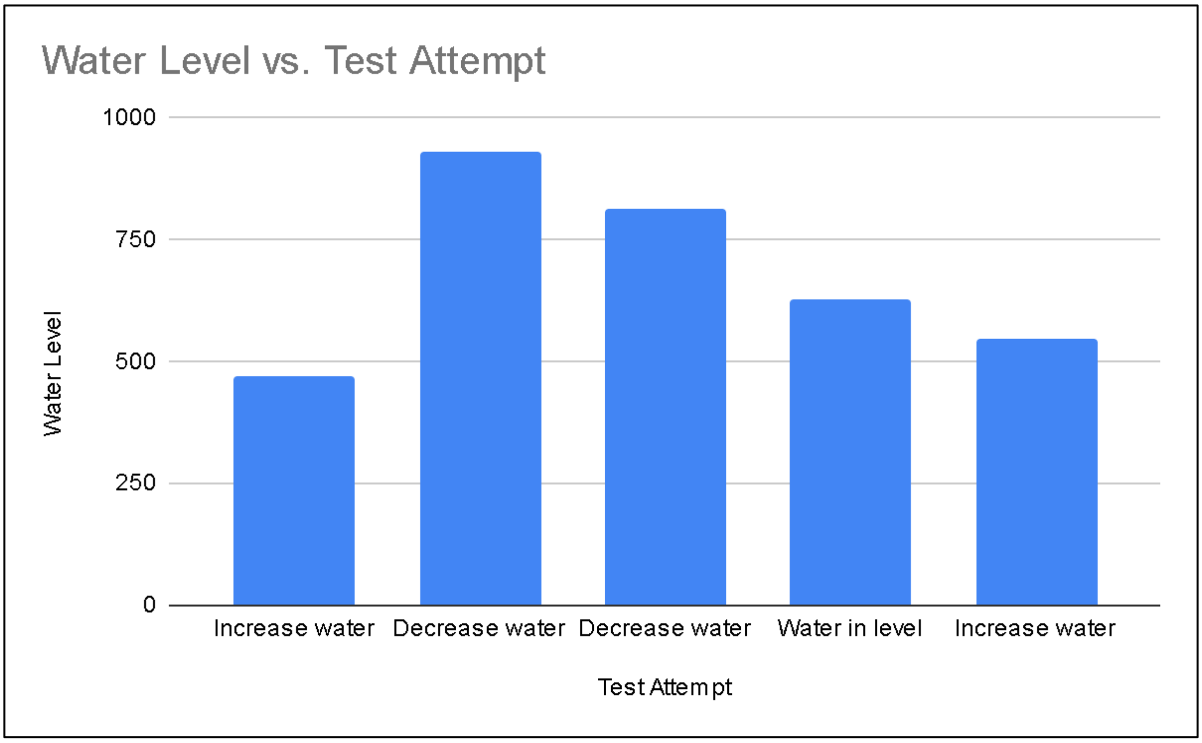


Figure 32. Column chart of Ultrasonic Sensor with result

In figure 32, the graph shows the ultrasonic sensor readings which indicated the water level vs the output result from the sensor reading from Table 11. The threshold water level for a specific Biofloc tank container is always compared with the sensor readings and the output results signals desired actuator to turn ON.

Turbidity Sensor

Trial	**Turbidity (NTU)**	**Threshold Value (75°C - 150°C)**	**Result**	**Alert**
1	125	Within	No Alert	OFF
2	170	Above	Send Alert	ON
3	156	Above	Send Alert	ON
4	95	Within	No Alert	OFF
5	80	Within	No Alert	OFF

Table 12. Performance Evaluation of Turbidity Sensor

According to Table 12, when the turbidity value exceeds the threshold value, consumers will receive an alert via the mobile app. On the other hand, when the turbidity level is within the standard value, no alarms will be sent.

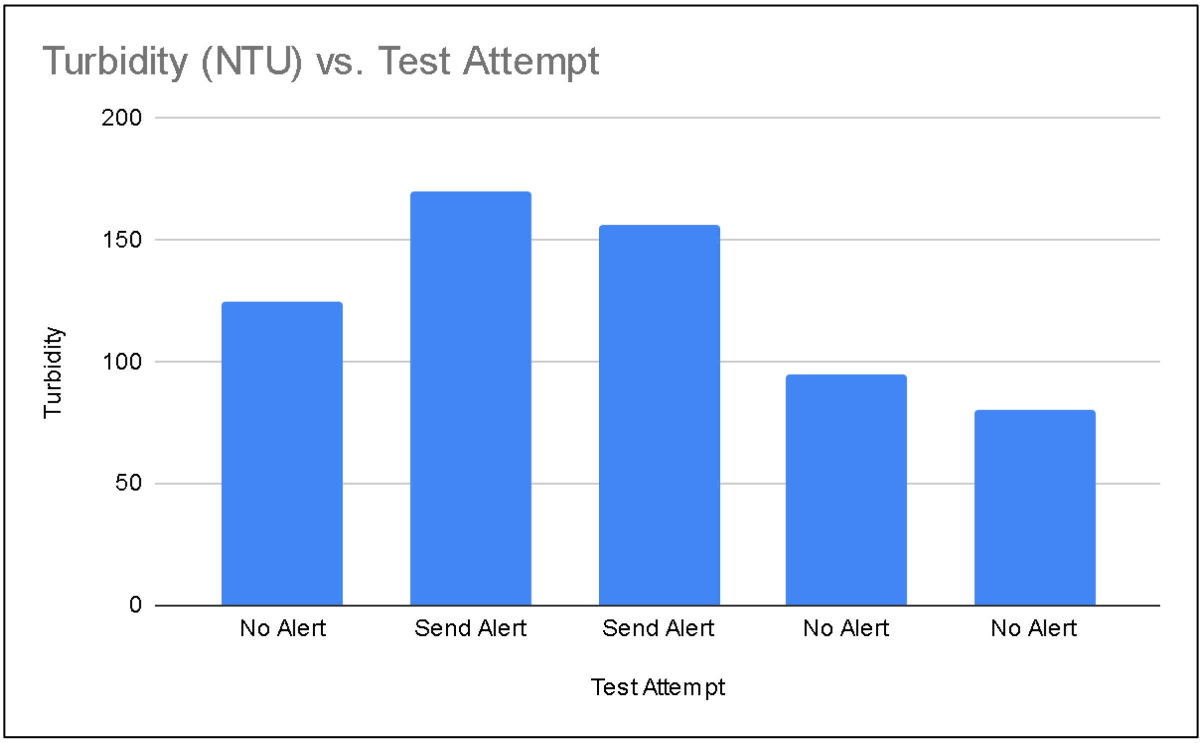


Figure 33. Column chart of Turbidity Sensor with result

In figure 33, the graph shows the turbidity sensor readings and the output result from the sensor reading from Table 12. The threshold turbidity level for a specific Biofloc tank container is always compared with the sensor readings and the output results gives an alter or reminder to the user.

TDS Sensor

Trial	TDS (mg/L)	Threshold Value (300 mg/L - 600 mg/L)	Result	Alert
1	480	Within	No Alert	OFF
2	956	Above	Send Alert	ON
3	870	Above	Send Alert	ON
4	560	Within	No Alert	OFF
5	1068	Above	Send Alert	ON

Table 13. Performance Evaluation of TDS Sensor

Table 13 demonstrates that a mobile application alert will be sent when TDS is above the threshold value, but not if TDS is within the standard value.

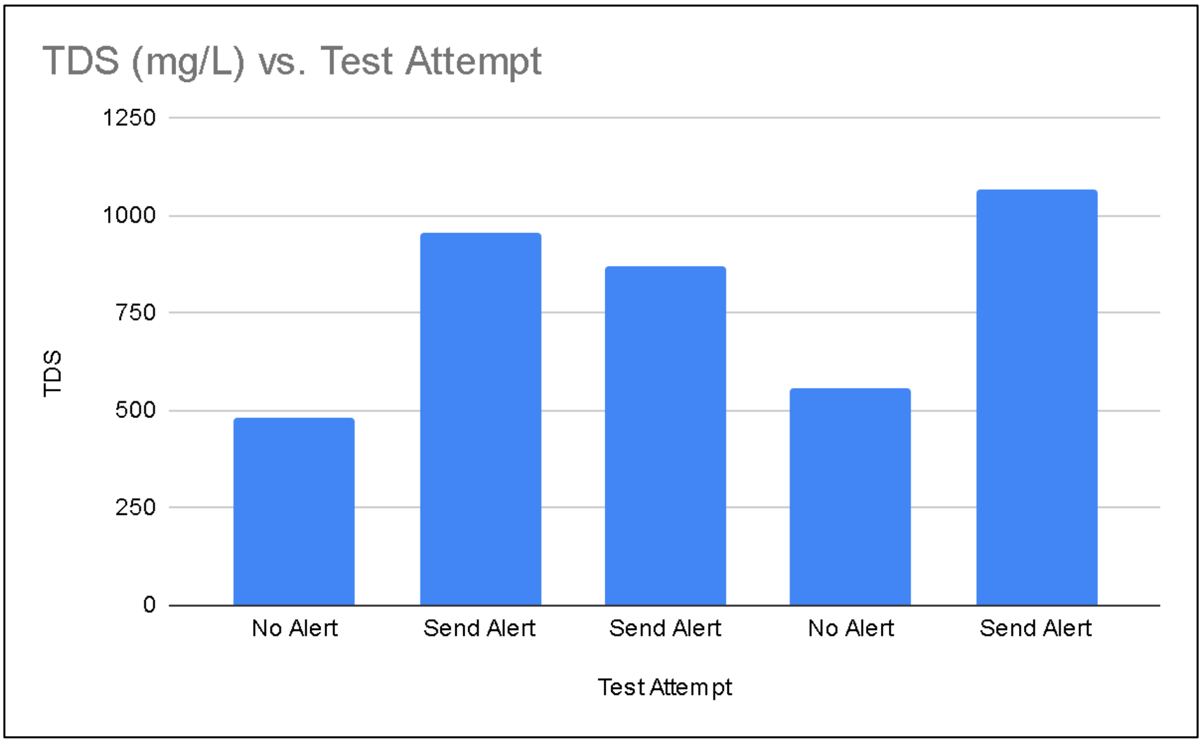


Figure 34. Column chart of TDS Sensor with result

In figure 34, the graph shows the TDS sensor readings and the output result from the sensor reading from Table 13. The threshold TDS level for a specific Biofloc tank container is always compared with the sensor readings and the output results gives an alter or reminder to the user stating if the value is within or out of range.

4.5 Conclusion

From Table 6 and SWOT analysis, we have found that Design-1 is the optimal solution, which meets all the objectives of our project by keeping the system efficient Therefore, we have analyzed all the factors to determine the optimal design as Design-1 to proceed with.

Chapter 5

Completion of Final Design and Validation [CO8]

5.1 Introduction

In the previous chapter, we have implemented the proposed designs and through some software simulation we have find the optimal solution. Here, we have implemented the optimal design as prototype. Moreover, in the prior moment we have faced some challenges and by overcoming these problems we have got our desired prototyped. In this chapter, the detailed overview of the final designed prototype is being presented.

5.2 Completion of Final Design

In the Figure 35, we can see the simulation schematic of system. For some limitation in the software, we had use COMPIM instead of Wi-Fi module. However, in real life we had faced some problem too. We had to change the Arduino UNO in the actuator part with Arduino Mega. Because we needed more pins which were absent in the Arduino UNO.

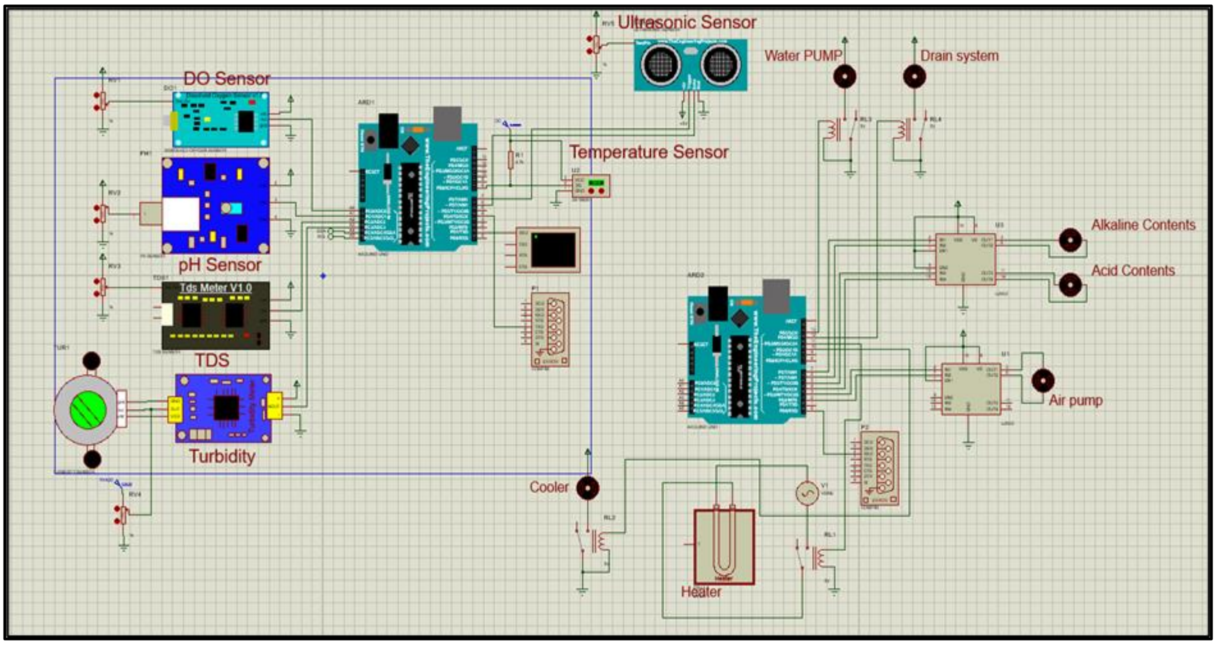


Figure 35. Proteus implementation of our project prototype

To put the idea into practice, we first built a 3D overview of the entire prototype. A clear picture of the finished product in our mind makes a task easier to complete. We can see it in the Figure 36.

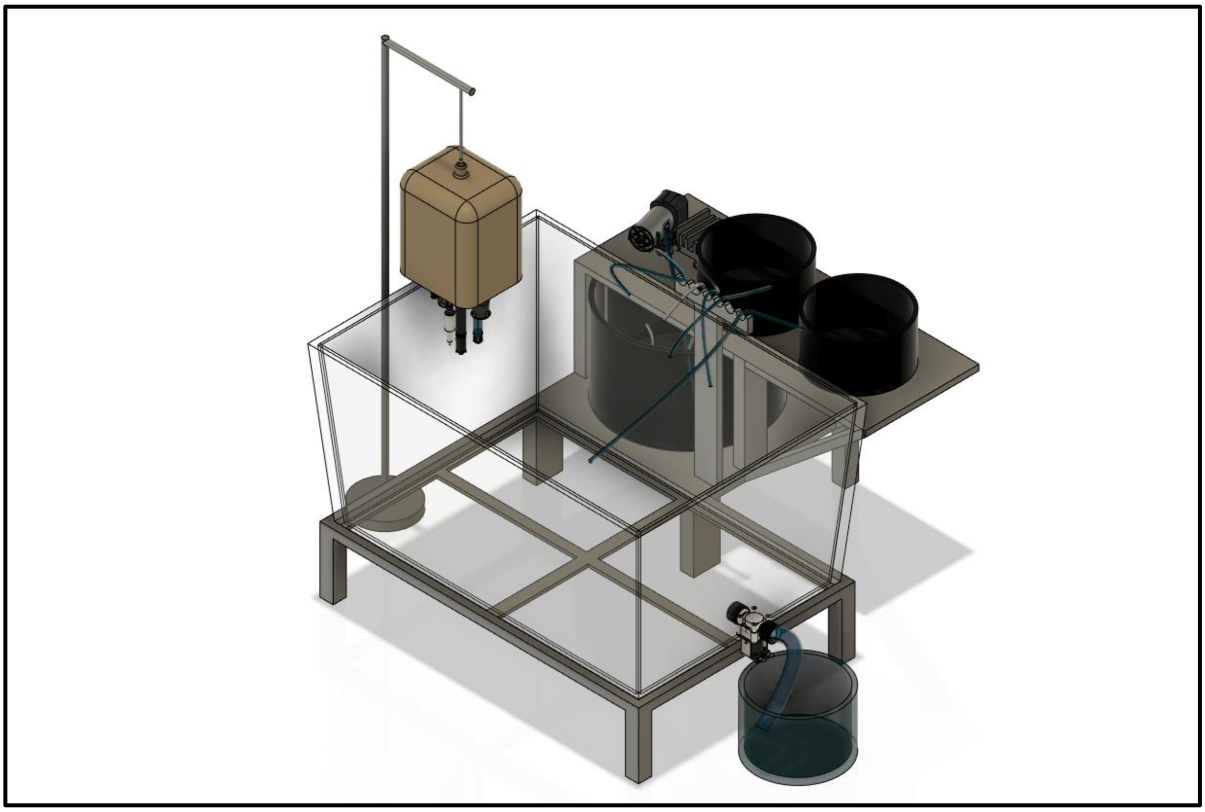


Figure 36. Full 3D Overview of the system

After that we worked with individual subsystems. In the sensor subsystem, first we had implemented the breadboard model and validated the readings. Some sensors had shown some imbalance readings. Those sensors needed calibrations. After calibrating those sensors showed accurate values, and the readings were validated by testing in some known compound values. Moreover, we have created EPS (Electrical Power System) for the sensor subsystem. This EPS is for the powering up the whole sensor subsystem. In the Figure 37 we can see the sensor subsystem. After that we have created another breadboard model for the actuator subsystem with the EPS system (Figure 38). After uploading the sensor data in the database, it is fetched by the actuator subsystem and related motor are being turned ON through relays and the motor drivers. The motor drivers control the PWM of the dedicated motors. To show the real-time data we built a mobile application for our proposed system which can be seen in the Figure 39.

After we were able to complete the breadboard and system were running actively, we move to the PCB (Figure 40). Moreover, we created a 3D model for the sensor to make it compact (Figure 41). Finally, we printed those PCBs and 3D model for the sensor subsystem. In the Figure 42, the stacked PCB has shown.

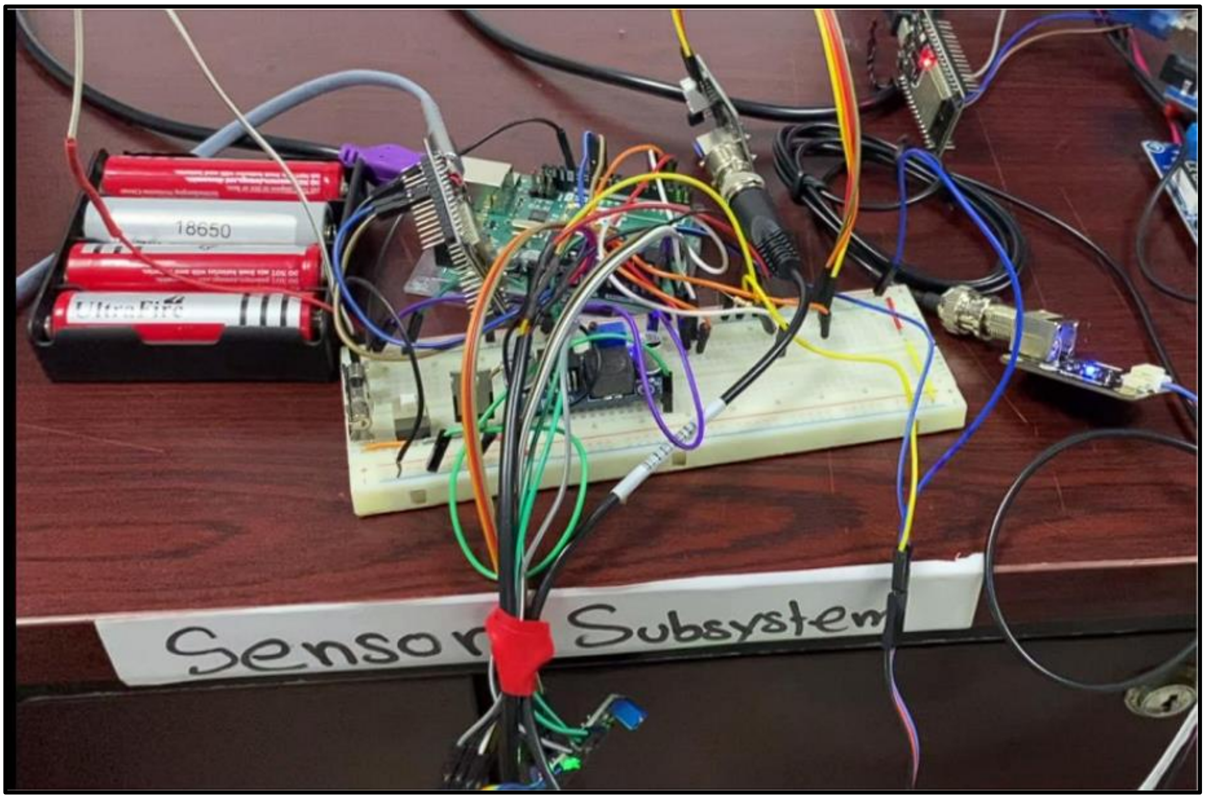


Figure 37. Sensor subsection of our project prototype

In this sensor subsection we used Arduino UNO to collect sensor data and ESP32 is used to send sensor data to Firebase server.

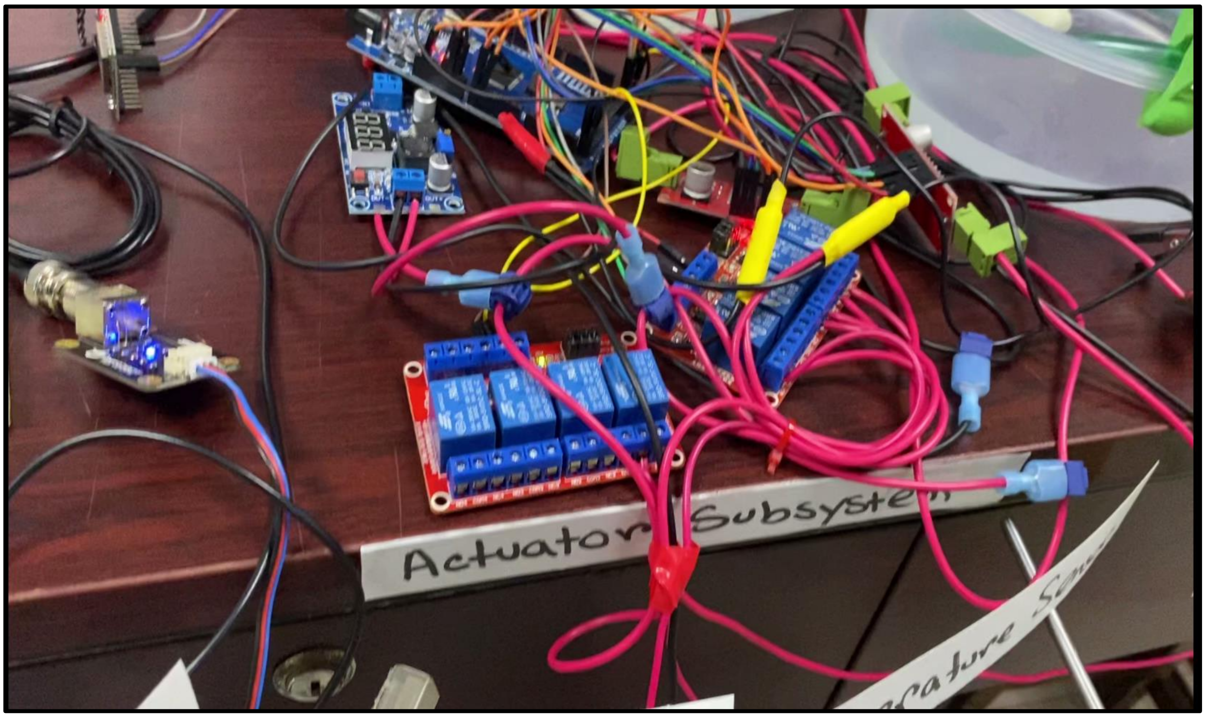


Figure 38. Actuator subsection of our project prototype

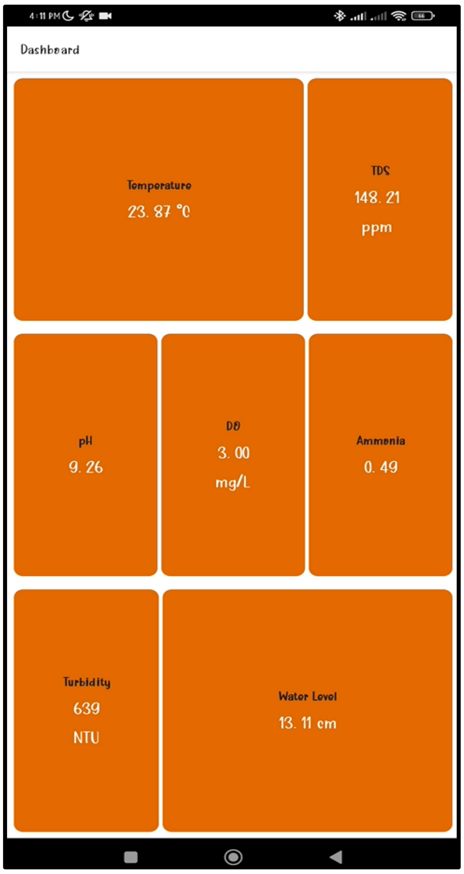
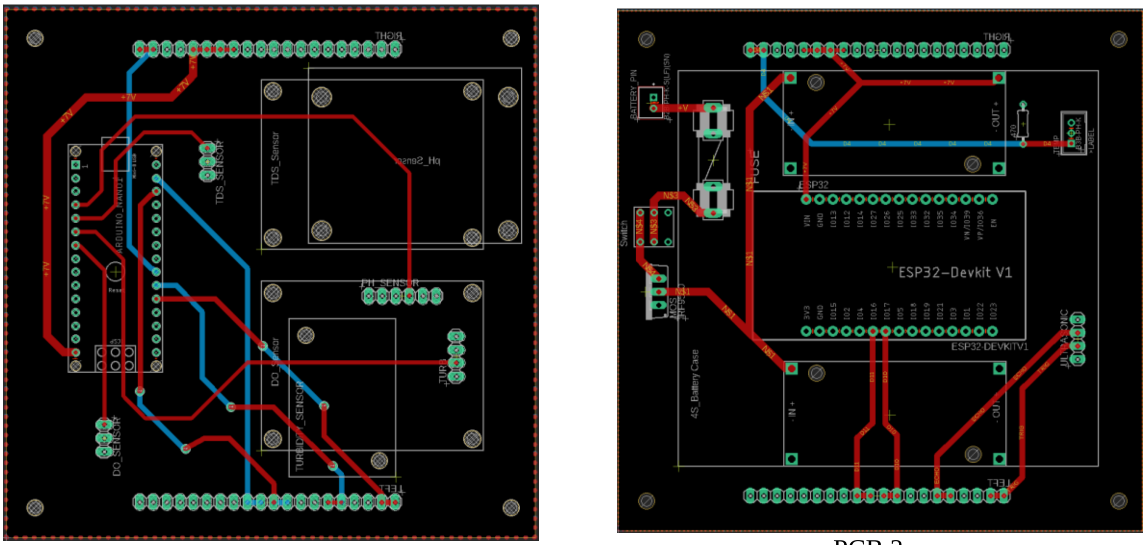
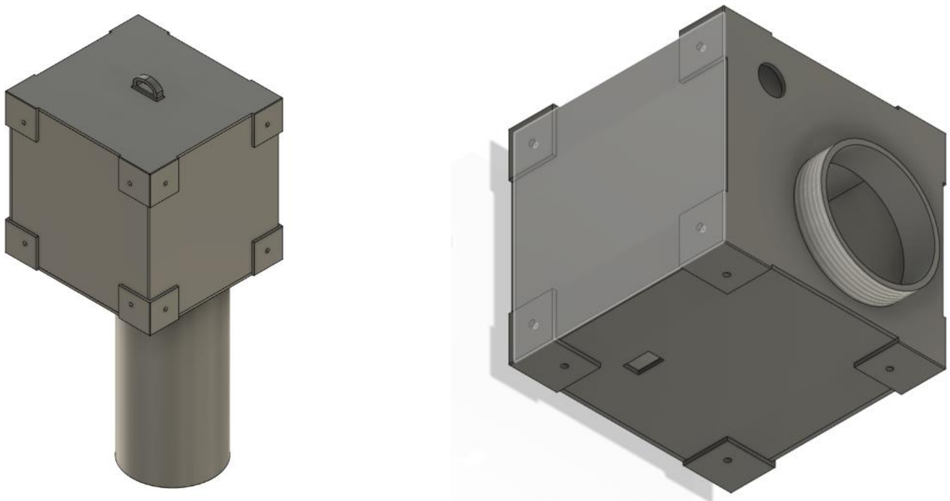


Figure 39. Mobile application for the monitoring system



PCB 1 PCB 2

Figure 40. PCB for the sensor subsystem



Top view with lower cover Bottom view without lower cover

Figure 41. 3D model of the sensor subsystem

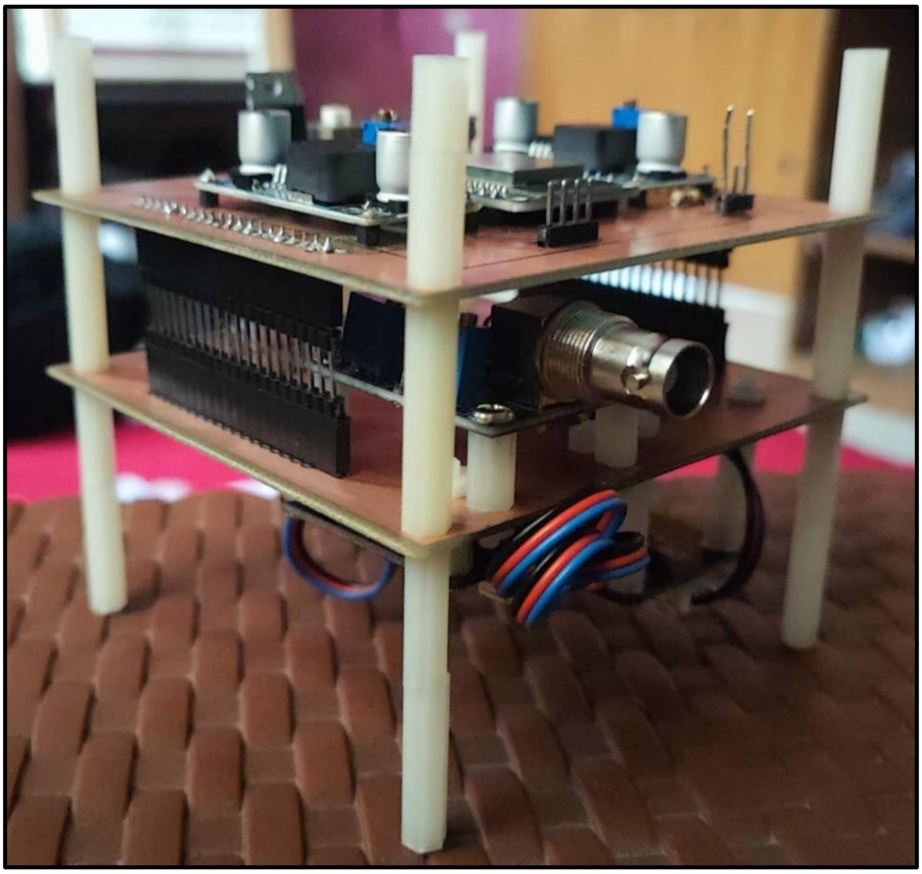


Figure 42. Sensor subsystem in a stack

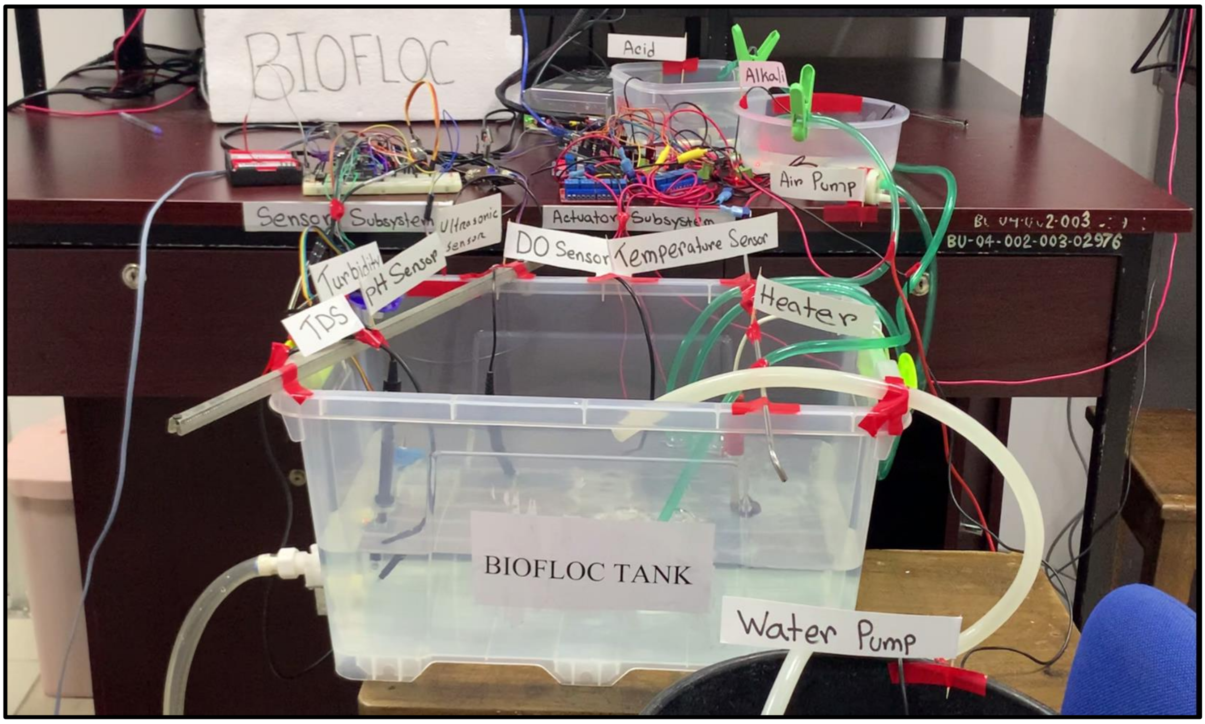


Figure 43. Implementation of the project prototype

The actuators are being controlled by Arduino mega. Where we are using buck converter to convert high power supply to the necessary amount which is needed to activate actuators these actuators are connected with relays of necessary values through these relays Arduino mega get connected with the actuators. For some actuators we need pulse width modulation to control power supply on them motor driver is the key through which we are controlling pulse width modulation of these actuators. In Figure 43, the whole implemented system has been shown.

5.3 Evaluate The Solution to Meet Desired Need

The system we have developed mainly consists of two subsections. In order to collect water quality parameters, we are using sensors. We are using an Arduino mega to control all the sensors of the system. In this case, the DO sensor will measure the amount of oxygen that is present in water. In our Arduino code we have set up a threshold value of DO if this DO level falls below this threshold value, then our aeration pump will be activated automatically. Same will happen for temperature, pH, and ultrasonic sensor as well. Whenever values such as temperature will fall the heater will be turned on. For pH sensor the threshold value level is 6.5-7.5. If the pH level is over this value, acid container pump will be activated and if the pH level is below this value, the alkali container pump will be activated. The ultrasonic sensor detects the level of water in the tank. When the water level of the tank goes down or up, the corresponding actuators will override the situation to maintain the tank parameters. These cases are shown below:

Aeration pump is turned ON as DO value is below the threshold (Figure 44).

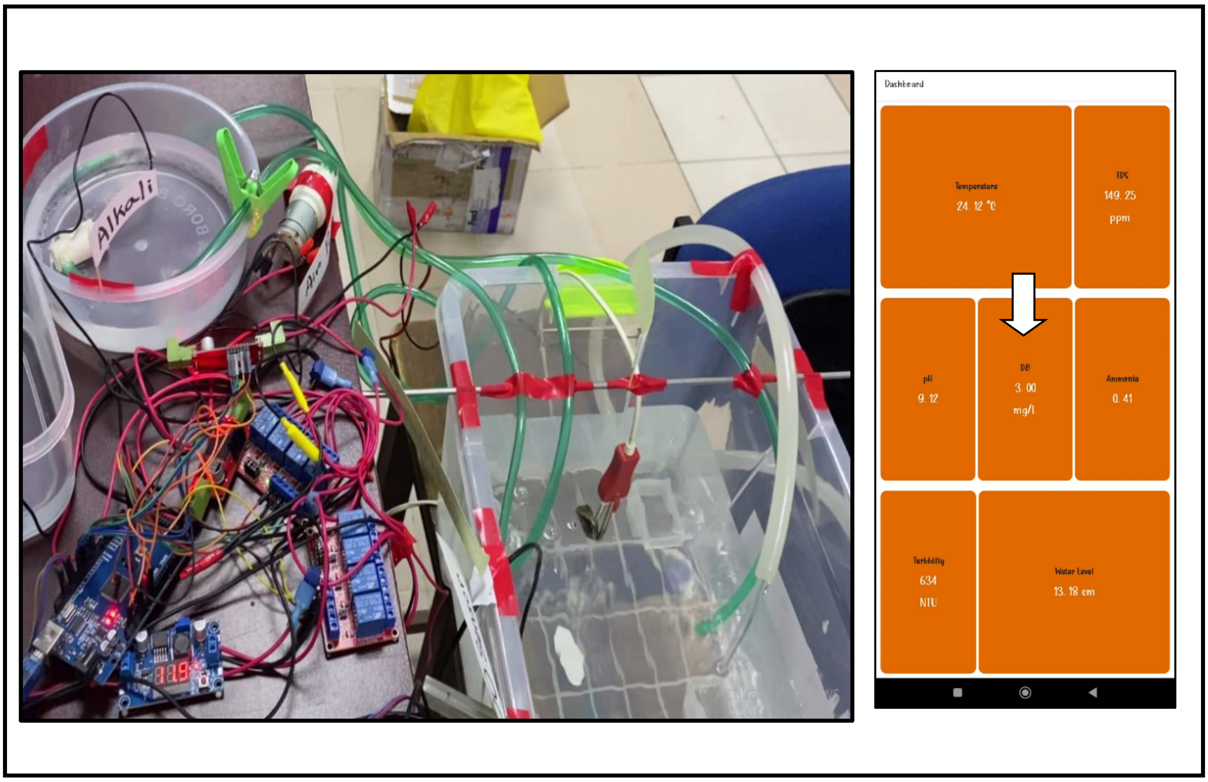


Figure 44. Aeration pump is ON

Acidic solution pump is turned ON as pH value is over the threshold (Figure 45).

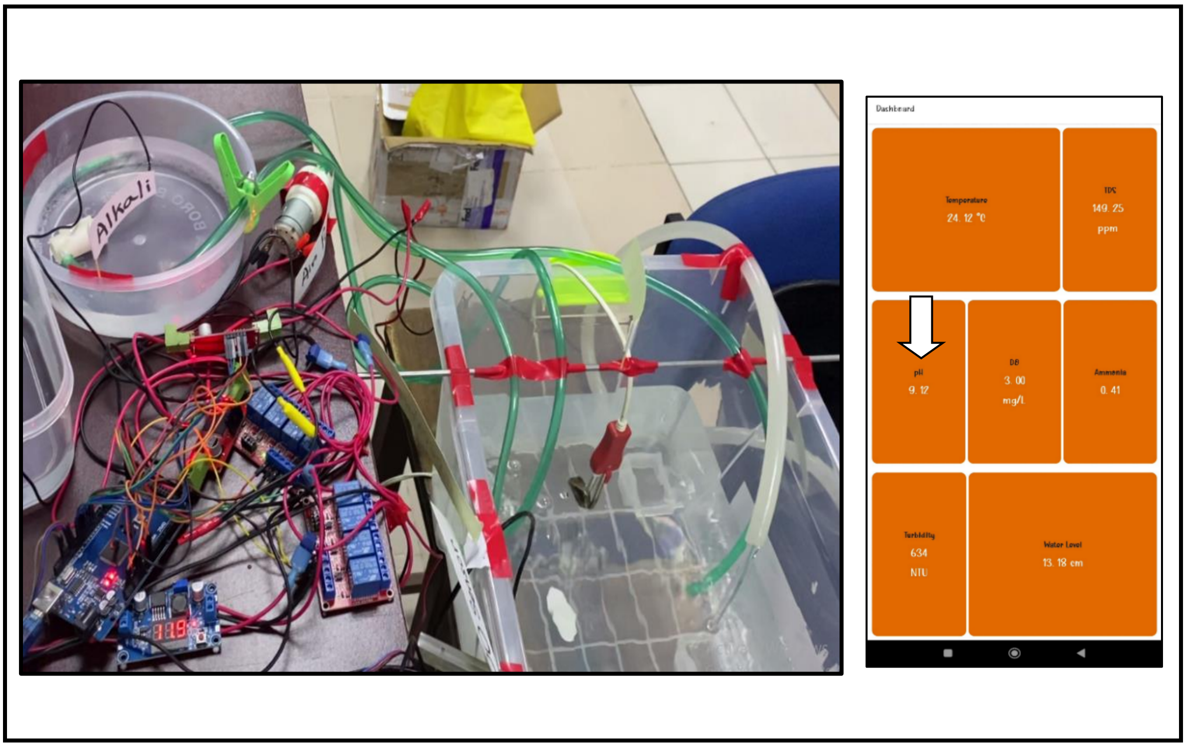


Figure 45. Acid pump is ON

Alkali solution pump is turned ON as pH value is below the threshold (Figure 46).

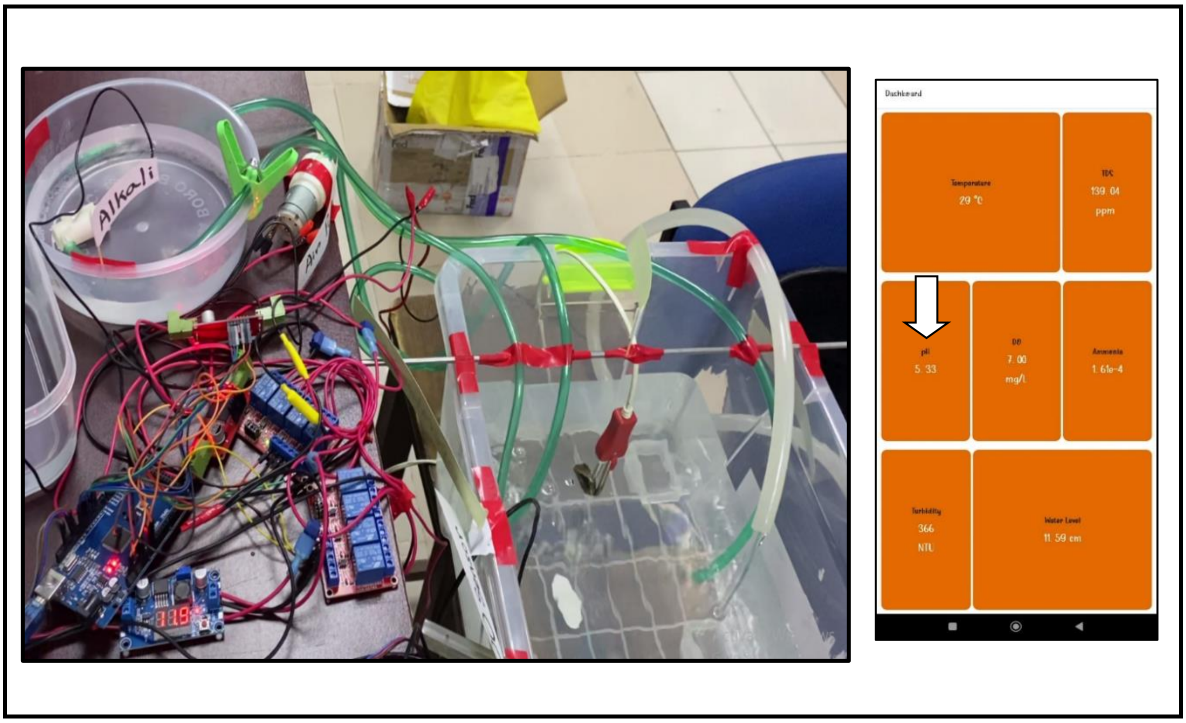


Figure 46. Alkali pump is ON

Solenoid valve is turned ON as water level is over the threshold value to drain excess water from the tank (Figure 47).

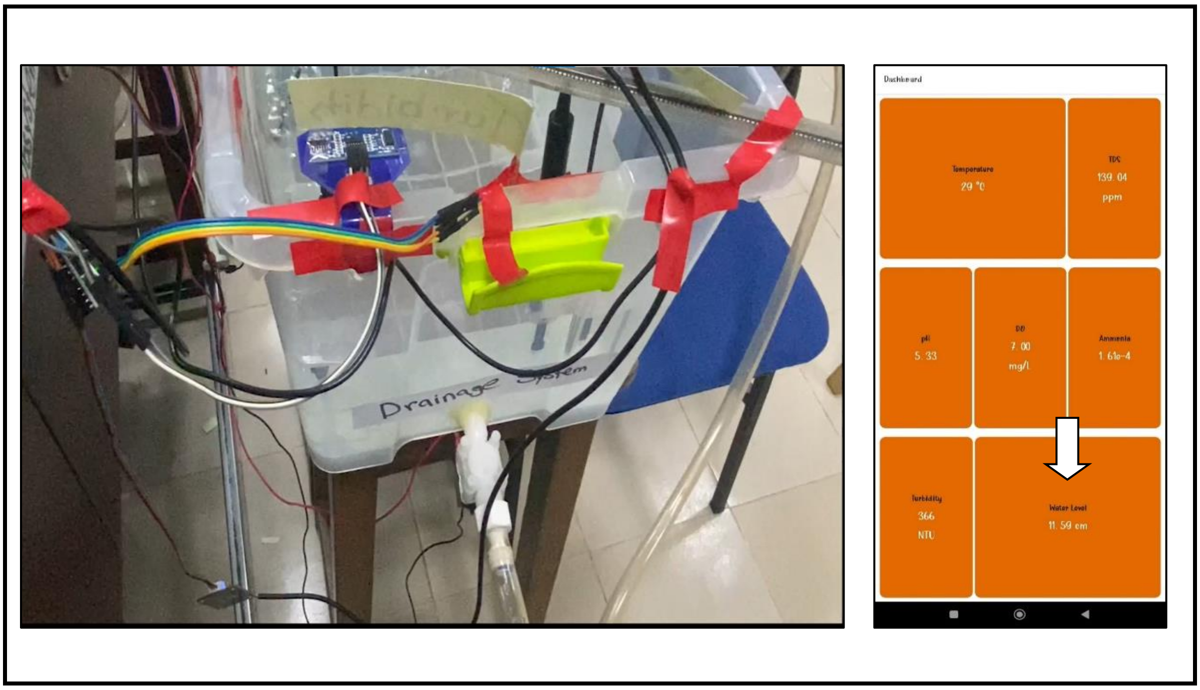


Figure 47. Drainage system is ON

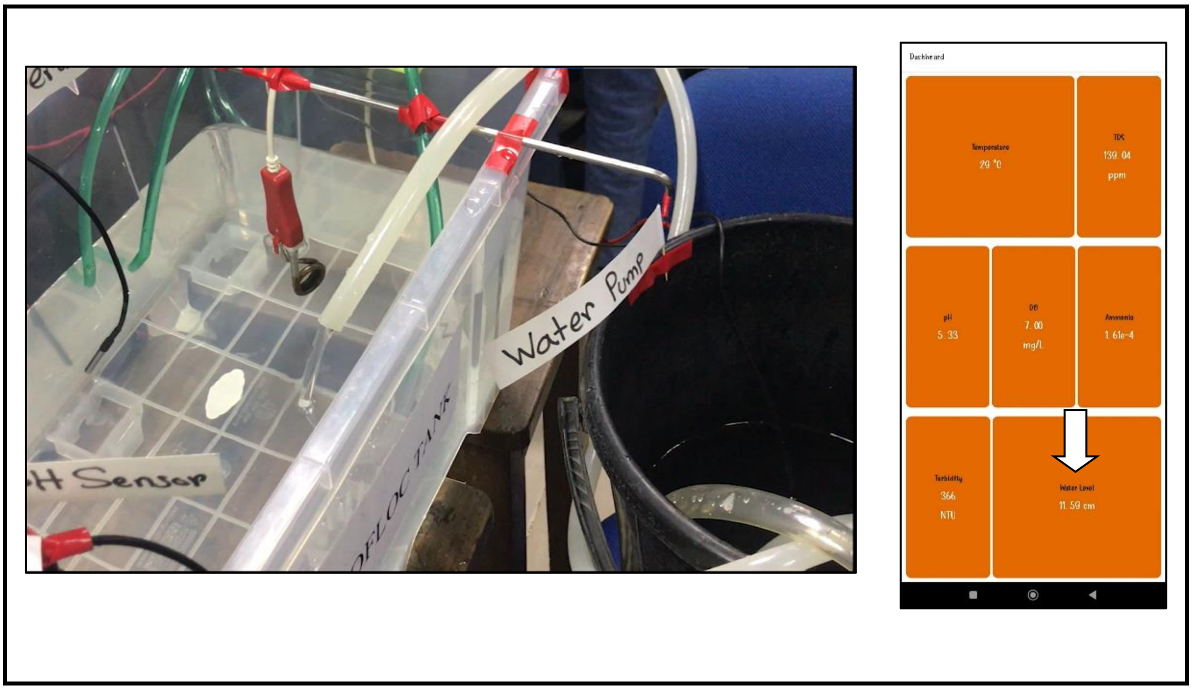


Figure 48. Water pump is ON

In Figure 48, the water pump is turned ON and adding water to the tank since the level of water in the tank is lower than the threshold. All these actuators are being activated based on the corresponding sensor values which are being uploaded on Firebase.

5.4 Conclusion

In conclusion, it can be said that our prototype successfully satisfies all the requirements that were necessary to design our system. Our all sensors here collect data successfully from the system and these data are being uploaded and stored in Firebase. Through these data actuators are being controlled. Thus, after a lot of trials and debugging the desired result of the prototype design has been achieved.

Chapter 6

Impact Analysis and Project Sustainability [CO3, CO4]

6.1 Introduction

It is always a big apprehension if the product will be welcomed to stakeholders and general people. This depends on the sustainability and the impact of the product in the fish farming business. Many tradeoffs had to be performed between to maintain the needs of the stakeholders and prioritizing other factors such as environment culture and optimizing impact.

6.2 Assess The Impact of Solution

- **Constant water quality monitoring**

  Collecting data from the Biofloc system constantly through various sensors.

- **Real-time data analysis**

  Users can check the quality of water at any time as the sensors will be connected to a dedicated cloud server that will be collecting real-time data.

- **Data Comparison**

  Real-time parameters collected by sensors will be compared in the cloud server with threshold values.

- **Alerting user during abnormality**

  When comparing the collected data with pre-settled threshold values, if there is any abnormality in the system. An alert notification will be sent to the user via a mobile application.

- **Altering parameters if not matched with the pre-settled value**

  If the data does not match the pre-settled threshold values, the system will automatically change pH, temperature, water level, and DO level.

- **Freedom to chance parameters remotely**

  Users can remotely change pH, DO, temperature, and water level by commanding the mobile application according to their needs.

- **Greater profit**

  As the labor cost will decrease due to automation, fish quality and quantity will be much better than traditional fish farming. This will eventually lead to more significant profit.

- **Entrepreneurship**

  This could be a new initiative for entrepreneurs as this Biofloc can be maintained by anyone with little basic prior knowledge.

6.3 Evaluate The Sustainability

This project aims to be sustainable both in terms environmental and economical perspective. The microbial community in the Biofloc system is able to use the dissolved nitrogen leached from fish excrement and transform it into microbial protein, which can be used in place of fishmeal. Subsequently, for environmental sustainability Biofloc plays an important role. Biofloc fishing technique is a susceptible system as a minimum fault can cause tremendous damage. For example, minimum fault in the oxygen supply can result in massive fish death. So, Biofloc operators must ensure 24/7 monitoring of the system for human resource management costs to increase a lot.

Along with this, to observe water quality parameters like pH, TDS, etc., operators must use kits for measurements, and these kits are expensive. Moreover, this project aims to minimize these costs like human management through a smart design that can monitor real-time performance of the actuators and water quality which deals with 24/7 human monitoring. Furthermore, expensive kits will not be used because of the smart sensors used in the system to monitor the water quality parameters. Such things will make our project economically sustainable.

6.4 Conclusion

The process of creating something is unpredictable since consumer opinion can be inconsistent. This project will help Biofloc fish farmers achieve new milestone in fishing business and increase profitability promptly and for this many investors will be attracted. Moreover, this project is sustainable in terms of environmental, cultural, ethical, and economical way.

Chapter 7

Engineering Project Management [CO11, CO14]

7.1 Introduction

Project management is often defined as an important facet, to define the plan, process, goal, and deliverables of the project. For making a project successful, we need to define the project scope and maintain and update the project timeline on a regular basis. In addition, we need to assess the resources and the project plan. Moreover, making sure of efficient communication between the team members and the persons involved is vital. Finally, we should also prepare contingency plans, in case any emergency arises.

7.2 Define, Plan, and Manage Engineering Project

❖ **EEE400P**

Task	Start Date	End Date	Duration
Find complex Engineering problem	10/14/21	11/07/21	23
Related papers and Journals	11/01/21	11/09/21	8
Tentative problem statement and objective	11/08/21	12/2/21	24
Multiple design approach	11/08/21	12/02/21	22
Specifications, Requirements, and constraints	11/12/21	11/23/21	11
Applicable standard codes and conclusion	11/15/21	11/25/21	10
Final concept note	11/08/21	12/02/21	24
Preparing slides	11/10/21	11/17/21	7

Progress presentation 1	11/18/21	11/18/21	1
Field visit	12/9/21	12/9/21	1
Methodology, Project plan	12/02/21	12/22/21	20
Budget, expected outcome, Impact	12/7/21	12/18/21	11
Sustainability, Ethical consideration	12/14/21	12/23/21	9
Risk Management, Analysis and Safety Consideration	12/14/21	12/23/21	9
Progress Presentation	12/2/21	12/23/21	21
Preparing Slides	12/24/21	12/30/21	6
Progress Presentation 2	12/30/21	12/30/21	1
Final Presentation	01/06/22	01/06/22	1

Table 14. Gantt Chart of EEE400P

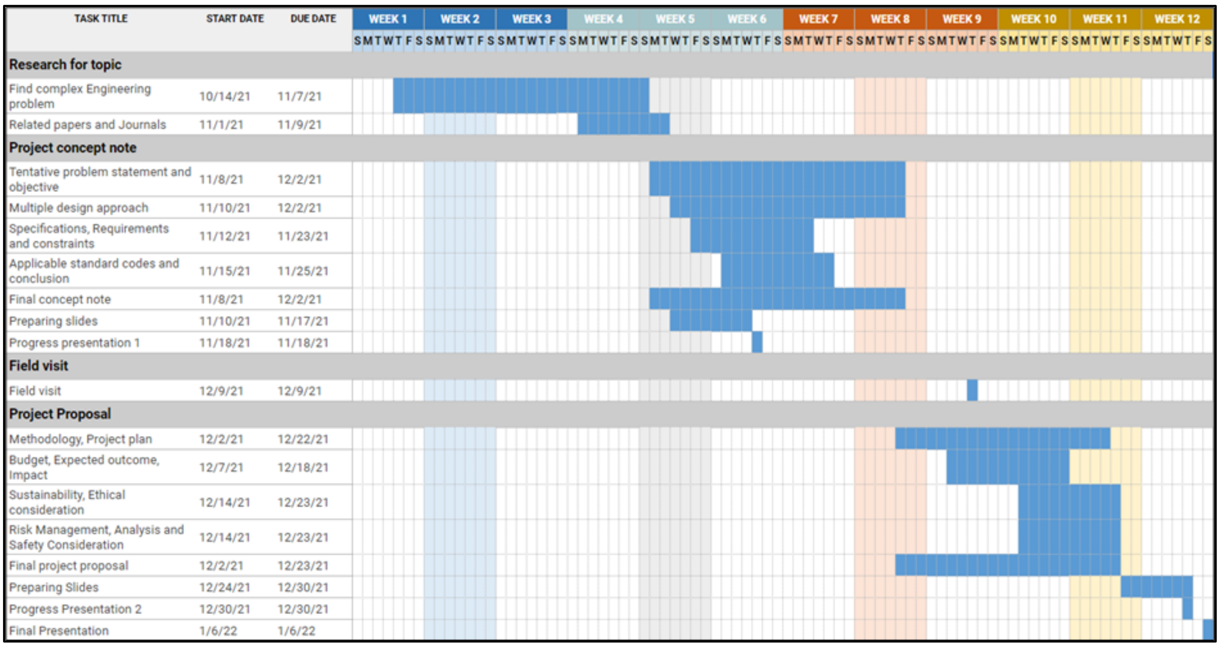


Figure 49. Gantt Chart of EEE400P

❖ EEE400D

Task	Start Date	End Date	Duration
Preliminary Design	2/2/22	2/10/22	8
Selection of Engineering Tools	2/10/22	2/17/22	7
Building Model for Simulation	2/17/22	2/28/22	11
Performing Analysis for Alternate Designs	2/18/22	3/2/22	14
Simulation	2/18/22	3/10/22	22
Progress Presentation	3/3/22	3/3/22	1
Design Debugging	2/24/22	3/12/22	18
Identifying Appropriate Solution	3/1/22	3/12/22	11
Validating the Design Solution	3/8/22	3/17/22	9
Identifying Ethical Issues	3/17/22	3/24/22	7
Impact of Optimal Design	3/24/22	3/31/22	7
Project Management	3/31/22	4/7/22	7
Design Draft	3/30/22	4/7/22	7
Design Report	4/6/22	4/21/22	15
Presentation Slides	4/21/22	4/27/22	6
Final Presentation	3/28/22	4/28/22	1

Table 15. Gantt Chart of EEE400D

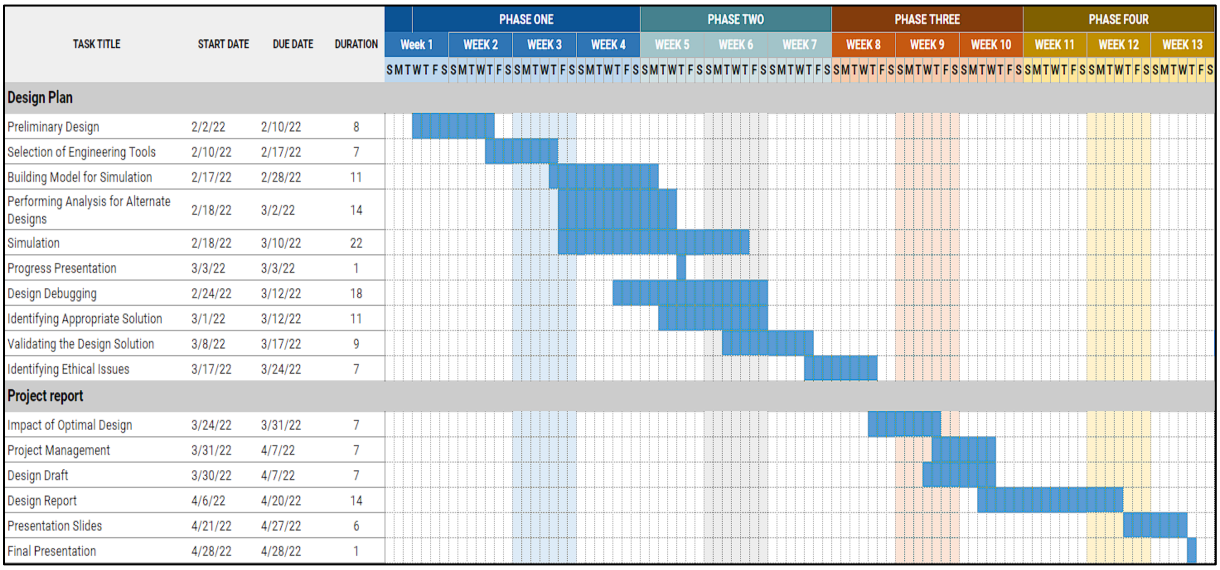


Figure 50. Gantt Chart of EEE400D

❖ EEE400C

Task	Start Date	End Date	Duration
Monitoring part Development	5/28/22	7/4/22	38
App development & Firebase	5/28/22	6/25/22	29
Actuator part Development	6/4/22	7/6/22	33
Research	5/28/22	6/20/22	24
Progress Report	7/6/22	7/27/22	22
Prototype Development	7/4/22	7/9/22	6
Prototype Testing	7/9/22	7/18/22	10
Prototype Debugging	7/9/22	7/25/22	17
Progress Presentation Slides	7/22/22	7/27/22	6
Progress presentation & Prototype Demonstration	7/28/22	7/28/22	1

Project Report	7/29/22	8/10/22	13
Draft Project Report Submission	8/11/22	8/11/22	1
Project Final Report	8/12/22	8/31/22	20
Mock Presentation Slides	8/19/22	8/24/22	6
Mock Presentation	8/25/22	8/25/22	1
Project Final Report Submission	9/1/22	9/1/22	1
Final Presentation Slides	8/26/22	8/31/22	6
Project Final Presentation	9/1/22	9/1/22	1

Table 16. Gantt Chart of EEE400C

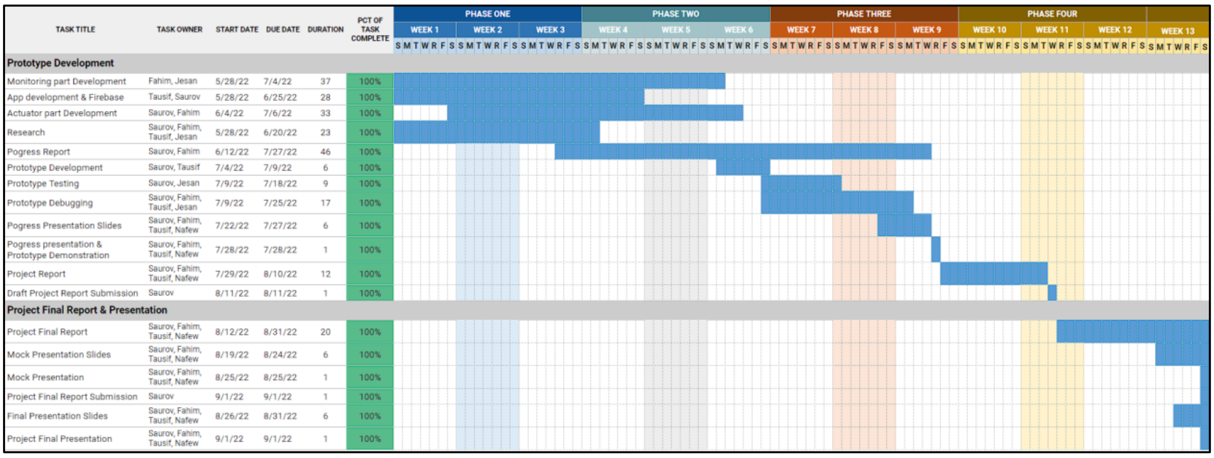


Figure 51. Gantt Chart of EEE400C

7.3 Evaluate Project Progress

There are a few risks at the component level. The sensors may malfunction and can contribute to severe problems in the system. Error data from the sensors leads to unbalanced parameters for the aquaculture environment. A few backup pairs of sensors can be stored to resolve these issues. Also, any abnormal data from the sensor will be cross-checked with the threshold value set in the cloud server. Moreover, as IoT is used in system design and plays a vital role, the unavailability of the internet may cause some problems. A backup internet connection can be provided to assure the availability of continuous data flow from the cloud server and proper monitoring of the system with the help of the mobile application.

Risk Response Matrix:

Risk Event	Responsibility	Contingency Plan
Sensor malfunction	Examine sensors before implementing and buying good quality sensors.	Keeping backup sensors on the farm.
Air compressor failure	Check the air compressor motor and wiring connection.	Turning on the backup air compressor and checking the DO level.
Excess sludge	Setting a threshold value for the TDS sensor.	Add an extraction pipe to remove excess sludge.
Loss of internet connection	Restart the router and contact the internet provider.	Use a portable SIM router till the internet is restored.

Table 17. Risk Response Matrix

7.4 Conclusion

Project management includes risk management as a key component. A planned construction framework aids us in our advancement and enables us to address problems as fast as it could be expected. To make a project complete and run successfully the essential part is project management and risk management, which at the end makes a worthwhile impact. In essence, project management serves as the foundation for all projects.

Chapter 8

Economical Analysis [CO12]

8.1 Introduction

In order to evaluate the costs and benefits of a project an economic analysis is a must. Economic analysis guides us to understand how much feasible a project is. However, the main objective of such analysis is to understand what kind of response a product is getting like profit generation. Moreover, for a better understanding of any business outcome economic analysis is a very useful medium.

8.2 Economic Analysis

Economic analysis provides us a guidance to upgrade resource allocation in order to generate better revenue from any product. By using economic analysis, we can develop an understanding of how much profit gaining a business or a product is based on this we can determine how much effective a product or business is. Currently BFT systems are running manually for this situation the stakeholders connected with this industry heavily depend on manual testing kits to know about the factors affecting water quality. On the other hand, actuators such as aeration pump, water pump are also maintained manually. Our system comes with a solution to both monitor and control the system automatically which is heavily cost effective comparing to the current manual system. As stakeholders will no longer have to buy test kits every time to know about water quality parameters and manual control will also not be needed. So, if our system can have mass production, it will become more cost efficient.

8.3 Cost Benefit Analysis

The feasibility of a project is investigated through cost benefit analysis. It is a part of economic analysis and if carried out properly and with precise assumptions, a cost-benefit analysis has the advantage of offering a reliable, quantifiable guidance for making decisions related to the future of the product. It is not necessary to complete the project for the minimum possible cost for it to be cost-effective. The most important factor is the effectiveness, performance and also longevity of the components and sensors used in the project. For the completion of the prototype design, variety of components and sensors were available in the market and selecting the optimum one in regard of cost and performance was a challenge. To achieve the best results, we must select the component that is both affordable and effective. Although each component selected for the prototype design has some advantages and disadvantages among them. For the final product to guarantee consumer satisfaction, this governance process is essential. The CPU of the system in Design-1 uses an Arduino microcontroller to process data from the sensors where else Raspberry Pi is used as the CPU for Design-2. Next, to transfer the data to mobile phone we have used Wi-Fi shield and NodeMCU for design-1 and in case of design-2 the use of GSM module is necessary which is more costly than both the components combined for data transfer in Design-1. For Design-1 no additional ADC is required as Arduino can take analog sensor data directly which is also a cost-efficient part. For Design-1 a table containing core components of Design-1 is given below:

Components	Price	Strength	Weakness
Arduino UNO	3500	1. Low Cost 2. Easily swapable 3. Works as the controller of the system	1. Low power processing 2. Cannot get connected with internet directly
Arduino Mega	5500	1. Easily swappable 2. Can handle more components than Arduino UNO	1. Cannot get connected with internet directly 2. More expensive comparing to Arduino UNO
ESP32	820	1. Connect to Firebase database 2. Easily swappable	1. Low power processing
Motor driver	1000	1. Can control Pulse Width Modulation of the actuators	

Table 18. Core Components Analysis For Design-1

For Design-2 a table containing core components is given also:

Components	Price	Strength	Weakness
Raspberry pi 4	15000	1. Powerful processing system	1. Not easily swapable 2. Expensive 3. Requires ADC (Analog to Digital Converter) for analog sensors
MPC3008 Analog to Digital Converter	500	1. Capable of transforming analog signals to digital	1. Includes noise 2. Brings non-linearity

Table 19. Core Components Analysis For Design-2

By analyzing both Table 18 and Table 19, we can clearly see the difference between the core components of both Design-1 and Design-2. This gives a clear idea why Design-1 is more cost beneficial for stakeholders.

8.4 Evaluate Economic and Financial Aspects

This project will be beneficial in both economic and financial aspects, as we will be able to fabricate this system in accordance with the needs of any Biofloc farmer, business entrepreneur, or researcher. This system examines and monitors many important water quality parameters; therefore, this project can also be beneficial for many other fields other than Biofloc. For building up the commercial system for any particular field a suitable fund will be required, and this funding will help us improve the system for better performance. Building and developing IoT based smart Biofloc monitoring and maintenance system in our country will steadily put on a positive impact on our economy and importing different water quality monitoring system will come to an end. The following budget is allocated for the implementation of a prototype:

Component name	Unit	Price (BDT)	Links
Arduino Uno	1	3500	Purchasing link
Arduino Mega	1	5500	Purchasing link
ESP32 (NodeMCU)	2	1640	Purchasing link
TDS Sensor	1	2004	Purchasing link
Temperature Sensor (DS18B20)	1	1769	Purchasing link
Turbidity sensor	1	2461	Purchasing link
Dissolved Oxygen Sensor	1	29877	Purchasing link
Dissolved Oxygen Probe Film Cap	1	2277	Purchasing link
Waterproof Ultrasonic Sensor	1	3294	Purchasing link
pH Sensor	1	9000	Purchasing link
Water Heating Rod	1	550	Purchasing link
DC 12V Water Pump	1	1450	Purchasing link
DC 5V Submersible Pump	2	420	Purchasing link
12V Solenoid Valve	1	1080	Purchasing link
4 Channel 5V Relay Module	2	730	Purchasing link
Motor Driver	2	1998	Purchasing link
DC 12V Air Pump	1	600	Purchasing link
Chemical Solutions		2000	Purchasing link
Miscellaneous Cost		800	
Total Budget		**70950**	

Table 20. Budget For Prototype Design

8.5 Conclusion

Understanding how the project will perform hereafter in the future requires an economic and financial viewpoint. Economic analysis helps us to maintain the project and make sure it's sustainable, where else the necessary resources are assessed by the financial analysis. Only the system's performance and productivity are insufficient to support a project to be sustainable in the future.

Chapter 9

Ethics and Professional Responsibilities [CO2, CO13]

9.1 Introduction

In order to develop a sustainable and beneficial engineering project for people it is important to consider the ethical and professional responsibilities of the project. Focusing on these ethical and professional responsibilities can help us to understand what social, economic and environmental impacts can be caused by our project. Our ethical considerations can guide us to design project while keeping a goodwill in terms of moral and social point of view. On the other hand, our professional responsibilities will guide us to display our engineering skills properly while designing the project.

9.2 Identify Ethical Issues and Professional Responsibility

The project aims to automate the monitoring and maintenance of the Biofloc systems using the Internet of Things (IoT). In the modern world engineering projects aim to make people's lives easier. Along with technological advancements every project must have a concern on ethical and professional responsibilities. Throughout the development of this project, we have tried to be responsible in terms of ethical issues and professional responsibilities. The context is as follows:

A. Our project means to be environment friendly. By our project no harm to the environment will be caused. To ensure this environmental safety our design will not dispose of any acid, alkaline, or excess sludge directly to outside the Biofloc tank.

B. As IoT is involved in our project the data security will be a major concern. We will ensure proper data protection for the users. To ensure complete data protection our project will have a user authentication system.

C. Unnecessary data collection has been a big issue in recent years. Through our project we will not collect any data from the user which is not relevant with the system.

9.3 Apply Ethical Issues and Professional Responsibility

Environmental safety

We are maintaining environmental safety by not disposing of fish waste haphazardly; instead, we are utilizing it so that it can be beneficial to the environment. The use of fuel or gas is harmful to the environment, and we have no use for it in our design.

Maintaining quality

We have focused on consumers' health as each tank's water quality and environment are maintained so that each fish develops with optimum health. This process, in turn, will be beneficial to the consumers as the upstanding fish quality will be of no harm to their health.

Maintaining relation between clients and stakeholders

We have tried to keep the cost minimum and did not compromise on the quality of the product so that Biofloc farmers could use this system without any distress. As this would help us to maintain the public faith in implementing the project in real life scenarios.

Ensuring quality and optimization

To achieve the project's goal of automating the system, numerous tasks must be completed. We kept the integrity by not infringing from the internet and instead worked on creating a subtle and robust design for our system. To retain professionalism, we gathered ideas and knowledge and attempted to incorporate them in the project rather than impulsively following past works done with Biofloc technology.

9.4 Conclusion

Central focus of this project is to develop an IoT based system to maintain and monitor the Biofloc Technology which can create a new hope for the stakeholders related to the Biofloc fish farming. While developing this project it becomes a necessity to maintain all the ethical and professional responsibilities to make our project reliable for people and sustainable to maintain. By fulfilling these responsibilities people will be encouraged more to use our system as we will be able to win their trust.

Chapter 10

Conclusion and Future Work

10.1 Project Summary/Conclusion

The automation of the Biofloc technology is an IoT-based approach used to monitor and maintain a suitable environment for the system. However, the first design would benefit the Biofloc operators the most due to its efficiency, usability, and maintainability. If the mobile application user interface is simplified, it will help most farmers operate a Biofloc system independently.

10.2 Future work

Every project face challenges to survive in this competitive world of engineering. Our project is also no different from this. As a result, it is very much important to note down some future works for this system:

- **Using multiparameter aquaculture quality analyzer**

  Multiparameter water quality analyzer which is not widely available in the market and expensive as well but for a large Biofloc system this analyzer can provide accurate water quality parameter values with a long-term service.

- **Applying Machine Learning**

  Machine learning can predict the future data based on its training and testing data. For our project machine learning can forecast water quality for the fish.

- **Developing a system to monitor and control salt level in the water**

  Water must have a standard amount of salt in it based on the fish which is being farmed at the system. Therefore, developing a system for monitoring and controlling the salt level in the might help to improve the system.

Chapter 11

Identification of Complex Engineering Problems and Activities

11.1 Identify The Attribute of Complex Engineering Problem (EP)

A. Attributes of Complex Engineering Problems (EP)

	Attributes	**Put tick (√) as appropriate**
P1	Depth of knowledge required	√
P2	Range of conflicting requirements	√
P3	Depth of analysis required	
P4	Familiarity of issues	√
P5	Extent of applicable codes	
P6	Extent of stakeholder involvement and needs	√
P7	Interdependence	√

Table 21. Attributes of Complex Engineering Problems (EP)

11.2 Provide Reasoning How The Project Address Selected Attribute (EP)

- **P1 – Depth of knowledge required**

  Depth of knowledge is required in IoT, Biofloc, microcontroller for collecting and converting analog to digital data, programming for deciding to turn on the actuators.

- **P2 – Range of conflicting requirements**

  A Range of conflicting requirements is present as the ammonia factor increases when we increase the temperature. Here we must make a tradeoff between temperature and ammonia; that is why a range of conflicting requirements is present.

- **P4 – Familiarity of issues**

  As electrical engineers, we are not familiar with Biofloc fish farming, and in general, we are not familiar with any agricultural sector. Therefore, this is an issue we need to be familiar with for doing this project. In addition, we need to build a mobile application where specific problems may arise.

- **P6 – Extent of stakeholder involvement and needs**

  Our goal is to make the system easier to operate and monitor. Moreover, making data available through mobile applications will improve stakeholder participation.

- **P7 – Interdependence**

  There are some subsystems in this project, such as the temperature detection system, water level detection system, oxygen level, the alert system. These are interdependent.

11.3 Identify The Attribute of Complex Engineering Activities (EA)

B. Attributes of Complex Engineering Activities (EA)

	Attributes	**Put tick (√) as appropriate**
A1	Range of resource	√
A2	Level of interaction	√
A3	Innovation	
A4	Consequences for society and the environment	√
A5	Familiarity	√

Table 22. Attributes of Complex Engineering Activities (EA)

11.4 Provide Reasoning How The Project Address Selected Attribute (EA)

- **A1 – Range of resource**

  To implement the system, we will need microcontrollers, different sensors, motors, and other components available in local markets.

- **A2 – Level of interaction**

  In this system, there will be many sensors and actuators. Controlling and maintaining these components are challenging. In such cases, the microcontroller must control several sensors and actuators. As a result, the system may draw many currents, or some actuators may get stalled.

- **A4 – Consequences for society and the environment**

  In our project, we will use different components that will not harm the environment. Moreover, with the help of Biofloc, fish production can be increased with a reduced cost of fish in markets.

- **A5 – Familiarity**

  In this project, we will work with microcontrollers and sensors. From previous experiences, we are familiar with working with these components.

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Appendix A.

[1]**Ammonia Factor:**

The Total Ammonia Nitrogen (TAN), which contains two different types of ammonia are always present in water. The NH_3 and NH_4^+ are always present in water and are in equilibrium ($NH_3 + H^+ \rightleftharpoons NH_4^+$), hence, their relationship can be determined by the equation below:

$$\frac{[NH_3]}{[NH_3] + [NH_4^+]} = \frac{10^{pH}}{e^{\left(\frac{6344}{273+T}\right)} + 10^{pH}}$$

The graph below shows the relationship between the contents of Total Ammonia Nitrogen (TAN) and the pH measure.

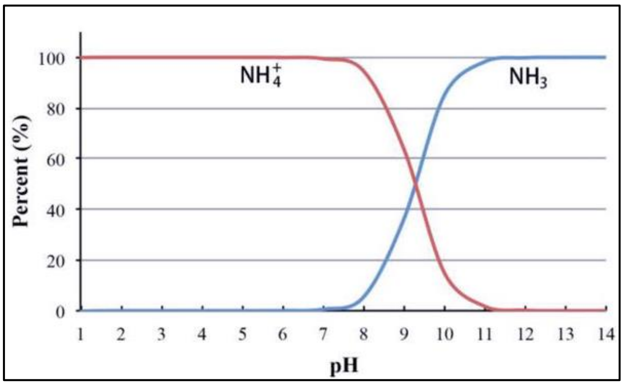

Figure. Relationship between NH_3 and NH_4^+

Code:

Sensor Subsystem:

Arduino code:

```
#include <EEPROM.h>

#include <OneWire.h>

#include <Arduino.h>

#include <DallasTemperature.h>

#include <SoftwareSerial.h>

#include "GravityTDS.h"
```

Available on Request

```
7560, 7430, 7300, 7180, 7070, 6950, 6840, 6730, 6630, 6530, 6410};
```

```
#define turbidPin A2 // Turbidity Pin to A2

sensors.begin();
```

```
}

vo
  re
  re
  re
  re
  re
  re

  d
  u

  d
}

vo
  d
  A
  A

  B
}

vo
  s
  B
}
```

```
void read_pH() {
...
}
```

```
  float duration = pulseIn(echoPin, HIGH);

 }
}

vo

}

vo

}

vo

}

vo

  Serial.print("Water Lvl: "); Serial.println(Biofloc.distance);
```

```
  Serial.print("Temp: "); Serial.println(Biofloc.temp);

}
```

ESP code:

```
#include <Arduino.h>
#include <WiFi.h>
#include <Firebase_ESP_Client.h>

#define RXp2 16

//Provide the token generation process info:
```

```
#include "addons/TokenHelper.h"
```

```
vo
}
vo
== 0)){
}
vo
}
vo
  Serial.print("Connecting to Wi-Fi");
```

```
  while (WiFi.status() != WL_CONNECTED){

}

}
```

Actuator Subsystem:

Arduino code:

```
#include <SoftwareSerial.h>

SoftwareSerial Arduino_SoftSerial(10, 11); //Rx, Tx

const unsigned long eventInterval = 15000;
unsigned long previousTime = 0;
```

```
//#define watr_relay 40

  pinMode(sole_relay, OUTPUT);  // solenoid relay
```

```
  pinMode(acid_relay, OUTPUT);  // acid relay
  [illegible]
}

[illegible]
}

[illegible]
  indexOfD = dataIn.indexOf('D');
```

```
  indexOfE = dataIn.indexOf("E");
}
}
   digitalWrite(temp_relay, HIGH);
```

```
  Serial.print(Biofloc.temp);

}

}

v

  motor_speed = 250;
```

```
  } else if (Biofloc.dissolved_oxygen < Biofloc.dissolved_oxygen_target - 1) {
...
    digitalWrite(MOTOR_B2_PIN, LOW);
```

```
  digitalWrite(MOTOR_A2_PIN, LOW);

  analogWrite(PWM_MOTOR_2, motor_speed);
}
```

ESP code:

```
#include <Arduino.h>
#include <WiFi.h>
#include <Firebase_ESP_Client.h>

#define RXp2 16

#define DATABASE_URL "biofloc-automation-default-rtdb.asia-southeast1.firebasedatabase.app"
```

```
//Define Firebase Data object
Fi

Fi
Fi

un
bo

vo
  /
  S
  /
  S

}

v
                                                                        == 0))
{

}

v

}

v

  signupOK = true;
```

```
}

}

Serial2.print(Biofloc.pH_target); Serial2.print("D");
```

```
  Serial2.print(Biofloc.depth); Serial2.print("E");

  delay(1000);
}
```

Application code:

```
For Home:
<?xml version="1.0" encoding="utf-8"?>
<RelativeLayout xmlns:android="http://schemas.android.com/apk/res/android"
    xmlns:app="http://schemas.android.com/apk/res-auto"
    xmlns:tools="http://schemas.android.com/tools"
    android:layout_width="match_parent"

        android:layout_marginBottom="-115dp"
```

```
    android:text="TDS"
```

```
    <
</R
```

For

```
<?x
<an
xml
  xm
  xm
  an
  an
  too

  <T

  <

    android:textStyle="bold"
```

app:layout_constraintStart_toStartOf="parent"

app:layout_constraintStart_toStartOf="parent"

```
    app:layout_constraintTop_toTopOf="parent" />
```

```
</a
```

Fo

```
<?
<a
xm
```

```
    android:id="@+id/button"
```

```
android:layout_width="wrap_content"
[illegible]
android:layout_width="wrap_content"
```

```
android:layout_height="wrap_content"
```

```
android:layout_marginTop="40dp"
```

```
    android:text="On"

  <

  <

  <

  <

</a

Fo

<?x
<an
xm
  xmlns:app="http://schemas.android.com/apk/res-auto"
```

```
xmlns:tools="http://schemas.android.com/tools"

    android:layout_height="wrap_content"
```

```
    android:layout_marginTop="28dp"

</a

Fo

<?
<a
xn
```

```
@Override
[illegible]
}
[illegible]
super.onCreate(savedInstanceState);
```

```
        setContentView(R.layout.activity_main);
    }
}
```

FYDP (P) Fall 2021 Summary of Team Log Book/ Journal

Group No: 03

Title: IoT Based Smart Biofloc Monitoring and Maintenance System

Final Year Design Project (P) Fall 2021			
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FYDP (P) Fall 2021 Summary of Team Log Book/ Journal

Date/Time/Place	Attendee	Summary of Meeting Minutes	Responsible	Comment by ATC
03.11.2021 (ATC meeting - 1)	1. Prof. Dr. AKM Abdul Malek Azad 2. Md. Nahid Haque Shazon 3. Afrida Malik 4. Saurov 5. Nafew 6. Tausif 7. Anoy	1. Finalize the topic. 2. E-mail the topic by 07.11.2021. 3. Present the topic and related research papers to ATC.	Task 1: Saurov, Nafew, Tausif, and Anoy Task 2: Saurov Task 3: Saurov, Nafew, Tausif, and Anoy Task 1: completed. Task 2: completed. Task 3: completed.	
04.11.2021 (Group meeting -1)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Finalize and prioritize the topics. 2. Collect relevant research papers and materials.	Task 1: Saurov, Nafew, Tausif, and Anoy Task 2: Saurov, Nafew, Tausif, and Anoy Task 1: completed. Task 2: completed.	
09.11.2021 (Group meeting -2)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Discuss EP and EA checklists.	Summary: Completed the EP, EA checklists and Log Book	
10.11.2021 (ATC meeting - 2)	1. Prof. Dr. AKM Abdul Malek Azad 2. Md. Nahid Haque Shazon 3. Afrida Malik 4. Saurov 5. Nafew 6. Tausif 7. Anoy	1. Concept note should be completed by 15.11.2021. 2. FYDP progress presentation-1 slides by 15.11.2021.	Task 1: Saurov, Nafew, Tausif, and Anoy Task 2: Saurov, Nafew, Tausif, and Anoy Task 1: completed. Task 2: completed.	1. Remove the guideline. 2. Title and group number must be added. 3. Submit the documents in pdf format.

13.11.2021 (Group meeting - 3)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Discuss the problem statements and project objectives.	Summary: Working on concept note draft	
15.11.2021 (Group meeting - 4)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Discuss the specifications, requirements, constraints. 2. Making the presentation slides.	Summary: Completed the concept note draft and presentation slides	
17.11.2021 (ATC meeting - 3)	1. Prof. Dr. AKM Abdul Malek Azad 2. Md. Nahid Haque Shazon 3. Afrida Malik 4. Saurov 5. Nafew 6. Tausif 7. Anoy	1. Make the necessary modifications to the presentation slides as instructed. 2. Mail the updated slide by 11:59 pm on 17.11.2021. 3. Rewrite the concept note and mail it by 24.11.2021.	Task 1: Saurov, Nafew, Tausif, and Anoy Task 2: Saurov Task 3: Saurov, Nafew, Tausif, and Anoy Task 1: completed. Task 2: completed. Task 3: completed.	1. Modify the multiple design approach part in the presentation slide and concept note. 2. In the presentation slide and concept note, include details about the applicable standards and codes. 3. In the presentation slide, increase the font size and maintain consistency. 4. Merge the first two pages of the presentation slide, including the title and information about the group. 5. Revise the concept note's equipment and component section for multiple design approaches. 6. In the conclusion slide, write two to

				three bullet points from the concept note. 7. All the COs have been written perfectly.
17.11.2021 (Group meeting - 5)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Making necessary changes to the presentation slides as directed by ATC.	Task 1: Saurov, Nafew, Tausif, and Anoy Task 1: completed.	
23.11.2021 (Group meeting - 6)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Defining the standard codes and working on multiple design approaches.	Task 1: Saurov, Nafew, Tausif, and Anoy Task 1: completed.	
28.11.2021 (Group meeting - 7)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Updating the concept note as instructed. 2. Mail the updated version of the concept note two days before the next ATC meeting.	Task 1: Saurov, Nafew, Tausif, and Anoy Task 2: Saurov Task 1: completed. Task 2: completed.	
1.12.2021 (ATC meeting - 4)	1. Prof. Dr. AKM Abdul Malek Azad 2. Md. Nahid Haque Shazon 3. Afrida Malik 4. Nafew 5. Tausif 6. Anoy 7. Saurov (absent) [Personal Problem]	1. Updating the concept note as instructed. 2. Mail the final version of the concept note to ATC by 11:59 of 2.12.2021. 3. Begin working on a project proposal draft.	Task 1: Saurov, Nafew, Tausif and Anoy Task 2: Saurov Task 3: Saurov, Nafew, Tausif and Anoy Task 1: completed. Task 2: completed. Task 3: completed.	1. Modify the multiple design approach. 2. Fix grammatical errors in the concept note. 3. Add attributes of complex engineering problems check table. 4. Add a comparison table for Design-1 and Design-2. 5. Work on Functional and Non-functional requirements.
1.12.2021 (Group meeting - 8)	1. Saurov 2. Nafew 3. Tausif	1. Preparing an alternate design and comparing it with the optimal design.	Task 1: Saurov, Nafew, Tausif and	

	4. Anoy		Anoy Task 1: completed.	
2.12.2021 (Group meeting - 9)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Updating the concept note as instructed. 2. Mail the final version of the concept note to ATC.	Task 1: Saurov, Nafew, Tausif and Anoy Task 2: Saurov Task 1: completed. Task 2: completed.	
7.12.2021 (Group meeting - 10)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Discussion on Project plan, Budget & expected outcome. 2. Dividing the workload among the group members. 3. Preparing Gannt chart.	Task 1: Saurov, Nafew, Tausif and Anoy Task 2: Saurov, Nafew, Tausif and Anoy Task 3: Saurov, Nafew, Tausif and Anoy Task 1: completed. Task 2: completed. Task 3: completed.	
8.12.2021 (ATC meeting - 5)	1. Prof. Dr. AKM Abdul Malek Azad 2. Md. Nahid Haque Shazon 3. Afrida Malik 4. Saurov 5. Nafew 6. Tausif 7. Anoy	1. Work on the draft Project proposal. 2. Mail the draft Project proposal before the ATC meeting – 6. 3. Take photographs, short videos from the plant visit. 4. Make a list of all the farm owner's significant suggestions for the project's advancement.	Task 1: Saurov, Nafew, Tausif and Anoy Task 2: Saurov Task 3: Saurov, Nafew, Tausif and Anoy Task 4: Saurov, Nafew, Tausif and Anoy Task 1: completed. Task 2: completed.	1. Correct the missing feedback and instructions from ATC meeting – 4 in the Log Book. 2. Complete the draft concept note before the next ATC meeting.

			Task 3: completed. Task 4: completed.	
9.12.2021 (Plant visit - 1)	1. Saurov 2. Nafew 3. Tausif 4. Anoy 5. Md. Zahir (Owner of Fishzone Agro Fisheries)	From the visit we got some insights, those are: 1. A clear idea about the real environment of the Biofloc system. 2. Difficulties of the current methods. 3. Ideas about the requirements of the stakeholders. 4. Getting an idea about the automated feeder.		
12.12.2021 (Group meeting - 11)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Correcting the missing points in the logbook. 2. working on methodology, sustainability, and risk management.	Task 1. Saurov, Nafew, Tausif and Anoy Task 2: Saurov, Nafew, Tausif and Anoy	
			Task 1: completed. Task 2: completed.	
14.12.2021 (Group meeting - 12)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Working on Safety consideration, impact, and ethical considerations. 2. Preparing the draft project proposal.	Task 1: Saurov, Nafew, Tausif and Anoy Task 2: Saurov, Nafew, Tausif and Anoy	
			Task 1: completed. Task 2: completed.	
19.12.2021 (Group meeting - 13)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Discussed and worked on the problem statement and background research.	Task 1: Saurov, Nafew, Tausif and Anoy	
			Task 1: completed.	

21.12.2021 (Group meeting - 14)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Updating the draft project proposal as instructed. 2. Mail the updated draft project proposal to ATC.	Task 1: Saurov, Nafew, Tausif and Anoy Task 2: Saurov Task 1: completed. Task 2: completed.	
22.12.2021 (ATC meeting - 7)	1. Prof. Dr. AKM Abdul Malek Azad 2. Md. Nahid Haque Shazon 3. Afrida Malik 4. Saurov 5. Nafew 6. Tausif 7. Anoy	1. Modify and mail draft project proposal by 27.12.2021. 2. Prepare and mail Progress presentation - 2 slides by 27.12.2021. 3. Modify and mail draft project proposal by 03.01.2022. 4. Prepare and mail Progress presentation - 2 slides by 03.01.2022. 5. Mail the Final Project Proposal to the ATC by 06.01.2022.	Task 1: Saurov, Nafew, Tausif and Anoy Task 2: Saurov, Nafew, Tausif and Anoy Task 3: Saurov, Nafew, Tausif and Anoy Task 4: Saurov, Nafew, Tausif and Anoy Task 5: Saurov Task 1: completed. Task 2: completed. Task 3: completed. Task 4: completed. Task 5: completed.	1. Fix the grammatical error in the functional requirement part. 2. Add dimensions and parameters of Biofloc according to propose a budget. 3. All the parts in the project proposal have been mentioned and done nicely. 4. Necessary modification has taken place in Log Book as per instructions. 5. Start of 400D give a presentation mentioning the project procedure in detail. 6. Propose to the stakeholders about the investment and sign an MoU.
27.12.2021 (Group meeting - 15)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Updating the draft project proposal as instructed. 2. Mail the updated draft project proposal to ATC.	Task 1: Saurov, Nafew, Tausif and Anoy Task 2: Saurov,	

		3. Making the progress presentation-2 slides. 4. Mail the slides to the ATC.	Nafew, Tausif and Anoy Task 3: Saurov, Nafew, Tausif and Anoy Task 4: Saurov, Nafew, Tausif and Anoy Task 1: completed. Task 2: completed. Task 3: completed. Task 4: completed.	
29.12.2021 (Emergency meeting)	1. Prof. Dr. AKM Abdul Malek Azad 2. Saurov 3. Nafew 4. Tausif 5. Anoy	1. Make the necessary modifications to the presentation slides as instructed. 2. Mail the updated slide by 11:59 pm on 29.12.2021.	Task 1: Saurov, Nafew, Tausif, and Anoy Task 2: Saurov Task 1: completed. Task 2: completed.	1. Add headings for each in comparison content. 2. Change the theme of the slides. 3. Correct the grammatical errors and sentence structure. 4. Use bullet points in the Impact slide. 5. Add captions and references for pictures and figures.
29.12.2021 (Group meeting - 16)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Make the necessary modifications to the presentation slides as instructed. 2. Mail the updated slide to the ATC.	Task 1: Saurov, Nafew, Tausif, and Anoy Task 2: Saurov Task 1: completed. Task 2: completed.	
03.01.2022 (Group meeting - 17)	1. Saurov 2. Nafew 3. Tausif	1. Updating the draft project proposal as instructed.	Task 1: Saurov, Nafew, Tausif and	

	4. Anoy	2. Mail the updated draft project proposal to ATC. 3. Making the Final slides. 4. Mail the slides to the ATC.	Anoy Task 2: Saurov, Nafew, Tausif and Anoy Task 3: Saurov, Nafew, Tausif and Anoy Task 4: Saurov, Nafew, Tausif and Anoy	
			Task 1: completed. Task 2: completed. Task 3: completed. Task 4: completed.	
05.01.2022 (Group meeting - 18)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Make the necessary modifications to the presentation slides as instructed. 2. Mail the updated slide by 11:59 pm on 05.01.2022. 3. Mail the Final Project Proposal to the ATC.	Task 1: Saurov, Nafew, Tausif, and Anoy Task 2: Saurov Task 3: Saurov	
			Task 1: completed. Task 2: completed. Task 3: completed.	

FYDP (D) Spring 2022 Summary of Team Log Book/ Journal

Group No: 03

Title: IoT Based Smart Biofloc Monitoring and Maintenance System

Final Year Design Project (D) Spring 2022			
Student Details	**NAME & ID**	**EMAIL ADDRESS**	**PHONE**
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Member 3	Tausif Ahmed – 17221011	tausif.ahmed@g.bracu.ac.bd	01797877540
Member 4	Syed Nafew Hasan Jesan – 18221045	syed.nafew.hasan.jeasn@g.bracu.ac.bd	01745966995
ATC Details:			
ATC 3			
Chair	Prof. Dr. AKM Abdul Malek Azad	a.azad@bracu.ac.bd	01556528695
Member 1	Md. Nahid Haque Shazon	nahid.haque@bracu.ac.bd	
Member 2	Afrida Malik	afrida.malik@bracu.ac.bd	

FYDP (D) Spring 2022 Summary of Team Log Book/ Journal

Date/Time/Place	Attendee	Summary of Meeting Minutes	Responsible	Comment by ATC
10.02.2022 (ATC meeting - 1)	1. Prof. Dr. AKM Abdul Malek Azad 2. Md. Nahid Haque Shazon 3. Afrida Malik 4. Saurov 5. Nafew 6. Tausif 7. Anoy	1. Search resources for the simulation. 2. Review the Gantt chart. 3. Make a component list with collected items and items that need to collect. 4. Make an overall project overview. 5. Maintain the logbook as well as the design report.	Task 1: Saurov, Nafew, Tausif, and Anoy Task 2: Anoy and Tausif Task 3: Saurov Task 4: Nafew Task 5: Saurov and Nafew Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed Task 5: Completed	
12.02.2022 (Group meeting - 1)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Making project overview. 2. Finding resources for simulation (Design-1). 3. Finding resources for simulation (Design-2). 4. Creating a Draft design report.	Task 1: Nafew, and Anoy Task 2: Saurov, Nafew, Tausif, and Anoy Task 3: Tausif, and Nafew Task 4: Nafew, Tausif, and Saurov Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed	
16.02.2022 (Group meeting - 2)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Making component list. 2. Making logbook for EEE400D. 3. Revised the Gantt chart.	Task 1: Saurov, and Nafew Task 2: Saurov Task 3: Anoy, Tausif	

			Task 1: Completed Task 2: Completed Task 3: Completed	
19.02.2022 (Group meeting - 3)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Start working on the simulation model (Design-1). 2. Finding a solution for the design-2 simulation and making a contingency plan for emergencies. 3. Discussion on the cloud server model. 4. Mail related materials to the ATC before Thursday.	Task 1: Saurov, Nafew, Tausif, and Anoy Task 2: Saurov, Nafew, Tausif, and Anoy Task 3: Saurov, Nafew, Tausif, and Anoy Task 4: Saurov Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed	
24.02.2022 (ATC meeting - 2)	1. Prof. Dr. AKM Abdul Malek Azad 2. Md. Nahid Haque Shazon 3. Afrida Malik 4. Saurov 5. Nafew 6. Tausif 7. Anoy	1. Complete and mail the draft design report before the ATC meeting - 3. 2. Search resources for Raspberry Pi for Design-2.	Task 1: Saurov, Nafew, Tausif, and Anoy Task 2: Saurov, Nafew, Tausif, and Anoy Task 1: Completed Task 2: Completed	1. Did not send design report before ATC meeting - 2. 2. To complete the design need to work with the app and other simulations. 3. Components update in every meeting. 4. Decision about Raspberry Pi.
25.02.2022 (Group meeting - 4)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Make an overall project overview for Design-2. 2. Discussion on Design-2 simulation and share the resources	Task 1: Saurov, Nafew, Tausif, and Anoy Task 2: Saurov,	

		among the group members.	Nafew, Tausif, and Anoy Task 1: Completed Task 2: Completed	
28.02.2022 (Group meeting - 5)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Start working on the simulation model (Design-2). 2. Updating the Budget for the project.	Task 1: Saurov, Nafew, Tausif, and Anoy Task 2: Saurov, Nafew, Tausif, and Anoy Task 1: Completed Task 2: Completed	
01.03.2022 (Group meeting - 6)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Making the progress presentation slides. 2. Mail the slides to the ATC.	Task 1: Saurov, Nafew, Tausif, and Anoy Task 2: Saurov Task 1: Completed Task 2: Completed	
02.03.2022 (Group meeting - 7)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Make the necessary modifications to the presentation slides as instructed. 2. Mail the updated slides to ATC. 3. Mail the draft Design Report and Logbook to the ATC.	Task 1: Saurov, Nafew, Tausif, and Anoy Task 2: Saurov Task 3: Saurov Task 1: completed Task 2: Completed Task 3: Completed	
06.03.2022 (Group meeting - 8)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Modifying the simulation for Design-2. 2. Modifying design report.	Task 1: Saurov, Nafew, Tausif, and Anoy Task 2: Saurov, Nafew, Tausif, and Anoy	

			Task 1: Completed Task 2: Completed	
09.03.2022 (Group meeting - 9)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Modifying the simulation for Design-1. 2. Updating Ethical Consideration. 3. Start working on designing the mobile application.	Task 1: Anoy, and Saurov Task 2: Nafew Task 3: Tausif Task 1: Completed Task 2: Completed Task 3: Completed	
19.03.2022 (Group meeting - 10)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Updating functional verification in the design report. 2. Updating Risk Management and Contingency Plan in the design report.	Task 1: Saurov, Tausif, and Anoy Task 2: Nafew, and Saurov Task 1: Completed Task 2: Completed	
23.03.2022 (Group meeting - 11)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Updating Draft design Report. 2. Mail the draft Design Report, Logbook, and component list to the ATC.	Task 1: Saurov, Nafew, Tausif, and Anoy Task 2: Saurov Task 1: Completed Task 2: Completed	
24.03.2022 (ATC meeting - 3)	1. Prof. Dr. AKM Abdul Malek Azad 2. Md. Nahid Haque Shazon 3. Afrida Malik 4. Saurov 5. Nafew 6. Tausif 7. Anoy	1. Update the draft design report as instructed. 2. Mail the draft design report before the ATC meeting - 4.	Task 1: Saurov, Nafew, Tausif, and Anoy Task 2: Saurov	1. Use the correct format for citation. 2. Proper naming and numbering of figures. 3. Add justification for not using NodeMCU and add prototype budget. 4. Revise 'Background Research',

			Task 1: Completed Task 2: Completed	‘Objectives, Specifications’, and ‘Analyze the Multiple Design Solutions to find the Optimal Solution’. 5. Recheck grammatical mistakes and mention figure no in descriptions. 6. Add description for esign-2 simulation part. 7. Give updates on App and LabVIEW. 8. Collect other components.
27.03.2022 (Group meeting -12)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Revising and updating Background Research and Objectives. 2. Revising and updating Specifications and Analyze the Multiple Design Solutions to find the Optimal Solution. 3. Searching resources for LabVIEW.	Task 1: Nafew, and Tausif Task 2: Anoy, and Saurov Task 3: Saurov, Nafew, Tausif, and Anoy Task 1: Completed Task 2: Completed Task 3: Completed	
30.03.2022 (Group meeting -13)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Revising and updating the Prototype Budget and other necessary changes in the draft Design Report. 2. Check resources for LabVIEW that can be used for Wi-Fi simulation.	Task 1: Saurov, Nafew, Tausif, and Anoy Task 2: Saurov, Nafew, Tausif, and Anoy Task 3: Saurov	

		3. Mail the draft Design Report and Logbook to the ATC.	Task 1: Completed Task 2: Completed Task 3: Completed	
31.03.2022 (ATC meeting - 4)	1. Prof. Dr. AKM Abdul Malek Azad 2. Md. Nahid Haque Shazon 3. Afrida Malik 4. Saurov 5. Nafew 6. Tausif 7. Anoy	1. Add SWOT analysis in Functional Verification of Multiple Design Solutions. 2. Update the draft design report as instructed. 3. Mail the draft design report before the ATC meeting - 5.	Task 1: Saurov, Nafew, Tausif, and Anoy Task 2: Saurov, Nafew, Tausif, and Anoy Task 3: Saurov Task 1: Completed Task 2: Completed Task 3: Completed	1. Demonstrate both simulations in the next meeting. 2. Revised Background Research (use single tense, write drawback first then mention the solution). 3. Revised Objectives. 4. Rewrite Functional Verification of Multiple Design Solutions for both designs. 5. Rewrite the figure names. 6. Try MATLAB for Wi-Fi simulation.
03.04.2022 (Group meeting -14)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Working on SWOT analysis. 2. Taking decisions for Wi-Fi simulation. 3. Revising and updating Background Research and Objectives.	Task 1: Tausif, Saurov, and Anoy Task 2: Saurov, Nafew, Tausif, and Anoy Task 3: Nafew, Anoy, and Saurov Task 1: Completed Task 2: Completed Task 3: Completed	

06.04.2022 (Group meeting -15)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Updating Draft design Report. 2. Mail the draft Design Report and Logbook to the ATC.	Task 1: Saurov, Nafew, Tausif, and Anoy Task 2: Saurov Task 1: Completed Task 2: Completed	
07.04.2022 (ATC meeting - 5)	1. Prof. Dr. AKM Abdul Malek Azad 2. Md. Nahid Haque Shazon 3. Afrida Malik 4. Saurov 5. Nafew 6. Tausif 7. Anoy	1. Make simulation videos for the ATC members. 2. Make and send slides for mock presentation by 20/04/2022.	Task 1: Saurov, Nafew, Tausif, and Anoy Task 2: Saurov, Nafew, Tausif, and Anoy Task 1: Completed Task 2: Completed	1. In the Background research part- for universal truth use present tense, add reference numbers at end, rephrase sentences, add standard values and then add percentage then. 2. Rephrase Objectives by using gerund. 3. Remove blank pages. 4. Rewrite SWOT analysis part. 5. Change reference number 10.
13.04.2022 (Group meeting -15)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Updating Background Research and Objectives in the paper. 2. Updating SOWT analysis.	Task 1: Anoy, Saurov, and Nafew Task 2: Saurov, Anoy, and Tausif Task 1: Completed Task 2: Completed	
17.04.2022 (Group meeting -17)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Making simulation videos for ATC members. 2. Updating Draft Design Report.	Task 1: Saurov, Anoy, and Tausif Task 2: Saurov, Anoy, and Nafew	

			Task 1: Completed Task 2: Completed	
20.04.2022 (Group meeting -18)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Updating Draft design report. 2. Mail the simulation videos, draft Design Report and Logbook to the ATC.	Task 1: Saurov, Nafew, Tausif, and Anoy Task 2: Saurov	
			Task 1: Completed Task 2: Completed	
21.04.2022 (ATC meeting - 6)	1. Prof. Dr. AKM Abdul Malek Azad 2. Md. Nahid Haque Shazon 3. Afrida Malik 4. Saurov 5. Nafew 6. Tausif 7. Anoy	1. Mock presentation to ATC. 2. Modify the slides as per ATC comments and mail it before Final Presentation.	Task 1: Saurov, Nafew, Tausif, and Anoy Task 2: Saurov, Nafew, Tausif, and Anoy	1. Focus on time management. 2. Use pointer throughout the presentation. 3. Show the results more clearly in the slides. 4. Modify methodology, Risk management slide, and Conclusion slides.
			Task 1: Completed Task 2: Completed	
21.04.2022 (Group meeting -19)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Review the Final Design Report. 2. Mail the Final Design Report.	Task 1: Anoy, Saurov, Nafew, and Tausif Task 2: Saurov	
			Task 1: Completed Task 2: Completed	
24.04.2022 (Group meeting -19)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Working on the Slides as per ATC comments. 2. Practicing for the final presentation.	Task 1: Anoy, Saurov, Nafew, and Tausif Task 2: Anoy, Saurov, Nafew, and Tausif	
			Task 1: Completed	

			Task 2: Completed	
27.04.2022 (Group meeting -19)	1. Saurov 2. Nafew 3. Tausif 4. Anoy	1. Working on the videos/.gif/result window. 2. Practicing for the final presentation. 3. Mail the Final Presentation Slides and Logbook to the ATC.	Task 1: Anoy, Saurov, Nafew, and Tausif Task 2: Anoy, Saurov, Nafew, and Tausif Task 3: Saurov	
			Task 1: Completed Task 2: Completed Task 3: Completed	

FYDP (C) Summer 2022 Summary of Team Log Book/ Journal

Group No: 03

Title: IoT Based Smart Biofloc Monitoring and Maintenance System

Final Year Design Project (C) Summer 2022			
Student Details	**NAME & ID**	**EMAIL ADDRESS**	**PHONE**
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Member 3	Tausif Ahmed – 17221011	tausif.ahmed@g.bracu.ac.bd	01797877540
Member 4	Syed Nafew Hasan Jesan – 18221045	syed.nafew.hasan.jeasn@g.bracu.ac.bd	01745966995
ATC Details:			
ATC 3			
Chair	Prof. Dr. AKM Abdul Malek Azad	a.azad@bracu.ac.bd	01556528695
Member 1	Afrida Malik	afrida.malik@bracu.ac.bd	
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FYDP (C) Summer 2022 Summary of Team Log Book/ Journal

Date/Time/Place	Attendee	Summary of Meeting Minutes	Responsible	Comment by ATC
02.06.2022 (FYDP committee and Students)	1. Saurov 2. Anoy 3. Tausif	1. Introductory session of EEE400C.		
07.02.2022 (Group meeting - 1)	1. Saurov 2. Anoy 3. Tausif 4. Nafew	1. Updating the EEE400C Gantt chart.	Task 1: Saurov, Anoy, Tausif, and Nafew Task 1: Completed	
09.06.2022 (ATC meeting - 1)	1. Prof. Dr. AKM Abdul Malek Azad 2. Afrida Malik 3. Saurov 4. Nafew 5. Tausif 6. Anoy	1. Start working with the final report and the prototype. 2. Review the Gantt chart. 3. Make the collected components list with pictures. 4. Mail the Log Book, component list, progress update and the Project report.	Task 1: Saurov, Anoy, Tausif, and Nafew Task 2: Saurov, Anoy, Tausif, and Nafew Task 3: Saurov, Anoy, Tausif, and Nafew Task 4: Saurov Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed	
12.06.2022 (Group meeting - 2)	1. Saurov 2. Anoy 3. Tausif 4. Nafew	1. Updating the project plan for prototype. 2. Reviewing the Gantt chart. 3. Updating the monitoring circuit. 4. Start working on the Final report.	Task 1: Saurov, Anoy, Tausif, and Nafew Task 2: Saurov, Anoy, Tausif, and Nafew Task 3: Saurov, Anoy, Tausif, and Nafew Task 4: Saurov, Anoy, Tausif, and Nafew	

			Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed	
15.06.2022 (Group meeting - 3)	1. Saurov 2. Anoy 3. Tausif 4. Nafew	1. Updating the project overview (Actuator part). 2. Making the collected components list with pictures. 3. Updating some sensor data in Firebase. 4. Mailing the Log Book, component list, progress update and the Final report.	Task 1: Saurov, Anoy, Tausif, and Nafew Task 2: Saurov, Anoy, Tausif, and Nafew Task 3: Saurov, Anoy, Tausif, and Nafew Task 4: Saurov Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed	
16.06.2022 (ATC meeting - 2)	1. Mohammed Thushar Imran 2. Saurov 3. Anoy 4. Tausif 5. Nafew	1. Introduced with new ATC member and forwarded documents to him.		
17.06.2022 (Group meeting - 4)	1. Saurov 2. Anoy 3. Tausif 4. Nafew	1. Working with the sensor part. 2. Updating some features to the application and resolving some problems.	Task 1: Saurov and Anoy Task 2: Tausif, and Nafew Task 1: Completed Task 2: Completed	
19.06.2022 (Group meeting - 5)	1. Saurov 2. Anoy 3. Tausif 4. Nafew	1. Designing Electrical Power System (EPS) for the	Task 1: Saurov and Anoy Task 2: Tausif, and Nafew	

		sensor part and actuator part. 2. Research for aquaculture parameter changes.	Task 1: Completed Task 2: Completed	
22.06.2022 (Group meeting - 6)	1. Saurov 2. Anoy 3. Tausif 4. Nafew	1. Updating Log Book and Project Paper. 2. Mail the Log Book, component list, progress update, and the Project report.	Task 1: Saurov, Anoy, Tausif, and Nafew Task 2: Saurov Task 1: Completed Task 2: Completed	
23.06.2022 (ATC meeting - 3)	1. Prof. Dr. AKM Abdul Malek Azad 2. Afrida Malik 3. Mohammed Thushar Imran 4. Saurov 5. Nafew 6. Tausif 7. Anoy	1. Give update on the sensor and actuator part. 2. Bring some modification in the report. 3. Inform about the progress presentation date.	Task 1: Saurov, Anoy, Tausif, and Nafew Task 2: Nafew, Anoy, Tausif, and Saurov Task 3: Saurov Task 1: Completed Task 2: Completed Task 3: Completed	1. Revised the Table of content. 2. Revised the 3. Review the Literature Gap. 4. Add Current Industry part in chapter 1.1.4. 5. Add Specifications of 2nd approach. 6. Separate the technical and non-technical constraints. 7. Use table for standard codes. 8. Elaborate 2nd approach. 9. Revised chapter 3 and chapter 4.
26.06.2022 (Group meeting - 7)	1. Saurov 2. Anoy 3. Tausif 4. Nafew	1. Updating the Project report. 2. Debugging the Sensor module.	Task 1: Nafew, and Saurov Task 2: Anoy, and Tausif Task 3: Saurov	

		3. Implementing the EPS system.	Task 1: Completed Task 2: Completed Task 3: Completed	
29.06.2022 (Group meeting - 8)	1. Saurov 2. Anoy 3. Tausif 4. Nafew	1. Debugging issues on Firebase. 2. Working with actuator part. 3. Mail the Log Book, and the Project report.	Task 1: Tausif, and Nafew Task 2: Anoy and Saurov Task 3: Saurov Task 1: Completed Task 2: Completed Task 3: Completed	
30.06.2022 (ATC meeting - 4)	1. Prof. Dr. AKM Abdul Malek Azad 2. Afrida Malik 3. Mohammed Thushar Imran 4. Saurov 5. Nafew 6. Tausif 7. Anoy	1. Send presentation slides by July 24, 2022. 2. Update the report. 3. Give an update on the prototype.	Task 1: Saurov, Anoy, Tausif, and Nafew Task 2: Saurov, Anoy, Tausif, and Nafew Task 3: Saurov, Anoy, Tausif, and Nafew Task 1: Completed Task 2: Completed Task 3: Completed	1. Update Literature Gap. 2. Shift constraints after Technical and non-Technical. 3. Elaborate summary of the proposed project. 4. Use a different numbering format for figures. 5. Update the report format. 6. Improve simulation picture quality. 7. Add risk response matrix. 8. Revise Chapter – 9.2.
03.07.2022 (Group meeting - 9)	1. Saurov 2. Anoy 3. Tausif 4. Nafew	1. Revising the report. 2. Working on the prototype. 3. Research on Serial communication for Arduino.	Task 1: Nafew, Anoy, Tausif, and Saurov Task 2: Anoy, Saurov, Tausif, and Nafew Task 3: Anoy, and Tausif	

			Task 1: Completed Task 2: Completed Task 3: Completed	
06.07.2022 (Group meeting - 10)	1. Saurov 2. Anoy 3. Tausif 4. Nafew	1. Resolving the voltage drop issues. 2. Mail the Log Book, and the Project report.	Task 1: Anoy, Saurov, Tausif, and Nafew Task 2: Saurov Task 1: Completed Task 2: Completed	
07.07.2022 (ATC meeting - 5)	1. Prof. Dr. AKM Abdul Malek Azad 2. Mohammed Thushar Imran 3. Saurov 4. Nafew 5. Tausif 6. Anoy	1. Include System level specification, review other formats. 2. Review section 4.3, and section 6.3. 3. Review section 2.3, section 4.4, and section 9.3.	Task 1: Nafew, Anoy, Tausif, and Saurov Task 2: Nafew, Anoy, Tausif, and Saurov Task 3: Nafew, and Tausif Task 1: Completed Task 2: Completed Task 3: Completed	1. Review Literature Gap. 2. Review 1.2 spelling. 3. Add full system level specification before component level specification. 4. Review section 2.3, section 4.3, and section 6.3. 5. Add tables for other parameters in section 4.4. 6. Review chapter 9. 7. Give update about the DO.
14.07.2022 (Group meeting - 11)	1. Saurov 2. Anoy 3. Tausif 4. Nafew	1. Working the actuator part and debugging the problems. 2. Creating 3D overview for the system. 3. Managing the DO sensor filling solution.	Task 1: Anoy, Saurov, Tausif, and Nafew Task 2: Saurov and Anoy Task 3: Anoy, Saurov, Tausif, and Nafew Task 1: Completed Task 2: Completed	

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			Task 3: Completed	
19.07.2022 (Group meeting - 12)	1. Saurov 2. Anoy 3. Tausif 4. Nafew	1. Updating the Project report. 2. Mail the Log Book, and the Project report.	Task 1: Nafew, Anoy, Tausif, and Saurov Task 2: Saurov Task 1: Completed Task 2: Completed	
21.07.2022 (ATC meeting - 6)	1. Prof. Dr. AKM Abdul Malek Azad 2. Mohammed Thushar Imran 3. Saurov 4. Nafew 5. Tausif 6. Anoy	1. Send Presentation Slides by 24th July 2022. 2. Send videos of individual sensor nodes.	Task 1: Nafew, Anoy, Tausif, and Saurov Task 2: Nafew, Anoy, Tausif, and Saurov Task 1: Completed Task 2: Completed	1. Specify the task in the Log Book. 2. Correct the page numbers. 3. Change diagrams to similar sizes. 4. Complete sections 4.4 and 4.5. 5. Use references throughout the whole paper.
24.07.2022 (Group meeting - 13)	1. Saurov 2. Anoy 3. Tausif 4. Nafew	1. Calibrating DO sensor. 2. Build the prototype environment. 3. Make the Presentation Slides. 4. Mail the Presentation Slides	Task 1: Anoy, and Saurov Task 2: Nafew, Anoy, Tausif, and Saurov Task 3: Nafew, Anoy, Tausif, and Saurov Task 4: Tausif Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed	

27.07.2022 (Group meeting - 14)	1. Saurov 2. Anoy 3. Tausif 4. Nafew	1. Debug the Prototype. 2. Updating the sensor and actuator codes. 3. Update the Presentation Slides with videos.	1: Anoy, and Saurov Task 2: Anoy, and Saurov Task 3: Anoy, Saurov, Nafew, and Tausif Task 1: Completed Task 2: Completed Task 3: Completed	
28.07.2022 (FYDP committee and Students)	1. Saurov 2. Anoy 3. Tausif 4. Nafew	1. Progress Presentation.	Task 1: Saurov, Anoy, Tausif and Jesan Task 1: Completed	1. Add ATC details. 2. Revise Attributes of Complex Engineering Problems (EP) (P2, P5). 3. Real Biofloc data collection. 4. Elaborate ethical consideration. 5. Weight the parameters. 6. Reasons for using the sensors. 7. Add slides for the Budget.
30.07.2022 (Group meeting - 15)	1. Saurov 2. Anoy 3. Tausif 4. Nafew	1. Update codes for actuators. 2. Make corrections to Project report.	Task 1: Saurov, Anoy, and Tausif Task 2: Nafew, and Saurov Task 1: Completed Task 2: Completed	
03.08.2022 (Group meeting - 16)	1. Saurov 2. Anoy 3. Tausif 4. Nafew	1. Updating the Project report. 2. Mail the Log Book, and the Project report.	Task 1: Saurov, Anoy, Nafew, and Tausif Task 2: Saurov	

			Task 1: Completed Task 2: Completed	
04.08.2022 (ATC meeting - 7)	1. Prof. Dr. AKM Abdul Malek Azad 2. Afrida Malik 3. Mohammed Thushar Imran 4. Saurov 5. Anoy 6. Tausif 7. Nafew	1. Showcase the full system to the ATC panel in the meeting hour. 2. Revised the paper as per comments and start working on the further sections. 3. Make videos of the full system as per requirements.	Task 1: Saurov, Anoy, Nafew, and Tausif Task 2: Saurov, Anoy, Nafew, and Tausif Task 3: Saurov, Anoy, Nafew, and Tausif	1. Revised the Gantt chart and maintain it. 2. Mention the ATC name in the Slides from next times. 3. Add analysis and description in section 4.4. 4. Revised section 9.3. 5. Remove P5 and keep P2 in the Attributes of Complex Engineering Problems (EP) section.
			Task 1: Completed Task 2: Completed Task 3: Completed	
07.08.2022 (Group meeting - 17)	1. Saurov 2. Anoy 3. Tausif 4. Nafew	1. Updating with the section 9.3 and EP. 2. Updating Section 4.4. 3. Updating chapter 8 and chapter 10.	Task 1: Saurov, and Anoy Task 2: Tausif, and Saurov Task 3: Tausif, and Nafew	
			Task 1: Completed Task 2: Completed Task 3: Completed	
10.08.2022 (Group meeting - 18)	1. Saurov 2. Anoy 3. Tausif 4. Nafew	1. Rechecking the sensors. 2. Updating the Project repot. 3. Mail the Log Book, and the Project report.	Task 1: Nafew, Anoy, Tausif, and Saurov Task 2: Nafew, Anoy, Tausif, and Saurov Task 3: Saurov	

			Task 1: Completed Task 2: Completed Task 3: Completed	
11.08.2022 (ATC meeting - 8)	1. Prof. Dr. AKM Abdul Malek Azad 2. Afrida Malik 3. Mohammed Thushar Imran 4. Saurov 5. Anoy 6. Tausif 7. Nafew	1. Complete the report with all the chapters. 2. Complete the video and mail it.	Task 1: Saurov, Anoy, Nafew, and Tausif Task 2: Saurov, Anoy, Nafew, and Tausif Task 1: Completed Task 2: Completed Task 3: Completed	1. Fixed the spelling mistake in the Log Book. 2. Update chapter 5 and chapter 8. 3. Make video of the whole system and sent it to the ATC panel. 4. Try to make the sensor compact.
14.08.2022 (Group meeting - 19)	1. Saurov 2. Anoy 3. Tausif 4. Nafew	1. Complete the video. 2. Edit the video as per requirement.	Task 1: Saurov, Nafew, Anoy, and Tausif Task 2: Tausif, and Nafew Task 1: Completed Task 2: Completed	
20.08.2022 (Group meeting – 20)	1. Saurov 2. Anoy 3. Tausif 4. Nafew	1. Complete Chapter 5. 2. Complete Chapter 8. 3. Mail the video by 21.08.2022.	Task 1: Tausif, and Anoy Task 2: Nafew, and Saurov Task 3: Saurov Task 1: Completed Task 2: Completed Task 3: Completed	
24.08.2022 (Group meeting – 21)	1. Saurov 2. Anoy 3. Tausif 4. Nafew	1. Complete the Draft Project report. 2. Mail the Draft Project report and Log Book.	Task 1: Saurov, Nafew, Anoy, and Tausif Task 2: Saurov	

<table>
<tr><td></td><td></td><td></td><td>Task 1: Completed
Task 2: Completed</td><td></td></tr>
<tr><td rowspan="2">25.08.2022
(ATC meeting - 9)</td><td rowspan="2">1. Prof. Dr. AKM Abdul Malek Azad
2. Afrida Malik
3. Mohammed Thushar Imran
4. Saurov
5. Anoy
6. Tausif
7. Nafew</td><td rowspan="2">1. gave Mock presentation to the ATC panel.
2. Prepare the Final presentation slides.
3. Update the report as per comments.
4. Mail the presentation slides and Project report on 1 September, 2022.</td><td>Task 1: Saurov, Anoy, Tausif and Nafew
Task 2: Saurov, Anoy, Tausif and Nafew
Task 3: Saurov, Anoy, Tausif and Nafew
Task 4: Saurov</td><td rowspan="2">1. Check time management.
2.Add a Thank You slide in the end.
3. Use pointer in the time of presentation.
4. talk more about the optimal design overview.
5. one person explain the video.
6. show app in the video.
7. use one video only.
8. Fixed budget section in the paper.</td></tr>
<tr><td>Task 1: Completed
Task 2: Completed
Task 3: Completed
Task 4: Completed</td></tr>
<tr><td rowspan="2">27.08.2022
(Group meeting – 23)</td><td rowspan="2">1. Saurov
2. Anoy
3. Tausif
4. Nafew</td><td rowspan="2">1. Updating the report.
2. Updating video as per ATC comment.</td><td>Task 1: Saurov, Anoy, Tausif and Nafew
Task 2: Saurov, Anoy, Tausif and Nafew</td><td rowspan="2"></td></tr>
<tr><td>Task 1: Completed
Task 2: Completed</td></tr>
<tr><td>30.08.2022
(Group meeting – 24)</td><td>1. Saurov
2. Anoy
3. Tausif
4. Nafew</td><td>1. Updating Slides and Project Report.
2. Mail the Project Report and Slides to the ATC.</td><td>Task 1: Saurov, Anoy, Tausif and Nafew
Task 2: Saurov, Anoy, Tausif and Nafew</td><td></td></tr>
</table>

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			Task 1: Completed Task 2: Completed	
01.09.2022 (FYDP committee and Students)	1. Saurov 2. Tausif 3. Jesan	1. Final Presentation.	Task 1: Saurov, Tausif and Jesan Task 1: Completed	
01.09.2022 (Group meeting – 25)	1. Saurov 2. Anoy 3. Tausif 4. Nafew	1. Mail the Final Project Design Report to the ATC.	Task 1: Saurov Task 1: Completed	