AUTOMATED MONITORING AND CONTROL SYSTEM FOR BOTTOM CLEAN RACEWAY FISH CULTURE TECHNOLOGY

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A Final Year Design Project (FYDP) submitted to the Department of Electrical and Electronics Engineering in partial fulfillment of the requirements for the degree of
Bachelor of Science in Electrical and Electronics Engineering

Department of Electrical and Electronics Engineering
BRAC University
May 2023

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Declaration

It is hereby declared that

1. The Final Year Design Project (FYDP) submitted is my/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. I/We have acknowledged all main sources of help.

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Approval

The Final Year Design Project (FYDP) titled "Automated Monitoring And Control System For Bottom Clean Raceway Fish Culture Technology" submitted by

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Abstract/ Executive Summary

Fish farming in bottom-clean raceway systems has a number of benefits, including better waste control and efficient water use. However, due to the intricate interplay of many environmental conditions, the correct maintenance and monitoring of these systems can be difficult. We suggest an automated monitoring and control system that is especially created for bottom clean raceway fish production technology to overcome these issues. The system continuously monitors variables including water quality and dissolved oxygen levels using a network of sensors that are placed strategically throughout the raceway system. Advanced algorithms are used by the control unit to examine sensor data and make defensible decisions about system functioning. This system has a number of advantages. It reduces the amount of manual intervention required and the labor costs related to system maintenance. Additionally, it increases the effectiveness of the entire system, which enhances fish health and development rates.

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Chapter 1: Introduction- [CO1, CO2, CO10]

1. Project Title

Automated monitoring and control system for bottom clean raceway fish culture technology.

1. 1 Introduction

Bottom clean raceway is a type of fish culture technology that utilizes circular or oval-shaped raceways with a sloping bottom to facilitate the removal of waste and uneaten feed. Bottom Clean raceway systems can be used to raise a variety of fish species, including tilapia, trout, and salmon.

It is crucial to maintain ideal water quality parameters, including temperature, dissolved oxygen levels, pH, and ammonia and nitrate concentrations, to guarantee the health and productivity of fish in Bottom Cleaning Raceway systems. Automatic monitoring and control systems can assist in achieving these conditions by monitoring these metrics continually and modifying the water flow, aeration, and other elements as necessary.

In this situation, an automated monitoring and control system for Bottom Cleaning Raceway fish culture technology may significantly boost productivity and accuracy, lower labor expenses, and lessen the chance of human error. The general health and productivity of the fish in the Bottom Cleaning Raceway system can be enhanced by this system's ability to offer real-time data on water quality conditions and to permit quick adjustments to any changes or abnormalities.

Large-scale Bottom Cleaning Raceway operations, where manual monitoring and control would be difficult or impossible, can benefit significantly from this technology. An automated monitoring and control system can assist Bottom Cleaning Raceway operators in streamlining their processes, increasing yields, and maintaining ideal conditions for the fish by utilizing cutting-edge sensors and software.This report visualizes information regarding the whole procedure of building the project in detail.

1.1.1 Problem Statement

The bottom clean raceway fish culture technology requires constant monitoring and management to maintain optimal water quality conditions for the health and productivity of the fish. However, manual monitoring and control of the bottom clean raceway system can be operationally expensive, labor-intensive and prone to errors, especially in large-scale operations. Fish stress, illness, and mortality can result from water quality fluctuations in bottom clean raceway systems if they are not properly monitored and controlled. Moreover, poor water quality conditions might result in slower growth and poorer yields, which can cost bottom clean raceway operators money. A bottom clean raceway fish culture technique that can offer real-time data on water quality conditions and alter water flow, aeration, and other elements as necessary is required to handle these issues. A system like this would decrease the possibility of human error, increase production, decrease labor expenses and save electricity.

1.1.2 Background Study

Bangladesh is one of the world's most important inland fishing nations. Bangladesh has ranked 3rd in the world in inland fish production, 5th in aquaculture production and 11th in marine fish production in 2018 (FAO, 2018). Bangladesh is now self-sufficient in fish production and has started to get global recognition as one of the biggest fish producers among the countries (FRSS, 2017). There are different methods of fish cultivation in our country. One of the new and most promising fish cultivation methods is the bottom clean raceway fish culture. The daily removal of fish waste from the pond is part of the bottom clean system, which also includes devices such as an oxygen generator, an ozone (o3) generator, a roots air blower with nano bubble aeration system, and a pond water circulation system. Moreover it includes application of salt, lime, molasses, and activated carbon powder as needed. Unfortunately, everything in this fish cultivation requires manpower and manual application of electrical equipment. Therefore,this process causes huge electricity consumption and as a result it leads to a great amount of electric bill which is not affordable for the general public.

In the paper 'A new cleaning system for rearing tanks in larval fish culture'[1] the authors mentioned that a preliminary test using Atlantic halibut was conducted to create and evaluate an automatic system for cleaning the bottom of larval rearing tanks. Therefore, a variety of species and feeding schedules can use the system. A cleaning system is necessary to maintain proper hygiene, especially when specially designed food is utilized during the larval stage. Hence, the use of automated fish culture technology substantially reduces labor and disturbance due to tending and accumulation of organic material as substrate for bacterial growth can be prevented. The authors found in their experiment that the use of this automated technology ensured a lesser amount of ammonia accumulation and the larval growth rates were twice as much as the traditional fish cultivation methods[1].

In order to reduce system expenses and boost production, in this paper 'Review of circular tank technology and management'[2] the author examines some of the current round culture tank design and management strategies. design of water inlet and outlet flow structures, waste feed observation structures, and other engineering structures: potential mechanisms and related engineering criteria For big circular tanks, crowding and grading structures will be discussed. The focus of the discussion is tank systems, however it can be applied to either flow-through systems for recirculating water designs .

Some of these designs are:

- **Circular tank inlet flow structures:** By injecting water flow tangentially to the tank wall, circular tanks are operated.at the tank's outer radius, causing the water to begin spinning around the tank's core.systems for recirculating water designs.

- **Circular tank outlet flow structures:**The bottom and middle of circular fish culture tanks are concentrated with settleable solids, such as feces, feed particles, and uneaten feed. The constant withdrawal of settleable solids from the tank's center through a standpipe that also regulates water depth necessitates the employment of two concentric pipes. The inner pipe is used as a weir to control the water depth within the tank and has perforated slots or a gap at the base that pushes flow to be pulled from the tank's bottom.

- **Dual-drain structures for concentrating solids:** Due to their capacity to concentrate sediments at their bottom and middle, circular fish culture tanks can be used as "swirl settlers," settling basins with two effluents. A bottom-drawing center drain can be used to remove solids that collect at the bottom center while the majority of flow is taken from an elevated drain.[2]

Furthermore, in the paper ‘Assessment of Pond Water Quality for Fish Culture: A Case Study of Santosh Region in Tangail, Bangladesh ’[3] it is mentioned that water quality is the primary limiting factor in fish culture, which is often controlled by a variety of factors, including as color, odor, temperature, pH, DO, BOD, TDS, EC, transparency, acidity, alkalinity, and hardness (Boyd, 1990). There is a standard value for each of these variables in fish culture (James, 2000). A guiding premise of fish culture is that good water chemistry results in high water quality, which in turn leads to efficient production (Swann, 1993). In order to maintain a healthy fish culture, good water quality must be maintained. For freshwater aquaculture the suitable range of temperature is about 25-32ºC (Das, 1997). According to Swingle (1967) pH 6.5 to 9 is suitable for pond fish culture. DO content should be above 6.0 mg/l for drinking water and more than 5.0 mg/l is suggested for fisheries, recreation and irrigation (EQS, 1997). The acceptable BOD value for fish culture is less than 5 mg/l (Das, 1997). According to DoE (2004), suitable BOD for fish culture is 5 mg/l or more. According to the EQS (1997), the tolerable limits of BOD are 0.2 mg/l for drinking, 3 mg/l for recreation, 6 mg/l for fish and 10 mg/l for irrigation. The toxicity of ammonia to fish and shrimp has been extensively studied in laboratory experiments where the pH and ammonia content were held constant. 0.3 to 0.9 mg/L for coldwater fish, 0.7 to 3.0 mg/L for warmwater fish, 0.6 to 1.7 mg/L for marine fish, and 0.7 to 3.0 mg/L for marine shrimp are the LC50 concentrations (concentrations needed to kill 50% of test animals). Coldwater fish should be exposed to safe quantities of 0.015 to 0.045, while warm water and marine fish and shrimp should be exposed to safe amounts of 0.05 to 0.15. Fish and shrimp in culture systems are not exposed to a steady ammonia content, and pH and temperature change during the day in aquaculture systems.[3]

1.1.3 Literature Gap

The wastes produced from the bottom clean raceway fish culture technology can be reused in the biofloc fish cultivation. Further work can be made in future to integrate the two systems together and make an efficient fish cultivation technology. Around 2500 fishes can be cultivated in 1% of the area and around 1 lac fishes in an area of 0.5 acres. In the bottom clean raceway planktons are created as well which acts as a natural food for the fishes. The ratio of food per kg of fish is 1.2 kg:1 kg. Furthermore, approximately 95 lac revenue can be generated from a fish cultivation in 1 acres of land. According to Matt Tyalor's writing[6][7][8], our main goal of automation is to raise more fish on one fish farm using advances in breeding technology to improve the breeding health of fish. For example, there was a breakthrough in the breeding technology in Vietnam that allowed them to go from 50,000 tons of catfish in the year 2000 to over 1 million tons of catfish in 2010. The world's oceans and rivers used to be under a lot of pressure to produce enough fish for humans or few fish to feed the fish that are utilized for human consumption. However, improvements in technology are enabling more sustainable breeding, fish health practices, and better feed for farmed fish, reducing the burden on the environment and our natural resources.

1.1.4 Relevance to current and future Industry

In the current industry, operators of bottom clean raceways confront a number of difficulties while manually monitoring and regulating water quality parameters. These difficulties include the requirement for regular monitoring of the water's quality, the laborious manual adjustment of water flow and aeration, and the possibility of human error. By delivering real-time information on the state of the water quality and automatically altering water flow, aeration, and other elements as necessary, an automated monitoring and control system would be able to overcome these difficulties. This would increase production, accuracy, and efficiency while lowering labor expenses.

Aquaculture will become more crucial in supplying this need as the need for ecologically friendly and sustainable food production increases in the future. Bottom clean raceway technology, which is reasonably inexpensive and uses less water and land than conventional aquaculture systems, is a potential solution for sustainable fish production. However, the requirement for manual monitoring and management of water quality conditions restricts the expansion and scalability of bottom clean raceways operations.

The development and scalability of bottom clean raceway operations would be made possible by an automated monitoring and control system, increasing the effectiveness and productivity of the sector. Also, the adoption of such technologies would improve bottom clean raceway operations' sustainability and environmental friendliness, thus boosting their importance to future industry.

1.2 Objectives, Requirements, Specification and constraint

1.2.1. Objectives

In order to mitigate the effort of the bottom clean raceway fish culture technology and save the electricity we propose to implement an automation to this technology. Using this automation will help reduce the cost of the whole fish culture maintenance and it will be more power efficient. Furthermore, the system can be monitored remotely without being physically present near the water body.

The objectives of our project are:

- Analysis and design of automation for bottom clean raceway fish culture technology.
- Monitoring of the system performance.
- Ensuring the water quality and maintenance of the ammonia level.
- Saving electricity.
- Ensure cost efficiency due to automation.
- Maintaining standard codes.

1.2.2 Functional and Nonfunctional Requirements

Functional Requirements:

- **Volume of 10,000 liters of water:** We will need a water body having 10000 liters of water in order to successfully implement our automation and test the necessary parameters and data to tune the system.

- **Control system for two air pumps:** Our automation consists of two automated air pumps which will turn on and off according to the oxygen demand.

- **Control system for two motors:**. There will be two motors one of which will drain the water out from the water body and the other will fill the new water based on the data readings of water quality.

- **Usage of GSM/LTE/Wifi network:** The data from our automated system will be sent to the mobile device via IoT (Internet Of Things). So, it is necessary to ensure proper mobile connectivity in the area where we will design and build our project.

- **Ability to run automation from a phone/laptop:** We will also need a software or device through which we can remotely control the system.

Non-Functional Requirement:

- **Ability to work in LAN:** Our system can also be monitored and controlled through devices in a small area which is connected through LAN.

- **Renewable energy source:** It will help us by saving more electricity and reducing the electricity bill. For example: we can use solar panels connected to our system which will gain solar energy and supply electricity to our system.

1.2.3 Specifications:

Component	Model	Specification	Comments
Dissolved Oxygen Sensor	Extech DO600	5% accuracy, DC 6~12V, current <50mA Measuring range 0~20 mg/L or 0-200% saturation	Reading data for the amount of dissolved oxygen required and the amount present in our system.
Ammonia Sensor	MQ137	range :0~2/0~10/0~1000 mg/L NH4-N Measurement accuracy: ±5%	Checking the amount of ammonia present in our system that needs to be filtered out.
pH Sensor	Apera Instruments AI311 Premium Series	Measuring range PH: 4-10ph Measurement accuracy PH: ±0.1ph	Measuring the pH of our water body.
4G Module	4G LTE Module PC Computer Accessory NGFF Wireless Network Card for LT4211	LTE FDD: B1/B3/B5/B8 LTE TDD: B38/B39/B40/B41 WCDMA: B1/B8 TD-SCDMA: B34/B39 CDMA2000 1X/EVDO: BC0 GSM: 900/1800	Used to upload data to our IoT server.
Microcontroller (8-bit)	Arduino Uno R3	32 Kbytes of In-System Self-programmable Flash program memory 1024 Bytes EEPROM 2k Bytes Internal SRAM	Reading data and enabling certain tasks of our system.
Air Pump	Danner Manufacturing, Inc. Supreme Oxy-Flo High Volume Air Pump AP-100 40528	-5000-cubic inch per minute air volume with steady air flow -3/4 inch FPT inlet and MPT outlet. It includes a 3/4 inch barbed outlet adapter.	Supplies oxygen to the system.

Software Components:

1. Blynk Library
2. Proteus
3. Virtual serial port emulator
4. Arduino IDE

1.2.4 Technical and Non-technical consideration and constraint in design process

Technical constraint:

- **Sensor Availability:** The sensors we will use for the project are very uncommon in our country. We have to import it from other countries. It may hamper our project.

- **Network Coverage:** We are using IOT in our project. If we want to implement this in an area where no network is available then our project might not work.

- **Water resistance of sensors:** Since there will be sensors submerged in the water, some sensors may not be water resistant or a certain level of water resistivity. If we work beyond that depth of resistivity we need to ensure that the sensor.

Non-technical constraint:

- **Budget:** Most of the sensors we have used are very expensive. So the cost will be an issue for us to manage. Fitting the sensors in our budget will be a great challenge for us.

- **Availability of desired water body:** For 1 acre of land we will need around 325,851 gallons of water which is a tough task to ensure. So, we need to find a proper location with available land area with water holding capacity and water supply.

- **Load shedding:** In order to properly implement our project we will need electricity. Without electricity our automation will not work. So, during this national crisis of electricity it will be a challenge for us to implement our project.

- **Availability of land:** One of the major constraints is the availability of land to build the bottom clean raceway fish culture technology. According to our stakeholder the land requirement is about 1-2 acres of land with around 5 ft of depth.

1.2.5 Applicable compliance, standards, and codes

Component Name	Standards	Details
DO sensor	IEEE 2017.2700.670	IEEE SA Board of Governors BOG/Secom - Strategic and Emerging Standards
NH4 Sensor	IEEE Std 1309-2005	IEEE Standard for Calibration of. Electromagnetic Field Sensors and. Probes (Excluding Antennas)
PH sensor	IEEE 802.11	IEEE Guide for the Selection of Monitoring for pH levels
4G module	IEEE 802.15.4-2020:	IEEE Standard for Low-Rate Wireless Networks

Battery	IEEE 2030.2.1-2019	IEEE Standard for Ratings and Requirements for AC Battery 200AH
Microcontroller	IEEE SA - IEEE 2413-2019:	IEEE Standard for an Architectural Framework for the Internet of Things (IoT)

1.3 Systematic Overview/summary of the proposed project

The proposed project is the development and implementation of an automated monitoring and control system for bottom clean raceway (BCR) fish culture technology. There are certain outcomes that this system needs to meet in order to be fully functional.

- The system will continuously monitor water quality parameters such as temperature, dissolved oxygen levels, pH, and ammonia and nitrate concentrations.
- It will adjust water flow, aeration, and other factors as needed to maintain optimal conditions for fish health and productivity.
- The system will consist of advanced sensors that measure water quality parameters and send real-time data to a software platform.
- The software platform will analyze the data and make adjustments to water flow, aeration, and other factors through actuators and controllers.
- The project will involve several stages, including the design and development of the sensor system, software platform, and control mechanisms.
- The implementation of the system would enable the growth and scalability of bottom cleaning raceway operations, making them a more attractive choice for sustainable fish production.

1.4 Conclusion

In this section, a complex engineering issue is identified and we apply our engineering expertise to develop a workable solution that takes several factors into account. Background investigation has been conducted in this regard and it has been demonstrated that pertinent works in the agricultural area support the difficult issue. The gap in the literature has been highlighted, and our system's potential for improvement is also mentioned. Moreover, the intelligent system is given a number of tasks to fulfill. A specification of tools and components has been given to meet all the intended functional and non-functional requirements in accordance with the working mechanism. Finally, a brief summary of the entire process that takes into account the entire project is provided.

Chapter 2: Project Design Approach [CO5, CO6]

2.1 Introduction:

The project design technique identifies the feasible options from which to select in order to tackle the aforementioned complicated problem. With the help of our experience and expertise, a number of approaches are taken into account, along with a specification of each one, its unique configuration of adaptable components, and an explanation using a work breakdown structure.

2.2 Identify multiple design approach

Workflow of our system

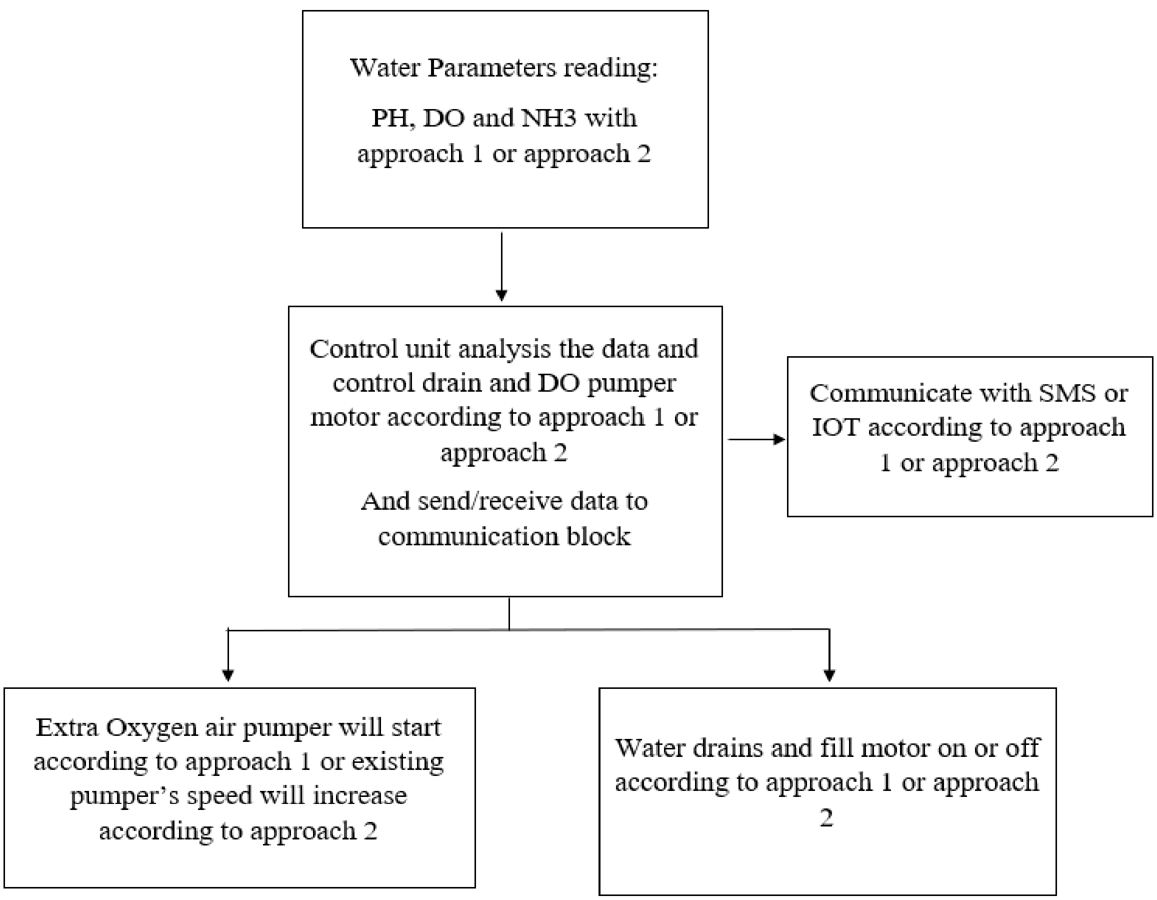


Figure: System workflow

The above workflow shows the step by step actions taken within our system in order to ensure a proper monitoring and control. In the beginning the sensors inside the water which are: pH sensor, dissolved oxygen sensor and ammonia sensor, will read the amount of ammonia, dissolved oxygen and the pH water. Then the data collected from the sensors are sent to the microcontroller. The microcontroller takes the data and communicates with our IoT server with the help of a 4G module/Wifi and matches the threshold values. If the data from the water exceeds the threshold values the air pump and motor will automatically turn on resulting in the proper maintenance of the water quality. If the water quality is too bad then the drain motor will be on and the water will be drained out. On the other hand a filling motor will turn ON and it will fill the space with water. Our IoT server will also have the option to remotely monitor and control the system. Furthermore the communication of the system to the stakeholders will be done with the help of either SMS or the IoT server.

Design Approach-1 & 2 Breakdown

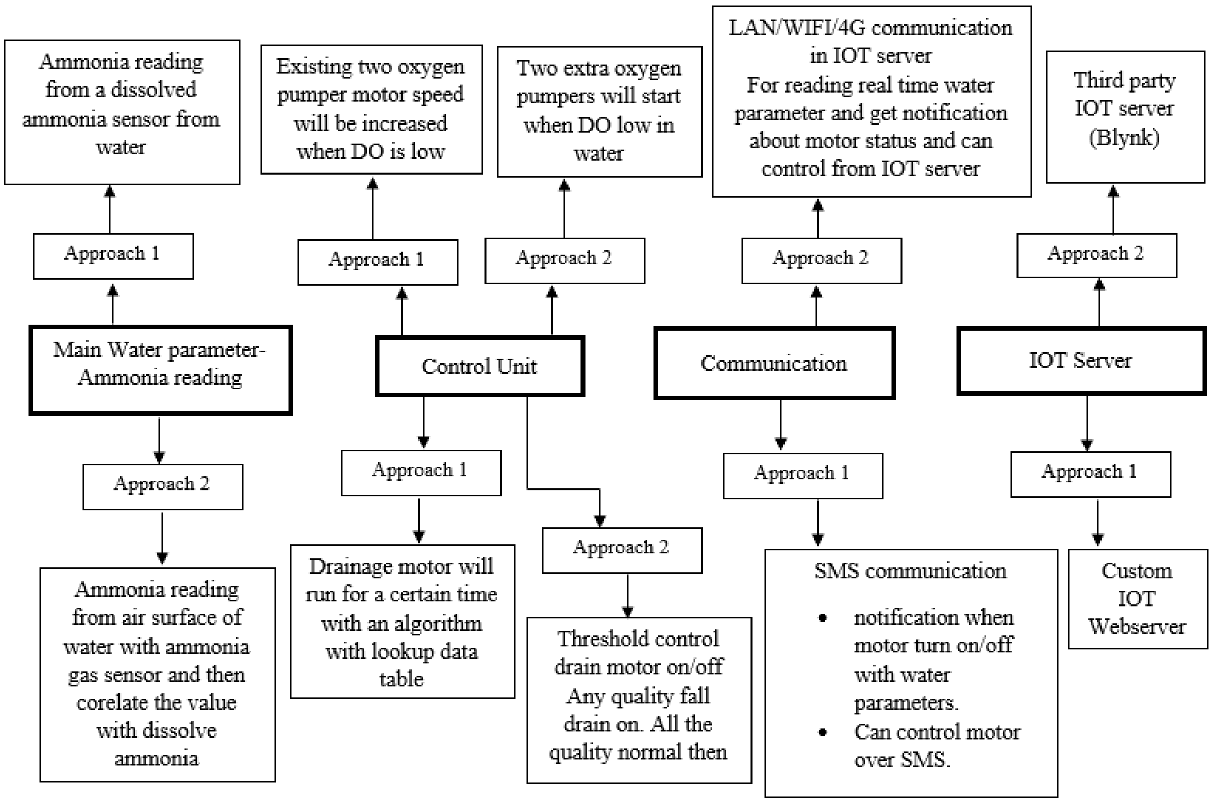


Figure: Breakdown Units of our approaches

We divided our system into 4 sub-systems. They are the water parameter reading unit, control unit, communications unit and IOT server. The first subsystem which is the water parameter reading unit basically reads the parameter present in our water system. Moreover, the amount of ammonia present in our water can be measured in two different ways. In one method we can get the readings about the ammonia directly from our dissolved ammonia sensor inside the water and on the other hand, in approach-2 we can get the readings about ammonia from the air surface of the water using ammonia gas sensor and then we will correlate the value with the dissolved oxygen sensor.

The second subsystem is the control unit. We have divided it further into two parts. In one part we see how we will control the air pump inside the water and in the other part we mentioned two approaches on how the water drainage system will work. In approach-1, in the DO motor the control unit we used two existing air pumps but with increased speed when DO is low and in the Drain motor control unit the motor will turn ON/OFF according to an algorithm based on a lookup data table the motor will turn on for a certain amount of time and then turn off. But in case of approach-2, we will be using two extra DO motors to adjust the amount of dissolved oxygen in our water system and for the Drain motor a threshold table with data will be provided to the microprocessor. When the threshold limit is reached the motor will turn ON and the water drainage will occur.

Furthermore the third consists of the method and technology of communication. In approach-1 we will use SMS as the means of communication with the stakeholder. The system will send a SMS to the stakeholder informing about the water quality and the condition of the system. The stakeholder will also be able to send a command through SMS to the system in order to run the motors and air pumps. In approach-2 we will have an IOT communication from the system to the stakeholder using an IOT server where the stakeholder can monitor the condition of the system and control as well.

Lastly, our fourth subsystem consists of the way we design and arrange the IOT server provided to the stakeholder. In approach-1 we will be making a custom web server where the stakeholders don't have to rely on any other third party servers. But in approach-2 we will be using a third party IOT website where the server stability and availability will be on the hand of the third party server owner and developers.

2.2.1 Approach -1

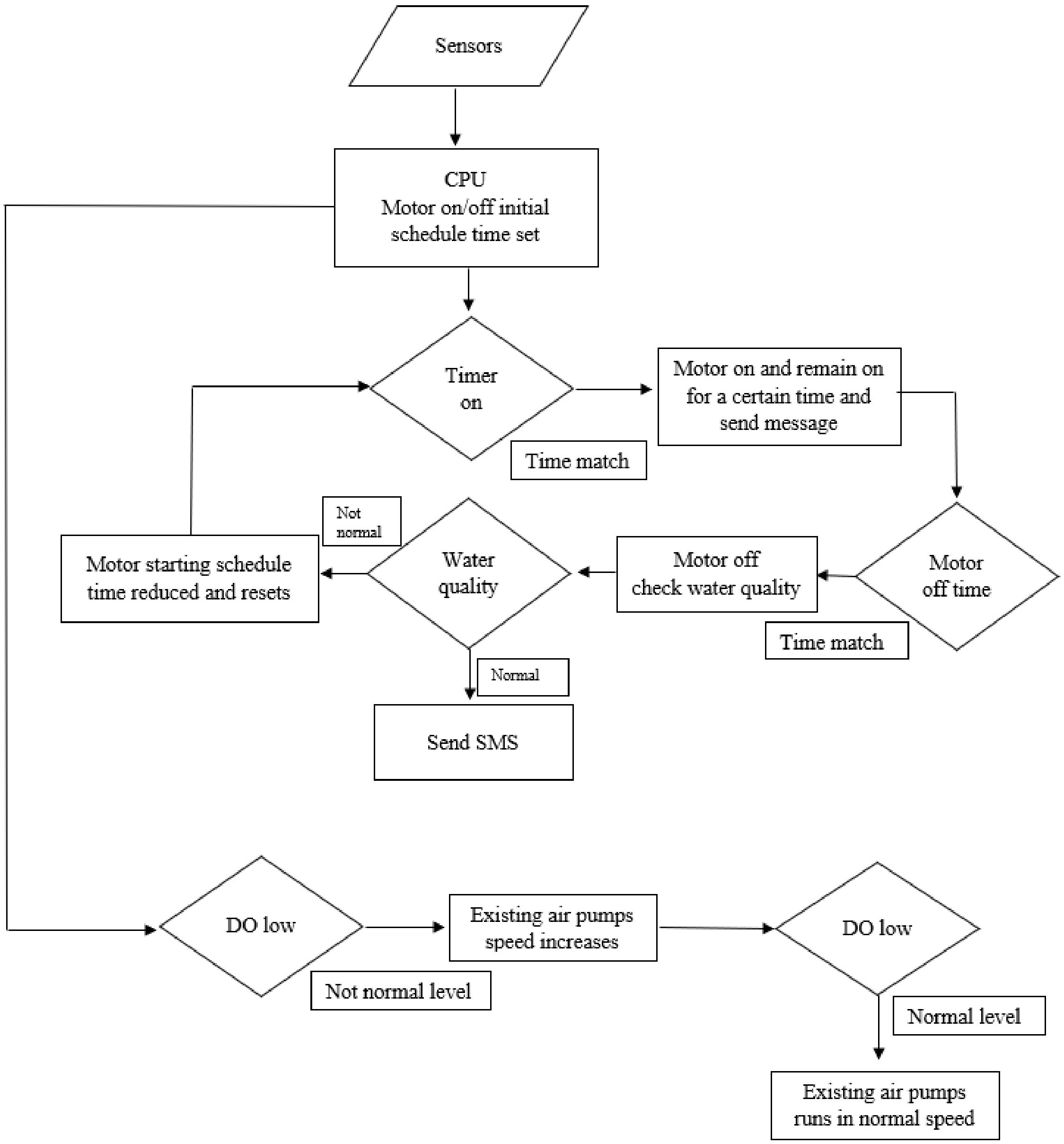


Figure: Flowchart for design approach-1 using all approach 1 blocks

Here the sensors read the data and send it to the microcontroller and based on the lookup table algorithm timer data, the motor is switched ON for a certain period of time. After being ON for that certain period of time the motor turns OFF and checks the water quality. If the water quality is not normal then the timer is ON for a longer period of time. But once the water quality is normal then it sends a SMS to the stakeholder about the condition of the water. On the other side once the dissolved oxygen level is low then the existing air pump turns ON with an increased speed. Once the dissolved oxygen level is back to normal the air pump speed turns down and keeps running at a normal speed.

2.2.2 Approach-2

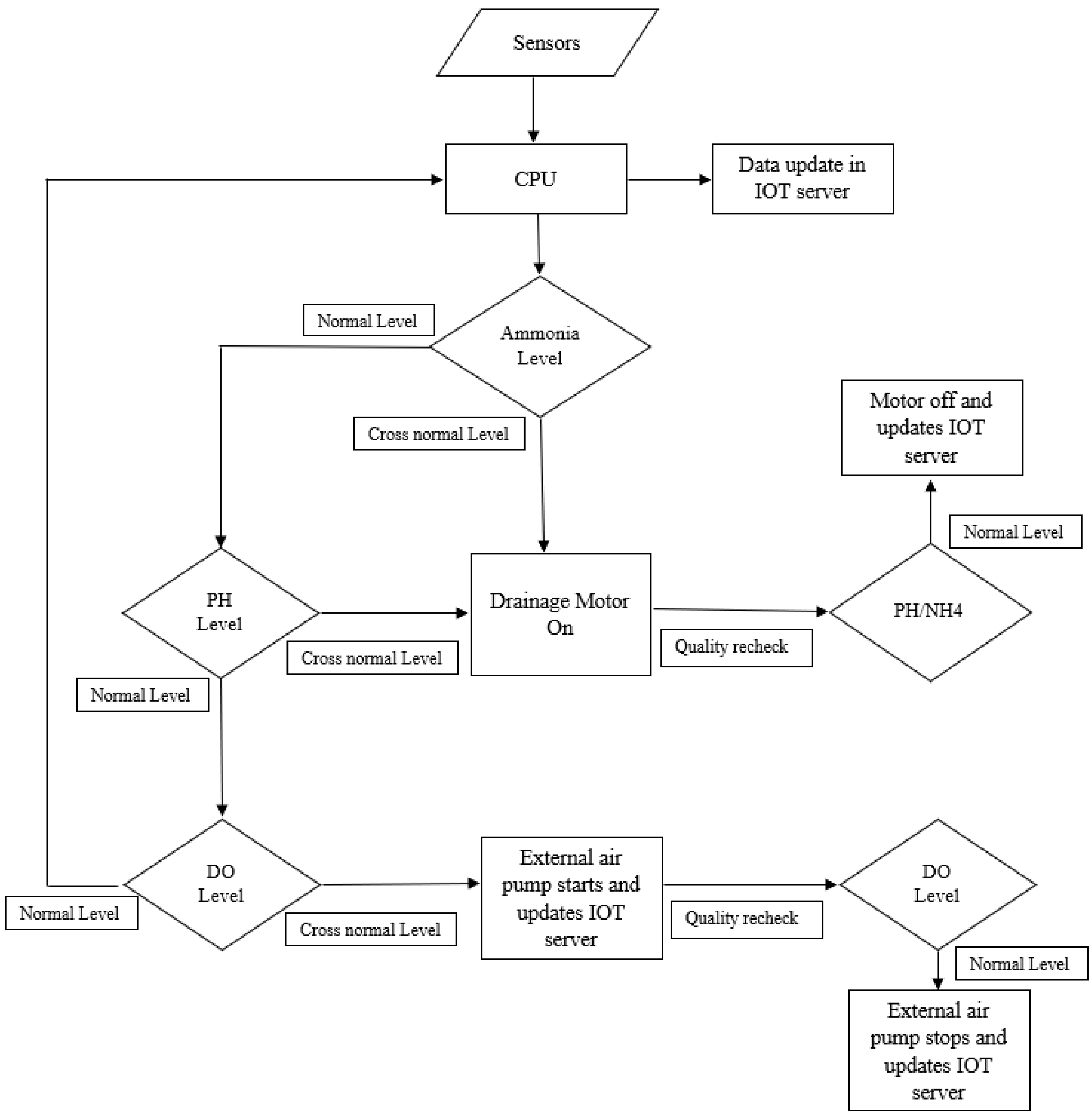


Figure: Flowchart for design approach-2 using all approach 2 blocks

Sensors reading data and sending it to the microcontroller. In this approach some threshold data of NH3 and PH will be saved in the microcontroller and from the microcontroller the data will be sent to the IOT server. When the level of the pH and NH3 is getting higher than the given threshold data in the microcontroller the drain motor will start automatically and after when it will come back to the normal condition the motor will stop automatically. Same thing will happen when the dissolved oxygen level will be below the threshold value. The extra air pump will be turned on and it will also send message notification through the IOT server.

2.2.3 Water parameter reading block

Approach-1

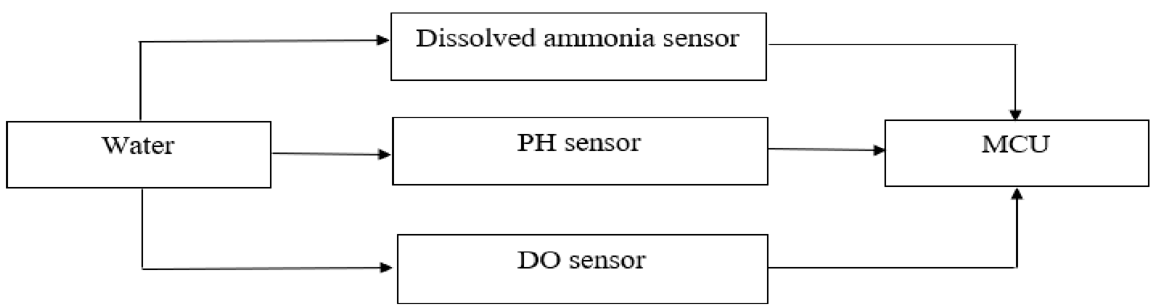


Figure: block diagram of water parameter reading approach-1

Here the dissolved oxygen sensor, pH sensor and dissolved ammonia sensor collects data from the water body and sends it to the microcontroller.

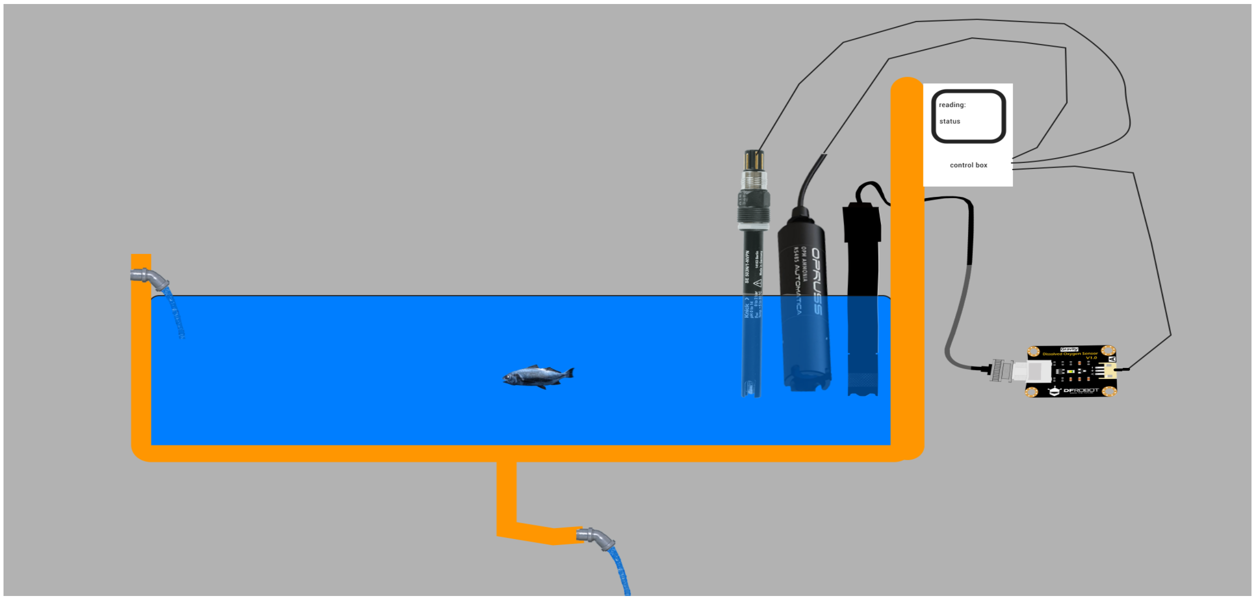


Figure: 2D Model for water parameter reading block approach 1

Approach-2

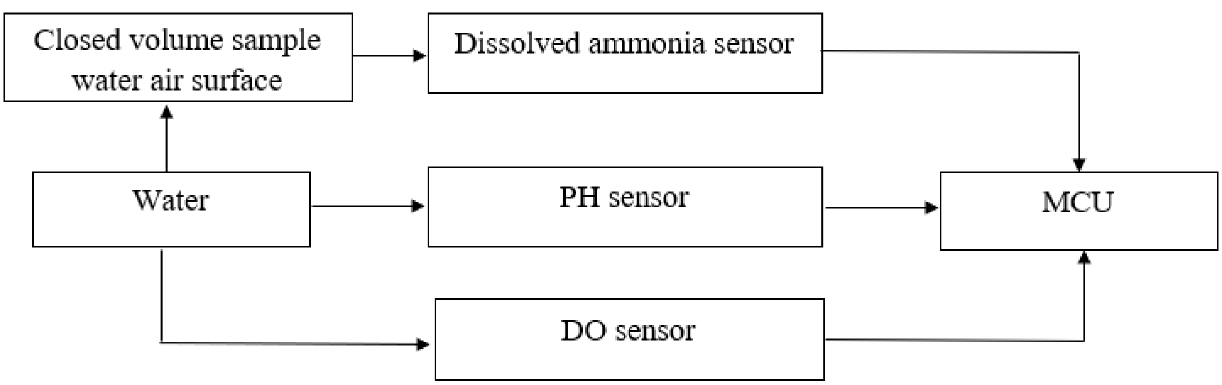


Figure: block diagram of water parameter reading approach 2

In this approach the sensors work the same as approach-1 but the ammonia sensor works a bit differently. The ammonia reading is taken from the ammonia gas sensor which we get from the air surface of the water body. Then all the three readings from the three sensors are sent to the microprocessor and the microprocessor does the rest of the work.

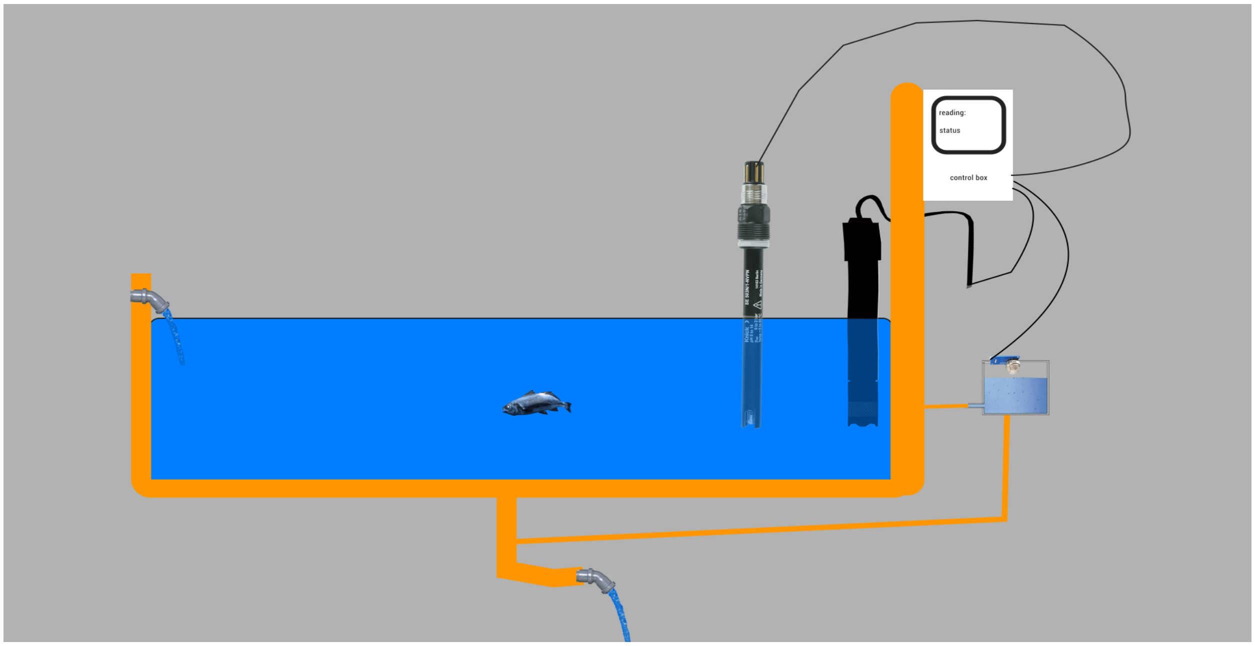


Figure: 2D Model for water parameter reading block approach-2

2.2.4 Control Unit Dissolve Oxygen motor control block:

Approach-1

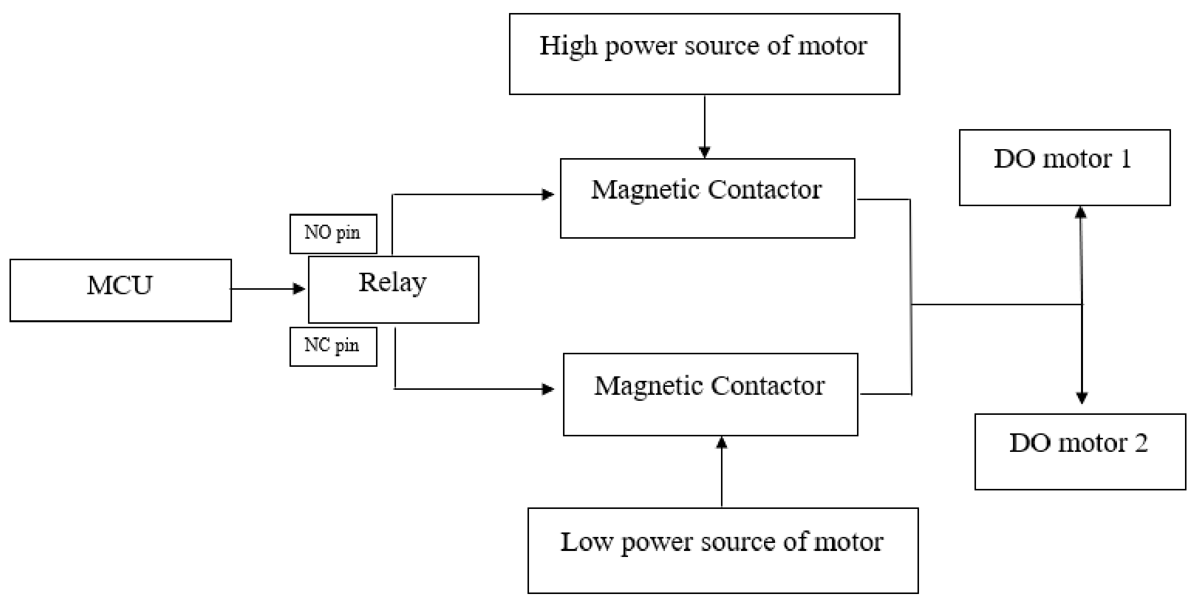


Figure: block diagram of Control of DO generator motors approach-1

In the control unit the microcontroller is connected to a relay which further connects to two magnetic contactors. We will use two dissolved oxygen motors which will help increase the amount of dissolved oxygen in water and it will also help to create a stream in the water. The two dissolved oxygen motors are connected to the magnetic contactors. When the microcontroller senses the time to turn ON the motors, it will send the command to the relay and the relay will switch ON and send signals to the magnetic contactors which will help to turn the dissolved oxygen motors. One of the magnetic contactors will get a power supply from a high power source and another magnetic contactor is connected to a low power supply.The NO pin of the relay is connected to one of the magnetic contactors and the NC pin of the relay is connected to another magnetic contactor.

Approach-2

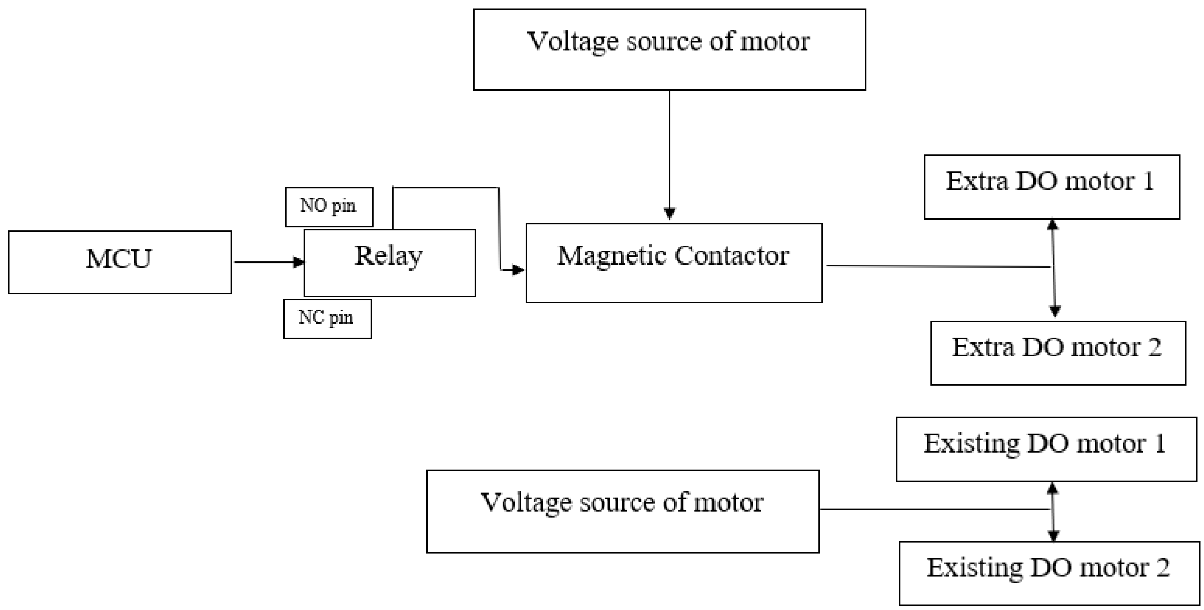


Figure: block diagram of Control of DO generator motors approach-2

In this approach the microcontroller is connected to a relay and the relay connects a magnetic contactor which controls two extra dissolved oxygen sensors. Previously we had two dissolved oxygen sensors but now we have a total four dissolved oxygen sensors but with less power rating than the approach-1. The existing two dissolved oxygen motors will stay ON while the extra two dissolved oxygen motors will be controlled through the microcontroller. A voltage source is provided at the magnetic contactor of the two dissolved oxygen sensors which will be controlled. Keeping the power consumption in mind we cannot use a dissolved oxygen motor with high rating since we will be using four of them and two of them will be ON almost all the time.

2.2.5 Control Unit Drain motor Control Block:

Approach-1

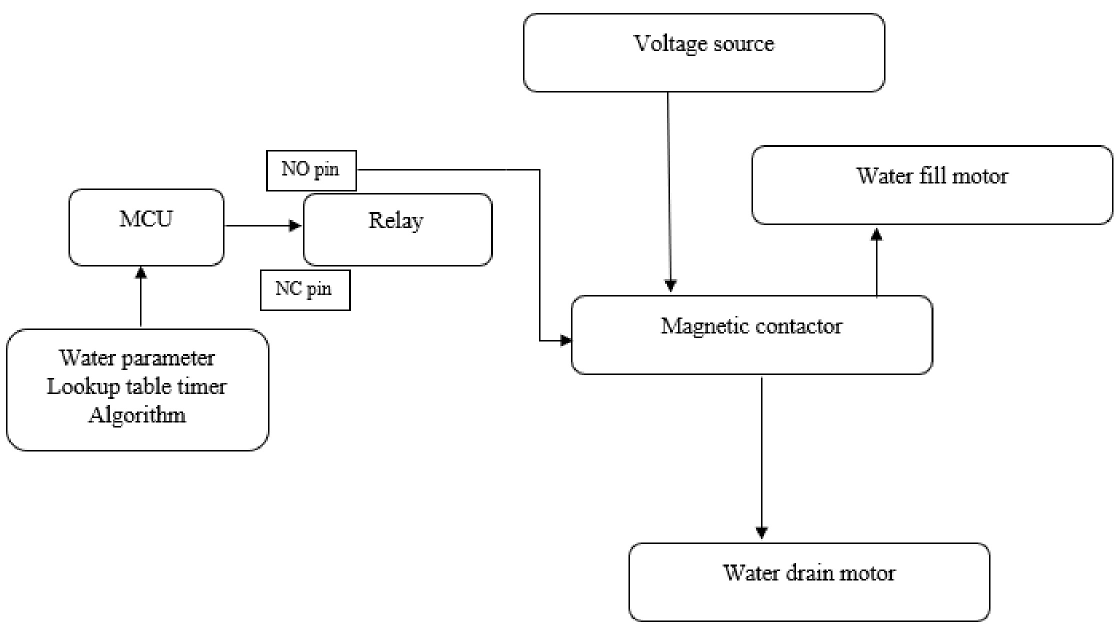


Figure : Block diagram of Control of fill and drain motors approach-1

Lookup table some sample data :

NH3	**pH**	**Motor on timer**
0.7	8	30 min
0.6	7	15 min
0.6	9	1 hour

The microcontroller is connected to a relay and the relay is connected to a voltage source and the magnetic contact which is connected to both the fill motor and drain motor. Here we will be controlling the drain motor using some algorithm. A number of data will be collected by the microprocessor initially based on water source quality and water fill and drain motor speed and volume of water a lookup table will be provided. Based on this both the filling motor and drain motor will turn ON for a limited time, based on the parameter of ammonia and the pH value.

Approach-2

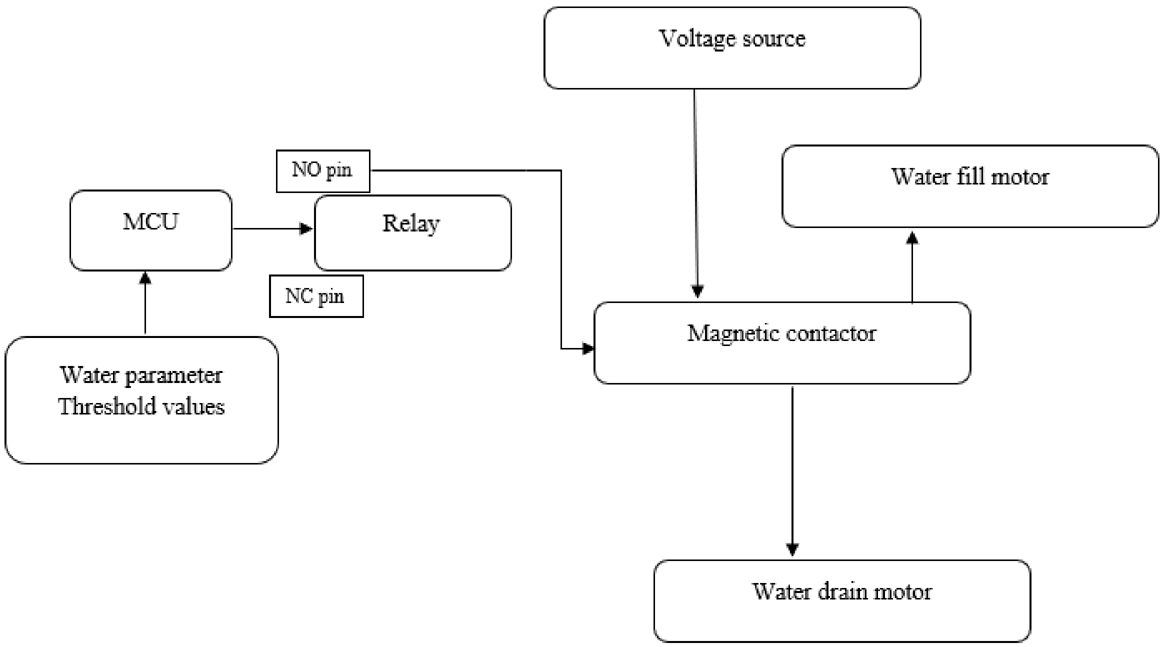


Figure : Block diagram of control of water will and drain motors approach 2

<u>**Threshold Values :**</u>

Parameter	**Threshold motor on value**	**Threshold normal value motor off**
NH3	=>0.6ppm	=<0.4ppm
pH	>8.5 or <7.5	<8.5 and >7.5

Here we will have some threshold value pre determined for the system. We found these data table threshold values from the research papers. Once the threshold value is reached the drain motor and fill motor will turn ON. But until the threshold value is reached the motors will stay off. The threshold values are shown above in a table and the states of the motor. We can see when the value of ammonia is greater than or equal to 0.6 ppm then the motor will be ON and similarly in case of the pH, if the pH value is more than 8.5 or less than 7.5 then the motor will turn ON. And the motor turns OFF for the ammonia value less than 0.4ppm and pH less than 8.5 and more than 7.5.

2.2.6 Communication Block:

Approach-1

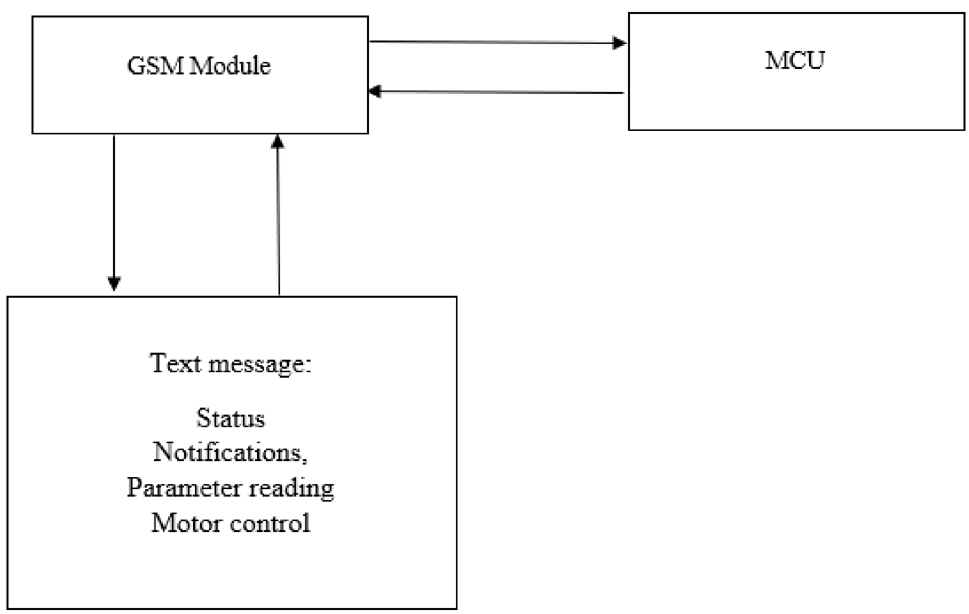


Figure: block diagram of communication approach 1

The communication block shows us the way the system communicates with the stakeholder. In approach-1 we used a GSM module. The GSM module helps by sending a SMS status of the system to the stakeholder. It also allows the stakeholder to control the motors and air pumps with a SMS command. The stakeholder can be anywhere he wants and still get an update about the water system using the SMS notification. The GSM module will be connected to the microcontroller. According to the algorithm, once the water parameter reaches the certain threshold range then the microcontroller will automatically turn ON the motors.and notification SMS will send with the help of the GSM module But if the stakeholders want to know about the condition of the water, he/she can send a SMS command which will return a SMS from the system that will show all the water parameters.
But the system needs to be in an area where the network connectivity is good. Otherwise the system will face difficulty to send a notification to the stakeholder.

Approach-2

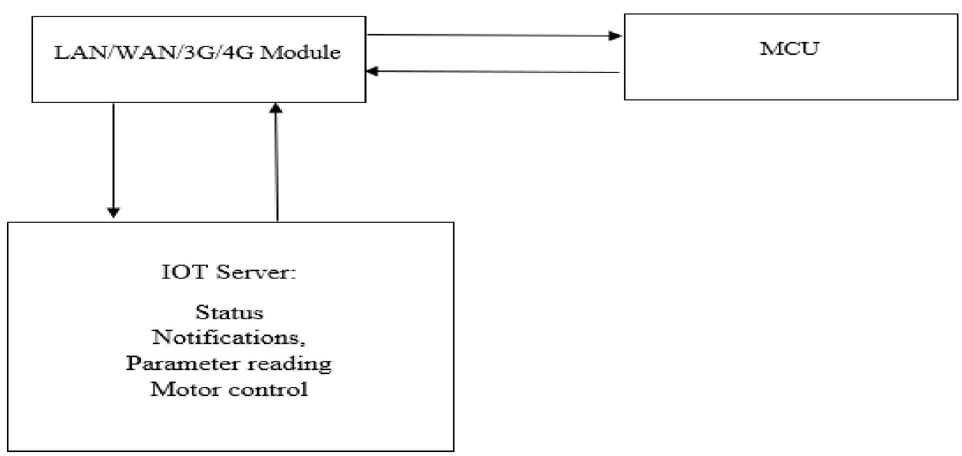


Figure: block diagram of communication approach 2

In this approach the microcontroller will be connected to a LAN/WAN/3G/4G module which will allow the system to send a notification to the stakeholder. We are using Blynk 3rd party IoT server and we can also build a custom IOT server where all the water parameters will be stored and updated real time. The stakeholder can enter the website and see the values of Ammonia, dissolved oxygen and pH of the water. Although our system will automatically detect and turn ON the motors when the threshold is reached. But there will be an option in the IOT server through which the stakeholder can manually turn ON/OFF the motors. The IOT server can be accessed through the mobile phone and also through the computer or laptop.

For this approach the stakeholder will need constant network connectivity in order to access the IOT server.

2.3 Analysis of multiple design approach

2.3.1 Power Consumption comparison

Power Consumption for design approach 1

Component	**Power Rating(Watt)**	**Quantity**	**Power consumption(KW per unit)**
Dissolved Oxygen sensor	0.06	1	(0.06*1)/1000 = 0.00006
Dissolved Ammonia Sensor	0.5	1	(0.5*1)/1000 = 0.0005
pH sensor	0.002	1	(0.002*1)/1000 = 2*10^-6
gsm module	1	1	1/1000 = 0.001
Air Pump	120	2	(120*2)/1000 = 0.24
Micro-controller	0.25	1	(0.25*1)/1000 = 0.00025
		Total	**0.2418**

Power Consumption for design approach 2

Component	Power Rating(Watt)	Quantity	Power consumption(KW per unit)
Dissolved Oxygen sensor	0.06	1	(0.06*1)/1000 = 0.00006
Ammonia gas Sensor	0.5	1	(0.5*1)/1000 = 0.0005
pH sensor	0.002	1	(0.002*1)/1000 = 2*10^-6
Micro-controller	0.25/	1	(0.25*1)/1000 = 0.00025
2G/4G/LAN/WLAN module	1	1	(1*1)/1000+= 1*10^-3
Air Pump	50	4	(60*4)/1000 = 0.20
		Total	**0.2018**

2.3.2 Budget Comparison

Component	Approach-1 Budget	Approach-2 Budget
Dissolve Oxygen sensor	23,000/-	23,000/-
Ammonia Sensor	30,000/-	3,000/-
pH Sensor	5,500/-	5,500/-
lan/wlan/2g/4g module	1,000/-	1000/-
Air pump	40,000/-	40,000/-
Battery	9,000/-	4,500/-

Micro-controller	450/-	450/-
Wires	3,000/-	2,000/-
Total	**1,11,950/-**	**79,450/-**

2.3.3 Design Comparison checklist

Property	**Design-1**	**Design-2**
IOT Status	No	Yes
SMS communication	Yes	No
Complexity	Moderate	Moderate
Power Consumption	Moderate	Moderate
Cost	Very High	Comparatively low
Sensor availability	low	High
Maintenance	High	Low
Sustainability	Moderate	High

2.4 Conclusion

In this section,we showed two approaches of our project and we have seen in detail each and every sub-systems of approaches of our project.From the above approaches we can see that approach 2 is much more efficient and effective as compared to approach 1.For the power consumption part the approach 2 needs less power than the approach 1 and this is most important for our project as rural areas of our country dont have much electricity facilities. Also, approach 2 will cost less than approach 1 in the budget section and along with that we can see design sustainability is also much better for approach 2 from approach 1.

Chapter 3: Use of Modern Engineering and IT Tool. [CO9]

3.1 Introduction

The software and coding language used to replicate every aspect of the system's functioning are both described in this section. Building the circuit diagram's architecture using the software's libraries and components is done to make sure the system is operating properly. The tools have been separated into many categories, such as simulation, 3D modeling, and website design, for all the prototype validation. For each work that needs to be completed, popular software is first taken into account, and the best one has been chosen for the prototype. For instance, Proteus, a simulation software, was chosen over Eagle because it has design and simulation tools.A comparison of the software's performance criteria has also been given, which indicates the advantages of each. Aside from that, each sensor has been mentioned in accordance with an examination of its availability and cost.

3.2 Select appropriate engineering and IT tools

Tools Comparison:

Software	Portability	Library resource	Available component	Import Facility	User Complexity	Graph Generation	User Popularity
Proteus	Yes	High	High	Yes	Low	Yes	High
Eagle	Yes	Moderate	Moderate	Yes	Moderate	Yes	Low

Software	Portability	Library resource	Available component	Import Facility	User Complexity	Graph Generation	User Popularity

Arduino IDE	Yes	High	High	Yes	Low	Yes	High
Code Vision AVR	Yes	Moderat e	Moderat e	Yes	High	No	Moderate

3.3 Use of Modern IT Tools

Proteus:

Because of its versatile features, proteus is employed for the circuit simulation. It is primarily used for PCB automatic layout and wiring, intelligent principal layout, hybrid circuit simulation and precise analysis, single chip software debugging, single chip and peripheral circuit co-simulation, and single chip and circuit co-simulation. On the other hand, Eagle lacks the ability to emulate any software that is integrated into it. Proteus is therefore chosen to construct the circuit in addition to simulation.

Arduino IDE:

An embedded system's integrated development environment The written programs for Arduino have been compiled and converted to machine-readable language using the Arduino IDE. so that the sensor's data can be analyzed and used to further the work

Blynk Cloud:

Blynk cloud will be our custom pre-built IoT server where all the data will be sent from the microcontroller. The stakeholder will be able to monitor the water quality through this server and has the option to turn on the cleaning system which will refill the system with fresh water.

3.4 Conclusion:

Following analysis and selection, information on choosing the software and hardware IT tools needed to develop the prototype has been listed down. Through comparative analysis, all of the tasks for simulation, validation, and design have been taken into consideration. The restrictions for the hardware and software requirements in each situation have also been discussed.

Chapter 4. Optimization of Multiple Design and Finding the Optimal Solution. [CO7]

4.1 Introduction

Out of the various designs that were previously considered, the best one has been chosen for the project in this chapter. For each design, all the specifications, requirements, and standards have been taken into account. In order to choose the best system among two designs, several variables have been taken into account, including usability, cost analysis, and power consumption. This is because different systems have different components and models linked with them. The validation is then verified using the chosen program and the performance criteria are verified through examination of the simulation readings. On the basis of the performance that each design is providing, an idea rating matrix is constructed.

4.2 Optimization of multiple design approach

Multiple design approaches have been chosen, thus the objective now is to validate the designs using system performance data collected by the software chosen for the system. For the simulations of the designs, proteus is being used. To check the performance and functionality in accordance with the goals stated for the systems, the appropriate code has been generated. The approximate cost of each design has been computed and compared. Furthermore, user flexibility is also evaluated while choosing the best course of action. Hence, every design is evaluated against these criteria to find the best one.

4.3 Identify optimal design approach

4.3.1 Design scoring

Categories	Design 1	Design 2	For design 1 (Rating out of 10)	For design 2 (Rating out of 10)
Cost	NH3 sensors are very expensive.	NH3 Sensor is inexpensive.	**3**	**8**
Efficiency	results are not in real time. As using timer algorithm and sms communication	Gives result in real time. As threshold value control and IoT server for monitoring	**7**	**8**
Maintainability	NH3 Sensor maintenance is very costly. Need to use a reagent in the sensor. Very often needed to refill the reagent.	NH3 gas sensors don't need any maintenance.	**5**	**9**
Sustainability	The DO motor has no rest option. So it can be damaged by overheating	The DO motor has a rest option. As we are using an extra two air pumps. So the motor can be turned off while overheating.	**5**	**6**
Power Consumption	Using more powerful DO motor so take more power at the time of running	Using comparatively less power at the time of running As using low power 4 air pump	**5**	**5**
Complexity	Moderate	Moderate	**5**	**5**
		Total Rating	**30**	**41**

4.3.2 Power Consumption comparison

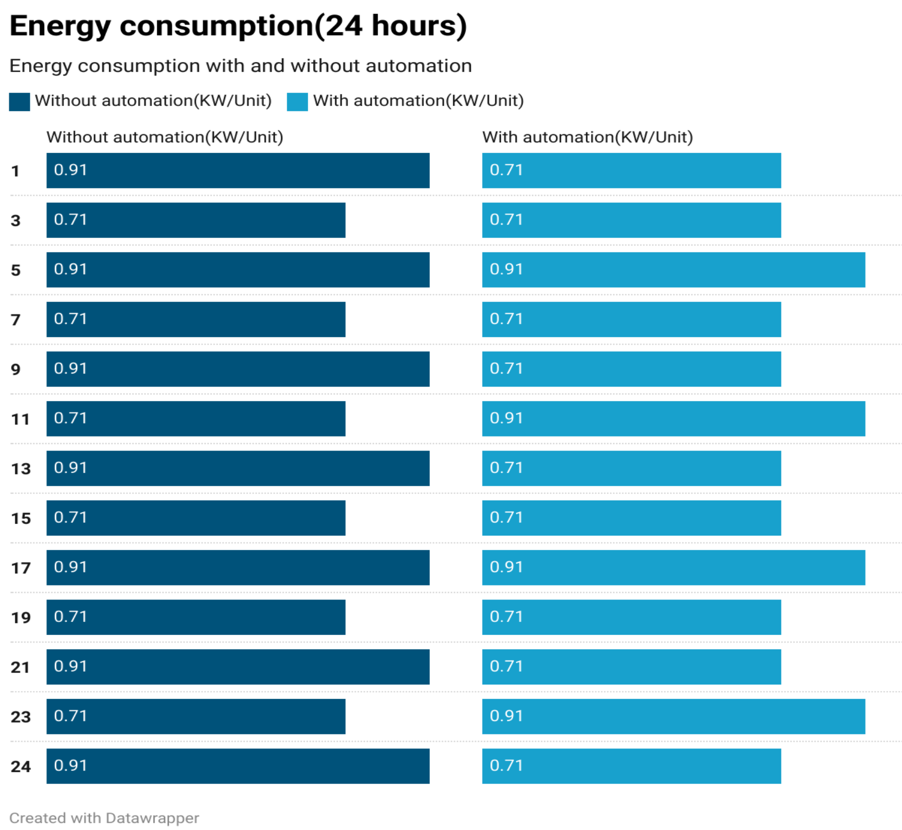


Figure: Power consumption comparison

4.3.3 Approach 1 simulation:

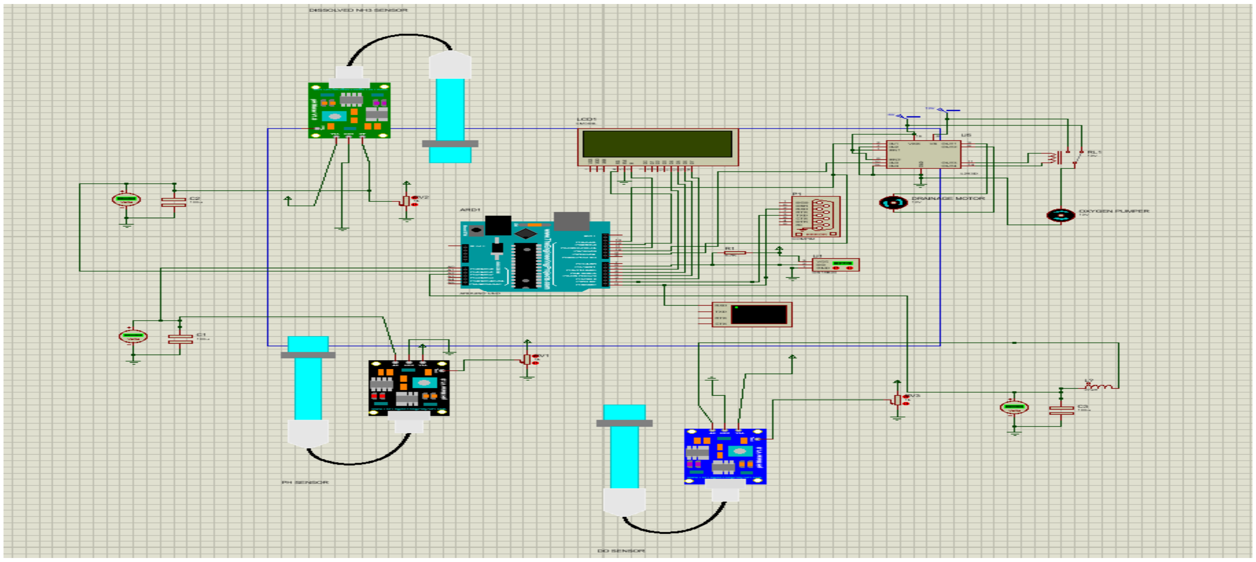


Figure: Simulation for approach-1

4.3.4 Approach 2 simulation:

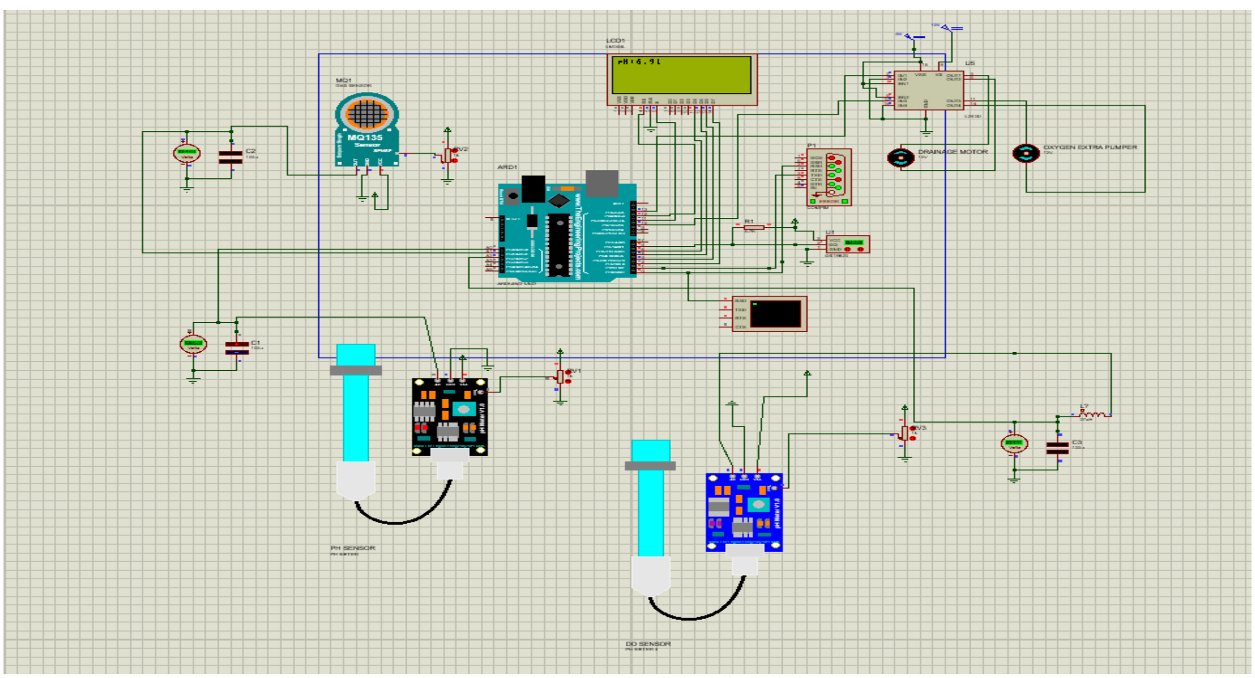


Figure: Simulation for approach-2

The two design approaches can be analyzed considering the four parts of our system.

1. **Sensors:** For approach-1 we have selected a water soluble ammonia sensor whereas in approach-2 we have selected an ammonia gas sensor which will be set above the water body and it will detect ammonia gas coming out of the water body. Depending on the availability of sensors and the cost of the sensors, the ammonia gas sensor is easily available and economical.

2. **Control Unit:** In approach-1 the drain motor will automatically turn on based on the algorithm from the data sent from microcontroller and on the other hand in approach-2 we will control the water quality based on a pre built look up table which will have the threshold limits and turn On/Off based on the limit we set up.

3. **Communication:** In approach-1 we designed the communication system using LAN/4G network where a SMS will be sent to the stakeholder. Similarly we can send messages to our stakeholder but in a more efficient and non disruptive method through a pre-built IoT server which can be used on phone or laptop. With SMS, if there is a place with no network coverage, the stakeholder will not be able to get a SMS. But with the widespread use of Wifi/mobile data, people can easily access their personal server and monitor as well as control their system.

4. **Server:** In approach-1 we will have to build an IoT server from scratch using HTML, CSS and javascript which will be more cost heavy but on the other hand in approach-2 we can have a pre built IoT server with minimal effort and reliable which will cost the stakeholder no money where they will be able to monitor and control freely with full access to data.

5. **Power consumption:** The overall power consumption or approach-2 is less than the power consumption of approach-1.

6. **Cost:** The capital cost for the approach-1 is much higher than that of approach-2.

Based on the above economic, power consumption, availability of sensor, strength and weaknesses we can say design approach-2 has the most sustainable design. This might cost the stakeholders higher capital expenditure but it will reduce the operational cost by almost 30% for the stakeholder. This will reduce electricity bill for the stakeholder by around 5% monthly and much more integrations can be done in our system to optimize it further and make it more robust.

4.4 Performance evaluation of developed solution

4.4.1 Test cases

4.4.1.1 Device Status for both approaches

When our device is not running then the IoT server shows offline, so stakeholder can easily know about the device status by seeing this:

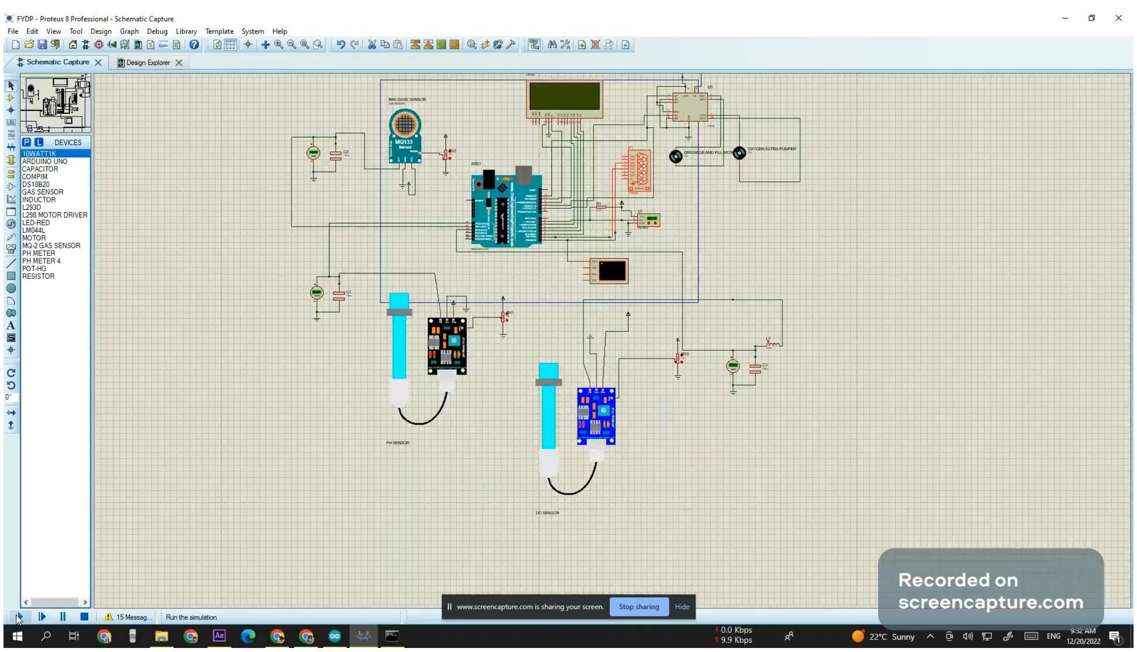


Fig: When simulation not running

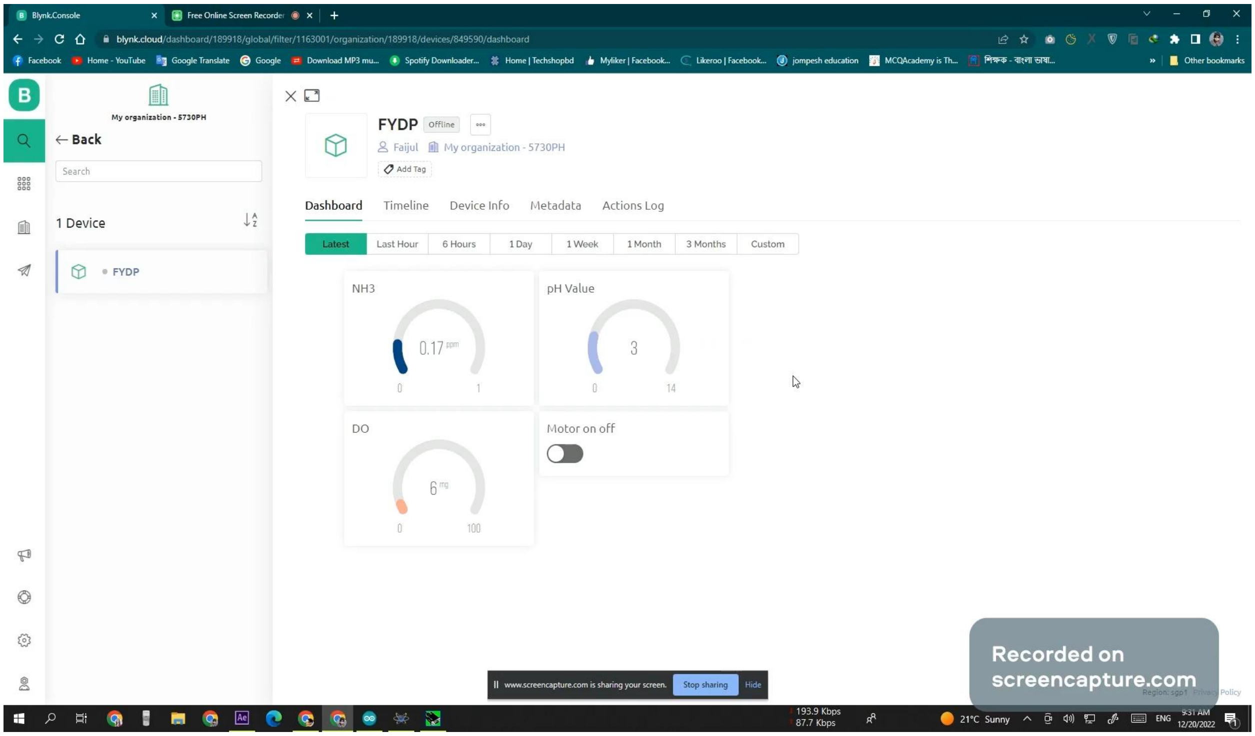


Fig: Device showing offline in IoT server

Here we can see that after turning on the device the IOT server is also showing online.

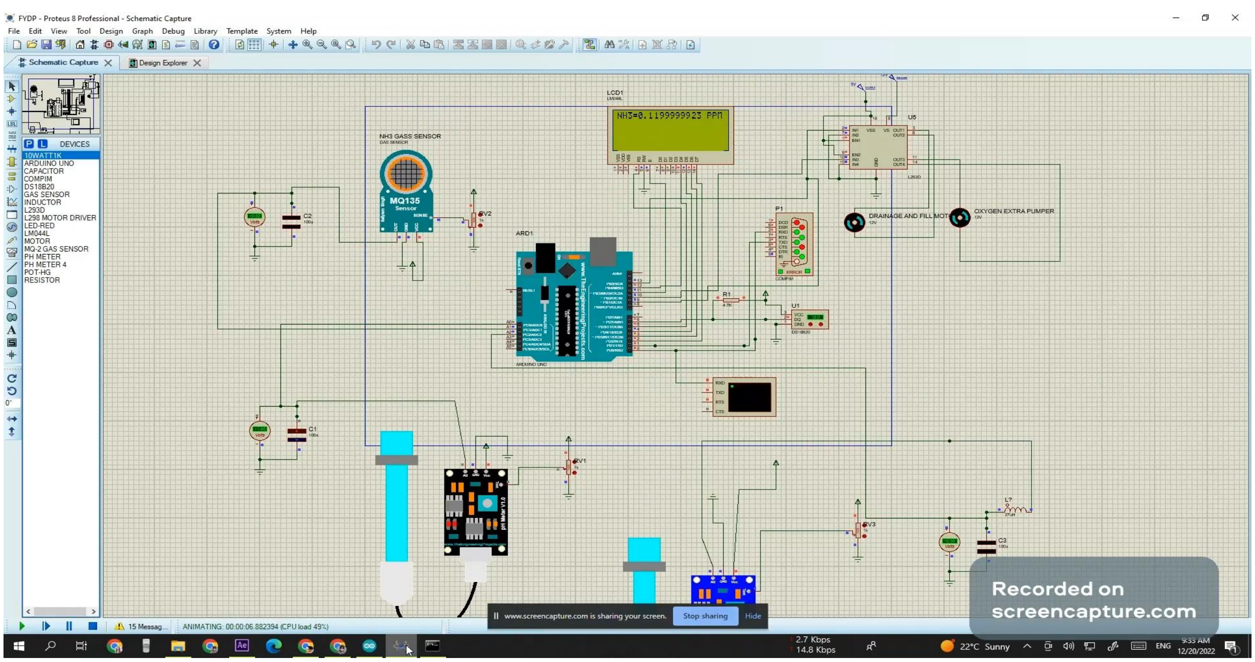


Fig: Simulation running

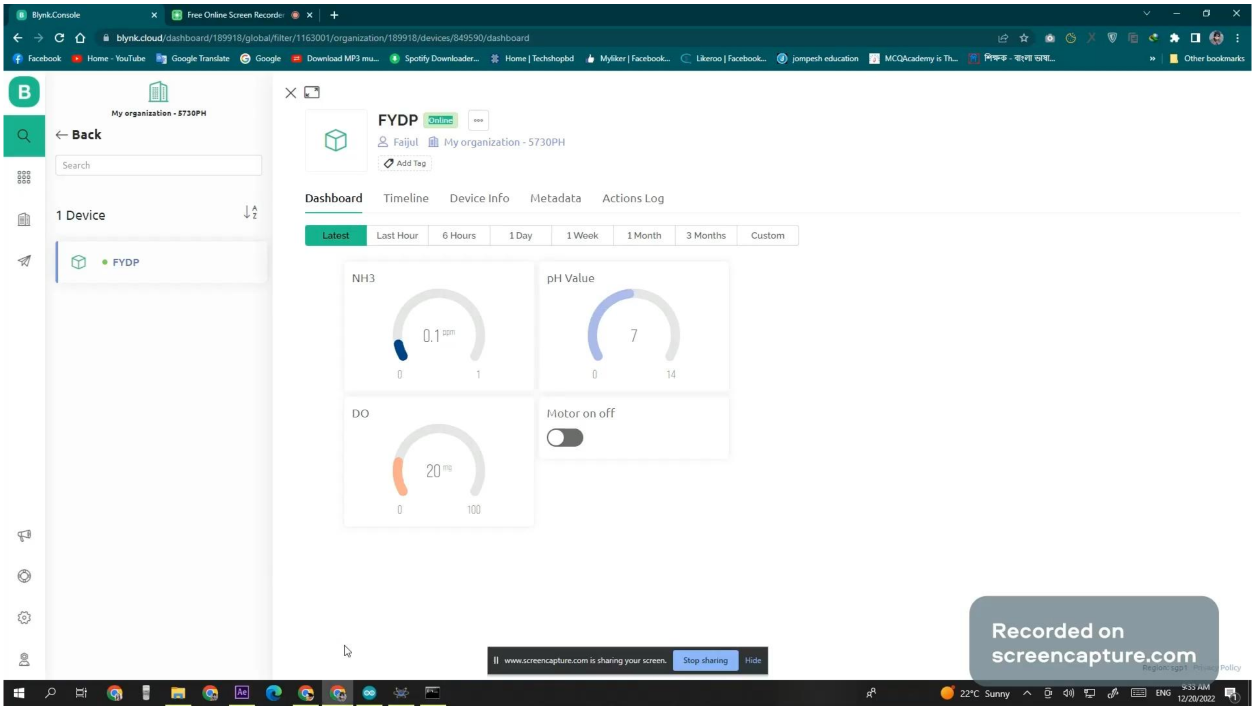


Fig: Device showing online in IoT server

4.4.1.2 Dissolved Oxygen motor control

Approach-1

Here the DO motor is now running with low voltage and DO value is normal.

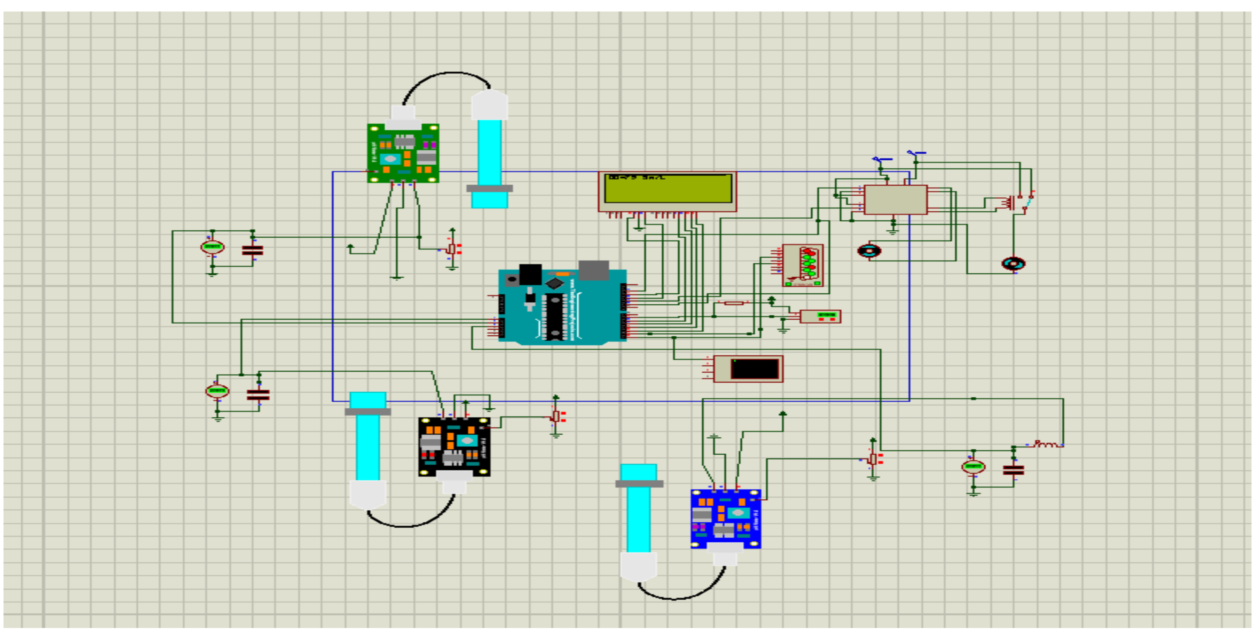


Fig: DO Value 79 gm/L relay NC pin connected with 5v supply with DO motor

The DO motor will be running continuously with a certain voltage when the water DO is normal range. So the relay NC pin is connected with a certain low voltage. So the motor will be running with a certain low speed continuously. As DO is in normal range so microcontroller output is 0 for the relay so the relay will be connected to the NC pin which is connected to 5v supply with the DO motor here.

Here DO in low and relay connected to high voltage and motor speed increases so oxygen generation increases.

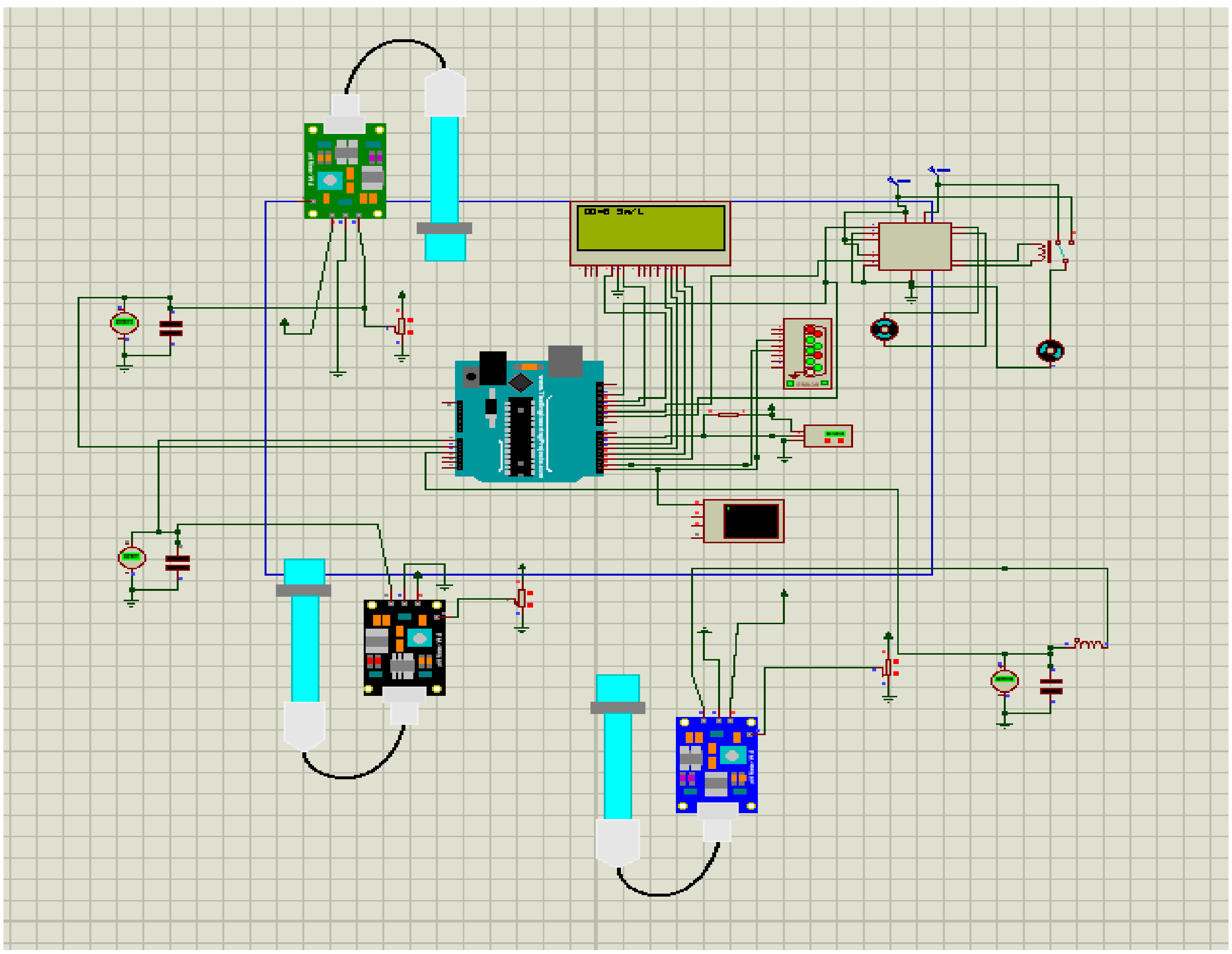


Fig: DO Value 0 gm/L relay NO pin connected with 12v supply with DO motor

The DO motor will be connected with a relay and relay NO pin is connected with a certain high voltage. So when the DO crosses normal range the DO motor speed will be increased. As DO crossed the normal range so microcontroller output is 1 for the relay so the relay will be connected to the NO pin which is connected to 12v supply with the DO motor here.

Approach-2

Here we can see the dissolved oxygen is low and the extra air pump will start to run and generate oxygen.

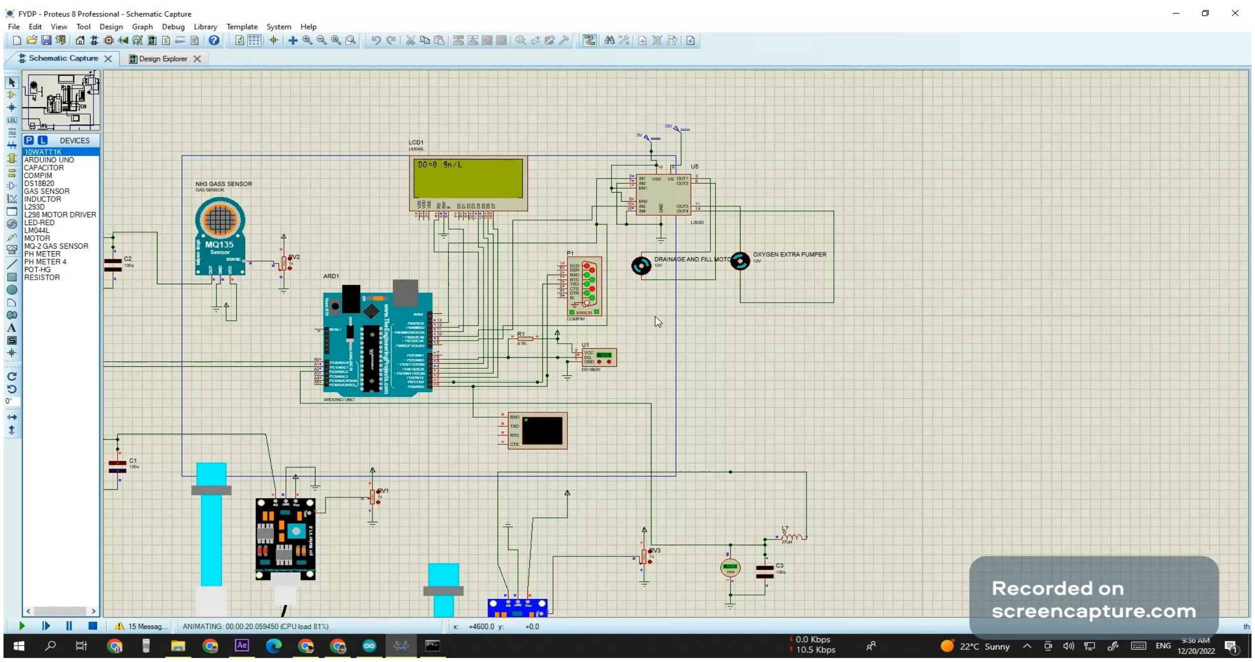


Fig: DO turned down to 0 mg/L

In the figure given below we can see that the dissolved oxygen level gets back to normal and the extra DO running motor will be turned off.

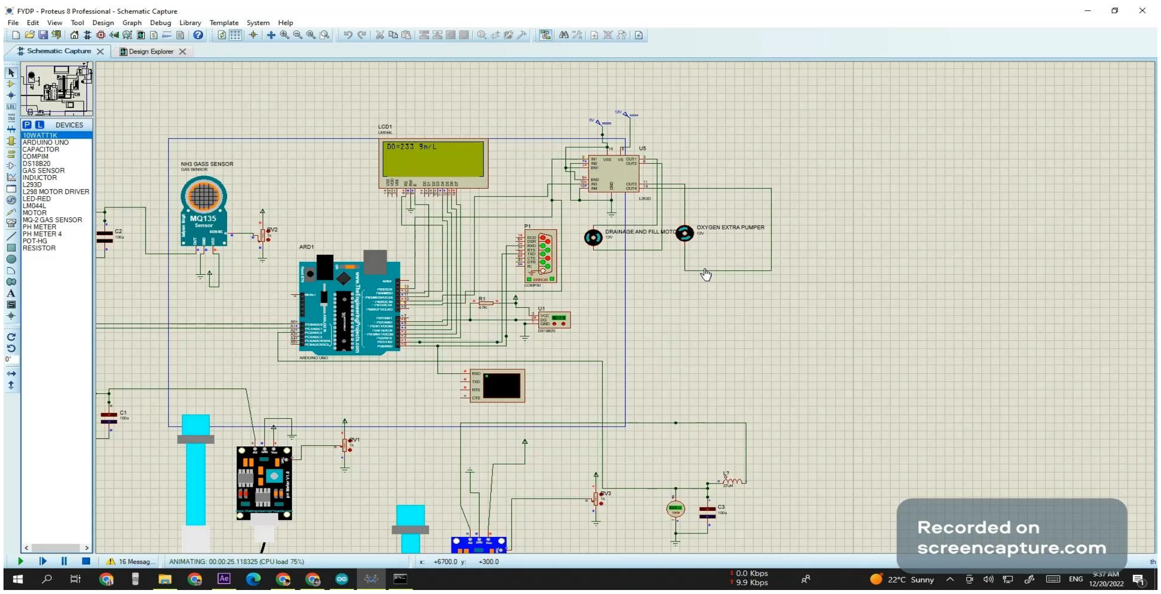


Fig: DO reading 233 mg/L

And here the dissolved oxygen motor is turned off. Motor driver IN3 pin is controlling the DO motor here.

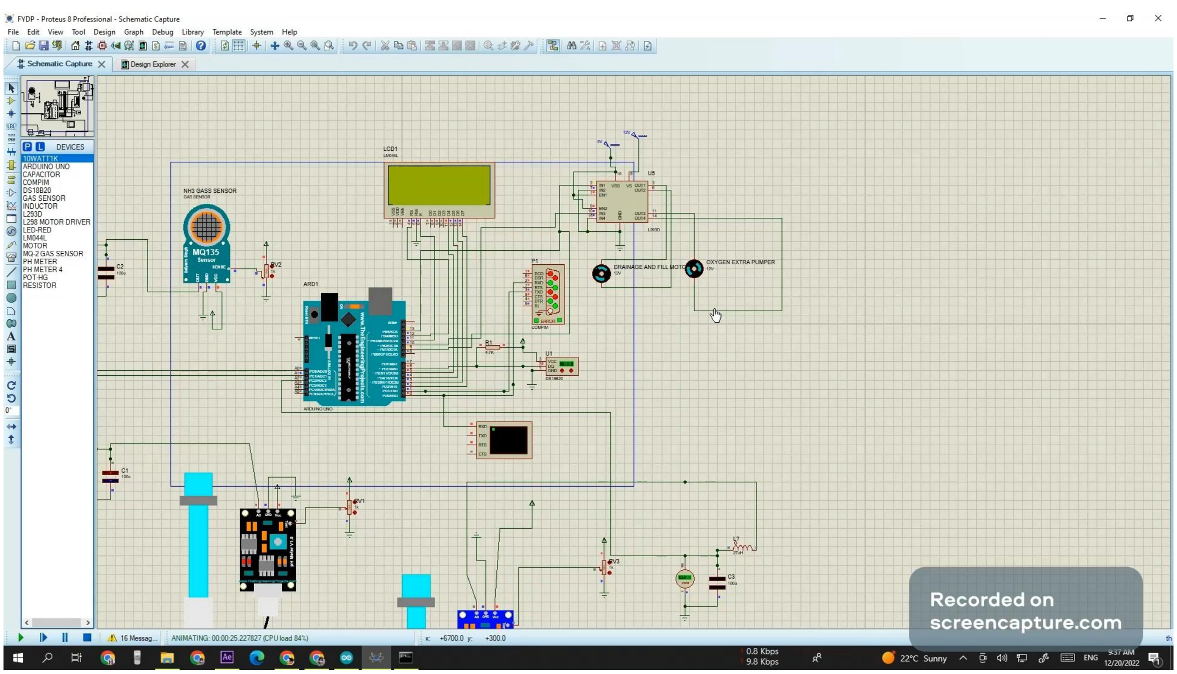


Fig: DO motor turned off in the motor driver IN3 turned 0.

4.4.1.3 Manual Control from IoT server

Here we can also control the drainage motor manually through the IoT server.

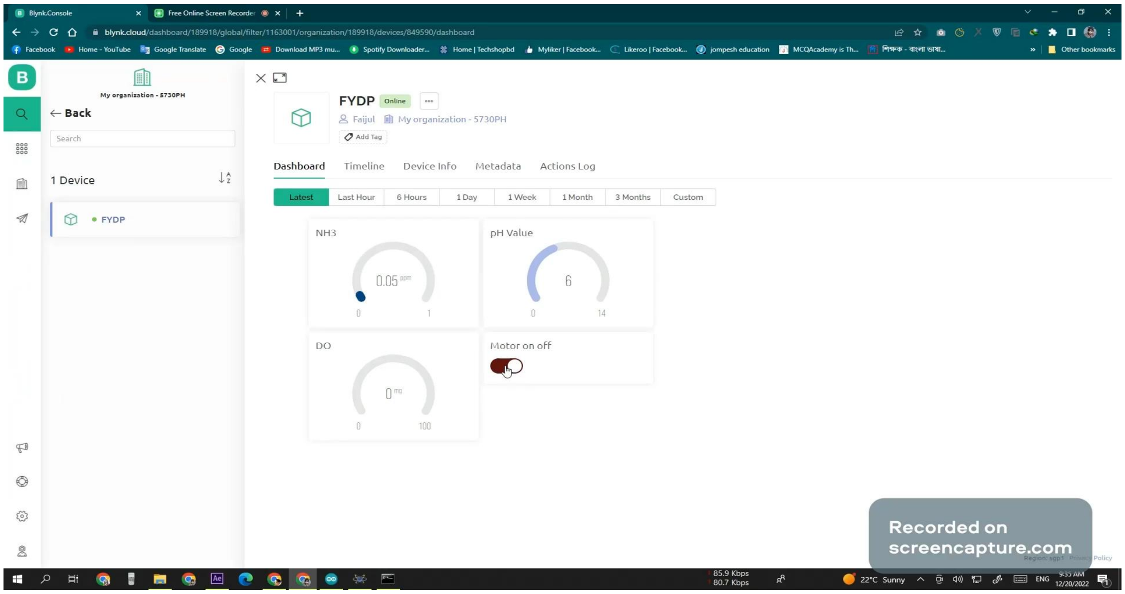


Fig: Motor Turned ON Using IOT Server Switch

Here motor driver IN1 pin is controlling pin of Drain and fill motor

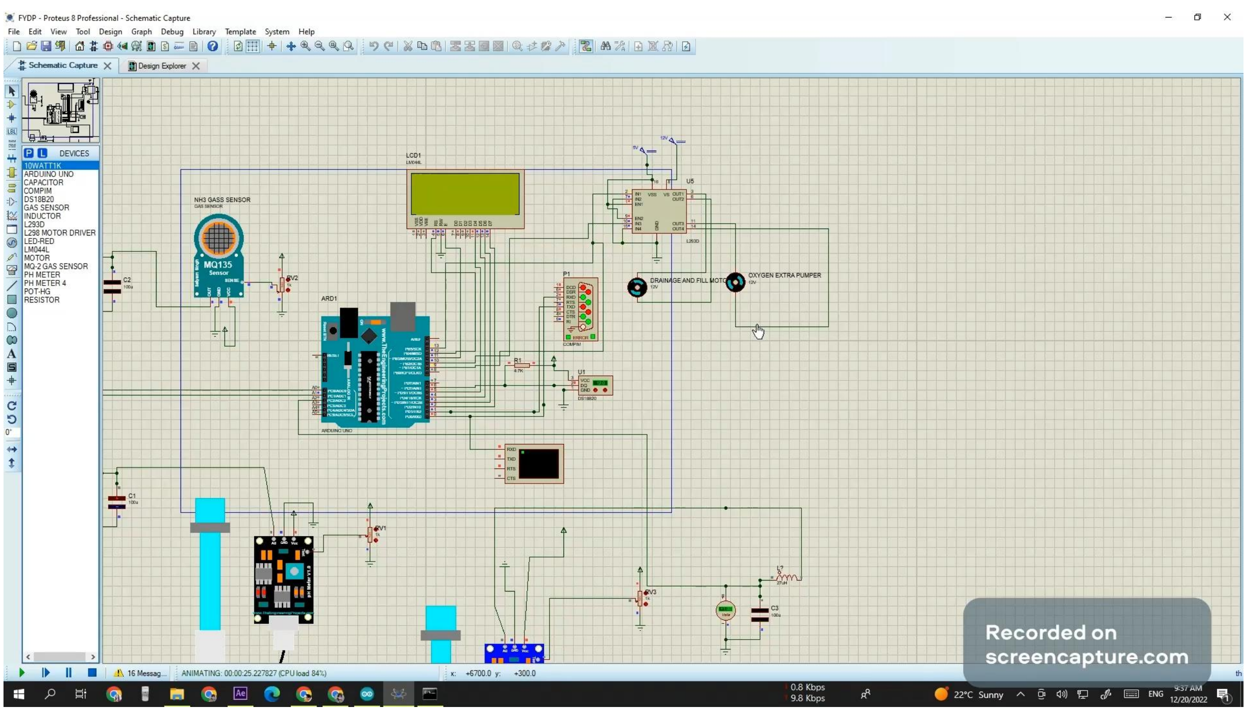


Fig: Drain and fill motor turned on motor Driver IN1 input is now 1.

Here we turned of the drainage motor manually

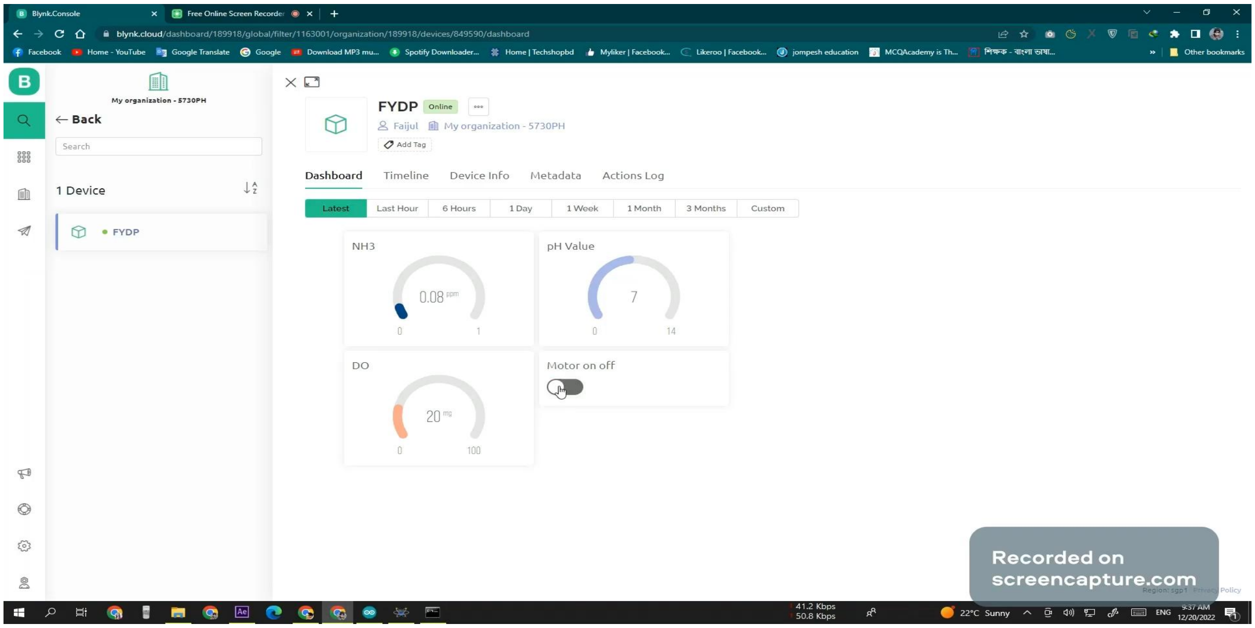


Fig: Manual Button Turned OFF

So the simulation shows us that the motor is turned off:

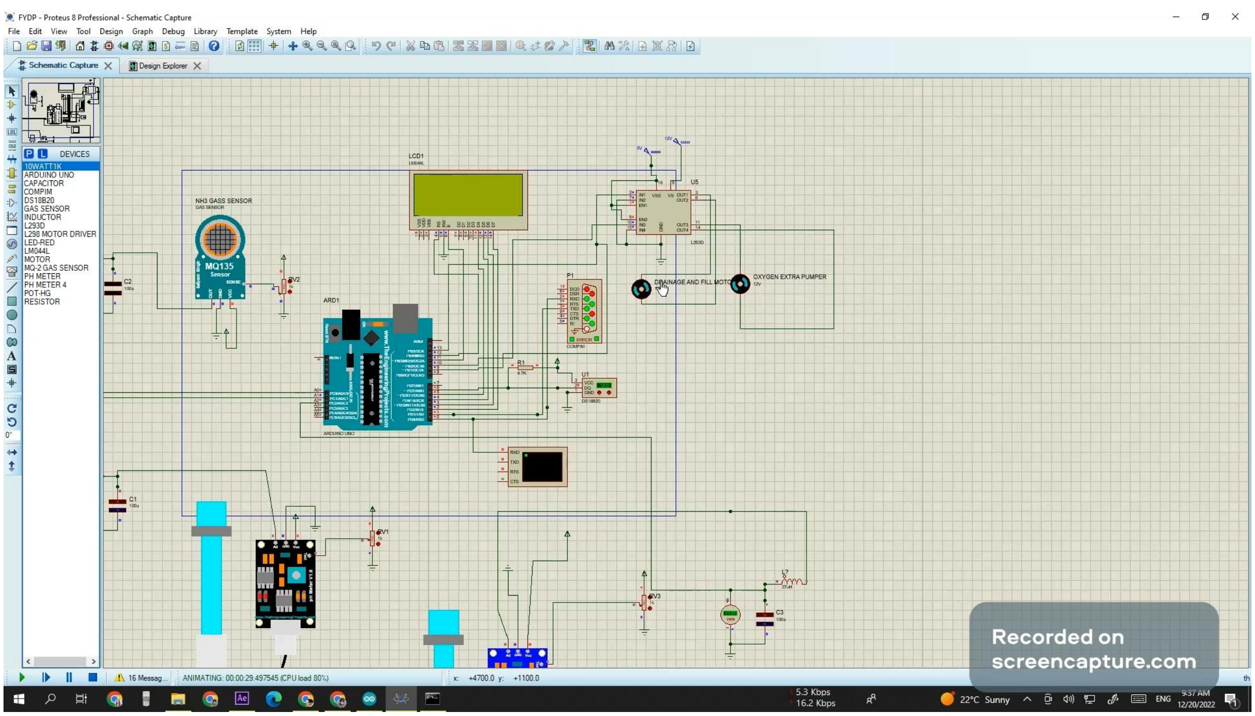


Fig:Drain and fill motor turned off motor Driver IN1 input is now 0.

4.4.1.4 Fill and Drain motor control

Now NH3, and pH level is high so the drainage motor moto is turned on automatically and takes out the waste water and fill new water

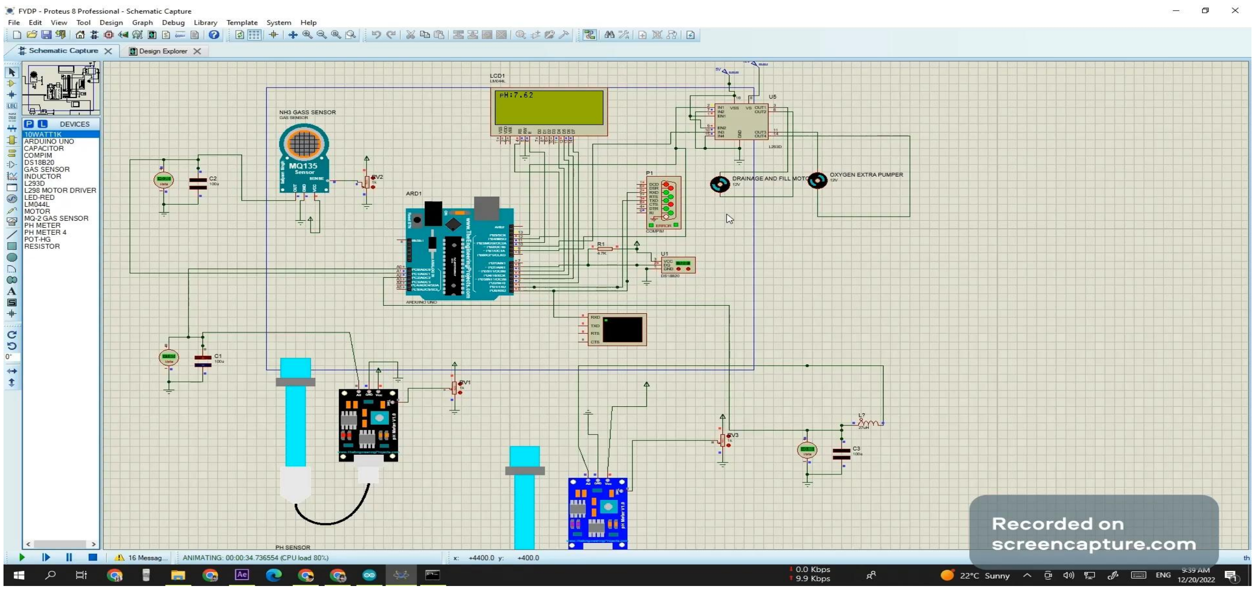


Fig:Drain and fill motor turned on motor Driver IN1 input is now 1.

After the NH3 and pH level become low and gets to normal condition the motor turned off automatically:

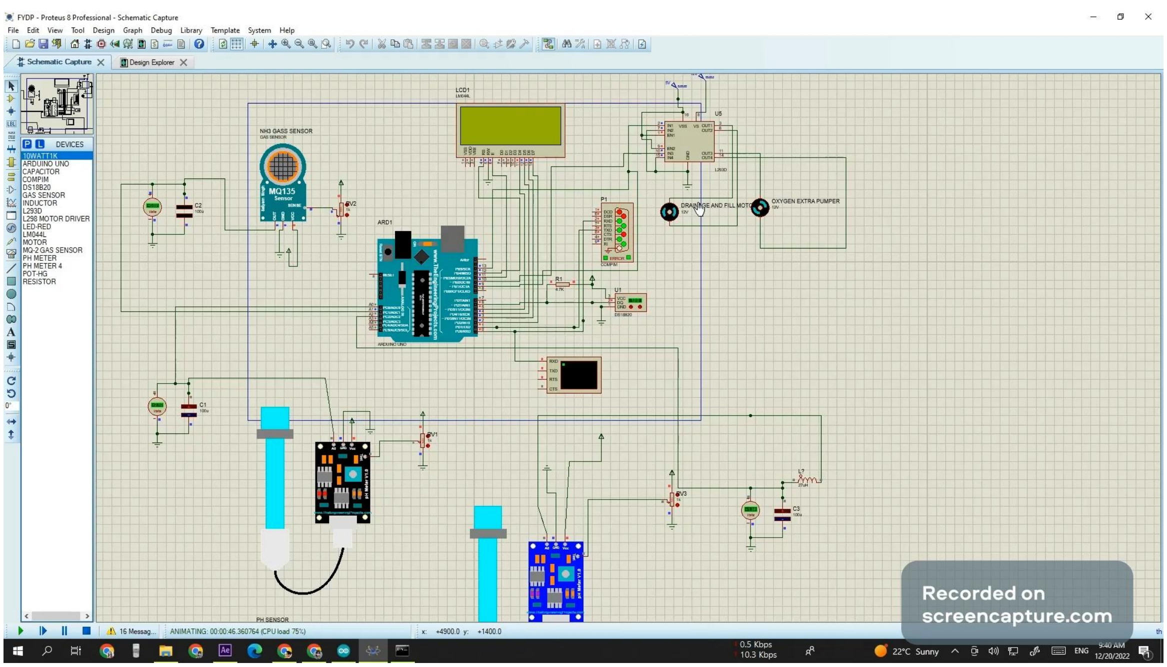


Fig:Drain and fill motor turned off motor Driver IN1 input is now 0.

Here in a microcontroller we use motor driver IN1 pin to control drain and fill motor.When the microcontroller gets that pH level and NH_3 level is under the normal condition then it will send the output to the driver pin IN1 is 0. The motor will be turned off by the motor driver.

4.5 Conclusion

In conclusion, the electrical components and all the sensors have been functioning properly. The tricky element was mounting every sensor so that it could collect data from the water while ensuring water does not touch the sensors. However, because it is not an implemented product, there is a lot of risk involved. The prototype's wire connections are taken care of.

Chapter 5: Completion of Final Design and Validation. [CO8]

5.1 Introduction

The next step is to construct the final prototype after the best answer has been found. The components are assembled in accordance with the guidelines provided for the ideal design. Although there was a little modification in the description used to develop the project and the components that were accessible in the market. As a result, the orientation depicted in the 3D modeling design differs somewhat from the orientation of the prototype. In the final design, even some functional verifications are changed. Because of this, the functional verification of the objectives' fulfillment is done by comparing the simulation-based verifications with the real produced prototype.

5.2 Completion of final design

The Automated monitoring and control system for bottom clean raceway fish culture is the system that was required to be designed. There were two alternative approaches and one was determined to be the most effective one.

5.2.1 Sensor Data

The objective is to automate the monitoring and control system of cleaning waste from the water. To do this, multiple sensors have been used to collect data from the water. The pH sensor, ammonia sensor, and dissolved oxygen sensor have been used.

Figure: Sensor values on LCD

These sensor data are important for the system to detect the quality of water . the pH sensors , dissolved oxygen sensor and ammonia sensor all are fixed under the water so that they can easily detect the values of pH ,ammonia, oxygen gose lower then than the given threshold values

5.2.2 Microcontrollers

The ESP32 chip has been employed to drive the entire system. Through the use of a microprocessor, the system automatically moves mechanically and controls itself.

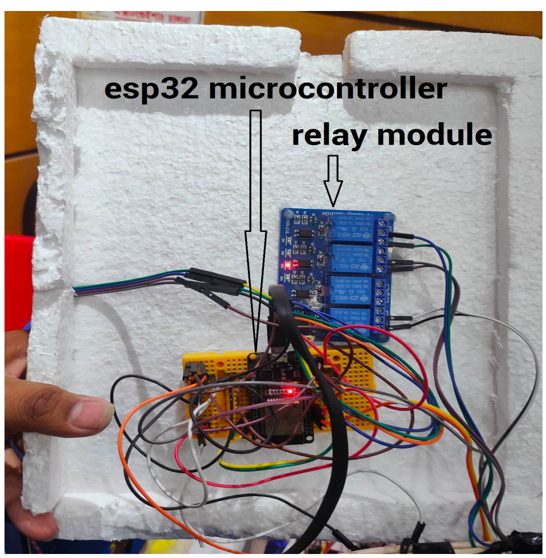


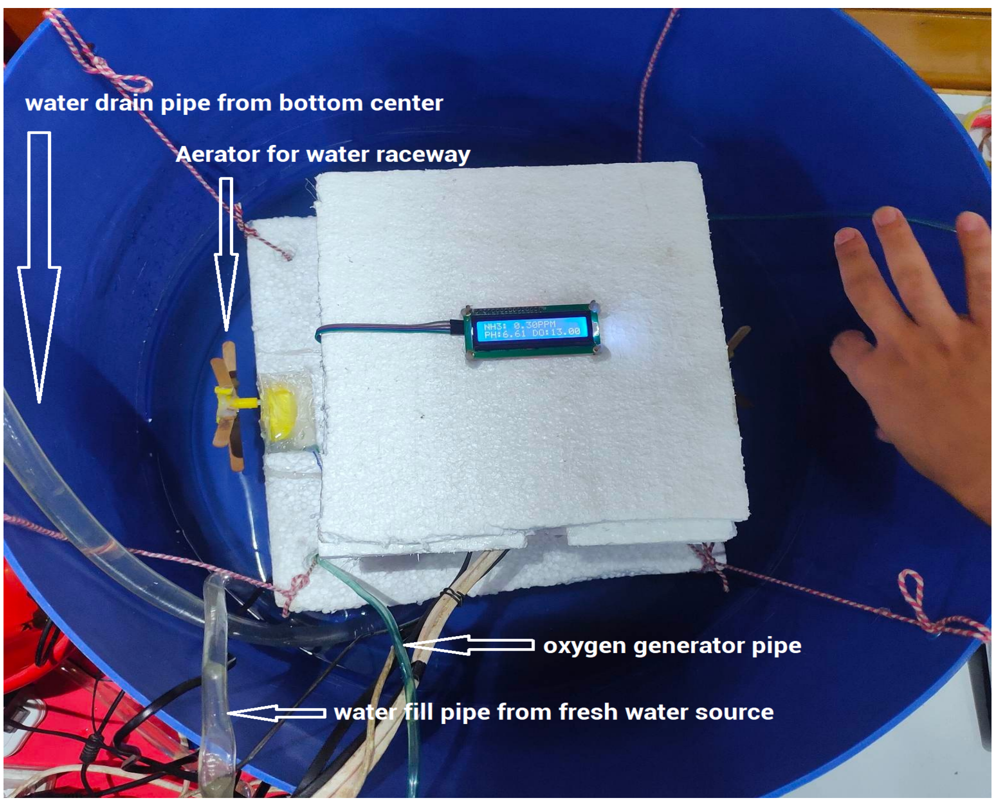
Figure: Relay and ESP32

5.3 Evaluate the solution to meet desired need

Building a fully automated system with the ability to automatically monitor and manage water quality factors including dissolved oxygen levels, pH, and ammonia levels was the major goal in order to maintain the best circumstances for fish growth and health.

5.3.1 Complete System

The system is ready once everything has been placed in place to maintain the quality of water by draining water and releasing fresh water.



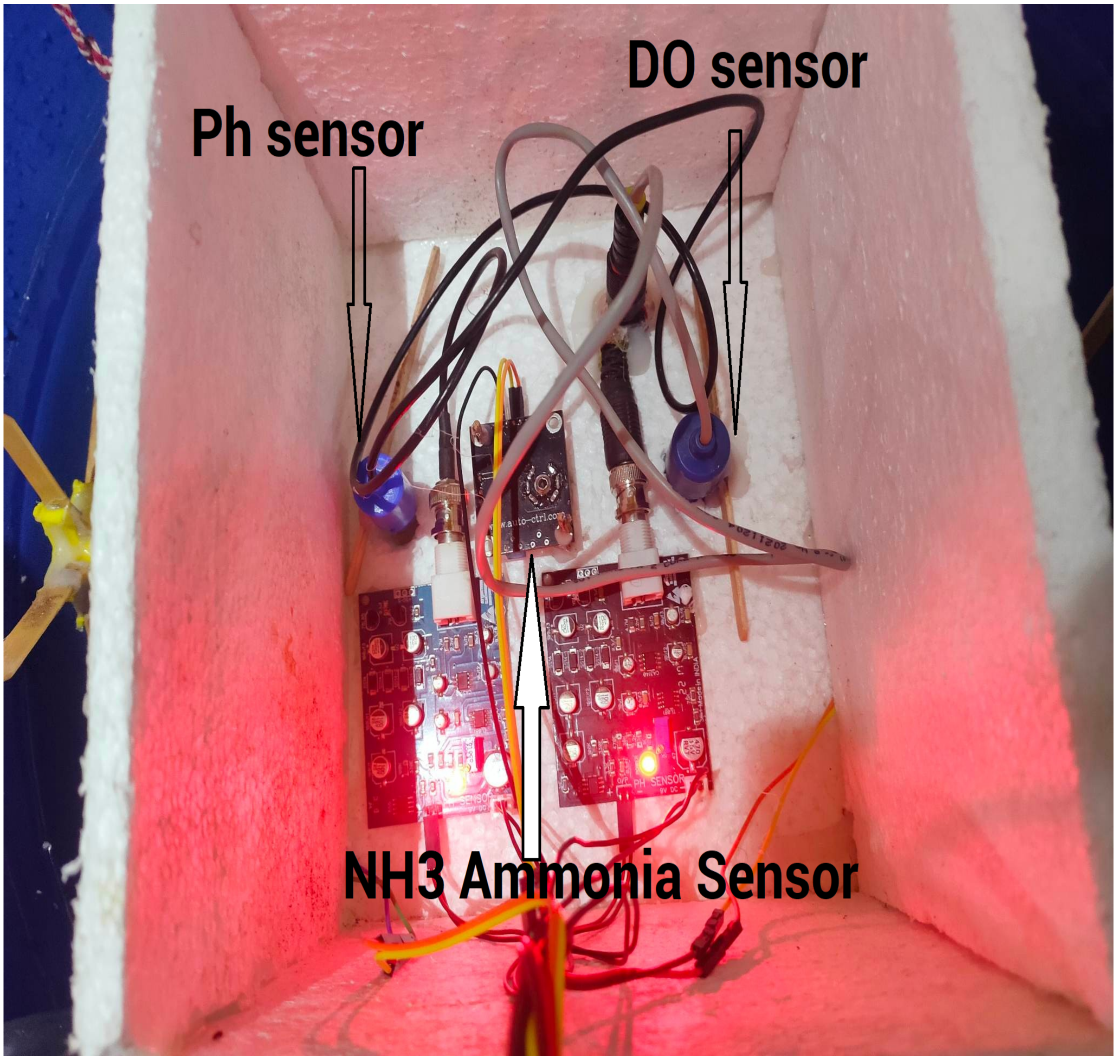
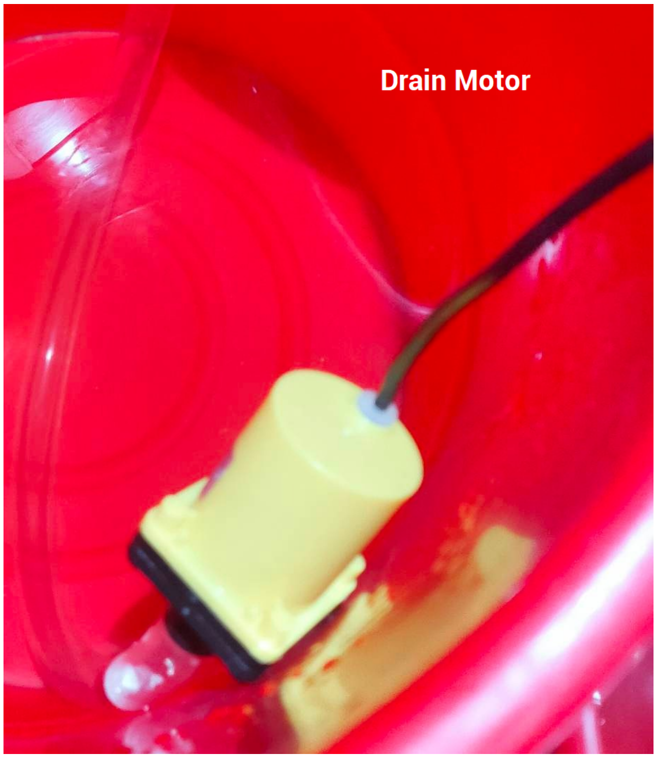


Figure: Final Setup



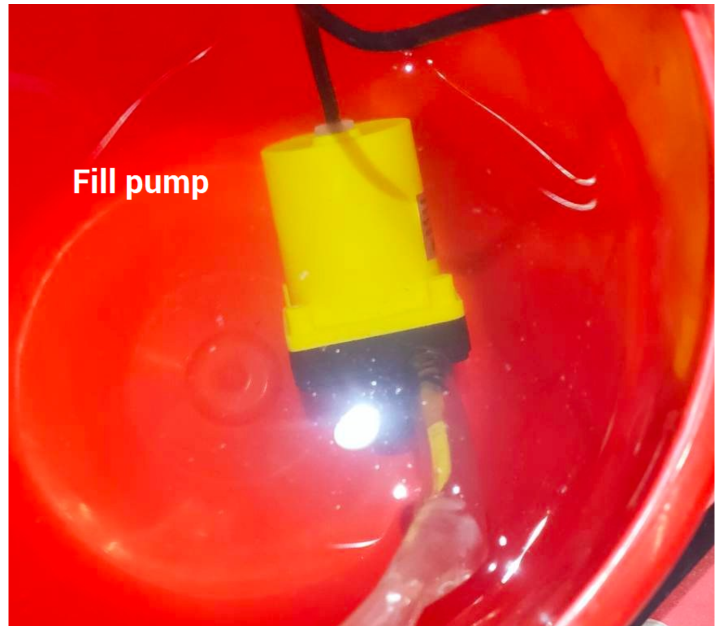


Figure: Refill motor, Drain motor and oxygen pump setup

Here when the the pH and ammonia is getting lower or crossing the threshold limit of given data tha drain motor and the fill pump will run and clean the water and by draining water from the reservoir and also filing the fresh water through the by the help of fill pump and if the dissolved oxygen is became low the air pump will supply oxygen to the reservoir or the fishes

5.3.2 Control and monitoring server

To control the whole system the IOT server is designed. And it is fully functional.

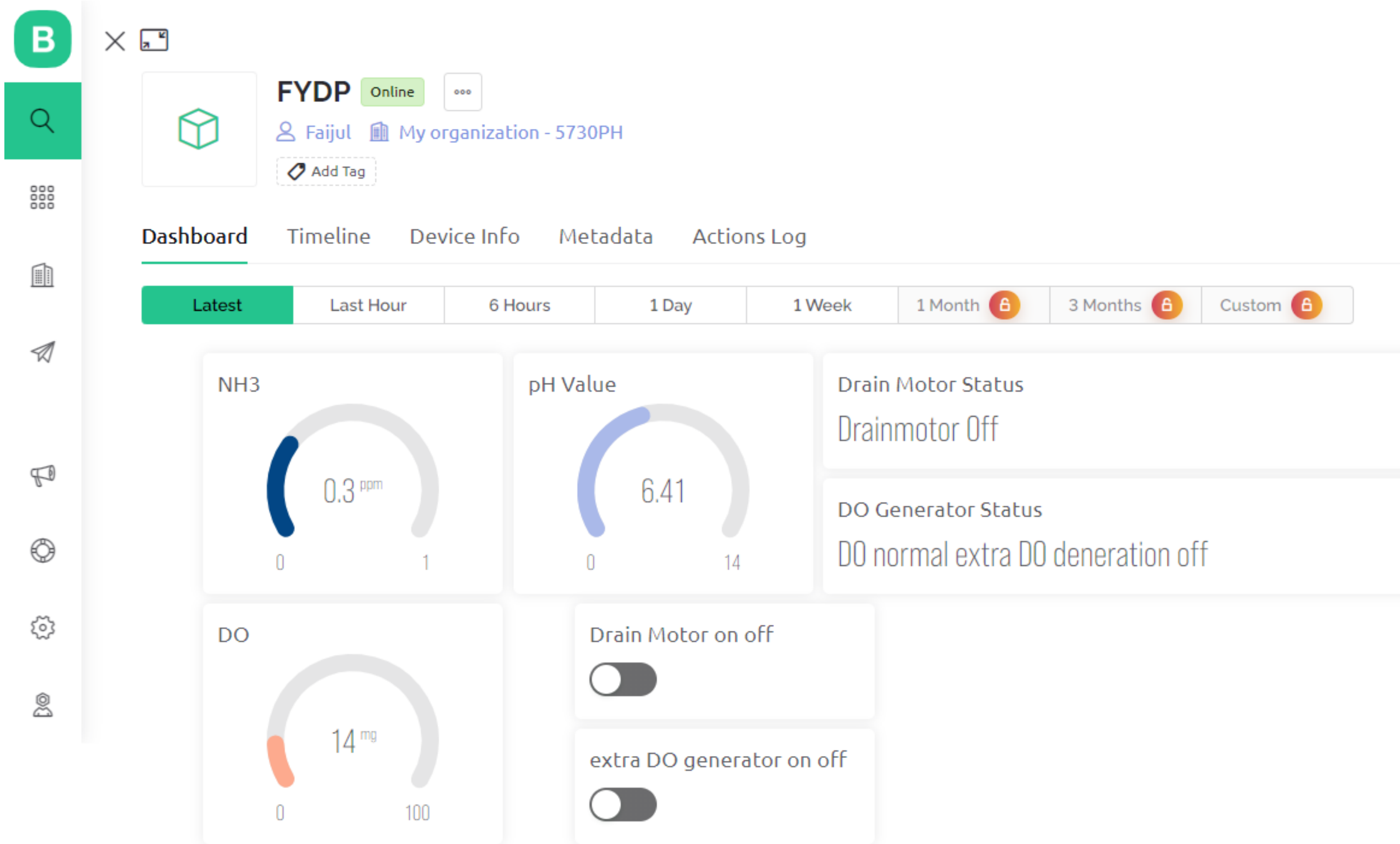


Fig: Blynk IoT Server

Here from the IOT server the user can monitor the system the user can easily get all the data of the system and can control the system if the user wants to turn on and off the drain motor according to his own he can do it by the server also if the user wants to give extra oxygen he can turn the dissolved oxygen generator on and also according his own way .

5.4 Conclusion:

Any video references in the report are challenging to use. However, more images could be included to fully validate the system. There may be additional modifications made before the final submission, as this is only a draft.

Chapter 6: Impact Analysis and Project Sustainability. [CO3, CO4]

6.1 Introduction

Impact analysis involves taking into account how the project will affect people and the environment in many ways. Several things may be either positively or negatively related to the project. These elements are briefly and thoroughly explained with appropriate research in this section. and trustworthy data. In addition, the SWOT analysis is used to examine sustainability in order to have a deeper understanding of the project.

6.2 Assess the impact of solution

The fact that pollution of all kinds is getting worse every day in the context of the modern world does not require an explanation. Thus, all recently released products share at least one or two characteristics. And those are the effects it has on the environment and consumer health. There are other additional crucial effects factors, but they vary according to the product.

Environmental:

Pollution is a major problem in large cities like Dhaka. For several groups of individuals, Dhaka's water quality is highly unfavorable. Also, recently, factories built next to rivers caused Dhaka's water to become the most contaminated of any country in the world.Which is creating Aquatic pollution can cause fish to die in large numbers. Polluted water reduces the amount of dissolved oxygen, which fish need to survive. Additionally, pollutants such as heavy metals, pesticides, and oil spills can directly harm fish and their habitats.Fish productivity may decline as a result of pollution's harmful effects on fish growth and reproduction. The livelihoods of fishermen and the availability of seafood for human consumption may be significantly impacted by this. Human health hazards from eating contaminated fish include cancer, reproductive disorders, and neurological and developmental issues.

In order to live a healthy life in Dhaka, the city's water bodies must be cleaned. Which is not easily possible. So by using this technology we can help to reduce fish mortality caused by aquatic pollution and also increase fish production. But in cities like Dhaka there is not a lot of space to do fish culture but using Automated monitoring and control systems for bottom clean raceway fish culture technology fish can be cultured in a huge and healthy number in small spaces. Unlike other farming processes, this system will have proper planning and drainage systems that will never affect the environment badly.This will reduce the pollution of the environment and require small space and it is more environment friendly.

Health:

The automated system has been designed to reduce problems that are damaging to the human body, as has been stated numerous times.This can help to reduce the risk of contaminated fish that may cause health problems such as cancer, neurological, and developmental issues.This can encourage consumers to choose fish that are produced under environmentally friendly and safe conditions,This can help to reduce the risk of waterborne diseases and promote safe and healthy fish production.. This can help reduce the risk of antibiotic resistance and chemical residues in fish,providing high-quality and nutritious seafood options for consumers.Less formalin and other chemical compounds will be required because fish transportation will be drastically reduced. The fish will stay fresh during this process and be available for consumption by the consumers. The fish that will be produced can quickly get to the surrounding markets, which is another benefit.

Societal:

Every system that is sold and used by consumers has an effect on society either directly or indirectly. Some of them have deep emotional connections with the users, while others might only have a gradual impact on society. The societal effects of the autonomous agricultural system are mentioned here.

1. Owner consumer relationship:

It will create a strong bond between the owners and the consumers that are dependent on them. The consumers may be the families of his societies or from some other society

2. Job opportunities:

There are numerous companies that provide consumers various services. The provision of everyday resources is unique. With the help of this system, existing organizations can work together to produce new items, or new businesses can enter the market and provide their services.Certain products' costs drastically rise when they need to be transported over long distances.The autonomous system will eliminate the need to import fish from other cities.significantly. Customers will have suppliers right in their own neighborhoods, which will result in lower costs for them. Moreover, labor costs will decline, and maintenance costs will also decline.

Economical:

In the sociological section, it has been discussed how this autonomous farming system will bring down the price of fish. If correctly implemented, this approach will have a tremendous impact on the economy. Better fish are available to consumers for comparably less money. It will open up employment prospects for thousands of people and foster connections between those from various backgrounds.

6.3 Evaluate the sustainability

Strengths:	**Opportunities:**
● Cost efficiency ● Reduces power consumption ● Remote monitoring ● More growth of fishes in less amount of time ● Environment friendly	● Renewable power source can be added ● Wasted water can be recycled. ● Generator can be used for load shedding ● Market is increasing
Weakness:	**Threats:**
● No backup for load shedding. ● Requires all time mobile network. ● Lack of government support.	● Political instability. ● Increase price of components. ● Low sales leading to low revenue.

As per our project, the automated control system can adjust aeration, and water flow rates to maximize efficiency while using less resources and lowering costs. The system can control important factors including water flow rates and aeration, which lowers energy use and helps save money. System may be remotely accessed, enabling real-time monitoring and intervention. System can promote quicker growth rates, resulting in greater fish growth in less time, helping to reduce costs. can aid in promoting environmentally friendly, sustainable fish farming methods and reducing the harmful effects of fish farming on the environment.

Bottom clean raceway fish culture technology presents several opportunities for fish farmers to improve sustainability, reduce costs, and increase productivity.Using sustainable fish farming techniques and renewable energy sources like solar and wind power can help to further minimize energy consumption. enabling the use of water treatment techniques that can recycle and repurpose squandered water, hence lowering the total amount of water used in fish farming operations. By using a generator as backup power, fish farms can become more resilient and productive by reducing the loss of fish resulting from power outages. The use of technology can assist fish farms profitably enter this expanding industry.

Although this system has a very important and effective role to show, it has several flaws that could delay the anticipated result. here are also some weaknesses that need to be addressed, such as the need for backup power options, reliable mobile network connections, and government support for promoting sustainable fish farming practices.Lack of backup power choices can result in fish losses during power outages in places with variable power supplies, which lowers the productivity and profitability of fish farms. The accessibility of the automated monitoring and control system is constrained by the need for a solid mobile network connection, which may not be available or stable in some isolated or rural places. Fish farmers may be discouraged from investing in the technology due to a lack of government incentives and assistance for using sustainable fish farming techniques, such as automated monitoring and control systems.

Hence, taking technology into account, a new age for the farming system in urban areas will have beneficial effects and very quickly adapt to the environment, along with a few drawbacks that have been briefly highlighted.

6.4 Conclusion

After examining the relevant information, it becomes clear that this project will have a variety of effects on the environment, society, health, and economy. The responsibility of analyzing this data to ascertain the project's long-term effects on people and the community is crucial. All of the potential chances and features are presented when the project is chosen for the overall improvement of the farming system and to make it more sustainable for the people living in cities and villages.To determine how much of the project will be acceptable for fish farming, the entire summation of the impacts is noted down in the sustainability section. In light of the technological advancement it offers, the acceptability of the project for particular places and people, as well as the general concerns that may arise during installation and daily use, are all represented in this analysis.

Also, the potential failures of the project are also reviewed to ensure that all subsequent measures will be taken.

Chapter 7: Engineering Project Management. [CO11, CO14]

7.1 Introduction

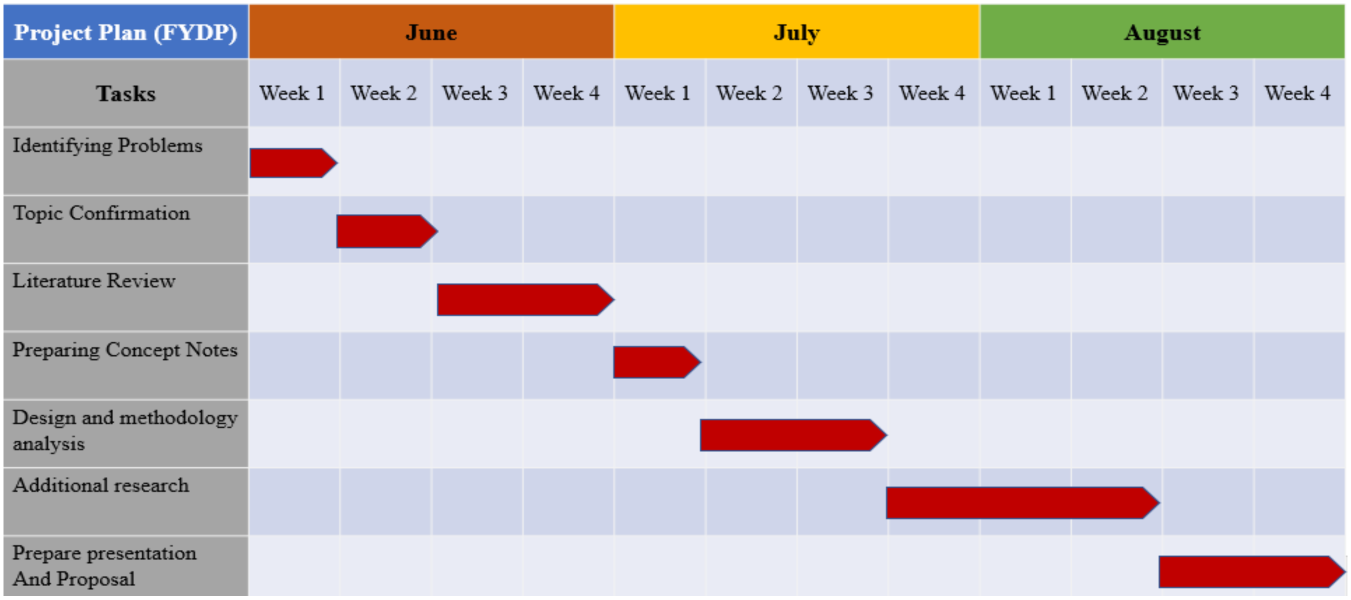
In addition to having the necessary engineering knowledge and abilities, one needs to be able to manage their time effectively and get along with their peers in order to carry out initiatives like this. So, it always begins with establishing clear objectives that must be achieved within a particular amount of time. The job is divided into a set period that must be finished, and there is peer discussion. Even so, unpredictable events can still happen, and dealing with them requires appropriate planning. The administration of the entire project, from topic selection through design and implementation, is briefly explained in this section.

7.2 Define, plan and manage engineering project

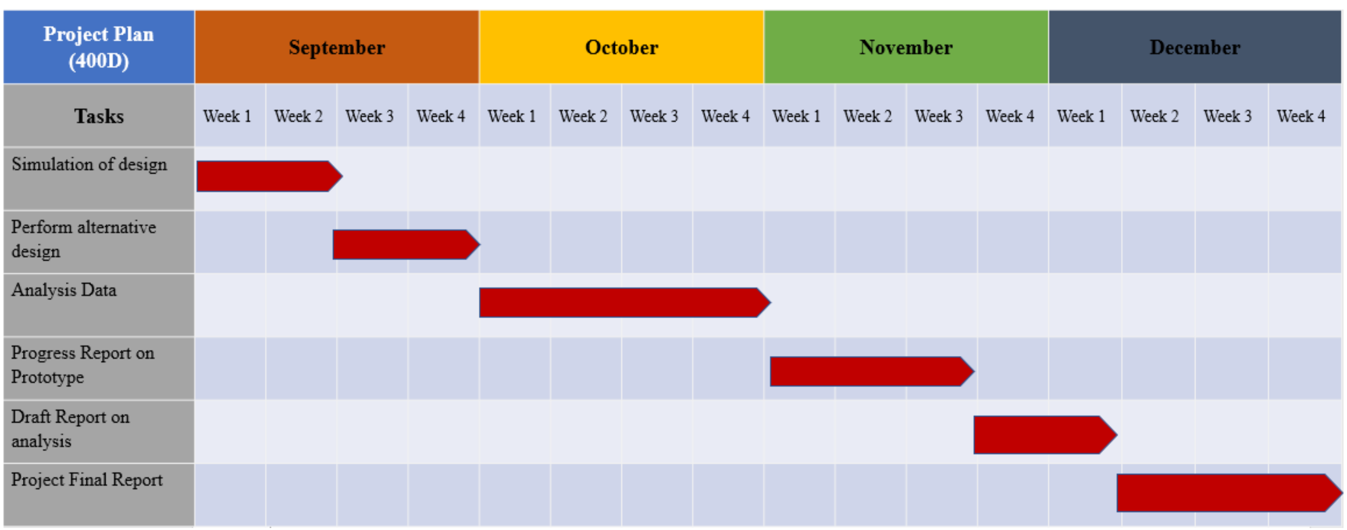
An "engineering project" is any undertaking that largely entails engineering work, involves the construction of new works, the modification of existing works, or both, and for the planning of which the client engages an engineer. A goal is established to be achieved in accordance with the project's requirements. Plans are established in order to accomplish the goal and ultimately meet the objectives in a good manner. Peers manage their time and workload in accordance with these activities.

Topic selection, design creation, and prototype implementation are the three main phases of this project. Three courses, EEE400P (Topic selection), EEE400D (Design development), and EEE400C, were assigned to these stages (Prototype Implementation). The Gantt Charts have been used to illustrate the exact actions that needed to be taken at each step. These graphs demonstrate how much time was allotted for each stage of the project's development. Also, a log book is kept each time a peer discussion or a conversation with the project coordinator takes place.This makes it easier to organize tracking of the development. Plans were modified and the Gantt Chart was updated in the event of unclear issues. For instance, during design selection, the EEE400P prediction for the EEE400D was received. In this continuous implementation phase, the prediction made for EEE400C is also significantly altered as it is observed that the hardware assembly was a bit irregular because the components were not always readily accessible in the local market.

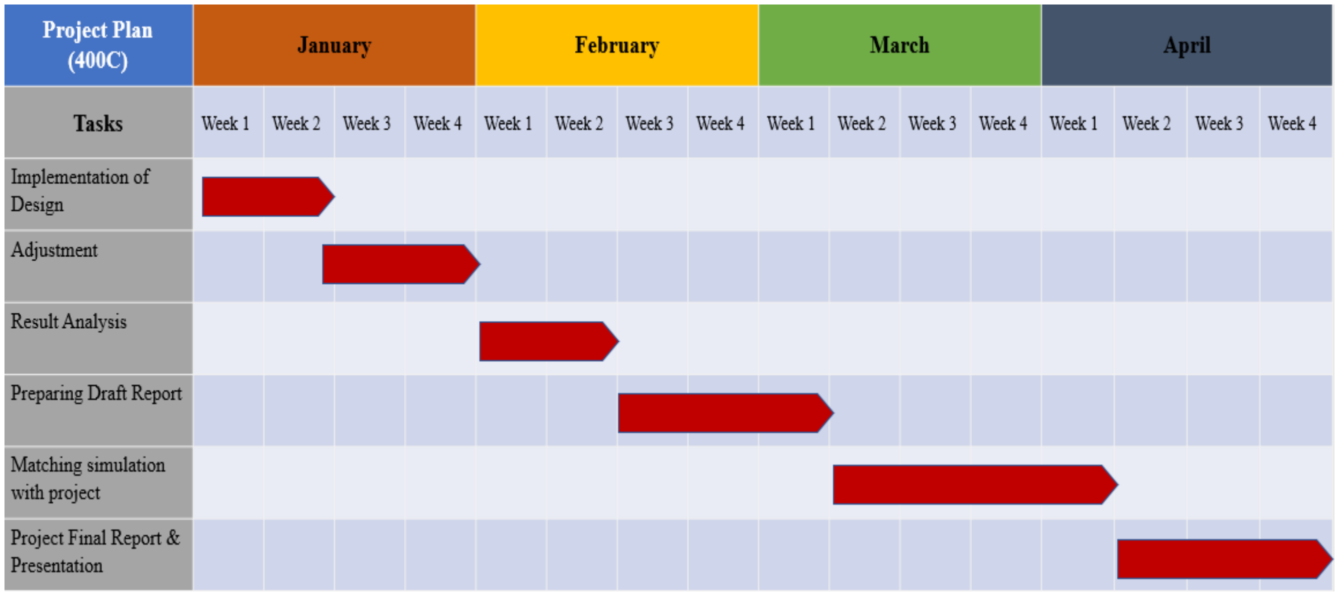
EEE 400P



EEE 400D



EEE 400C:



7.3 Evaluate project progress

Planning for all three semesters, as shown in the preceding section, is necessary to evaluate this project. For clearer understanding, a number of separate stages can be illustrated.

7.3.1 Design with alternate approaches:

Firstly, the problem has been identified which is taken into consideration. The main objective is to solve the fishing cultivation problem by creating a suitable and waste free environment for the fish To solve this problem, an engineering design has been planned. After that, another alternative solution has been proposed.

7.3.2 Finding Optimal Design Solution

Simulation has been performed for two designs in an effort to identify the best answer. Several factors have also been taken into account. Budget, power usage, stakeholder opinion, weight distribution, and sustainability are a few examples.

7.3.3 Work Breakdown for the Optimal Solution

The remaining work has been divided into many portions and distributed among the participants in accordance with their areas of expertise after choosing the best design option.

- IoT server development.
- Simulation of sensors.
- Improved prototype design.
- Finished prototypes.
- Report writing.
- Presentation.

7.4 Conclusion

All group members contributed equally to the project's completion in order to achieve the desired result. The majority of the tasks were finished on schedule. To keep track of our development over time, all the information is recorded in the log book. Hence, project management practices are quite helpful in keeping the participants engaged and organizing everything within a time constraint.

Chapter 8: Economical Analysis. [CO12]

8.1 Introduction

The analysis of a project's economic impact and other economic factors is the second-most crucial step in determining whether or not it will be financially viable for its consumers. The economy can be examined from a variety of angles. Economic analysis, cost-benefit analysis, and the assessment of economic and financial elements are all available.
Yet, this analysis needs analytical skills, knowledge of economic growth, and a thorough understanding of the market.

8.2 Economic analysis

When the project work draws to a close, it is possible to compare the results to what we had anticipated and how they might affect other indirect economic relativities like economic growth. Economic analysis looks at the system's direct and indirect costs as well as advantages. This system has various economic features that will directly impact the society's citizens. The impact section has already covered the societal repercussions. This system can be broken down into a few components to make it easier to understand while yet maintaining a direct connection to the people and their economic development.

8.2.1 Health and Economy

In earlier sections, the effect of this system on health has already been highlighted. Due to the extensive use of chemicals and other forms of pollution in the water resources, thousands of diseases that are currently prevalent can be reduced by this system, which is being developed with the aim of growing fresh fish. It may very well have a direct effect on the medical costs that members of society are forced to pay. Also, this method can lower the rising risks of cancer brought on by the body's consumption of chemicals as well as a significant amount of risk and financial burden.

8.2.2 Transportation

Many fish are brought from rural and maritime locations outside the city because it is impossible to cultivate fish in large cities owing to space constraints. Because of this, the suppliers are compelled to apply chemicals to preserve the fish for up to 24 to 36 hours. Although this has already been covered in the health section, there is still the issue of the transportation costs, which are added to the cost of the goods. This device can grow fish in the basement of its own home and can provide both consumer and outside needs.

8.2.3 Other Economic Aspects

Further economic advantages of this system include the creation of employment chances, encouragement of entrepreneurs, and a different source of income for those looking for opportunities.

8.3 Cost benefit analysis

By assessing the costs and advantages offered by the system or product, the cost benefit analysis seeks to maximize productivity. Prior to comparing the productivity, the costs of the product should be determined, followed by the economic and financial benefits.

8.3.1 Individual Costs

Here, the direct costs are the costs of the materials that are used to build the whole system and directly attached to it. The direct cost for this system is :

Section	Components	Unit Price (Taka)	Total Price (Taka)
Hardware	Air pump, Micro-controller, Wires, drain motor, relay, LCD with I2C circuit, adapter, aerator motor	1000/-, 450/-, 300/-, 200/-, 250/-, 450/-, 600/-, 400/-	3,650
Sensors	Dissolve Oxygen sensor, Dissolve ammonia Sensor, pH Sensor	5192/-, 1752/-, 1787/-	8,731
Others	water container, transportation cost, pipes	750/-, 500/-, 200/-	1,450

8.3.2 Indirect costs

They are often fixed costs that go toward the overhead of running a firm, such utilities and rent. The rent expense is not present because this system is installed in their basement or field.

8.3.3 Intangible costs

Any existing and upcoming costs that are challenging to quantify and measure fall under this category. Examples can be lower productivity levels after the implementation of a new company process or lower customer satisfaction following modifications to customer care procedures that result in fewer repeat purchases.

8.3.4 Opportunity costs

This speaks about the potential or benefits that are lost when a company chooses one product or approach over another. There is hardly any chance to estimate the opportunity without any estimation because the technology is still a prototype.

8.3.5 Direct Benefits

The overall cost of the system has been shown in the direct cost section. Now that the financial benefit and the product sales amount have been taken into account, we can determine the direct benefits.

The fish that will be raised by the system will now be the main source of income. There are some things that need to be considered.

For instance, the location of the pond or drum where this technology will be used. Production is inversely correlated with drum size and area. Therefore, the budget will not grow linearly with the size of the drum's surface area. So, it can be claimed that the system is more advantageous, in terms of production and budget, the larger the area. It can seem that it will take some time to see the financial gain from the system because it has a moderate budget requirement. But, because this system was created for a social good, there are advantages that cannot be quantified in terms of tangible possessions.

8.4 Evaluate economic and financial aspects

A financial analysis should be done before starting a project to determine its viability. It is also vital to look at the project's cost, risk, and return. If there are many potential initiatives, the choice is based on the financial analysis of the best project. Simply said, determining the financial viability of a project by using the methods below.

8.4.1 Evaluate Cost of Product

The direct cost of the product, which is equal to 13,831 BDT, has already been covered in the parts before this one. It is almost 130.33 US dollars. Moreover, operations and other costs for implementing this system should not exceed 2000 BDT.

8.4.2 Time Value of Investment in Money

It's critical to calculate the time value of the product for every project. The product should enable users to save time, money, or other resources. This technology, which automates fish culture and monitoring, exists to save its users a significant amount of time.

8.4.3 Payback period

Any technique or product has a time frame for recouping the advantages or monetary sum that was anticipated. The payback period for this system can last however long the consumer chooses to keep the system operational. For instance, if there is maintenance, the system may endure a long time. With ongoing fish production, certain expenditures will be subtracted from the benefit, but the earnings will remain constant.

8.4.4 Risk Evaluating

Every system has a certain amount of risk. The only potential danger in this situation is the maintenance, which, barring any unusual circumstances, must be completed within 1.5 to 2 years. There are additional risks, but they shouldn't worry you because they are extremely unlikely to occur.

8.5 Conclusion

The system's financial and economic features have been covered in this chapter. The primary purpose of the measuring methodology is to compare the system to its potential. Even so, there are some factors that are ethereal and practically hard to quantify with the right instruments. Nonetheless, the conversation can show a distinct picture of the system's economic advantages.

Chapter 9: Ethics and Professional Responsibilities CO13, CO2

9.1 Introduction

Ethics and professional obligations are essential to any engineering project. Concerns about the selection of products, methods, systems, and solutions fall under the category of ethics and professional responsibility. User autonomy, safety, sustainability, and privacy are some of the issues. In this case, ethical concerns and professional obligations are upheld well. In our project, we exercise extreme caution when it comes to issues like plagiarism, performing duties without the owner's/consent, person's and invasions of personal privacy. Every safety precaution is taken, and while working, honesty is upheld. By referencing them, credits are properly given. In the subsequent papers, all hazards are evaluated, their levels are listed, and their backup plans are discussed.Useful, durable materials and equipment are employed. Also included are facts regarding upkeep. In other words, all work is performed honestly and without plagiarism.

9.2 Identify ethical issues and professional responsibility

9.2.1 Ethical Consideration

There are various ethical issues for studies that should be followed in research projects in any nation. These moral considerations are always taken into account in this project such as

- One crucial ethical principle that has been scrupulously upheld in this study is that none of the group members plagiarized text from other works. Just 5% and 4% of resemblance, respectively, have been detected in the project concept note and project proposal report following checking, which is significantly less than the minimum rate permitted.
- Before creating this project plan, permission from the building's owners will be required to work in their basement because it is their private property. If necessary, further informed-consent rules with accurate information regarding benefits and dangers will be signed. The process for creating the project, how long it will take to set it up, the contractors' contact information, and other information will be provided. If the person is

underage or has a disability, this will be taken into consideration, and the guardian will also be given the full story before receiving their signature.

- Users will be made aware of how the information is used.
- Together with consent, user data privacy and confidentiality shall be upheld. For viewing the live or recorded data, users will receive a pass. The information will be kept in a secure location with controlled access.
- Regarding the water line and electrical wire connection, safety precautions shall be upheld. In other words, efforts will be made to lessen dangers and improve user safety.
- If a need for any ethical consideration materializes, it will be reviewed with the local ethical consideration Committee.
- Honesty, justice, and impartiality shall be upheld, meaning that the designs will be created with consideration for a person's moral obligations.
- The project is not a carbon replica of any existing work. Compared to other projects created on related ideas, it has undergone some alterations and upgrades.
- The update will definitely be made if there is any information obtained about the premise of the research findings changing.
- The references for the books, articles, websites, and other sources used for this project's study are listed at the conclusion of the proposal report. Hence, the authors cannot claim full credit for the research.

Inspiring Excellence

Department of EEE
Spring 2023
EEE400C
BRAC University

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ATC Panel-2

Group-8

Project Name: Automated monitoring and control system for bottom clean raceway fish culture technology.

This is to acknowledge that group-8 from FYDP-C has taken permission to work in BRAC university laboratory under supervision.

Nazma
27.04.23

Signature

9.3 Apply ethical issues and professional responsibility

9.3.1 Risk Management and Contingency Plan

There will always be certain process and component risks for any project. Here is a list of those issues, along with recommendations for how to avoid them.

Risk Type	Analysis	Level	Contingency Plan	Responsible
Short Circuit	Due to physical damage	High	Fuse	fardin
Continuous Electricity Supply	Lack of power supply from national grid	Moderate	Solar Panel	Mahfuz,fardin wadood
Fire	Due to short circuit	High	Automatic Watering System and Alarm	Wadood ,fardin
Sensor Error	Long time usages	Moderate	Warning and physical replacement	Faijul, Mahfuz
Server Error	Due to mismanagement	Moderate	Maintenance	Faizul
App Malfunction	Due to mismanagement	Low	Maintenance	Faizul, Mahfuz
Data Loss	Server Error, Connection Problem	Moderate	Maintenance	Mahfuz

9.3.2 Continuous electricity supply

For bottom clean raceway fish culture technology to work correctly, an ongoing energy supply is needed for the automated monitoring and control system. A variety of problems, including equipment failure, fish death, and loss of productivity, can arise from any interruption in the power supply. To lessen the effects of power outages, it is crucial to have a risk management and contingency strategy in place.In the project, sensors will be utilized.For the sensors to detect the ammonia, dissolved oxygen, and other wastes, they will need a constant electrical connection.We will either utilize a size of battery or connect the entire system to a generator to ensure a constant supply of electricity.so that our system can function without issue even when there is a supply of electricity from the national grid.

9.3.3 Power connection and Fire

A number of live wires will be employed in this project to supply the system with energy continuously . The system may occasionally get electricity at varying levels. Again, anyone may be electrocuted if they touched live wires. Therefore, no one will be able to simply approach the plug connections or the live wires thanks to the system's architecture. In order to increase the distance between people and the wires, plastic covers can be used above the connection lines. This will add an additional layer of protection even if the wires' original insulation covering eventually becomes visible on their exposed surface. Once more, difficulties may arise as a result of earthquakes and power connections may be disrupted or damaged. In this situation, careful investigation and appropriate connections must be established with the goal of preventing the equipment from receiving an excessive amount of electric power.The components of the devices may now be harmed by the supply of excessive or insufficient electricity and may even sustain permanent damage. Accidental fires caused by short circuits are possible, but not likely. We shall thus utilize fuses or circuit breakers to stop these kinds of events. Any excess flow of power will be stopped by these electrical components. As a result, the system's components will always be secure.

9.3.4 Data loss

To protect the health of the fish, we will need accurate information about them. Data is a crucial component in this scenario for all consumers. Anyone who loses data will be negatively impacted. Data loss is a relatively common problem in wireless systems. The devices restart whenever there is a power outage. The entire data set or a portion of the data set could be lost after resuming. An information storage system can be utilized to avoid this problem. For approximately seven days, one month, or six months, the data storage system will retain the data. The system might also have a backup of the data in online data storage here with improvements. Software tools for preventing data loss are also available. As a result, we will effectively avoid data loss in this manner.

9.3.5 The incapability of the components of devices to work in high voltage or low voltage

The system will receive a substantial supply of voltage. In the system, many materials are employed. Not all of them can function under the same circumstances. We require a sufficient voltage supply to ensure efficiency. Low voltage supplies could disrupt system operations, whilst high voltage could injure some of the more delicate components. A subsystem can be utilized in this situation to first step down the direct voltage that is received from the. Second, ac (alternating current) connections can be made using rectifiers. Thirdly, an inverter can be utilized to guarantee that the project's gadgets continue to operate. By consuming the least amount of electricity necessary to perform flawlessly, the inverter will guarantee that the components will operate continuously. We may utilize the power supplied extremely well by using various gadgets under various operational situations.

9.3.6 Safety Consideration

Every project must be created in such a way that it can be operated flawlessly and without causing any harm to any individual or community. As a result, while developing the concept for the project, safety measures for the system were taken with regard to the choice of technological equipment, the manufacturing process, and the end product. Below, some key safety precautions have been thoroughly outlined.

- First and foremost, while working on the project, the required safety precautions will be performed and workers will wear specific protective gear to keep them away from parts that may potentially break easily or become contaminated with other materials.[11] For working with low voltage electrical equipment, employees can put on flame-retardant clothing that does not rip open in an accident to lessen their suffering. Different levels of protective gear can be worn instead of having a single fixed level of protection in order to force the wearer to adjust to the level of protection and actually receive some protection. When necessary, personal protective equipment should be worn.
- The electrical connections will then be secured securely enough to prevent somebody from becoming shocked by touching the wires from the outside. There will be actions made to tackle the hazards at their source.[10] The right insulating material will be used to cover the wires. Electricity overflow will not be a possibility thanks to the installation of fuses and circuit breakers. A wire needs to be used to properly ground the electrical system. In order to prevent wires from breaking easily and to ensure that there is a large space between the conductor wires and the ground, the mechanical design should take into account the entire electrical connection.[9]
- Furthermore, the project will be presented in such a way that there won't be any chance of short circuits in the device's path during the provision of water because electrical components will be present alongside the water supply. So, without any concern, anyone can wander along that walkway and touch items.
- The machine will only carry out the tasks that we have given it. Neither nature nor people would be harmed.
- To ensure that the system operates efficiently and that each individual owner's secrecy and privacy are maintained, the programming commands must be precise and effective.
- Always keep in mind that the project must not harm any natural elements of the environment. The entire system will be built so that it won't disturb the environment or any living things with its noise. Additionally, heat generation will be kept within a reasonable level.

- To prevent any incidents, maintenance will be performed according to the schedule.[9]
- Users will be provided with system information and warned of any concerns. It is important to try to minimize any dangers that may be avoided. By substituting unsafe items with safer ones, risks that cannot be avoided will be lessened or preventative measures will be adopted.
- There are several possibilities available when choosing the materials. The overall material mix will be created in a useful method to aid in the system's durability.

9.4 Conclusion

From the texts above, it is clear that every group member maintains their professional standards and takes into account all ethical aspects. Laws and regulations are rigorously upheld. The dangers are all examined. To ensure the safety of people, measures are done to lower overall risks and prevent accidents. IEEE references are attached and properly cited.
As a result, we can draw the conclusion that all work has been done ethically and in accordance with professional obligations.

IEEE Standards	Name
IEEE 830 / IEEE 1233	Software requirements specification
IEEE 829	Software Test Documentation
IEEE 12207	Information Technology– Software life-cycle processes

Chapter 10: Conclusion and Future Work.

10.1 Project summary/Conclusion

Automated Bottom clean raceway fish culture is the advanced technology is the advance system in this bottom clean culture.This type of fishing process is already exist in our country and its a popular types of fishing system but the automated bottom clean raceway will be the future technology of this type of project.The most important point of this project is scientifically removing the waste from the bottom of the reservoir and the rotation of oxygen and food supply to the fisher in this type of culture system and as the amount of oxygen is higher so it is possible to culture fishes 10-15 times more than the previous production..Initially we have designed two approaches for our project and both of the approaches were very effective for this project but we had to consider efficiency and other improvements so we have selected the approach 2 for the optimal choice.Approach 2 is different from the approach 1 in some ways like more power efficient, cost effective and sensors availability and ease of monitoring.In our project, Sensors will receive data and sending it to the microcontroller. In this approach some threshold data of NH3 and PH will be saved in the microcontroller and from the microcontroller the data will be sent to the IOT server. When the level of the pH and NH3 is getting higher than the given threshold data in the microcontroller the drain motor will start automatically and after when it will come back to the normal condition the motor will stop automatically. Same thing will happen when the dissolved oxygen level will be below the threshold value. The extra air pump will be turned on and it will also send message notification through the IOT server.Our main objective is to ensure the automated system which will affect the production and also monitoring system. We are trying to save energy and ensure the quality of water along with all parameters of water which is very important for the fishes. After doing some data analysis, we have found that the energy consumption after automation is much less than the previous manual processes.This project will help to the people whom are already working this bottom clean technologies to produce more fishes in less time will less electricity and proper maintenance and ultimately this will encourage other people to start this types of fishing cultures.

10.2 Future work

This automated bottom clean raceway technology will be the future of this bottom clean culture.In future, we can add solar panels for the backup energy system.Nowadays, our country is facing some load shedding issues in many areas specially for the rural areas.Suppose when the oxygen pump is needed to start because of decreasing the level of oxygen but if there is no electricity for 1 hour and it will affect the fishes.So, for this kind of situation we can add the solar panels for the backup energy sources.

We can use a mud block machine at the center of the system for the drainage purpose and it will clean only the wastewater from the tank. Also we can set an aeration pump to the system depending on the capacity of our system.

Chapter 11: Identification of Complex Engineering Problems and Activities.

11.1: Identify the attribute of complex engineering problem (EP):

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	√

11.2: Provide reasoning how the project address selected attribute (EP)

11.2.1 Depth of knowledge required

This project involves implementing electrical circuits, various sensors, and location detection techniques with the right expertise and giving the system's additional features command through coding. So, this project cannot be completed without proficiency in these softwires, such as Proteus, Arduino IDE, Blynk cloud, as well as understanding of the devices and sensors.

11.2.2 Depth of analysis required

Several criteria have been taken into account in order to accomplish this project, including if it can be shown in an urban setting from an environmental, economic, and cultural point of view. A comparison has been done with other emerging nations that have been using this technology for some time with positive results. So, for a consistent result, the design approach, sensor placement, and power distribution all need to be precisely estimated.

11.2.3 Familiarity of issues

In Bangladesh, one of the industries with the greatest potential for technological advancement is agriculture. This initiative focuses on raising the profile of this industry in urban areas so that city dwellers can benefit from fresh fishes and become acquainted with the technologies

11.2.4 The extent of stakeholder involvement and needs

The eventual goal of this research will be to accustom people with automation. Because it's a new system, people must adjust to it and grow accustomed to it while also taking the cost into account. The more actively they participate, the easier and more widely accepted the system will be as it spreads throughout the city.

11.3 Identify the attribute of complex engineering activities (EA)

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	√

11.4 Provide reasoning how the project address selected attribute (EA)

11.4.1 Range of resource

Research has been conducted to get as many thoughts as possible about this project and to gather information that will enable us to choose the precise range of components we need to employ and how to make the project cost-effective. Also, it has broadened our perspective so that we may consider several operating strategies and pick the optimal one in terms of parts, technology, and software.

11.4.2 Level of interaction

Due to the fact that users will become aware of the system's advantages when they utilize this component, it is also essential to its usability. The project's advantages must be shared from person to person. This will encourage the people who make up our target audience to carry out this activity locally. People with enthusiasm would always learn about new technologies like this.

11.4.3 Consequences for society and the environment:

The user will be able to precisely monitor the fish culture system thanks to this project. Fish production will therefore be excellent and fish culture will be simple. As the majority of people eat fish, this can strengthen neighborhood ties and persuade others to adopt similar technology. Consequently, it has repercussions for society.

11.4.4 Familiarity :

One of the sectors in Bangladesh with the greatest potential for technological advancement is agriculture. This program intends to grow this industry in metropolitan areas so that city dwellers can take advantage of nutritious, fresh fish and learn about cutting-edge technologies that can help them solve their problems. Hence, this effort has had a significant positive impact on urban regions.

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Appendix:

Codes:

```
#define BLYNK_TEMPLATE_ID "TMPLidw0Vaum"

#define BLYNK_TEMPLATE_NAME "Test"
#define BLYNK_AUTH_TOKEN "8tIjtqZbiQuQGHInPCDxWFWVrZ-ntvk_"
#define BLYNK_PRINT Serial


#include <WiFi.h>
#include <WiFiClient.h>
#include <BlynkSimpleEsp32.h>
BlynkTimer timer;
#include <Wire.h>
#include <LiquidCrystal_I2C.h>

LiquidCrystal_I2C lcd(0x3F, 16, 2);

char ssid[] = "NaduFai";       // Your WiFi network name
char pass[] = "fjl.lv.ndu";   // Your WiFi network password
int drainbuttonState;
int dobuttonState;

const int analogPin = 32; //NH3




const int phpin= 34;



//Do part

#define TWO_POINT_CALIBRATION 0
#define DO_PIN 35
```

```
#define VREF 3300
#define ADC_RES 4095
#define READ_TEMP (25)
#define Cal1_V (1455)
#define CAL1_T (25)
#define CAL2_V (1300)
#define CAL2_T (25)
const uint16_t DO_Table[41] = {14460, 14220, 13820, 13440, 13090, 12740, 12420, 12110, 11810, 11530,
11260, 11010, 10770, 10530, 10300, 10080, 9860, 9660, 9460, 9270, 9080, 8900, 8730, 8570, 8410, 8250,
8110, 7960, 7820, 7690, 7560, 7430, 7300, 7180, 7070, 6950, 6840, 6730, 6630, 6530, 6410};
uint8_t Temperature;
uint16_t ADC_RAW;
uint16_t ADC_Voltage;
uint16_t DO;
uint16_t readDO(uint32_t voltage_mv, uint8_t temperature_c)
{
 #if TWO_POINT_CALIBRATION == 0
 uint16_t V_saturation = (uint32_t)Cal1_V + (uint32_t)35*temperature_c - (uint32_t)CAL1_T*35;
 return(voltage_mv*DO_Table[temperature_c]/V_saturation);
 #else
 uint16_t V_saturation = (uint16_t)((int8_t)temperature_c - CAL2_T)*((uint16_t)CAL1_V - CAL2_V)/
((uint8_t)CAL1_T - CCAL2_T) + CAL2_V;
 return(voltage_mv*DO_Table[temperature_c]/V_saturation);
 #endif
}

// Do part end



void setup() {
 pinMode(12,OUTPUT);
 pinMode(13,OUTPUT);
 pinMode(14,OUTPUT);
 pinMode(15,OUTPUT);
 digitalWrite(12, HIGH);
 digitalWrite(13, HIGH);
 digitalWrite(14, LOW);
 digitalWrite(15, HIGH);
```

```
  lcd.init();
  lcd.backlight(); // initialize the LCD
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("FYDP-C Group8");
  lcd.setCursor(0, 1);
  lcd.print("bottmcln prjct");
  delay(3000);
  lcd.clear();
  Serial.begin(115200);
  delay(1000);

  // Connect to WiFi network
  WiFi.begin(ssid, pass);
  delay(3000);
  lcd.clear();
  lcd.print("Connecting to ");
  lcd.setCursor(0, 1);
  lcd.print(ssid);

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

    delay(3000);
    lcd.clear();
    lcd.print("connecting");
  }
  delay(3000);
  lcd.clear();
  lcd.println();
  delay(3000);
  lcd.clear();
  lcd.println("WiFi connected");

Blynk.begin(BLYNK_AUTH_TOKEN, ssid, pass);
delay(3000);
  lcd.clear();
}
```

```
BLYNK_WRITE(V0) {
 drainbuttonState = param.asInt(); // get the state of the button
 digitalWrite(12, drainbuttonState); // turn the LED on or off depending on the button state
 digitalWrite(13, drainbuttonState);
 if(drainbuttonState == 0){
  Blynk.virtualWrite(V5, "Drainmotor on manually");
  }

}

BLYNK_WRITE(V4) {
 dobuttonState = param.asInt(); // get the state of the button
 digitalWrite(15, dobuttonState); // turn the LED on or off depending on the button state
 if(dobuttonState == 0){
  Blynk.virtualWrite(V6, "DO generator on manually");
  }
}




void loop() {
 Blynk.run(); // Run the Blynk library

 //...........................................................................





 //...............................
 int sensorValue = analogRead(analogPin);  // read the analog voltage
 float voltage = sensorValue * (3.3 / 4095.0);  // convert the value to voltage
 float nh3v = voltage*1.5;

 float rs= (50/nh3v)-10;
 float ro= rs/3.6;
```

```
float ratio= rs/ro;
float ppm= pow(10,((log10(ratio)-0.42)/(-0.263)));

 //.........................................




  float   Value= analogRead(phpin);
  float   phvoltage=Value*(3.3/4095.0);
  float   ph=(3.3*phvoltage);

//DO part start
 Temperaturet = (uint8_t)READ_TEMP;
 ADC_RAW = analogRead(DO_PIN);
 ADC_Voltage = uint32_t(VREF)*ADC_RAW/ADC_RES;
 float Do= readDO(ADC_Voltage,Temperaturet)/1000;

 delay(1000);
 lcd.init();
 lcd.backlight(); // initialize the LCD
 lcd.clear();
 lcd.setCursor(0, 0);
 lcd.clear();
 lcd.print("NH3: ");;
 lcd.print(ppm, 2);
 Blynk.virtualWrite(V1,ppm);// print the voltage with 2 decimal places
 Blynk.virtualWrite(V2,ph);
 Blynk.virtualWrite(V3,Do);
 lcd.print("PPM");
 lcd.setCursor(0, 1);
 lcd.print("PH:");
 lcd.print(ph,2);
 lcd.print(" DO:");
 lcd.print(Do);

 //..................
 if(ppm>=0.6 || (ph>8.5 || ph<6 ) && drainbuttonState==1){
```

```
  Blynk.virtualWrite(V5, "Drainmotor on Due to Water Quality Fall");
    digitalWrite(12, LOW);
    digitalWrite(13, LOW);
  }
 else if(ppm<=0.4 && (ph<8.5 || ph>6) && drainbuttonState==1){

  Blynk.virtualWrite(V5, "Drainmotor Off");
    digitalWrite(12, HIGH);
    digitalWrite(13, HIGH);
  }
 if(Do<5 && dobuttonState==1){
  digitalWrite(15, LOW);
  Blynk.virtualWrite(V6, "Extra DO generation started due to low DO");
  }
  else if(Do>5 && dobuttonState==1){
    digitalWrite(15, HIGH);
  Blynk.virtualWrite(V6, "DO normal extra DO deneration off");
    }


 delay(3000);

}
```

Logbook :

	Final Year Design Project (C) Spring 2023		
Student Details	**NAME & ID**	**EMAIL ADDRESS**	**PHONE**
Member 1	Md Faijul Islam Mobin	md.faijul.islam@g.bracu.ac.bd	01911477155
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ATC Details:			
ATC 8			
Chair	Dr. Abu Hamed M. Abdur Rahim	abu.hamed@bracu.ac.bd	
Member 1	Md. Mehedi Hasan Shawon	mehedi.shawon@bracu.ac.bd	
Member 2	Dr. Saifur Rahman Sabuj	srsabuj@bracu.ac.bd	
Member 3	Tasfin Mahmud	tasfin.mahmud@bracu.ac.bd	

FYDP (P):

Date/ Time/ Place	Attendee	Summary of Meeting Minutes	Responsible	Comment by ATC
7/06/2022	Member-1 Member-2 Member-3 Member-4	1.Discussing ideas. 2.Research for a good (FYDP) topic. 3.25/2/22_11.00am new meeting	Task 1:F,N,F,M Task 2:F,N,F,M Task 3:F,N,F,M	**Find a topic which one can complete in one year. **Simulation result **cost effective.
14/06/2022	Mahfuz(M) Fardin (F)	**Things we have to analyze. 1. 1 year time. 2. 3 different designs. 3. Is it possible with a simulation tool?	Task1:F,N,F,M Task2:F,N,F,M	1.New topic 2.Find some research paper related to this 3.You have to complete it in one year.
20/06/2022	Member-1 Member-2 Member-3 Member-4	Design and Development of a Glove for Post Stroke Hand Rehabilitation. T1: paper findings T2: paper reading next meeting 10pm (6/3/22) T3: Sharing Idea from Pape	Task1:Faizul Task2:F,N,F,M Task3:	N/A
28/06/2022	Member-1 Member-2	T1: Multiple Design Approach T2: Specifications, Requirements, and Constraints T3:Specifications,	T1:Mahfuz T2: Fardin,Nahid T3:Faizul T4: Mahfuz	N/A

	Member-3 Member-4	Requirements, and Constraints T4: Conclusion next meeting 9pm(7/3/22)		
7/07/2022	Member-1 Member-2 Member-3 Member-4	Project Concept note Writing. 08.03.2022 ATC meeting.(offline)	T1,T2,T3,T4	N/A
14/07/2022	Member-1 Member-2 Member-3 Member-4	Project concept draft with papers. project selected. 9-03-2022 Concept note presentation. Slide making for presentation.	T1- F,N,F,M	N/A
21/07/2022	Member-1 Member-2 Member-3 Member-4	Revising our project again.	No, task	N/A
25/07/2022	Member-1 Member-2 Member-3 Member-4	Discussion about the project proposal.	Writing their own part common with the concept note	N/A
2/08/2022	Member-1 Member-2	Writing the draft proposal. T1- Design 3, Methodology T2- Safety consideration, Applicable standards	T1- Faizul T2-Mahfuz	N/A

9/08/2022	Member-3 Member-4	Correction in design writing. submitting the draft project proposal.	T1- Fardin,Nahid	Make corrections on those marked positions
18/08/2022	Member-1 Member-2 Member-3 Member-4	Expected outcomes, Impact, sustainability, Project plan, Budget. Meeting with ATC at 11am on 19.04.2022	T1- F,N,F,M	Use some block diagrams for representation.
23/08/2022	Member-1 Member-2 Member-3 Member-4	Correcting project proposals.	F,N,F,M	N/A
27/08/2022	Member-1 Member-2 Member-3 Member-4	Presentation slide	F,N,F,M	N/A
31/08/2022	Member-1 Member-2 Member-3 Member-4	Final Project proposal.	F,N,F,M	N/A

FYDP (D) :

Date/ Time/ Place	Attendee	Summary of Meeting Minutes	Responsible	Comment by ATC
28/09/2022	Member -1 Member-2 Member-3 Member-4	Task1: Meeting with Tasfin sir to revisit the design approaches and finally confirming how to implement those designs.	Task 1:F,N,F,M Task 2:F,N,F,M Task 3:F,N,F,M	N/A as it was an introductory meeting.
14/10/2022	Member -1 Member-2 Member-3 Member-4	Task 1:Importing necessary libraries for proteus	Task1:F,N,F,M	Task1: Completed
20/10/2022	Member -1 Member-2 Member-3 Member-4	Task 1: Further research on each individual approach	Task1:F,N,F,M	N/A
28/10/2022	Member -1 Member-2 Member-3 Member-4	Task 1: Completion of background research	Task1:F,N,F,M	Task1: Completed
7/11/2022	Member -1 Member-2 Member-3 Member-4	Task 1: Prototype designing for first two methods	Design 1: Fardin, Mahfuz Design 2 : Nahid ,Faizul	Task1: Completed

14/11/2022	Member -1 Member-2 Member-3 Member-4	Further validation of two different designs.	T1- F,N,F,M	Completed
21/11/2022	Member -1 Member-2 Member-3 Member-4	Validating the outputs and checking with different parameters.	F,N,F,M	Completed
9/12/2022	Member -1 Member-2 Member-3 Member-4	Task 1: Choosing optimal design among the two designs using comparison analysis	F,N,F,M	Task 1 : Completed
11/12/2022	Member -1 Member-2 Member-3 Member-4	Slide preparing & Report writing	F,N,F,M	N/A
17/12/2022	Member -1 Member-2 Member-3 Member-4	Presentation.	F,N,F,M	Completed
19/12/2022	Member -1 Member-2 Member-3 Member-4	Task1: Modification	T1- F,N,F,M	Completed

FYDP(C) :

Date/ Time/Place	Attendee	Summary of Meeting Minutes	Responsible	Comment by ATC
04/2/2023	All members from Students ATC Chair	Meeting time fix, feedbacks from FYDP D	ATC Chair	
11/2/2023	All members from Students ATC Chair	Feedbacks on optimal solution	ATC Chair	
18/2/2023	All members from Students ATC Chair	Simulation process and work distribution	Member 4	
25/2/2023	All Members from Students ATC Chair	Website Development 1 hours	Member 1 & 4	
01/3/2023	All Members from Students ATC Chair	Presentation Slide and progress on prototype 2 hours	Member 3 & 4	
15/3/2023	All Members from Students ATC Chair	Prototype and website Development	Member 4	
22/3/2023	All Members from Students ATC Chair	Prototype and website Development	Member 3	
29/3/2023	All Members from Students ATC Chair	Prototype and website Development	ATC Panel	
06/4/2023	All Members from Students ATC Chair	Prototype and website Development	Member 1	

08/04/2023	All Members from Students	Prototype and website Development	Member 4	
12/04/2023	All Members from Students ATC Chair			

Assessment Guideline for Faculty

[The following assessment guideline is for faculty ONLY. **This portion is not applicable for students**.]

Assessment Tools and CO Assessment Guideline

	Distribution of assessment points among various COs assessed in different semesters														
PO	l	c	f	g	c	b	d	c	e	l	k	k	h	i	j
CO	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6	CO 7	CO 8	CO 9	CO 10	CO 11	CO 12	CO 13	CO 14	CO 15
EEE 400C/ ECE 402C (Out of 100)							30	24	6	4	4	6	7	7	12
Project Final Report/ Project							x	x	x	x	x	x	x		x

Progress Report															
Demonstration of working prototype							x								x
Progress Presentation/ Final Presentation								x			x				
Peer-evaluation*													x	x	
Instructor’s Assessment*													x	x	
Demonstration at FYDP Showcase								x							x

Note: The star (*) marked deliverables/skills will be evaluated at various stages of the project.

Mapping of CO-PO-Taxonomy Domain & Level- Delivery-Assessment Tool

Sl.	CO Description	PO	Bloom's Taxonomy Domain/Level	Assessment Tools
CO7	**Evaluate** the performance of the developed solution with respect to the given specifications, requirements and standards	d	Cognitive/ Evaluate	• Demonstration of working prototype • Project Progress Report on working prototype
CO8	**Complete** the final design and development of the solution with necessary adjustment based on performance evaluation	c	Cognitive/ Create	• Project Final Report • Final Presentation • Demonstration at FYDP Showcase
CO9	**Use** modern engineering and IT tools to design, develop and validate the solution	e	Cognitive/ Understand,	• Project Final Report

			Psychomotor/ Precision	
CO10	**Conduct** independent research, literature survey and learning of new technologies and concepts as appropriate to design, develop and validate the solution	l	Cognitive/ Apply	• Project Final Report
CO11**	**Demonstrate** project management skill in various stages of developing the solution of engineering design project	k	Cognitive/ Apply Affective/ Valuing	• Project Final Report • Project Progress presentation at various stages
CO12	**Perform** cost-benefit and economic analysis of the solution	k	Cognitive/ Apply	• Project Final Report
CO13	**Apply** ethical considerations and professional responsibilities in designing the solution and throughout the project development phases	h	Cognitive/ Apply Affective/ Valuing	• Peer-evaluation, • Instructor's Assessment

				• Final Report
CO14**	**Perform** effectively as an individual and as a team member for successfully completion of the project	i	Affective/ Characterization	• Peer-evaluation • Instructor's Assessment
CO15**	**Communicate** effectively through writings, journals, technical reports, deliverables, presentations and verbal communication as appropriate at various stages of project development	j	Cognitive/ Understand Psychomotor/ Precision Affective/ Valuing	• Project Final Report • Progress Presentations, • Final Presentation • Demonstration at FYDP Showcase