



Senior Design Project

IOT BASED SUBMERSIBLE ROV FOR PISCI CULTURE

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LETTER OF TRANSMITAL

5th April, 2019

To

Dr. K. M. A. Salam

Chairman,

Department of Electrical and Computer Engineering

North South University, Dhaka

Subject: **Submission of Capstone Project on “IOT BASED SUBMERSIBLE ROV FOR PISCICULTURE”**

Dear Sir,

With due respect, we would like to submit our **Capstone Project Report** on **“Iot based submersible ROV for pisciculture”** as a part of our BSc program. The report deals with pisciculture automation. We gained much valuable experience while working in this project which helped us immensely. We tried to the maximum competence to meet all the dimensions required from this report.

We will be highly obliged if you kindly receive this report and provide your valuable judgment. It would be our immense pleasure if you find this report useful and informative to have an apparent perspective on the issue.

Sincerely Yours,

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APPROVAL

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DECLARATION

This is to certify that no part of this report or the project has been previously submitted elsewhere for the fulfillment of any other degree or program. Proper acknowledgement has been provided for any material that has been taken from previously published sources in the bibliography section of this report.

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ABSTRACT

In this work we propose an IOT based submersible ROV for pisciculture for real-time monitoring and automatic control of fish farming.

Our project is divided into three parts: a submersible ROV, a sensor integrated system box and an automated system assistance box.

Our system is held in the center of the ROV. Our system consists of various sensors: temperature, turbidity, total dissolved solid and pH integrated in raspberry PI. A camera module is used in ROV for underwater image processing and an outdoor camera is connected with the outdoor system box for indoor surveillance. Some parts of image processing are also included in our project which is done using the surveillance camera module. Fish tracing, fish size measurement and fish counting is done via the camera module integrated in the system box and thief detection and fire detection is done using camera module 2.

Healthy fish rearing requires intensive care and ensuring stable and healthy production environment inside the fish farm task is a challenging task. Water quality, oxygen concentration in water, temperature plays important roles in intensive fish farming management. Our goal is to make fish farming easier, cost efficient and bring automation in this field.

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Chapter 1

Overview

1.1 Introduction

Technology is developed by human to improve the quality of human life. In this modern age all are using technological advances in many different ways. Because the increasing demands for fish and sea-food, fish-farming has become a widespread activity all over the world. The fish industry is becoming widespread all over the world. The world's appetite for fish is steadily growing. One of the most important food for humans are fishes. Fishes play many important roles such as providing employment, national economic development, providing nutrition and earning foreign currencies. About 5.3% income come from fish among the total national income. To meet the demand of the increasing population, fish farming needs to increase at a larger rate

1.2 Project Description

In our country before pisciculture our fishermen suffered a lot of hardship for fish farming. For doing fish farming they have to be aware about many factor of water such like DO, pH, alkalinity, temperature, turbidity, water level etc. They were looking for these manually. But there is a problem if any factor of water changes they couldn't able to know about this. As a result they faced some losses in this field and pisciculture couldn't be so developed. So, to develop this field we introduce our idea to bring some revaluation and make the system in automated way.

1.3 Purpose of the Project

PISCI culture can maximize the annual fish production of a nation. Over the years fish protein has played a vital role in eradicating malnutrition from Bangladesh. Using PISCI culture ensure the supply of fish of a certain breed throughout the year. It also reduces the risk of extinction of some endangered species among fishes. Moreover PISCI culture has several

economical benefits. We can export the surplus fishes produced every year to various nations. This will improve our economic growth and stabilizes our socioeconomic condition.

1.4 Project Goal

Healthy fish growth is necessary for the betterment of humans, growth of economy and enhancement of employment.

For Human - Fish is an important part of our diet since it is lower in fat than any other source of protein and is rich in nutrients such as vitamin A, vitamin B12, calcium, zinc and essential fatty acids (omega-3 fatty acids). It also helps in lowering risk of heart attack and strokes.

For economy - Fish farming plays an important role in the national economy of Bangladesh, contributing 3.96% to the Gross Domestic Product (GDP) of the country and 22.60% to the agricultural GDP. The position of fish is in third for earning foreign currency to Bangladesh. About 10% of total exported income comes from the fish and fish products. [1]

For employment - Many people earn their livelihood by catching fish from water bodies (seas, rivers, oceans)

Therefore, we have few goals set initially which we achieved success upon completing the project. We tried our hard best to achieve the goals while upgrading the system when needed. We came up with new and more improved plans for the betterment of the system. Goals are mentioned below:

- Submersible ROV
- Real-time water quality monitoring
- Automatic water pump controlling
- Fish counting, fish disease, fish pellet counting using image processing.
- Automatic water filtering, O₂ pump, controlling water temperature.
- Fish feeding system
- Indoor security system using computer vision.
- Cloud database

- Motion activated Surveillance system with Artificial intelligence
- Custom Triggers and alert system from IOT Panel
- Scheduling Events via IOT

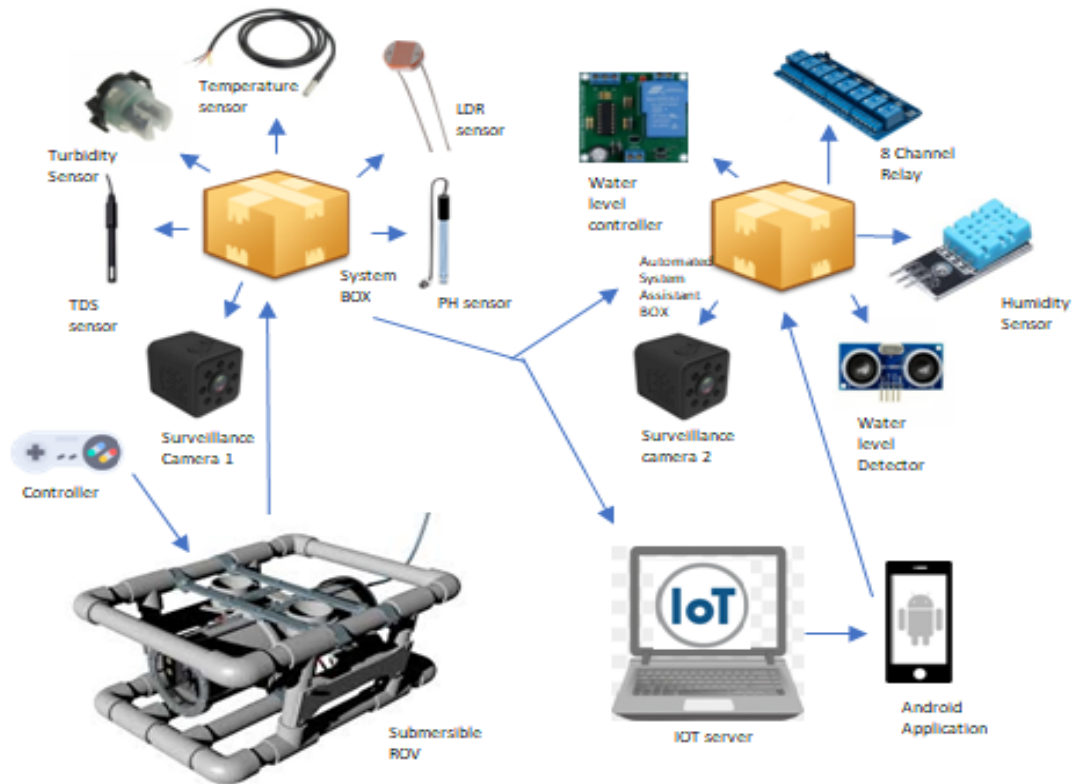


Figure 1.1: System Architecture

1.5 Summary

In this chapter we have discussed the importance and goal of our project. Fish farming remains an important part of our agricultural sector but traditional farming requires logistics and doesn't guarantee efficient fish rearing. The introduction of an automated fish farming system, especially in developing countries, will maximize the profit of the farmers, will ensure the healthy growth one of our important staple foods and enhance the national revenue by maximizing the growth of pisciculture.

Chapter 2

Existing Systems

2.1 Introduction

Currently pisciculture is done mainly due to personal interest and it is done is smaller scale because the amount of manpower it needs is high. The size of the manpower is not the only limitation, it is very difficult to find large number of skilled workers that can extract the information and use it. In most cases people who are affiliated with pisciculture do not have clear idea on fish disease detection. So they cannot maximize their yield and the pisciculture remains within a cottage industry level. Measuring a single parameter like a water quality monitoring requires a lot of steps: A qualified person takes measurements of quality variable normally using a multi-parametric instrument. In case of detecting a contamination alarm, a sample of water is taken and transported to a chemical laboratory in order to analyze the hazardous substances mixed with water. The maintenance of the measurements and alarm events is manual and time-consuming. Otherwise, some contamination episodes might be missed

We are introducing a fully automated IOT based submersible ROV that takes the value of the various water quality parameters through the sensors and send it to the user through IOT. Depending on various conditions the user can take necessary steps using the auto- mated system assistance box connected with a mobile application like turning on heater or cooler; turning on water pump; water filter; water drain valve; fish feeder etc

2.2 Similar Existing Systems

There are several ways to establish a fish farm. You can raise fish in a natural or man-made outdoor body of water, such as a lake or river, by placing barriers between your farmed fish and other aquatic wildlife. You may also use above-ground tanks and filters to construct a fish farm away from a natural water source. In addition to the basic requirements of almost any business, there are some specific tools and equipment you will need for a fish farm.

- **Boats and Docks** - For an outdoor fish farm, you may need to move over your captive fish in order to feed, monitor and harvest them. A modular or movable floating dock will allow access to your fish while providing enough surface area to hold feed, nets and other equipment. If you have less equipment, or if you need to cover a larger area more quickly, use a motorized boat to move over your fish farm. Any type of boat will work, including durable inflatable rafts and aluminum fishing boats, provided it has enough capacity to accommodate all of your cargo.
- **Submersible Cages and Nets** - For an outdoor pond, separate your farmed fish from other fish in the lake with submersible netting or a cage. Cages may be made of any durable material, such as plastic or metal, and are essentially mesh or perforated walls that allow water to flow through while preventing unwanted fish from entering and disrupting your livestock. Nets have the same effect, but are more flexible and collapsible for easy storage and transport outside of the water.
- **Aerators and Diffusers** - An aerator can either be a stationary air pump that circulates oxygen into the water through attached tubing, or it can be floated on a movable platform in order to move across the surface of the water. A diffuser is made of porous media such as stone, wood or rubber. As air passes through rubber tubing into the diffuser, the medium ejects it as tiny bubbles, which dissolve more readily into the water.
- **Filters and Tanks** - For above-ground fish farms, in which you do not use a natural body of water, use large tanks or pools to house your fish. Aeration is especially important for

these systems, as there is no natural circulation by which oxygenated water can enter the farming area. You will also need filters which maintain the health and livability of the water as it cycles through various concentrations of ammonia, nitrates and nitrites as the waste from your fish goes through chemical changes.



Figure 2.1: Modern way of Fish farming



Figure 2.2: Primitive way of Fish farming

2.3 Summary

In this chapter, we discussed about the similar systems that are being in traditional pisciculture by fish farmers or that are already existing in the society and being sold in markets for higher prices. There are various kinds of tools for pisciculture which are mainly invented to make the fish farming more efficient but costs a good amount of money that is not affordable for many. These tools are focused on various features and all these feature are made to ensure the right security for the owner of the systems. Sometimes a system may not have all the features that one needs.

Chapter 3

System

Design

3.1 Introduction

This system is designed to make Pisciculture more manageable, reliable and safer. The system is integrated into the ROV and rest of the system is in outside. User can also control ROV via IOT and remotely. This design is able to take readings automatically from different sensors and modules and do specific action based on users setting. And this system is enough for Pisciculture and judging water quality. In the System Assistance box, user can connect their 3rd party tools such as water filter, lights etc. Those things can be control via out Virtual system. Even user can set triggers on it. Such features make the system multi leveled and unique at the same time. Both main system and assistant system has high quality camera, one is in underwater and one of the camera is in outside water. Both camera can detect and do action based on AI. So this design makes users easier to surveillance the whole environment. Most importantly user can control the whole pisciculture from anywhere in the world via IOT.

3.2 System Description

The whole is divided in to two parts. They are hardware system and the virtual system. Both parts are described in details below:

3.2.1 Hardware Part

Our hardware system consists of three parts: a ROV, a sensors integrated system box, an automated system assistant box. Below the major parts are described briefly:

ROV: This is the main star of our project. We have built this in such a way that it can go underwater into very deep easily as well as this ROV part is associated with some features also.

We have built this ROV by using up thrust model of submersible machine. We have used six brushless motor which are so much powerful and as well as efficient also. Among those six motors 4 motors are used to carry our ROV into the deep part of water bodies and the rest two motors are used for moving our ROV left right and 360 degree rotation. The whole power supply of the ROV will be provided from the outside of water bodies because this power supplier will be connected with the wires come from the motors. So this ROV can be controlled from outside without any trouble. We will use mechanics for controlling our ROV in the water. Because we can use Bluetooth transmitter but we didn't because it will not be efficient as our system requires. The main reason behind this is actually under deep water Bluetooth will not work efficiently that's why we use mechanics to control our ROV. This way is the best and easiest way to control this ROV .Beside in the ROV there is a surveillance camera and a strong light to get clear video and image from deep of the water and our main system box is also integrated with this ROV

Sensor integrated system box: We have used an ESP8266 module and a Raspberry Pi and a MCU for controlling and processing the system mechanism. Our “Automated System” contains two parts, Main system box and Assistant system box. The Main system box contains ESP8266 module with sensors and modules. And Assistance system box contains Raspberry Pi, MCU and 10 Channel Relay and Power sources. ESP8266 has been used for controlling all the sensors, water quality sensing modules and probes. Like LDR, TDS module, Turbidity module, water temperature sensor, pH module and liquid level sensor is connected through ESP8266 module. A 16bit i2c ADC is used along with logic level shifter to ESP8266 module so that we can get more accurate readings

Automated system assistant box: Raspberry Pi has 10 channel Relay and Humidity and Air temperature sensor, one enhancement light and two IR Night vision camera. One camera is for underwater and one camera is for outside water. Underwater camera is used for Surveillance, fish counting, fish size measurement, detecting fish disease, food pellet counting and motion capture fish images based on AI. And Outside camera is used for environment surveillance which can detect thief, fire and many more abnormalities. Where the system can also setup different actions based on detection. Standalone MCU has been used to control water motor pump with 12V relay based on 3 probe water level sensing. This MCU need 12V power supply to be activated. User can connect Magnetic Carburetor where they can connect water motor pump. Here user can set probe for water range and based on water probe, MCU will detect when to enable water motor pump and where to not.

3.2.2 Virtual system part:

In the Virtual Part, MQTT broker has been used mainly for IOT. As ESP8266 and Rasp- berry Pi both have Wi-Fi SOC inbuilt. So both are connected through IOT. With the help of MQTT, user can get data and send data for real-time with cloud database. Our web interface and mobile application is the platform where user can do that. User can control both Website and App independently. User can do Event Scheduling and set Triggers and alert management based on their choice. This setting is just like a variable and more robust. Like user can setup a specific action based on calendar, time or user can setup and setup certain threshold of sensing parameters to take actions or alert. For Alert, we have been used SMS service and buzzer. We just used Web Hook applet of ITTT for SMS service which is a free SMS service. This service replace GSM module and make the system more cost efficient.

Figure 3.1: Virtual System Overview

3.3 System Design

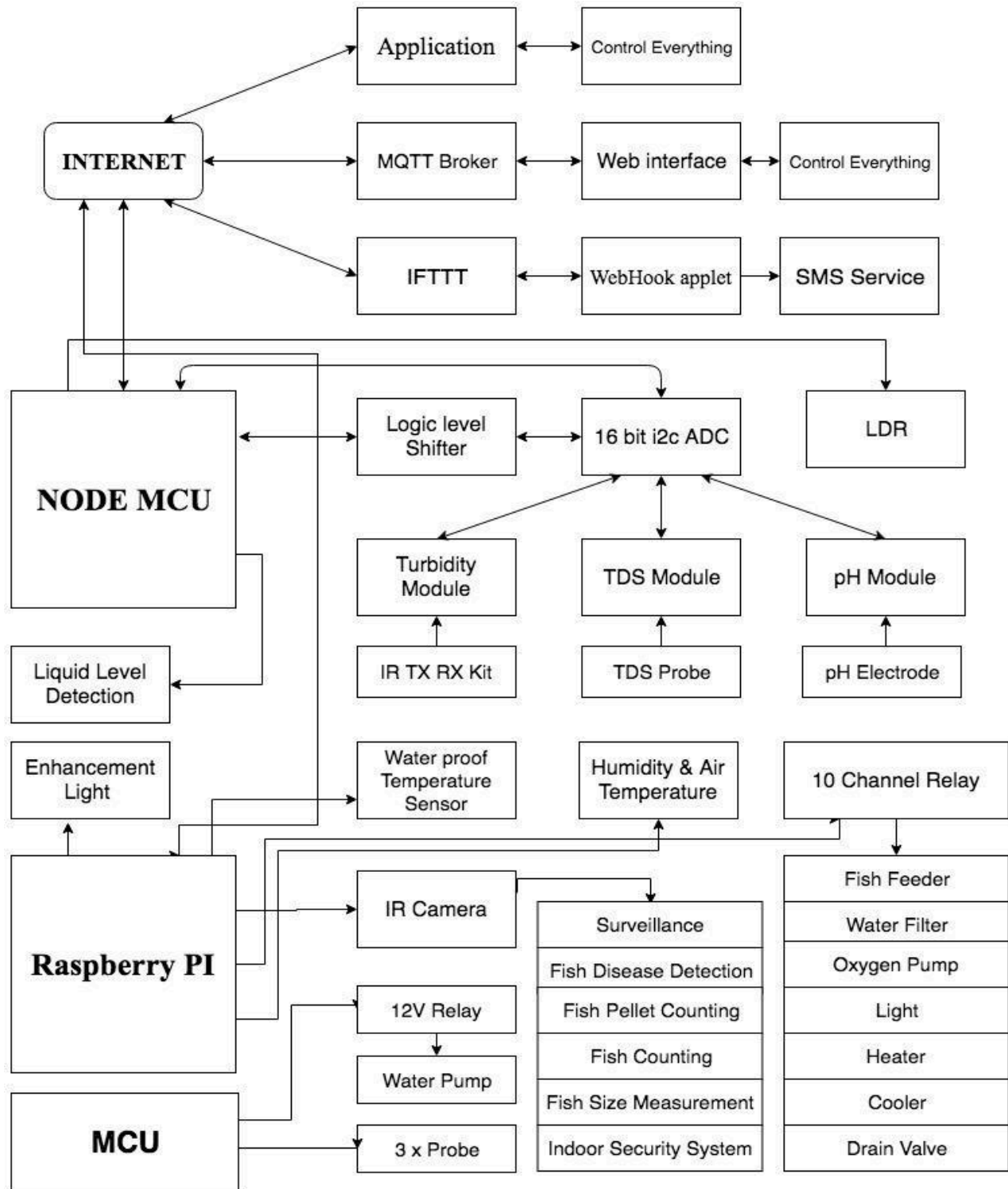


Figure 3.2: Full System Design

3.4 Summary

In this chapter, we have discussed how the system parts works for a better understanding of the system. As the system is designed into two main parts: the Automated System and Virtual System so we have discussed both the parts of the system in this chapter. The Automated system is designed in such a way that it will monitor many water quality parameters for real-time, control water pump automatically. And Indoor and underwater camera system using computer vision. The Indoor camera makes us aware about people who think of doing unethical activities with water or fish. And underwater camera for detecting fish disease, size measurement, fish counting and tracking, fish food pellet counting based on AI. Therefore it will set scheduling and triggers automatically on fish size and previous data it will give food for the next time. Even this system is designed such a way that people can add their own tools and control those tools via Virtual system. Our system lets an individual to keep an eye and track pisciculture and control flexibly and automatically and provide smart alert based on their choice.

Chapter 4

Technical

Description

4.1 Introduction

This chapter is dedicated for the description of the components used for technical functions of this project. The technical description of our project will be discussed in this section. Since our project contains various features we will discuss them one by one.

4.2 System Description

Our IOT based submersible ROV project consists of various components all of which works together to make the project standardized.

4.2.1 pH sensor

pH sensors measure the level of pH in sample solutions by measuring the activity of the hydrogen ions in the solutions. This activity is compared to pure water (a neutral solution) using a pH scale of 0 to 14 to determine the acidity or alkalinity of the sample solutions.

The pH sensor components are usually combined into one device called a combination pH electrode. The measuring electrode is usually glass and quite fragile. The preamplifier is a signal-conditioning device. It takes the high-impedance pH electrode signal and changes it into a low impedance signal which the analyser or transmitter can accept. The sensor's electrical signal is then displayed. This is commonly done in a 120/240 V ac-powered analyser or in a 24 V dc loop-powered transmitter.



Figure 4.1: pH Sensor

4.2.2 Temperature sensor

A simple temperature sensor is a device, to measure the temperature through an electrical signal it requires a thermocouple or RTD (Resistance Temperature Detectors). The thermocouple is prepared by two dissimilar metals which generate the electrical voltage indirectly proportional to change the temperature. The RTD is a variable resistor, it will change the electrical resistance indirectly proportional to changes in the temperature in a precise, and nearly linear manner.



Figure 4.2: Temperature Sensor

4.2.3 Turbidity sensor

Turbidity is the quantitative measure of suspended particles in a fluid. Turbidity sensors measure the amount of light that is scattered by the suspended solids in water. As the amount of total suspended solids (TSS) in water increases, the water's turbidity level (and cloudiness or haziness) increases.



Figure 4.3: Turbidity Sensor

4.2.4 Total dissolved solid (TDS)

Total dissolved solids (TDS) are a measure of the combined inorganic and organic substances dissolved in water. It is directly related to the electrical conductivity of water and as such can be used as an indication of change. Only relevant in freshwater systems as salinity will dramatically increase the conductivity and therefore apparent TDS.



Figure 4.4: TDS Sensor

4.2.5 Humidity Sensor

A humidity sensor (or hygrometer) senses, measures and reports both moisture and air temperature. The ratio of moisture in the air to the highest amount of moisture at a particular air temperature is called relative humidity.

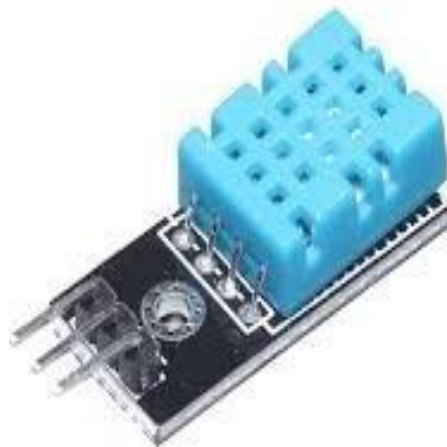


Figure 4.5: Humidity Sensor

4.2.6 LDR Sensor

While in deep water there are some regions where light cannot be reached so a LDR sensor is integrated with our underwater ROV so that in deep water we can turn on the light for clear vision.



Figure 4.6: LDR Sensor

4.2.7 Water Level Detection

The Water Level Indicator includes a simple mechanism which helps to detect and indicate the water level in an overhead tank or any other water container. The sensing is done by using a set of nine probes which are placed at nine different levels on the tank walls (with probe-9 to probe-1 placed in increasing order of height, common probe (i.e. a supply carrying probe) is placed at the base of the tank). The level 9 represents the “tank full” condition while level 1 represents the “tank empty” condition.[10]



Figure 4.7: Water Level Detector

4.2.8 8-Channel Relay

When there is any changes in the water parameters the relay channel takes various actions to counteract the changes. Like if oxygen level of water decreases it turns on the oxygen pump; if temperature increases or decrease it operates heater/cooler as per requirements.

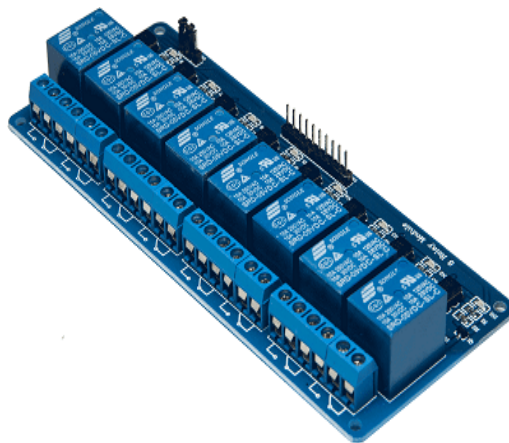


Figure 4.8: 8-Channel Relay

4.2.9 Remotely Operated Vehicle (ROV)

A remotely operated underwater vehicle (ROV) is a tethered underwater mobile device.

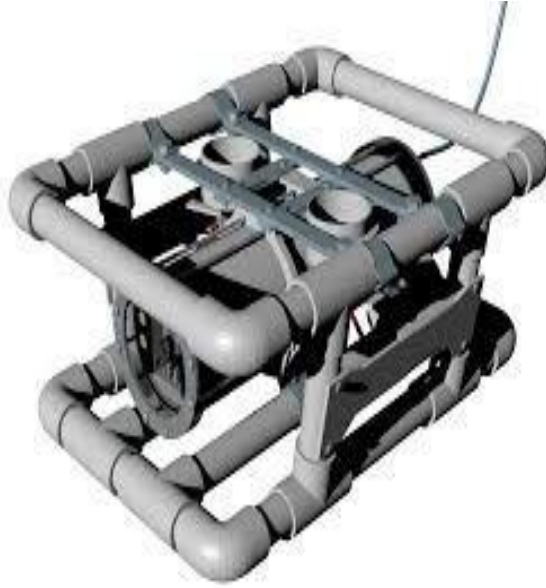


Figure 4.9: ROV

4.2.10 Surveillance camera

We have used two surveillance camera one with the ROV that is used for underwater visualization and another in our system box to do indoor surveillance. The indoor camera is used for fire and thief detection.



Figure 4.10: Camera

4.3 Summary

In this chapter we have discussed all the necessary components of our project. All these sensors work together to a fully automated system for pisciculture. All the sensors are tested for safety and are user friendly

Chapter 5

Design Implementation

5.1 Introduction

In this chapter, we will discuss about the design of the technical functions of the project. Implementation is the action that must follow any preliminary thinking in order for something to actually happen. Our project features required perfect design implementation in order to run in harmony with other features. We have discussed the entire design implementation in this part

5.2 List of necessary hardware components

- Raspberry PI
- ADS1135
- Dfrobot TDS Module
- Dfrobot pH sensor
- Water Turbidity Module
- Ds18b20
- Automatic Pump Controller
- 8 Channel Opto Isolated Relay
- Propeller
- DHT11 and LDR
- PVC Pipes
- IR Camera
- Logic Level Converter
- Sonar Sensor

5.3 Principle of Operation

The whole system is divided into five parts.

1. Sensor Integrated System Box
2. Automated System Assistance Box
3. ROV
4. IOT Server
5. Mobile Application

Each part has some principles for working properly and they are described below:

5.3.1 Sensor Integrated System Box

Various sensors are integrated in the system box to get real time values of water quality parameters. The sensors integrated are:

- Temperature sensor
- pH sensor
- Turbidity sensor
- Humidity sensor
- TDS sensor
- LDR
- Surveillance camera 1

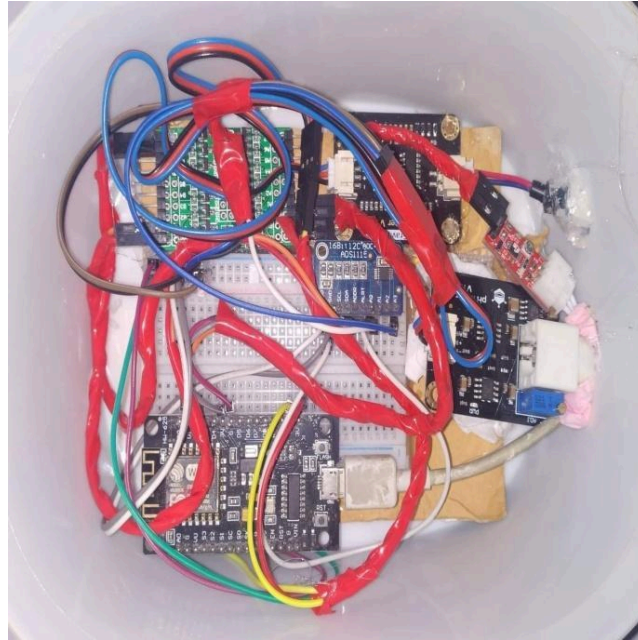


Figure 5.1: System Box (inside ROV)

All the sensors coding are done using ESP8266 and raspberry PI. The system box is sent under water by placing it at the center of the ROV. The values of the sensor are sent over to the user using IOT. The android application is used to display the values to the user. The surveillance camera is placed in front of ROV but it is integrated with raspberry PI outside the system box because the camera module sometimes heats up and creates problem. The surveillance camera 1 is used for fish image processing.

- **Fish counting and tracking:** For fish counting we have used Cam shift, edge detection algorithm, FAST algorithm etc. Here in image processing in brief there is a lot of steps and process. In brief when camera takes live streaming through camera it point out the fishes first by edge detection. Then It subtract and prune the whole background and using CAM shift algorithm it works for fish tracking and counting both. It's a very efficient and flexible for Raspberry PI processing to fish track and count.

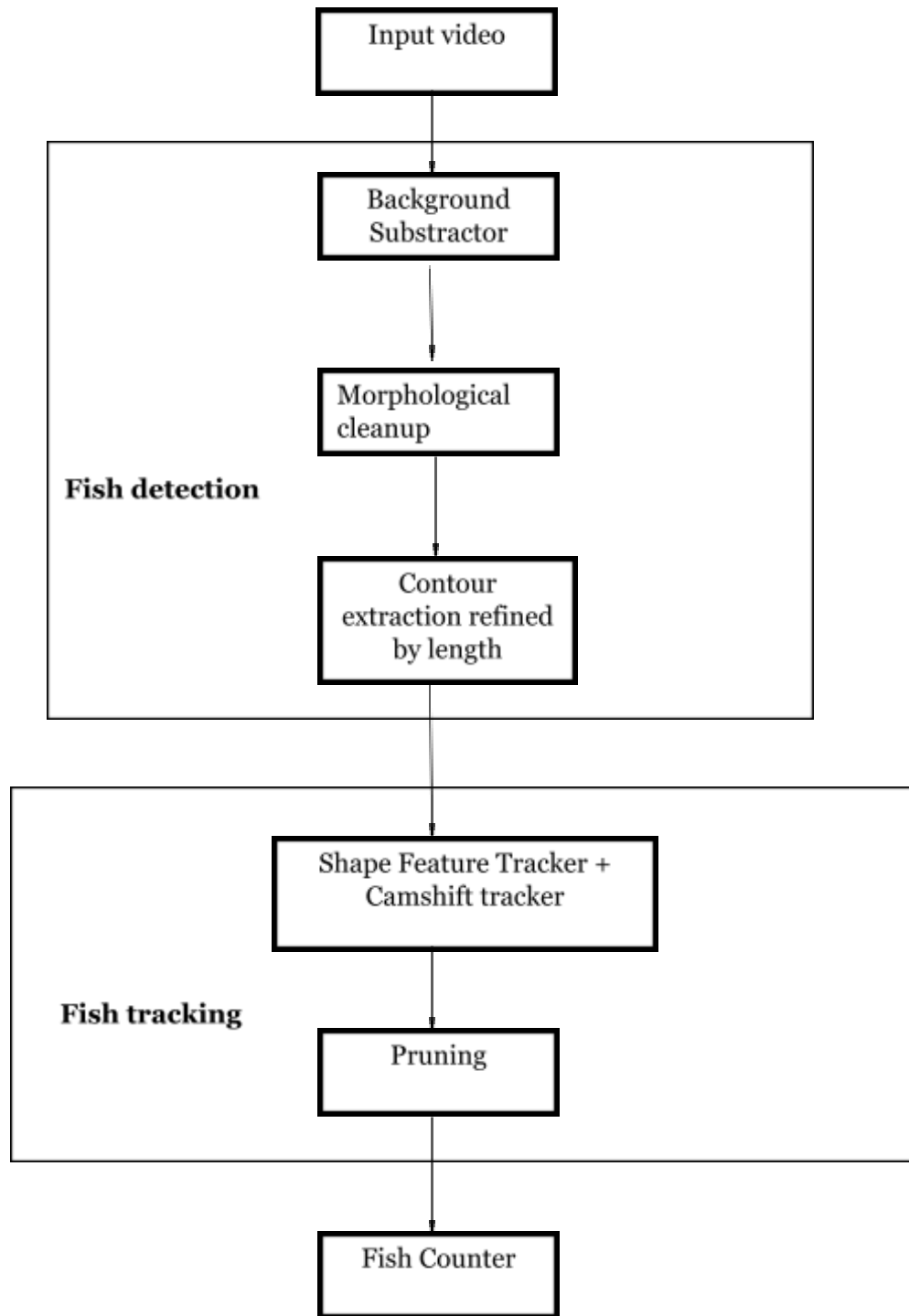


Figure 5.2: Fish tracing flow chart

Figure: 5.3 Fish Counting

- **Fish food pellet counting:** In our Image processing Fish food pellet counting is one of our features by which we can count the fish pellet. Actually we have do this to feed the fish according to their demand that how many fish pellet need to given on the water bodies. For this firstly our camera take capture from vedio of fish pellet then it turns to RGB to Grayscale. After that it does noise cancellation to get sharper image of the pallet and make the pellet's color black . To do this system contours the image than count the black dot. Thus after processing it shows u how many pellets are there to feed fish food.

- **Epizootic Ulcerative Syndrome detection:** Image processing is used to detect red like spot in fishes which are symptoms of epizootic ulcerative syndrome detection. Further accuracy is needed and we will improve this is our future work.

Figure 5.4: Fish skin disease (EUS)

- **Fish size measurement:** Underwater camera can capture the motion of the fish. Then it computes the distance from camera to a Fish. After that it computes the ” pixels per metric” ratio . In order to determine the size of fish from an image, a calibration is needed using a reference object. The formula is:

$$\text{Pixels Per Metric} = \frac{\text{fish_width}}{\text{known_width}}$$

Using this ratio, the system can compute the size of the fish from an image.

5.3.2 Automated System Assistance Box

The automated system assistance box contained the following:

- Humidity Sensor
- 8-Channel Relay
- Water level detector
- Surveillance Camera 2
- Water level controller



Figure 5.5: External System Assistance Box

- This assistance box plays a vital role in the project. The conditions of water bodies are not always ideal. Many a times the parameters changes and causes fatal effect on the fishes. Some of the important parameters values are discussed below:

- **Temperature Monitoring:** Temperature is an important factor that affects the welfare of fish. Fish are cold-blooded organisms and assume approximately the same temperature as their surroundings. The temperature of the water affects the activity, behavior, feeding, growth, and reproduction of all fishes. Metabolic rates in fish double for each 18°F rise in temperature. General temperature range for coldwater is 55-65°F, for warm water 75-90°F.
- **pH Monitoring:** pH is the measure of acidity or alkalinity in the water. The pH of pure water is exactly 7. Acidic water has a pH range from 0-7 and alkaline water has a pH range from 7-14. The optimum pH levels for fish are from 6.5 to 9. If the pH of water is too high or too low, fishes can become stressed and die. The more sensitive a fish, the more it is affected by changes in pH. Young fish are more sensitive to higher acidic water than adult fish. If the pH of the water falls below 4, it will kill off fish eggs and they will not hatch.
- **Turbidity Monitoring:** With respect to direct lethality, average turbidities as high as 200 units are harmless to fish and that fish can thrive in waters over 400 units. However, turbidities of 3,000 units are considered dangerous to fish when maintained over a 10-day period. At very high concentrations, the particulate matter that produces turbidity can be lethal. At turbidities causing death, the ocular cavities were found to be matted with soil and the gills had a layer of soil on them. Symptoms of distress generally appeared at turbidities much lower than those producing death. Harmful effects were observed as the turbidity approached 20,000 units [3]
- **Water Level Monitoring:** Water level is a critical factor that should be taken into

consideration in ensuring optimum growth, nutrient utilization and survival of fish species. This study was conducted to investigate the effects of water level on nutrient utilization, growth; survival of fish species. Water level is a crucial factor that must be achieved for optimum growth, nutrient utilization and survival of fish.

Maintaining Ideal Condition: To maintain the optimum condition of the water bodies we have designed the system assistance box. To maintain the ideal temperature cooler/heater if the temperature goes above or below a threshold value.

If the water decreases below a certain limit a water pump is automatically switched on to restore the water level.

A surveillance camera is also integrated for indoor security. When the owner is away it can be used to monitor the farm from far. Also many cases of fish stolen and poisoning water in fish farms are registered every year. So the camera is used to capture any motion in farm and image processing is used of thief detection. We have also implemented fire detection through image processing due to increased fire incident cases happening now-a-days.

5.3.3 ROV (Remotely Operated Vehicle)

Our ROV is designed to go underwater with our system box. The ROV will have all the sensors that will allow us to extract all the data. We have used PVC pipes for the skeleton of the ROV. It's approximate mass is 5 kg. The PVC pipes are cut in semicircular shape. PVC pipe will make the whole structure waterproof. For buoyancy, we have used 4 dc motors which gives us upthrust and help us to take our ROV deep into the water bodies. The DC Motors will

control the movements of ROV which can go left right and 360 degree rotation. For control we have used mechanics from the outside of the water bodies which will help us efficiently for controlling. The power supply part will be outside of the ROV which is easy to setup and control from outside. [4]

5.3.4 IOT server

The internet of things, or IoT, is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

MQTT stands for Message Queuing Telemetry Transport. It is a lightweight publish and subscribe system where you can publish and receive messages as a client. MQTT is a simple messaging protocol, designed for constrained devices with low-bandwidth. So, it's the perfect solution for Internet of Things applications. MQTT allows you to send commands to control outputs, read and publish data from sensor nodes and much more.

Figure 5.6: Device Side to Application Relation

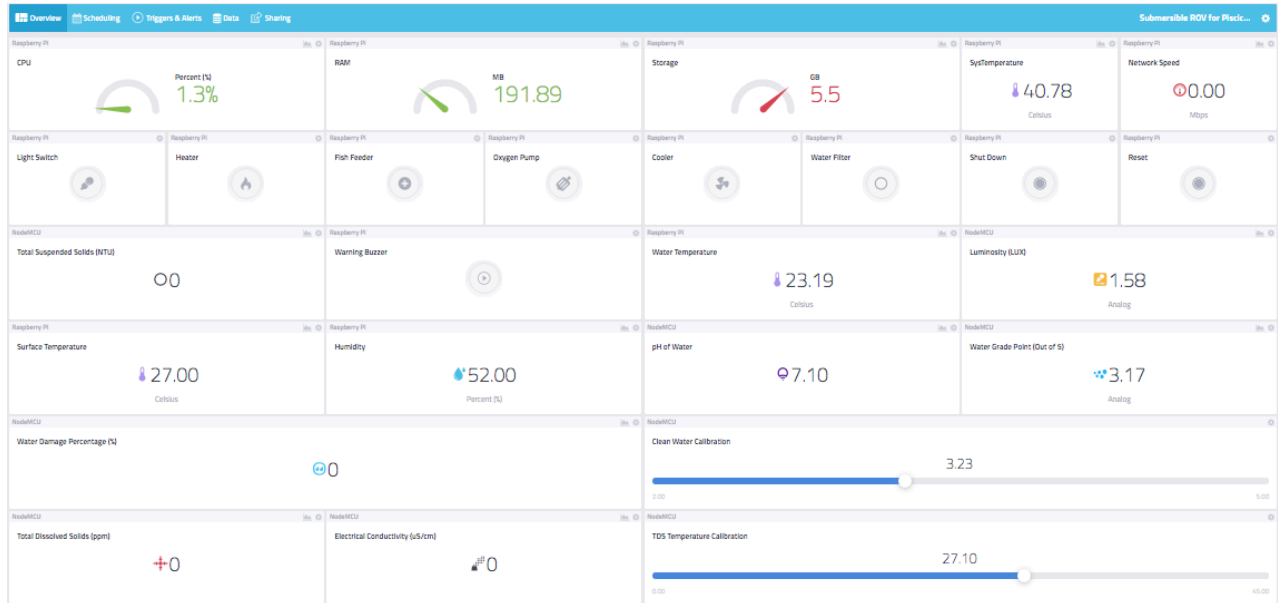


Figure 5.7: Actual Server Interface

5.3.5 Android Application

We have built an android application for users to make it user friendly. In this application we keep the option for live getting info real time without any delay. This application shows users the real time data of water bodies and user can take necessary step from the application by operating third party tools. Suppose the temperature of water increases suddenly, but when user will see it he can turn on the switch on of water cooler from the application to balance temperature of the water. One can operate his farm from anywhere in the world through this application.

SMS Service: A user will not always on net to observe the current situation of his farm that is

there any problem or not so to reduce the chance of accidents we have manages the SMS alert service for the user that a text message will be send to the user's mobile to alert him when any incidents will happen.

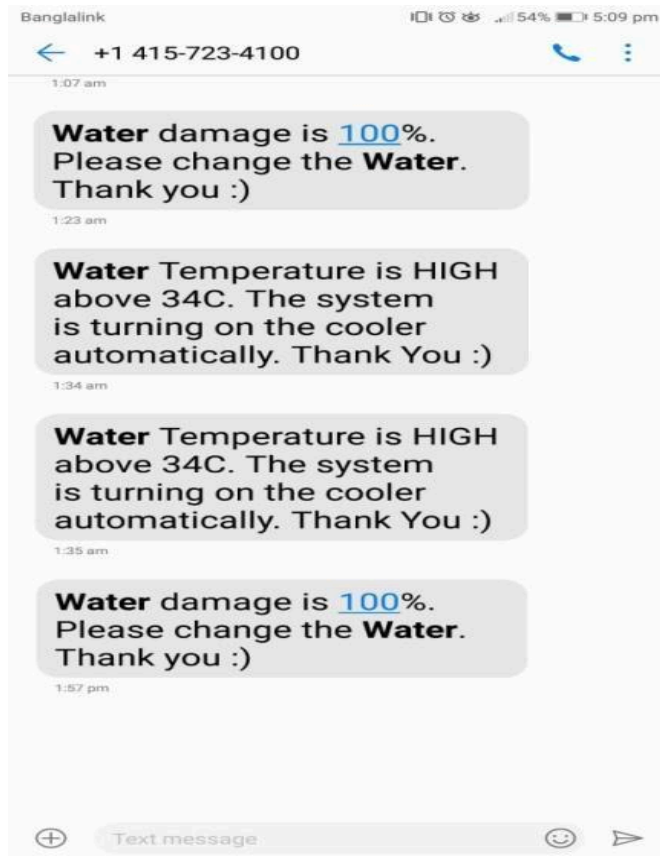


Figure 5.8: SMS Service

5.4 Summary

In this chapter, we have discussed the design of our project and how we achieved it with proper implementation. This process helped us to achieve more than we expected. We have integrated the entire whole with IOT which helps in making it very convenient to use and easier too.

Chapter 6

Cost of Implementation

6.1 Introduction

For the completion of our project we listed down all the necessary components before starting implementation. We bought all equipments according to our project requirements. We excluded some of the equipments that were faulty or not perfect of the project. We tried to made project as cost efficient as possible.

6.2 Cost of Implementation

We tried to keep our budget as minimal as possible which adds great value to the system. We are successful to finish implementation of our project within our estimated budget. The table below illustrates the name of the required components name, quantity, and the price (taka). Some expenses like wires, breadboard are treated as miscellaneous here.

Material	Quantity	Price (taka)
Raspberry PI	1	3700
ESP8266	1	350
ADS1115	1	650
Dfrobot TDS Module	1	1200
Dfrobot pH sensor	1	2275
Water Turbidity Module	1	1055
Ds18b20	1	100
Automatic Pump Controller	1	250
8 Channel Opto Isolated Relay	1	750
Propeller	6	1200
DHT11 & LDR	1	150
PVC Pipes	1	220
IR Camera	2	2000
Logic Level Converter	1	150
Sonar Sensor	1	75
Miscellaneous	1	1700
		Total : 15825

Table 6.1: Total Costing Breakdown

6.3 Summary

In this chapter we have discussed our costing for the project. Our budget friendly project will be very much affordable for fishing farms and especially individuals who are looking for cost efficient ways of doing pisciculture. Some of the existing tools used in pisciculture are expensive and less efficient which adds up to their cost but we have designed our project using as minimal cost as possible so people will be able to afford it easily.

Chapter 7

Result and Analysis

7.1 Introduction

In this chapter we will talk about the outcome or result of the project we have obtained and analyses it. Actually, we will see how we get our result from our project and what the findings of our project are. Here we will also discuss about how we will do betterment of this project of result.

7.2 Result and analysis

After the analysis, we have seen that our project is working fine and smoothly. Every part of our project is running nicely. So, it means we have planted the whole system efficiently as we planned before. Our project has three hardware parts and two virtual parts. All the parts are working simultaneously and perfectly. In these hardware parts we have 1 submersible ROV, a sensor integrated system box, an automated system assistant box these three are the main components of our project. Actually, the main system box and the submersible ROV works together in the field. If we want to get some necessary parameters of any kind of water bodies, we have to throw our ROV along with system box to the water. This ROV can go underwater and move 360 degree anywhere in the water. So, it can go deeper of the water bodies as user's need.

There is a camera in front of the ROV. This camera can give you a surveillance video streaming of underwater beside there is a system of image processing integrated with the camera. This camera will give you some features of automation suppose you will get know about fish diseases through image processing beside this will let you know how much fish are there and

accordingly the fish's size also.

Now the main system box comes with the integration of sensors. There are sensors of PH meter, TDS (Total Dissolve Solid), Turbidity, Temperature, DO (Dissolved Oxygen). These sensors get reading from the water bodies. The ph meter get the ph value of water, TDS will do get notified for dissolved solid, Temperature sensors shows us the temperature of water and the DO show us the oxygen level of water. So, these information is very much important for us to do pisciculture because if there is any kind of lacking of these parameters' fishes can be harmed of can die also.

The automated system assistant box which will be placed out of the water, it will work like assistant of the system. Actually, when there is a any change in the water bodies of parameters it takes the sudden necessary steps to reduce the emergency situation. There is relay on which many devices is connected through the AC line. Suppose if there is low oxygen in water automatically the oxygen pump will be on to do balance oxygen level in the water and this System assistant box will operate every device according to the parameters of the bodies if there is any imbalance

The whole system is connected with IOT server. So that we can get the parameters value which we get From ROV and take the necessary steps as well. Beside if there is emergency situation in water, we will get a text message from the server. And there is also a android application which is very useful and user-friendly for everyone to maintain pisciculture farm automatically and remotely no doubt.

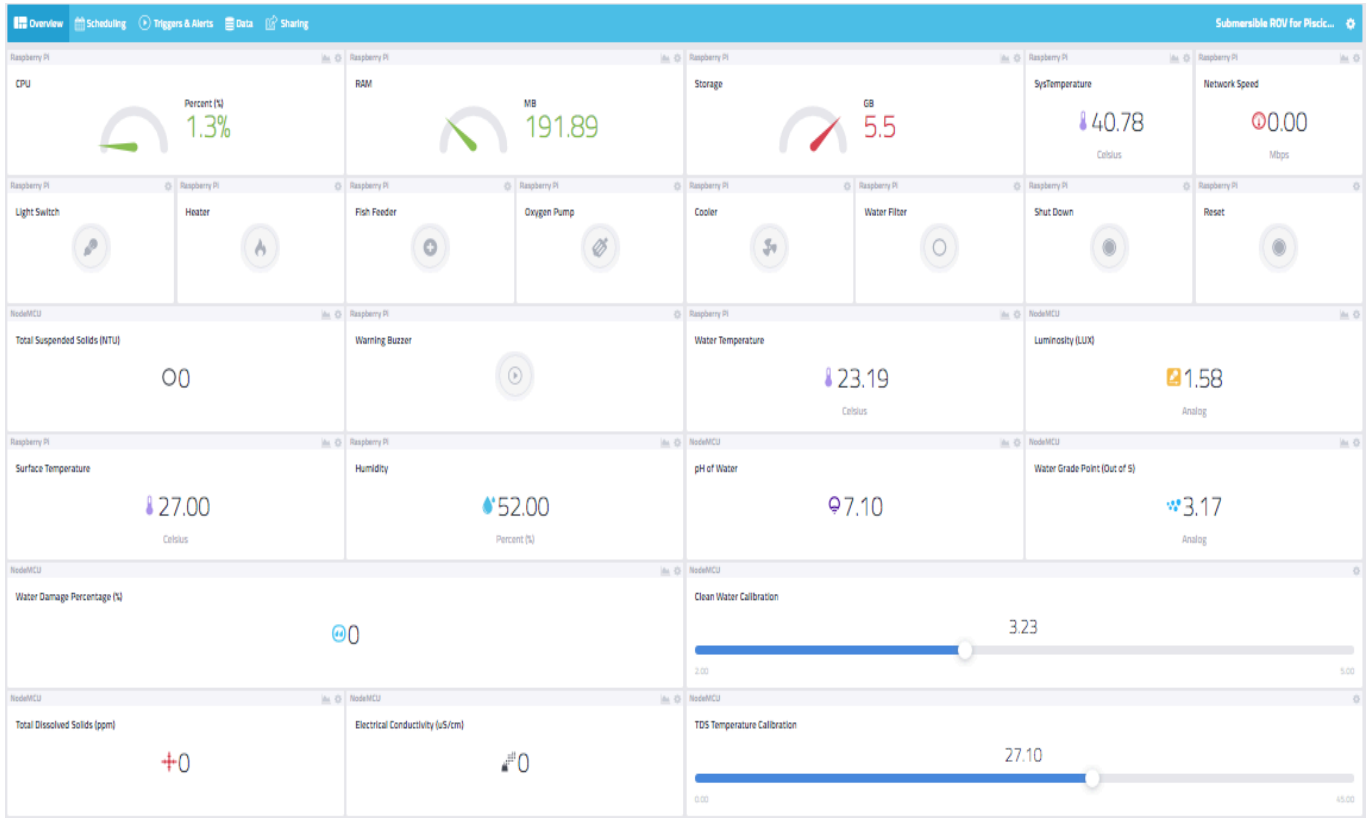


Figure 7.1: MQTT Broker Server Interface

Figure 7.2: SMS Service

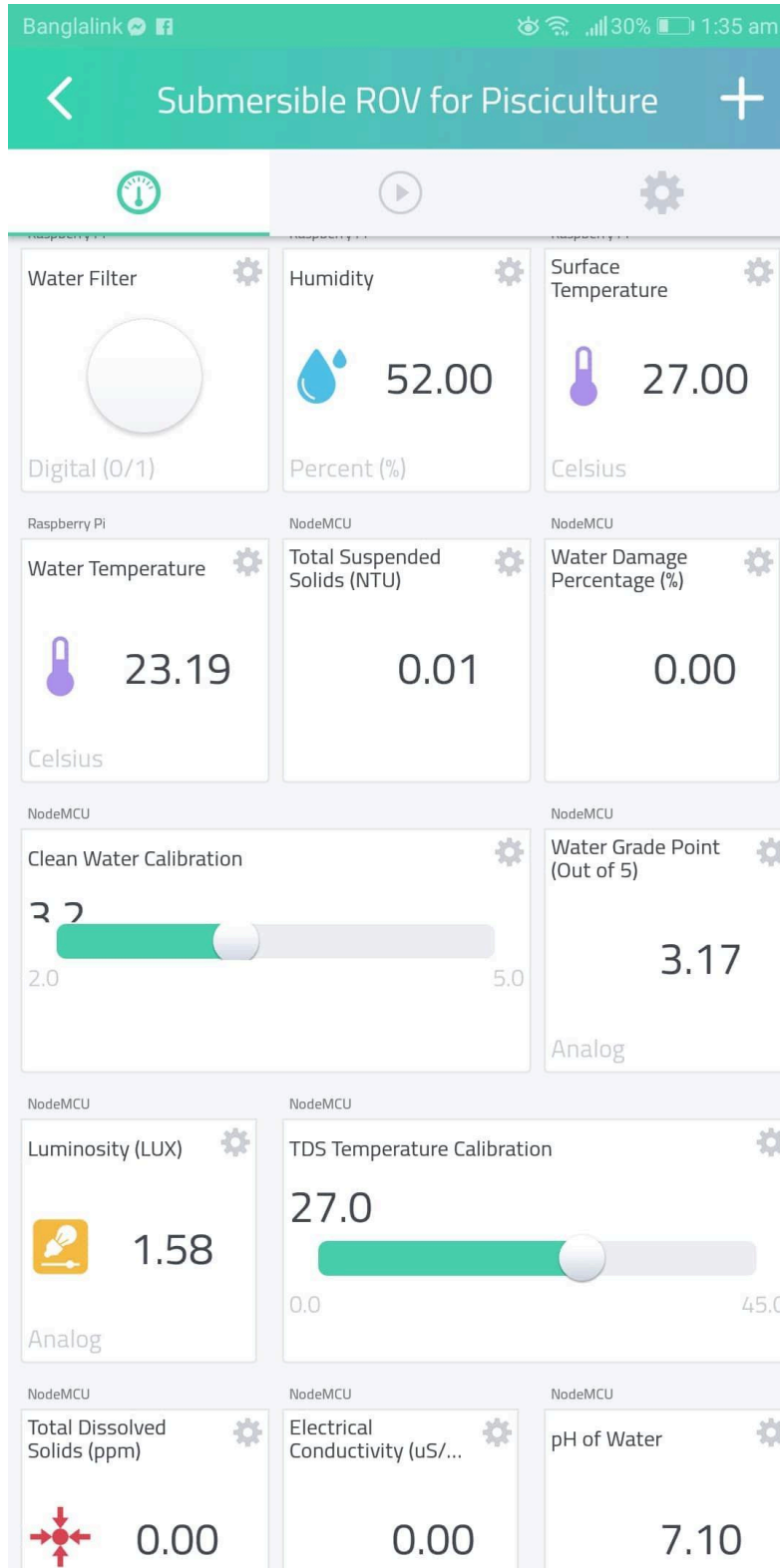


Figure 7.3: Mobile Application Interface

7.3 Summary

In this chapter we have discussed about the result and analysis of our project. We have discussed how we obtain our result and as well as how we integrate it with the whole system. The IOT introduced here with the system and we have shown it that how all the hardware and virtual parts of our projects are working simultaneously and perfectly in an efficient way. So that we have got the perfect result than we expected.

Chapter 8

Compliance with standards

8.1 Introduction

There are several international standards which a system should meet, among which the IEEE, US and European standards are noteworthy to mention. The compliance of our designed system to all these standards is discussed in this chapter. There are a few distinct standards, amongst which the IEEE standards, US standards and European standards are talked about in this part.

8.2 Compliance with IEEE standards

There are a few distinct guidelines put forward by IEEE Standards affiliation. The equipment we have used for our project are also used in most of the IEEE standard projects like raspberry PI, Humidity Sensor, 8-Channel Relay, Water level detector, Surveillance Camera, Water level controller etc. Our ROV is designed to go underwater with our system box. The ROV will have all the sensors that will allow us to extract all the data. Our project concerns fish farming automation hence we look at standards that relate to the IEEE standards concerned with fish farming automation. It involves the control and automation of lighting, heating, feeding and water level control security. The IEEE standard [IEEE 802.6](#) that is relevant to our project applies to Standards for information exchange between systems which was detecting through sensors and sending text to the owner using GSM Module. Our system manages to maintain the mentioned standards and meet with IEEE code. The Data protocol for MQTT broker is used for server connection.

2700-2017 - IEEE Standard for Sensor Performance Parameter Definitions. This standard provides a common framework for sensor performance specification terminology, units, conditions, and limits. This standard is intended for sensor technologies with digital I/O interfaces. The specific

sensors discussed in this standard are the accelerometer, magnetometer, gyrometer/gyroscope, accelerometer/magnetometer/gyroscope combination sensors, barometer/pressure sensors, hygrometer/humidity sensors, temperature sensors, light sensors (ambient and RGB), and proximity sensors. [3]

The standard IEEE1451.2 can be a helpful tool to design smart temperature sensor compatible with the possibility to use different sensors technologies without major redesigning efforts.[4]

8.3 Compliance with US standards

In case of US standards, we could not find exact standard for our system. However, there were some standards that could be attributed to our project. ANSI recommends that copyrighted software should only be included for informational purposes, or in forms which do not mandate particular implementations of the standard. Object code should never be included in a standard as a normative requirement. Typically deployed on an ANSI/CEA-709.1 LonWorks® protocol network, these application elements define how to interact with disparate devices from multiple vendors in the same system ANSI recognizes that there may be circumstances in which inclusion of some software, provided it is accompanied by adequate legal permissions, may facilitate development of multiple, competing and interoperable implementations of the standard. Our project has been established based on the above ANSI principles and it completely relies upon it. Though this does not entirely match our project, it is the closest we could find that relates to our work.

8.4 Compliance with European Standard

The European Telecommunications Standards Institute (ETSI) recently released Technical Specification 103 645, seeking to help protect consumers from IoT devices. The specification was produced by the ETSI Technical Committee on Cybersecurity. EN-50121-4 is a European standard for emission of electromagnetic wave for disturbing interference with electromagnetic apparatus. Our system has significantly low EM emission. It thus meets the EN-50121-4 standard. [5]

8.5 Summary

The different ways we examined the different standards of rules analyzed in this chapter, and how the system we designed meets the system by the IEEE, US and European standards has been discussed. we examined the different standards for our fish farming System.

Chapter 9

Design Impact

9.1 Introduction

In this chapter we will discuss about the impact of our project's design on various part of our country. We have to concern on this because any innovation needs to use for the beneficial purpose in our country for that we have to see the impact on different aspects of our society such as environment, economic aspect and as well as health also. Actually, we will discuss about the effect of our design on these aspects of our society. We will also discuss about the personal benefit also. Our system does some works suppose it enhances the production of fish, ensuring the business will not be in loss, it gives the chance of self-employment, it can be controlled from remote distance, It reduce the logistic regarding for fish farming, it takes part in ensuring good health for the people as it increase the growth of source of protein which is fish. So, short it has a great value in our society and there are also some major aspects those are given below:

9.2 Economic Impact:

We all know that from exporting fish to foreign a big amount of national revenue come from here. So, no doubt it has a great impact on our economy. Beside in our country different food which are the source of protein and costly also those are replaced by fish which is a great source of protein. By our project we can efficiently enhance the production of fish in mass. On the other hand, this can also give you the indoor security system for the industrial purpose which has also economically good effect there.

9.3 Social Impact:

Our project has a great value of social impact. Though our system has that efficiency of enhancing the production of fish so that our society's poor persons will be able to do good business by farming fish. Again, in our country unemployment is a big curse for our society. This problem can also be removed if we can use our system in mass so that in our young generation who are suffering from unemployment problem they can go to self-employment category because this system is fully automated and gives you accurate output simultaneously and you can take action any time regarding emergency case. Beside to do pisciculture you don't need logistics for fish farming you alone can manage this though you are not experienced. After all this system is very user friendly and so efficient that anyone can use it.

9.4 Political Impact:

Politics is the greatest power for a country. This power can change our country bringing a great revaluation. If our system and idea is approved by our young leaders and politicians and if they understand the efficiency of this, we can use this for the betterment of the nation. Beside by getting government fund we can launch our system design industrially so that everyone can get this system easily and at low cost so that many social problems can be removed for human blessings.

9.5 Health and safety impact:

As we said before our project is the great arms for enhancing fish production rate so this

has clearly a good health impact on human. As more fish production will be increase more health impact will be arise beside our nation will be good in health sector and our future will be a healthy future. As fish is a good source of protein but in our country other protein food are not so much cheap so the more fish will grow the more price will get cheap and general people can buy it and meet their want of protein and vitamin by eating fish so it has a great impact on health. About safety impact it has no such type of safety impact accept related to health. Suppose it secure our health by meeting our want of protein beside though we thought to use this project as industrial purpose we all kept some indoor security issue like fire detect through 46 image processing and also intruder detection by motion integrated in surveillance camera 2 which is in Automates system assistant box.

9.6 Environmental Impact:

Everything has its own impact on environment it means where we live in, air, soil, and tree, human all are the components of environment. Our project has also an impact on environment. Because of fish farming the ecosystem will be balanced in environment. Beside though fish eat the wastage of our environment so if we think from this perspective out project helps to keep the environment clean more. So, this is a very great impact on our environment.

9.7 Ethical Impact:

Everything has some point of ethics as like everything our system design should follow some code of ethics which's outcomes should be positive. Our system has no effect on any kind perspective of human thought and also it has no harmful side for our environment. Our system is a very useful and healthy for our environment and it is so much friendly to use.

9.8 Manufacturability:

If we want to go to industrial production of our project, we can make this at lower cost and will be efficient more than before. For this we need government help as well as proper support and huge fund also. So, that we can buy the components at huge quantity at low cost this will reduce the manufacture cost. Actually IOT based automation pisciculture system is the future if we can do this at huge rate this will be a ideal and blessing for our nation and also a good deal for us and society.

9.9 Sustainability:

The present era is the time of using technology, make your job more efficient and accuracy and obviously there should be no mistake as well. So, the time certainly is ripe for this pisciculture business so for this pisciculture business our automated system is the best for this business because anyone can do this business by using our automated device. This will give one efficiency, accuracy, user friendliness and less logistics and more features on etc. So, if we launch our system design for business purpose as well as human blessing there will be no one to complain about its sustainability because its performance is very efficient and the values we get are all real time values.

9.10 Impact in Real Life:

Our project is very budget friendly though this handmade prototype but if we launch it industrially cost can be reduced further . Anyone can operate this ROV system easily with little knowledge about it. So, that this very friendly to use. So, this user-friendly project has many

features to do help the human make their life very easy and help to improve economic life. This project can be used as personal purposes, Business purposes, Research purposes, industrial purposes etc. So, in real life this project has a great impact. Actually, we have some purpose to make this project, how we make it true described below:

9.10.1 Remote controlled farming

At the first phase of designing project we thought about the controlling part of this project that anyone who is not at home or he has to go out to somewhere for an emergency how he will maintain his pisciculture farm. So, we introduce here IOT. By which we can easily control our farm with any help. We can see the parameters of the water bodies like temperature, ph, Turbidity, Dissolve oxygen etc. and automatically action will be taken if there will be any imbalance in parameters. So, our first motive of remotely controlled farming is done which is good for real life.

9.10.2 Growth of economy

From the thinking of features to do integration in this project we thought about the economy our country. We see if our project can be used for mass production of fish then a huge revenue will come from here so our economy will be stable more and we are successful in this issue because our project is able to enhance fish farming at huge rate so that our national revenue will be more high by exporting fish to foreign countries.

9.10.3 Business purposes

Actually, we thought about the unemployment problem of our country when we are planning of a project and our dreams come true. This project can help young generation from being unemployed. Anyone who have little knowledge can operate our system and easily start a business of fish by farming. So, this is a very good also for our nation and our country will be more developed in business and job sector also in future.

9.10.4 Industrial Security

In this project we keep the option of indoor security because sometime our enemy wants to harm us. So, they harm one's business of fish by mixing poison in to the water so that fish will die and the owner faces a great lose so to prevent it we have done a system of security indoor problem as we have a surveillance camera to detect intruder through image processing and also keep fire detection through image processing. Because in industrial space anytime fire incident can happen so we have to be concern about the safety of our industry as well as business.

9.11 Summary

In this chapter we have discussed about the impact of our project on various parameters of our country like as on economic aspect, environmental aspect, health aspect and many others purposes also. So, our project fully user and nature friendly we can say that and there are no occurrences of pollution is done by our project. Beside if we launch this project industrially this can be our future of our country because it will develop many sectors of our country such as economy, health, employment etc. So, this project is the better future of the citizen our country. This has a great affect on human's real life through this one easily established and be good in his or her financial condition. On the other hand, this project brings you a huge amount of foreign currencies which makes stable our economy more. At last we can say that this system design will bring blessing in our society if we can use this for the betterment of our country. -

Chapter 10

Conclusion

Our project is now initially a prototype which is actually handmade. Though this is a handmade project but every parts of our project is working functionally and perfectly. Our Project has two major parts hardware and software. In hardware part we have a ROV and sensors integrated system box and an Automated system assistant box which be placed out of the water bodies and assist the system for outside. The ROV will go underwater as user want to take it from there it will send us parameters of the water quality such as ph, oxygen level, turbidities and so on. It will send this information to users through IOT. The IOT server will analyze it and according to the condition if there is any imbalance in water the system assistant box will go to action for making it balance. On the other hand, a text message will go to user's mobile because may be user will not check the application all the time and may busy at some other work at that time if there is any emergency occurrence happen text will notify users that there is something wrong. For example, if suppose oxygen level fall down suddenly so DO sensor sense it and send the info to IOT server and server will give the command to system assistant box and that box will turn on the Oxygen pump to make it balance. Actually, here we bring the automation through IOT. Besides, there is camera in ROV and also outside the ROV in System assistant box. This camera will give you a live streaming video under the water where image processing is integrated with feature of skin diseases detection, Fish count, Fish tracking like some image processing works so that user will get notified if any fish is diseased or not by the way quantity of fish all can be measured. Beside there is another camera on system assistant box which is kept for actually security purposes there is also integration of fire detection and intruder detection for security purposes. So, these are the function and features of our hardware part and in our software part there is IOT server which can be controlled by user and observed also by this time there is also an Android application for the user which so much

user friendly that anyone can use this without any hassle. This is our project has some great effect in our social and economy as well as on our real life also. We have plan to make it vast and more low cost for general people because if this can be done a great revaluation can be possible in our country which will bring a great development in all aspects of our society In brief we can say that our project can bring blessing for our country if we can use it in good efficient way as well as if we can make it with the help of giant company. It will help our country in all aspects which are described already. Fish is a part of our staple food and we can make this a revaluation for the betterment of our future. By this many person be solvent by doing business. In a word a great blessing will be possible to bring through this project.

Chapter 11

Future Work

11.1 Introduction

Introduction: In this chapter we will discuss about further development of our project that how our system can be more stable and efficient for the field and how we can make it more useable as well as more commercial by adding more features by which anyone will be encouraged to use our device. According we will try make it more available for industrial use and make it low cost for general people who are interested for pisciculture as their profession and financial development

11.2 Future Planning

We have planned to make our project more industrial form and more efficient. We will add more features to make user's comfortable more and friendly. So, though our project has the most vibe in the economy world we will make it international form for some group of people in our society. Because of this, we feel that our idea and system will be boom as it is revolutionary movement in this field, we are planning to make it industrial tool in order to make this idea bigger we will make our project more commercial and industrial marketing if we get support and fund from government. We can ensure that our system will provide the user of high efficiency and accuracy feedback actually what a client's desire. Our system will be one of the best products in the international marketing field as well as it will create a large market share in world economy, the largest market being in Asia, Europe, America etc.

Actually, behind every good work we need support. If we get a lot of support and fund from government as well as government nourished this properly, we will be able to do work perfectly and our future planning:

- We will give the best customer service if our logistic and products quality will be more efficient and reliable.
- We will make the system smaller and mobile as well as more sustain we will use more light but quality full ingredients in our project at the time of fabrication.
- If we can setup an industrial line our product will get available to the customers and product's availability will be increase more. That's why we need an industry so that this system can be more qualityful.
- We will make a team to give the customer service 24/7 every day. Because customer's service will be the highest priority in our ethics.
- We will make a technical supportive website from where anyone in the any part of the world will get service instant.

11.3 Method of productization and Marketing

The entire method of productization and Marketing process on how we can implement the system in larger scale for marketing purpose is described below:

- **System Functionality:** Our service is of higher priority to us than price. Whoever in any part of the world needs our device for pisciculture purpose we will support them will all offer and technical advancement. We will make a R & D team to do more development and adding features in our project. As we get more update form of our project, we will provide to our customer's more update technology for pisciculture purpose.
- **The efficiency:** Any customer will want value for money product from anywhere in the

world. So, keep that in our mind our system has been build. Our system will give the full of features to our clients as they want as well as we will operate a survey team for our product so that we can know the customer's choice and want and as per their survey result, we will include more efficient technology they need actually. Our automated pisciculture system will be the best tool for a fish farmer. Because we have use here the best IOT system on which full technology world is moving in the cloud. Though our project can be controlled from remote place and user can do any thing regarding pisciculture any time. So, from this it is clear that we have a great value in business field if we can fulfill our plan as our planning.

- **Pisciculture as a noble job:** Though like our developed country we have a lot problem in our society If we can reduce some problem it will be a great development for our society. In our country employment problem is a great curse for us. If our young generation use our idea and system to do pisciculture they will be able to be self employed and beside no unemployment will be available in our country. So, when this pisciculture will get a great revenue in our national income this job will be great in our society at least better than now. So, I believe our project will be able to do this easily just by using our device as a technical development.

11.4 Current situation of pisciculture and its condition around the world

Pisciculture is a big part of national revenue not only in Bangladesh but also in many other countries in the whole world. But we have to make it bigger and availability because we

all know that fish is the best source of protein, vitamin, salt etc. which are very much important component to keep our body healthy. So, in order to be the whole world a healthier world as well make the world economy more stable and larger we should make it an industrial marketing and in future It will get a rapid speed in the world economy. But current situation is very much poor and primitive. People still do fish farming in old way and check their water bodies parameters manually which no efficient and all are going on guess. There is no accuracy of reading in this way. So we feel our demand in this pisciculture field to make the production more high as well more efficient in mean time. Beside a great social curse can be cured if we can be successful in our future plan.

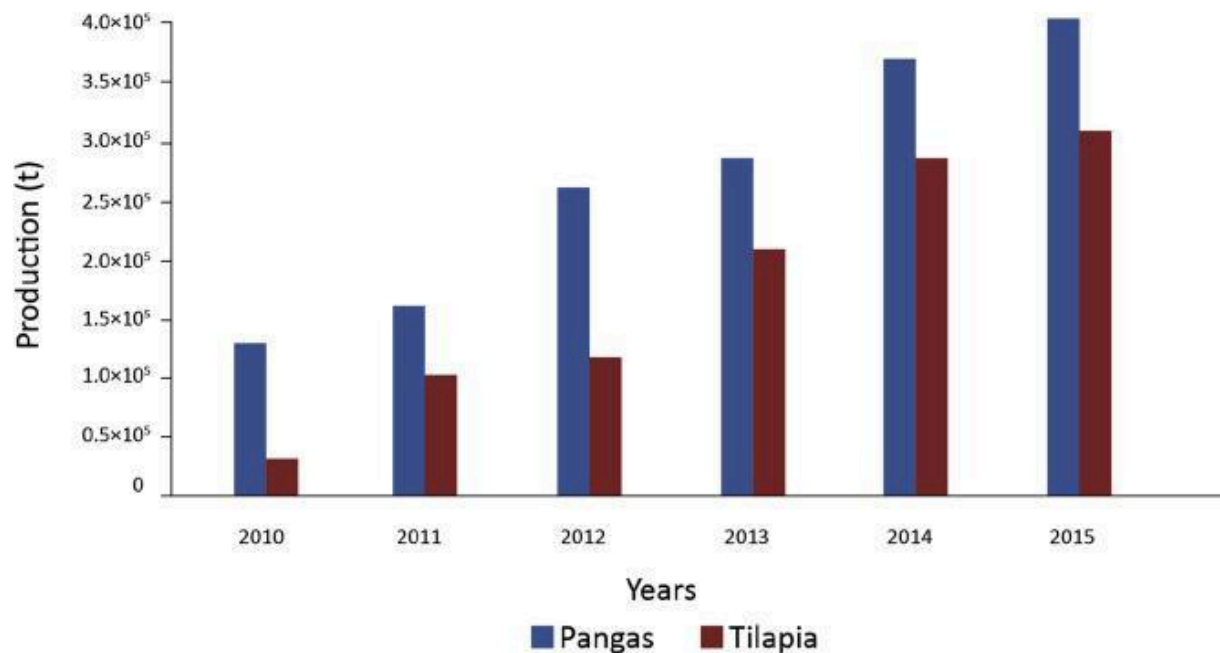


Figure 11.1: Current Fish Production

11.5 Summary

This chapter full of future planning and necessary step and hope. We discussed here how we can make our device more available and as well as more efficient more our users. We talked

here about the planning of industrial marketing and how we will do marketing of our product. Beside we also talked about our demand of this project and talked about world economy how pisciculture can do great development in the world economy. In brief we want to say that our device will be a blessing for our nation because it has a great potential in pisciculture field. It can also reduce some social curse of unemployment in our country. So, our device will be a great technology revaluation to all users and world. This advanced technology can meet anyone's sorrow and financial problem commercially and our customer service will be our high priority as well as their smile will be our achievement. We wish that we can give world a great gift of technology if we can operate our future planning as we planned.

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