IoT BASED FISH FARMING AND MONITORING SYSTEM

BY

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This Report Presented in Partial Fulfilment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering

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APPROVAL

This Project titled **"IoT BASED FISH FARMING AND MONITORING SYSTEM"**, submitted by Reafat Summum, ID No: 191-15-12835 to the Department of Computer Science and Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 26 January, 2024.

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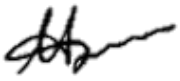

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We hereby declare that this project has been done by us under the supervision of **Dr. Sheak Rashed Haider Noori, Professor and Head, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for the award of any degree or diploma.

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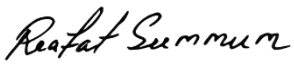

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ABSTRACT

Current human population is 7.8 million and the growth rate is around 1.05% per year hence food demand is also increasing accordingly. Globally 155 million tons of fish production is consumed by humans. Fish for human consumption is anticipated to rise by 16.3% globally by 2029. Vitamins, minerals, protein, and nutrients are abundant in fish. To provide the market with healthy food and meet consumer demand is a difficult task for farmers. The supply and demand for fish are not being met, and aquaculture can help. Aquaculture involves cultivating freshwater and saltwater fish under controlled or semi-controlled natural conditions. But many farmers are facing huge losses due to inadequate management and manual equipment. Many farmers want to start aquaculture but don't have enough knowledge to start. Use of IoT will bring automation in the aquaculture field. Farmers that use a conventional method manually measure, check, and manage the aquaculture's water quality, water level, oxygen level, and stress level. In this work, we presented a smart aquaculture model based on the Internet of Things (IoT) that will assess water quality (pH, water level, temperature, turbidity) and maintain water quality (change water, add chemical to the water, give food to the fish) for aquaculture. In this work, we will develop a device with wireless modules and sensors and a web application where the real time data will be displayed and manage the whole aquaculture.

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CHAPTER 1
INTRODUCTION

1.1 Introduction

Global resources include fresh water. It is a gift from nature and essential to supporting both human life on earth and agricultural development. Facilities for safe drinking water are now dealing with a number of issues. Slow population growth owing to the scarcity of drinking water, urbanization in rural areas and overexploitation of marine resources for salt extraction have significantly degraded the quality of water available to humans. Day by day people are using highly chemicals used in building, manufacturing, and other sectors. Farmers are using chemical fertilizers in the farm. Contaminated water from industry into surrounding water bodies has made a huge contribution to the decline in water quality worldwide, It has grown to be a significant issue. The generation of contaminated water is increasing day by day. People are losing their lives because of this. Besides, various aquatic plants such as small fish, big fish, small fish, various necessary aquatic plants etc. No good quality water is available for fish farming and what is available cannot be fish farmed.

The rate at which monitoring and automation technology is advancing in the current era has improved the quality of fish farming ponds by developing production technology in aquaculture. Thus technology is driving aquaculture production towards improvement and growth. Ponds are created for fish farming through artificial man-made eco-systems. At the most basic level there is a type of pond in which to breed tropical fish. It is commonly known as aquarium, where pets and fishes are artificially bred [2].

Pollution is increasing due to industrial and population growth, so it needs to be remedied very quickly. For this, the most effective method can be that monitoring system has been developed by using several sensors containing several sensors without statistical past data through the Internet. Water pollution and climate change play a major role in fish farming. As a result the farmers have to face many types of diseases among other problems in their farmed fish. As a result, the use of modern technology to monitor and control all these problems i.e. unhealthy environment should be encouraged [4].

Aquaculture, often known as aqua-farming, is one of the most dependable and low-impact technologies that yields high-quality protein for people. It involves breeding, growing, and harvesting fish, seaweed, algae, and many other creatures. In many countries in the world Aquaculture has become one of the thriving areas as the Demand for fish and fish-based foods is rising quickly.

In the last ten years, we have seen significant improvements in practically every aspect of the industrial process that are made available to us by computers. Machines actually automates the phases involving human involvement that increase the likelihood of errors in the processes. The idea is to help the fish farming industry and bring automation.

Currently, fish farming is becoming a financially productive process. But, in absence of proper services, more fish perish when being raised. Still, most of the fishermen lacks the necessary information to properly develop ponds for successful fishing. Usually, fishermen depend on manual checking and measuring for knowing the condition of every parameter and Each component of a fish farming pond must be carefully inspected, which takes a lot of time and may produce inaccurate findings because factors used to gauge water quality are constantly changing. Another problem is less chance to put fisheries in a sort of remote location where it is only possible to In distant locations without frequent internet access, check once daily instead of several times. Running a fish farm without any human intervention, even for a few days, might occasionally be problematic. To overcome these problems, we need a smart system which can detect alkalinity, acidity, dissolved oxygen, water temperature and water level from water floating point at every moment. It will be better if the monitoring system can be automated and through modern technology, it is possible. An Arduino based fish farming and monitoring system can determine the proper water condition for the specific fish which is needed. It can also control the water oxygen level and water level. People will benefit from this helpful knowledge, which will enable them to produce more fish. Farmers are going to be aware of the oxygen level in water, pH, temperature in the water from the device and according to that information, they can take necessary steps to protect their fish from harmful substances. Through this technology, fish producers will also be able to monitor the water's temperature and safeguard their fish from dangerous toxins. It can also measure the water level for the specified fish.

We shall keep an eye on the ponds that produce fish for human consumption. These ponds are normally constructed and maintained in isolated, environmentally sound locations close to freshwater springs. Because fish are cold-blooded animals that's why it's needed to Their environment directly controls their body temperature. Consequently, temperature is an important factor that needs should be kept an eye on together with other significant aspects like light intensity, pond water level, etc.

Our model will be able to help fish owners use IoT to monitor their ponds. The user-friendly interface using internet technology, Real-time fish pond monitoring will be available through online services, desktop applications, and smartphone applications. The system database also makes a substantial contribution to efficiency gains and lowering the risk of losses.

The proposed quality monitoring system for fish farming consists of develop a device with wireless modules and sensors and a web application, It is small and extremely practical for measuring pH, turbidity, water level, temperature, and air humidity. With this technology we can always get real time data will be displayed and manage the whole aquaculture.

1.2 Motivation

Environment consists of five important components. There is soil, water, climate, natural vegetation, and land forms. All of these elements are essential to our environment and human survival. Water is also so important for the survival of other living organisms.

Due to lack of adequate proper knowledge, fish farmers often face losses and other complications in the project or business. We want to develop a technology that can reduce losses and maintenance costs. Using IoT is a possible solution to bring automation in fish farming. With this technology We presented a smart aquaculture model based on the Internet of Things (IoT) that will assess water quality (pH, water level, temperature, and turbidity) and maintain water quality (change water, add chemicals to water, feed fish automatically will give). In this work, we will develop a device with wireless modules and sensors and a web application to display real time data and manage the entire aquaculture.

Our main project also IoT based project. Our main motive,

- People can easy to use.
- We can our time saving.
- The cause of polluted water for fish farming needs to be found. We easily check and alert the authorities.
- We can get real time data, and 24 hours service are allowed and get data in our website.

1.3 Objectives

The demand for fish and fish-based foods is rising daily. Aquaculture's significance is also rising. In an aquaculture system, fish are raised in tanks or other small artificial water bodies where they may live, eat, grow, and remove waste. Since there is no natural water supply, the water quality soon deteriorates, which has an impact on the development and wellbeing of fish. Thus, a crucial component of the aquaculture system that ensures the correct development and health of fish is water quality [2]. Farmers are dependent on manual testing to determine the state of the water's different parameters. however manual testing, inappropriate as parameters water changes continuously and this is also time consuming. It will be a revolutionary innovation if autonomous maintenance and monitoring are possible. To solve these issues, modern technologies like IoT, machine learning, and web technology should be applied to aquaculture.

To implement this kind of technology in rural areas it must support several key features. Device needs to be cheap and easy to use. So, we have to be careful in choosing the appropriate technologies for this kind of innovation. Raspberry pi is like a small computer with an integrated Wi-Fi module which can be used in our system to process the raw data, take initial immediate decisions if needed and communicate the web application through API and send data so that users can see the data and what is happening in real time.

1.4 Expected outcomes

We will make an automated feeding and monitoring system for people to be able to feed fish time to time without any delay. People will also be able to personalize the feeding time. By using this system, remote monitoring via wireless communication technologies will be possible. Using this system, it is possible improving the water quality, fish productivity as well as survival of the

aquatic life, and to reduce the stress on the environment that has an impact on the fish population. Besides this, less human interaction, time consumption will be seen and most importantly this system will reduce the cost and minimize the loss.

- Fish Farming Water Quality monitoring system.
- Realtime Auto/Semi-Auto water quality maintenance.
- Realtime Auto/Semi-Auto fish feeding system.
- Keeping up an environment suitable for proper fish growth.

Environmental:

- Reducing the quantity and frequency of CSOs in metropolitan settings.
- Lowering the number of pollutants emitted to rivers and lakes (e.g., pathogens, organic matter etc.).
- By measuring pollutant load rather than outflow volume as is customary as well as using two separate dispersion models both inland and coastal waterways, proven in BCN & Berlin, respectively, it is possible to more accurately quantify the "actual" environmental effects of CSOs.

Technological:

- Full evaluation of water quantity and quality during transient pollution events in the wastewater system network, sewage discharge point, and receiving water bodies.
- Enhancing wastewater treatment and sewage efficiency.
- Boost bathing water governance and the decision-making process.

Socio-Economic:

- Improve aquaculture water quality both during and after rains.
- Reduce the threats to bathers' health from poor bathing water quality.
- raising awareness of the effects of rainwater discharges on the environment and public health.

Market:

- Assist in replication in those other cities/regions and making it easier to comply with EU standards by providing success stories of implementation.

- To hasten the adoption of the " Fish Farming Monitoring System" technologies on the market, obtain environmental verification for them through the EU-ETV initiative.
- Promote the " Fish Farming Monitoring System" solution through marketing, business, and commercial endeavours.

1.5 Project Management and Finance

This is the project planning and organisation that results in on-time and within-budget completion of the task. The components of the process—people, money, technology, and creative work—can be one-time projects or ongoing operations. Information technology (IT) and project management are related fields, as are engineering and construction. Because a working product requires the completion and integration of a complex set of components in these disciplines in an organised manner. As we know that for the project, we need a website where all the data from the server will be displayed. So, the front end, back end and database work is done by the development group. The user-friendly design makes maintenance and customization a breeze.

1.6 Report Layout

In this paper we have developed an IoT device that can prevent water pollution in fish farming and act accordingly. As we develop a device to detect changes in polluted water in fish farming, we will be able to detect water quality for fish farming. There are a total of seven sections in this context. The remaining portion of the paper is segmented into six parts: Section 2 covers the background, Section 3 addresses requirement specifications, Section 4 delves into design specifications, Section 5 explores implementation and testing, and Section 6 examines the impact on society, environment, and sustainability. Ultimately, Section 7 will provide the concluding remarks for the paper.

CHAPTER 2
BACKGROUND

2.1 Preliminaries

Monitoring the environment and the quality of aquaculture waters is essential for determining the chemical and biological composition of aquaculture waters and for taking appropriate corrective measures. Since our independence most people have access to clean water. But with our water now so polluted, we don't know how many more years it will last. It is also causing damage to our environment such as degradation of watery ecosystems and unchecked phytoplankton growth in lakes, canals and rivers, suffocating plants and animals. Ecosystems are extremely dynamic and react to even minute alterations in their surroundings. If left uncontrolled, water contamination may wipe out a whole ecosystem. Moreover, unstable environment can cause human diseases. Water pollution of rivers is so bad for fish and river that it loses its navigability and temperature also increases due to chemical reactions from chemical industry waste.

2.2 Related Works

Water monitoring for fish farming is an important part of ensuring the safety and quality of water resources. There is a growing need for reliable, affordable water monitoring systems that can provide real-time information about the health and condition of water bodies and help people make more informed decisions about the management and protection of our natural resources.

California State University Sacramento's Freshwater Eco-Tech Lab is working to develop affordable and easy-to-use water monitoring systems that meet the unique needs of communities in the developing world. These systems are designed to provide environmental engineers and scientists with the information they need to make informed decisions about their community's water resources ie fisheries management. One of the projects we are currently working on is the development of an affordable and cost-effective aquaculture water monitoring system using Internet of Things (IoT) technology. IoT technology has the ability to completely transform how we keep an eye on and control our surroundings. by making it possible to monitor a variety of environmental parameters in real-time at low cost. We use wireless technology to collect and analyse data through IoT devices and send it to a remote server where it is analysed and stored. We are currently working on developing a low-cost, portable water monitoring device that can be

used to measure water quality in rivers and ponds for fish farming. This device would be mounted on a drone that would fly over a pond or river and collect data such as pH, temperature, turbidity and dissolved oxygen readings. We will be able to record video of the site using a camera attached to the drone. This data will help us better understand how aquaculture water quality changes in response to different environmental conditions and help us improve the way we monitor and manage our water resources. At an estimated cost of less than $100 per unit, this device represents a major improvement over existing aquaculture water monitoring devices and can be used to identify problems and make data-driven decisions about water resource management and conservation.

This may seem daunting on the surface. How can a school team build and deploy a device they've never seen? The answer lies in creating a 3D-printed proof of concept model that can be used to conduct initial field tests and generate the data we need to further develop the device. The following steps will outline the process we use to build a proof-of-concept model of one of our IoT devices. This has proven to be an effective approach for our school teams and one that has allowed us to develop promising new IoT devices for a variety of applications. The first step is to select an area of research that the school team feels passionate about and develop a project idea that can address this issue in a meaningful way. In this case, our team is focused on developing a cost-effective, portable fish farming monitoring device that can be used to detect problems and make data-driven decisions about the management and conservation of our water resources. After coming up with a project idea, the next step is to start the research process. We will begin by doing some research on our existing aquaculture water supply infrastructure and explore ways to improve or enhance the current aquaculture management system.

J.Janet et al. [2] propose a research paper shows how a fish farm can be fully monitored through IoT. That is, monitoring of water condition, temperature measurement, pH measurement and water height level monitoring using IoT is done here. Various types of hardware like ATmega328 microcontroller, pH, water temperature, water level sensor, market, heater, LED, LCD display etc. are used here. Also, remote master monitoring can be easily controlled through IoT for monitoring the entire farm.

Junaedi et al. [3] propose a research paper shows how IoT can be used to monitor water and fish health in a fish farming farm, reducing fish mortality. That is, monitoring of water condition, temperature, pH, turbidity, gas monitoring, good yield of guppy fish, increase in production and reduction in mortality using IoT is done here. Different types of hardware such as ATmega328 microcontroller, pH, TDS, Tur, water temperature, DO, electrical conductivity, pressure, and water level sensor etc. are used here. Besides, servers are controlled using Thingspeak and Mitapp through IoT to monitor the entire farm.

Abdallah Waddah Al-Mutairi et al. [4] propose a research paper shows how to use Internet of Things to provide real-time monitoring, control, and management of a fish farming farm. In other words, in addition to measuring different types of variables, monitoring has been done using IoT to increase fish control and increase production. There are different types of hardware like ATmega328 and Esp8266 microcontroller, pH, TDS, Tur, water temperature, DO, electrical conductivity, pressure, and water level sensor etc. are used. Besides, the server is controlled using Esp8266 Microcontroller's Wi-Fi network via IoT for monitoring the entire farm.

JAJA KUSTIJA et al. [5] propose a research paper shows how to monitor everything in a fish pond like temperature, water height label, different gas levels, daily feeding etc. through IoT. In other words, water temperature, water level, different types of gases such as oxygen carbon dioxide level, pH value and how to feed the fish automatically through IoT have been monitored. Different types of hardware such as dissolved oxygen, pH sensor, temperature sensor, real time clock or RTC sensor, ESP32 microcontroller, relay etc. are used here. Also, control is done through IoT and Ginger server for monitoring the entire farm.

EPIFELWARD NIÑO O. AMORA et al. [6] propose a research paper shows how to monitor a fish farm smartly through IoT based apps. That is, the entire system is monitored through IoT to check water temperature, salinity, water level. Various types of hardware like Raspberry PI 3B+, Waymos Wireless Microcontroller, Paddle Wheel Aerator, Water Pump, Pipe Valve, Conductivity, Temperature, Toxic Gas Sensor, Relay Switch, etc. are used here. Besides, SMS is sent by computer and mobile phone through IoT to monitor the entire farm.

Rabiya Abbasi et al. [7] propose a research paper shows how to monitor a fish farm for aquaponics facility using complete IoT and computerization technology. That is, monitoring of water and air

temperature and humidity, pH, electroconductivity, light intensity monitoring has been done using IoT. Different types of hardware like Arduino UNO microcontroller, Water temperature sensor, air temperature and humidity sensor, electrical conductivity sensor, LDR sensor, wireless sensor, relay module, power supply, Camera Module etc. are used here. In addition, cloud-based monitoring of IoT can be easily controlled without human hands to monitor the entire farm.

Luong Vinh Quoc Danh et al. [8] propose a research paper shows how pangasius fish can be monitored in Mekong River del time using complete IOT and computing technology. That is, here the physicochemical changes of water for pangasius fish are monitored using AOT in real time. Different types of hardware such as liquid pH value detection sensor, dissolve oxygen, salinity, water and air temperature and humidity sensor etc. have been used here. In addition, cloud-based monitoring of IoT can be easily controlled via mobile for monitoring the entire farm.

Walidatush Sholihah et al. [9] propose a research paper shows how disease, nutrition and spawning of silver arowana fish can be monitored through complete IoT and computerization technology. That is, here the physio-chemical water quality for silver arowana fish is monitored using real-time IoT to support fish growth. Different types of hardware such as ESP32 microcontroller, sensors for turbidity, pH, MQ137, temperature, TDS, and salinity are also included are used here. In addition, cloud-based monitoring of IoT servers using ESP32's Wi-Fi module network for monitoring the entire farm.

Muhd Nazrul Hisham Zainal Alam et al. [10] propose a research paper shows how to use solar energy through aquaponics to monitor fish and plants together with complete IoT and computing technology. That is, together with the physicochemical quality of fish and plants monitored in real time using IoT to support fish and plant growth. Various types of hardware such as Arduino microcontroller, smart meter, copper, inverter, AC load, electric grid, router, PV array etc. are used here. In addition, IoT has cloud-based monitoring on servers for monitoring the entire farm.

Azimbek Khudoyberdiev et al. [11] propose a research paper shows how to increase healthy fish production and reduce resource consumption by fully implementing IoT and computerized fish monitoring technologies. That is, monitoring has been done using IoT by creating a good environment for fish farming to help the growth of fish. Various types of hardware such as Arduino microcontroller, water temperature, pH level, water level, conductivity etc. are used here. In

addition, IoT has cloud-based monitoring on servers for monitoring the entire farm. And the water condition is estimated through data science with the data received from the server.

The research [12] addresses increased fish mortality in Rojo Koyo SMEs during Subang's rainy season. Aiming to provide a cost-effective solution for small-scale aquaculture, the study implements a low-cost IoT system for monitoring water parameters in aquaponics. The system, utilizing sensors like DS18B20, SKU: SEN0161, and SKU: SEN0244, is integrated with Android programming (C Language) and NodeMCU ESP8266 for data transmission via the Blynk app, enabling SMEs to manage water quality and mitigate fish mortality during adverse weather conditions.

The paper [13] analyzes water quality parameters' impact on fish farming and disease in Bangladesh through pond data. Machine learning algorithms are compared, with logistic regression showing better accuracy. It predicts if new pond water is suitable for fish farming. An IoT-based system design is proposed for future predictions. The research explores environment parameters, fish growth standards, reasons for fish death, and growth rates by monitoring water quality.

The IoT-based [14] Aquaponics Monitoring System integrates aquaculture and hydroponics, utilizing sensors and Arduino UNO for real-time data on water quality, nutrient levels, and fish behavior. Accessible through a mobile app, it enables analytics, automatic alerts, and historical analysis for informed decision-making. This sustainable solution enhances efficiency, productivity, and environmental sustainability in aquaponic farming.

The paper [15] introduces an IoT framework for efficient monitoring and control of aquatic parameters in cultivating ponds. Utilizing sensors and Arduino Uno, it records pH, temperature, turbidity, and ultrasonic data. The system stores data in ThingSpeak IoT cloud for analysis. Validation with data from 5 ponds reveals that only three meet standard fish farming criteria. The paper concludes with a hardware implementation of the real-time aquatic monitoring IoT framework.

The paper [16] introduces an IoT-based system for monitoring essential aquaculture parameters. Utilizing sensors for pH, water temperature, dissolved oxygen, and ammonia levels, an Android

app notifies users, including farmers and fishermen, about water conditions. This enables timely interventions to maintain an optimal aquatic environment for fish farming, enhancing efficiency and preventing disturbances in the aquaculture system.

The service activity [17] focuses on developing a LoRaWAN-based IoT system and mobile app for ornamental fish farming. By implementing and mentoring the technology, the system effectively minimizes ornamental fish seedling mortality, enhancing fish quality. The initiative positively impacts the income of CV Home Aquafish partners in Kalipaten Village, Gading Serpong, Tangerang, resulting in increased earnings from the ornamental fish nursery.

The research [18] focuses on creating a real-time freshwater monitoring system using IoT and fuzzy logic. It accurately monitors temperature, pH, and water turbidity by employing IoT sensors connected to a centralized network. The system, equipped with an intuitive user interface, facilitates easy access and analysis of real-time data. Through trials spanning 20 days, the system demonstrated good accuracy levels, with pH sensors at 97%, turbidity sensors at 92%, and temperature sensors at 96%.

This research [19] introduces an IoT-connected Aquaculture and Fishery Management System, leveraging sensors for pH, temperature, and water level. The system enables remote monitoring of fish farming operations, enhancing efficiency and sustainability. The integration of pervasive computing and IoT technologies aims to revolutionize fisheries, providing a comprehensive solution for modern and profitable fish farming practices.

2.3 Comparative Analysis

Water quality for fish farming is affected by various parameters of biological, chemical and physical nature. There are many rivers in our country and there are many industries that make multiple types of products using certain materials such as clothing companies, ornament companies, printing companies, food companies, etc. Most industries discharge their waste into rivers through sewage. Line provided by Govt. Disposing of more waste than the prescribed limits further pollute the water. Chemical wastes contaminate water with discarded wastes such as animal or human medications, bleach, salts, insecticides, metals, bacterial toxins, and pesticides with plastics. Waterways are also contaminated by chemicals and heavy metals from urban and industrial trash. These contaminants are harmful to aquaculture and aquatic life and frequently

reduce an organism's longevity, capacity for reproduction, and ability to move up the food chain when predators consume prey. This is how huge fish, like tuna, build up toxic levels of mercury. Biological pollutants are organisms in water. Most wastewater is returned to the environment without treatment or reuse. Prior to releasing the cleaned water back into the rivers, these facilities lower the quantity of contaminants including pathogens, phosphorus, and nitrogen in sewage as well as heavy metals and harmful compounds in industrial waste. But if we throw more than the border, it will take more time to reuse the wastewater and it will also be the most expensive. If the water becomes too polluted, the overall environment on both sides will deteriorate, making it unsuitable for fish farming. When a lake or marine environment has an algal bloom due to water pollution, freshly added nutrients spread across the area and encourage the development of plants and algae, which lowers the amount of oxygen in the water.

2.4 Scope of the problem

Monitoring of the environment and water quality is essential for determining and comprehending the chemical and biological quality of water for fish farming and to take responsive remedial action. Since our independence most people have access to clean water. But with our water now so polluted, we don't know how many more years it will last. It is also causing damage to our environment such as degradation of aquatic habitats and unchecked phytoplankton growth in lakes, canals and rivers, suffocating plants and animals. Ecosystems are incredibly dynamic and react to even the slightest alterations in their environment. If left uncontrolled, water contamination may completely destroy an environment. Moreover, people can get disease due to unstable environment. Water pollution of rivers for fish farming is so bad for the river that it loses its navigability and temperature also increases due to chemical reactions from chemical industry waste.

2.5 Challenges

We are all to some extent responsible for the water pollution problem caused by fish farming. But most of the industries that discharge their effluents across the border are more responsible for polluting the river water.

- Implement IoT devices to monitor water and collect necessary data from water for fish farming.
- We need to check from the root which sewage line is causing so much waste.

- We need to check how polluted our fish farming water is.
- To identify water condition for fish farming we need to check water temperature, pH, turbidity.
- Check the data every single day and find the sewage line that is polluting the water the most.
- Then find the industries where those lines are connected to that sewer line.
- Use friendly manners so as not to face any challenges.
- Collect information without interruption.
- To receive the service properly, it must be evoked.
- Depend on internet to fetch data properly.

CHAPTER 3
REQUEREMENT SPECIFICATION

3.1 Business Process Modelling

A business process model can represent one or more business processes and describes how operations are conducted to meet an organization's planned objectives. Such a model is still abstract and is dependent on how it is used in planning. The BPM lifecycle serves as a framework that offers a standardized methodology for strategizing, implementing, and overseeing business processes within an organization. Comprising five key stages—design, model, execute, monitor, and optimize—the BPM process provides a structured approach. Our proposition introduces six fundamental BPM components, informed by research in the realm of development models: key alignment, administration, techniques, information technology, people, and culture. This BPM Handbook's framework is based on these six elements.

Company process analysis and process improvements are facilitated by the Business Process Model and Notation (BPMN), which offers a graphical depiction of company operations that anybody can readily grasp. Process modelling is a vital part of efficient business process management. Process modelling software provides an analytical depiction of an organization's "as-is" processes and contrasts them with "to-be" processes to increase their efficiency. Here’s the business process modelling of our project:

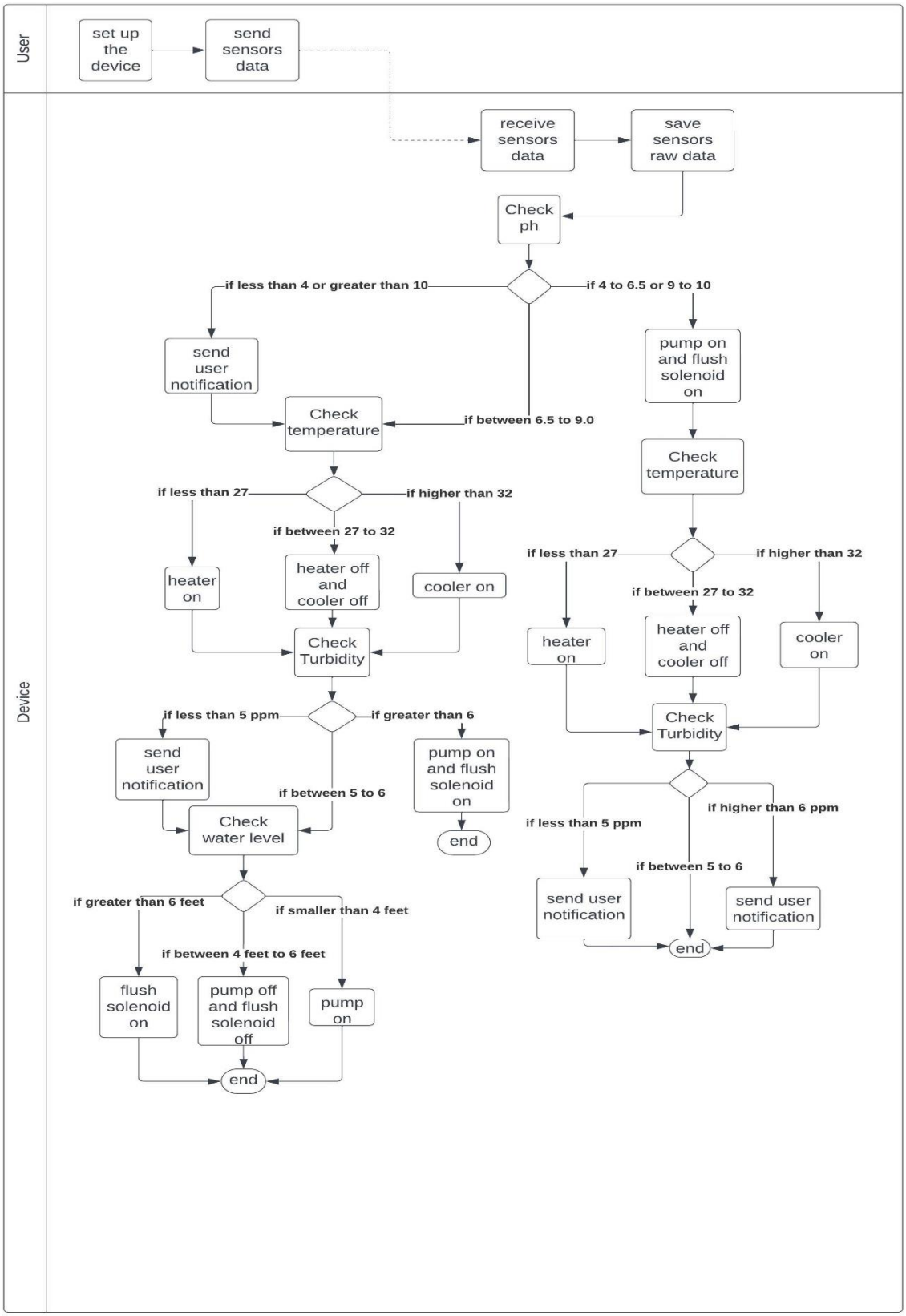

Figure 3.1: Diagram of Business Process Modelling Notation

3.2 Requirement Collection and Analysis

The process of requirements analysis commences with the collection of requirements, followed by an in-depth analysis to assess the feasibility and accuracy of transforming these requirements into potential products. The creation of a project necessitates consideration of various factors, such as the expected outcome, customer usability, potential errors during usage, effective management, involvement of other organizations or individuals, functional capabilities, and the necessary resources for project execution. Ensuring proper functionality and sufficiency of resources are crucial aspects in determining the success of the project.

3.2.1 Hardware Requirements

The hardware requirements are the sensors and microcontrollers we have used to implement the project. The framework also provides minimum standards and recommended standards for running computers.

- ESP32S Microcontroller.
- DHT11 Temperature and Humidity Sensor.
- Ultrasonic Sonar Sensor.
- Water temperature sensor.
- Relay module.
- Gsm module.
- Turbidity Sensor.
- Flush Solenoid.
- PH Sensor.
- Power unit.
- Mobile/Computer.

In addition to the previously mentioned elements, the project necessitates the use of a desktop computer, mobile phone, and printer. A desktop computer, laptop, or mobile phone is indispensable for effective project management. The data from the system will come to the telephone through server through IoT, so telephone is required. Printers are used to print and store various heavy data on paper, such as heavy data output from the system, or printing a document like a useful report, or extracting something needed from online.

3.2.2 Software Requirements

The software requirement entails specifying the software utilized in our project, detailing the programming language employed, identifying the database associated with the language, and specifying the compatible operating system. An essential operating system for seamless functionality is Windows, with Microsoft Windows XP being the chosen operating system for our project. The operating system is crucial to ensure the proper execution of the system.

- Arduino.
- Visual Studio Code.

3.2.3 Feasibility Analysis

Our system is meticulously designed and implemented using cutting-edge technology, rendering technology-driven systems economically, technologically, and operationally feasible in this digital era.

Economic Feasibility:
The digitalized technology-based system is accessible to all fish farmers for implementation on their farms. By adhering to a specific model outlined in Gantt charts or software development life cycle models, the system can be established quickly, efficiently, and at a reduced cost.

Technical Feasibility:
Our system is entirely digitized and technology-based, employing digital servers and online specialized technologies to establish all fish farmers on their farms. This ensures a high level of technical convenience and efficiency.

Operational Feasibility:
With our fully digitized technology-based project, fish farmers can be easily connected in their farms through digital servers and online platforms. This allows for seamless monitoring by individuals or organizations from the comfort of their homes at any time, making it operationally feasible.

3.3 Use Case Diagram and Description

A use-case diagram outlines the overarching functionality and scope of a system. It establishes connections between the system and its actors. Use case diagrams are used to compile a system's requirements, taking into account both internal and external factors. The majority of these needs are design requirements. The use case diagram basically analyses what the actors do with the system and how the actors use it. A use case diagram's primary goal is to illustrate a system's dynamic nature. The system's requirements, which take into account both internal and external factors, are accumulated. It refers to individuals, use cases, and a number of other things that refer to the actors and components responsible for putting use case diagrams into practise. The needs of the system are gathered. It shows the interaction between the players, the external perspective of the system, and the internal and external influences on the system. Here's our use case diagram:

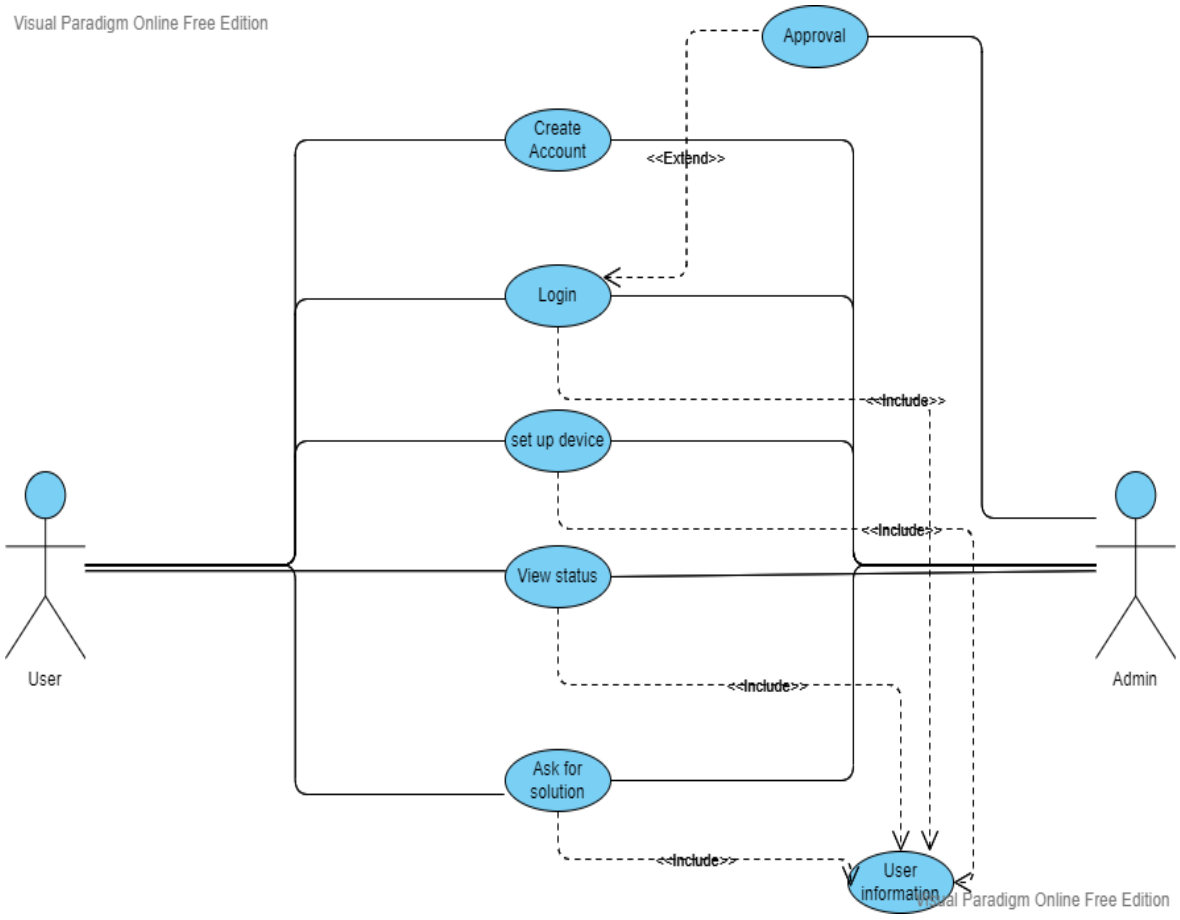

Figure 3.2: Diagram of Use Case Diagram

Here, the admin can monitor all the received data from the sensors and control user access.

Table 3.1: Use Case of Monitor Data

Use Case Name	Monitor data
Use Case Details	Gathering data and securing the data.
Pre-condition	Login
Actor	Admin
Post- Condition	None

Here, admin can control user access.

Table 3.2: Use Case of Control User Management

Use Case Name	Control user access
Use Case Details	Have control over user
Pre-condition	Login
Actor	User
Post- Condition	None

3.4 Logical Data Model

A logic model serves as a practical representation of the connections between a program's resources, activities, and anticipated outcomes. It provides a clear and concise depiction of how interventions influence behaviour to achieve a specific goal. Conversely, a logical data model is a non-database-specific representation that outlines the information an organization aims to collect and the relationships among these data elements. Entity-relationship (E-R), dimensional, and relational data models are the three main types of data models. Additional terms include hierarchical, network, object-oriented, and multi-value, which are not frequently used. The qualities connected to a data component are also detailed by logical data modelling. A logical data model, for instance, might describe the kind of a data component, such as an account name (string) or account number (integer).

To create the database for our project, three tables are required. The tables are device, standard, actuators, data and user. The attributes of the tables are Device id, Name, Fish, pH, Water Level, Water Temperature, Pump, Flush, Heater, Cooler, Time, pH, Water Level, Water Temperature, Temperature, Humidity, Username, Password, Email, First name, Last name. All the tables are independent except data table have one-one relation with device table. Here we design our database for the device, data and user.

Table 3.3: Logical Data Model

Device	Standard	Actuators	Data	User
Device id	PH	Pump	Time	Username
Name	Water Level	Flush	PH	Password
Fish	Water Temperature	Heater	Water Level	Email
		Cooler	Water Temperature	First name
			Temperature	Last name
			Humidity	

3.5 Circuit Diagram

Here's our device circuit diagram:

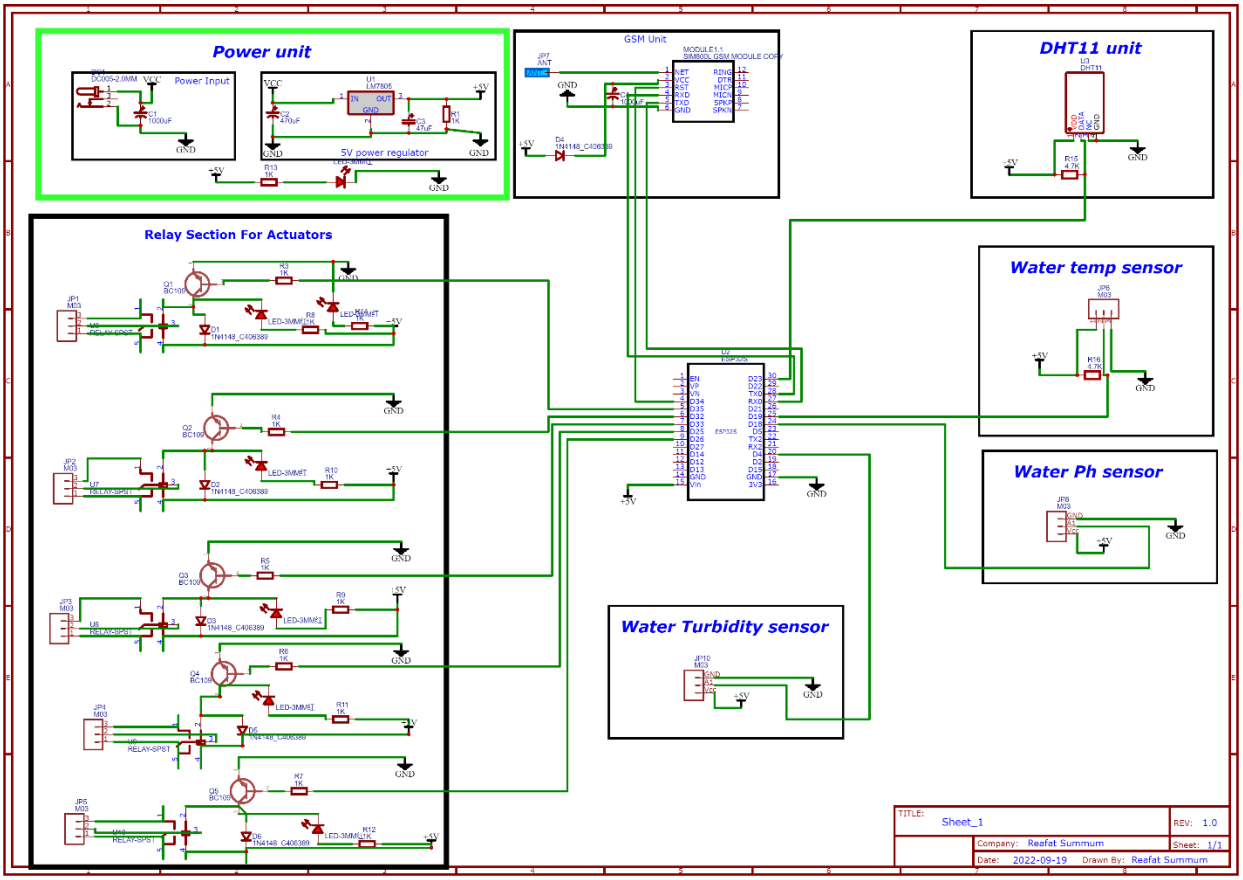

Figure 3.3: Circuit Diagram

3.6 Design Requirement

Python is a strong, flexible, and all-purpose programming language. Python is a fantastic introductory language since the code is concise and simple to comprehend. Anyone may use it to work more quickly and integrate systems more successfully. High-level Python web framework Django promotes quick development and tidy, practical design. It was created by skilled programmers, taking care of numerous web development headaches so that we could concentrate on building your app without having to invent the wheel. It's ridiculously fast, reassuringly secure, highly scalable and incredibly versatile. An SQL database engine that is compact, quick, self-contained, highly reliable, and fully featured is implemented by the C-language library known as SQLite. The most popular database engine in use today is SQLite. The creators pledge to maintain the stability, cross-platform compatibility, and backwards compatibility of the SQLite file format

into the year 2050. Commonly used as containers for sending rich material across computers are SQLite database files. In this project we used SQLite database to store our data and monitor them. Designed our application frontend and backend with Python and Django frameworks, REST-API. Following the completion of the system diagram, the subsequent phase will focus on the design aspect. During this phase, we will delve into both frontend and backend design aspects, encompassing hardware considerations and visual representation. The previously mentioned diagram incorporates Business Process Modelling, Use Case Diagram and Description, Circuit Diagram, as well as a visual flow diagram.

CHAPTER 4
DESIGN SPECIFICATION

4.1 Front-end Design

The front end represents the portion of a website or application that users encounter. It is also referred to as the "user interface" and encompasses elements such as images, text fields, and layouts. When visitors access a website, the front end is what shapes their overall visual and interactive experience. It plays a pivotal role in determining the website's aesthetic appeal and user interface. The significance of a positive first impression cannot be overstated, and a well-designed frontend contributes to that impression. Frontend design involves employing various programming languages, including HTML, CSS, and presentational JavaScript, to create code that shapes the user interface design of the website. This not only enhances the visual appeal of the site but also improves loading speed and responsiveness. The graphical user interface (GUI) of our project reflects the frontend design.

4.1.1 Home Page

The homepage is a website's front door, offering a glimpse into its essence. It acts as a visual and functional hub, presenting key information, navigation options, and a compelling design to captivate visitors. A well-crafted homepage serves as a guide, directing users to explore the diverse facets of the site effortlessly.

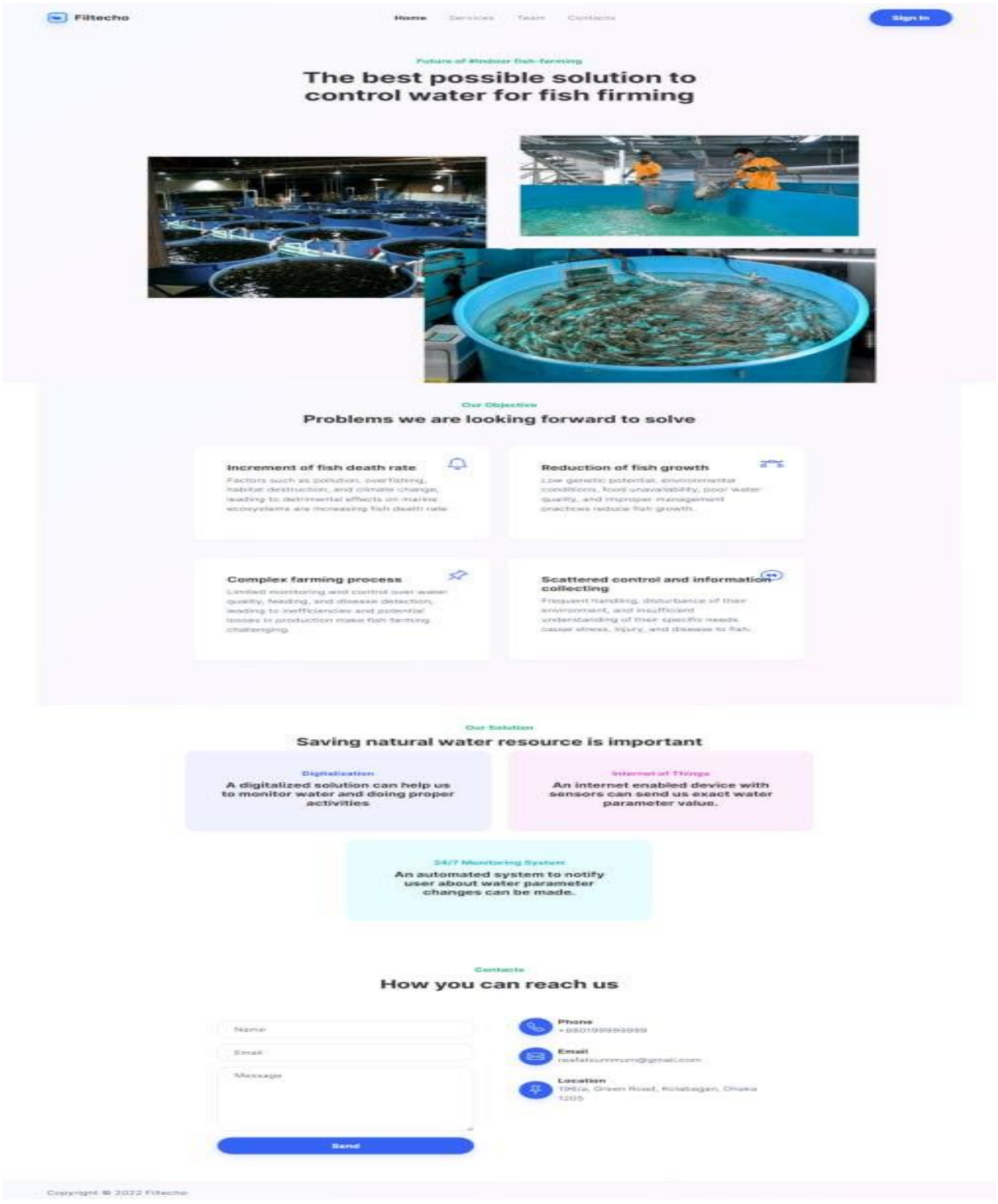

Figure 4.1: Home Page

4.1.2 Service Page

A service page on a website serves as a comprehensive resource outlining the range of products or services a company offers. It delves into details like features, benefits, and pricing, providing potential customers with crucial information. Well-crafted service pages not only convey the value proposition but also establish trust through transparency. Employing engaging visuals and concise content, these pages play a pivotal role in converting visitors into customers. A strategically designed service page acts as a virtual sales representative, guiding users through the offerings and addressing their specific needs, thereby contributing significantly to the overall success of a business's online presence.

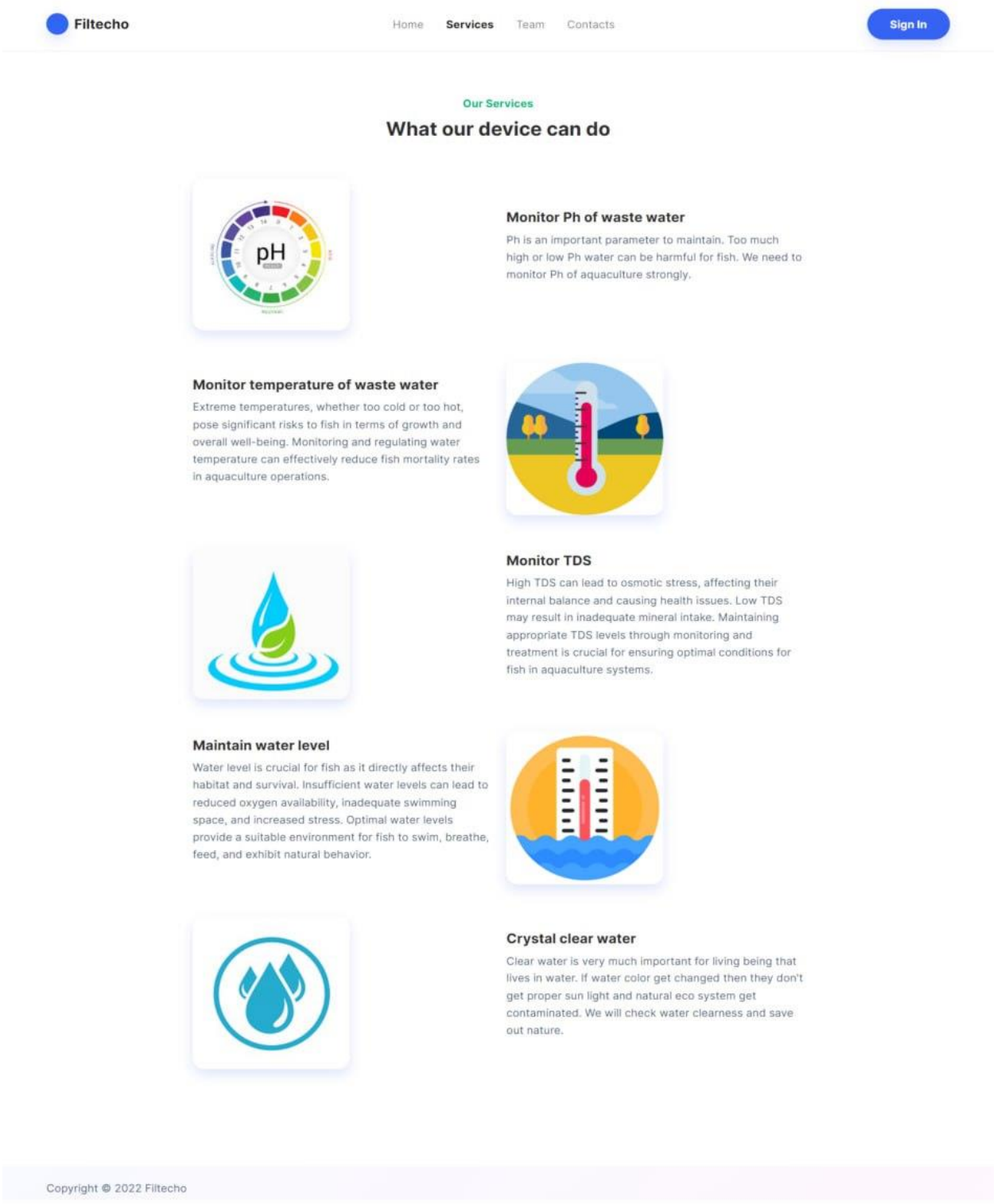

Figure 4.2: Service Page

4.1.3 Team Information Page

The team information page on a website offers a glimpse into the individuals behind a company. It showcases the expertise, roles, and personalities of team members. This transparency fosters trust, allowing visitors to connect with the faces driving the business. Engaging visuals and concise bios contribute to a compelling presentation, providing insight into the collective strength and professionalism of the team.

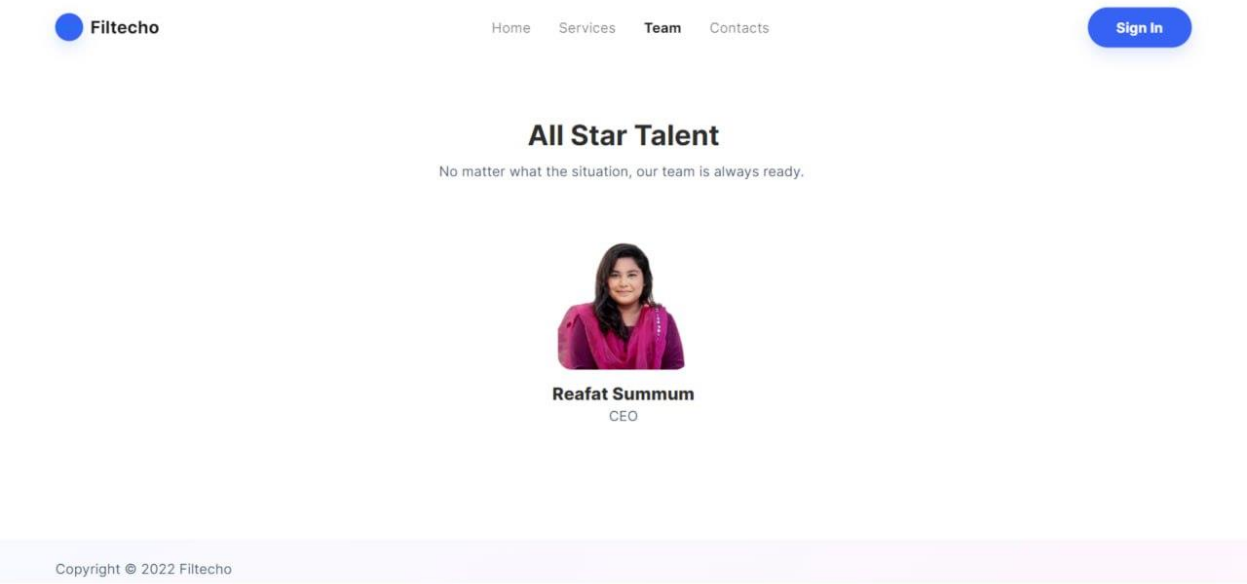

Figure 4.3: Team Information Page

4.1.4 Contact Page

A contact page is a vital element of a website, serving as the bridge between businesses and their audience. It features essential information, such as email addresses, phone numbers, and sometimes a contact form. This accessible platform facilitates communication, encouraging visitors to reach out with inquiries, feedback, or collaboration proposals. A well-designed contact page enhances user experience, fostering seamless interaction and building trust.

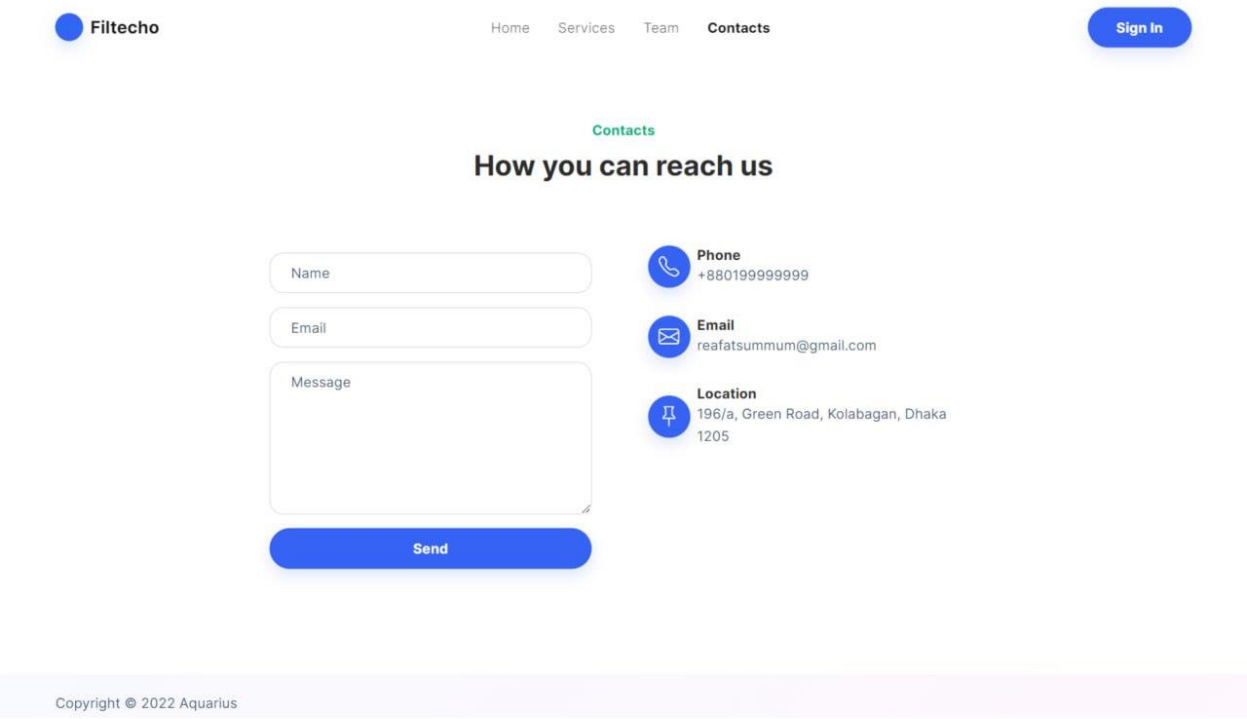

Figure 4.4: Contact Page

4.1.5 Login Page

A login page is the gateway to secured access on a website, requiring users to authenticate their identity. It typically features fields for entering usernames and passwords, ensuring privacy and security. Well-designed login pages offer a user-friendly experience, incorporating measures like password recovery options. They play a pivotal role in safeguarding user accounts while providing a seamless entry point to personalized content.

Figure 4.5: Login Page

4.1.6 Dashboard

A dashboard is a central hub on a platform, consolidating and presenting key information in a visual format. It offers users an overview of data, analytics, or system performance at a glance. Well-designed dashboards enhance user experience, providing insights and facilitating efficient decision-making. They serve as intuitive tools, empowering users to navigate and interact with complex information effortlessly.

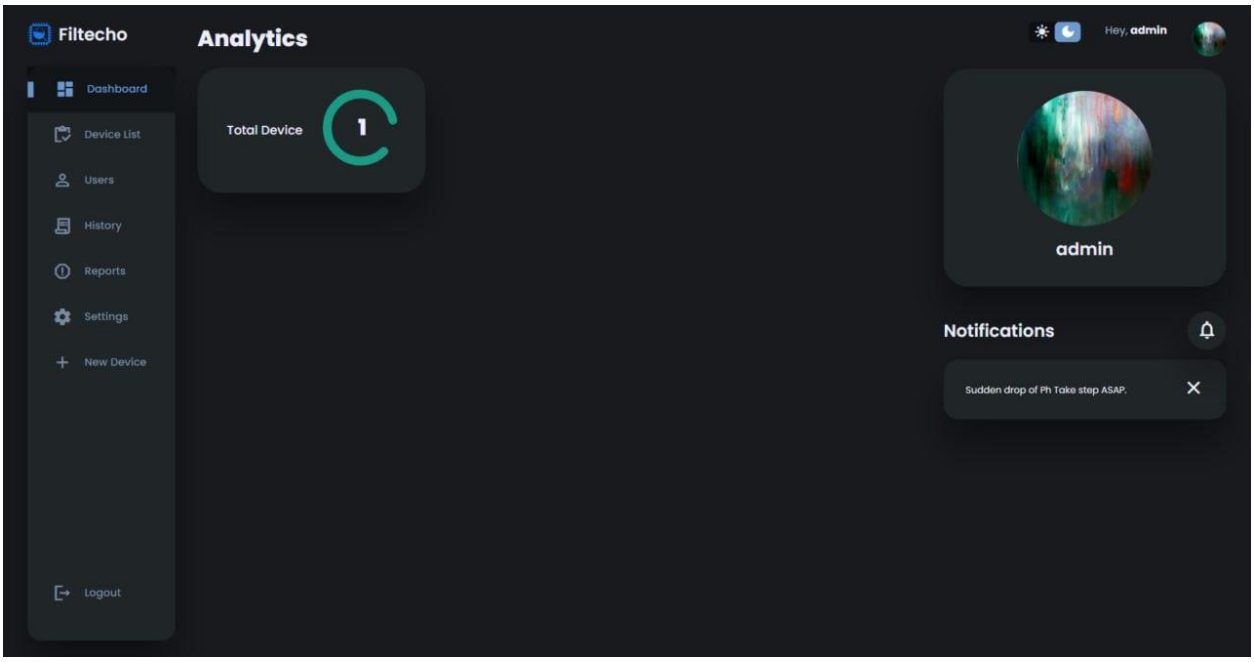

Figure 4.6: Dashboard

4.1.7 New Device Add

The "New Device Add" page simplifies integration by enabling users to input essential device details. This user-friendly feature ensures a smooth process for adding and activating new devices within the system, enhancing efficiency and functionality.

4.1.7.1 Device Information Set up

The device information setup is a crucial step in system integration, where users input essential details for seamless functionality. This user-friendly process streamlines the integration of new devices, ensuring efficient and effective operations within the system.

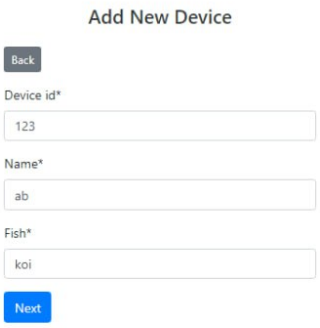

Figure 4.7: New Device Add Step-1(Device Information Set up)

4.1.7.2 Standard Value Set up

Standard value setup is pivotal for system optimization. Users configure predefined values, ensuring consistency and efficiency in operations. This streamlined process enhances functionality and adherence to established standards, contributing to a well-organized and efficient system.

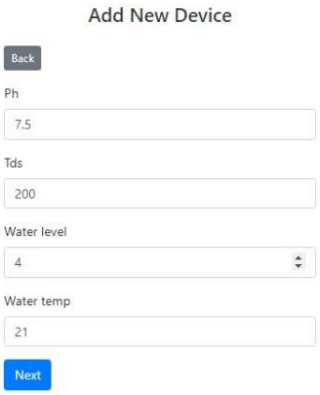

Figure 4.8: New Device Add Step-2(Standard Value Set up)

4.1.7.3 Actuators Initialization

Actuators initialization is a critical stage in system deployment. Users set parameters, initiating the precise functionality of actuators. This essential process ensures accurate and synchronized operation, contributing to the system's reliability and optimal performance.

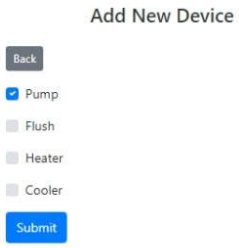

Figure 4.9: New Device Add Step-3(Actuators Initialization)

4.1.8 Device List

The device list catalogues active devices, providing a quick overview for users. This concise feature facilitates efficient monitoring and management.

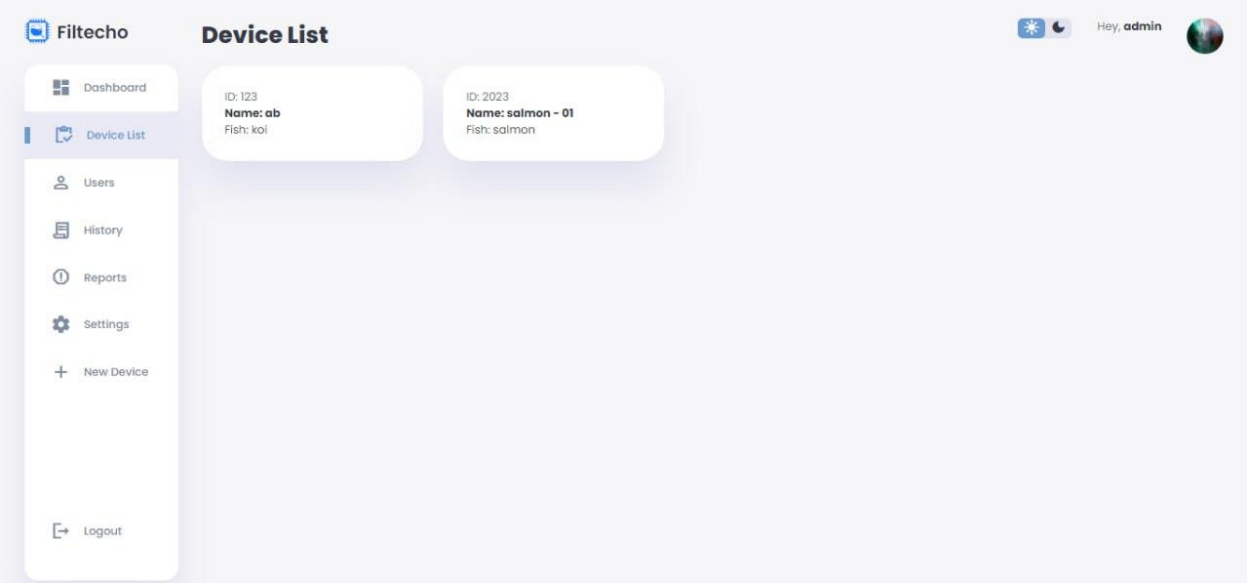

Figure 4.10: Device List

4.1.8 Data Control and Monitoring Page

The Data Control & Monitoring Page is a centralized platform, empowering users to oversee and manage data. This feature ensures efficient control, analysis, and monitoring for streamlined operations.

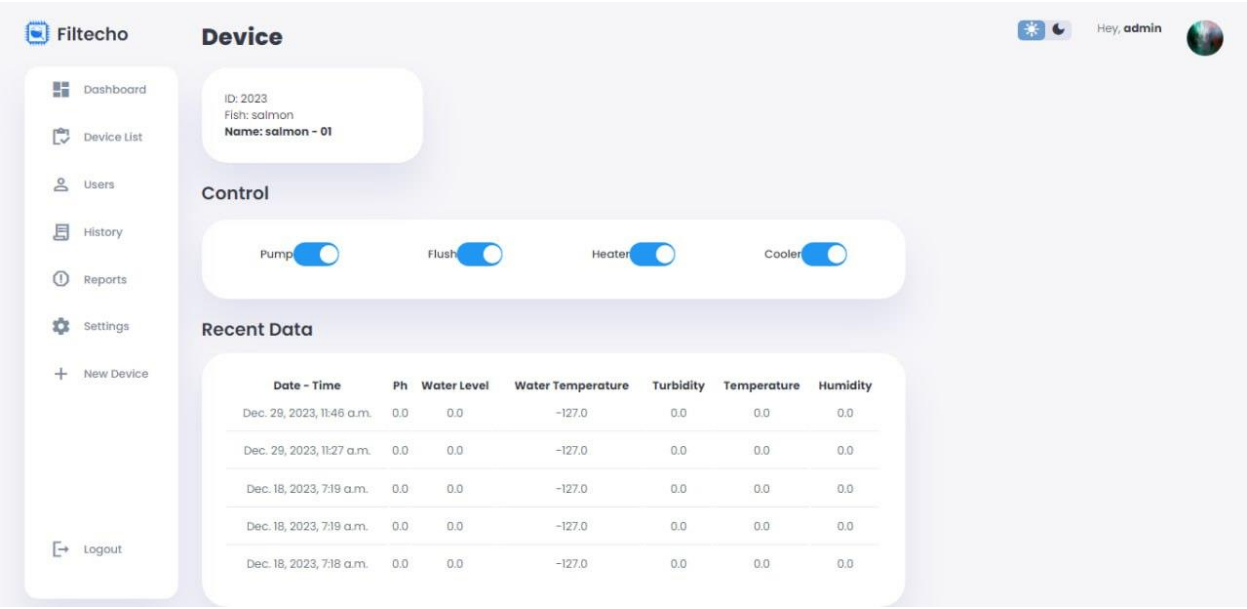

Figure 4.11: Data Control & Monitoring Page

Front-end tools and technology-

- HTML, CSS, and JavaScript
- Design tools: Sketch or Figma

4.2 Back-end Design

Any project's back end is a component that the developer completes. Both the client and the administrator cannot see it. It could be computer code or a server-based programme that fulfils the client's request. When a customer requests to establish an account on our website, the server will send the requested information to verify the customer's eligibility. The back-end then verified the data and gave the client access to the account. The back-end also includes the database. Here we use a Django, SQLite and Rest-API.

Back-end tools and technology-

- Web framework: Django REST-API
- Database: SQLite.

4.3 Interaction Design and User Experience (UX)

User experience design involves the comprehensive approach a developer takes to interact with a new product, focusing on transforming the overall experience. It encompasses the developer's interaction experience with the new product. On the other hand, interaction design is concerned with the immediate experience a developer has while using a product, aiming to ensure a pleasant experience. In simpler terms, UX design includes interaction design. The objective of interaction designers is to improve the user experience specifically at the point of interaction with a product. In summary, user experience and interaction design are separate concepts.

4.4 Implementation Requirements

Following the completion of the website's design phase, the implementation stage will commence. During this phase, we will outline the necessary elements for website creation, including required equipment, frontend and backend programming languages, chosen frameworks, and the designated database. Subsequently, the testing phase will ensue, involving the selection of browsers for comprehensive testing and the subsequent discussion of the testing report. The technology used as follows

- Programming Language: HTML, CSS, Python, JavaScript
- Framework: Django
- Database: SQLite

CHAPTER 5
IMPLEMENTATION AND TESTING

5.1 Implementation of Database

To store, remove, and update the data for our project, we utilise a SQLite database. It is a relational database because the data is organised into distinct "tables" and linked together with "keys" in this instance. Additionally, this database allows us to manage, alter, and remove data in an orderly manner. We also use Rest-API to interact with the device and collect the raw data from the sensors that we will be using. For the backend, the Django framework was employed, and in conjunction with it, an SQLite database was utilized. The Operating Systems of Windows 2000, NT, and XP were employed. Additionally, I3 and I5 processors were recommended for optimal performance. As for web browsers, Chrome, Microsoft Internet Explorer, and Mozilla Firefox were the browsers of choice.

5.2 Implementation of Front-end Design

In software implementation, distinct programming languages are employed for frontend and backend design. Specifically, HTML, CSS, and Bootstrap language were utilized for frontend implementation, while Python and JavaScript were chosen for backend implementation. The entire website was developed using the Django framework. Additionally, we may utilise Windows XP Home Edition, Windows XP Professional, Windows 2000 Server, Windows 2000 Advanced Server, among other operating systems.

5.2.1 Procedures

Prior to commencing work on this project, extensive analysis was conducted on the idea. Various types of analysis were undertaken, focusing on evaluating the feasibility of the concept's sustainability in the future and anticipating potential challenges or complications. Following a successful feasibility analysis, the next step involved designing the prototype. Once the prototype design was completed, we proceeded with the direct implementation of the concept.

First, we drew the circuit design and diagram for our entire project. After the circuit design and diagram, we complete the whole project by putting together all the microcontrollers and sensors.

Second, we focus on the implementation of the frontend design part. Because the frontend must be designed to display the data received from the hardware through the server. HTML, CSS, Bootstrap languages are used to implement this frontend design.

Third, after the frontend part is complete, we implement the backend design part. We use Python and JavaScript languages to implement the backend design part. Also, we chose Django as the framework.

Fourth, after the frontend and backend are complete, we connect the system to the database. Here we have used SQLite database. Once the database is connected our initialization is done.

Fifthly, then after all the preliminary work comes the testing phase, where the preliminary work is tested and passes the test successfully.

5.2.2 Detailed System Description

Currently, water is becoming more polluted from industrial wastewater. This pollution must be stopped to improve our environment and improve the quality of life of the people of the country as well as the area. So, we want to develop an IoT device that can prevent water pollution in fish farming and work accordingly. As we are developing a device to detect changes in water that is contaminated with fish farming, we will be able to identify water quality for fish farming. So, we need to bring sensors to measure water quality like temperature, pH, turbidity, Ultrasonic Sonar Sensor etc. Set the sensor with the ESP32S development board and create the device to measure the value. We will collect data after some time using API through our developed application. Analyse the condition of fish farming water using the values obtained and note the condition. If any significant changes are observed for fish farming water, take appropriate measures to conserve water.

5.3 Testing Implementation

Any software needs performance testing to ensure it performs as expected. Checking certain metrics, such as application output, data processing speed, network bandwidth utilisation, load-carrying capability, memory consumption, command reaction time, etc., is necessary to evaluate a website or programme. We need to check the incoming data for our site. All our work like many types of analysis, feasibility analysis, prototype design for concept implementation, HTML, CSS,

Bootstrap language for frontend design implementation, Python and JavaScript language for backend design implementation etc. comes to testing stage. During the testing phase, the primary objective is to execute the entire code and verify its correct functionality, ensuring the absence of errors. Any identified errors or bugs are addressed during this testing phase. The process involves troubleshooting the detected bugs and subsequently rerunning the code to validate its proper execution. This testing is conducted across various internet browsers such as Chrome, Microsoft Edge, Internet Explorer, Mozilla Firefox, among others. From the sensors, user can log in or not, data is updated after certain time or not, data status is read correctly or not etc. Here, we utilise three approaches to examine a programme while checking our website. or online. The three methods are:

- Black box method
- White box method
- Gray box method

5.4 Test Results and Reports

Three techniques are used in this instance to test our project. White box, black box, and grey box methods are available. In order to develop the project, we must use the white box testing approach to check for code errors, page links, routing, server connections, etc. The dashboard administration, login, password setting, data sent, read, and data analysis that are part of the black box testing methodology must also be examined. We verify server connection, login, password set, etc. as a grey box technique. Upon completing the testing of our website, no bugs were identified, and the entire code ran smoothly without errors. Consequently, our testing results are free from any issues or discrepancies. The report has been meticulously crafted based on the testing outcomes, ensuring a professional and concise presentation without any extraneous content.

CHAPTER 6

IMPACT ON SOCIETY, ENVIRONMENT AND SUSTAINABILITY

6.1 Impact on Society

- Water monitoring is important to ensure that the water we drink and use is safe. Proper water monitoring can identify problems before they become serious and help improve our water quality.
- Water monitoring is important to ensure that the water we use for fish farming is safe. Proper aquaculture water monitoring can identify problems before they become serious and help improve aquaculture water quality.
- Improved water monitoring systems for fish farming can improve fish health.
- Unsafe water can be harmful to fish health and harm our environment.
- Water is used for drinking, washing and cooking. It is also used to flush toilets and wash medical equipment in hospitals. Some industries use water for cooling equipment and cleaning operations. Protecting our water supply and ensuring it is safe for people and the environment is important to us.
- According to the US Centres for Disease Control and Prevention (CDC), 1 in 9 Americans become ill each year from exposure to contaminated drinking water.
- Unsafe water can also cause environmental damage to soil and water sources. Changes in our climate may increase rainfall in some areas, but also lead to droughts or floods in others. These extreme weather events can affect water quality in our reservoirs and other water systems.
- By maintaining the integrity of this water system, this aquaculture water monitoring system assists.

6.2 Impact on Environment

- Monitoring of fish farming water is an important part of environmental protection.
- Fish farming water monitoring systems can reduce the number of pollutants discharged into water bodies and provide a positive impact on habitat conservation.
- Without an effective aquaculture water monitoring system, many ecosystems, such as oceans, can be severely damaged by excessive pollution.

- Monitoring of polluted areas helps the authorities to develop effective strategies to limit the impact of this pollution on human health and environment. Implementation of a well-designed monitoring program is an important first step in restoring aquatic ecosystems affected by human impacts.
- Pollution can adversely affect the environment in various ways. Poor water quality caused by industrial waste can enter rivers, lakes and oceans through direct discharge or leakage from waste containment facilities. So, water monitoring can prevent them.

6.3 Ethical Aspects

Our fish farm will be ethically honest. To operate our fish farm ethically, no fattening drugs can be used in fish feed. So that there is no nutrient inside the fish. Because in this way, the population will eat fish, but there will be no nutritional value, as a result, even if the demand for non-vegetarian food is met, neither nutrition nor non-vegetarian food is fulfilled. Which will create a very bad impression on fish farmers. So, fish farmers have to be more ethically conscious and we ourselves have to be morally honest.

6.4 Sustainability Plan

Given the nationwide scope of our project, it is imperative to establish a robust plan. Prior to initiating the project planning phase, a detailed and specific plan must be developed to guide and execute all activities systematically. As per this plan, the objective is to consolidate all fish farming projects across the country onto a unified platform. This entails bringing together all types of fish farming establishments, including private, institutional, and government-owned farms, under the umbrella of our project. If there are not enough people to look after the fish farming farm, it also needs to be arranged. That is, the project development and management team should move forward with a good plan, so that the system does not face any bottlenecks in the future.

CHAPTER 7
CONCLUSION AND FUTURE SCOPE

7.1 Discussion and Conclusion

The design and development of aquaculture water quality monitoring systems demonstrate the ability to produce products that are more dependable and efficient. The system mainly focuses on analysing the quality of fish farming water with accuracy in real time. Observations made during indoor testing indicate that the output is nearly accurate and trustworthy. On the other hand, the outcomes of the outdoor tests demonstrate the system's effectiveness for a variety of water bodies. It is a flexible system, allowing for the measurement of additional fish farming water parameters by simply swapping out the sensors and altering the computer code. The system may be expanded to assess the water pollution caused by fish farming and is dependable and simple to maintain. The model provided a reasonable concept of how the system may be applied in various fish farming farms while maintaining the same design aesthetic and business plan in mind. The suggested system may be carried anywhere, is simple to use, and doesn't require much technical expertise to operate. The device works best in environments with water and inaccessible locations for people. Fish farming water turbidity, pH, and temperature are monitored utilising special GSM infrastructure and water detection sensors. The system is low-cost, self-contained, and can automatically check the quality of the water. Testing the water quality in aquaculture may be more affordable, practical, and quick. The method is very adaptable. This system may be adapted to track other aquaculture water quality metrics by only swapping out the required sensor and altering the relevant software. Really simple to use. It is possible to expand the system to track hydrologic conditions, air pollution, industrial and agricultural output, etc. It has a broad scope of use and extension value. allows for the creation of a smart environment that is capable of monitoring itself thanks to embedded gadgets. In order to do this, sensor devices must be placed in the environment to collect data and conduct analysis. We can make the world more realistic by adding sensor devices so that it can interact with other things over a network. The user will then have access to the gathered data and analysis findings through Wi-Fi.

In this paper we have developed an IoT device that can prevent water pollution in fish farming and act accordingly. As we develop a device to detect changes in polluted water in fish farming, we will be able to identify water quality for fish farming. So, we need to bring sensors to measure

water quality like temperature, pH, turbidity etc. Set up the sensor with the ESP32S development board and create the device to measure the value. We will collect data after some time using API through our developed application. Analyse the condition of the fish farming water using the values obtained and note the condition. If any significant change is observed in fish culture water, take appropriate measures to conserve water.

7.2 Scope for Further Development

Future measurements of the quality of fish farming water may take into account factors like conductivity, hardness, chloride, ammonia, iron, fluoride, and others. These parameters are already used to check the purity of water for a variety of purposes, including fish farming and everyday requirements. By doing more testing on various surfaces and using casing bodies composed of lightweight, robust, and long-lasting materials, the system may be further enhanced. The secret to long-distance communication is to use a SQLite database, and the data will be stored online so that everyone may access real-time data from any location.

In the future, we will apply the IoT idea in this project-

- To detect more criteria for the safest usage.
- By adding more sensors, the parameters may be increased.
- By interacting with relays, we can regulate the water supply.

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