SciFish-Smart Bio Floc Monitoring

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SESSION 2018-2022

SciFish-Smart Bio Floc Monitoring

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A DISSERTATION SUBMITTED AS A PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF BACHELOR OF SCIENCE IN SOFTWARE ENGINEERING

DEPARTMENT OF COMPUTER SCIENCES

COMSATS UNIVERSITY ISLAMABAD,

ATTOCK CAMPUS-PAKISTAN

SESSION 2018-2022

UNDERTAKEN

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FINAL APPROVAL

Certified that we have read this project report submitted by Ms Laraib Noor and Ms. Eqra Khattak and it is, in our judgment, of sufficient standard to warrant its acceptance by Department of Computer Science, COMSATS University Islamabad, Attock Campus, for the BSSE degree.

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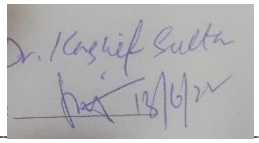
1. External Examiner 

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DEDICATION

To my Loving Parents and Teachers

ACKNOWLEDGEMENT

We would like to express our gratefulness to our Supervisor Dr. Saud Khan who provided us with the vision for this project and guided us despite his busy schedule and work routine. By working on this project, we learned how to integrate different sensors with Arduino. The experience we gained while working on this project is invaluable, and no doubt, it will help us inthe future.

PROJECT BRIEF

PROJECT NAME	SMART BIOFLOC MONITORING
ORGANIZATION NAME	COMSATS UNIVERSITY ISLAMBAD, ATTOCK CAMPUS
OBJECTIVE	TO MONITOR PH, TEMPERATURE AND WATER LEVEL OF FISH TANK
UNDERTAKEN BY	LARAIB NOOR EQRA KHATTAK
SUPERVISED BY	DR SAUD KHAN LECTURER CS DEPARTMENT COMSATS ATTOCK
STARTED ON	FEB 2021
COMPLETED ON	JUN 2022
COMPUTER USED	DELL INSPIRON 500 CORE i5
SOURCE LANGUAGE	DART
OPERATING SYSTEM	WINDOWS 10 PRO
TOOLS USED	ANDROID STUDIO ARDUINO IDE

ABSTRACT

Smart Bio Floc Monitoring is a system consisting of a mobile application (SciFish), sensors to measure pH, temperature, oxygen, water level connected through wifi by esp8266 making a WSN(Wireless Sensor Network). It will contain various sensors to look at the changed properties of water. In Pakistan, there is no such system as to monitor a whole floc of fishes in a fish farm farmers must maintain conditions for better fish life manually. Also, there is no consultancy for farmers to counsel for the development and medical problems of fishes. The thought is fundamental for those farmers who are neglected to develop their business at a high proportion. The project contains a great deal of data and grandiosity in a novel technique for the fresher who needs to begin their startup as a fish farmer. Feed given to the fishes is determined by the no. of fishes and dosage per day. Fish mortality rate is being optimized through SciFish by maintaining conditions that are necessary for fish life. Whenever the conditions being monitored deviate from normal the farmer is notified through application notifications.

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LIST OF ABBREVIATIONS

SRS	Software Require Specification
PC	Personal Computer
PH	Power of Hydrogen
DO	Dissolve Oxygen
OOP	Object-Oriented Program
OTP	One Time Password
IoT	Internet of Things

Chapter 1

Introduction

Introduction

Traditional fish farming is not sensitive to aquatic life as the ponds are already made, there's always more water, more space, more fish and more of about everything but it has its perks. Such as, it can prove too unhealthy and contaminated for the fish to survive. The waste excreted by the fish and the leftover food can cause the formation of ammonia gas which is harmful for fish. In contrast, Bio floc is a symbiotic process that includes confined aquatic animals, heterotypic bacteria, and microbial species in the water. Bio floc provides environment that is good for fish growth and survival providing certain parameters are fulfilled. Consumption of bio flocs also provides nutritional value to cultured aquatic species.

Smart Bio Floc Monitoring is the monitoring of a bio floc in an artificially generated pond. This project will be an ultimately huge helping guide for bio floc fish farmers to do successful bio floc farming, from seed deployment to selling fish in the market. It will be looking into various factors such as monitoring sensors and their integration in the mobile app to look for any slight change in the properties of water or food. For example, dissolved oxygen level detection, temperature, pH, and water level etc. Also, to undergo the survival rate of fish in a pond according to its symmetry and then provide tips for its betterment. The sensors are directly connected to the mobile app and can be used remotely from anywhere to keep an eye on things. It can be used for both natural and artificial ponds.

1.1.1 Brief

Smart Bio Floc Monitoring is a project based on a controlled synthetic environment which is highly suitable for survival and growth of a floc. Automated by a mobile application that runs on both Android and iOS with a single codebase Dart. This project is a simple program for a bio-floc fish farmer to help him in doing his job properly and efficiently with minimum efforts.

Computer literacy is a major issue in our country for farmers that are either on a small scale or in a large-scale production. They lack critical information about most of their farming practices and are unaware of the upgrade in resources. Numerous fish die in their ponds due to poor consideration.

Specifically, in Pakistan there's no consultancy for farmers to consult for the growth, fertilization, and health issues of fish. Our objective is to provide them with the

solutions to their problems so they can become better and successful fisherman of their region.

Considering, the farmers must create artificial ponds in order to grow fish in ideal environments, there might be an issue with the area and the design of the pond. The problems can be a rectangular shaped pond which might stop the fish in their paths as fish tend to keep swimming most of the time, to avoid that, we decide to shape it circular.

It's a fact that fish requires utmost care as their environment is different from land animals, so they need specific conditions like oxygen level, temperature, pH, water level, food etc. Fish feed is deployed according to the pound areas but first these parameters must be satisfied which will ultimately lead to reduction in fish death rate.

Survival area for 1000 fishes in a pond is 1 square meter. If 1 Acre farm is converted in to 1 single tank, a 1000 fish can survive. Parameters that must be met for bio floc are Temperature, Dissolved Oxygen, pH, Salinity, Solids (total suspended solids and settling solids), Alkalinity, and Orthophosphate. So, for its management, a technology called WSN (Wireless Sensor Network) is used in this project. WSN monitors and records the physical conditions of the environment and organize the collect data at a central location.

This project will decrease labor time and increase efficiency as it can be controlled from a mobile phone when installed on an Android or an iPhone. The sensors attached to the ponds will be integrated in the mobile app and the user will continuously examine the situation of the pond such as water quality and environment for better growth. In addition to that our app will advocate the best marketplace and farmers can manage all expenses and stocks record.

1.1.2 Objectives

The objectives of this application are as follows:

- Wireless connection through Wi-Fi with sensors allowing us to monitor from a distance saving the data in Firebase Firestore.
- To check the level of ammonia by checking its PH.
- To observe the water temperature according to the ideal temperature conditions for certain fish.
- Observe the amount of dissolved oxygen in the water based on number of fish and its providence through air pump.

- Deployment of fish feed in tanks based on the amount set in the app.
- Users will be notified when there is a change in the ideal conditions set for certain fish in the tank.
- To fetch the data from database to the mobile application.
- Monitoring the fish through the camera.

1.1.3 Hardware Design

In designing the hardware of our project, we have integrated all the components. The detailed explanation of each component is and its working has been explained in this chapter. We have also explained how different components are linked to each other.

1.1.4 Components

In Hardware architecture, we have used the following components.

1.1.4.1ESP8266

The ESP8266 Wi-Fi Module is an independent SOC (system on chip) that can help any microcontroller to connect to the Internet with dual-mode Bluetooth and Wi-Fi. You can essentially attach this to your Arduino gadget and get about as much Wi-Fi-capacity as a Wi-Fi Shield offers. The ESP8266 includes built-in antenna switches, RF balun, power amplifier, low- noise receive amplifier, filters, and power management modules. ESP8266 is created by a Shanghai-based Chinese company and is manufactured by TSMC using their 40 nm process.

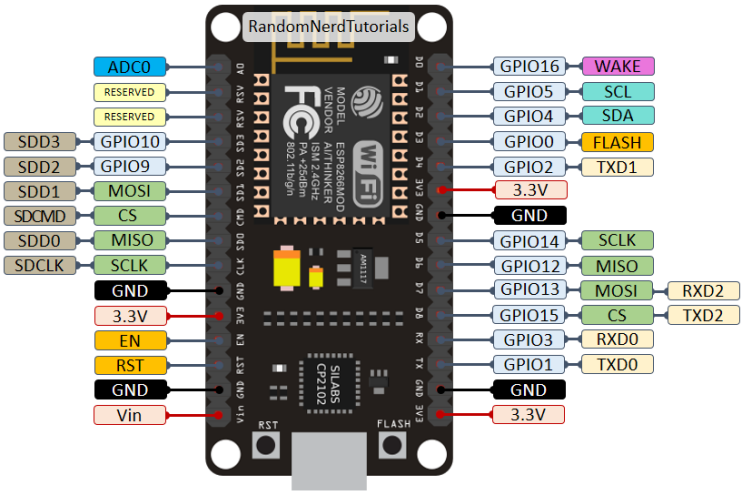

Figure 1.1 ESP8266

1.1.4.2pH Sensor

PH sensor is used to measure hydrogen ion concentration in a solution. Glass pH electrode is widely used in pH sensors. The electrode is the main part of measuring the pH in a solution. It works on the principle of voltmeter and uses a potential difference

to check solution voltages and compare them with existing ones. The ideal value for a solution should be pH=7 and if it is more than 7 it will a basic solution and if pH is less than 7then the solution will be acidic.

Figure 1.1 pH Sensor Kit

1.1.4.3Temperature Sensor

Temperature sensor plays an important role in many applications like in the case of fish farming it is necessary to check the temperature. Temperature sensors are usually thermocouple or RTD. We have used a thermistor-based temperature sensor, which is capable of monitoring water temperature. It works on the inverse time characteristics phenomena. The resistance of the thermistor decreases when the temperature increases and gives the signal of rising in temperature.

Figure 1.3 Temperature Sensor

1.1.4.4Raindrop Water Level/Height Depth Detection Sensor Module for

Arduino

The water level sensor is super easy to use and only has 3 pins to connect. S (Signal) pin is an analog output that will be connected to one of the analog inputs on your Arduino. + (VCC) pin supplies power for the sensor. It is recommended to power the sensor with between 3.3V – 5V.

The below figure shows analogue water level sensor and a digital water level sensor that we used in the project due to lesser number of pins.

Figure 1.4 Water level sensor analogue

Figure 1.4 Water level sensor digital

1.1.5 Tools and Technologies

The tools and technologies which we will be using for our project are:

1.1.5.1Android Studio Chipmunk 2021.2.1

Android Studio is the IDE that provides Google to develop professional Android applications. It is used to develop a different variety of applications for the Android operating system. It is an IDE & platform to design a user-friendly interface by drag and drop. Firstly, we started up on Arctic Fox 2020.3.1, then Bumblebee 2021.1.1 and project ended at the android studio version Chipmunk 2021.2.1.

1.1.5.2Flutter 3.0.1

Flutter is Google's UI toolkit for building beautiful, natively compiled applications for mobile, web, desktop, and embedded devices from a single codebase.

1.1.5.3Dart 2.17

Dart is an Open-Source, client-side programming language. It is easy to learn, stable, and creates high-performance applications.

1.1.5.4Arduino IDE 2.0

The open-source Arduino Software (IDE) makes it easy to compose code and transfer it to the board.

1.1.5.5Firebase

For database operation firebase will be used to store the records.

1.1.6 Relevance to Course Modules

As we studied different courses in the previous semester like Report writing skills. This course helps me a lot in improving my English and I am writing this report with help of it also programming, Database, software engineering, OOP in java, android, Applied physics for engineers. Android would be used for Designing interface and other functionality will be done by using different concepts of programming languages. In this project. Applied physics and Microprocessor and Assembly language will be used in Arduino Uno and hardware related work like Arduino Uno and for different sensors calibrations like PH, temperature, etc. In addition to that, the firebase database will also use for storing data. Software engineering will be favorable for us in making the use case diagrams activity diagrams.

1.1.7 Project Background

The idea behind this project particularly occurred in our mind when the business encountered such Problems in fish farming. So, we prefer this idea because this is a profitable business in our country there are a lot of apps available which provide a guideline about the farming of fish some provide only tutorials which are not enough

for a farmer, some app provided techniques, but they use some other languages, the only need is a farmer to have proper knowledge regarding how to feed fish, how to check the PH of the water. Also, lower-level farmers can use this application as our main target is to provide a maximum guideline about fishes that will help the farmers to grow their business on a high level. The feed is the main thing for fishes also users can check weather prediction this will be done by using different sensors like PH sensors as fish is dependent upon water to grow and breath, understanding the physical quality and chemical quality of water because success and failure depend on it. Less than 7 PH and greater than 8 PH are not suitable for fishes. Young fish may die to the PH level below. High PH levels above between 8 to 14 pH can be harmful for fish. One more sensor will be used i.e., Temperature sensor and weather predictions API will be used. For Selling sell their fishes Fish markets information will also be given. Users will get to know that how much seed they can deploy in the pound by providing the basic information of the pound.

1.1.8 Literature Review

We look at the current system that is in use and state its strengths and weakness. Pakistan is an agricultural country, acknowledging the fact that fisheries play an important role in the life of humans and country development. In the past few years, fish farmers are facing numerous challenges such as type checking method for detecting fish's health. These factors greatly affect the Economy of the country and food security. If we look at recent past years, there were several detection systems exist but when we talk about fish farming in Pakistan there is no consultancy for farmers to grow and health issues of fishes. By the time previous ways are replacing by the most efficient and latest ways, some current systems were made for the identification of fish.

1.1.9 IOT Based Fish Aquarium

IoT Based fish aquarium is a fully automated and remotely monitored aquarium, fully capable of operating without human intervention or interaction. Major features of this project are the mechanical feed design, fish feeding over the internet, and remote monitoring of all the parameters. The parameters include feed level, water temperature, pH, and water level. They can be accessed through a website on a computer or through the app on a phone.

1.1.10 System Conceptual Diagram

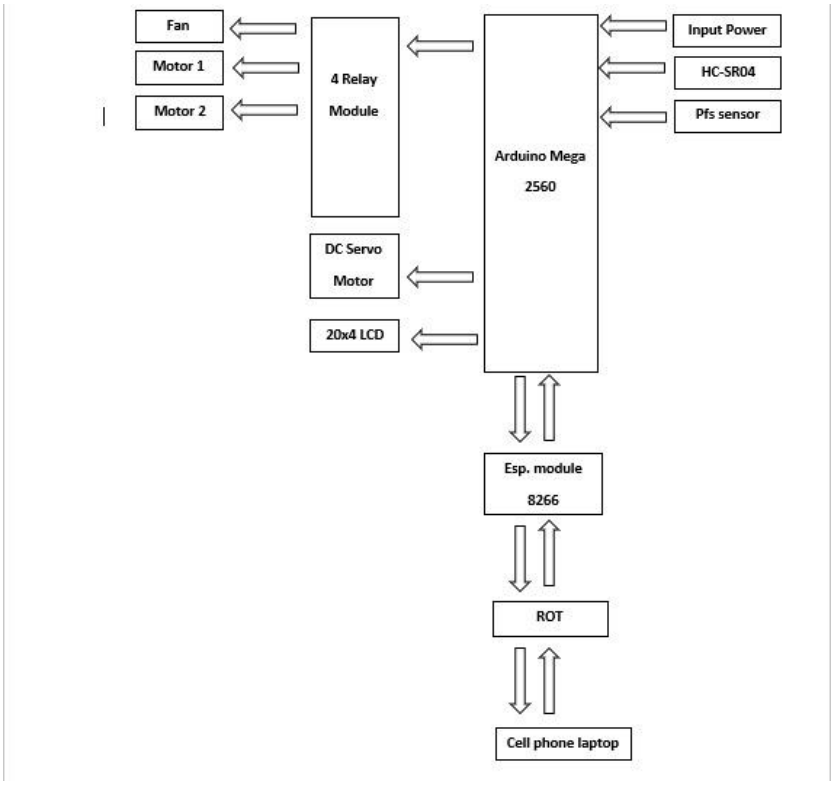

Figure 1.6 System Conceptual Diagram

In this project, they have used different types of sensors, which are connected to the microcontroller. Arduino gets the data from sensors, controls, and all the processes according to the commands given to it. The water level can also observe and refill the tank. This project has the following objectives

- To monitor the water level of the aquarium.
- To automate the refilling and drainage systems of the aquarium.
- In case if the aquarium is leaking or the water level drops to some extent it will refill the tank.
- To automatically feed the fishes at a specific interval of times.
- To check the purity of water by checking its ph.
- To transfer all the data to the internet.
- To make a system that can display and monitoring the sensor's data online in real- time.
- To display the useful data of the aquarium on the screen

1.1.11 Analysis from Literature Review

A thought comes to our mind from IoT based systems because humans do not do routine tasks very well and must discipline themselves over time, but machines or computers do not have these limitations. Every individual nowadays has cell phones, so our point is to create an android application, which handy & on the Go. We will provide the best solutions to their problems, attempting to incorporate everything in one application and propose the best market to sell their stocks. Our application will be beneficial for uniquely little scope farmers.it is effectively replaceable by a cell phone which is portable, time-Saving, and accessible at any time.

1.1.12 Methodology and Software Lifecycle for This Project

The fundamental and building block of a project is to describe the methodology. The methodology is essential for managing the project. We make an all-around considered structure record, there are a few highlights that despite everything do not give a similar impact as it gave on the paper. During the execution stage, numerous highlights are included or altered. One needs to make a few changes in system design and requirement analysis. For creating of "Ultimate fishing guide", we have chosen a flexible model type that can be molded easily after designing. Used as an agile development methodology for the development of our model.

1.1.13 The Rationale behind Selected Methodology

Agile development is an interactive software development strategy that involves cooperation and self-organizational cross-functional teams. This involves the delivery of the project incrementally rather build and deliver the whole project at once. We must deliver a progress report to the supervisor on an incremental basis and on that we gradually develop this application. Henceforth, agile is a combination of methodology and technique.

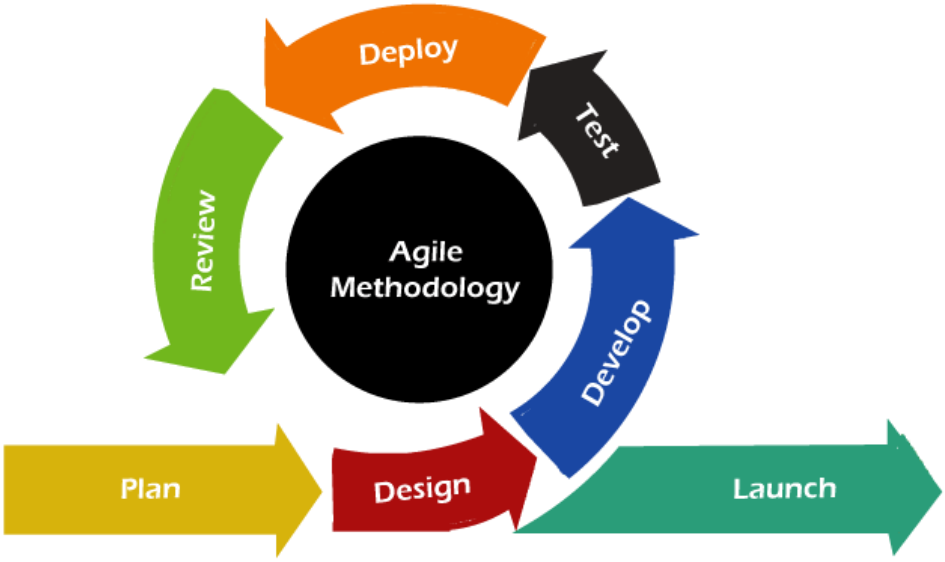

Figure 1.2 Agile Model

Chapter 2

Problem Statement

Problem Statement

Considering the farmers must create artificial ponds in order to grow fish in ideal environments, there might be an issue with the area and the design of the pond. The problems can be a rectangular shaped pond which might stop the fish in their paths as fish tend to keep swimming most of the time, to avoid that, we decide to shape it circular.

It's a fact that fish requires utmost care as their environment is different from land animals, so they need specific conditions like oxygen level, temperature, pH, water level, food etc. Fish feed is deployed according to the pound areas but first these parameters must be satisfied which will ultimately lead to reduction in fish death rate.

Survival area for 1000 fishes in a pond is 1 square meter. If 1 Acre farm is converted in to 1 single tank, a 1000 fish can survive. Parameters that must be met for bio floc are Temperature, Dissolved Oxygen, pH, Salinity, Solids (total suspended solids and settling solids), Alkalinity, and Orthophosphate. So, for its management, a technology called WSN (Wireless Sensor Network) is used in this project. WSN monitors and records the physical conditions of the environment and organize the collect data at a central location.

This project will decrease labor time and increase efficiency as it can be controlled from a mobile phone when installed on an Android or an iPhone. The sensors attached to the ponds will be integrated in the mobile app and the user will continuously examine the situation of the pond such as water quality and environment for better growth. In addition to that our app will advocate the best marketplace and farmers can manage all expenses and stocks record.

The major reason behind developing the ultimate fishing guide is to facilitate farmers either old or fresher because the government is assuming no job in preparing fish farming and giving them specialized help. They show their obliviousness on issues of how to think about the strength of the developing seed, their weight, and contrasts between the kinds of seeds Research on the possible species, taking care of and seeding advancement, and medical issues are the need of great importance. Most peoples don't have access to higher levels for the seed, feed, and recovery from different diseases that a high-level farmer can easily manage thus their business doesn't have a growth ratio as compared to other successful farmers. Several Fish identification Recommendations, and automated Fish farms controlling systems deployed for farmers using features of

fishes to identify its health and maintaining other necessary problems. However, in a case wherein our country these techniques are failed due to ignorance of government we aim to provide an android application. Keeping in view the above performance problems; [Smart Bio floc Monitoring] is introduced for recommending feeds, seeds, and the best market for their stock. Users will get to know that how much seed they can deploy in the pound by providing the basic information of the pound.

Deliverables and Development Requirements

When we launch our application. Users visit our application and know about the features of the smart Bio floc monitoring app the user must know about some basic knowledge that they can understand easily. While developing the Applications. We use android studio for developing our screens. User will see all the following features in our application.

User Interface

Android application is developed through which:

- Results from sensors
- PH of water
- Temperature of water
- Temperature of environment
- Water level

Development Requirement Including Following Software Requirements

2.1.1 Frontend

Android studio (Flutter)

2.1.2 Backend

Database: Firebase

Programming Languages: Dart

2.1.3 Arduino

Attached with the sensors in order to get readings and to save in database.

Chapter 3

Requirements Analysis

Use Case Diagram(s)

It is the representation of the user with the system. It is used to describe the use cases (set of different actions) that can be performed by the actors (external users) by using the system. With the help of the use case, you can visualize the behavior of the system when the user uses it.

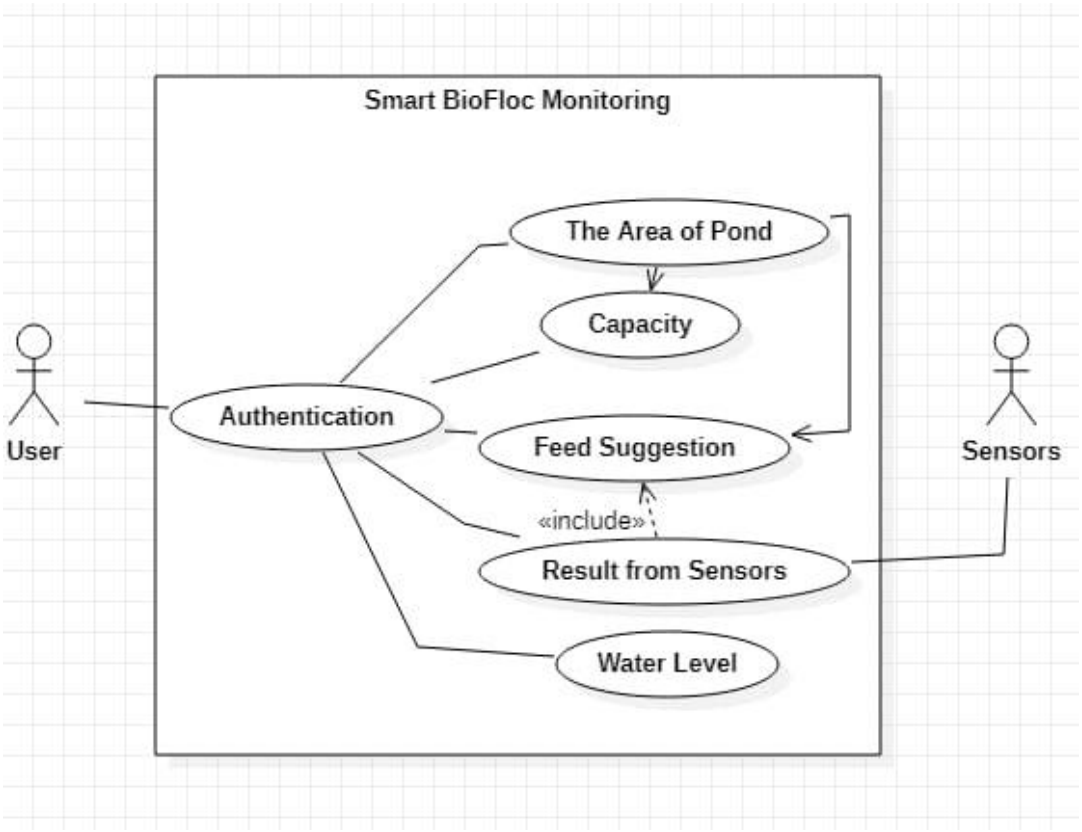

Figure 3.1 Use Case Diagram

Sequence Diagram

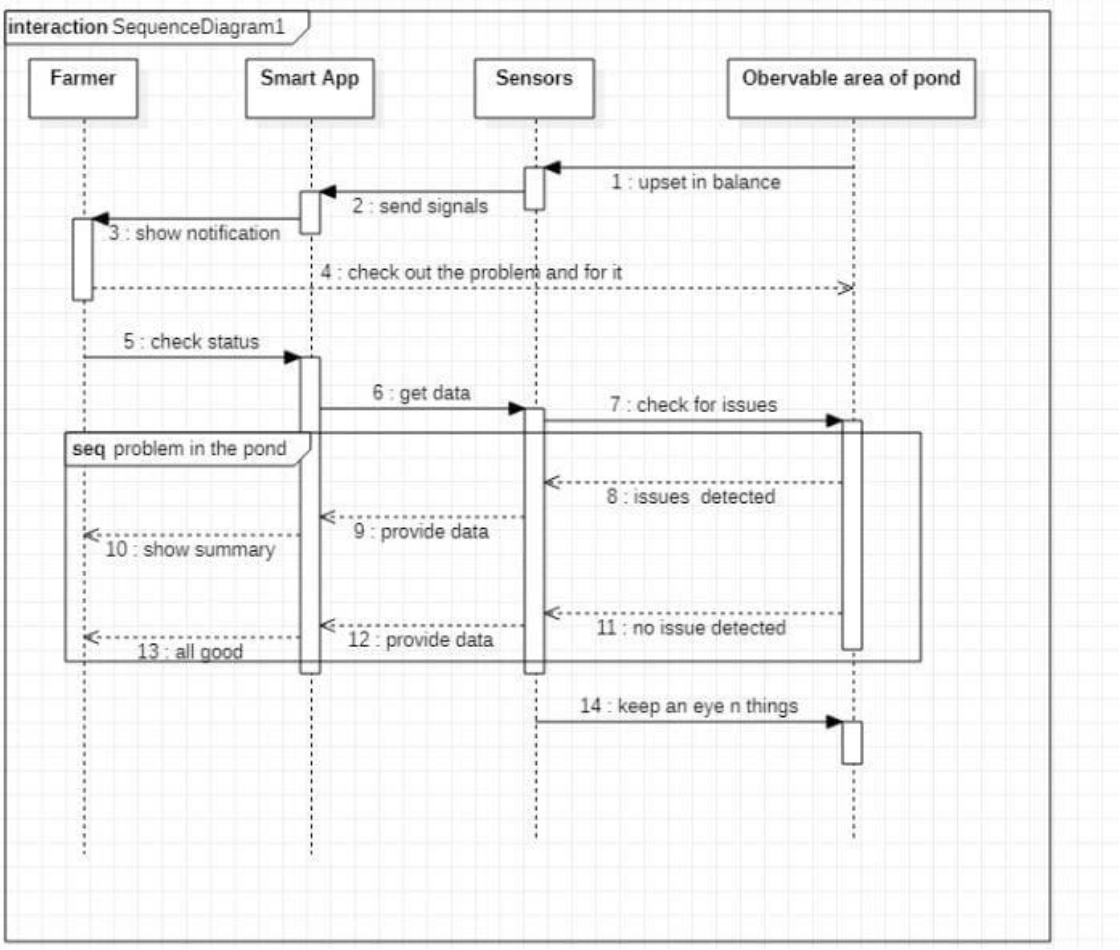

Figure 3.2 Sequence Diagram

Detailed Use Case

3.1.1 Authentication

Table 3.1 Authentication

Use-case name	Authentication
Actor	User
Description	User will authenticate his/her phone No
Pre-	Users Login/Signup.

condition	
Post-condition	The user should get the desired outcome.

3.1.2 Area of Pond

Table 3.2 Area of Pond

Use-case name	Area of pound
Actor	User
Description	The user must provide informationabout the area of the pound.
Pre-condition	Users must be using the application.
Post-condition	The user should get the desired outcome.

3.1.3 Result from Sensors

Table 3.3 Result from Sensors

Use-case name	Result from Sensors
Actor	Sensors
Description	Using this Arduinosensor all the Important test on the water is donewhich are important for fishes' growth.

Pre-condition	All sensors must be attached to Arduino and Arduino with our android app.
Post-condition	Based on test result feed suggestions are Done.

Functional Requirements

Functional requirements are those functionalities that software must offer. It describes the basic behavior of the software. Functional requirements should include the details of functionality or operations provided by each screen. The complete workflow of the software should be made clear.

- Firebase authentication.
- Sensors are connected wirelessly through WSN.
- Temperature sensor gets temp data of water stores it in Firebase Firestore.
- pH sensor data fetch and stored in firebase Firestore.
- Water level observed through sensors and data stored in Firebase Firestore.
- Power the system ON and OFF.
- Camera Live feed in the app.
- Dissolved oxygen level observation and data collection.
- Fish mortality rate.
- Change feed palette in the app and show graphs for all the changing variables in the app.
- App will notify the farmer about the change in set conditions.

Non-Functional Requirements

Non-functional requirements show that how the system should perform certain functionality. Non-functional requirements generally deal with the quality of the software. Following are the non-functional requirements of this system:

Table 3.4 Non-Functional RE#01

Name	**Performance**
Summary	Performance defines efficient application
Requirement	The ultimate Fishing guide will be good in a performance like it will provide the user allthe necessary information to carry out fishing from seeds to sell them in the market involving most of the process with details

Table 3.5 Non-Functional RE#02

Name	**Portability**
Summary	Portability means when using an application user is not restricted to use it by sitting on a fixed place or it does not need a different system to operate
Requirement	It will be in your android mobile phone with attached sensors which you always carry withyou on your farm side.

Table 3.6 Non-Functional RE#03

Name	**Usability**
Summary	By usability of software, you mean that it

	should be easy to learn. The user should notfeel any difficulty in using this system
Requirement	In Ultimate Fishing Guide, we have included this in our priorities that this application should be user friendly, moreover it should not be complex in its working mechanism

Table 3.7 Non-Functional RE#04

Name	**Compatibility**
Summary	It means to ensure that customer is satisfied or not by testing.
Requirement	This application is compatible with the android operating system, it is being designed for specifically android OS.

Table 3.8 Non-Functional RE#05

Name	**Maintainability**
Summary	In which component can be modified to improve performance.
Requirements	The requirement of maintainability is easilyachieved in this application because first it is providing the functionality of user profile maintainability and all the basic record of the application is saved in the

	database.

Chapter 4
Design and Architecture

System Architecture

Our system architecture consists of 3 main modules: Frontend, Backend and Hardware. The frontend is an interactive interface that allows our users to visit our application and ease of use. Users can monitor the basic requirements for ideal pond conditions such as Oxygen level, pH of water, temperature, and other nutrients crucial for the fishes' survival. Feed suggestions, latest updates on farming technologies and practices and the nearest Fish Market through Google Map. The results are displayed on the screen. Our project architecture diagram is shown below:

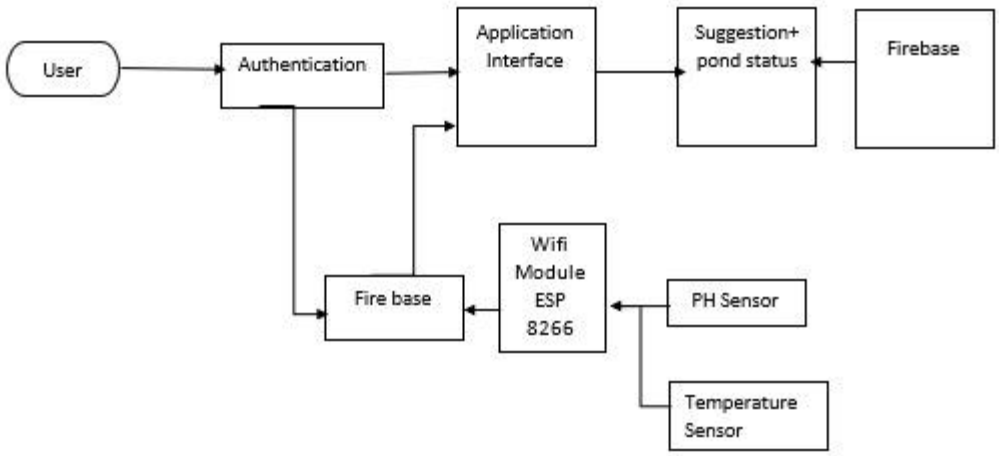

Figure 4.1 System Architecture

This diagram explains how the overall interaction between user and application takes place. A user interacts using the android interface which is used to control the whole process and background processing. The application gets input through different sensors which are PH sensors and temperature sensors also user can check the current weather of his city. Users can add multiples pond information and can easily manage every pond data which includes the area of a pond. This application will suggest the best marketplace to sell fishes users will follow the direction of the market by Google map API. Also, the user will maintain its record in the database.

Data Representation [Diagram + Description]

It contains different symbols & connectors. It is known as graphical representations between people and objects. An ER model is made of an entity and some specific relationships which exist between entities.

Process Flow [Representation]

It is a way of representing the flow of data through the system.it provides information about the outputs and inputs of entities and processes.it shows a complete flow of data between system modules. Ultimate fishing guide main modules are a value of PH of the water, suggest Nearby Fish Market, and gives a feed suggestion According to Area of a pound. The application will take input i.e., water pH, temperature from the user, and give results. Following is a data flow diagram of the ultimate fishing guide app.

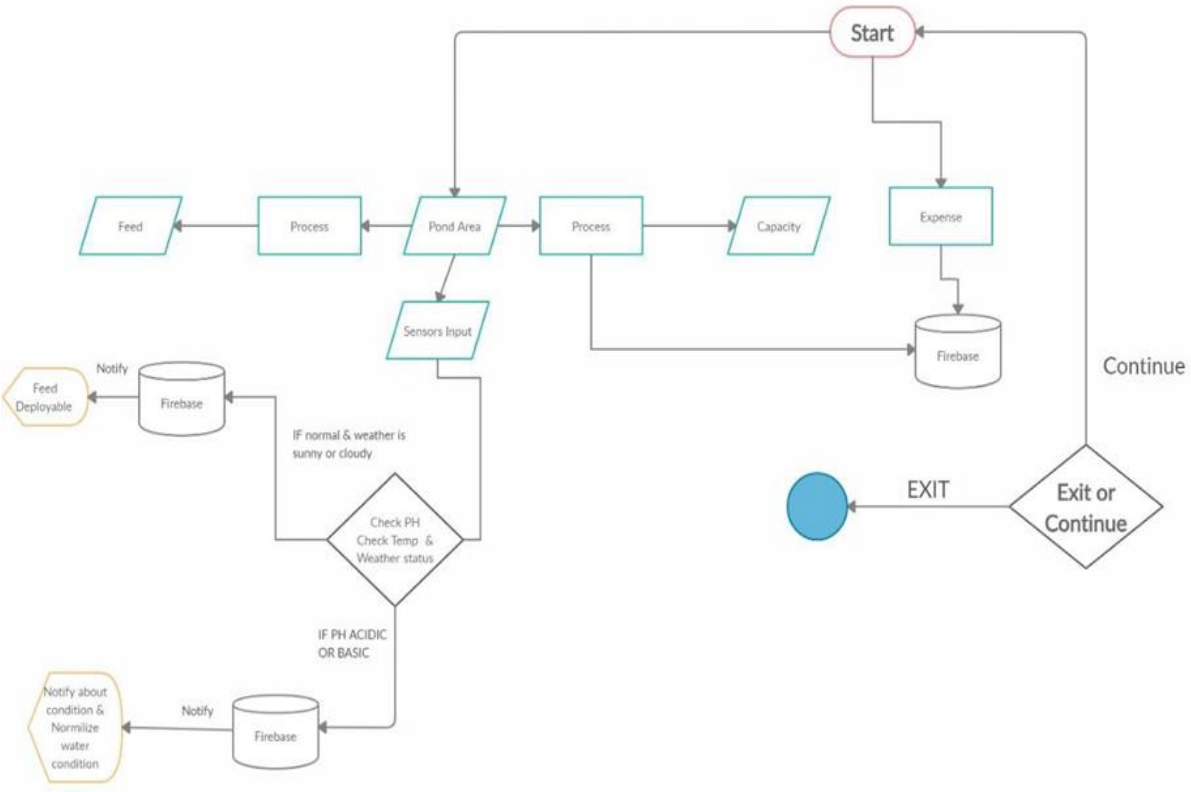

Figure 4.2 Process Flow

The figure demonstrates the data process of the overall system that how a user will operate our application. To do this he will first look for seed information by giving an area of a pound. The further user gives input to the system using a sensor then these sensors upload this data to our firebase and the firebase sent a notification to the farmer

to generate respective output. Also, our firebase contains data about pond status including area, so it suggests feed to the farmer too. When the farmer is done using the application, he can exit the process and leave!

Data Flow Diagram [Level Zero]

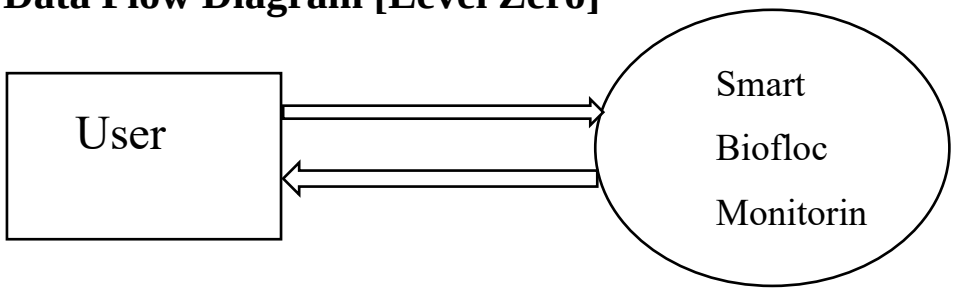

Figure 4.3 Level 0 Data Flow Diagram

In 0 level we have 2 entities “user” and “application”. Users can see multiple options like pond status, manage expenses & stokes, and weather prediction through our app user will also get to know about feed suggestions. In Figure 41, the system architecture diagram of the "Ultimate fishing guide" application is shown, represents that the user can check the value of ph. and can check the temperature. Based on these values and weather prediction user can deploy a suitable feed. Users will find the best marketplace. Availability of internet is necessary.

Data Flow Diagram [Level 1]

The complete flow and functionality of each module have been shown in the figure below.

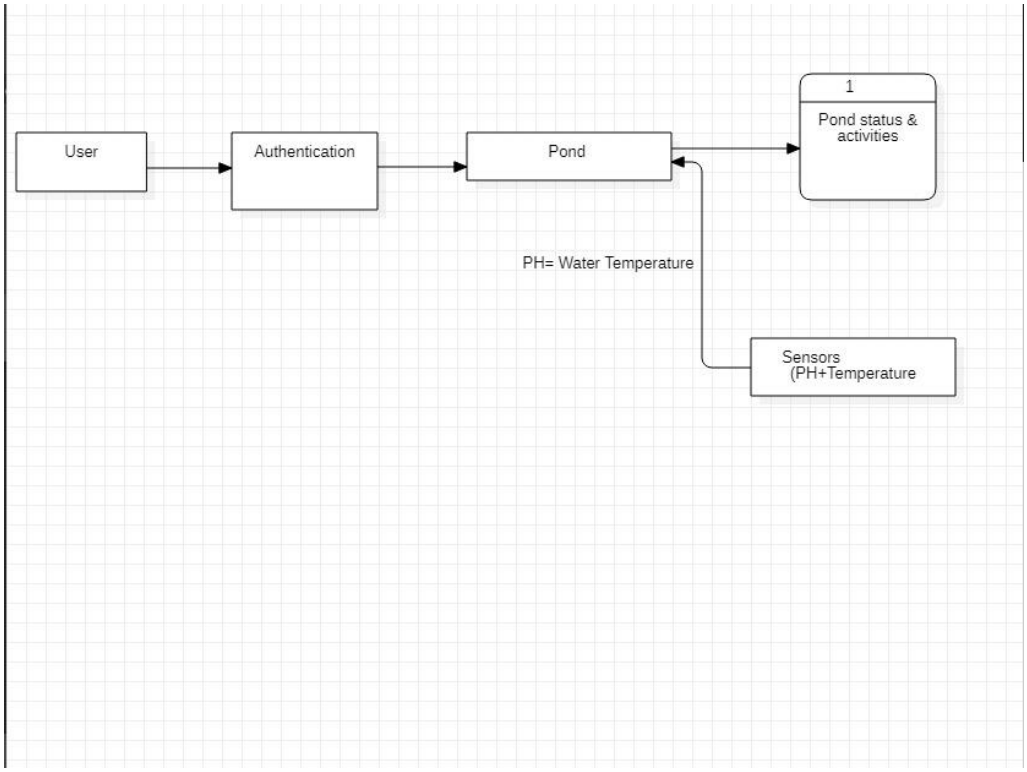

Figure 4.4 Level 1 Data Flow Diagram

Tree Structure for Firebase

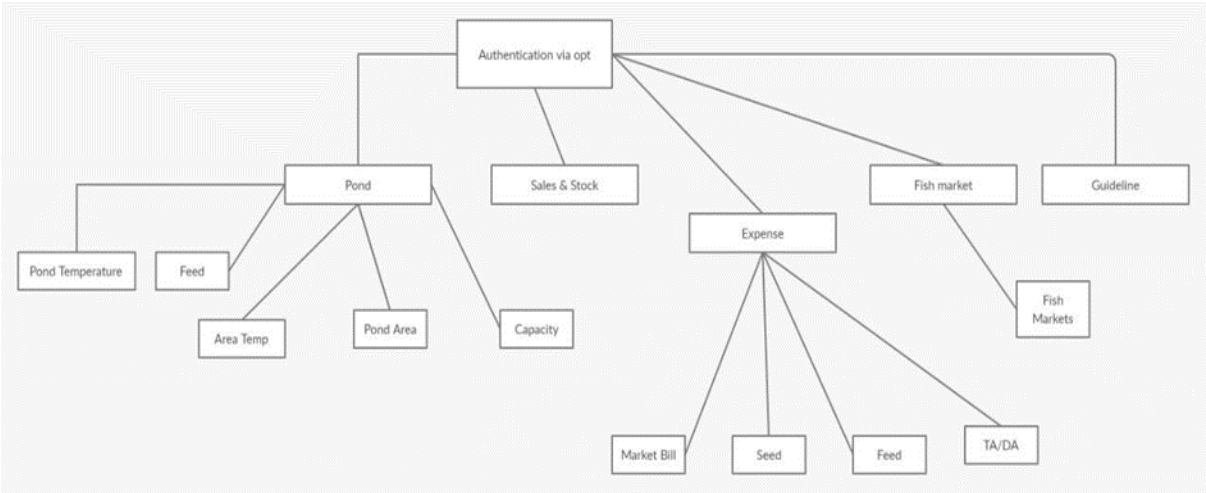

Figure 4.5 Firebase Tree Structure

This Diagram shows the full structure of our firebase nodes and their hierarchy. The root node is the authentication node under that all the application hierarchy is explained in this tree structure. As our pond's node contains multiple child nodes all the graphical information about these child nodes is being explained in a diagrammatical manner. The expense node contains all the data about sales and expenditures in its child node.

Chapter 5

Implementation

In this chapter, we will discuss the techniques and tools we use to develop the project. This phase is the most prominent phase of development; as from this step, we transform our idea into a meaningful picture. This is a significant and challenging step toward learning or developing skills. An application is the result of the successful implementation of tools and technologies. Following are the tools and techniques we use during the development of our application

Tools and Technologies

5.1.1 Tools

- Android Studio 4.1 chipmunk 2021.2.1
- Arduino IDE
- MS Word
- MS PowerPoint
- MS Project

5.1.2 Languages

- Dart

5.1.3 Libraries &Framework

5.1.3.1Hardware

- ESP 8266
- Water level sensor
- Temperature sensor
- PH sensor
- Dissolved oxygen level sensor
- Jumper wires
- Bread Board
- LED

5.1.3.2Libraries

- cupertino_icons: ^1.0.2
- font_awesome_flutter: ^10.1.0
- firebase_core: ^1.17.0
- firebase_auth: ^3.3.18

- cloud_firestore: ^3.1.16
- fluttertoast: ^8.0.9
- connectivity_plus: ^2.3.0
- internet_connection_checker: ^0.0.1+4
- lottie: ^1.3.0
- local_auth: ^2.1.0
- flutter_local_notifications: ^9.5.3+1
- ESP8266WiFi.h
- Firebase_ESP_Client.h
- OneWire.h
- DallasTemperature.h

Development Stages

After the designing phase, we move towards the developmental phase to have a clear demonstration of the project. In the implementation phase, we will discuss the phases, which we face incrementally during the development of the application. We use the "Arduino" IDE for our project.

5.1.4 Firebase Firestore Integration

Using Nodejs we created a function named firebase cloud function that has defined method for calibration of hardware and integration of weather API and other function with firebase. Calibration includes Change of PH, change in temperature, change in weather, change in timebefore and after changing the value of PH and Temperature. There is a Function name sendfollowernotification() that is responsible for alarming and sending the notification to the user. The notification includes Change in PH. If the Ph value is high or low, then it will suggest a solution. If there is a rise in temperature above a certain threshold it will notify the user to stop the increase. For feed and fertilizer function will check the weather condition if the weather is rainy, sunny, or cloudy according to rule it will notify the user what to do.

```
/* 1. Define the WiFi credentials */
#define WIFI_SSID "vivoS1"
#define WIFI_PASSWORD "laraib12"

/* 2. Define the API Key */
#define API_KEY "AIzaSyDm-OvE0fLLSBQuIAma0W9dVbkufL_ovlw"

/* 3. Define the project ID */
#define FIREBASE_PROJECT_ID "scifish-570ad"

/* 4. Define the user Email and password that alreadey registerd or added in your project */
#define USER_EMAIL "eqra@email.com"
#define USER_PASSWORD "123456"

// Define Firebase Data object
FirebaseData fbdo;
FirebaseAuth auth;
FirebaseConfig config;
```

Figure 5.1 Firestore Connection

5.1.5 Hardware Set

For the initialization of our ESP32 module for the pond status i.e. phone number that that farmer will register via OTP and location where the pond is situated. Initial values will be given to the function defined in firebase.

Figure 5.6 Firebase Node

After these values are initialized by the firebase the Esp32 will start working.it will get the node position and send all the data to our cloud function for the computational work. The user will be able to change the Node position from the android application. As it's not possible for the farmer to have different hardware for the different pond. For the reusability of our hardware anytime anywhere we have created a function in android that will get the correct value of pond name and location it will automatically overwrite

the function of set hardware() in firebase and hardware will start working on the corresponding pond.

5.1.6 PH Calculation

Using Arduino IDE, we created a C++ file that contains code for our hardware that is integrated inside our ESP32. We will be explaining how the Calculation of Ph is carried out first we will look out at our mathematical expression and then we will go through the code.

To calculate the pH value, we took an average of 10 samples and then store these values in an array. After adding these values we sort the array using the swapping technique in ascending order. Using loop we take out mid 6 values .adding them up and by taking an average of these values we applied conversion on the value and then the value is a return from the function.

```
//print pH
value= analogRead(potPin);
Serial.print(value);
Serial.print(" | ");
float voltage=value*(3.3/4095.0);
ph=(3.3*voltage);
Serial.println(ph);

//Create document and add ph data to firestore
FirebaseJson phContent;
String phDocumentPath = "pH/" + String(generateRandom());
phContent.set("fields/potpin/stringValue", String(value, 2));
phContent.set("fields/phvalue/stringValue", String(ph, 3));
Serial.print("Create a ph document... ");
if (Firebase.Firestore.createDocument(&fbdo, FIREBASE_PROJECT_ID, "" /* databaseId can be (default) or empty */, phDocumentPath.c_str(), phContent.raw()))
    Serial.printf("ok\n%s\n\n", fbdo.payload().c_str());
else
    Serial.println(fbdo.errorReason());
```

Figure 5.7 ISO CODE OF PH

5.1.7 Pond Temperature

Our attached sensor has an embedded code for temperature calibration. Using the sensor library method name request temperatures() is simply called. This method initializes thesensor and sends a request for the temperature. After all this, a method from the sensor library is called the name getTempCByIndex(0) reads the temperature in Degree centigrade and returns the values to the main method.

```
//print the temperature in Celsius and Fehrenheit
sensors.requestTemperatures();
float temperatureC = sensors.getTempCByIndex(0);
float temperatureF = sensors.getTempFByIndex(0);
Serial.print(temperatureC);
Serial.println("°C");
Serial.print(temperatureF);
Serial.println("°F");

//Create document and add temp data to firestore
FirebaseJson tempContent;
String tempDocumentPath = "temp/" + String(generateRandom());
tempContent.set("fields/celcius/stringValue", String(temperatureC, 2));
tempContent.set("fields/fahrenheit/stringValue", String(temperatureF, 2));
Serial.print("Create a temperature document... ");
if (Firebase.Firestore.createDocument(&fbdo, FIREBASE_PROJECT_ID, "" /* databaseId can be (default) or empty */, tempDocumentPath.c_str(), tempContent.raw()))
    Serial.printf("ok\n%s\n\n", fbdo.payload().c_str());
else
    Serial.println(fbdo.errorReason());
```

Figure 5.9 Pond Temperature Calculation

User Interface

5.1.8 Home

On the Home, screen the user can go through all of the major activities of the application.

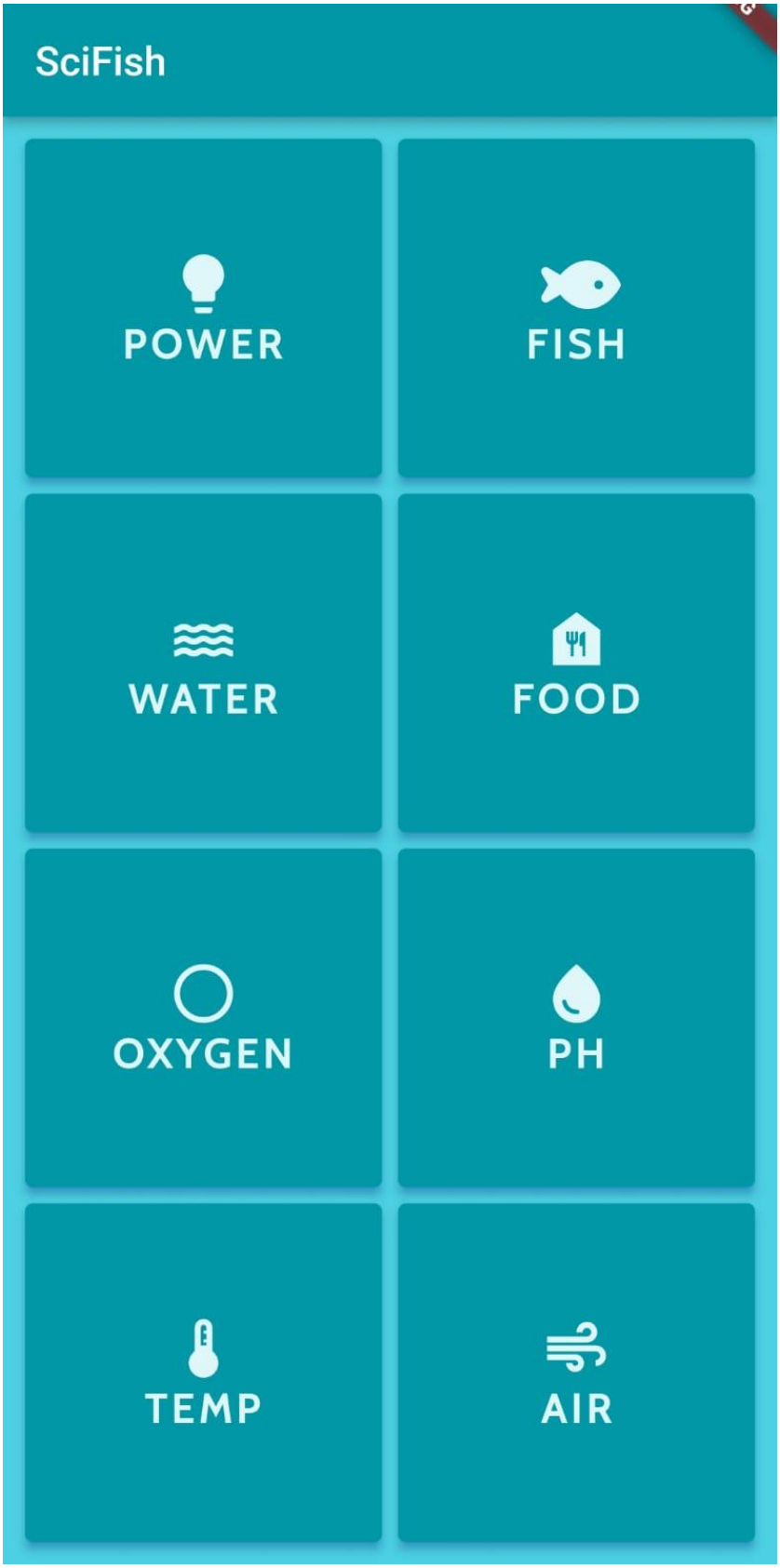

Figure 5.10 Home Screen

5.1.9 Power Screen:

Figure 5.11 Config hardware

5.1.10 Fish Life Screen:

Figure 5.12 Fish Life screen

5.1.11 Water Level Screen

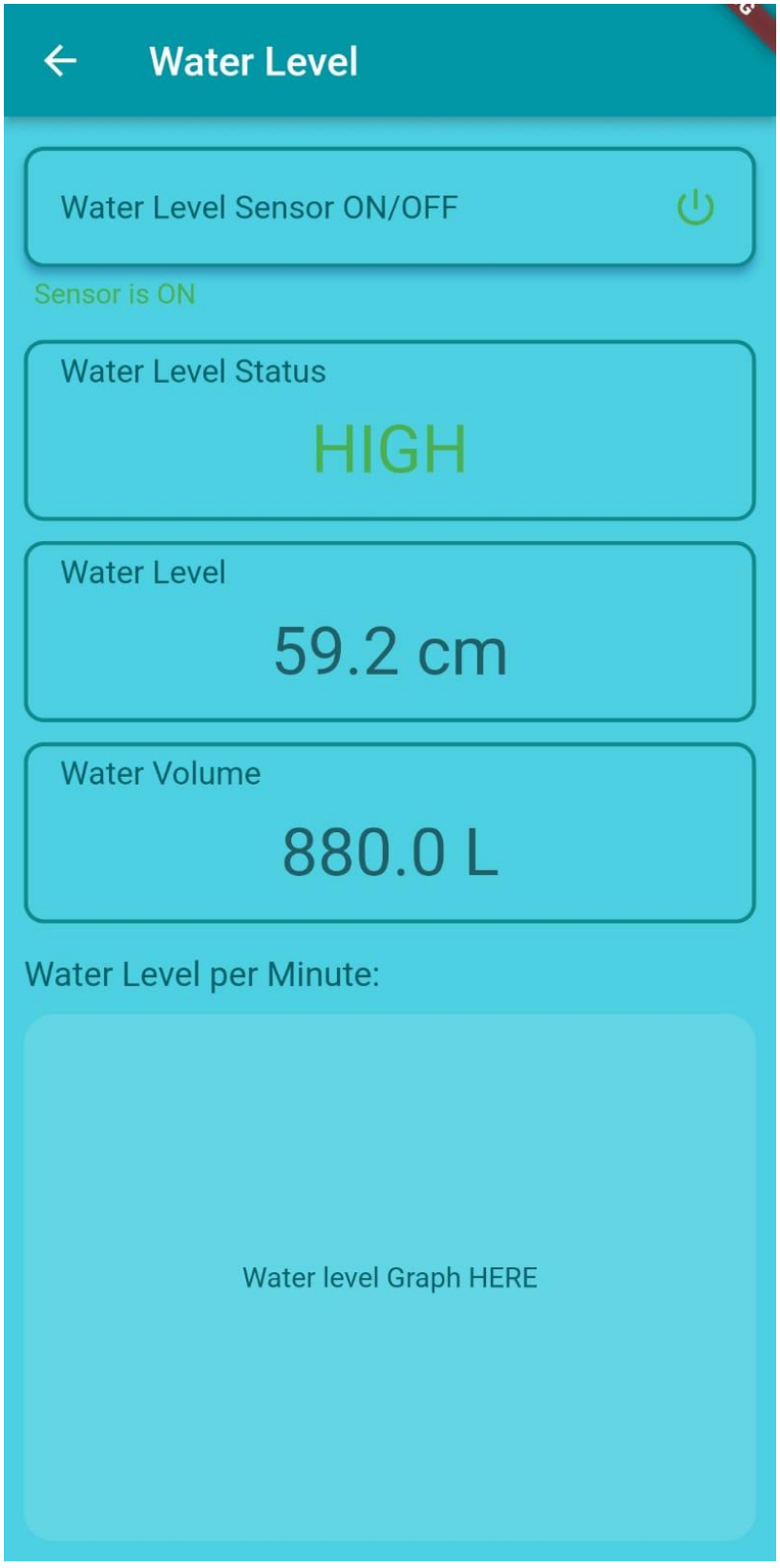

Figure 5.13 Water level Screen

5.1.12 Food Screen

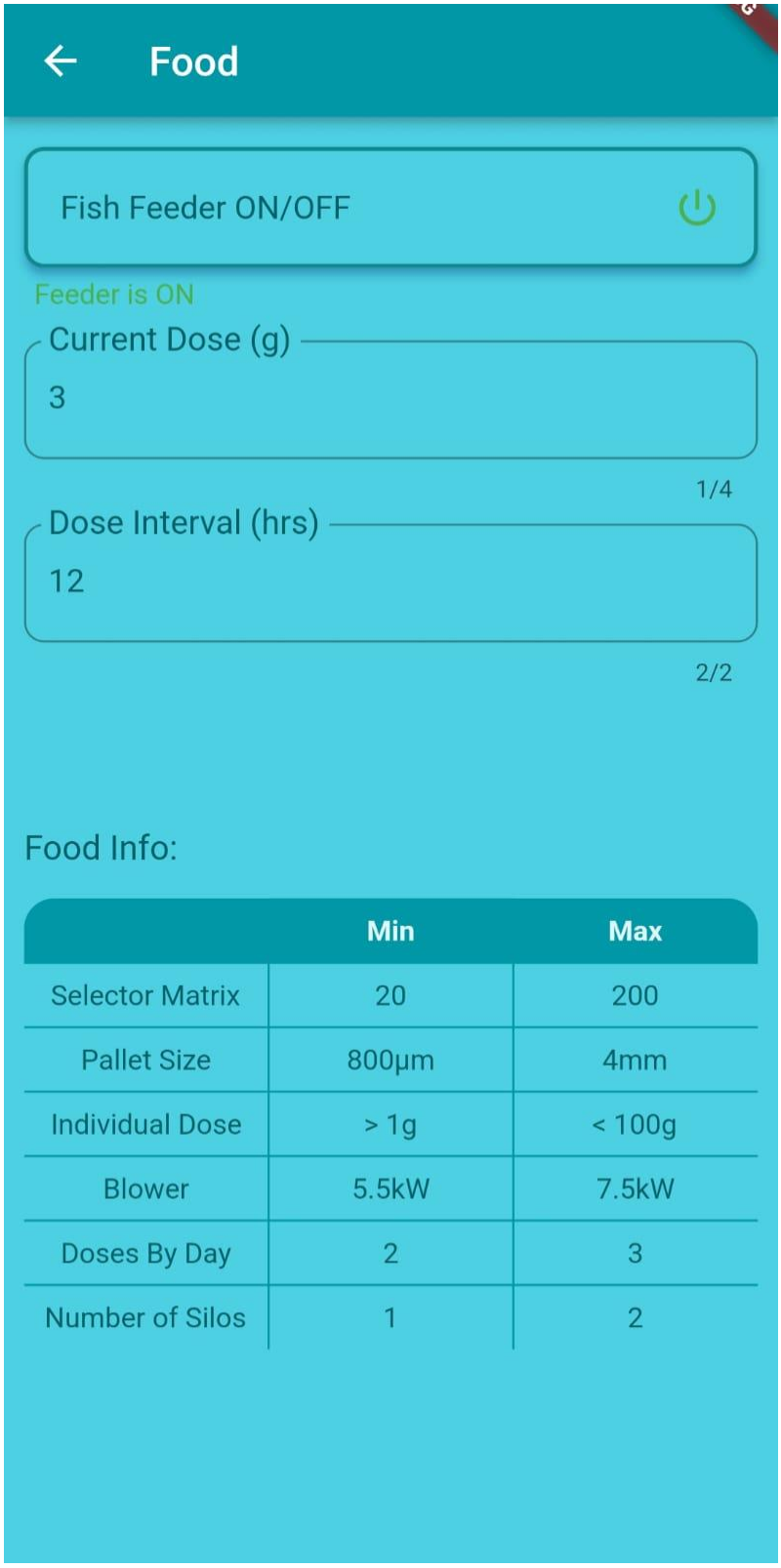

Figure 5.14 Food Screen

5.1.13 Oxygen Level Screen

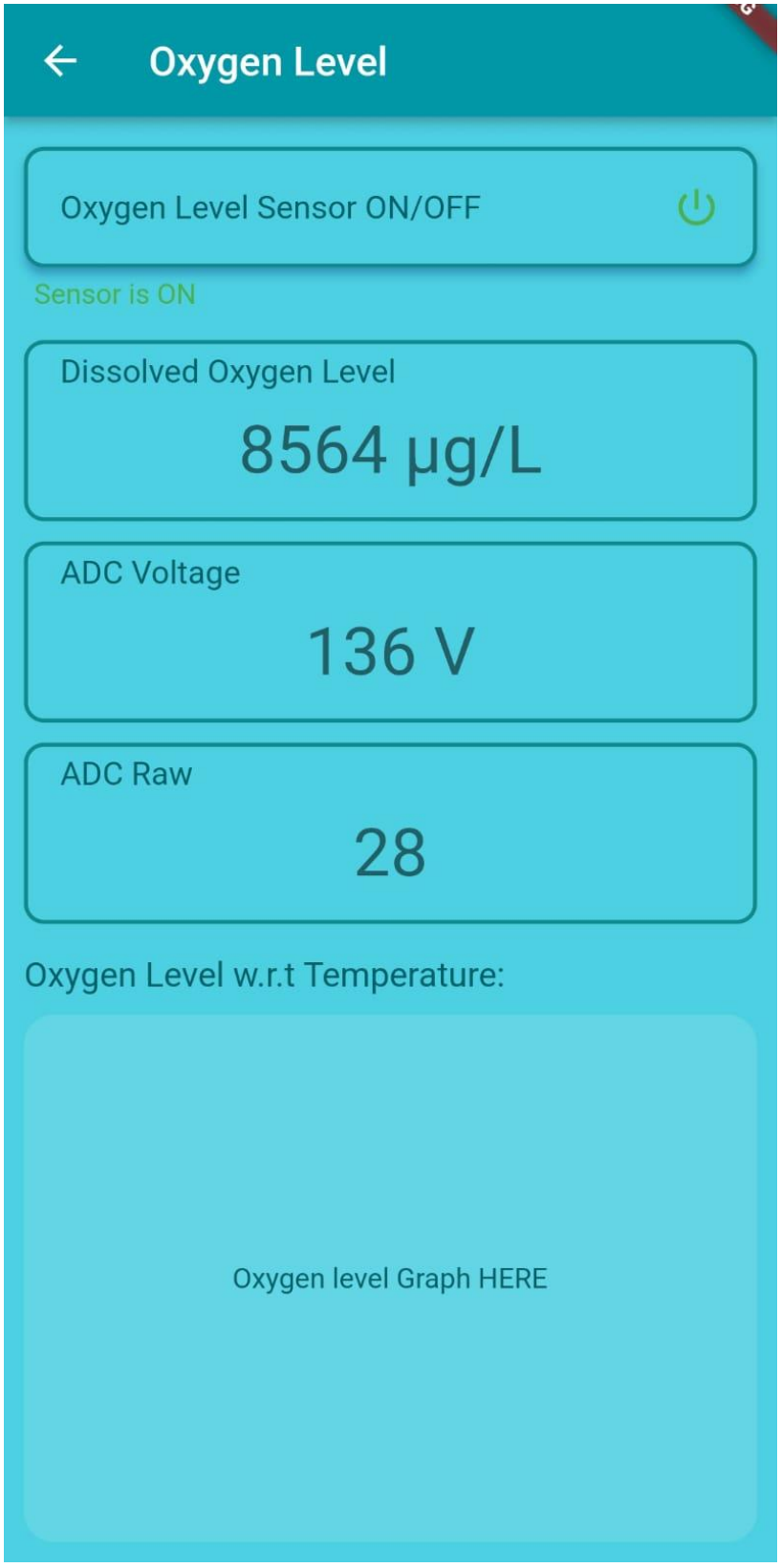

Figure 5.15 Oxygen Level Screen

5.1.14pH Screen

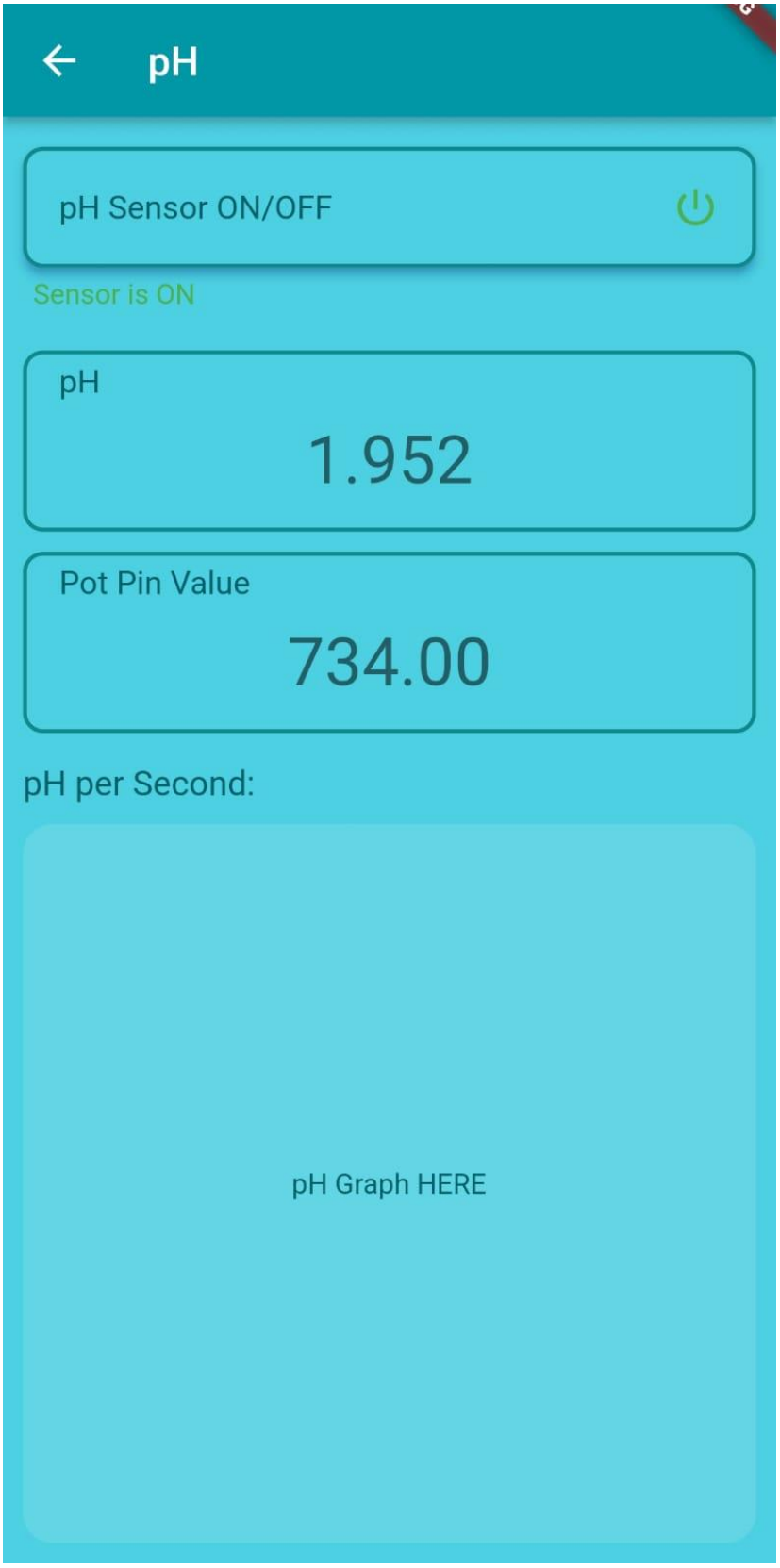

Figure 5.16 pH Screen

5.1.15 Temperature Screen

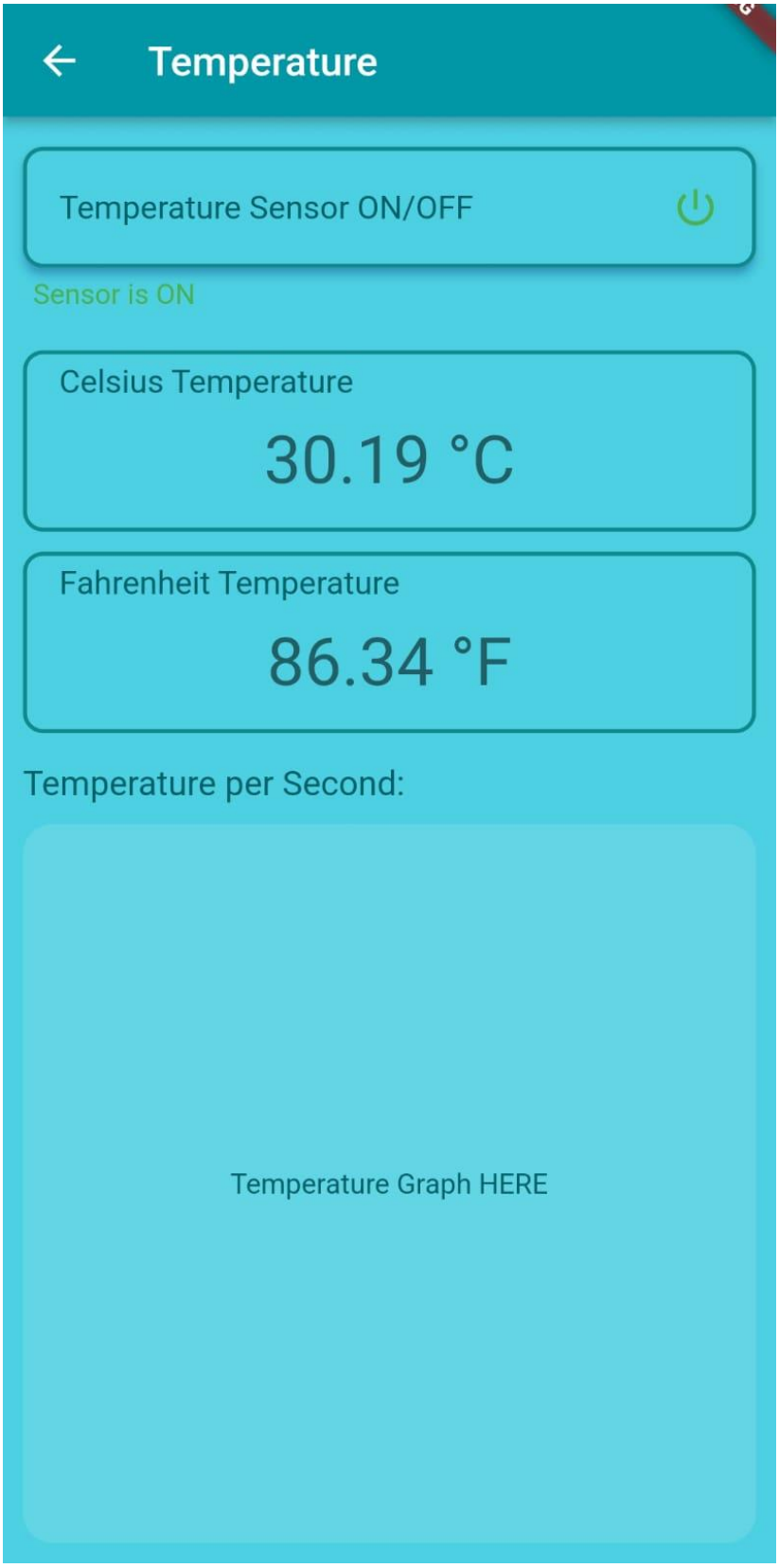

Figure 5.17 Temperature Screen

5.1.16 Air Flow Screen

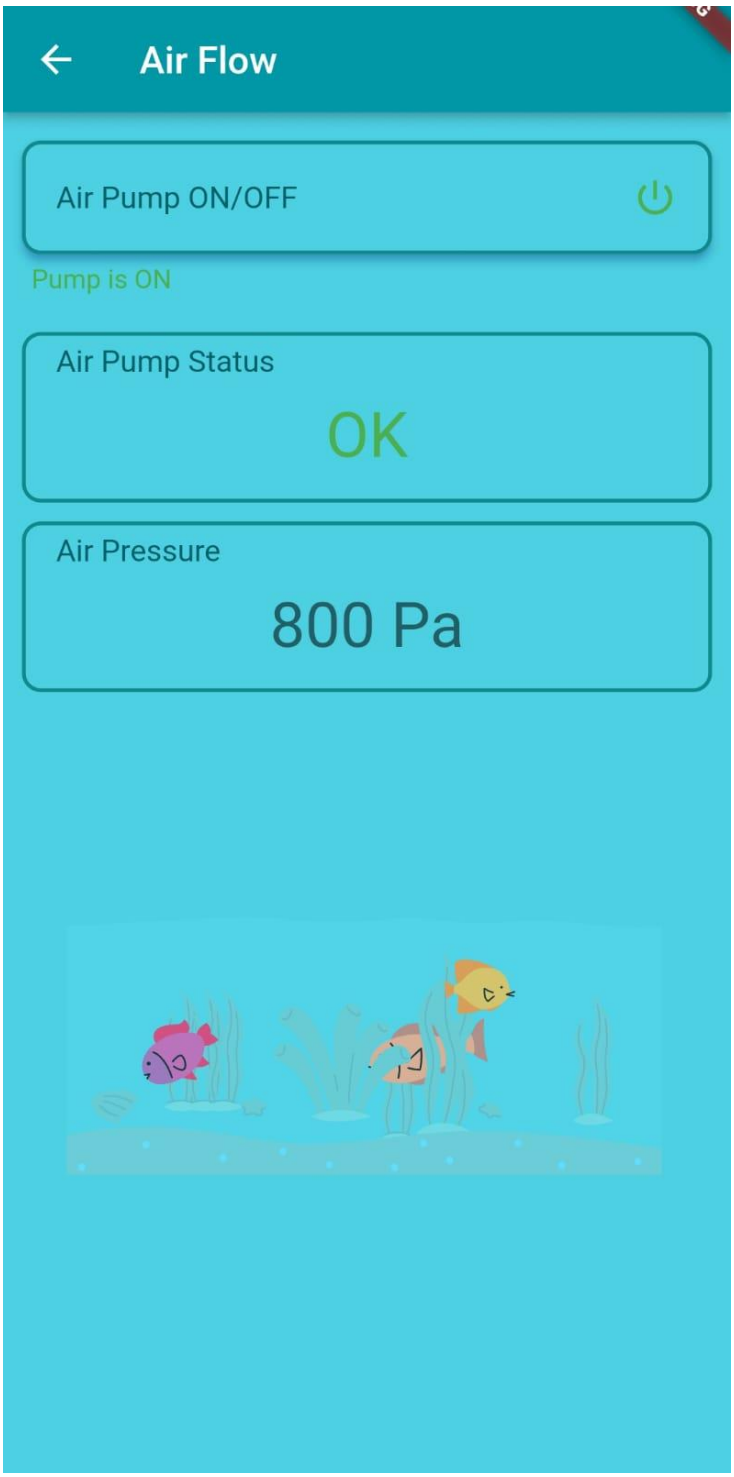

Figure 5.18 Air flow Screen

Chapter 6

Testing and Evaluation

Manual Testing

Once we create any application we must check or analyze its features so that when it gets delivered, it is free of error, bugs, and other issues. The process of testing any software manually.To ensure completeness of testing. By following some written test plan that leads it to test cases. The test cases are done one by one by a person who is involved in the testing phase or testers. Itis done in an automated way without using any tool. The main purpose of manual testing is to resolve or fix bugs and issues in software. It is the most primitive technique that helps to find bugs in the application. Every new application must be tested manually first. The two main reasons for ensuring the quality of software are given below:

- Finding out errors that arise during running the application.
- Check that the application fulfills the system requirement or not

6.1.1 System testing

System testing validates the integrated software product. It takes an input of all integrated components. It is performed on the entire system.it tells the expectation of the customer. It tells us the actual result or behavior of the product when the system is tested. In our system, we will test that all hardware is configured correctly or not we check the value that comes from sensors and then finally we integrate it with our android application.

6.1.2 Unit Testing

In unit testing, the smallest part of an application is tested independently. we check each unit of our system in accordance with user requirements. we check each piece of code to check the continuity and flow of an application. Every module has a relation with the previous and next steps. We can find errors by inspect code by click on analyze after the inspection result, we can see detailed errors and warnings messages. USB debugging mode helps to the copied the app via USB to the device for testing. We also faced several exception handlings during done this project.Unit testing for the whole application has been mentioned.

6.1.3 Function Testing

In functional testing, we generate test cases to check the functionality of each module and its accuracy compared with the actual outcome. It is the stage where we analyze the accuracy of the module as correct or not. We not only tried to make every functionality performing but also hada focus on making it easy and attractive. We went through the complete process of testing. Starting with user authentication, log in through the app, and see all the results that happen in the app. These things are done by the admin. Admin is responsible for managing

data firebase. They are performed to check the usefulness of the application from the user point of view.

6.1.4 Test Cases Results

Test Cases and Results Test cases are created for each of the functional requirements. These test cases provide the action to test case; expected results and actual results along with test Fail/Pass remarks.

6.1.4.1 User Sign-in

Objective: To ensure Sign in working correctly

Table 6.1 Sign-in

No	Action	Expected results	Actual results	P/F
1	Click on the Send code button without filled the phone number	Highlight as required fields	Highlight as required fields	**P**
2	Enter an unregistered	Highlight as entering a phone number	Highlight as entering a phone number	**P**
3	Enter the wrong phone number	Highlight as a show error message	Highlight as a show error message	**P**
4	Enter the registered phone number	Successfully login	Successfully login	**P**

6.1.4.2 User Sign-up

Objective: To ensure Sign-up working correctly

Table 6.2 User Sign-up

No	Action	Expected results	Actual results	P/F
1	Click send code with empty fields.	Highlight as required fields	Highlight as required fields	**P**
2	Enter phone no less than 11 digits	Highlight as required fields.	Highlight as a required field.	**P**
3	Enter the wrong phone number	Highlight as entering a correct phone number	Highlight as the wrong input.	**P**
4	Enter wrong verification code	Highlight as error	Showed error message	**P**
5	Enter all the entries as required	Registered phone number	Registered	**P**

6.1.4.3 Configure hardware

Objective: To ensure integrated hardware with specific pond working correctly

Table 6.3 Configure hardware

No	Action	Expected results	Actual results	P/F
1	Click on right 3 dots click ‘‘config hardware’’	Highlight as next activity	Highlighted as the next activity.	**P**
2	Phone no	Highlight as add successfully	Highlighted as add successfully	**P**
3	Enter pond name	Highlight as add successfully	Highlighted as add successfully	**P**
4	Enter city name	Highlight as add successfully	Highlighted as add successfully	**P**
5	Configured successfully	Highlight as configured successfully	Highlighted as configured successfully	**P**

6.1.4.4 Stock

Objective: To ensure data is added or removed successfully

Table 6.4 Stock

No	Action	Expected results	Actual results	P/F
1	Click on '+' fertilizers	Add amount	Add amount	**P**
2	Click on '+' powder	Add amount	Add amount	**P**
3	Click on '+' synthetic feed	Add amount	Add amount	**P**
4	Click on '-' fertilizers	Amount removes	Amount removes	**P**
5	Click on '-' powder	Amount removes	Amount removes	**P**
6	Click on '-' synthetic feed	Amount removes	Amount removes	**P**

6.1.4.5 Logout

Objective: To ensure user log-out working correctly

Table 6.5 Log-out

No	Action	Expected results	Actual results	P/F
1	Click logout option	Log out	Logged out	**P**
No	**Action**	**Expected results**	**Actual results**	
1	Click logout option	Log out	Logged out	

Integration Testing

Table 6.6 Integration testing

No	Test case	Expected result	Actual result	P/F
1	Integrate Ph sensor	Send ph. value to firebase	Value send successfully	**P**
2	Temperature sensor	Send temp value to firebase	Value send successfully	**P**
3	Firebase integration with android	Send sensor values and weather forecast	Send sensors value and weather forecast	**P**
4	Jason file integration with firebase	Capture JSON and get desired data	Capture JSON and get desired data	**P**
5	Send a notification from hardware to android using firebase median	Pop-up notification on the screen	Successfully pop-up notification on screen when ph. value increases or decreases	**P**

Chapter 7

Conclusion and Future Work

Conclusion

Due to the fast changes in the era of computerized technology we need to convert manual systems to automated systems. Fish farming gives Pakistan the economy speed by the exportation of fishes. Our system going to boost fish farming by giving them handy techniques and procedures to fasten the growth of fishes by keeping track of each activity needed for fish farming.

There is no such app that guides the farmer using such a technique we used IOT based system to automate farmers work of keeping track of water quality and weather conditions.

Several fishes die each year because the farmer is not aware of the situation inside the ponds.This app will surely awake and keep the farmer updated about the feasibility of the pond and give the most probable solution for the cure.

Another issue related to farming was kept in view and we give solutions to them too i.e.managing sales, stock, expenses, fish market suggestions, and keeping data of all ponds.

Future work

The following can be implemented as future Work.

1. Disease Control
2. Sensors Such as (Opacity sensor, DO sensor)
3. Fish growth Progress
4. Fish Type identification
5. Healthy and unhealthy Fish classification

Chapter 8

References

References

1: International Journal of Fisheries and Aquatic studies

An economic analysis of the fisheries sector of Pakistan (1950-2017): Syed Babar Hussain Shah, Yongtong Mu

https://www.fisheriesjournal.com/

2: Department of Fisheries Punjab

http://www.punjabfisheries.gov.pk/

3: Vaishnavi V. Daigavane and Dr. M.A Gaikwad: Water Quality Monitoring System Based onIoT

https://www.ripublication.com/awmc17/awmcv10n5_24.pdf

. https://www.jmas.biz/abstract.php?article_id=6416&title=Implementation%20of%20Smart%20Aquarium%20System%20Supporting%20Remote%20Monitoring%20and%20Controlling%20of%20Functions%20using%20Internet%20of%20Things

. https://www.dawn.com/news/550765/issues-in-fish-farming#:~:text=The%20major%20reasons%20for%20this,the%20control%20of%20local%20administrations

.https://github.com/mobizt/HTTPClientESP32Ex

githubb for HTTPClient
library

7 Arduino integeration with Esp32

.https://dl.espressif.com/dl/package_esp32_index.json