SMART PISCICULTURE USER RECOMMENDATION SYSTEM

Thesis submitted to the SASTRA Deemed to be University
in partial fulfilment of the requirements
for the award of the degree of

B. Tech. Electronics & Communication Engineering

Submitted by

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Bonafide Certificate

This is to certify that the thesis titled "**Smart Pisciculture User Recommendation system**" submitted in partial fulfilment of the requirements for the award of the degree of B. Tech. Electronics & Communication Engineering to the SASTRA Deemed to be University, is a bona-fide record of the work done by **Mr. Akkshaya Balaji (Reg. No.123004014)**, **Mr. Boddu Hima Venkata Ganesha Saisriram(Reg.No. 123003042), Mr. Kesava Satish Boppana (Reg. No. 123005064)** during the final semester of the academic year 2021-22, in the **School of Electrical & Electronics Engineering**, under my supervision. This thesis has not formed the basis for the award of any degree, diploma, associateship, fellowship or other similar title to any candidate of any University

Signature of Project Supervisor :
Name with Affiliation :
Date :

Project *Viva voce* held on ________________

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Declaration

We declare that the thesis titled "**Smart Pisciculture User Recommendation system**" submitted by us is an original work done by us under the guidance of **Dr. Hemavathi .N, Assistant Professor - III, School of Electrical and Electronics Engineering, SASTRA Deemed to be University** during the final semester of the academic year 2021-22, in the **School of Electrical and Electronics Engineering**. The work is original and wherever we have used materials from other sources, We have given due credit and cited them in the text of the thesis. This thesis has not formed the basis for the award of any degree, diploma, associate-ship, fellowship or other similar title to any candidate of any University.

Signature of the candidate(s) :

Name of the candidate(s) **:** S Akkshaya Balaji, Boddu Hima Venkata Ganesha Saisriram
Kesava Satish Boppana

Date **:**

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Abstract

Smart Pisciculture User Recommendation System' uses advanced technology that is designed to revolutionize the way fish farming is carried out. The system integrates advanced algorithms and sensors using IoT to provide real-time insights and recommendations to fish farmers. With the ability to monitor the water salinity, pH levels, Temperature, Turbidity, D.O levels and the colour of water. It can provide accurate and timely warnings of potential problems, as well as offer suggestions for improvement. The system is also designed to help farmers make informed decisions about medicines and chemicals which are needed to be added in fish tanks. By providing data driven insights, the Smart Pisciculture User Recommendation System helps farmers improve their operations and increase yields, while also reducing the risk of disease outbreaks and environmental impacts.

Specific Contribution

- Creation of Application as an interface with the IoT.

Specific Learning

- Application development.
- Interfacing of sensors and implementation of an IoT network.
- Knowledge about rearing of fishes.

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Specific Contribution

- Developed the code in Arduino IDE and calibrated the sensors.
- Connected the system to Thingspeak and helped to interface the system with App

Specific Learning

- Learned about the working of various sensors.
- Interfacing of sensors and implementation of an IoT network.
- Knowledge about rearing fishes.

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Name : Dr. Hemavathi N　　　　　　　　　　Name : Boddu Hima Venkata Ganesha saisiram

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Specific Contribution

- Developed and interfaced the hardware setup and helped to calibrate the sensors
- Collected the required Data for the recommendation system

Specific Learning

- Insights of Thingspeak and Application development
- Interfacing of sensors and implementation of an IoT network.
- Knowledge about rearing fishes.

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List of abbreviations

1. DO - Dissolved Oxygen
2. DS - Dissolved Solids
3. HC-SR04 - High Conductor Ultrasonic Sensor
4. HW-828 - A pH sensor Model name.
5. ESP32 - Low Cost Low Power Micro Controller

CHAPTER 1

INTRODUCTION

1.1 MOTIVATION

Pisciculture, or fish farming, is a practice that has become increasingly popular as a way to produce food sustainably. However, there are problem that needs to be addressed.

One of the primary concerns in pisciculture is the water quality. Poor water quality can lead to disease outbreaks and stress in fish populations, as well as impact the growth and survival of the fish. Overcrowding can exacerbate this problem, as it can lead to poor water quality and disease outbreaks.
Feeding fish is another challenge in pisciculture. Providing the right amount and type of food can be a challenge, as overfeeding can lead to excess nutrients in the water, while underfeeding can result in malnourished fish.
Disease outbreaks are also a major concern in fish farming. Fish are susceptible to a range of diseases, and when they are raised in close quarters, disease outbreaks can quickly spread throughout a population.
Environmental impact is another issue to consider. The release of excess nutrients and waste from fish farms can impact water quality in surrounding ecosystems, and escaped fish can also impact wild populations by introducing disease or competing for resources

Overall, successful pisciculture requires careful management to ensure optimal water quality, nutrition, and disease control, as well as consideration of environmental impact and financial risks. While there are challenges involved in fish farming, it can be a sustainable and profitable way to produce food when managed properly.

1.2 Monitoring and Data Collection

The Data collection and monitoring are essential for successful pisciculture. By collecting and analysing data on various aspects of fish farming, farmers can make informed decisions that improve the health and growth of their fish, increase productivity, and reduce the time taken to get lab reports.

One of the main benefits of data collection and monitoring is the ability to track water quality. By monitoring water quality parameters such as pH, temperature, dissolved oxygen, and turbidity, farmers can quickly identify issues and take action before they impact the health of the fish.

Data collection can also help with feeding management. By tracking feeding rates and observing the behaviour of the fish during feeding, farmers can determine the optimal amount and type of food to provide, reducing waste and ensuring that the fish receive adequate nutrition.

In addition, data collection can aid in disease prevention and control. By monitoring fish health and behaviour, farmers can detect early signs of disease outbreaks and take action to prevent the spread of disease. Data on disease incidence and mortality rates can also help farmers make informed decisions about disease management strategies.

Finally, data collection can help farmers optimize production and reduce costs. By tracking growth rates, feed conversion rates, and mortality rates, farmers can identify areas for improvement and adjust their management practices to increase efficiency and profitability.

1.3 Data

The Data used were taken from fisheries by recording the values of each breed of fish recommended by the government of India for the commercial growth of fishes for consumption. For each breed of fish the optimal conditions of growth varies accordingly to their specific needs.

Fish Species	**pH**	**Dissolved Oxygen**	**TDS (mg/L)**	**Temperature (°C)**	**Turbidity (NTU)**	**Minimum Water Depth (m)**
Rohu	6.5- 8.5	5-7 mg/L	<1000	25-32	<25	1.5-2.0
Catla	7.0-8.5	5-7 mg/L	<1000	25-32	<25	1.5-2.0
Mrigal carp	7.0-8.5	5-7 mg/L	<1000	25-32	<25	1.5-2.0
Common carp	7.0-8.5	5-7 mg/L	<1000	20-30	<25	1.0-1.5
Silver carp	7.0-8.5	5-7 mg/L	<1000	20-30	<25	1.0-1.5
Grass carp	7.0-8.5	5-7 mg/L	<1000	20-30	<25	1.0-1.5
Tilapia	6.5-8.5	5-7 mg/L	<2000	25-30	<25	1.0-1.5
Striped murrel	6.5-8.5	5-7 mg/L	<1000	25-30	<25	1.0-1.5
Great snakehead murrel	6.5-8.5	5-7 mg/L	<1000	25-30	<25	1.0-1.5
Spotted snakehead murrel	6.5-8.5	5-7 mg/L	<1000	25-30	<25<25	1.0-1.5
Pangasius	6.5-8.5	5-7 mg/L	<1000	25-30	<25	1.5-2.0
Roopchand	6.5-8.5	5-7 mg/L	<1000	25-30	<25	1.5-2.0

Table 1.1

1.3.1 Attributes used:

1. pH: Concentration of hydrogen Ions which decides the acidity or basicity of water.

2. Temperature: Temperature is an important attribute which decides the survival of fishes as different breeds of fishes need different range of temperature to ensure survival

3. Dissolved Oxygen: The oxygen Content Dissolved in the water is a deciding factor for fish growth.

4. Turbidity: An indirect way of measuring Dissolved oxygen and other effluents mixed in the water

5. Dissolved Solids: It gives us the details about the Impurities mixed with water and also for the details about concentration of food still present.

6. Depth: the depth and size of the reservoir is helpful for estimating the penetration of sunlight and feeding habits of fish. It also helps in prevention of overcrowding and fish dying of congestion.

CHAPTER 2

LITERATURE SURVEY

"IoT Based Automated Fish Farm Aquaculture Monitoring System" Sajal Saha, Rakibul Hasan Rajib, Sumaiya kabir., *2018 2nd Int. Conf. on Innovations in Science, Engineering and Technology (ICISET)27-28 October 2018, Chittagong, Bangladesh.*

The authors researched about the monitoring of fish farms with use of Internet of things by designing an Apparatus which periodically measures certain parameters. But this research did not take into account of accessibility of farmers and focused on a more theoretical approach.

"IoT-Based Fish Farm Water Quality Monitoring System" Chiung-Hsing Chen, Yi-Chen Wu, Jia-Xiang Zhang and Ying-Hsiu Chen., *Selected Papers from the 2021 International Symposium on Intelligent Signal Processing and Communication Systems (ISPACS 2021)).*

The authors of this paper researched about a more manual and practical approach of Implementation of Internet of Things by using a Robotic Arm for monitoring and regulating the water body, this project involves more investment whereas the work done is just automated instead of doing it manually.

"IoT-based Solutions in Aquaculture: A Systematic Literature Review" Aleksandar Petkovsk, Jaumin Ajdari, Xhemal Zenuni., *2021 44th International Convention on Information, Communication and Electronic Technology (MIPRO)*

The authors who worked on the project of implementing IoT and Cloud based servers for collection and Storage of data for easy reference. Again there was a issue of accessibility on the farmers end, since the project approached the issue theoretically.

"IoT Based Aquaculture" Tanvi Patkar, Komal More, Sarthak Lad, Rohit Tanawade, Amit Maurya., *International Research Journal of Engineering and Technology (IRJET).*

The Authors of this project created a Local area network which is used for relaying data from one node to another. But such a network is prone to disadvantages like High Initial Investment and Technical issues caused due to wet environment.

CHAPTER 3

OBJECTIVES AND METHODOLOGY

3.1 OBJECTIVES

We have formulated the objectives as follows:

- To create and Implement an IOT network working effectively in wet environment.
- To reduce time consumed and ease the tedious process for Monitoring and Data Collection drastically.
- To make an accessible and user friendly suggestion software application for the benefit of the people.

3.2 METHODOLOGY

- ➢ We started by gathering the data about the different essential parameters, which were necessary for the growth of fish and we found out the attributes such as temperature, pH value, Dissolved Oxygen (DO), Depth, Dissolved Solids (DS) and turbidity were the ones we decided to take into consideration/
- ➢ Among these six parameters dissolved oxygen, pH and temperature were crucial for the growth of fish and even small changes in their values may result in their stunted growth or increasing the mortality rate.
- ➢ So Monitoring and regulating these values must be harder as a small change might affect the quality and quantity of the yield, so in order to reduce such impacts due to change in their growing environment constant care must be taken to ensure proper growth.
- ➢ For the Data gathering we start with deploying the sensors for pH, Temperature, Depth, Turbidity, Dissolved Solids and Dissolved Oxygen. The pH and the temperature sensors is a waterproof Probe which can measure the change in the conditions of the water, The dissolved Oxygen sensor is also a water proof probe which needs to taken care of periodically.
- ➢ For the depth, Dissolved solids and turbidity, we used Ultrasonic and turbidity sensors to find the respective Measurements, All of these sensors are to be deployed in a wet environment, therefore sufficient precaution must be taken in order to avoid malfunctions due to moisture and humidity.

3.2.1 Work Flow Chart

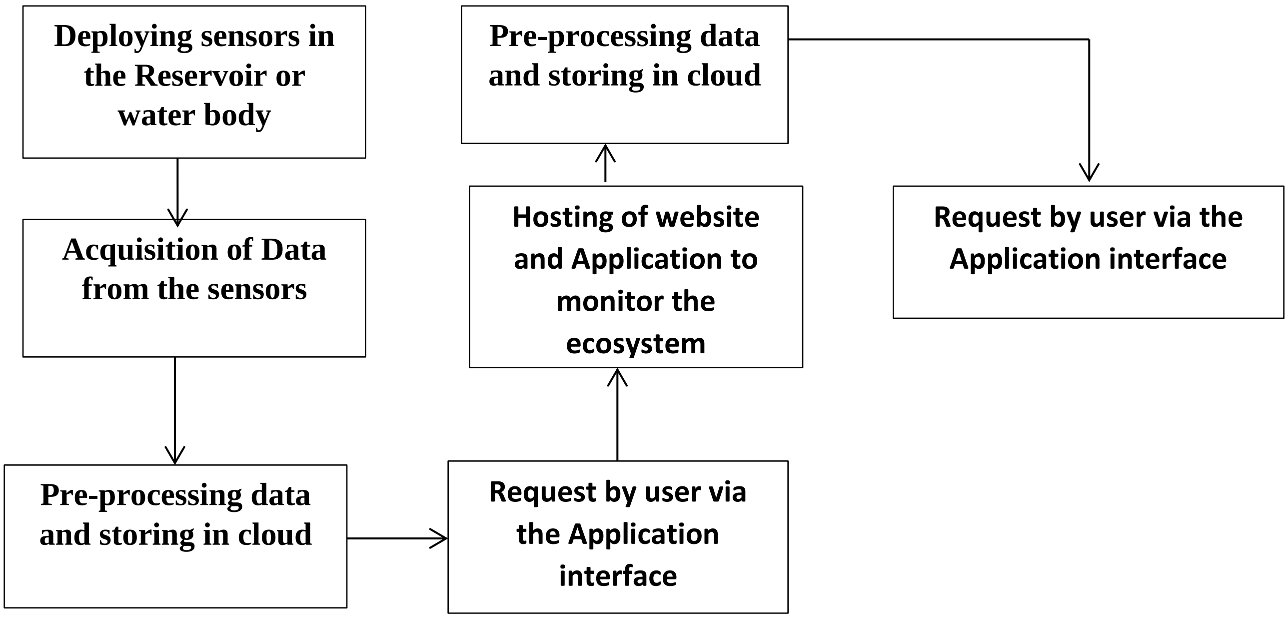


Fig 3.1

3.2.2 Interfacing of sensors

- In order to provide an overview of a data collection and transmission system developed for monitoring environmental parameters in pisciculture. The system utilizes an Arduino Mega and ESP32 to gather sensor data and transmit it to the cloud-based platform ThingSpeak for analysis and visualization.
- The system consists of an Arduino Mega and ESP32, which work together to collect and transmit data from six different sensors. The Arduino Mega serves as the central unit for data collection, while the ESP32 handles the communication with ThingSpeak.
- The ESP32 module is responsible for establishing a connection to the cloud-based platform ThingSpeak. Using its communication capabilities, the ESP32 securely transmits the collected data to the ThingSpeak platform, ensuring seamless data transfer for further analysis.

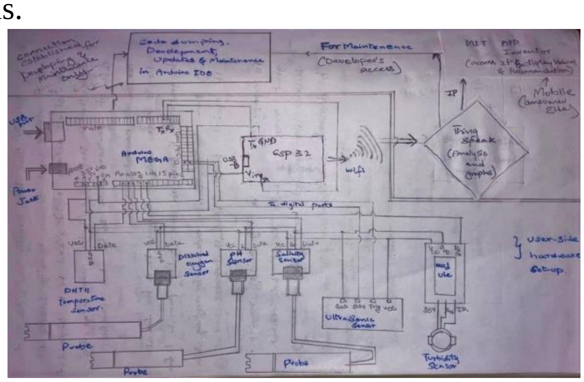


fig 3.2

3.2.3 Sensor Configuration: The sensors employed in the system are as follows:

3.2.3.1 Temperature & pH Sensor

HW-828 pH sensor is an electronic device measures the acidity or alkalinity of a solution. It operates on the principle of a glass electrode which was made up of a special glass membrane that interacts with hydrogen ions (H+) in the solution to get tested.

This also serves as a temperature sensor to detect changes in temperature with its inbuilt digital temperature.

Fig 3.3

3.2.3.2 Depth Sensor

HC-SR04 is an ultrasonic sensor module used for measuring distances and detecting objects. It consists of an ultrasonic transmitter and receiver. The transmitter emits a short ultrasonic pulse (40 kHz) toward the surface to measure. This pulse propagates through the air as a sound wave. On contact with surface it gets reflected back toward the module. HC-SR04 module provides a digital output that represents the measured distance.

Fig 3.4

3.2.3.3 Dissolved Oxygen Sensor

A dissolved oxygen (DO) sensor is a device used to measure the concentration of dissolved oxygen in a liquid. The DO sensor includes a cathode and an anode. The cathode is a noble metal that facilitates the reduction of oxygen, while the anode is often composed of silver chloride.

When immersed in the water, oxygen molecules from the liquid come into contact with the cathode surface. Electrons are released after reduction. These electrons flow through an external circuit to the anode, creating an electrical current.

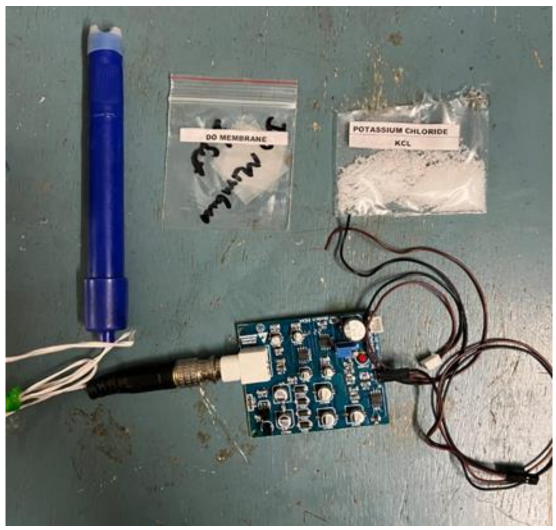


Fig 3.5

3.2.3.4 Turbidity Sensor.

To measure the cloudiness or turbidity of a liquid, turbidity sensor is used. It consists of a light source which emits light into the liquid. Then a photodetector measures the intensity of the light after interacting with particles. More the scattered light or absorbed by the particles, the detected light intensity is decreased. The change in light intensity is converted into an electrical signal, which is then calibrated and correlated to a turbidity value.

Fig 3.6

3.2.3.5 Dissolved Solids Sensor.

A total dissolved solids sensor is used to measure the concentration of dissolved solids in a liquid. The electrodes are usually made up of conductive materials, such as metal or graphite, and were placed in the liquid being tested. The ions in dissolved solids carry some charge. This is detected and carried as current to Arduino, where the code is used to calibrate it into ppm or mg/l as required.

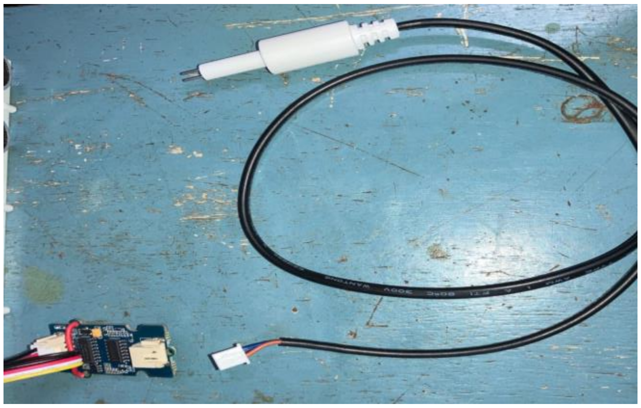


Fig 3.7

3.2.4 Integrating sensors with Thinkspeak API

- The collected sensor data is uploaded to ThingSpeak, where it can be visualized and analysed. ThingSpeak's user-friendly interface simplifies the process of monitoring and gaining insights into the environmental parameters being measured. This integration
- allows for real-time monitoring, historical analysis, and the ability to set up alerts based on specific thresholds.

- ➢ The integration of multiple sensors and the seamless transmission of data to ThingSpeak provide valuable insights into the environmental conditions crucial for fish health and growth.

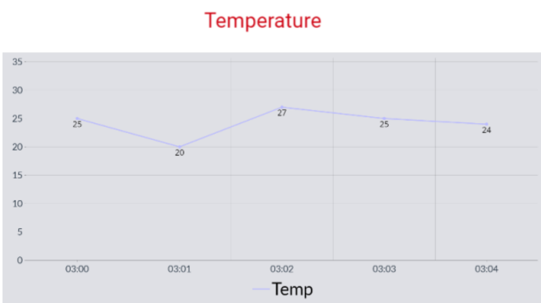


Fig 3.8

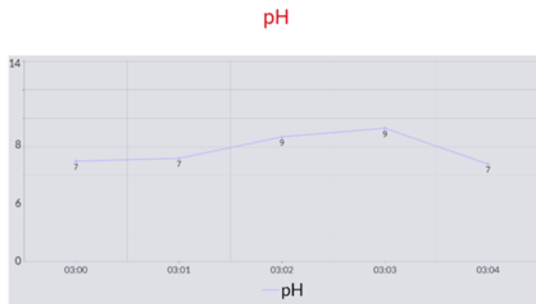


Fig 3.9

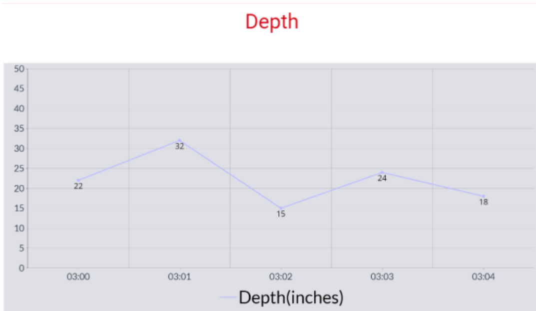
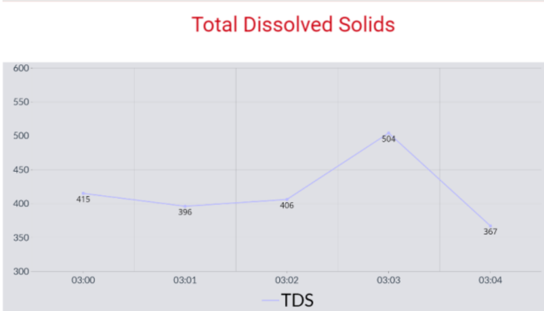


Fig 3.10

Fig 3.11



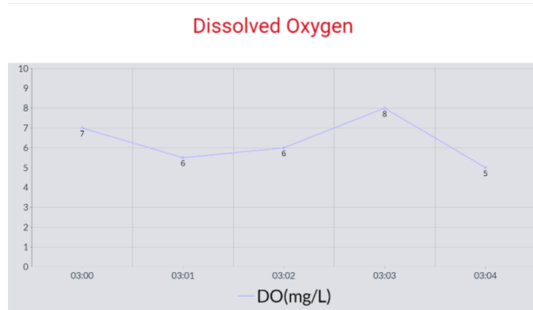


Fig 3.12

Fig 3.13

3.2.5 Creation of Web application

The development of a data collection and transmission system using an Arduino Mega and ESP32 for pisciculture monitoring demonstrates the potential of advanced technologies in enhancing data management and analysis.

This gave rise to the idea of monitoring as a service for pisciculture, to help increase the yield.

The Application was made with accessibility in mind, so that everyone with the correct IoT setup could acquire the data from the fishery regardless wherever the user is from their fish farm.

It relays the Information collected by the sensors to the users by acquiring it from Think speak API to the App on the user phone as long as they have Internet Connection for their phone.

The Application was created with the help of MIT app Inventor; it helps in building of apps with a Drag and Drop Approach for its creation.

3.2.5.1 Frameworks and Development

- The framework for the App is done by MIT app Inventor by drag and drop method to create the UI design whereas the Coding for the App was done in the form of attaching blocks together.
- The way the Code Blocks works are similar to Coding itself, we need to Attach blocks together just like coding a web page.
- Instead of typing each and every code lines, they readily available in the form of blocks, joining together the blocks following the correct syntax easily made the page work as it is intended to.
- The pages can be navigated with the help of the Side Bar menu with header of each page.

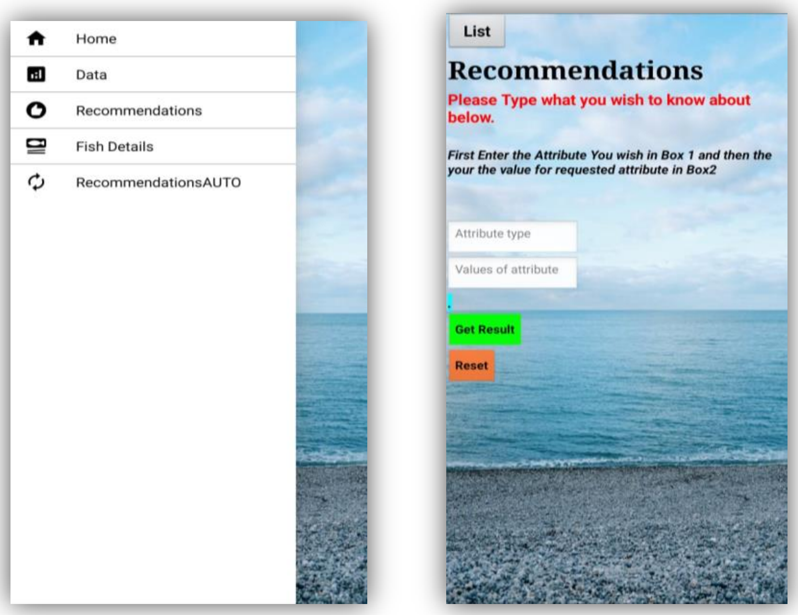


Fig 3.14

3.2.5.2 Getting values from Think Speak API

The values from think speak is shown in the app by getting the values of each field from the total of 6 fields with help API Token keys.

This enables the field values to be directly be displayed in the application from the channel feed from the Thinkspeak server.

This is a secure way of collecting data as all that is required by the user is make a think speak account and connect that account with the SPURS app and integrate it with the IoT Network.

3.2.6 Recommendation system

The recommendation system can be implemented manually and as well as be made automated. Manual recommendation system is implemented in a way that the user themselves have to enter the parameters they found out with their own means.

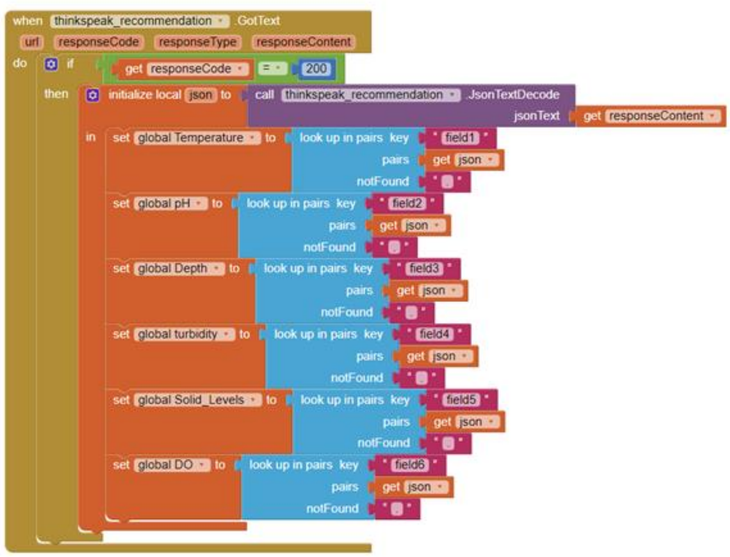


Fig 3.15

3.2.6.1 Manual Recommendation System

The users have to enter the attribute which they wish to check for suggestions or optimal conditions and the value they got while measuring the parameter.With this information the system will give them the suggestion based on the value of the input of the give attribute.

This type of recommendation system can be utilised by everyone, Even if they don’t have an IoT network integrated with Thinkspeak or the attribute values is from some other sources. Hence it is a public ad open ended recommendation system.

This system is more of a short term solution or for those who want to utilise the software temporarily and hence it cannot constantly monitor or give out suggestions and send warning or alert notifications, as the user may not have an IoT implementation in their farm.

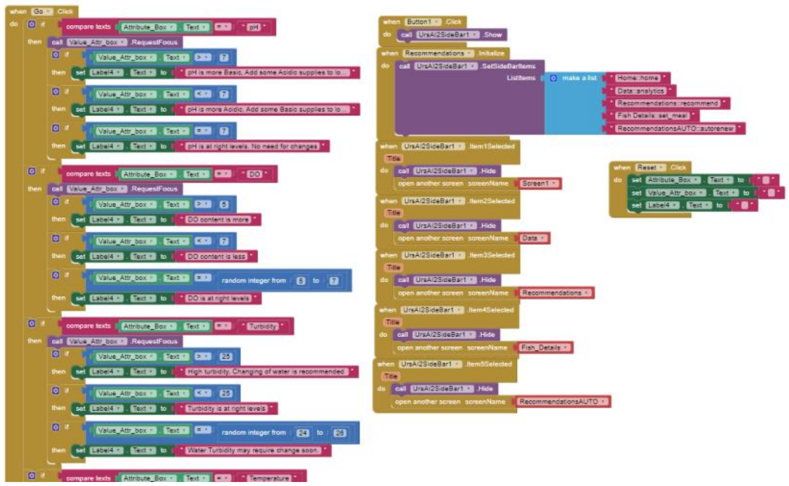


Fig 3.16

3.2.6.2 Automated Recommendation System

The automatic recommendation system Acquires the value from the Thinkspeak channel feed and displays the field values on the app. It -9also coded in a way to compare the field values to the optimal values of the respective fields for different breeds of fish

The system itself differentiates among the attributes in the field against the optimal value of said attributes and recommends safety measures and other suggestions automatically

As along as the user has an fishery Integrated with IoT with any online IoT tool like Think speak or Blynk, They can sync the App with the respective IoT tool they are using and can constantly monitor their farm, and will also get immediate suggestions automatically and Alert or warning Notifications in case if there is any abnormality.

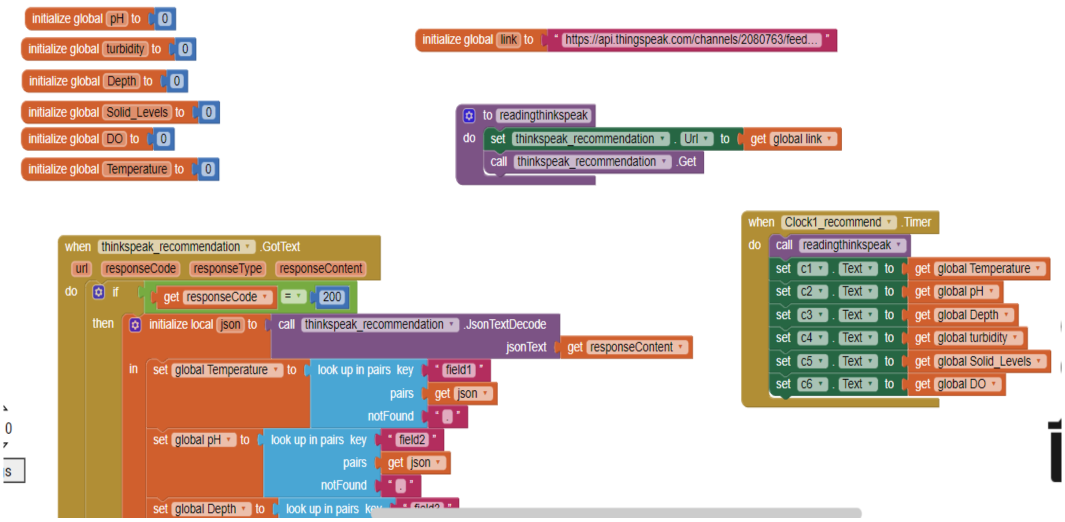


Fig 3.17

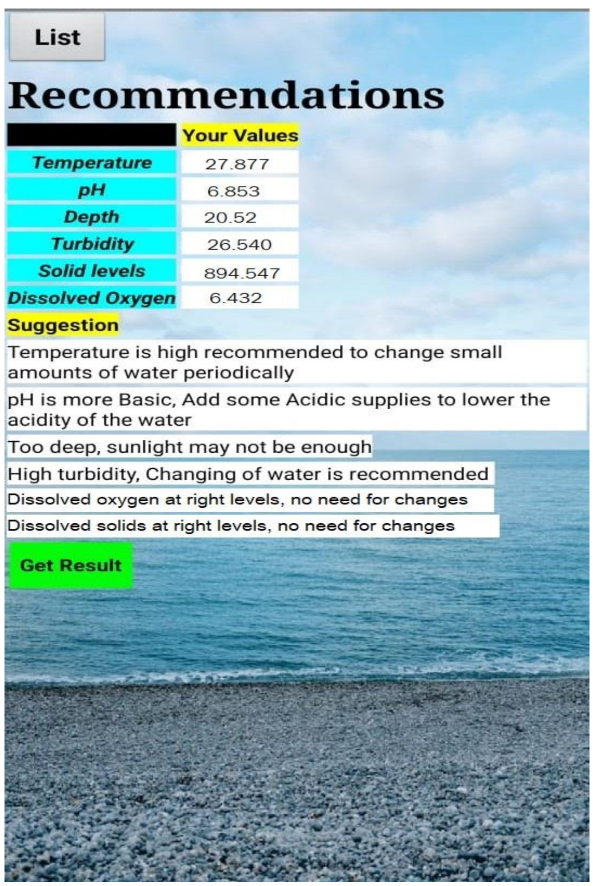


Fig 3.18

CHAPTER 4

RESULT AND DISCUSSIONS

We successfully integrated our IoT with Think speak API, This IoT Implementation proved its worth after a round of on-site demonstrations in fisheries. We were able to get the real time values of the water quality immediately without any issue and were able to give the suggestions or recommendations in the app as well.

The issue which would occur in future would be related to maintenance of sensors as they are subject to wear and tear.

Fig 4.1

Fig 4.2

CHAPTER 5

CONCLUSION AND FUTURE SCOPE

5.1 CONCLUSION

The Integration of sensors with IoT helps in Real-time monitoring. IoT devices collect data from various sensors installed in fish farms, providing real-time information on water quality, this allows farmers to monitor their fishes and the overall farm conditions remotely and make informed decisions promptly. IoT sensors can detect anomalies or deviations from the optimal conditions in the fish farm environment. Early detection allows for timely interventions, preventing potential losses and reducing the risk of fish diseases or mortality, thereby decreasing losses and increasing yield.

5.2 SCOPE

Advantage is that IoT solutions for fish farm data collection can be easily scaled and adapted to various farm sizes and configurations. Whether it's a small-scale fish farm or a large commercial operation, this field has a lot of room to grow in various ways and will have a lot of utility based on its usage.

Fig 5.1

CHAPTER 6

REFERENCES

[1] "IoT Based Automated Fish Farm Aquaculture Monitoring System" Sajal Saha, Rakibul Hasan Rajib, Sumaiya kabir., *2018 2nd Int. Conf. on Innovations in Science, Engineering and Technology (ICISET)27-28 October 2018, Chittagong, Bangladesh*

[2] "IoT-Based Fish Farm Water Quality Monitoring System" Chiung-Hsing Chen, Yi-Chen Wu, Jia-Xiang Zhang and Ying-Hsiu Chen., *Selected Papers from the 2021 International Symposium on Intelligent Signal Processing and Communication Systems (ISPACS 2021)).*

[3] "IoT-based Solutions in Aquaculture: A Systematic Literature Review" Aleksandar Petkovsk, Jaumin Ajdari, Xhemal Zenuni., *2021 44th International Convention on Information, Communication and Electronic Technology (MIPRO)*

[4] "IoT Based Aquaculture" Tanvi Patkar, Komal More, Sarthak Lad, Rohit Tanawade, Amit Maurya., *International Research Journal of Engineering and Technology (IRJET).*