Ornamental Fish Disease Prediction System

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ABSTRACT
Now, many individuals practice ornamental fish breeding as a part time, while others do it as their primary source of income. Some people practice ornamental fish breeding while having little expertise in the subject. Some individuals do this without knowing what illnesses might affect fish under varied environmental circumstances or what treatments are available. As a solution, we intend to find out what ailment's animals may have by monitoring the aquatic environment's environmental conditions and developing remedies for them. The key technology we utilized to create the IoT device was Arduino. To transport data from the device to the database, the PHP programming language is employed. We gathered data from prior articles. It is anticipated which aquatic plants are ideal for growing in this habitat by monitoring the aquatic environment of this water using an IoT device. If the aquatic habitat is unsuitable for fish, they will investigate what diseases the fish might contract in that setting and what treatments are available. Simultaneously, the number of fish that can be held in a tank, the amount of food they require, and the amount of food are projected. We illustrate the source of fish illnesses and how to avoid them. It is more useful for fish dealers and consumers to have a thorough awareness of what fish diseases are and what treatments can be done. We can surely declare that the accuracy of our study is 99%.

Keywords
Fish disease, Ornamental fish farming, Water quality, Internet of things, Ornamental fish foods, Ornamental fish environment, Fish count, Income.

1. INTRODUCTION
Sri Lanka has been increasingly interested in ornamental fish farming since time immemorial as one of its main export growth and economic growth industries in the world, and today many employees and investors are inclined towards this industry. Sri Lanka is blessed with natural watersheds, favorable climate change, and many ornamental varieties. Also, Sri Lanka is a country close to the equator surrounded by beautiful beaches, and is an evergreen country within 12 months of the year. It also shows the foreign exchange generated by the country through fish farming, which has seen a significant increase in the last year as compared to other years. It's $20.97 million. It can be seen how this industry has affected the export growth and economic growth of the country. Carp are extremely sensitive to freshwater. Creating a conducive environment for these carp to make a real profit from the carp industry is an important factor. Therefore, the main conditions affecting those environmental conditions can be defined as temperature, pH, O2 level, and TDS. The environmental conditions required for each species Ex: Grass Carp: "Temperatures required for stimulation of sexual maturation, egg incubation, and survival of young range from 19 to 30 °C, with an optimum of about 23°C."Therefore, maintaining the aquatic environment of the fish is a very important factor here. The main purpose here is to create a suitable environment for each carp species of fish. If those fish do not have a suitable environment, they can become extinct and cause huge losses. When fish do not have a suitable environment to live in, their metabolic and biological functions are disrupted. If the issues that directly affect this industry, such as suitable water conditions, are not given priority, the losses to these associated industrialists and investors will be huge, and the fish will die in vain. The loss to the industry due to experience and long-term cultural activism is enormous. The main objective is to make these carp fish easier to do their biological processes, thereby increasing their fish production and minimizing the extinction of these ornamental fish, paving the way for industry development by providing a highly efficient system.

2. LITRETURE REVIEW
The ornamental fish industry is not new to Sri Lanka or the world, so there has been a lot of research in the fish industry over the years. Among them, they used various sources and strategies to diagnose fish diseases. Similarly, research in recent years has shown that they have developed various devices for diagnosing pet fish diseases. Research conducted by the Beijing Fish Research Institute [1] introduces a method to diagnose fish diseases. There they use a micro image of the infected fish to diagnose the infected fish. There, they use a camera to capture the image. Here they correctly diagnose the disease related to the fish and the problem is that it is difficult to get a micro image. Since most of the people in the fishing industry are unaware, it is questionable whether this micro-image is done correctly.

According to research conducted by the College of Information Technology School of Information Shanghai, China,[2] identify pet fish diseases based on the data they collect. When the symptoms of the fish are entered, the relevant disease and treatment are given to the user by a software system. However, the study of research papers related to this research showed that the data obtained immediately from any device is not used. But they transmit the disease to the fishpond correctly based on user input. The research, launched by Zhejiang Ocean University, specializes in notifying users when they enter input via SMS. They judge the disease using mathematical logic [3].

Research by Jeong-Seon Park, Myung-Joo Oh, and Soonhee Han Eco Aquafarm Research Center, Chonnam National

University, Korea, [4] can be used as a diagnostic system for fish using image processing. But a micro image is also used in this research. Here, image processing is used. Microbes in the body of the fish are often identified through image processing. Data is obtained by micro-imagery from a device with a camera [5].

A part of the activities involving decision-making systems in aquatic environment operations are described in the literature. There are numerous decision-assistance systems available. While some of them do, others do not utilize deep learning techniques. Uttara University, MD Monaural Islam used 11 fish of different species, aquatic environment characteristics, and fish species datasets. an imported dataset containing input pH, temperature, and turbidity water parameters and a selected model for the classification section. The output is predicted. The pH, temperature, and turbidity values of the 11 fish species mentioned are predicted using machine learning algorithms. The accuracy of the ML obtained here can be seen as naïve base algorithm. Here, according to a model using random forest, the accuracy for the aquatic environment data set for 11 fish is 88.48%. Kappa statistics: 87.11%, TP rate: 88.5%, as results. [6] Here, the performance of the freshwater has been assessed in a four-month experiment. This is an experiment oriented more toward the biological side than the technological side, and conclusions have been reached based on the results of the lab tests for the data set.

Koi carp species have been used for the test here[7]. A DO prediction model was given by merging Long Short-Term Memory Network

(LSTM) WITH GBDT to improve the forecast accuracy of dissolved oxygen (DO) in aquaculture, according to a study by Chang Zhou Fishery Demonstration Base in China. Here, a typical pond in the Chinese province of Viangsu is used for DO verification. Marzia Ahmed, MD Mostafijur Rahman of the software engineering department at Daffodil University of Dhaka, Bangladesh, and Obaidur Rahman of the Computer Science and Engineering department researched a water prediction component in selected ponds in Bangladesh. There IoT device has taken data of several water quality parameters (Temp. PH, COD, TSS...) Here, the predictions have been made by several algorithms, such as IBK, Nave Bayes, SMO, and Random Forest. The team, which includes MD Mamunur from the CSE Department of the Liberal Arts University in Dhaka, Bangladesh, conducted research on smart water quality prediction in 2021.

A new technology called BioFloc has been used to identify bacteria and algae in the water. Here pH, TDS, and NH3 values are obtained from the device. The device provides a comprehensive understanding of the nature of water. [8] The team led by Theyazn H.H. Aldhyani of the Department of Chemical Engineering, Saudi Arabia, developed an algorithm using AL to predict the water quality index (WQI) and water quality classification (WQC). developed artificial natural models (NARNET) and LSTM deep learning algorithms for WQI prediction. Support Machine vector, K-NN, and Naïve bias machine learning algorithms used for WQC forecasting.

When focused on fish disease-related research articles and books in recent years in this literature review. When considering the background, adopting a culture-related pattern instead of proper technique, and timely remedies 57% of Sri Lankans do not have the technical know-how associated with the industry. lack of adequate and technical support with regard to water quality management, feed availability, and cost. Lack of quality brooders and information on the most suitable fish varieties for the different areas of the country pose problems. The impact of the aquatic environment on the fish in each case For many years, various research has been done on smart aquaculture using the Internet of Things (IoT) and machine learning. According to the research papers, the following are some of the most commonly used machine learning algorithms related to the water prediction framework.

2.1 Bacterial Fish Diseases in Agriculture System

The goal of this review is to bring together some of the scattered literature on various aspects of the most dangerous bacterial diseases that affect fish cultured in marine waters around the world, such as vibriosis, "winter ulcer," photobacteria, furunculosis, Flexi bacteriocins, "winter disease," streptococcus, Lactococcus, BKD, dysbacteriosis, and piscirickettsios. We also go through the traditional methods for isolating microbes from their hosts, as well as the serological and/or genomic tools for illness diagnosis.

2.2 Web-based Expert System for Fish Disease Diagnosis

This study outlines a Chinese Nationally Funded Research Project (863 projects) aimed at developing a web-based intelligent fish disease diagnosis system. For various diseases and symptoms, the system comprises around 300 rules and 400 visuals and graphics. It can detect 126 different illnesses in nine different kinds of primary freshwater fish. The technique has been tested and is currently being used in a trial program by fish farmers in North China.

2.3 Aquaculture of Warm Water Fish

Parasitic diseases in subtropical and tropical fish grown in fresh and marine waters are discussed. The parasites listed below are discussed. Epizootic ectoparasitic diseases are frequently the result of poor growth conditions, which might be climatic or caused by poor management. Internal parasite infections, particularly heterogeneous infections, are more complex, especially in man-made systems, since they are determined by a greater variety of interacting ecological conditions. The majority of diseases that harm fish in these systems are caused by infections that have been introduced. In areas where indigenous species are farmed, only a few of the autochthonous parasites become implicated in epizootic illnesses. Epizootic illnesses and mortalities caused by parasites contracted from the local environment as well as parasites linked with the cultivated species have previously been documented in the relatively brief history of piscine agriculture.

3. REASEARCH GAP

Studies in various research papers have shown that many devices are designed to detect changes in the external body of fish and their associated symptoms. The device that detects the parameters in the water and uses them to diagnose diseases is minimal. The table below illustrates the recent research in the ornamental fish industry and how our IoT devices are changing.

The device processed using image processing technology can be identified as a device to compete with the IoT device we are creating. Research papers show that each of these devices is designed to process micro images. Getting a proper micro image is not an easy task.

It is also difficult to use, and it is difficult for farmers in the ornamental fish industry to do so due to their low level of knowledge. The user does not need to do anything because the IoT device we create automatically obtains the required parameters and stores them in the cloud. Below is a comparison chart of our device and the equipment that was created using image processing technologies.

There are several features in this system. Disease prediction, treatments, and solutions We use machine learning to predict those solutions. When compared with other systems, lots of systems predict symptoms and solutions only. In "Bacteria from the Ornamental Fish Project," their system predicts disease and treatments. They used image processing, but we do not. But we do not use image processing because it does not predict the disease before it infects the fish. This is how our system changes with other systems.

Ornamental fish farming is becoming more popular these days. It has been demonstrated that many people are interested in ornamental fish farming. However, some ornamental fish farmers are aware of it, while others are not. Today, there is a good market for farming ornamental fish. It has been demonstrated that many people are interested in ornamental fish

farming. However, some ornamental fish farmers are aware of it, while others are not. Today, there is a good market for farming ornamental fish. However, most farmers do not have a thorough understanding of fish habitats and diseases. Many carp fish have died in fish tanks as a result of this situation. As a solution for this situation, we proposed a system to predict diseases that can be transmitted to aquatic organisms, how to treat them, and how to care for fish so that they do not become infected. For that, it takes into account the temperature of the water, the percentage of oxygen, the pH of the water, and the views of breeders who breed aquatic organisms. However, this system is one that is associated with health. This system deals with these lives. Therefore, the decisions made by this system must be exact. That is the most important thing. Therefore, we collect data from large-scale fish farmers, conduct surveys, and collect lots of data to predict the final decision more accurately. After that, we create a data set and make final conclusions with the help of machine learning. Machine learning is a subfield of artificial intelligence and computer science that focuses on using data and algorithms to mimic how humans learn, gradually improving its accuracy. So, we hope to make good predictions and solutions using these technologies and the ideas of experts in the field. The other problem is dealing with non-technical people. We illustrate our final solution as a web application. But most fish farmers do not have much technical knowledge. Due to this situation, we have to pay attention to this problem.

4. METHODOLOGY

The main purpose of this component is to accurately measure the water level in the fishponds and to accurately measure the parameters of the water required to diagnose fish diseases. Here is a tool for that. In the ornamental fish industry, the IoT device is configured for outdoor use, as it is often located outdoors with pools, and data is stored in a database.

Therefore, there are two main parts to this component The IoT device has several sensors connected to detect water parameters. These are the only ones that are in contact with water. This is because we get all the parameters from water, and the sensors that get those parameters must also be connected to water. Here we mainly want to get the data from water pH, TDS, and temperature. The internal structure of the IoT device to be built is described in depth in the following blueprint diagram.The sensors are the input devices for the IoT device that is expected to be built. These senses are shown in “Figures 2” in this outline. All these senses are connected to the water so that the input data immediately travels through the breadboard to the Arduino Uno board [9]. This Arduino Uno board is expected to be used as the malware processing unit of this IoT device. Although there are other main panels in Arduino, the reason the Uno board is used for this is that it can connect more sensors. Therefore, if you want to input a water parameter that you do not currently expect to get in the future, this sensor can also be mounted on this board without any problems. of the outline shows that Arduino Uno board. The cable that provides instructions to this Arduino board is shown in programs written for the Arduino.

Computer languages are sent to the Arduino board via that cable. The data from the input sensors is processed through the Arduino board, and a cloud database is used to store that data. An internet connection is required to establish a connection between the Arduino board and the cloud database. Therefore, it is expected to install another Wi-Fi-enabled device on the Arduino board. Also, it is not practical to connect power to this circuit, so the circuit is powered by batteries. Here, a 5V battery supplies power to the circuit. It is then sent to the cloud database via the Arduino board and used for prediction tasks. To maintain the bioactivity of each type of fish used in carp farming, they must have an aquatic environment that is suitable for them to live in and maintain their metabolic activities. We can get a rough idea of the surrounding environment, for example, a day with more sun is hotter, and the oxygen in a very small room can be very low. But it is very difficult for us to determine the range of water conditions that carp

require by looking at them or putting their finger on them, or whether they have a suitable environment. It is very difficult to determine the range of water conditions they require. Therefore, fish owners should create the right environment for their fish. If not, the fish may die and cause huge economic losses [10].

Here, implementation takes place in three phases. The collection of data is required to predict the most suitable environment for carp fish growth It is very important to get the data of those parameters and conditions in determining the suitable environment for the carp fish. More than 250 carp tanks were selected for this over a period of more than a month. To obtain the parameters of these fish tanks, the IoT device takes the water temperature, pH, and TDS values twice a day (6:00 am–10:30 am and 1:00 pm–4:00 pm) by each of the relevant sensors. The data was recorded. Here, we followed a survey-based method to predict the suitable aquatic environment for the growth of these carp fish. We have studied many research papers related to this. The data obtained by our measurements were created by statistical analysis. We also monitored the data from the sources in the places where we went to get the data [10]. Identify the deep learning agriculture to predict the most suitable environment for carp fish growth.

Here the dataset obtained by statistical analysis is recorded on an excel sheet. Then the excel sheet is imported into the model. Then the dataset is subjected to pre-processing. By repeating this, the dataset is studied by the model. Ex: when we prepare for an exam, we do lot of past papers. We can write that past paper about 3 times and then the 4th time we can memorize it. Here, by re-processing, the dataset is well recognized and studied by the convolution neural network model. After the dataset is trained, the model is created. With the help of the IoT device, the values of the parameters are obtained for that convolution neural network model (CNN). Here to confirm the accuracy of the model, the dataset accuracy is important to determine the most suitable aquatic environment for the carp fish growth. Here, a high model accuracy has been obtained (85 %+). Feed inputs, illustrates user with recommendations and user friendly.

Here the values (temp, pH, TDS) obtained by the IoT device are given as input to the trained module and then validate. Here four labels have been used to determine the conditions of the water as Excellent, Good, Bad & Very Bad. There the output depends on the parameters obtained from the IoT device. This allows the user to easily determine the appropriate environment for the growth of the carp fish. Then according to each of those outputs, this model gives recommendations. For example, if very bad is mentioned as output. Then the system will give recommendations, such as applying the corresponding fertilizer as the acidity is high. The purpose of this proposed solution is to increase the efficiency of fish growth by meeting the most suitable conditions for carp fish to live in each species and age, creating an environment, comparing water diversity, and making recommendations for water conditions. Here we use our IoT device (with relevant sensors) to input water prediction parameters and train the user to compare the water condition of the tank, location, fish species, age classification, and prediction. The relevant inputs are defined, and a specific model is developed from the trained model. Accordingly, is it suitable for fish to live in or not? It aims to give a proper prediction and make predictions regarding the relevant recommendations. First, we will gather the TDS value, O2 level, and temperature from the IoT device. further gather information from farmers, articles, and other sources. We will collect information about fish disease and solutions from farmers. People who have been involved in fish farming for more than 5 or 6 years have a good understanding of the industry. They should be aware of the diseases that carp fish have faced, as well as the solutions and actions that can be taken to prevent those diseases. We conducted a survey and gathered data. Not only that, but when it comes to climate change and how it affects the industry, as well as how they deal with natural disasters, we will conduct a survey. Following that, we will create a data set. Also, conduct data analysis. We must prepare the data once it has been collected. We can accomplish this by combining all of the data we have and randomizing it. This ensures that data is distributed evenly and that the ordering does not interfere with the learning process. The data is then cleaned to remove unnecessary data, missing values, rows and columns, duplicate values, and data type conversion. The data is then visualized to understand how it is structured and the relationships between the various variables and classes present. The cleaned data was then divided into two sets: a training set and a testing set. The training set is the set from which the model learns. A testing set is used to assess the model's accuracy after training [11]. Then we must find a suitable model for training data. It is critical to select a model that is appropriate for the task at hand. Scientists and engineers have developed various models over the years that are suitable for various tasks such as speech recognition, image recognition, prediction, and so on. As a result, there is no need to develop a new training model. We must train the data set using the model. The most important step in machine learning is training. Pass the prepared data to the machine learning model during training to find patterns and make predictions. As a result, the model learns from the data and can complete the task set. The model gets better at predicting over time as it is trained. We must evaluate the model’s performance after training it. This is accomplished by testing the model's performance on previously unseen data. The unseen data is the testing set that you created earlier. If we test on the same data that was used for training, we will not get an accurate measure because the model is already familiar with the data and finds the same patterns in it as it did previously. This will result in a disproportionately high level of accuracy. Finally, we could use this model on unseen data to make accurate predictions.

We collected the necessary data from the relevant resources. We analyzed the collected data and created the dataset. monitored the core relationship between each variable using the heat map. Accordingly, I selected the variables we needed. Then we selected the most suitable regression model, multi-linear regression. Then, after entering the size of the tank and the age of the fish, the number of fish that can be included and the amount of food that should be given to them will be predicted, and then, after entering the value of one fish, their income is predicted.

5. HARDWARE

Arduino technology is the main technology used to make the device. It uses several sensors to measure the water quality of the water. In addition, the data from the sensors is brought to a main Arduino board. It prepares the data properly and sends it to the database. This is because all of this data retrieval takes place in a waterlogged environment, which can result in water damage to equipment. To do this, you must design a safety device that prevents all equipment from colliding with water

6. SOFTWARE

In addition to the hardware of this component, you also have to turn to the software side because all the instructions on the device must be given in computer language. Similarly, the PHP computer language is used to transfer data from the device to the database. The below diagram shows the complete diagram of the water parameter retention device to be created. The first data to be collected is from live fish tanks. Most often, such tanks are in the form of fishponds. This device is also installed in the fish ponds. The device takes water readings from the pond where the fish live.

7. RESULTS

When investigating the conditions of the water environment in carp ornamental fish farming, the user can get a clear reading of the conditions and parameters of the water tank through this system. Here the model has been trained using a deep learning algorithm, and therefore the input from the IoT device is given to the system. Here, more attention was given to the accuracy of the model to confirm the correctness of the data. As per the table below, the model has an accuracy of more than 90%. "Figure 1".

Here, the parameters taken from the IoT device are validated by the model, and then the necessary recommendations are given to the user according to those parameters. Thus, the user is given the space to identify and create the most suitable environmental conditions for carp fish to live.

Fish are susceptible to many unusual types of diseases. They are Ich, Hemorrhagic Septicemias, Fungus, Dropsy, Fin Rot, Pop Eye, Anchor Worms, Lice, Clamped Fin, Red or White Sores, and Skin Flukes (Gyrodactylus). The solutions to be taken and the remedies to be done for all these diseases have been introduced above. We show the cause of these diseases and the steps to be taken to avoid them through this research, it is more beneficial for the fish traders and fish buyers to have a clear understanding of fish diseases and problems and the remedies that can be taken. We can confidently say that the accuracy of the research we have done is 99%. The purpose of creating an IoT device is to mitigate human errors and keep the availability of real-time data. IoT device provides accurate data into 2 decimal places and it helps to maintain accurate data. This IoT device is waterproof, and it helps to keep maintain accurate data for the software system.

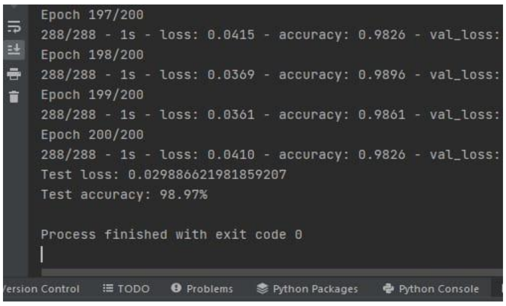

Figure 1 : Model Accuracy

8. CONCLUSION

This software system and the IoT device have been a great support to the existing problems of the Sri Lankan ornamental fish industry. Here farmers can identify their carps fish diseases in advance. There are also ways to get rid of the disease before it gets infected. In addition, the system can calculate the growth of aquatic plants in the aquatic environment, the amount of food to be fed to the fishpond to obtain the desired return, and the monthly income received by the farmer through, this system. This solution can be classified as a long-term solution, not a short-term solution. Although the initial cost is high, this software system can be used for a long time, so I want to take advantage of Tight, especially for a long time. Considering that, this solution can be classified as a very good and intelligent option.

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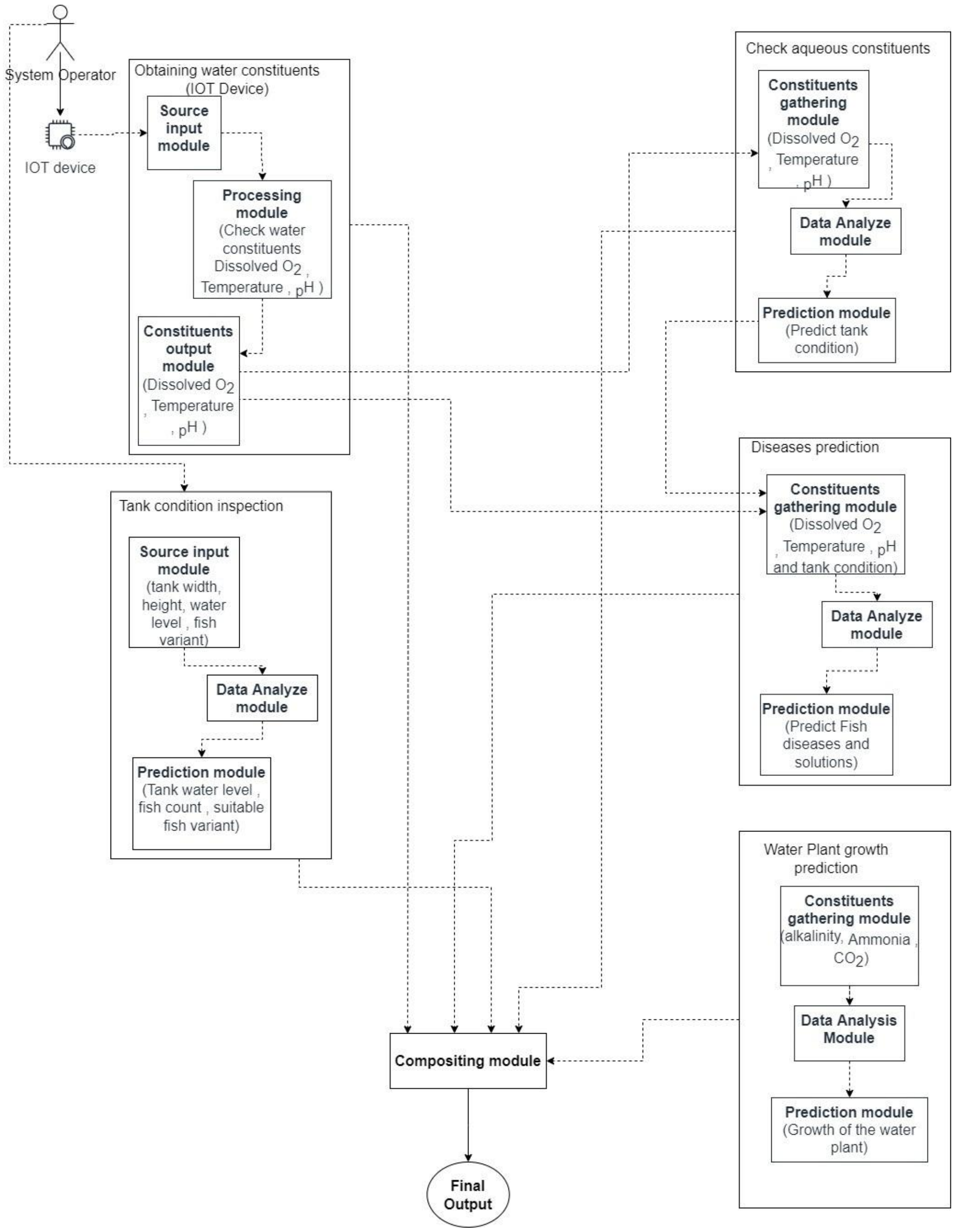

Figure 2: System Diagram