Automated pH Regulator For Freshwater Prawns With Analog pH Meter Pro

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Abstract—**In Malaysia, farmers face the problem of prawn diseases which causes billions of USD in damage, along with the loss of prawn production. The number of farmers begin to decrease as investors are unwilling to finance prawn productions due to this. There will be a risk that it will decrease the productivity of Malaysia's prawn production due to the prawn affected by diseases. Research shows that an uncontrolled pH level in the prawn tank causes the prawn to be stressed and lowers the prawn's immunity level. As a result, diseases such as Early Mortality Syndrome (EMS), White Spot Syndrome Virus (WSSV), and Taura syndrome virus (TSV) can easily attack the prawns. The existing water quality monitoring system lacks a complete solution from monitoring the pH level to the autonomous remedial action is taken to control the pH level. When developing the system, no autonomous remedial action is being taken to control when the pH level is out of range. Automated pH Regulator for Freshwater Prawn with Analog pH Meter Pro helps farmers to monitor and control the pH level in prawn tanks. The logged data is stored in a personal computer for reference to prawn health. This paper proposes a conceptual framework with three (3) stages that consist of monitoring pH level with threshold data to determine pH level, provide autonomous remedial action to control the pH level in prawn tanks, and logged data into a personal computer for reference. By having an Automated pH Regulator for Freshwater Prawn with Analog pH Meter Pro, immediate action can be carried out to save the prawns from diseases.**

Keywords—Automated pH regulator, Analog pH Meter Pro, diseases

I. INTRODUCTION

PRAWN farming is a vital industry in Malaysian aquaculture as it is a highly profitable business and constitutes 75-80 percent of total annual household income [1]. By 2020, the Malaysian government has set production targets of aquaculture 214,000 tonnes valued at RM6.5 billion [2]. In Malaysia, there are currently about 11, 580 prawn ponds operating, covering a total of about 7,309 hectares. Rendering to Bohari Leng, Sarawak Marine Fisheries Department deputy director, lands located at Loba Stoh, Santubong, Telaga Air in Kuching, Selalang, Belawai in Sarikei and Tanjong Manis in Mukah have the potential to be turned into prawn farms and is capable to generate RM 1 billion in annual revenue [3]. In recent years, the production of cultured prawns has markedly decreased because of serious viral disease outbreaks. In Malaysia, the outbreak of Early Mortality Syndrome (EMS) resulted in a drop in prawn species named 'L. Vannamei' production from 70,000 metric tonnes in 2010 to 40,000 metric tonnes in 2011 [4]. The Global Aquaculture Alliance [5] has estimated that losses to the Asian prawn culture sector amount to USD 1 billion and they lost about 80% of their products in some regions.

According to an industry expert, Mohamad Nazri bin Puasa [6] uncontrolled pH level causes the prawn to be depressed and has a low prawn immune system to protect itself against diseases.

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As a result, diseases such as Early Mortality Syndrome (EMS), White Spot Syndrome Virus (WSSV), and Taura syndrome virus (TSV) began to attack prawns. EMS diseases are transmitted orally, colonizes the prawn gastrointestinal tract besides producing a toxin that causes tissue destruction and dysfunction of the prawn digestive organ known as the hepatopancreas. WSSV is one of the main causes of the stagnating prawn industry. TSV causes serious diseases in the prawn post-larval, juvenile, and adult stages of prawn called 'Penaeusvannamei'.

To minimize the risk of disease attacks, it is important to come out with an Automated pH Regulator for Freshwater Prawn with Analog pH Meter Pro that can monitor pH level and provide autonomous remedial action to control the pH level. Deplorably, there is a lack of complete solution from monitoring the pH level until autonomous remedial action is taken to control the pH level. The techniques for monitoring the pH level by conducting colorimetric tests consume a lot of time and effort [7]. Occasionally, information might reach farmers but there is a late response from the farmers to control the pH level, result in prawn die. This paper aims to purpose architecture and develop a prototype for an Automated pH Regulator for Freshwater Prawn with Analog pH Meter Pro that can monitor the pH level of the water in the prawn tank and provide autonomous remedial action to control pH level.

In the real-world application, the proposed system will be using an Analog pH Meter Pro that is placed in the prawn tank to measure pH level. The sensor is connected to Arduino UNO R3 that will analyse the current pH level with threshold data, trigger DC motor to pump pH Up or pH Down when the pH level is not in between an optimal range of 6.5 to 8.5 and display the information on LCD 16x2. As proof of concept, the project is scaled down to only lab-scale setup experimentation. A proposed prototype that consists of Analog pH Meter Pro, Arduino UNO R3, LCD 16x2, DC motors, and pump tubing are tested in a lab-scale aquarium tank. Analog pH Meter Pro will detect pH level changes and send it to Arduino UNO R3 to analyse the current pH level with threshold data and send the pH level reading to LCD. Any changes beyond the optimal pH level will trigger the DC motor to pump pH Up or pH Down to the prawn tank. The logged information of date, time, and pH level will be stored in the personal computer database.

The following sections of this paper will discuss the literature review, design, and project modelling, results and discussion, and conclusion and recommendation.

II. METHODOLOGY

In methodology, the research method carried out throughout this project will be explained. Chapters 2 are structured in a way to discuss; 2.1 Problem statement, 2.2 conceptual frameworks, 2.3 Completion of Comparative Study between Existing Technologies, 2.4 System Architecture, 2.5 Prototype Development, 2.6 Prototype Testing, and Enhancement. As illustrated in Figure 1, the applied method involves a process that comprises six (6) phases that begins with a problem statement, conceptual framework, a comparative study between existing technologies, system architecture design, prototype implementation and ends with prototype testing and enhancement.

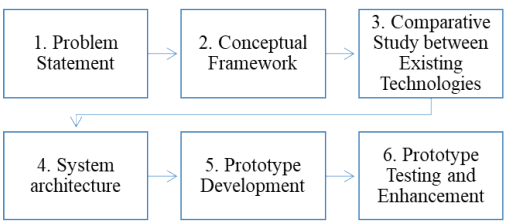

Fig. 1. Research Method for Automated pH Regulator and Remedial for Freshwater Prawn

A. Problem Statement

In this section, a problem statement is to identify by the research study on an existing problem in prawn aquaculture. This is done by referring to literature studies written by others. The interview has been conducted with the Head of Centre of Fresh Water Lobster Hatchery, Sitiawan, Perak to investigate the important factor that needs to be taken into consideration during prawn hatching. In taking care of the freshwater prawn, the water quality parameters;

pH, temperature, salinity, dissolved oxygen must be in an optimal range.

The objective is defined to narrow down the scope of the project. The focus of this research project is to develop an Automated pH Regulator and Remedial for Freshwater Prawn that overcomes the lack of existing systems. The existing system lacks immediate feedback taken to control the pH level.

B. Conceptual Framework

Based on the preliminary research and problem, a conceptual framework for the Automated pH Regulator and Remedial for Freshwater Prawn system is illustrated in Figure 2.

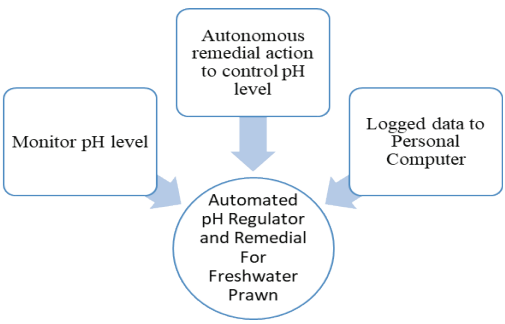

Fig. 2. Conceptual Framework of Automated pH Regulator and Remedial for Freshwater Prawn

The conceptual framework in Figure 2 signifies that there are three (3) main stages involved in the Automated pH Regulator and Remedial for Freshwater Prawn. The first stage of the system focuses on monitoring the pH level at the prawn tank to determine the pH level. Based on the pH level, stage two of the system plays an intelligent role in an automated DC motor to pump acid or alkaline to control the pH level in the prawn tank. The data is the log to a personal computer for references or prawn health.

C. Completion of Comparative Study between Existing Technologies

Before propositioning an appropriate architecture for Automated pH Regulator and Remedial for Freshwater Prawn, essential facts about technology need to be used need to be analysed for an enhanced explanation. A comparative study on monitoring the pH level system relevant to this research project was conducted to analyse the type of sensor, microcontroller, and the system architecture of existing works. The tenacity of conducting the comparative study is to first-rate the exact apparatuses, chemicals, and veracious technology that is suitable to be used in the prawn tank to monitor pH level and take autonomous remedial action of control pH level.

The system is developed based on the requirements of the freshwater prawn breeders and observation at the prawn tank.

D. System Architecture

After the accomplishment of the comparative study between the existing technologies and with the framed conceptual framework, the system architecture for this research project is designed to come out with a complete solution of monitoring pH levels in the prawn tank. The system architecture is used to provide a perfect illustration of how the Automated pH Regulator and Remedial for Freshwater Prawn work with an explanation of the tools that are used. The equipment uses to develop this project are Analog pH meter for detecting pH level changes, Arduino UNO R3 to control system operation, DC motor to pump acid or alkaline to the prawn tank, LCD 16x2 to display pH level, and personal computer for the log data. Freshwater prawn breeders can view the pH level in the prawn tank, the log data in a personal computer.Prototype Development.

The development of the prototype model for this research project requires the integration of hardware and software components. The prototype model is built using a medium-sized plastic aquarium, Analog pH meter, Arduino UNO R3, LCD 16x2, DC motor, and pump tubing. The prawn aquarium is filled with 1500 ml distilled water and prawn. Analog pH meter will detect pH level changes and send it to Arduino UNO R3 to analyse the current pH level with threshold data and send pH level reading to LCD. Any changes beyond the optimal pH level will trigger the DC motor to pump acid or alkaline to the prawn tank. The logged information of date, time, and pH level will be stored in the personal computer database.

E. Prototype Testing and Enhancement

After the completion of prototype development, prototype testing will be conducted to validate the proposed prototype system. Besides, three (3) types of tests will be carried out to evaluate the system's reliability when it operates in a real environment. The tests include precision of pH level testing, volumetric flow rate testing, and pH level impact on freshwater prawn behaviour testing. Based on the results gathered, continuous enhancement will be made to increase the effectiveness and efficiency of the proposed system.

III. RESULTS AND DISCUSSION

A. Accuracy of pH level testing

The purpose of conducting this test is to determine the accuracy of pH collected from the pH meter pro. The accuracy of the pH level collected from the pH meter pro is determined by comparing its measurements with manual measurements using a pH meter. According to the measurements recorded from the graph in Figure 3, out of the 30 trials that have been performed, it appears that the highest pH level measured by the Analog pH meter pro is 10.9, while the actual pH level recorded 10.7.

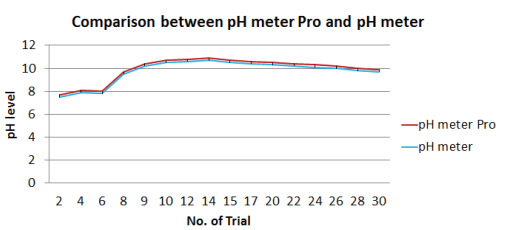

Fig. 3. Comparison between pH meter Pro and pH meter

In conclusion, the results proved that there is a good correlation between the pH level recorded with the pH meter and the actual distance measured with a pH meter. It is proved it is relevant to use pH meter pro as its measurement is less than 0.1cm of error.

B. Time is taken to control pH level testing

The purpose of conducting this test is to calculate the average time taken to control the pH level. Table 1 shows a list of values gathered from the experiment, in which the value represents the following parameter. It is important to get a good estimation on the time frame to ensure a healthy environment for the prawn to live.

TABLE I. TIME TAKEN TO CONTROL PH LEVEL

No of trial	pH level	Time is taken (s)
1	2.1	3.2
2	5.1	2.27
3	4.4	2.58
4	2.8	2.79
5	5.8	1.21
6	3.9	2.62
7	2.5	2.99
8	3.1	2.7
9	6.1	0.88
10	6.4	0.04
11	8.8	1.64
12	8.7	1.16
13	9.4	2.52
14	9.1	2.23
15	9.5	2.56
16	10.2	2.77
17	10.6	2.91
18	8.6	0.05
19	8.88	1.67
20	9.3	2.46
Average Time Taken		2.24

From the testing, Figure 4 shows the graph of the time taken to control the pH level. The difference between those values is due to the different strengths of the pH level.

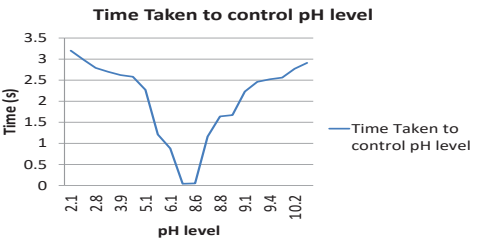

Fig. 4. Graph for Time Taken to control pH level

TABLE II. OUTPUT DISPLAY ON PERSONAL COMPUTER

Date	Time	pH Value
24/01/2021	12:50:01	7.7
24/01/2021	12:50:02	7.7
24/01/2021	12:50:03	7.7
24/01/2021	12:50:46	8.1
24/01/2021	12:50:47	9.7
24/01/2021	12:50:48	10.4
24/01/2021	12:50:49	10.7
24/01/2021	12:50:50	10.8

C. Performance Testing

The purpose of conducting this test is to measure the stability of an Automated pH Regulator for Freshwater Prawn with an Analog pH Meter Pro system. This is done to ensure the system can perform well in measuring the pH level accurately as well as logged data immediately. A similar setup to the setup of an experiment is used. Based on the results, the system is already stable in recording pH levels accurately and logged the data.

IV. CONCLUSION

In the nutshell, an Automated pH Regulator for Freshwater Prawn with Analog pH Meter Pro will enable the farmers to improve the productivity of the prawn hatching and breeding process. By having a desirable pH level, prawns will be in healthy condition to continue living. It can also reduce the risk of diseases attacking the prawn. Diseases such as Early Mortality Syndrome (EMS), White Spot Syndrome Virus (WSSV), and Taura syndrome virus (TSV) causes billions of USD in damage, loss of prawn production, farmers wiped out and unwilling investors to finance in prawn production. Automated pH Regulator for Freshwater Prawn with Analog pH Meter Pro has a complete solution from monitoring the pH level until autonomous remedial action taken to control pH level. It helps the farmers to take care of the pH level quality in the prawn tank for twenty-four (24) hours.

For further recommendation, more parameters are needed to obtain more accurate results such as temperature, light intensity, and salinity. The proposed solution can also be further enhanced by allowing the system to detect the water quality suitable for various kinds of aquaculture as the current system can only monitor the water quality suitable for the prawn tank.

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