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Automatic Sluice Monitoring Based On The Water Ph In a Brackish Water Pool Using a Web Server

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Abstrak

Perikanan merupakan salah satu sumber devisa negara yang paling potensial. Kualitas air pada budidaya ikan dikolam air tawar merupakan bagian sangat penting karena pertumbuhan dan umur ikan sangat dipengaruhi oleh suhu dan perubahan level oksigen terlarut, pH air dan keasinan garam. Ikan yang dibudidayakan di kolam air tawar dianggap lebih sensitif terhadap perubahan mendadak pada kualitas air. Agar tetap menghasilkan kualitas ikan yang baik, maka diperlukan alat untuk mengontrol pH air pada kolam air payau tempat budidaya ikan dilakukan.dirancang prototipe kolam air payau dengan pintu air otomatis yang dapat menjaga stabilitas pH pada kolam berisi air payau. Pintu air digerakan menggunakan motor servo dengan mikrokontroller Esp 32. Sistem mampu mengukur pH air secara akurat serta hasil dari pengukuran dikirimkan ke database melalui Esp 32 dan ditampilkan melalui web server. Ketika nilai pH pada kolam berisi air payau kurang dari 7, maka pintu air yang berisi air asin akan terbuka secara otomatis untuk menstabilkan pH pada kolam air payau. Namun, apabila nilai pH pada kolam air payau bernilai 8 maka pintu yang berisi air tawar akan terbuka secara otomatis.

Kata Kunci*:* Air, Esp 32, ikan, kolam, payau

Abstract

Fisheries are one of the most potential sources of foreign exchange for the country. Water quality in fish farming in freshwater ponds is a very important part because the growth and age of fish is strongly influenced by temperature and changes in dissolved oxygen levels, water pH and salt salinity. Fish farmed in freshwater ponds are thought to be more sensitive to sudden changes in water quality. In order to continue to produce good quality fish, a tool is needed to control the pH of the water in brackish water ponds where fish farming is carried out. A prototype of a brackish water pond with automatic sluice is designed that can maintain pH stability in a pond filled with brackish water. The floodgates are driven using a servo motor with an Esp 32 microcontroller. The system is able to accurately measure the pH of the water and the results of the measurements are sent to the database via Esp 32 and displayed via a web server. When the pH value in a brackish water pool is less than 7, the floodgates containing salt water will open automatically to stabilize the pH in the brackish water pool. However, if the pH value in the brackish water pool is 8, the door containing fresh water will open automatically.

Keywords*: Water, Esp 32, fish, pond, brackish*

1. PREFACE

Fisheries are one of the most potential sources of foreign exchange for the country. The development of fish farming in brackish water ponds in Indonesia is very important for development in the fisheries sector and is one of the priorities that is expected to be a source of growth in the fisheries sector [1-3]. Brackish water itself is a mixture of sea water and fresh water. Less salt level than seawater and more salt level than fresh water. Fish commodities that can be kept and cultivated in brackish water include: milkfish, tiger prawns, crabs, tilapia, grouper, catfish and many more [4]. Monitoring is the process of collecting data and measuring progress on changes that occur, especially to the process and the resulting outputs. Monitoring provides basic data to answer problems, while evaluation is positioning these data so that they can be used and are expected to provide added value. In the monitoring system, a controlling function can be added. This function can be done with an unlimited distance, because it can take advantage of IoT technology[5, 6].

The pH quality of the water used for fish farming is very important, because fish cultured in brackish water ponds are considered to be more sensitive to sudden changes in the pH quality of the water. More attention is needed to maintain the pH quality of pond water. The growth and age of fish are directly affected by temperature and changes in salt level, dissolved oxygen and water pH [7]. In a previous study, a remote floodgate control monitoring system program based on Borland Delphi 7.0 was created. The data transmission system uses the FSK (Frequency Shift Keying) principle. The device can be used for various purposes such as monitoring water levels, sluice conditions for hydropower distribution and so on [8]. One area of technology that is developing is microcontroller technology. The application of the microcontoler technology is the Prototype Monitoring of Water Levels in Microcontroller-Based Reservoirs. In designing this tool, using an ATMega 8535 micro controller as a data processor and a ping sensor as input and a graphic LCD, LED, Buzzer and DC Motor as inputs [9].

Floodgate monitoring is related to monitoring the water level. Information regarding water level, water pH and floodgate status that can be seen on the web in real time is not yet available, so monitoring floodgates is considered difficult, less effective and maximal. Weir officers must go back and forth from the weir to the guard post and then to the control to move the floodgates. The goal is to design a website-based floodgate monitoring system. Assist officers in monitoring the floodgates to be more effective and maximal. Using the Wemos D1 R1 Microcontroller, the HC-SR04 Ultrasonic Sensor to read the water level, the DC Motor moves the floodgates. LCD displays runoff and level. Sirens as a warning of danger. The test results show that the system that has been made is running well. The system is able to open and close the floodgates through control from the web and runs automatically. Water runoff and level can be displayed on the LCD. Weir information regarding water level, runoff, level, floodgate status, and recap results can be viewed on the web in real-time [10-13].

Based on previous research, the authors are interested in conducting research and development to facilitate brackish water fish farmers in order to overcome the problem of pH water quality in ponds. The system can monitor the pH of the water and display it to the MIT Inventor application and is integrated with the website application. In addition, the system can also control the servo motor to open and close the floodgates that have been integrated with solar panels. Automatic floodgates for IoT-based shrimp farms with MIT applications are implemented using ESP 32 which is used as the primary node and using Arduino IDE 1.8.6 developer software which runs on the Windows 10 operating system.

2. Research Methods

This research started from conducting a literature study using reference books and journals. The author also collects data from several samples of brackish water pond fish culture. Furthermore, observations were made using the interview method to fish farming fishermen in freshwater ponds. The data collected is used as an illustration in making a prototype pond design that will be used as a culture pond in brackish water. The research process can be seen in the flow chart below

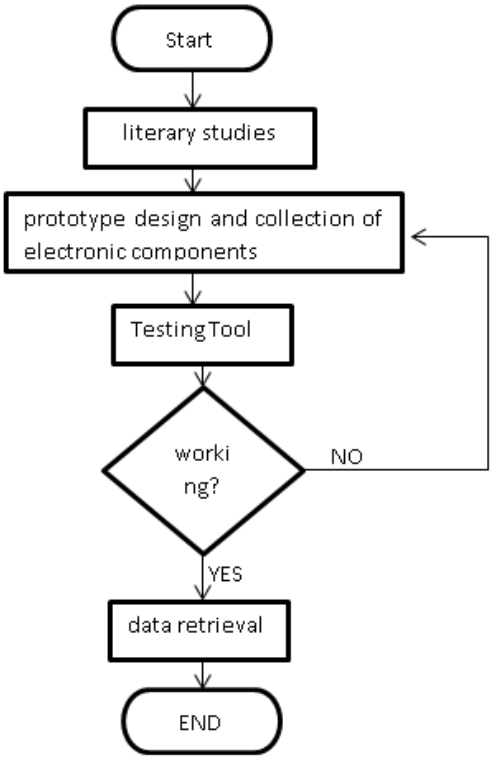

Figure 1. Flowchart research

then after the prototype design is made, thorough testing is carried out on each component used to ensure the performance of the entire system in detail. testing and data retrieval is carried out repeatedly up to 7 times to get valid results. From these results, an analysis is carried out in order to get conclusions from the whole tool made.

Basically the pond pond sluice is designed so that the water going in and out of the pond will be easy, this happens so that the pH of the water in the pond will remain stable according to the needs of tiger prawns besides that there are several things due to several reasons, namely:

1. So that the water temperature in the pond does not change drastically too quickly, because changes in water temperature that are too fast can cause shrimp to get sick.
2. Water pressure outside and inside the pool that is too large can cause the pool wall to burst.

Figure 2. Water Pool Prototype Design

Fish farming in freshwater ponds requires a water pH of 6 to 8 in order to breed and live in brackish water. Brackish water consists of a mixture of sea water and fresh water. Then made a pond with 3 rooms where 1 room contains sea water, 1 room contains brackish water for shrimp farming and 1 room contains fresh water from the river. So if the ph of the water is too high or too much seawater enters the pond, the fresh water gate will open automatically. On the other hand, if the pH of the water is too low due to excessive reduction in salt content, the seawater gate will open automatically so that water enters the room containing brackish water so that the pH remains stable.

The electronic design in this study uses Arduino Uno as the controller, the water ph level sensor as an indicator for driving the system which is displayed through the MIT application and a servo motor as the motion action of the system. The pH sensor is integrated with the module before it can be controlled by the ESP 32 microcontroller. The function of the module is as a translator for the pH sensor, so that the pH sensor can be controlled by the ESP 32 program. The floodgates that are directly ON when getting power will be controlled by the 5V relay so that the ON time of the floodgates can also be controlled through the ESP 32 program. The system configuration is shown in Figure 3.

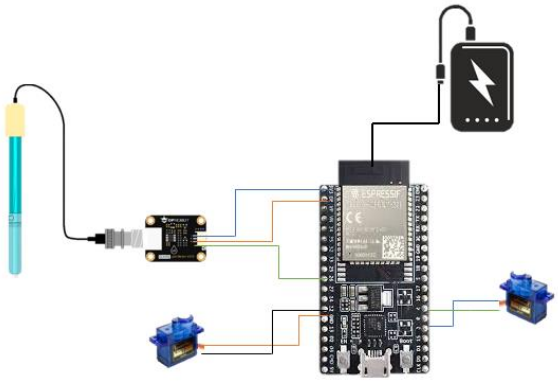

Figure 3. Electronic design

3. Results and Discussion

In hardware design, it will explain the design of the block parts that will be put together into a unified tool so that it can become the desired tool. Hardware has three parts, input, process, and output. Where the input is the pH meter sensor. The process is a control circuit from input to output, all circuits will be controlled by the Arduino microcontroller. The output is as an output which includes a servo motor as a door driver and a display in the MIT application. All blocks are related and have the function of each block diagram as shown in the block diagram below:

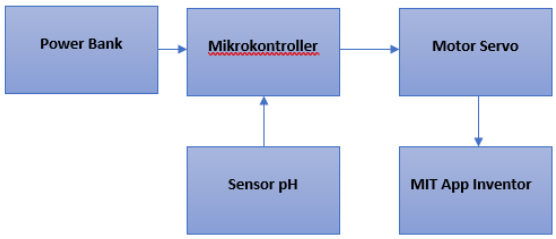

Figure 4. System block diagram

Tool testing is carried out to check the technical work of the implemented tools. The purpose of testing this tool is to ensure that the components of the tool have functioned as required. Tool testing is done by integrating each component used into a single unit with a prototype that is used as a prototype for tiger shrimp ponds. The parameters monitored are indicators of the quality of the pH of the water. Then, the data from the pH sensor will be sent to the microcontroller for further storage in the local WEB database and the data will also be displayed on the MIT application installed on the device.

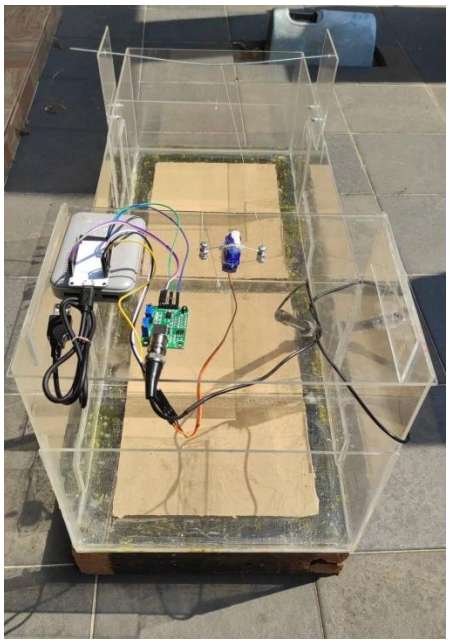

Figure 5. Brackish water pool prototype

ESP 32 Microcontroller

ESP32 is a microcontroller introduced by Espressif System which is the successor of the ESP8266 microcontroller. ESP 32 already has a WiFi module in the chip, so it is very supportive for creating Internet of Things application systems. There are also i/o pins that can be used as input or output to turn on the LCD, lights, and even to drive servo motors.

mySQL

MySQL is a DBMS (Database Management System) using SQL (Structured Query Language) commands that are widely used today in making web-based applications. MySQL is divided into two licenses, the first is Free Software where the software can be accessed by anyone. And second is Shareware where proprietary software has limitations in its use. The function of MySQL is to create and manage databases on the server side that contain various information using the SQL language. Another function it has is that it makes it easier for users to access data containing information in the form of String (text), which can be accessed personally or publicly on the web [14].

Servo Motor

Servo motor or electric motor is a device that can convert electrical energy into kinetic energy or movement. In other terms, servo motors are also often referred to as direct current motors. As the name implies, servo motors do have two terminals that require direct current voltage to be able to move them. This dc motor device is commonly used in electronic and electrical devices such as mobile vibrators, industrial equipment, machine tools, household appliances, disk drivers, dc electric drills, and dc fans. Of course the functions and uses of this servo motor are many. so that its role is so needed. At first glance it may be very trivial but if the component does not function properly it will affect other components that cannot run and function properly [15].

pH Sensor

A pH sensor is an instrument for measuring the concentration of hydrogen in a solution. Both water and soil pH sensors need to be calibrated periodically to ensure accuracy. To ensure the accuracy of the pH sensor, a buffer solution material with a known and accurate pH is needed. The buffer solution used is generally pH 4.0 and pH 7.0. Some pH sensor manufacturers also include instruments for manual calibration. However, if it is connected to an Arduino, the Arduino (reading instrument) also needs to be calibrated. This article includes a pH sensor calibration interface program via a serial monitor, which is an extension of the existing pH sensor library. The calibration results will be stored in the EEPROM for use in normal measurements [16].

MIT App Inventor

MIT App Inventor is a web-based system where Android applications can be used without knowing how to code them. This system was discontinued by google but was re-released by google as an open-source project and is currently maintained by the Massachusetts Institute of Technology (MIT). This app inventor is based on visual block programming because it allows users to use, view, compose and drag and drop blocks which are command symbols and event handler functions to create an application that can run on the android system.

pH Sensor Testing SEN 0161

The pH sensor is used to measure the pH level of water in ponds filled with brackish water. The test was carried out using a pH calibration powder which was dissolved in 250 mL of distilled water. The pH solutions used were 4.0 and 7.0. Taking the pH value is taken based on the measurement of 7 readings at room temperature 25 o Celsius, while the measurement results obtained are then averaged so that in Figure 5 it can be seen the average representation of the pH value reading data that has been calibrated. From the data obtained, it can be concluded that the pH readings measured by the Ph SEN 0161 sensor with the calibration solution have a value difference that is not too far away. In the test, the difference was obtained for each reading with a value of 6.80 pH for water in brackish water pools, 9 pH for pools filled with seawater and 4.30 pH for pools containing fresh water from the calibration solution. So it can be said that the accuracy of the SEN 0161 pH sensor is very good as shown in the datasheet that the accuracy of the SEN 0161 pH sensor is ±0.1 pH at a temperature of 25o Celsius.

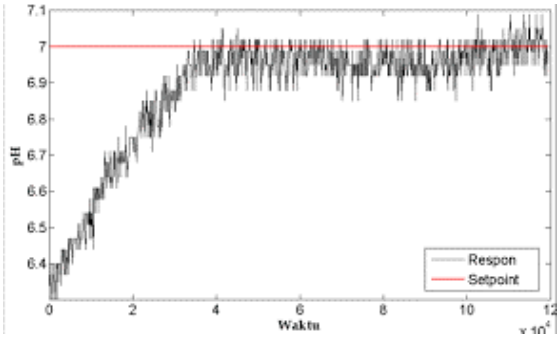

Figure 6. Graph of SEN0161 pH sensor test results

Servo Motor Test

The test is carried out by sending a command from the pH sensor SEN 0161 to the ESP 32 to control the servo motor which functions as the driver of the pond door. The servo motor gets power from the power bank. Figure 7 shows a servo motor to move the pond door.

Figure 7. Servo Motor drive sluice

Based on the test results in the picture above, it can be concluded that when the water pH sensor sends the pH measurement value of water in a room filled with brackish water to ESP 32 and the pH value of the water is too low or too high, the servo motor will automatically open the sea or water gate. fresh water to maintain the pH stability of brackish water. The rotational speed produced by an electric motor is also influenced by several factors, namely the frequency and the number of poles. rotational speed (Rpm) is also usually written with the letter N and the amount of Rpm is determined by how much electricity frequency is used multiplied by the phase angle (120) divided by the number of poles of the windings as in the formula below:

$$N = f \text{ x } 120 : \text{P} \qquad (1)$$

where N is the number of revolutions per minute (Rpm) and P is the number of poles

MIT Application Testing

ESP32 is a microcontroller introduced by Espressif System which is the successor of the ESP8266 microcontroller. ESP 32 already has a WiFi module in the chip, so it is very supportive for creating Internet of Things application systems. There are also i/o pins that can be used as input or output to turn on the LCD, lights, and even to drive servo motors.

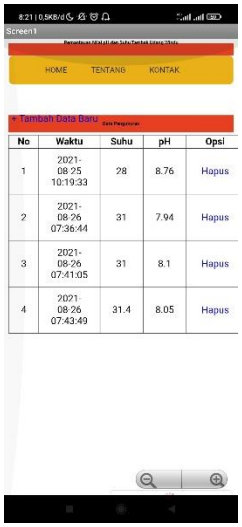

Figure 8. User Interface Monitoring

From the test image above, it can be concluded that when the SEN 0161 pH sensor takes measurements, the measurement results will be sent to ESP 32 and displayed in real time in the MIT application.

Overall Testing Tool

After testing each input and output device, then testing the entire tool, namely by reviewing the performance of all input and output devices into a system that can monitor and control automatic sluice gates for tiger shrimp ponds with the MIT application. Table 1 shows the overall test results of the tool.

Table 1. Overall Test Results of the Tool

Parameter	Test result
Power Input from Powerbank	Succeed (+5VDc)
Output Power can drive servo motor)	Succeed (rotate to 90 degree)
The system monitors pH based on input from the pH sensor SEN 0161	Succeed
The system is able to read input from ESP 32 to control the servo motor to open the floodgate	Succeed
The system displays the pH sensor readings on the Serial Monitor	Succeed
The system is able to send the	Succeed

reading of the results to the local database WEB	
The system is able to display the results of the pH sensor readings on the MIT application	Succeed

4. Conclusion

Based on the web server-based automatic sluice design that has been made, it can be concluded as follows:
1. With this proposed application, it is easy to control water quality and acidity in brackish water ponds.
2. This system makes it easy to control the pond floodgates automatically with a pH meter.
3. The system can monitor the pH of the water and display it to the MIT application and is integrated with the local database web server.
4. The system can control the servo motor to open and close the floodgates that have been integrated with the ESP 32 microcontroller. Automatic sluice gates for brackish water ponds based on a web server with the MIT application.
5. With the implementation of this system, it can help improve the quality of brackish water fish farming yields.

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