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Litopenaeus Vannamei Shrimp Pond Water Temperature And PH Monitoring System Using IoT-Based Sugeno Fuzzy Method

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Keywords

Internet of Things,
Fuzzy Sugeno,
Monitoring,
Water Quality Second

Abstract. In order to make it easier for white shrimp (Litopenaeus vannamei) farmers to monitor pond water quality so as not to disrupt the growth process of white shrimp, a system was built that can be used to monitor and control pH and water temperature conditions remotely using pH sensors and temperature sensors based on IoT. Internet of Things or IoT is a technology that uses the internet to carry out a process of sending data to several devices without using the help of computers and humans. In this case the research was carried out using two water quality parameters, namely water temperature and pH level. This control uses two actuators, namely a water wheel which is useful for lowering the water temperature and a water pump for adding water with the aim of increasing or decreasing the pH level using the fuzzy Sugeno method. The results of the error presentation on the pH sensor were 0.002% and the precision behavior (accuracy) on the pH sensor circuit was 99.998%, the error presentation results on the temperature sensor were 0.038% and the precision behavior (accuracy) on the temperature sensor circuit was 99.962%. carried out by researchers, it can be concluded that the fuzzy sugeno method can fulfill the purpose of monitoring the pH and water temperature of Litopenaeus vannamei shrimp pond water based on IoT, by using 3 temperature rules, namely low temperature: 0-26, normal temperature: 27-30, high temperature: 31 - 45 and 3 rule pH, namely acid: 0 -7.4, normal: 7.5-8.5, alkaline: 8.6 – 14.

1. INTRODUCTION

Businesses in the fisheries sector are related to the management and utilization of aquatic resources, one of the fields of fisheries is cultivation activities. This activity has several requirements, namely that there are organisms to be cultivated, living media for the organisms and a place for cultivation. One of these cultivation activities is fisheries in terms of managing white shrimp (Litopenaeus vannamei). White shrimp (Litopenaeus vannamei) is a shrimp that was officially designated as one of the superior commodities for aquaculture by the Minister of DKP in 2001, and since then the development of cultivation has been very fast. Currently, white shrimp cultivation has been commercialized and is growing very rapidly. This is because these shrimp have promising prospects and profits.

Physically, the quality of water for cultivating white shrimp is determined by ideal water clarity, having an ideal temperature value of between 25 – 31 degrees Celsius, and having a degree of acidity (pH), the optimal water pH for the life of white shrimp in ponds is between 7.5 –8.5 (neutral). The water content with this pH value shows that the water conditions are balanced and optimal. This provides benefits related to microorganisms that are difficult to develop because oxygen and carbon dioxide have optimal values. Monitoring pH and water temperature is very necessary for cultivating white shrimp and helps monitor the condition of pond water quality at that time. Monitoring the pH and temperature of white shrimp pond water is necessary to maintain the water quality of white shrimp ponds so as not to interfere with the growth process of white shrimp. Internet of Things or IoT is a technology that uses the internet to carry out a process of sending data to several devices without using the help of computers and humans. IoT uses sensors to interact with other devices and functions to control actuators. How IoT (Internet of Things) works is that machines or devices are interconnected automatically without user intervention and can be accessed remotely without restrictions.

Based on these problems, in this research a pH and water temperature monitoring system for Litopenaus vannamei shrimp ponds was designed using internet of things technology. This research aims to monitor and control the pH and water temperature conditions remotely. In this case the research was carried out using two water quality parameters, namely water temperature and pH level.

This control uses two actuators, namely a water wheel which is useful for lowering the water temperature and a water pump for adding water with the aim of increasing or decreasing the pH level using the fuzzy Sugeno method. In previous research conducted (Erwin K.P, 2020), regarding determining water quality in ornamental fish seedling ponds, using temperature, pH and turbidity level sensors to detect water quality levels. This research was carried out in ornamental fish seed ponds to control water quality using the Fuzzy Mamdani method, so that researchers will create a system for monitoring water temperature and pH in Litopenaeus Vannamei shrimp ponds using the Fuzzy Sugeno method to control water quality in the shrimp ponds.

So monitoring water quality is very helpful in maintaining the survival of shrimp. With the existence of Surah Al-Araf verse 56, it is the basis for humans to preserve the earth and all its contents. Therefore, a monitoring system was built which is expected to be able to bridge these problems, namely "Ph and Water Temperature Monitoring System for Litopenaeus Vannamei Shrimp Ponds Using the IoT-Based Fuzzy Sugeno Method". With this monitoring, it is hoped that it will be able to describe the conditions of pH levels, water temperature and water quality in shrimp ponds over long distances which can be accessed using an Android smartphone. This monitoring is beneficial for the survival of vannamei shrimp and crop yields.

2. METHOD

Research on the pH and water temperature monitoring system for Litopenaeus vannamei shrimp ponds using the IoT-based fuzzy Sugeno method, o obtain the required data, the author conducted research in Paluh Manan Village, Dusun V, Kec. Silver Expanse of Palmal Jaya POKDAKAN Shrimp Ponds. This research aims to outline all stages of activities carried out during the research so that they are in accordance with the specified objectives. Method for collecting data in a way carry out direct observations in the field to monitor the pH and temperature of the water in the Vannamei itopanealus shrimp pond located in Paluh Malnan Village Hamlet V District. Silver Expanse of Palmal Jaya POKDAKAN Shrimp Ponds.

3. RESULTS AND DISCUSSION

Planning

Tahap perancangan bertujuan dalam membuat suatu rancangan perangkat keras (hardware) yaitu mendesain rangkaian arduino uno yang menjelaskan suatu tata letak komponen yang dipasang teratur dengan menggunakan aplikasi software fritzing.

a. Hardware

The Arduino Uno circuit design using Fritzing software in this research is as follows :

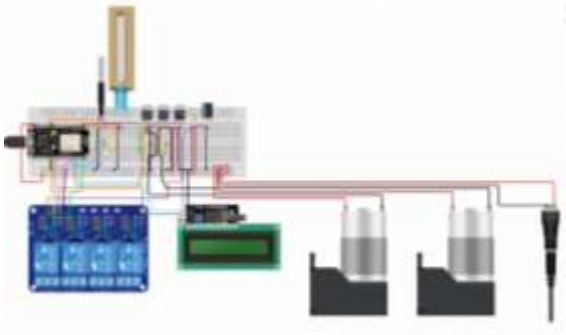

Figure 1. Arduino circuit with fritzing

At this stage, an Arduino circuit is carried out with other devices to connect to each other so that they can work properly. The description of the circuit in Figure 3.2 above is that the VCC pin on the pH-4502C sensor module is connected to a power source, the Output pin on the pH-4502C sensor module is connected to Pin A0 on the ADS1115, the GND pin on the pH-4502C sensor module is connected to the system GND. , the DS18B20 sensor data pin is connected to pin D5 of the ESP32, the SDA pin on the ADS1115 is connected to pin D21 on the ESP32 and pin D1 on the LCD, the SC pin on the ADS1115 is connected to pin D22 on the ESP32 and pin D2 on the LCD, the VCC pin and the GND pin on the realy The 4 5v channels are each connected to the power source and GND of the

system, pin IN1, pin IN2, pin IN3 on the 4 channel relay are each connected to pin D25, pin D26, pin D27 on the ESP32 microcontroller.

After understanding the design of the Arduino circuit in this research, the author will then describe the shape of the tool that has been assembled and draw a picture of the application form of the tool that has been assembled.

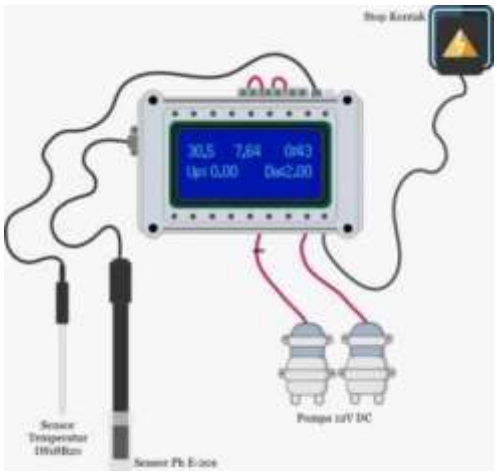

Figure 2. Shape of the Assembled Tool

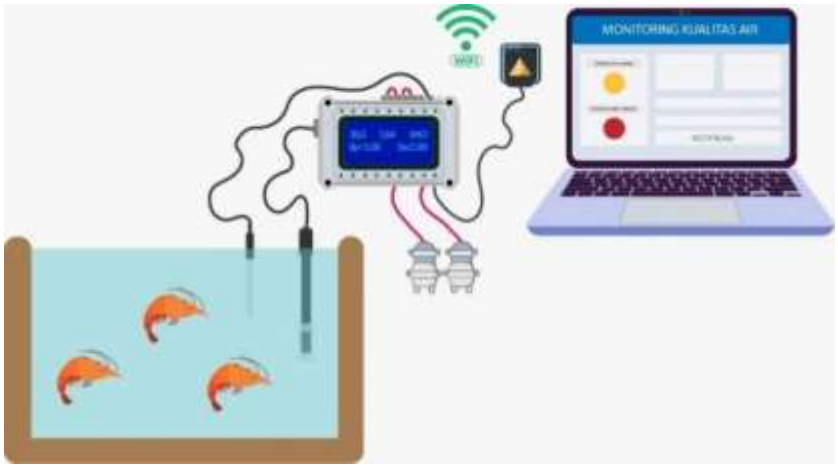

Figure 3. Form of ALalt Implementation that Has Been Assembled

Part from hardware, this research also requires software. The software in this research is used to design a system to be built, test system performance and also to implement the system to be built using a programming language. The software used in this research is as follows:

b. Software

Apart from hardware, this research also requires software. The software in this research is used to design a system to be built, test system performance and also to implement the system to be built using programming languages. The software used in this research is as follows: Arduino IDE, Fritzing Firebalse, Flowchalrt Systems.

Testing

The testing phase is not a separate area, but rather a continuous process throughout the project. This research requires testing to find out whether this system is running well or not. The test was carried out by checking the pH in the water temperature using the fuzzy Sugeno method and the hardware used was a temperature sensor and a pH sensor. The results from the sensors for these two parameters are processed using rules in accordance with the Sugeno fuzzy method. After processing the data, the results obtained are data on temperature, pH and hardware behavior related to the water wheel and pH buffer, whether it will turn on or off and whether the pH buffer is down or the pH

buffer is up. As for controlling these two parameters using a dual calculator, namely a water wheel which is useful for lowering the water temperature and a pH buffer to increase or decrease pH levels using the fuzzy Sugeno method.

Deployment / Users

The application/use of this system is to see the results of monitoring pH and water temperature. By using rules processed using the fuzzy Sugeno method, the results of the parameters of temperature, pH and behavior of the water pump or water wheel are obtained. This research uses a DS18B20 sensor for temperature and a pH sensor as data input. The ESP32 microcontroller device functions to read and manage data which will produce logic control output for real pumps and waterwheels. There are 3 response conditions from testing, namely :

1) Low Temperature and Acid PH Conditions
   In this condition, it is a condition where the temperature is low below 27°C and the pH is below 6. When the temperature is low and the pH is acidic, information will appear on the web that the water wheel is on and the water pump will turn on.
2) Normal Temperature and Normal PH Conditions
   In this condition, it is a condition where the temperature value is Normal Temperature between 27°C and 31°C and the normal pH value is between 6 and 8. When the condition value is normal temperature and normal pH, information will appear on the web that the water wheel is dead and the water pump is dead.
3) High Temperature and Alkaline PH Conditions
   The condition of high temperature and alkaline pH is a condition where the temperature is above 31°C and the pH is alkaline above 8. When the condition is high temperature and alkaline pH, information will appear on the web that the water wheel is on and the water pump will turn on.

With this temperature and pH monitoring system, shrimp pond owners can monitor water levels remotely via an Android smartphone or laptop. This system can also receive results from responses or output from conditions that occur.

Determining Criteria Data

The criteria data used in this system is the output which will later regulate the PH & Water Temperature, namely.

Table 1. Output Criteria

Criteria Output		
Name	**Weight**	**W**
BUFFER OFF	33%	00.33
PH UP	33%	00.33
PH DOWN	33%	00.33

Data analysis

Analysis of the data required in designing an IoT-based pH and water temperature monitoring system, the pH & temperature sensor system is run using a fuzzy system, for this reason fuzzy system analysis and hardware analysis are needed.

1) Fuzzy System Analysis
   The fuzzy system analysis in this research & design is the pH level in pond water and temperature. The monitoring & control system functions as an absolute parameter to obtain pH & temperature levels in water.
2) PH Sensor Analysis
   The PH sensor is used as a detector & to obtain values for the acidity and base levels in a solution. The PH sensor will be influenced by acidity which can generate a voltage current of 0.1 V, which will be converted into an acidity level value.
3) Temperature Sensor Analysis
   The temperature sensor is used to obtain the temperature value of the surrounding conditions, the temperature sensor used is the M5433 which is equipped with protection for flow resistance. Temperature sensors in shrimp ponds greatly influence the life span of the shrimp that live in them.
4) Software Analysis

Before the fuzzy program is embedded in the microcontroller, the choice of software greatly influences the digital output obtained. The software that is used is ALrduino IDE.

5) Analysis of Kerals Equipment
The operation of the Allalt system begins with the pH & temperature sensor reading the pH & temperature sensor, the values in the digital system will later be processed using the fuzzy method to get the appropriate output, the pH reading process will be prioritized first, because pH has a big impact on survival of shrimp in ponds. The variables that will be parameters in this test are pH (acid, normal, alkaline) and temperature (low, normal, high). The resulting output is the response of the diaphragm pump to neutralize the conditions that occur in the pond.

Data Representation

The value of each attribute is the result of the process of inputting data from the results of object distance measurements that have been converted based on the weight of the criteria that have been determined through the calculation process. The calculation pause time is determined once every 10 seconds for a duration of 3 minutes.

Table 2. Representation of Input Data

Time (second)	Alternative	Temperature	Ph
00.00	V1	25	4,9
00.10	V2	25	5,02
00.20	V3	25	5,37
00.30	V4	25	6,01
00.40	V5	25	6,60
00.50	V6	26	6,86
01.00	V7	26	7,05
01.10	V8	26	7,13
01.20	V9	27	7,98
01.30	V10	27	8,25
01.40	V11	27	8,50
01.50	V12	26	9,04
02.00	V13	26	9,22
02.10	V14	26	8,97
02.20	V15	26	9,08
02.20	V16	26	9,32
02.30	V17	26	8,85
02.40	V18	26	9,08
02.50	V19	26	8,81
03.00	V20	26	8,77

Table 2. is the result of a comparison between the temperature sensor and the temperature measuring device to obtain the error value of the sensor that has been made. Based on table 4.14, it can be seen that the average value of error presentation on the temperature sensor is 0.038% and the accuracy behavior of the sensor circuit is calculated using the equation

4. CONCLUSION

In writing this final assignment, the previous discussion has been explained, so the author will draw a conclusion from this description: From the experiments and implementation that have been carried out by researchers, it can be concluded that the fuzzy Sugeno method can fulfill the objectives of monitoring the pH and water temperature of Itopenaeus vannamei shrimp pond water based on IoT, by using 3 temperature rules, namely low temperature: 0-26, normal temperature : 27-30, high temperature: 31-45 and 3 rule pH, namely acid: 0 -7.4, normal: 7.5-8.5, balsa: 8.6 – 9.5. In several calibration tests of the pH sensor with a percentage error of 0.002% in the temperature sensor with a percentage error of 0.038%. Meanwhile, from the 20 trials that have been carried out, the accuracy rate for the pH sensor is 99.998% and the temperature sensor is 99.62%.

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