CONTROLING AND MONITORING SYSTEM IN EEL CULTIVATION POND

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ABSTRACT

In aquaculture, water condition is very important. Water conditions in pond where pH levels, temperature and volume of water in accordance with the needed. This paper aims to design a device that can monitor and control pH levels, temperature and volume of water. As a place of testing is aquarium eel cultivation, in designing the system there are several sensor input parts such as the pH sensor, temperature sensor, ultrasonic proximity sensor and output parts such as three pump motors, one valve and one wheel driven by a 12 volt dc motor. Microcontroller that is embedded in Arduino Uno as a place for processing data from the sensor which will then give the output to move the actuator and the sensor reading data on the PC or Laptop will be displayed. The design of this miniature system uses C languages as a programming which function as interfaces. The results of this study indicate that the system created can control the PH value in the between 8 can control the water level at levels 60 cm and can control the temperature by adjusting the rotation speed of the aerator where the higher of temperature, the motor speed also increases.

Keywords—aquaculture, microcontroller, aerator, C language, sensor

ABSTRAK

Dalam budidaya bidang perikanan, kondisi air sangat penting. Kondisi air di tambak dimana tingkat pH, suhu dan volume air sesuai dengan yang dibutuhkan. Makalah ini bertujuan untuk merancang perangkat yang dapat memonitor dan mengontrol tingkat pH, suhu dan volume air. Sebagai tempat pengujian adalah budidaya belut akuarium, dalam merancang sistem ada beberapa bagian input sensor seperti sensor pH, sensor suhu, sensor jarak ultrasonik dan bagian output seperti tiga motor pompa, satu katup dan satu roda digerakkan oleh 12 volt motor dc. Mikrokontroler yang tertanam di Arduino Uno sebagai tempat untuk memproses data dari sensor yang kemudian akan memberikan output untuk memindahkan aktuator dan data pembacaan sensor pada PC atau Laptop akan ditampilkan. Desain sistem miniatur ini menggunakan bahasa C sebagai pemrograman yang berfungsi sebagai antarmuka. Hasil penelitian ini menunjukkan bahwa sistem yang dibuat dapat mengontrol nilai PH di antara 8 dapat mengontrol ketinggian air pada level 60 cm dan dapat mengontrol suhu dengan menyesuaikan kecepatan rotasi aerator di mana semakin tinggi suhu, kecepatan motor juga meningkat.

Kata kunci – akuakultur, mikrokontroler, aerator, bahasa C, sensor

1. INTRODUCTING

Fisheries is one of the potential foreign exchange and one of the priorities expected is eel cultivation development. Eel (Anguilla spp.) is an Indonesian commodity in an effort to generate foreign exchange from non-oil and gas exports. It has been realized that the increase in eel production through cultivation can only be achieved if supplied by production factors, especially eel seeds can be fully guaranteed in order to support the cultivation effort that must be done is to establish eel cultivation centers.

The eel results can be good with maintain the quality of pond water. To control the pH level of water in eel aquaculture ponds, the manual method is still used by first measuring using a sensor in the form of a digital pH meter or litmus paper then add as much fresh water as needed and measure again with the sensor whether the water is completely neutral or not. The same thing also doing when you want to control the temperature and volume of water while still using the manual method. Starting from a thought to make a monitoring and control system that can see changes in water parameters of a pool and can control every change in parameters until a value condition is found that is in accordance with the needs of eel aquaculture pond water.

By utilizing a series of computers connected to the microcontroller through RS-232 serial communication, a prototype that can control equipment such as selenoid valve, water pump, water mill motor, can be built. The system is equipped with several types of sensors that serve to monitor the parameters of pH, temperature and volume of eel cultivation pond water. Based on this background, the authors conducted a study to build a prototype system with the title: "Controlling and Monitoring System Levels of pH, temperature and water volume level in eel cultivation ponds"

2. LITERATURES

Eel Cultivation

The business of cultivating eels that live in freshwater waters begins with capturing eel seeds in river estuaries. Until now, the eel cannot be spawned therefore the fishermen catch their glass eels raised in freshwater ponds with simple technology.

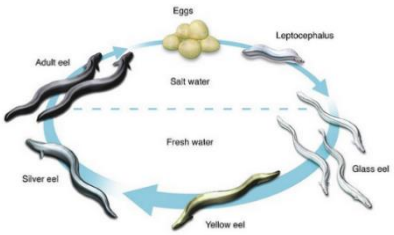

Figure 1 the life cycle of eel.

Water quality can be seen from several parameters (M. Ghufron H. Kordi). The parameters for eel cultivation are physical and chemical of water characteristics. The water characteristics include factors such as pH, temperature, oxygen, alkalinity and salinity. Water pH can affect water fertility because it affects microorganisms. Acidic waters less productive can actually kill aquaculture animals. At low pH conditions (high acidity), dissolved oxygen content will reduce, consequently oxygen consumption downhill, breathing activity increases and appetite decreases. The opposite happens in an alkaline atmosphere. So eel cultivation will work well with a pH of 6.5 - 9.0. Direct effects of low pH, among others eels trying to neutralize pH so that the growth experiences delays which will result in eel not being harvested according to their age and the impact on the texture of the meat will be rough, hard and spiny. The opposite, high pH increases ammonia levels, thus indirectly endangering eel.

Table 1 Water conditions needed

Water pH	The effect on eel
< 4,0	Poisonous

4,0 - 4,5	No production, acid dead point
4,6 - 6,0	Weak production
6,1 - 7,5	Medium production
7,6 - 8,0	Good enough
8,1 - 8,7	Good
8,8 - 9,5	Production began to decline
9,6 - 11,0	Alkaline dead point
> 11,0	Poisonous

Temperature affects the metabolic activities of organisms, therefore the spread of organisms both in the oceans and in freshwater is limited by the temperature of these waters. Vertical temperature distribution needs to be known because it affects the distribution water mineral that might occur reversal of the water layer.

Temperature drastically changes can kill aquatic biota due to changes in blood carrying capacity. The best range for eel growth and life is between 28-30 ° C although eel can still live at temperatures of 18° C and 36° C. Temperature can affect the solubility of oxygen in water. The higher the temperature the lower the solubility of oxygen in water and vice versa.

Water change is carried out if there has been a decrease in pond water quality parameters. Visually, it can be seen from the discoloration of the water to be clear and there are suspensions in the water due to the death of plankton. Visually, it can be seen from the discoloration of the water to be clear and there are suspensions in the water due to the death of plankton. The technique of changing water by removing water which contains a lot of dirt or organic mud, especially at the bottom of the pond, therefore the design of the disposal and construction of the pond is made that can drain the basic air or bottom mud or the upper air. Disposal of dirt or bottom mud can also be done by squeezing. The addition of water to replace the water in the pond plots until the specified water level uses water from the bio filter plot. The amount of water turnover/change from reservoir to eel enlargement plot with a density of 30-50 tails/m2, is arranged as follows:

Based on the references and data above, in this study will design a pH value control system with a range 6.0 - 8.5. When the sensor reading decreases and pH value of the water below 6.0, The motor pump will be activated to inject lime to increase the pH value until the pH value of the sensor reading is 7.5. Conversely, if the sensor reads there is an increase in the pH value of water above 8.5 the pump motor will be activated to inject acidic solution, to reduce the pH value until the pH value of the sensor reading is 7.5. Temperature control in this study uses a wheel that driven by a dc motor where the speed of the motor can be adjusted (rpm) by setting the PWM input on the H-Bridge (motor driver), where the higher the temperature value that is read, the greater the PWM output.

Water volume control in this study uses two actuators, a valve that serves to discharge water and a pump motor to fill water. If the water discharge pressed, the valve will be active and the water discharge and this process will continue until the proximity sensor detects the minimum water level has reached 40 cm. When the water discharge stop process, the charging pump motor will be active and this process will continue until the proximity sensor detects the maximum height of water reaching 60 cm.

Arduino Uno

The hardware that will be used in this system includes Arduino Uno that used in conducting communication control and data lines that occur on the system, then a Personal Computer or laptop that functions as a medium for human interaction can be displayed on the

Monitor screen. This system uses Arduino Uno as the main controller module. This module serves to receive and send data.

Arduino connects data communication between a PC and a sensor module. Arduino also has another function to send input instructions and character movements through SPI data communication lines (MOSI, SS, and SCK) to the matrix backpack.

Arduino stores all input data in EEPROM memory, the goal is when Arduino loses power, all input is not lost so Arduino can display the input that has been saved. Arduino Uno is an ATMega328 microcontroller card (datasheet) that uses a USB power supply or 7-12 volt. While Adapter power supply connect to a PC or laptop, Arduino Uno uses a USB port so that development using this microcontroller becomes simpler and faster.

3. METHOD

By observing the data obtained in the field, namely the parameter values of pH, temperature and level of water on pond and comparing the literature from books, journals or others the value of the setting point will be used. Consider the design of hardware with the type of microcontroller, type of sensor and the control that will be used. To communicate a PC with a microcontroller using the C programming language. Integrate the whole system built, both hardware and software with control devices.

Observing system work processes and parameter changes that occur in the farm. Make conclusions from the system being built. From the description above, we can compile a framework as a shown in Figure 2

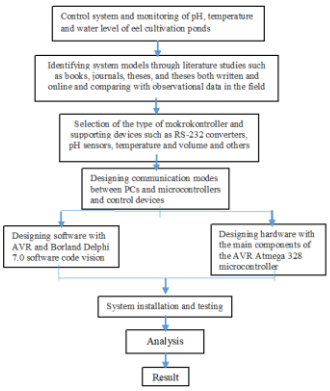

Figure 2 Skeleton

4. DESIGN

The block diagram of the monitoring and control system model for pH, temperature and water level in the pond model built in this study is shown in figure 3

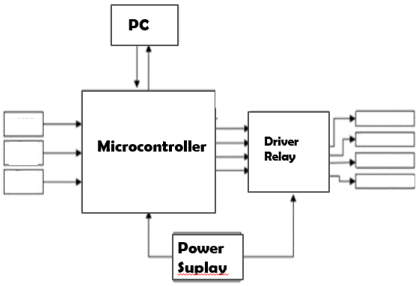

Figure 3. Block Diagram

This system consists of 1 PC/Laptop unit, 1 pH sensor unit, 1 parallax ping unit, 1 unit Arduino Uno which has an embedded microcontroller, USB cable, 1 unit Relay Driver, 1 Power supply unit, 30A H Bridge Driver, 1 12 volt DC motor unit, 3 water pumps and 1 Solenoid Valve unit.

The explanation of existing system elements is as follows:

1. Computer

   Computer as the center of control and monitoring. Computer and microcontrollers that are connected via a USB cable can read from data displayed in the form of numbers or display images.

2. Arduino Uno

Arduino Uno that already embedded in the microcontroller, functions as a data processor recorded by a pH sensor, temperature sensor, Ping sensor that is connected with analog pins and digital pins. From the microcontroller an application is made to read data input

3. Power Supply

The power supply circuit obtained from a relatively high voltage input source of 220V, is derived using a transformer step down. The output from the transformer secondary side is then rectified by using a bridge diode to produce the DC output still rude. To reduce alternating voltage results from rectification filtering circuit used is 2200 µF capacitor.

Software design consists of 2 parts, namely the application program on a computer in the form of a desktop program using the Borland Delphi 7 Compiler and microcontroller programming using the C language.

1. Mikrocontroler Programming

Microcontroller programming uses C language that comes in the Arduino default language itself. Flow chart of the monitoring and controlling system for pH, temperature and water level in the pool model embedded in Arduino Uno.

2. Application Program on the Computer

The application program on the computer is built using the Visual Borland Delphi 7 language. There are several forms appearing on the menu, namely: form port settings, open forms, Arduino clear log forms and parameter forms.

5. RESULT

Hardware and Software Settings

The method of operating the pH, temperature and water level control system in the pool model is as follows:

a. Make sure that Arduino is connected to Computer by opening an Arduino program then after the Arduino worksheet appears, type the program listing, after that the program is compiled to correct whether the program still has errors or not, if the compile results are missing, then the next will be uploaded to the microcontroller.
b. Open Borland Delphi 7 programming
c. Click form port settings and make sure that com is detected with the program
d. Click the open form so that the status on the program screen changes and the program automatically operates.
e. To stop the program, click the close form (this form automatically changes from open to close when online).
f. Click the clear log button to clear the display on the Arduino log, then click the "X" to close the application

Application Testing

The application testing phase includes:

a. Initial diagnosis stage
   There will be identification of existing problems.
b. Stage of design and manufacture
   The design is carried out, providing all components needed, then assembling and making tools, and filling necessary programs. Components that need to be prepared including: PC or Leptop, 1 module arduino Uno, cable USB, PH sensor, temperature sensor, ultrasonic proximity sensor.
c. Phase testing tool.
   The equipment is tested directly work the tool, then collect the data and arrange it as the final research data. Testing done by connecting a PC with Arduino via a cable USB that is connected to the sensors used. Then verify the accuracy of reading data from that sensor.
d. Evaluation stage.
   The overall results are evaluated and analyzed work tools and then

draw conclusions from how the tool works as a whole

3. Test result

The test results are displayed on the PC or the output of the results research that becomes information to the user, it can be seen on figure 4

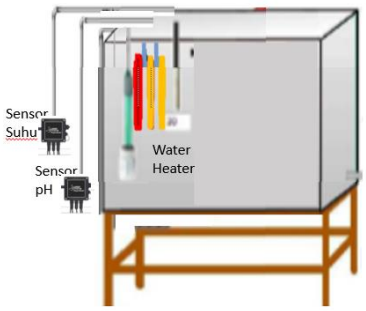

Figure 4 Monitoring Process

6. CONCLUSIONS

The conclusions that can be taken in this study are:

1. The monitoring and control system using Arduino as a microcontroller makes it easier for users in this case eel farmers because this system will automatically control the very decisive parameters of eel ponds such as temperature pH and water level which must always be controlled to obtain a good harvest.
2. The on-off control system using two pumps as an actuator can maintain pH values in the range 6.00 to 8.50. The testing results of pH value is less than the minimum time needed to return to the value of 7.50 about 330 seconds and when the pH value is more than the maximum time needed to return to the value of 7.50 about 217 seconds.
3. The change in temperature sensor readings as a reference output changes. The microcontroller PWM output can adjust the motor speed of the windmill when testing at 36 ° C maximal temperature in output PWM 240 with 11.38 volt H-Bridge output voltage and at minimum temperature 32 ° C PWM output 178 with 8.44 volt H-Bridge output voltage.
4. The on-off control system using one valve and one pump as an actuator can maintain the water level at a range of 40 cm to 60 cm. The results of testing when the water discharge, the time needed to reach the minimum limit is around 292 seconds. When filling water, the time needed to reach the maximum limit is around 247 seconds.

The suggestions that can be taken in this study are:

1. For data storage of reading results from the sensor can be made database storage so that it can be open the results of previous data storage.
2. In terms of further monitoring, a device can be installed in the form of wifi, making it easier for monitoring over the network
3. For future development, it should be added to a system of monitoring and controlling salinity, alkalinity, brightness and color of water.
4. It is better to use sensors that have high precision readings and low reading oscillations to get better monitoring and control results

REFERENCES

G. Eason, B. Noble, and I. N. Sneddon, “On certain integrals of Lipschitz-Hankel type involving products of Bessel functions,” Phil. Trans. Roy. Soc. London, vol. A247, pp. 529–551, April 1955.

J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68–73.

I. S. Jacobs and C. P. Bean, “Fine particles, thin films and exchange anisotropy,” in Magnetism, vol. III, G. T. Rado and H. Suhl, Eds. New

York: Academic, 1963, pp. 271–350.

K. Elissa, “Title of paper if known,” unpublished.

R. Nicole, “Title of paper with only first word capitalized,” J. Name Stand. Abbrev., in press.

Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, “Electron spectroscopy studies on magneto-optical media and plastic substrate interface,” IEEE Transl. J. Magn. Japan, vol. 2, pp. 740–741, August 1987 [Digests 9th Annual Conf. Magnetics Japan, p. 301, 1982].

M. Young, The Technical Writer’s Handbook. Mill Valley, CA: University Science, 1989.