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Performance of Control System Using Microcontroller for Sea Water Circulation

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Abstract. Now a day control system is very important rule for any process. Control system have been used in the automatic system. Automatic system can be seen in the industrial filed, mechanical field, electrical field and etc. In industrial and mechanical field, control system are used for control of motion component such as motor, conveyor, machine, control of process made of product, control of system and soon. In electrical field, control system can met for control of electrical system as equipment or part electrical like fan, rice cooker, refrigerator, air conditioner and etc. Control system are used for control of temperature and circulation gas, air and water. Control system of temperature and circulation of water also can be used for fisher community. Control system can be create by using microcontroller, PLC and other automatic program [1][2]. In this paper we will focus on the close loop system by using microcontroller Arduino Mega to control of temperature and circulation of sea water for fisher community. Performance control system is influenced by control equipment, sensor sensitivity, test condition, environment and others. The temperature sensor is measured using the DS18S20 and the sea water clarity sensor for circulation indicator with turbidity sensor. From the test results indicated that this control system can circulate sea water and maintain the temperature and clarity of seawater in a short time.

1. Introduction

Now a day control system having important rule which the development of the current control system is very fast. Control system have been used in the automatic system. Automatic system can be seen in the industrial filed, mechanical field, electrical field and etc. In previous, control system only is use in industry for control of part or component machine and processing to make of product. In industrial and mechanical field, control system are used for control of motion component such as motor, conveyor, machine, control of process made of product, control of system and soon During the development of equipment control system is fast and easy to use so the application of control system can be seen in home equipment such as refrigerator, rice cooker, air conditioner, heater and cooler for house, and etc. Control system are used for control of temperature and circulation gas, air and water. Control system of temperature and circulation of water also can be used for fisher community. Control system

consist an open loop system and close loop system. Open loop system are simple construction than close loop system, no need feedback from output system, easy for maintenance, cheaper but no stability problem. In closed loop system more complicated, need information feedback from output system to evaluate the process or program. Control system can be create by using microcontroller, PLC and other automatic program. In this paper we will focus on the close loop system by using microcontroller Arduino Mega to control of temperature and circulation of sea water for fisher community. Performance control system is influenced by control equipment, sensor sensitivity, test condition, environment and others.

In previous study, microcontroller has been used to control temperature on the circulation sea water in fish ponds by using ATmega and Arduino Mega [1] [3]. In this paper we will focus on the control of circulation sea water that integrated by temperature, water clarity, moisture content and acid (PH). Composition settings of control circulation of sea water are 30-33 ppt salt, oxygen ± 4 ppm, temperature 24^0 - 31^0C and acidity (pH) 7,6 - 7,8 [4-6]. The ideal water flow velocity is about 20 to 40 cm / sec where this velocity is required for the turn of water and oxygen. The temperature sensor is measured using the DS18S20 and the sea water clarity sensor for circulation indicator with turbidity sensor.

2. Research Method

Control system of temperature and circulation of sea water condition can be conducted by using Microcontroller Arduino Mega. Temperature sensor of sea water measure by sensor DS18S20 and for measure of other condition of sea water such as clarity using turbidity sensor. Testing step of this experiment can be seen in Fig.1. From Fig. 1 show that first step is observation of fish habits condition, second is manufacture of control system using Microcontroller Arduino Mega. Then continue to assembly and testing performance of control system temperature and circulation of sea water. After we get the data then continue to analyse and make the conclusion.

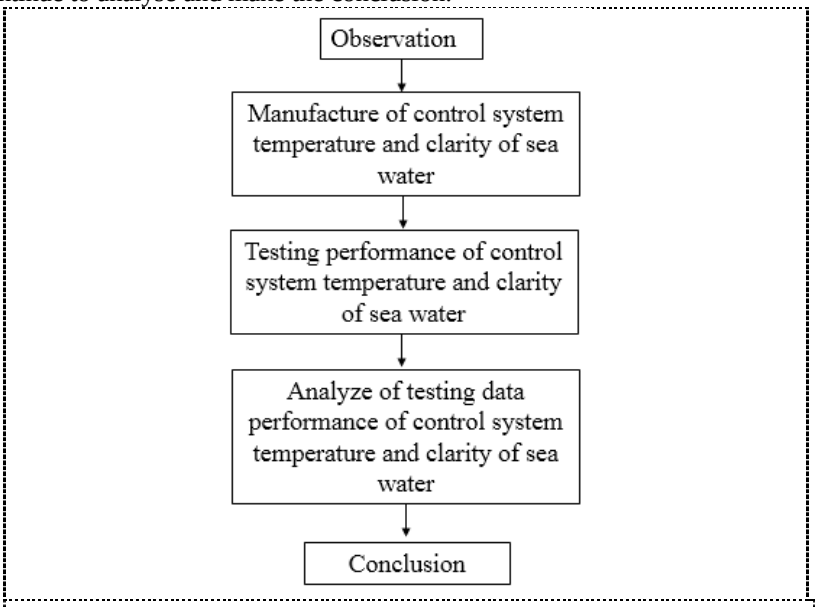


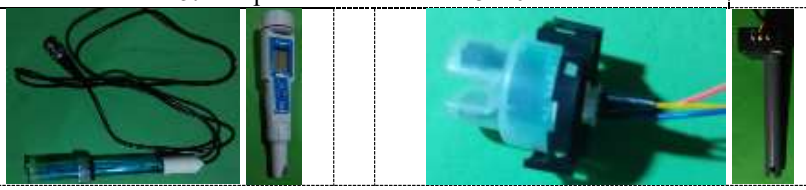
Figure 1. Testing step Control system of temperature and circulation of sea water condition

Figure 2. Microcontroller Arduino Mega for control system of Temperature and circulation of sea water

Material and equipment for experimental of control system of temperature and circulation of sea water includes:

1. Microcontroller Arduino Mega for control system of temperature and sirculation sea water (See Fig. 2).
2. Pipe for sea water circulation.
3. Pump.
4. Cooling machine and heater for sea water.
5. Pond pool.
6. Temperature sensor DS18S20, Turbidity sensor and measuring instrument (see Figure 3).
7. Multimeter to measure the voltage and current for generated of temperature and turbidity control sea water.
8. Power supply.
9. Solar panel
10. ADC.

a. Temperature Sensor DS18S20



b. Circulation Sensor (Turbidity, Clarity)

Figure 3. Temperature Sensor DS18S20 and Circulation Sensor.

3. Results

Result of machine control system for temperature and circulation of sea water can be seen in Table 1 into Table 3. The control system working by circulation sea water from pond pool using the pump. When the condition temperature setting of sea water has a lower or higher than the temperatures setting 25^0C-30^0C then the pump become active to circulated clean sea water into the pond pool. The heater become on when the temperature is lower than temperature setting of sea water (<25^0C). If the temperature sea water more than 30^0C then cooling machine become on to make sea water is cool. The amount of time required to decrease temperature of sea water with a capacity of 10 l from 31.8^0C to 30.53^0C is 6 minutes 37 seconds. At a capacity of 15 l the time required to decrease temperature from 31.6^0C to 30.69^0C (0.91^0C) is 13 minute 16 seconds. The length of time required to reduce the temperature with the capacity of sea water 10 l and 15 litters can be seen in Table 1.

Table 1. Testing Data Microcontroller Arduino Mega of Cooling Time for Sea Water Circulation

Vol. (L)	Volt. (V)	Current (A)		T_s (^{0}C)		t (m:d)	T Amb. (^{0}C)	Humidity (%)
		Pump	Compressor	T_o	T_i			
10	219.9	0.234	1.068	31.8	30.53	6:37	31.5	58%
	220.1	0.234	1.068	32.4	30.54	5:24	31.5	58%
	220.4	0.234	1.068	33.5	30.58	9:15	31.5	58%
	220.1	0.234	1.068	34.5	30.46	6:56	31.5	58%
	219.7	0.234	1.068	35.5	30.57	13:24	31.5	58%
15	219	0.234	1.068	31.6	30.69	13:46	33	61%
	219.3	0.234	1.068	32.4	30.65	15:58	33.5	51%
	219.4	0.234	1.068	33.7	30.66	19:50	33.3	50%
	219.5	0.234	1.068	34.5	30.65	29:35	33.2	54%
	219.5	0.234	1.068	35.5	30.68	34:28	33.1	54%

Table 2. Testing Data Microcontroller Arduino Mega of Heating Time for Sea Water Circulation

Vol. (L)	Volt. (V)	Current (A)		T_s (^{0}C)		time (m:d)	T Amb (^{0}C)	Humidity (%)
		Pump	Heater	T_o	T_i			
10	220.2	0.234	0.72	27.5	28.35	4:50	32.4	67
	219.7	0.234	0.72	26.5	28.37	7:03	33	61
	219.9	0.234	0.72	25.5	28.37	9:43	32.9	61
	220.1	0.234	0.72	24.5	28.36	13:10	34.4	56
	219.7	0.234	0.72	23.5	28.35	16:17	34	58
15	220	0.234	0.72	27.5	28.37	5:31	33.6	50
	218.2	0.234	0.72	26.5	28.35	9:00	34.2	46
	220	0.234	0.72	25.5	28.36	17:45	33.5	49
	220.4	0.234	0.72	24.5	28.36	21:03	33.3	51
	220.8	0.234	0.72	23.5	28.35	24:04	33.2	50

For increasing temperature of sea water with a capacity of 10 l, control system by Microcontroller Arduino Mega set the heater to be active. Current needed for activation of the heater is 0.72 Ampere and time required to increasing temperature is 4 minutes 50 seconds to raise the temperature of 27.5 ^{0}C until 28.35^{0}C. For sea water with capacity 15 l in pond pool, the time required to raise the temperature from 27.5 ^{0}C to 28.37^{0}C (0.8^{0}C) is 9 minutes as shown in Table 2. Referring to Tables 1 and 2 it is seen that the time required to increase the temperature is faster compared to process decrease in temperature.

Table 3. Testing Data Performance of Microcontroller Arduino Mega for Control System Temperature and Circulation of Sea Water

Vol. (l)	pH		Temp (^{0}C)		Clarity		Salt	
	Sensor	Manual	Sensor	Manual	Sensor	Manual	Sensor	Manual
10	8.4	8.42	30.01	30.4	0	0	3.59	3.08
15	8.8	8.3	29.08	30	0	0	3.58	3.03
17,5	8.17	7.85	30.31	30.4	0.006	0	3.53	3.1
20	8.38	8.01	30.16	30.1	0.003	0	3.59	3
22,5	8.53	8.03	30.54	29.7	0	0	3.65	2.96
25	8.19	8.03	30.44	30.2	0	0	3.62	2.94
27,5	8.4	8.12	30.04	29.9	0	0	3.6	3
30	8.49	8.1	29.67	29.6	0	0	3.64	3.02

Table 3 shows performance of microcontroller arduino mega for sea water circulation and difference measurement using manual and automatic by the microcontroller. From the measurement results visible difference in pH 0.02 in 10 l of sea water, sea water temperature 0.39 and clarity 0. For the other sea water capacity fluctuation margin manual measurements and use a microcontroller that is not too large (<1).

From Table 1 until Table 3 show that the control system of temperature and circulation of sea water working well and can control temperature and circulation system of sea water easily.

4. Conclusions

From experimental of performance of control system for temperature and circulation of sea water by using microcontroller we get conclusions are:

1. The control system by using Microcontroller Arduino Mega can be work well to regulate the temperature and circulation of sea water.
2. Time for decreasing of temperature of sea water with a capacity of 10 l from 31.8^{0}C to 30.53^{0}C is 6 minutes 37 seconds. At a capacity of 15 l the time required to decrease temperature from 31.6^{0}C to 30.69^{0}C (0.91^{0}C) is 13 minute 16 seconds. For increasing temperature of sea water condition with a capacity of 10 l need current for activation of the heater is 0.72 A. and time required is 4 minutes 50 seconds to raise the temperature of 27.5 ^{0}C until 28.35^{0}C. For sea water with capacity 15 l in pond pool, the time required to raise the temperature from 27.5 ^{0}C to 28.37^{0}C (0.8^{0}C) is 9 minutes
3. From measurement by using microcontroller and manual, the results show that visible difference in pH 0.02 in 10 l of sea water, sea water temperature 0.39 and clarity 0. For the other sea water capacity fluctuation margin manual measurements and use a microcontroller that is not too large (<1).

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