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Error of Assembly Microcontroller Arduino Mega and ATmega in the Control of Temperature for Heating and Cooling System

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Abstract. Microcontroller Arduino Mega and ATmega is a computer chip that needed and developed to control system or process. Microcontroller Arduino Mega and ATmega can be used to temperature control systems [1][2][3], the room lighting control, security control, the hazard warning [4], scheduling, monitoring water flow and dams actuator door and etc. Most studies on the microcontroller is focused on the functional capability of a microcontroller to read or measure the object. In addition to aspects of good function, microcontroller must have a high sensitivity in order to avoid delay or in-accuracies in the sensor reading measured object such as temperature. Microcontrollers has some advantages and disadvantages of the process accuracy depends on the processor and the ability microcontroller. In this paper focuses on the measurement errors that occur on microcontroller Arduino Mega and ATmega 8535 with a temperature sensor LM 35 and hygrometer digitizes dt05 for the application process cooling and heating sea water controls. The volume of sea water is measured is 3 to 35 liters with a temperature set point 28⁰C of lower temperatures above 25⁰C and 31⁰C. The results show that the maximum error obtained by using microcontroller Arduino Mega is 1,32⁰C or 13,2 mV and ATmega 8535 is 0,2⁰C or 2 mV. Also the microcontroller Arduino Mega is more suitable for control temperature measurement in the process of heating and cooling sea water.

Introduction

Microcontroller is a device to organize a system automatically and manual. Microcontroller consists at ATtiny, ATmega, AT90S, AT86RF, Arduino Uno, Arduino Mega and other types. Many this microcontroller have some advantages and disadvantages but they have same function to control of a system. The increasing of the automation systems in industrial and manufacturing as followed by development of the microcontroller rapidly. Application of Arduino Uno microcontroller can be seen in the automatic gas control valve [5], monitoring flood symptoms [6] environment monitoring system [7], turbo intercooler cooling system [8], a digital caliper to PC [9], control temperature for metal process in the pickling line [10] and etc [11]. Microcontroller ATmega is used for remote temperature monitoring and controlling the AC generator, heating, cooling and etc. Control temperature for heating and cooling sea water process by microcontroller ATmega 8535 and temperature of sensor LM 35 [7-8] and many other control systems.

Microcontroller Arduino Mega 2560 has some advantages compare with the other microcontroller such as the number of input and output pins, high speed, compatible with other programs and etc. In this paper a microcontroller-based Arduino Mega 2560 with a temperature of sensor DS18B20 and ATmega 8535 a temperature of sensor LM 35 are used for the control of temperature sea water (heating and cooling temperature) in fish farming. The microcontroller Arduino Mega 2560 has 54 digital input/output pins, 16 analog inputs 16 MHz crystal oscillator, a USB connection and others. Microcontroller ATmega 8535 with a sensor of temperature LM 35 [6] has the disadvantage that the sensor is available for a small volume of sea water and water easily

enter into the sensor of temperature LM 35 due to the connection that existed at the end of the sensor is not yet covered.

In this paper we will focused on the performance and error of microcontroller Arduino Mega 2560 with sensor of temperature DS18S20 and ATmega 8535 a temperature of sensor LM 35 to control a heating and cooling sea water for fish farming.

Research Method

Research method in this study is an experimental method for microcontroller Arduino Mega 2560 and ATmega 8535 a temperature of sensor LM 35 to control of temperature sea water. The data required is error appear on the microcontroller system such as performance and life time of function system to heating the sea water up to 31°C and cools the sea water up to 25°C from the set point of sea water temperature 28°C . Component or panel control system for heating and cooling sea water consists of:

1. Arduino Mega 2560 Microcontroller and ATmega 8535 to serves as a temperature control unit.
2. Relay for automatic switch heating and cooling.
3. Keypad as the input button magnitude of the desired set point temperature.
4. LCD as the display data in the form of temperature set point and the average temperature sensor.
5. The temperature of sensor DS18S20 and LM 35
6. Box control panel to holder microcontroller Arduino Mega and ATmega 8535 system, relays, keypad and LCD.

Components of heating and cooling control system can be seen in Figure 1 and the temperature of sensor DS18B20 and LM 35 in Figure 2. In addition to the temperature control components, some of mechanical components for heating and cooling sea water consisting such as compressor, evaporator and coil heater and cooler sea water.

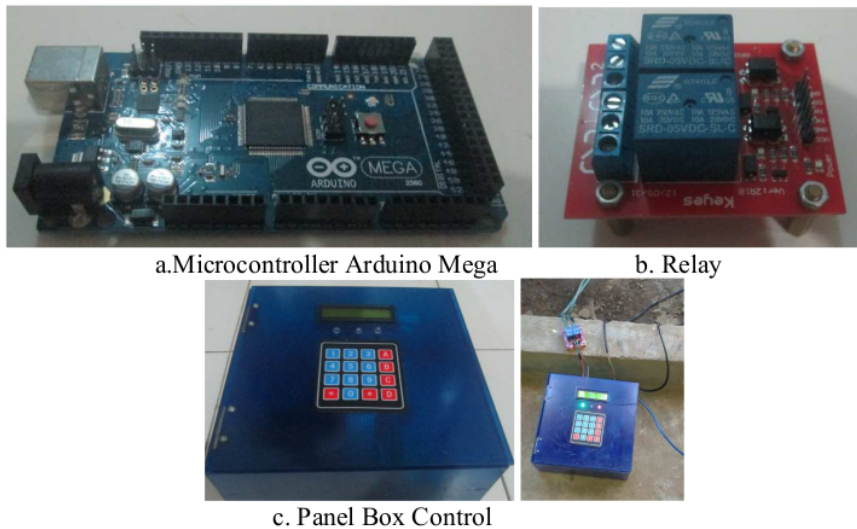


Figure 1. Component of Microcontroller Arduino Mega and Panel Box

Results and Analysis

Scheme architecture of temperature control system such as component of microcontroller Arduino Mega 2560, relays, LCD, Keypad, sensor 1 and sensor 2 can be seen in Figure 3. The initialization of the program by reading data from sensor DS18S20 and LM 35 with a set point value at 28⁰C. Furthermore, the sensor will detect a temperature that occur on the sea water in the pool or box. If the water temperature is drops from the set point 28⁰C, the indicator light will turn as red as a sign of an active heating system and other hand if the temperature of the water is passing through the value set point 28⁰C the indicator light will turn as blue as a sign of an active cooling system. Active and non-active forms of the control system can be seen in Figure 4. From this condition the performance are shown the microcontroller system are works well.



Figure 2. Temperature of sensor DS18B20 and LM 35

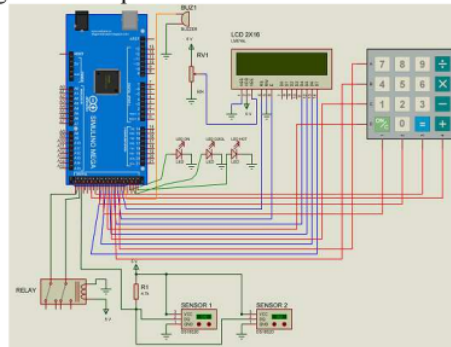
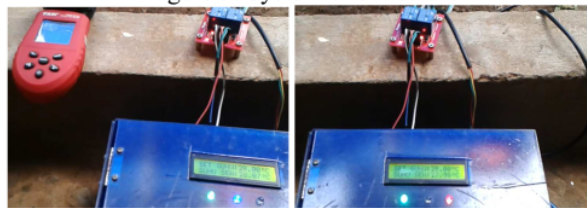


Figure 3. System Architecture



a. Cooling System On

b. Heating System On

Figure 4. Activation of Control System for Heating and Cooling Process

Table1. Error of Microcontroller Arduino Mega Table2. Error of Microcontroller ATmega

Sensor DS18S20 (°C)	Termometer (°C)	Error (°C)
25,32	24,00	1,32
25,02	25,00	0,02
25,20	25,00	0,20
25,36	26,00	-0,64
26,52	26,50	0,02
26,87	27,00	-0,13
27,33	27,50	-0,17
27,93	28,00	-0,07
28,25	28,50	-0,25
28,77	29,00	-0,23
29,30	30,00	-0,70
29,55	30,00	-0,45
29,70	30,00	-0,30

Sensor LM 35 (°C)	Termometer (°C)	Error (°C)
24,90	25,00	-0,10
26,00	26,00	0,00
27,00	27,00	0,00
28,10	28,00	0,10
29,00	29,00	0,00
29,90	30,00	-0,10
31,00	31,00	0,00
32,00	32,00	0,00
33,10	33,00	0,10
33,80	34,00	-0,20

Results of measurement accuracy of temperature using microcontroller Arduino Mega and ATmega 8535 are shown in Table 1 and 2. The results of measurement of temperature using thermometers and sensors DS18S20 show that error of temperature measurement is 1.32°C or 13,2 mV as shown in Table 1. On the other hand the accuracy of microcontroller ATmega 8535 with sensor of temperature LM 35 is $0,2^{\circ}\text{C}$ or 2 mV. This results shown that the accuracy microcontroller ATmega 8535 with the sensor of temperature LM 35 is better than Arduino Mega with sensor of temperature DS18S20 but the sensor of temperature LM 35 is weak for sea water resist compare the DS18S20 and also microcontroller is suitable to measurement of temperature heating an cooling for large volume.

Summary

Conclusions in this paper is:

1. Accuracy of microcontroller Arduino Mega with sensor of temperature DS18S20 is $1,32^{\circ}\text{C}$ or 13,2 mV and ATmega 8535 is $0,2^{\circ}\text{C}$ or 2 mV.
2. The microcontroller Arduino Mega with sensor of temperature DS18S20 is more suitable for the process of heating and cooling sea water because has resistan for effect of sea water compare with the ATmega 8535 with LM 35.

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