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Control and Stabilize System for Temperature in Operation Theatre by Using Microcontroller

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Abstract: *This project is to control and stabilize the temperature inside operation theatre. LM 35 will be placed inside the operation theatre that acts as a temperature sensor. It will give a signal to PIC16F876A to trigger the blower or heater. The temperature that is needed to be maintained is around 18˚C - 22˚C. Therefore, once the LM 35 detects the minimum temperature, the heater will turn ON until the stable temperature is reached. The blower will continuously activate. However, when the maximum temperature is detected by the LM 35, it will send signals to the microcontroller. Thus, the microcontroller will control the speed of the blower. The system also will implement a new technology for air conditioning method. Block of ice will be used to supply the cold air inside the operation theatre. Thus, the blower will blow the block of ice to regulate the temperature. The system will be regulated continuously.*

Keywords: *Block of Ice, LM35, PIC1Ff876A.*

1. INTRODUCTION

Nowadays temperature system introduce in the hospital is good and follow the standard requirement given by the government. However, to maintain the temperature in this range normally deals with failure. Normally the hospital gives a negative feedback regarding the temperature [1]. The temperature inside the operation room, usually cannot be controlled. When the surgery takes too long and it contributes to the people, the temperature inside the room will rise down [2]. The temperature is not in the range between 18˚C - 22˚C as standardize by MOH. This unfavorable temperature will give a side effect toward the working environment of the surgery team [3]. In addition, when the temperature is uncontrolled it can cause the infection to the patient. The temperature that is too high can lead to wound breakdown and also can cause bacteria breeding. This complication can occur in patients, especially patients who have just finished the surgery process. Further than that, the room
temperature will also affect the stability of the patient because the patient's body temperature will drop a new surgery [4]. So, if the room is too cold it will make the patient is in an uncomfortable situation thus will potentially other diseases such as hypothermia. This system is able to control and stabilize the temperature in the operating room [5]. Besides that, it is an interesting point where the system will use different method of air conditioning. Instead of using air conditioning, this system will use a block of ice for supply the cold air through the operation theatre. Therefore, the temperature in the operating theater is very important to ensure a smooth process surgery [6].

The Figure 1 above will explain the whole process of this project. The temperature sensor will read the temperature inside the operation theatre [7]. If the temperature rises to the maximum which is 22 ˚C and above, the blower will blow with the full speed. However, when the temperature detects the temperature minimum with the set point which is 18 ˚C and below, heater will turn ON and the blower will blow with half speed [8-9].

2. METHODOLOGY

Figure 1 below shows the flow chart of the whole system. It consists of three main processes which are circuit design, software implementation and lastly hardware implementation.

a. Circuit Design

The circuit was designed by using Proteus Software. Proteus PCB design combines the schematic capture and ARES PCB layout to provide a powerful, integrated and easy to use suite of tool for professional PCB design. Figure 3 below show the schematic diagram for this whole project. All components use is connected to the assign ports. By using this software, we are able to see the simulation of the project.

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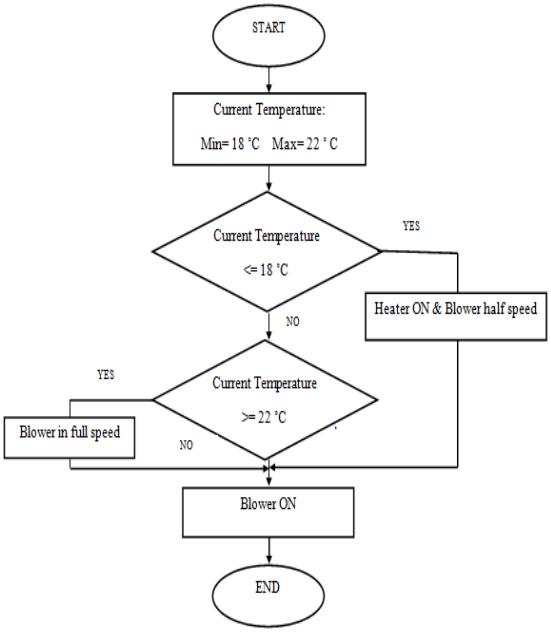

Figure 1: The Flow Chart of the Process

The project is conducted based the flow chart in Figure 2 below. The flow chart below used as the guideline during the project making.

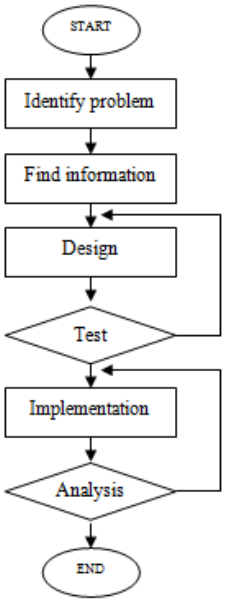

Figure 2: Flow Chart of the Overall Project

Thus, we can see the flow of the whole project such as what component that trigger at once time. Therefore, it can help us to countermeasure the problem that occurs.

Then from the ARES PCB layout, the construction of PCB board can be done. To design it will goes with the several process such as circuit printing, UV Curing, PCV developer, etching, photo resist stripper, and lastly drilling.

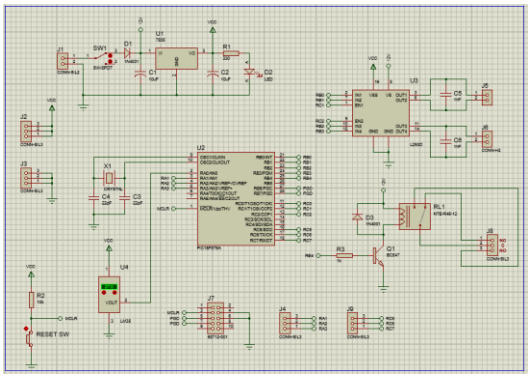

Figure 3: Schematic Capture Layout in Proteus

The PCB board need to place with the components and then testing the circuit.

Figure 4: The Connection of PCB Board

b. Software implementation

For the software implementation, the MPLAB IDE was use to program the whole process. The program will be written in this software and then it will be transfer to the brain of the project which is microcontroller PIC 16F876A [10]-[15]. The main program will be control the temperature sensor, speed of blower and also turn ON or OFF of heater [16]-[20]. The Figure 5 below shows the main function of the program.

```
    if(temp>29)
    {
    relay=0;
    motor_f1(255);
    }

    else if((temp>=25)&&(temp<=29))
    {
    relay=0;
    motor_f1(128);
    }

    else if(temp<25)
    {
    relay=1;
    motor_f1(0);
    }

}
}
```

Figure 5: The Main Function of the Program

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c. Hardware Implementation

For the hardware implementation, the process is done based on the design that has been planned. Therefore, it is important to ensure that the design of each material to be cut is in accordance with the right dimensions in terms of the structure for any errors that occur can have an impact on the design during the process of installation

Figure 6 above show the actual layout of the project. It's consisting with two main part which is mechanical part and the electronic part. The mechanical part consists of two boxes, and piping. For the electronic part, the PCB board, heater, temperature sensor and also blower.

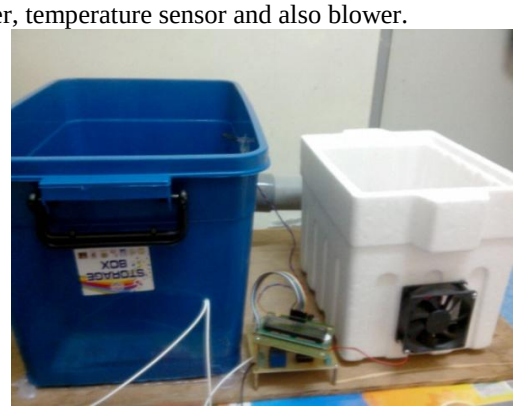

Figure 6: Actual Layout of Hardware Implementation

3. RESULT AND ANALYSIS

a. Time analysis

For this analysis, the parameter that needs to me measure is time and temperature. The purpose of making this analysis is to see within 1 hour how much temperature will drop and rise back. There are 6 data that have been made. The time conduct and the ambient temperature were different. From the graph it can be concluded that, temperature normally drops within 5 minutes. It will drop until certain temperature before it's stable. Once it reaches the stable temperature, it will maintain at the temperature within 30 minutes. Stable temperature means that the temperature should not drop again. Sometime the temperature rises, but rapidly drop back in less than 1 minute. If the ambient temperature is high, thus to reach the stable temperature will take more than 5 minutes. Figure 7 illustrated the data of temperature within 1 hour.

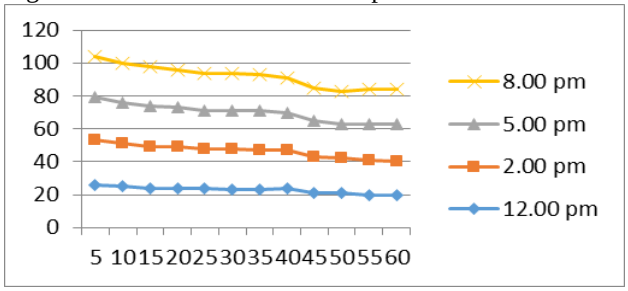

Figure 7: Temperature within 1 Hour

b. Quantity and Type of Ice Analysis

This purpose of this analysis is to see the relationship between the quantities of ice and affect the time for the temperature drop. While running this project, quantity of ice was manipulated.

Table 1: Quantity and Types of Ice Corresponding with Time

Quantity of ice	Type of ice	Time taken to reach the lowers temperature
500g	Cube	20 to 23 minutes
1kg	Cube	15 to18 minutes
1.5kg	Cube	15 to minutes
2kg	Cube	10 minutes
2kg	Block	More than 30 minutes
4kg	Block + cube	Less than 5 minutes

c. Length of the Sensor Analysis

This analysis was conducted to see the relationship of length of the sensor from the ice affect the reading of the temperature. Temperature sensor will be measuring the temperature of ice start with 0cm up until 20cm. Once the sensor direct measure the ice, the temperature will become 0^{C}. However, the temperature will rise up slowly if it's far from the ice. When it reaches 20cm, the temperature sensor detects that the temperature is equal to the surrounding. Here, it can be related that length of piping from the ice box to the operating theatre will affect the temperature due to the heat losses.

Table 2: Sensitivity of Temperature Sensor

Length (cm)	Temperature (° C)
0	0
2	3
4	7
6	10
8	13
10	16
12	18
14	19
16	20
18	23
20	25

d. Discussion

This project was being able to control and stabilize the temperature inside the operating room. It will use PIC16F876A as the controller so that this system will operate fully automated. Besides that, it also will use a new method of supply cooling air. Instead of using air conditioning system, this project will use ice to supply the cool air. To maintain the temperature as well, the heater was being used. When the temperatures reach the

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maximum ranges, the blower will blow in full speed. The increase of blower speed will help process of drop back the temperature. However, when the system detects the temperature in the minimum range, heater will trigger so it will be maintain back the temperature to be in range. This process can be monitor toward the LCD. Figure 8 above as the example when the system detects the temperature and it display in the LCD provided.

Figure 8: LCD Display of the Temperature

However, build up this project, there are many parameters that need to be considered. Thus, some analyses have been done. What can be concluded that, to supply the minimum temperature was a big deal. Many parameters need to be concerned, such as the joint of piping, the size of the box, material used in mechanical part, ventilation system, and also the limitation of the temperature sensor [21-22].
Because of this project just the prototype, thus it is assumed that the minimum range was 20 ˚ C instead in reality was 18 ˚ C. However, whole process was successful built and follow the requirement needed.

4. CONCLUSION

At the conclusion, this project can be implemented to the operation theatre as well. This project was able to use the PIC 16F876A as the main controller. Instead of that, this project also was achieved this mission for implementing a new method of cooling system However, because of this project just a prototype therefore the temperature that needs to be control was different from the reality. This project was able to maintain and control the temperature in the range of 22 ˚ C to 20 ˚ C. There is still need to be done some more research regarding the new method. Last but not least, this project will help the problem regarding the rise up of temperature inside the operation theatre and it gives benefit to people especially communities in the hospital.

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