FABRICATION OF PHOTOTHERAPY TOOLS WITH SENSORS TEMPERATURE AND TIMER BASED MICROCONTROLLER ARDUINO

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ABSTRACT

Phototherapy is a technology used for therapy in infants who suffer from hyperbilirubinemia or jaundice, this disease is due to the accumulation of bilirubin in the blood which is marked by the skin or the whites of the eyes turning yellow, babies who suffer from this disease are usually called yellow babies or icterus. This Phototherapy tool works by giving a blue light to the baby's skin directly for a certain period of time (depending on the level of bilirubin in the baby). The baby will be exposed to blue light which has a wavelength in the range of 450-490 nm for a certain period of time until the level of bilirubin in the baby's body drops to a safe level. With the advancement of technology, we want to add a little innovation by applying the use of a microcontroller to the phototherapy tool, in this case we add the time and temperature sensor DS18B20 as an indicator that will be displayed on the LCD screen so that it can make it easier for the user to turn off the tool and automatically and can notify the temperature of the baby who is getting sick. is doing this blue light therapy. In this case the time can be set according to user needs. From this research, it was concluded that phototherapy tools can be used to treat bilirubin babies. Advantages of this tool that users can monitor the baby's temperature and turn off the device automatically because we added a temperature sensor and timer to the phototherapy tools.

Keyword: Phototherapy; Arduino uno; microcontroller; temperature sensor.

Introduction

In general, jaundice is treated by bringing the baby to be irradiated with sunlight, which is usually done only in the morning and done repeatedly so that the healing time will be long. Currently, the most common medical treatment to cure jaundice is using phototherapy.[1]

Phototherapy tool is a tool used for therapy in infants who suffer from hyperbilirubinemia or jaundice, this disease is caused by an accumulation of bilirubin in the blood which is characterized by yellow skin and whites of the eyes, babies who suffer from this disease are also called jaundiced babies. or icterus.[2]

Phototherapy works by giving light to the baby's skin directly for a certain period of time (depending on the level of bilirubin in the baby). The baby will be exposed to blue light which has a wavelength range of 450-490 nm for a period of time until the bilirubin level drops to a level that is safe for the baby.[3]

Arduino is a microcontroller board which is "a functional computer system on a chip".[4] In the Arduino building, there is a processor, memory, input output, and you could say that this microcontroller is a mini version of a computer with supporting software for programming called Arduino IDE (Integrated Development Environment). Arduino adheres to an open hardware system, uses an Atmel AVR processor and has onboard I / O. A simple example of what we can do with Arduino, we can set the LED to blink once every 1 second or control the rotation of the servo motor and others.[5]

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The temperature sensor used is DS18B20. This sensor has 3 pins consisting of Vs, Ground and Data Input / Output.[6] The Vs leg is the source voltage leg. The source voltage for the DS18B20 temperature sensor is about 3V to 5.5V. In general, Vs is given a +5V voltage according to the working voltage of the microcontroller. Then the ground leg is connected to the circuit ground.[7]

For the timer, this study uses an hourmeter component. Hourmeter is a device to measure how long the unit is working or the number of hours of operation. The hourmeter data becomes a reference for the analysis of replacement of critical components that experience wear and tear. Hours meter is useful for recording the actual working hours of the engine on operational vehicles, whether service cars, trucks or heavy equipment. in the mining world, maintenance is calculated based on working hours, and not kilometers/mileage. This is because the mobility of the vehicle unit is relatively low, but faces a tough work area. For this reason, working hours are more accurate in determining service schedules.[8]

Phototherapy is the most widespread treatment for lowering bilirubin concentration in neonates. Phototherapy may be more effective if the light source is placed closer to the neonate. Objective To compare the effectiveness of phototherapy with a 20 cm distance between the light source and the neonate vs a 40 cm distance for decreasing serum bilirubin concentration.[9]

Based on the above problems, it is necessary to fabricate phototherapy tools with temperature sensors and timers based on the Arduino Uno Microcontroller where when this tool works it will display the baby's body temperature and will stop after this tool reaches the time limit that has been set by the user, so the user does not need to turn off the tool. manually, because with the help of a timer the tool will turn off automatically. This research aims to design and manufacture a phototherapy tools for the treatment of infants affected by bilirubin.[10] This phototherapy tool is equipped with a temperature sensor and timer that makes it easier for users to operate

it. The advantage of this tool compared to the existing tools.

Methods

In this study, a phototherapy tools with temperature sensors and timers based on the Arduino Uno Microcontroller was developed for infants with hyperbilirubinemia. The working concept of the tool can be seen in Figure 1.
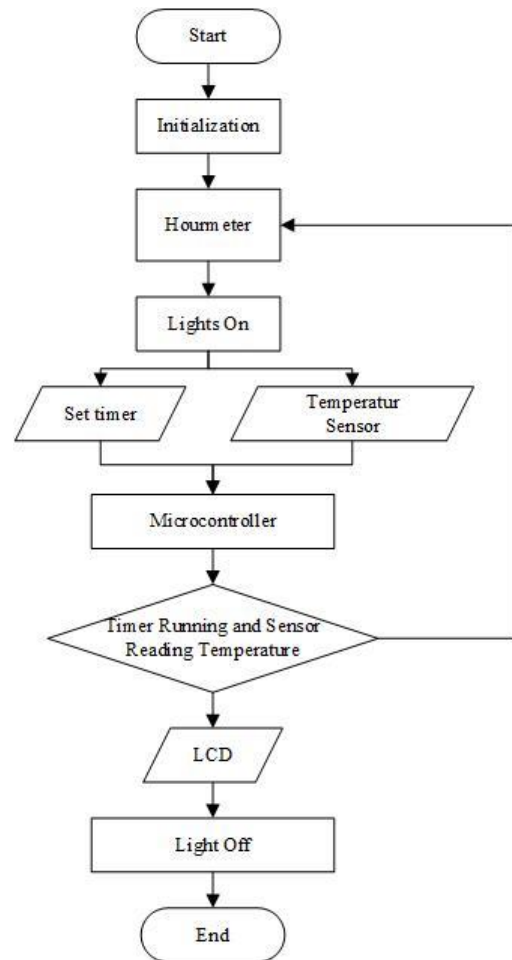

Figure 1. The mechanism of work phototherapy tools with sensor temperature and timer based microcontroller arduino

Based on Figure 1 regarding the flowchart of the phototherapy device fabrication with a temperature sensor and a timer based on the Arduino Uno microcontroller, it can be explained that.

The first step that must be done is to connect the power cable to the main voltage, after that the light will turn on then the user

just puts the sensor on the baby after that set the timer as needed, if it is then the command will be processed by the microcontroller, then the LCD will display the temperature indicator and calculate countdown from the timer, otherwise the timer and sensor will not work and the LCD will not display the

countdown temperature on the timer. After the irradiation is complete, the light will turn off and the buzzer will sound to inform the user that the tool has finished working, the tool will stop working and the buzzer will also sound when the temperature reaches a value of 39˚C.
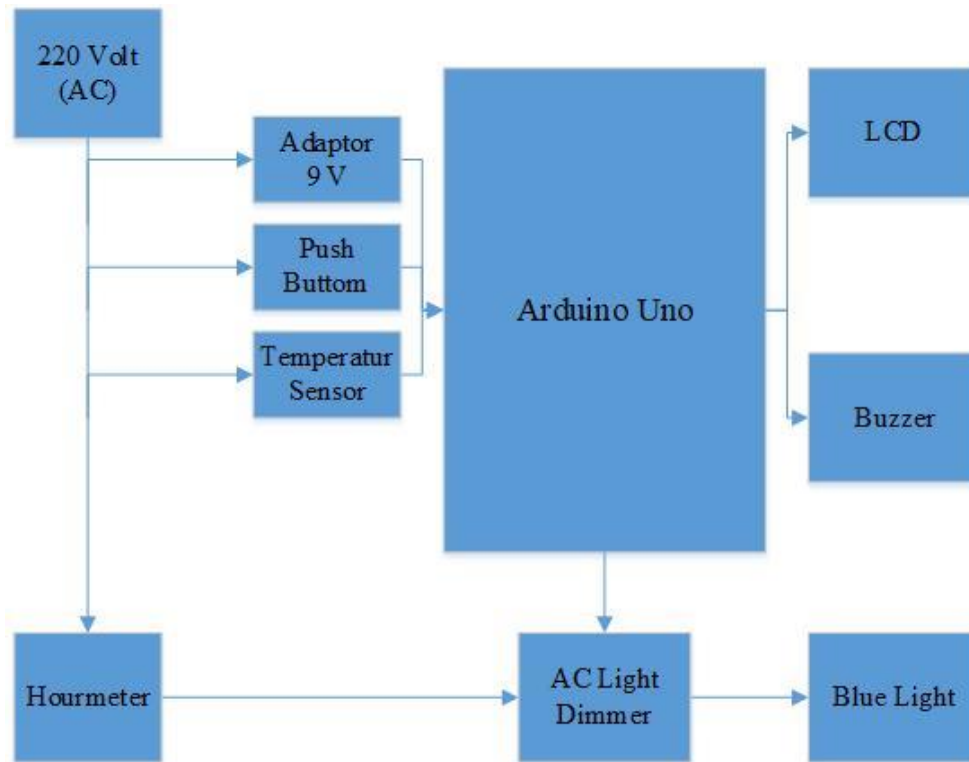

Figure 2. Blog Diagram

Based on Figure 2, the block diagram there is a push button that functions to start and set the timer contained in the phototherapy tool, here we use 4 push buttons where one functions as a start timer, increases and decreases the time and also as a stop button.

System Design Stage

The process of designing and manufacturing the tool, it is necessary to have a design or prototype of the tool to be made, then determine the size of the box to store the components used in the manufacture of the tool. The components used in this study are Blue light, Arduino uno, DS18b20 temperature sensor, AC light dimmer, 16x2 LCD, Hourmeter, and other components such as jumper cables to connect one component to another. Figure 3 shows a Phototherapy tools

with a temperature sensor based on the Arduino uno microcontroller.

Figure 3. Phototherapy tools with temperature sensor and timer

This phototherapy tool is in the form of a box with a length of 60 cm, a width of 40 cm and a height of 30 cm. This phototherapy tool uses sensor temperature DS18B20 and a blue light lamp with a power specification of 18 W,

a voltage of 52 V, and a irradiation spectrum with a wavelength of 400-550 nm. Installation blue light lamp at the top.

However, for the installation of the temperature sensor, it is in the baby box so that it can read the temperature received by the baby. The allowable temperature for babies is 33-36 °C. Meanwhile, the maximum time allowed is 3 hours.

Figure 4. Hourmeter on Phototherapy tools

Figure 4 is a display of the hourmeter installed on the phototherapy tools with a temperature sensor and timer based on Arduino Uno, where this hourmeter is used to find out how long the lamp has been used, and for the blue light here, if it has been used within 2000 hours, the lamp must be used. replaced.

This phototherapy tool has a temperature setting option such as an up button to increase the temperature degree and a down button to lower the temperature.[11] This makes it easier for the user to adjust the desired temperature and adjust it to the baby's condition. In addition, these phototherapy tools can also be set at the desired time and can be adjusted to the baby's needs.

Result and Discussion

1. Testing Temperature Sensor

This test, we do this by doing a comparison with the baby incubator in the Roemani Muhammadiyah Hospital in this way you can ensure the accuracy of the temperature sensor installed on the tool we made, when doing the comparison there are two comparisons installed on the baby incubator, the first is a temperature sensor installed on the tool and a mercury thermometer is also available on for this tool. See figure 5 and temperature result table 1.

Figure 5. Testing temperature sensor. (A) Phototherapy tool (B) baby incubator in hospital (C) Thermometer

Table 1. Temperature Result

Time	Temperature at phototherapy tool	Temperature at baby incubator	Temperature at termometer
Initial	28°C	28°C	28°C
5 menit	30°C	29,8 °C	29 °C
10 menit	33 °C	33,6 °C	33 °C
15 menit	36 °C	36,3 °C	37 °C
20 menit	36 °C	36 °C	36 °C
25 menit	36 °C	36 °C	36 °C
30 menit	36 °C	36 °C	36 °C

2. Testing Timer

This testing is done to find out the difference between the timer programmed on the device, we use the stopwatch on the laptop to make a comparison, the data we get from the comparison process is shown in table 2.

Table 2. Comparison timer on phototherapy tools with stopwatch

Setting time	Timer at phototherapy tool	Timer at stopwatch
1 hours	1 hours 1 minute	1 hours
2 hours	2 hours 1 minute	2 hours
3 hours	3 hours 2 minute	3 hours

These phototherapy tools can be applied to non-continuous light exposures. this condition is possible because when the phototherapy toos is set for 1 hour, but suddenly it turns off then when the tool is on again it will automatically reset to its previous state (1 hour light exposure). This is because these phototherapy tools have an hourmeter component that functions to calculate the duration of irradiation.

3. Comparison of the difference in temperature measurements using a thermogun

This comparison is carried out to determine the accuracy obtained by the temperature sensor installed on the device by using a thermogun as a comparison. In doing this comparison we used 3 people as samples in data collection. Table 3 shows the comparison of the temperature sensor with the thermogun.

Table 3. Comparison of the Temperature Sensor on phototherapy tools with Thermogun

Sample data	Temperature on phototherapy tools	Temperature on termogun
People 1	36°C	36,7°C
People 2	36°C	36,6°C
People 3	35°C	36,2°C

In this comparison there is a difference that is not too significant, because the LCD screen only displays numbers without commas so that the temperature achieved is always rounded up. In the comparison process the ambient temperature can also have an effect so that there is a difference in the measurement process.

The difference in temperature readings is 0.7 degrees, this condition is recommended before being used for calibration. All of contacted-measure temperature sensors have heat inertia, and the characters of heat response are different.[12] So the practical measuring temperature is a random function, especially in the baby's body, only increasing temperature sensor's precision in stable conditions can't satisfy the requirement of measurement. How to reduce heat inertia and improve capability of measurement rapidly and accurately lead the development direction of temperature measurement nowadays. Only by enhancing sensor's thermal response characteristic and calibrate it, can it be

possible to meet the requirement of dynamic measurement.[13]

Thermal sensor is a sensor that is used to detect symptoms of changes in heat/ temperature/temperature in an object dimension or a certain dimension of space. [14] Example bimetal, thermistor, thermocouple, RTD, photo transistor, photo diode, photo multiplier, photovoltaic, infrared pyrometer, and hygrometer. [15]

Conclusion

From the result of testing the phototherapy tools with sensor temperature and timer based microcontroller Arduino, the following conclusions can be drawn:

Temperature comparison with the baby incubator in Romani Muhammadiyah Hospital, we get the results of a comparison that is not too significant where the difference in temperature between our tool and a mercury thermometer is only around 2%.

The working principle of the tool that we make has the same principle as other Phototherapy tools, but has advantages in terms of programs so that users can monitor the baby's temperature and turn off the device automatically because we added a temperature sensor and timer to the phototherapy tools.

Acknowledgment

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