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Development of a Non-contact Infrared Thermometer as a Prevention Covid-19

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Abstract. Covid-19 is a contagious disease. Measurement of body temperature had defined by the WHO as a diagnosis parameter covid-19. Conventional temperature measurement is strongly discouraged because it can cause serious problems. The availability of innovative diagnostic devices is very much needed during the Covid-19 pandemic so that monitoring of body temperature can be done quickly and can help the screening process efficiently. Temperature detection using infrared allows it to be the best solution for measuring body temperature because it includes non-contact measurements. In this study, a non-contact temperature measurement system had developed using the MLX90614 sensor and Arduino nano as measurement controlled. The MLX90614 sensor works based on the phenomenon of black body radiation, which can detect infrared waves of the human body ranging from 9 - 10 μm and had equipped with a sensitive thermopile. The advantage of the MLX90614 sensor is that it has an accuracy of ± 0.5 ° C and a resolution of 0.02 ° C. The design results can detect the human body's infrared emission at a distance of 10cm. Analysis of the comparison test results between non-contact IR thermometer and contact thermometer (RTD) shows the same trend. So that the non-contact IR thermometer measurement system had can use properly.

Keyword: Non-Contact Thermometer, Covid-19, MLX90614, Infrared (IR), measurement

INTRODUCTION

Viruses and bacteria are generally in our daily life [1]. In recent years several viruses have emerged in the world, such as Severe Acute Respiratory Syndrome (SARS), Ebola, Swine Flu, and Covid-19 [2]. These viruses are highly contagious [2]. The movement of the human population may be one of the causes of transmission of the virus anywhere within hours [3]. Infection of this virus has spread by respiratory transmission [4], [2]. So, to delay or break the chain of infection, a rapid screening method is needed that must be applied immediately [3], and also advises the public to avoid direct contact with virus carriers [1].

Currently, the whole world is affected by the covid-19 virus pandemic. One of the clinical features that appear when exposed to COVID-19 is a change in body temperature [2] [5]. Body temperature is the most basic and vital indicator of life [6], as well as a direct marker of the immune response [7, 8]. Increased body temperature is the most important symptom of covid-19 [6] [9]. It is, therefore, necessary to monitor body temperature [3, 10] reliability in all public places (for example, schools, shopping centers, public transport, places of worship, hospitals, etc.) [11, 12].

Measuring body temperature can be done by a variety of methods, one of the most frequently used methods is a conventional method [5] using contact thermometers (mercury) [13]. This method monitors body temperature through the mouth, ears, or armpits. In addition to the mercury thermometer, there is a thermometer that utilizes a resistance temperature detector (RTD) which is the most appropriate temperature sensor [1, 5]. However, because covid-19 is a contagious disease, conventional temperature measurement is not recommended because it will cause serious problems [14].

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Availability of diagnostic innovative (non-contact, safe, fast, simple, and inexpensive) [11, 15] is warranted when a pandemic covid-19, so that the monitoring of body temperature can be done quickly [14] and can help the process of screening efficiently [3]. Infrared temperature detection is possible to be the best solution for body temperature measurement [1] because it includes non-contact measurement [6], [16, 17].

An infrared thermometer applies the principle of black body radiation to measure the wavelength of infrared radiation from the human body [6]. By using the radiation method, the infrared thermometer does not harm humans [5]. This method is very safe and convenient for measuring human body temperature without direct contact [11].

EXPERIMENTAL METHOD

Measurement of body temperature has been determined by WHO as a diagnosis parameter Covid-19. Measurements can be made non-contact or contact. In this research, a body temperature measurement system using a non-contact infrared.

Instrumentation system design non-contact temperature measurements are shown in Fig. 1. The block diagram of Figure 1 displays the temperature measurement system components. The main component in this design is an Arduino Nano (Fig. 2.a) as signal conditioning and control of temperature measurement. Arduino in the working process will control by a program that is planted in the IC chip and supported by the 5V power source. In addition there Arduino other main components, namely, the MLX90614 sensor (Fig. 2.b) function to detect body temperature.

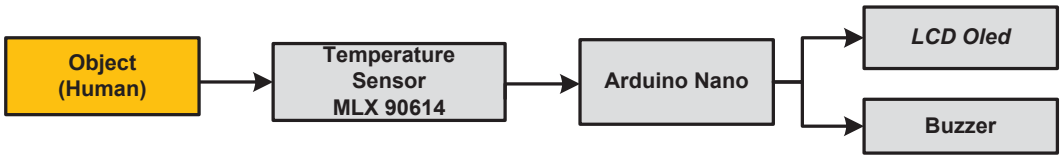

FIGURE 1. Infrared non contact temperature measurement system design

(a) (b)

FIGURE 2. (a) Arduino Nano Module and (b) MLX90614 infrared temperature sensor module

The MLX 90514 infrared temperature sensor works based on the phenomenon of black body radiation. Any object at temperatures above absolute zero has molecules moving within it. When the molecule moves, it emits infrared. Electromagnetic waves contain 0.75 - 100 μm infrared radiation. Wavelength infrared radiation in the human body ranges between 9-10 lm. MLX 90614 consists of a sensitive thermopile detector, signal conditioning chip, and a 17 bit ADC in one unit. This sensor uses the I2C protocol at a speed of 30KHz. The advantage of this sensor is the accuracy of ± 0.5 ° C and a resolution of 0.02 ° C for object temperatures from 0 ° C to 60 ° C. Complementary components are LCD Oled as a temperature display, Buzzer as an indicator if the measured temperature exceeds the criteria of WHO (37ºC).

System design testing method of non-contact temperature measurements using infrared done by taking a sample 1 object (humans) to be measured at a predetermined time within 1 (one) day. Tests are carried out by comparing commercial thermometers.

RESULT AND DISCUSSION

The block diagram implementation of Fig. 1 had applied to the circuit shown in Fig. 3. The MLX90614 IR temperature sensors (SCL and SDA) and LCD Oled (SCL and SDA) have connected to analog pins (A4 and A5) on

the Arduino nano. The MLX90614 IR sensor and Oled LCD use the I2C protocol for data transmission. Arduino nano functions as a controlled reading data detected by MLX9016 then, processed into the ADC and DSP and displayed on the LCD Oled. The buzzer in the circuit will function when the MLX 90614 temperature sensor detects a temperature above 37ºC.

The circuit is applied, then performed a simulation using the serial monitor and nano Arduino platform PCB board will generate after the simulation. Once all the parts are ready then simulation system Non-contact thermometer IR measurement.

The results had tested by two methods of characterization of the non-contact IR thermometer and the comparison of the non-contact IR thermometer with the contact thermometer. Fig. 4 is the result of testing the characterization of the IR non-contact thermometer. As shown in the graph, the test had carried out for 24 hours with the object of the research room wall. The graph results show the best non-contact IR thermometer measurement at a distance of 10cm because the MLX90614 sensor has good sensitivity. So it can detect temperature changes. In addition, the graphic results show the highest temperature on the object of research (the wall of the research room) at 14.00WIB to 16.00WIB. Because the research room has two air conditioners, the position of the research room is in between other rooms on the north and south sides, the placement of the entrance is on the west side, and the position of the window is in the east place. Measurement had done on the north side of the research room.

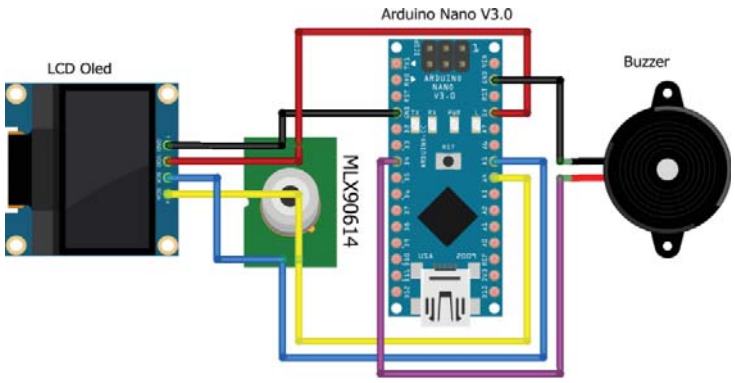

FIGURE 3. Implementation of the non contact IR thermometer circuit

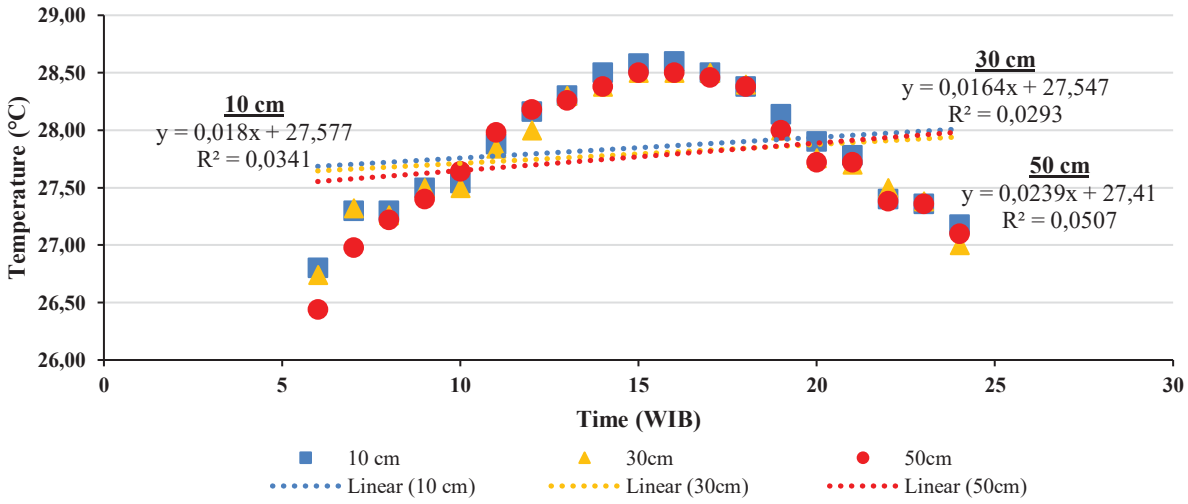

FIGURE 4. Characterization Of Non-Contact IR Thermometer

Fig. 5 is the test result using the non-contact IR thermometer comparison method with a digital contact thermometer. The graph shows that data was collect at certain times for 24 hours. The object used is the human body with a measurement distance of 10cm. The results graph shows the non-contact IR thermometer and different contact

thermometer, but they are still parallel. These results show the difference in the sensitivity of the sensors used. A contact thermometer uses an RTD sensor and is in direct contact with the human body. Meanwhile, the Non-contact IR Thermometer detects the IR radiation emitted.

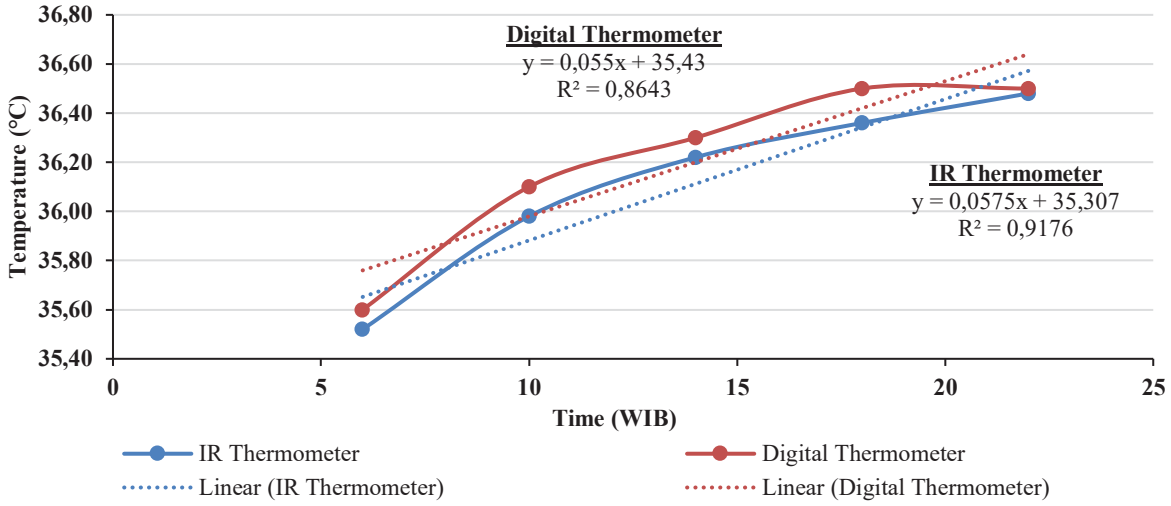

FIGURE 5. Comparison of Non-Contact IR Thermometer with Contact Thermometer (RTD)

CONCLUSION

This research is a non-contact temperature measurement system design applying IR radiation. Based on the test results of characterization, the MLX90614 sensor can detect infrared emission from the human body at a distance of 10cm because the MLX90614 sensor has good sensitivity. The results of the analysis in Fig. 4 show the temperature distribution information of the measurement object. The highest temperature is from 14.00WIB to 16.00WIB. Then the results of the measurement object use the human body. The test results show the comparison of the non-contact IR thermometer and contact thermometer. Analysis of the test results showed correct results. The measurement chart has the same trend, so it can conclude that the design results can measure human body temperature without direct contact.

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