Identification of Normal Body Temperature for Covid-19 based on Thermal Sensors and Raspberry Pi 3

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ABSTRACT
One of the activities to support the lecture process offline or face-to-face both in class and in the laboratory is monitoring the body temperature of all students, staff and lecturers who will enter the Electrical Engineering Department Building using an infrared thermometer temperature detector that is held by the officer. This is done, in order to monitor the body temperature of the academic community who enter the Electrical Engineering area not to exceed a temperature of 36.40C. Body temperature monitoring activities are disrupted, when officers are not in place or there is a queue from lecturers, students or employees who will enter the building, the temperature monitoring process cannot run properly, quickly and hinders the student process from entering to attend lectures in a timely manner. The choice of a thermal camera is because with a thermal camera the detection of human body heat can be done from a certain distance and the advantage is that the thermal camera continues to work even if the surrounding light dims. B. This study shows that the test results before using a human body heat detector using the AMG 8833 thermal sensor were used, compared first with a thermogun to see its accuracy with 30 experiments at a distance of 5 cm, 10 cm and 15 cm with objects on the human forehead with results with 5 cm are 1.23% more accurate than 10 cm distance, 5 cm are 2.7% more accurate than 15 cm distance and 10 cm are 1.51% more accurate than 15 cm distance. From the experiments carried out the results of measurements using AMG 8833 are still within normal limits for humans not affected by Covid-19, namely above 36.40C

General Terms
Internet of Things (IOT)

Keywords
Identification, temperature, sensor, Raspberry Pi 3

1. INTRODUCTION
The COVID-19 pandemic is an epidemic that cannot be separated from our lives. Covid-19, which was first identified in the Chinese province of Wuhan, has affected all aspects of Indonesian people's lives, including all members of the Department of Electrical Engineering, Manado State Polytechnic, both those whose activities are outside or in the environment around the campus.

Covid-19 has been declared a world pandemic by WHO in 2020 and nationally through the decision of the head of the disaster management agency Number 9A of 2020 which was updated through Decree number 13A of 2020 concerning Disease Outbreaks Due to the Corona Virus with the Status of Certain Emergency Conditions in Indonesia. The spread of the Covid-19 virus is similar to the spread of other flu viruses, namely through droplets and direct contact[1].

The Covid-19 Pandemic Period in 2022 with a Virus named Omicron became a new challenge for the Government, Society including in the World of Education such as the Manado State Polytechnic. Omicron is the latest variant of Covid-19 with symptoms in the form of a complete spectrum, such as asymptomatic infections, mild infections that cause people to be treated and some die[2].

The rapid spread of the Covid-19 Virus is due to the attitude and behavior of people who often underestimate small things such as existing protocol rules, which in the end do a lot of harm to other people. This attitude and behavior also occurs in the Manado State Polytechnic community, especially students from the Department of Electrical Engineering. Therefore, it is necessary to have more supervision and monitoring from study programs and departments regarding the attitudes and behavior of students who are on campus, especially in the Department of Electrical Engineering. This is intended so that lectures can run according to health protocols, so that the learning process which is currently based on Merdeka Learning Campus Merdeka can continue to run smoothly.

Efforts that have been made to prevent or minimize transmission and exposure to the Covid-19 Virus are implementing vaccines for the entire Manado State Polytechnic Community. The health protocol can also minimize the spread by wearing a mask, washing your hands and keeping your distance[1].

One of the activities to support the lecture process offline or face-to-face both in class and in the laboratory is monitoring the body temperature of all students, staff and lecturers who will enter the Electrical Engineering Department Building using an infrared thermometer temperature detector that is held by the officer. This is done, in order to monitor the body temperature of the academic community who enter the Electrical Engineering area not to exceed a temperature of 36.40C.

Body temperature monitoring activities are disrupted, when officers are not in place or there is a queue from lecturers, students or employees who will enter the building, the temperature monitoring process cannot run properly, quickly and hinders the student process from entering to attend lectures in a timely manner.

In 1800 infrared technology had begun to develop when it was discovered by Sir William Herschel [4]. This discovery inspired the military to implement infrared technology in 1947 as a camera for night vision[3].

Thermal cameras are classified as passive sensors [4]. The choice of a thermal camera is because with a thermal camera the detection of human body heat can be done from a certain distance and the advantage is that the thermal camera continues to work even if the surrounding light [5].

Based on the background above, the authors conducted research to make a tool to detect human body temperature using AMG 8833 as a sensor and Raspberry Pi 3 model B. So that the implementation of a thermal camera can be used to detect human body temperature and find out whether it has exceeded normal temperature limits or not and will used to support lectures.

2. RESEARCH METHODE

This study uses the Research and Development (R&D) method, which is a product-based method and tests its effectiveness. This method is oriented towards the products produced and the usefulness of the object of developing this system [4]. That consists of first, researchers study research findings that will be developed related to products; secondly based on the findings carried out product development, the test field in the setting where it will be used finally , and need to correct the deficiencies found then revised for the things found in the stage of submitting the test.

Simplified method as below

Product Development Field

Planning Stage

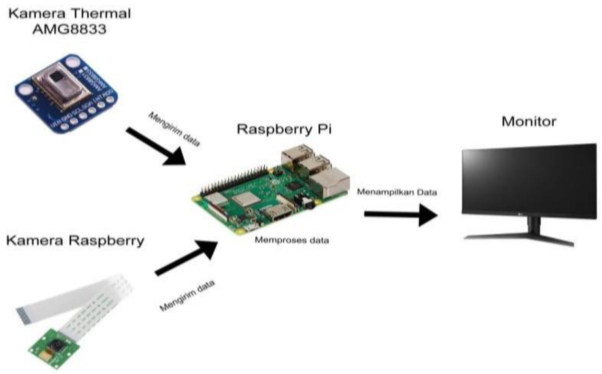

Figure 1. Arsitecture system

The Thermal Camera will be installed on the Raspberry Pi so that the Raspberry Pi can process temperature data taken by the Thermal Camera. Likewise with the Raspberry Camera. Connected to the Raspberry Pi so that the Raspberry Pi can process data taken from the camera, in this case the data is part of a person's face.

AMG8833 Thermal Camera Mounting Design

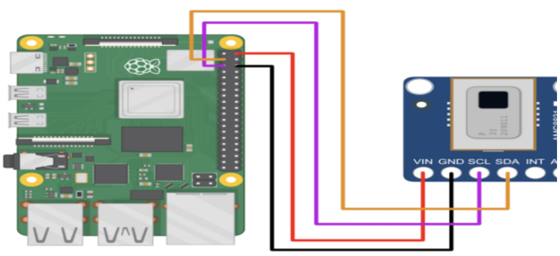

Figure 2. AMG 8833 implementation

To be able to get data from a thermal camera, AMG833 has provided several pins to be able to communicate, as shown in the picture above, but in this case only the VIN, GND, SCL, and SDA pins will be used. These pins are paired on the Raspberry Pi GPIO according to their respective pins.

LCD Display Design
A table is needed to place the Monitor so that you can see the capture from the AMG 8833 sensor. The sensor is placed on a pole so that the temperature camera is parallel to the face.

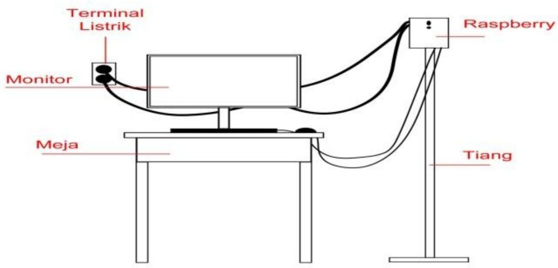

Figure 3. Temperatue monitor design

Test Field

The product in the form of a human body detection sensor system will be tested using the student t method with n = 30, meaning that data is collected 30 times. The test object is a human, the results are compared with data collection using a thermo gun. The goal is to validate body temperature detection using a sensor system that is built with another body temperature measuring device, namely the Thermogun

3. RESULT AND DISCUSSION

The results of implementing the AMG 8833 as a heat detection sensor and processing it using a Raspberry Pi in this study were tested at a distance of 5 cm, 10 cm and 15 cm.

Figure 4. Experiment on the forehead

Each of these distances was taken 30 times the human body temperature reading using the AMG 8833 thermal camera and thermogun to see a comparison of the results of body temperature detection. Thermogan is used to calibrate the AMG 8833 thermal camera.

Tabel 1 Temperature data at a distance of 5 cm

Experiment	Distance	Device		Difference	Error(%)	Accuracy (%)
		AMG 8833	Thermogun			
1	5 CM	36,25	36,5	0,25	0,0068493	0,9931507
2		36,25	36,3	0,05	0,0013774	0,9986226
3		36	36,5	0,5	0,0136986	0,9863014
4		36,25	36,5	0,25	0,0068493	0,9931507
5		36,5	36,5	0	0	1
6		36,5	36,4	-0,1	0,0027473	0,9972527
7		36	36,4	0,4	0,010989	0,989011

8		36,25	36,4	0,15	0,0041209	0,9958791
9		36,5	36,3	-0,2	0,0055096	0,9944904
10		36,25	36,4	0,15	0,0041209	0,9958791
11		36,25	36,4	0,15	0,0041209	0,9958791
12		36,5	36,4	-0,1	0,0027473	0,9972527
13		36,25	36,4	0,15	0,0041209	0,9958791
14		36,25	36,4	0,15	0,0041209	0,9958791
15		36,75	36,4	-0,35	0,0096154	0,9903846
16		36,25	36,4	0,15	0,0041209	0,9958791
17		36	36,4	0,4	0,010989	0,989011
18		36,25	36,4	0,15	0,0041209	0,9958791
19		36	36,4	0,4	0,010989	0,989011
20		36,25	36,4	0,15	0,0041209	0,9958791
21		36,25	36,4	0,15	0,0041209	0,9958791
22		36	36,4	0,4	0,010989	0,989011
23		36	36,4	0,4	0,010989	0,989011
24		36,25	36,4	0,15	0,0041209	0,9958791
25		36	36,4	0,4	0,010989	0,989011
26		36,25	36,4	0,15	0,0041209	0,9958791
27		36	36,4	0,4	0,010989	0,989011
28		36,5	36,4	-0,1	0,0027473	0,9972527
29		35,75	36,4	0,65	0,0178571	0,9821429
30		36	36,4	0,4	0,010989	0,989011
Rata-Rata		36,2166667	36,40666667	0.19	0,0067747	0,9932253

At a distance of 5 cm temperature readings with AMG 8833 get an average = 36.2166667^{0}C. This shows that the results are still smaller (AMG 8833 < Thermogan) compared to using a Thermogun = 36.40666666^{0}C with a difference of 0.19^{0}C. These results are still good for measuring body temperature during the Covid-19 pandemic with an accuracy of 0.9932 or 99.32%.

Table 2 Temperature data at a distance of 10 cm

Experiment	Distance	Device		Difference	Error(%)	Accuracy (%)
		AMG 8833	Thermogun			
1	10 CM	36	36,4	0,4	0,010989	0,989011
2		35,75	36,3	0,55	0,0151515	0,9848485
3		35,5	36,3	0,8	0,0220386	0,9779614
4		35,5	36,3	0,8	0,0220386	0,9779614
5		35,5	36,3	0,8	0,0220386	0,9779614
6		35,5	36,3	0,8	0,0220386	0,9779614
7		35,5	36,3	0,8	0,0220386	0,9779614
8		35,75	36,3	0,55	0,0151515	0,9848485
9		35,75	36,3	0,55	0,0151515	0,9848485
10		35,5	36,3	0,8	0,0220386	0,9779614
11		35,5	36,3	0,8	0,0220386	0,9779614
12		35,75	36,4	0,65	0,0178571	0,9821429
13		35,75	36,3	0,55	0,0151515	0,9848485
14		35,75	36,3	0,55	0,0151515	0,9848485
15		36,75	36,3	-0,45	0,0123967	0,9876033
16		37,75	36,3	-1,45	0,0399449	0,9600551
17		38,75	36,3	-2,45	0,0674931	0,9325069
18		36,25	36,4	0,15	0,0041209	0,9958791
19		35,75	36,3	0,55	0,0151515	0,9848485
20		36	36,3	0,3	0,0082645	0,9917355
21		36	36,3	0,3	0,0082645	0,9917355
22		35,75	36,3	0,55	0,0151515	0,9848485
23		36	36,3	0,3	0,0082645	0,9917355
24		35,5	36,3	0,8	0,0220386	0,9779614
25		35,75	36,3	0,55	0,0151515	0,9848485
26		35,75	36,3	0,55	0,0151515	0,9848485
27		35,75	36,3	0,55	0,0151515	0,9848485
28		35,25	36,3	1,05	0,0289256	0,9710744
29		35,75	36,3	0,55	0,0151515	0,9848485
30		35,5	36,3	0,8	0,0220386	0,9779614
Rata-Rata		35,90833333	36,31	0.4016	0,0190512	0,9809488

At a distance of 10 cm, the temperature reading with AMG 8833 based on an average = 35.90833333^{0}C which is taken shows the results are still smaller (AMG 8833 < Thermogan) compared to using a Thermogun = 36.11^{0}C has a difference of 0.401667^{0}C, the results are still good for measuring body temperature at during the Covid-19 pandemic with an accuracy of 0.9809 or 98.09%.

Tablel 3 Temperature data at a distance of 15 cm

Experiment	**Distance**	**Device**				
		AMG 8833	**Thermogun**	**Difference**	**Error(%)**	**Accuracy (%)**
1	15 CM	35,25	36,3	1,05	0,0289256	0,9710744
2		35,75	36,4	0,65	0,0178571	0,9821429
3		35	36,3	1,3	0,0358127	0,9641873
4		35	36,3	1,3	0,0358127	0,9641873
5		35	36,3	1,3	0,0358127	0,9641873
6		35	36,3	1,3	0,0358127	0,9641873
7		35	36,3	1,3	0,0358127	0,9641873
8		35	36,3	1,3	0,0358127	0,9641873
9		35	36,3	1,3	0,0358127	0,9641873
10		34,75	36,3	1,55	0,0426997	0,9573003
11		35,25	36,2	0,95	0,0262431	0,9737569
12		35	36,3	1,3	0,0358127	0,9641873
13		35	36,3	1,3	0,0358127	0,9641873
14		35,25	36,3	1,05	0,0289256	0,9710744
15		35	36,3	1,3	0,0358127	0,9641873
16		35,25	36,3	1,05	0,0289256	0,9710744
17		34,75	36,3	1,55	0,0426997	0,9573003
18		34,75	36,3	1,55	0,0426997	0,9573003
19		35,25	36,3	1,05	0,0289256	0,9710744
20		35	36,2	1,2	0,0331492	0,9668508
21		35	36,3	1,3	0,0358127	0,9641873
22		35	36,3	1,3	0,0358127	0,9641873
23		35,25	36,3	1,05	0,0289256	0,9710744
24		35	36,3	1,3	0,0358127	0,9641873
25		35,25	36,3	1,05	0,0289256	0,9710744
26		34,75	36,3	1,55	0,0426997	0,9573003
27		35,25	36,3	1,05	0,0289256	0,9710744
28		35	36,3	1,3	0,0358127	0,9641873
29		35	36,3	1,3	0,0358127	0,9641873
30		35	36,3	1,3	0,0358127	0,9641873
Rata-Rata		35,058333	36,29666667	1,238333	0,0341177	0,9658823

At a distance of 15 cm, the temperature reading with AMG 8833 based on an average = 35.058333^{0}C which is taken shows the results are still smaller (AMG 8833 < Thermogan) compared to using a Thermogun = 36.29666667^{0}C has a difference of 1.2363336.29666667^{0}C, the results are still good for measuring temperature body during the Covid-19 pandemic with an accuracy of 0.9659 or 96.59%.

Table 4 Average Summary

No	**Distance**	**AMG 8833**	**Thermogun**	**Difference**	**Error (%)**	**Accuracy (%)**
1	5	36,2166667	36,40666667	0,19	0,0067747	0,9932253
2	10	35,90833333	36,31	0,4016	0,0190512	0,9809488
3	15	35,058333	36,29666667	1,2383	0,0341177	0,9658823

Table 4 shows that overall the average experimental results of the AMG 8833 sensor in measuring normal human body temperature from a distance of 5 cm, 10 cm and 15 cm are smaller than the average results of the Thermogun tool.

The farther the human object is from the AMG 8833 and Thermogun sensors, there is a significant decrease in accuracy on the AMG 8833 sensor with a ratio of 5 cm to 10 cm of 1.23%, distance of 5 cm to 15 cm of 2.7% and distance of 10 cm to 15 cm of 1.51 %. This shows that in this experiment the distance between the human object and the AMG 8833 sensor will affect detecting normal human body temperature, namely between 36.50C – 37.2.0C with 5 cm more accurate 1.23% from a distance of 10 cm, 5 cm more accurate 2.7% from a distance of 15 cm and 10 cm is 1.51% more accurate than 15 cm.

4. CONCLUSION

This study shows that the test results before the human body heat detector using the AMG 8833 thermal sensor are used, are compared first with a thermogun to see its accuracy with 30 experiments at a distance of 5 cm, 10 cm and 15 cm with objects on the human forehead with results with 5 cm is 1.23% more accurate from 10 cm distance, 5 cm is 2.7% more accurate from 15 cm distance and 10 cm is 1.51% more accurate from 15 cm distance. From the experiments carried out, the results of measurements using AMG 8833 are still within normal limits for humans not affected by Covid-19, namely above 36.40C. The results of this study are not final because the experiment still needs to be added with other variables such as the time of the experiment and adding the experimental object.

5. ACKNOWLEDGMENT

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