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Implementation of Arduino-Based Body Temperature and Olfactory Detector Automatic Door

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***Abstract*— The serious problem faced by the world now is the pandemic caused by Covid-19. Currently, body temperature and olfactory screening are still important, especially for safety in closed rooms. This study aims to design and build a simple prototype of an automatic door integrated with contactless temperature and olfactory detection devices. This device consists of an MLX 90614 sensor as a temperature detector, an IR FC-51 sensor as a fragrance object detector, an Arduino UNO as a processor, and an LED display that displays instructions and screening results. The door automatically opens if the temperature and smell are normal and vice versa. The implementation results of this prototype provide the best detection distance of up to 2.5 centimeters with 5% error. While the FC-51 sensor is able to detect up to a distance of 5 centimeters. The performance of the MLX 90614 sensor in detecting temperatures is not significantly different from the detection results of the GXG01 thermogun, which is only around 0.17 degrees Celsius. In general, the entire device part works as expected with 100% accuracy. This simple prototype is expected to inspire screening techniques to prevent the spread of Covid-19 in closed rooms.**

***Keywords*—Covid-19, temperature detection, smell detection, Arduino UNO.**

I. Introduction

The world now is still struggling to overcome the pandemic, and Indonesia is no exception to this. The percentage of death rate at the end of March 2020 reached 8.9% [1]. Although it has decreased significantly, the spread of COVID-19 in Indonesia is not over yet. The areas with the highest level of spread include DKI Jakarta, West Java, Central Java, Banten, and East Java (Ministry of Health of the Republic of Indonesia, 2021). Preventive measures against infectious diseases must be carried out as soon as possible as mandated by Law Number 6 of 2018 concerning Health Quarantine. One of the policies stipulated in the regulation is the need for the community to limit social activities[2]. The most common early symptoms of people exposed to COVID-19 include loss of sense of taste and smell, similar to upper respiratory tract viral infections such as the common cold and loss of smell. Other mild symptoms are body temperature > 37.5°C and a dry cough at first which can develop into moderate case symptoms[3]. Therefore, people are advised not to interact directly with other residents especially those experiencing symptoms of high fever[3]. *Physical Distancing* in the community needs to be carried out as an effort to enforce health protocols to reduce the risk of exposure to COVID-19 [4].

Thus, until now, early diagnosis of COVID-19 is still important to be carried out by measuring body temperature and human olfactory ability to avoid virus transmission [5]. It's just that the weakness of measuring temperature with the thermometer gun used so far requires the presence of an officer when measuring body temperature. Several studies have developed anosmia (loss of smell) screening techniques[6], a review of automatic temperature screening research during the pandemic[7], as well as temperature screening techniques combined with disinfectant sprays[8]. Different from previous studies, this study aims to design and build a simple prototype of an automatic door that is integrated with temperature and olfactory detection devices that have the potential to be implemented in cases of early detection of the spread of the Covid-19 virus. The implementation of automatic temperature and olfactory detection without officers is expected to inspire a change in the testing of body temperature and olfactory in the pandemic era, especially when entering closed rooms.

II. Methodology

The research begins with the design of electronics, mechanics, and software from the prototype.

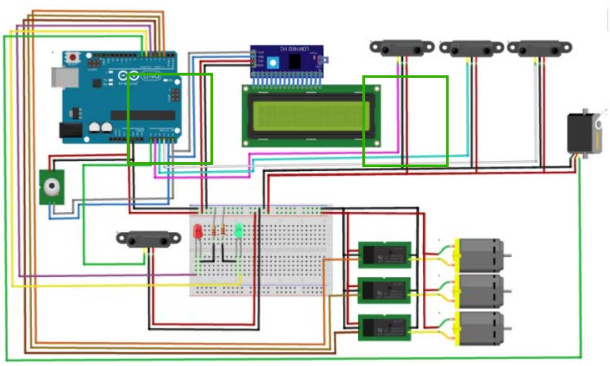

Fig. 1. Prototype Design Scheme

We use one MLX 90614 temperature sensor as the first-stage input component and 3 IR FC-51 sensors as the second-stage input components which have their respective functions and control different output components at each stage. The data is processed by Arduino UNO and its display uses the LCD display and LED indicator light. The block diagram is shown in Figure 1 while how the tool work is shown in Figure 2.

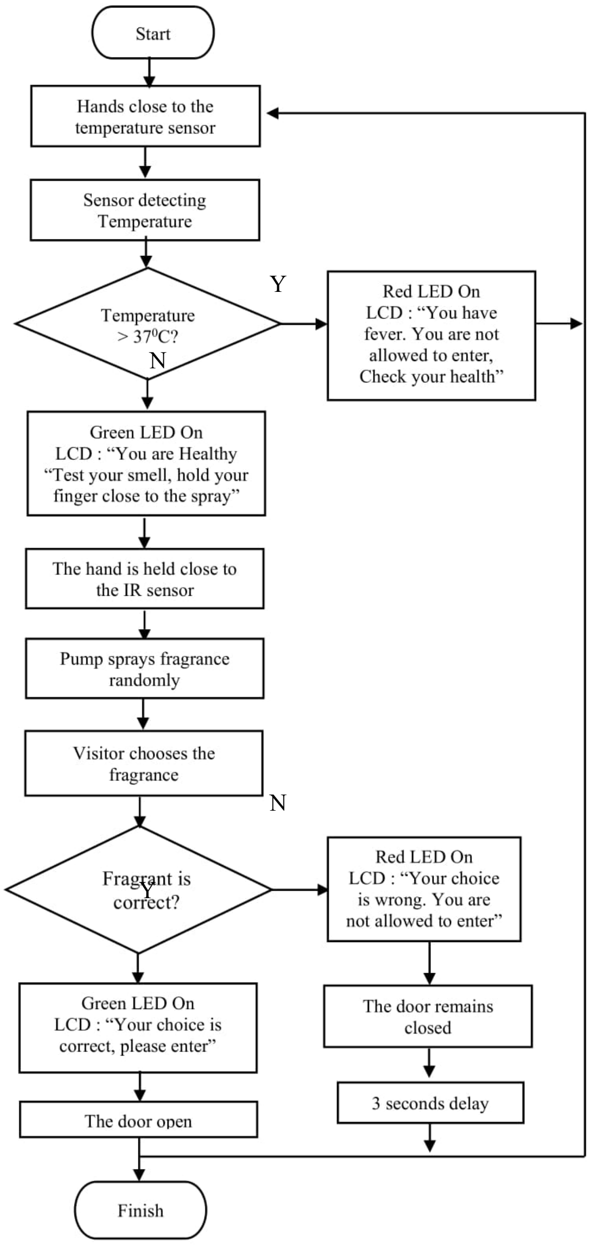

Fig. 2. Hardware design

First, we tested the MLX 90614 sensor with various distances between the sensor and the object in order to find the maximum effective distance. The tested distance is from 1 to 5 cm. The next stage is the testing of sensors for olfactory detection. The test was carried out by spraying the smell of fragrances into the palm, then the visitor has to identify the fragrance by choosing from the choice given. The door will automatically open if the detected temperature is normal and the choice of fragrant odors is correctly selected by the visitor. The final analysis was performed to see the performance of the MLX 90614 temperature sensor, the performance of the IR FC-51 sensor connected to the dc pump motor, the performance of the servo motor, and the overall performance of the system.

III. Results and Discussion

The result of the automatic door prototype is shown in Fig 3. The testing of the MLX90614 sensor was carried out by performing several treatments with various distances between the sensor and objects, ranging from 1 cm to 5 cm at a fixed source temperature of 60℃ indicated by Table I. A glass is placed in front of the MLX90614 Sensor to determine the effect of distance on the temperature that can be detected by the sensor.

Fig. 3. Result of automatic door prototype

TABLE I. MLX 90614 Sensor Test Results

Distance (cm)	Mercury Thermometer (°C)	Sensor MLX 90614 (°C)	Error (%)
1.0	60	60.65	1.08
1.5	60	59.31	1.15
2.0	60	59.21	1.32
2.5	60	58.99	1.68
3.0	60	56.35	6.08
3.5	60	50.67	15.55
4.0	60	45.91	23.48
4.5	60	44.45	25.92
5.0	60	43.11	28.15

The results of this test show that the smallest error value was obtained at a distance of 1 cm by 1.08% and the largest error was obtained at a distance of 5 cm by 28.15%. It means the closer the object is to the MLX 90614 sensor, the smaller the error rate is. Figure 4 shows a graph of temperature testing results by comparing the detected temperature of sensors and mercury thermometers.

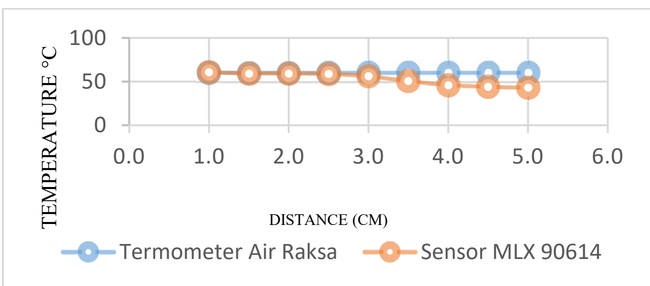

Fig. 4. Graph of temperature measurement test results between sensor and mercury thermometer

The next experiment is to determine the performance of the FC-51 IR sensor in detecting objects based on distances and variations of various materials. Distance testing aims to ensure the FC51 *infrared* sensor works with the required distance. Table II shows the results of testing the effective distance of each IR for detecting an object.

The results of such tests show that the sensor can detect up to 5 cm away from the sensor. Further than that, the sensor can no longer detect anything. It means that the maximum distance is 5 cm. The next experiment is based on the material variations to find out what types of materials can be detected by the FC-51 *infrared* sensor. The test was carried out at a distance of 2 cm with an infrared sensor FC-51. The results of such tests are shown in Table III.

TABLE II. EXPERIMENT RESULT OF SENSOR INFRARED FC-51

Distance (cm)	Sensor *Infrared FC-51*			
	IR 1	IR 2	IR 3	IR 4
2	Detected	Detected	Detected	Detected
3	Detected	Detected	Detected	Detected
4	Detected	Detected	Detected	Detected
5	Detected	Detected	Detected	Detected
6	Undetected	Undetected	Undetected	Undetected
7	Undetected	Undetected	Undetected	Undetected
8	Undetected	Undetected	Undetected	Undetected
9	Undetected	Undetected	Undetected	Undetected
10	Undetected	Undetected	Undetected	Undetected

TABLE III. EXPERIMENT RESULTS OF MATERIAL DETECTION USING INFRARED FC-51 SENSOR

Object	Infrared Sensor			
	IR 1	IR 2	IR 3	IR 4
Hands	Detected	Detected	Detected	Detected
Plastic	Detected	Detected	Detected	Detected
Glass bottle	Detected	Detected	Detected	Detected
Paper	Detected	Detected	Detected	Detected
Can	Detected	Detected	Detected	Detected

The results of this test show that the FC-51 *infrared* sensor can detect objects made of plastic, glass bottles, HVS paper, and cans. Testing the MLX90614 sensor on human body temperature with a distance of 1 cm was carried out by comparing it with the measurement results of the GXG01 thermogun. Table IV shows the results of the comparison of the two measurements.

TABLE IV. TEST RESULTS OF MLX90614 SENSOR AND THERMOGUN AGAINST HUMAN BODY TEMPERATURE AT A DISTANCE OF 1 CM

No	Sensor MLX9061 (°C)	Thermogun GXG01 (°C)	Error (°C)
1	36.08	36.00	0.08
2	36.07	36.30	0.23
3	36.15	36.40	0.25
4	36.03	36.20	0.17
5	36.17	36.20	0.03
6	36.03	36.30	0.27
7	36.16	36.00	0.16
8	36.15	36.50	0.35
9	36.4	36.61	0.21
10	36.07	36.50	0.43
Average	36.13	36.30	0.17

The temperature test results in 10 samples showed the average values of the MLX 90614 sensor and the GXG01 *thermogun* respectively are 36.13°C and 36.30°C. With a difference value of 0.17°C, the MLX 90614 sensor can be said to be worthy of use to detect human body temperature.

The last test is carried out to find out the performance of the entire device. This test includes 15 times which includes measuring human body temperature (whether above or below the set temperature standard), LED light performance (conformance of red and green lights with temperature measurement results), measurement of the main IR sensor, performance of the dc pump motor for each selected fragrance spray (rose, jasmine, pandan), performance of IR sensor for the suitability of the answers of each fragrance, as well as the performance of the motor servo that drives the door automatically. Table V shows the results of the overall testing of the automatic door.

TABLE V. Perpormance Testing of The Entire Prototype Part of The Automatic Door

No	Temperature (°C)	LED		Main IR	Sprayed Fragrance			Answer Results			Motor Servo	Results
		Red	Green		Rose	Jasmine	Pandan	Rose	Jasmine	Pandan		
1	33,29	Off	On	works	-	-	√	-	-	√	Move	Success
2	33,17	Off	On	works	-	√	-	-	√	-	Move	Success
3	33,61	Off	On	works	√	-	-	√	-	-	Move	Success
4	33,63	Off	On	works	√	-	-	√	-	-	Move	Success
5	33,83	Off	On	works	-	-	√	-	-	√	Move	Success
6	34,53	Off	On	works	√	-	-	√	-	-	Move	Success
7	34,15	Off	On	works	-	-	√	√	-	-	Not Move	Success
8	33,55	Off	On	works	-	-	√	-	-	√	Move	Success
9	37,51	On	Off	-	-	-	-	-	-	-	Not Move	Success
10	46,51	On	Off	-	-	-	-	-	-	-	Not Move	Success
11	33,43	Off	On	works	-	√	-	-	√	-	Move	Success
12	33,65	Off	On	works	√	-	-	√	-	-	Move	Success
13	33,57	Off	On	works	-	-	√	-	-	√	Move	Success
14	33,13	Off	On	works	-	-	√	-	-	√	Move	Success
15	34,37	Off	On	works	√	-	-	√	-	-	Move	Success

Table V overall shows that this simple automatic door prototype successfully behaves based on a combination of temperature and olfactory detection. The door automatically opens when the LED light is on (temperature below 37.5^0 C) and olfactory detection is appropriate (normal smell). From the entire experiment, there were only 3 times the door was locked, 2 times because the temperature was above 37.5^0 C, and 1 time because the smell was not correct. 15 out of 15 trials ended up with satisfactory results, meaning that the performance of the device is 100%. This shows that all sensors used are working as expected as long as the subject is within detection range. However, further research is important to find a longer detection distance so that the developed automatic door prototype is more precisely implemented in a real enclosed space.

IV. Conclusions

The experiment result shows that MLX 90614 sensor has 5% error with a maximum distance of 2,5 cm., with an average error of 0.17 degrees Celsius compared to the GXG01 *thermogun* measurement. While the infrared sensor FC-51 has a maximum distance of 5 cm. From 15 experiments of the entire system, the data shows that this device can work 100% well on detecting temperature and olfactory. This tool does not replace experts in diagnosing covid, it's just that it can prevent someone who has typical covid symptoms (fever and anosmia) from entering a room in order to prevent the spread of the virus. And for that purpose, this tool is already feasible. As for whether a person has Covid or not, it still requires a more thorough test and observation.

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