Physical Distancing and Temperature Sensing Bracelet

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Abstract. The world is enduring difficulties in numerous fields because of this Coronavirus pandemic flare-up. All government had played it safe to forestall the infection transmission, for example, rehearsing social distancing and temperature checking before entering any preface just as declaring a lockdown. Notwithstanding, the 1-meter distance is not straightforward to estimate by unaided eyes, and it is difficult to carry along a meter rule regularly. Subsequently, this would build our danger of getting contaminated by the COVID-19 infection. Moreover, the thermometer put at each person's passageway has the threat of causing disease since numerous individuals share it. Regardless of whether a specialist is appointed to quantify guests' temperature, the person does not have the option to keep up the guest's social distance when taking temperature. In this research, a sensing bracelet proposed to determine physical distancing and temperature. The bracelet has two fundamental capacities. It can continually screen distance among client and others utilising a sensor. It will warn the client to keep up social distancing and avoid swarmed places when it distinguishes individuals under 1 meter. Second, it has a temperature sensor to determine the client's internal heat level and will ring to caution the client if the internal heat level is more than 37.5°C. The experiment conducted able to achieve the requirement for a physical distancing.

1. Introduction
The COVID-19 first appears in Wuhan, China, in December 2019. The virus spreads rapidly through close contact and has become the most important reason for global health concern[1]. Since its emergence, the number of imported cases from China to other countries increases rapidly. Different organisations, such as the World Health Organization, have prepared methods for preventing further spread. Various companies specialises in technology launched applications to help provide updated information regarding coronavirus. Based on the data, 40% to 80% of Covid-19 cases caused by pre-symptomatic or asymptomatic individuals. Indicating that infectious individuals can continue to spread the virus without being aware of their status[2].

COVID-19 pandemic is also known as coronavirus pandemic. 'CO' stands for 'corona,' 'VI' for 'virus,' and 'D' for disease in COVID-19. In December 2019, an outbreak of pneumonia caused by a novel coronavirus occurred in Wuhan, Hubei province, and has spread rapidly throughout China, with an ongoing risk of a pandemic[3]. As of January 31 2020, this epidemic had spread to 19 countries with 11 791 confirmed cases, including 213 deaths[4]. The pathogen for this pneumonia was initially called 2019 novel coronavirus (2019-nCoV). But later been named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) by the WHO (World Health Organization) [5]. On March 11, 2020, WHO declared the COVID-19 outbreak a pandemic.
To prevent the spreading of COVID-19, wearing a mask is encouraged to help us avoid the spreading of COVID-19. Physical distancing 1 meter between individual help to control spreading the virus. In Malaysia, measuring our body temperature before going into any premises and keeping social distance are important SOPs to prevent the spreading of a virus of COVID-19. Social distancing or physical distancing is an infection control measure that requires us to maintain a safe distance of at least one metre from others.

In this pandemic situation, the activities that play an essential role in spreading coronavirus have to address. There is a lot of reason for the spread of coronavirus. Totally seven main activities have been reported and considered as primary criteria for the problem. Out of these seven criteria, the most apparent cause of the virus spread is social distancing and unnecessary touching. As stated by WHO [6], the coronavirus is not an airborne virus and spread by contact. Individuals must eliminate contact with people and the surrounding objects to be a medium for virus infection to reduce the infection rate.

In this new era, automation becomes essential. With the advancement of a microprocessor, automation is possible to apply in an area such as decision making [7, 8, 9], monitoring systems [10, 11], medical applications [12] and optimisation [13, 14].

This project's main objectives are: To develop wearable and lightweight devices with integrated distance checkers that warn the user when the distance between individuals becomes too close. And to implement continuous temperature checking and store feature within the device using a temperature sensor unnecessary touching during check into premises.

MLX90614 is a non-contact infrared temperature measurement device, and it uses a low-noise amplifier, 17 b A/D converter and powerful DSP processing unit with high-temperature resolution and measurement accuracy. The thermometer temperature range is -40--+125°C, calculate and store in RAM ambient temperature, and object temperature can achieve data with 0.01°C resolution. The sensor outputs digital signals that are accurate and linearly correlated with temperature, which simplifies the design.

The DS1307, which uses I2C communication protocol, is a low-power clock/calendar with 56 bytes of battery backup SRAM. The clock/calendar provides seconds, minutes, hours, day, date, month, and year qualified data. The end date of each month is automatically adjusted, especially for months with less than 31 days. The main advantage of RTC is that they have an arrangement of battery backup, which keeps the clock/calendar running even if there is a power failure. A minimal current required for maintaining the RTC animated.

The OLED screen displays the date, time, user's current wrist temperature and warning message if it violates social distancing or has a fever. The OLED display made of 128x64 individual blue LED pixels. As each pixel emits light on its own, it does not need a backlight panel like an LCD. This characteristic can produce high contrast texts/images, and it is easily readable under bright light. It uses an SSD1306 driver chip and can control via the I2C interface.

The 18650 battery has a capacity of 2000mAh. It is Lithium-Ion based and rechargeable. 18650 battery has become very popular nowadays, with many power banks are using it. Since the battery has high voltage and capacity, it is instrumental in electronic or robotic projects, incredibly portable.

The charger module used to charge the 18650 battery via USB Micro B receptor. The module has constant 5V 1A output. Therefore, it is suitable as an external power source for the bracelet. A micro-USB cable is needed to connect the module with Maker Nano to power it.

The module has integration charging and discharging management, intelligent temperature control and over-temperature management, output overvoltage protection, short circuit protection, overload protection, overcharging and over-discharging protection. Therefore, it is safe to use for this project.

2. Methodology

Figure 1 shows the overall system of the bracelet. The bracelet consists of two main structures: the social distancing detection system and the temperature scanning system. The temperature scanning system and the social/physical distancing detection system are input to the system. There are an OLED screen, buzzer, and vibrating motor apply as the output.
2.1. Flowchart

This project software design is divided into two main functions, as shown in Figure 2 and Figure 3.

**Figure 1:** Block diagram of the system

**Figure 2:** Flowchart social detection system  
**Figure 3:** Flowchart temperature sensing system
Interrupt use in the system so both of the systems can work simultaneously.

2.2. Hardware

The Maker Nano acts as a brain for the whole system, which executes the coding's instruction. Maker Nano is a board based on the ATmega328 microcontroller. It consists of 20 digital input/output pins, eight analogue inputs, a USB connection for programming the onboard microcontroller, a power input pin, 12 LEDs, a programmable push-button, a piezo buzzer, and a reset button. It has 32 KB flash memory, 2 KB SRAM, and 1 KB EEPROM. It uses CH340C USB to serial chip. It is effortless to use as the user needs to connect it to a computer with a USB cable or power it with a battery to get started. The board's microcontroller is programmed using the Arduino programming language and Arduino integrated development environment (Arduino IDE).

The social distancing detection system uses a passive infrared (PIR) sensor to sense human around the user. However, the PIR sensor's minimum detection range is 3-metre, an ultrasonic sensor added to detect the distance of 1-metre [15, 16]. The PIR sensor and ultrasonic sensor, as shown in Figure 4 and Figure 5, respectively. The ultrasonic sensor adjusted to detect the distance of 1-metre. After that, the PIR sensor will detect the presence of a human. Once the human is detected, the PIR sensor will send a HIGH signal to Maker Nano. Then, Maker Nano will trigger a buzzer, vibrating motor and shows a warning message on the OLED screen.

![Figure 4: PIR sensor](image1)

![Figure 5: Ultrasonic sensor](image2)

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3. Result and Discussion

Social distancing and temperature checking bracelet tested to detect a human in the distance of 1-metre and sense body temperature. Several conditions prepared to test the bracelet's function.

For social distancing detection system, it tested with the following conditions:

Condition 1: Two people stay at least 1-metre away from each other
Condition 2: Two people stay less than 1-metre for a few seconds.
Condition 3: When an object placed less or more than 1-metre in front of the user

Table 1 shows the result of all the condition. Each of these conditions reflected by the output shown on the OLED screen. Figure 6 and Figure 7 shows the message for all the condition above.

| Table 1: Status of the component in the social distancing detection system |
|---|---|---|---|
| Conditions | Buzzer | Vibrating motor | OLED Screen Display |
| 1 | Silent | Static | Safe |
| 2 | Buzz | Vibrate | Warning Message |
| 3 | Silent | Static | Safe |

Figure 6: Safe message displayed on the OLED screen for condition 1 and 3

Figure 7: Warning and keep social distancing message displayed on the OLED screen for a condition

As the PIR sensor minimum sensing range is 3-meter, the ultrasonic sensor is added into the bracelet to limit the sensing range to 1-metre. When an object is in front or nearby the user (condition 3), the buzzer will not buzz, and the vibrating motor does not vibrate. A safe message will be shown on the OLED screen to the user no matter how near the object is from the user. This is because the PIR
sensor sends a low signal to the Maker Nano as it does not detect humans. When there are people within 1-metre away from the user (condition 2), ultrasonic sensor and PIR sensor will send HIGH to the Arduino, trigger the buzzer to ring and motor to vibrate to alert the user and people around. Moreover, a warning message will be displayed on the OLED screen to remind the user to keep social distancing. Ultrasonic sensor and PIR sensor send LOW to the Arduino when there are no people around the user within 1-metre (condition 1). This means that the user is safe, the vibrating motor does not vibrate, and the buzzer has no sound.

There are three conditions in the temperature sensing system to be tested as listed below
Condition 1: Ice water placed close to the temperature sensor
Condition 2: Hot water placed close to the temperature sensor
Condition 3: Bracelet is worn on the wrist to sense user's body temperature

| Table 2: Status of the component in the temperature detection system |
|-------------------------|----------------------|--------------------------|
| **Conditions** | **Vibrating motor** | **OLED Screen Display** |
| 1 | Static | The temperature of the cold water |
| 2 | Vibrate | Warning Message |
| 3 | Vibrate when greater or equal to 37.5°C | Warning Message |
| | Static when less than 37.5°C | User's body temperature |

Table 2 shows the result of all the condition. Each of these conditions tested, and the output shown on the OLED screen and vibrating motor. Figure 8, Figure 9, Figure 10 and Figure 11 show the vibrating motor's status and the message for all the condition above.

**Figure 8:** Ice water's temperature reading displayed on the OLED screen for condition 1

**Figure 9:** Warning message displayed on the OLED screen for condition 2
Figure 10: Body temperature displayed on the OLED screen for condition 3
(body temperature < 37.5°C)

Figure 11: Warning message displayed on the OLED screen for condition 3
(body temperature ≥ 37.5°C)

The temperature sensing system, the temperature sensor, will continuously monitor the user's body temperature (condition 3). When the user's body temperature is greater or equal to 37.5°C, the bracelet vibrates by a vibrating motor and warning message to alert the user to see the doctor immediately. Buzzer sound is absent as an alert To avoid causing fear to people around the user. When the user's body temperature is lower than 37.5°C, the OLED screen will be shown the body temperature. The vibrating motor does not vibrate as Maker Nano does not trigger it.

The real-time clock (RTC) system, tested with three conditions:
- Condition 1: Lithium-ion battery connected to the bracelet
- Condition 2: Lithium-ion battery not connected to the bracelet
- Condition 3: Lithium-ion battery reconnected to the bracelet after the battery disconnected from the bracelet for a few minutes,

| Conditions | OLED Screen Display |
|------------|---------------------|
| 1          | RTC is running      |
| 2          | RTC continues running but a black screen on the OLED screen |
| 3          | RTC is running, display current date and time |

Table 3 displays statements on OLED in each condition. While Figure 12 and Figure 13 display the message on the prototype bracelet.
Figure 12: RTC continue running and current date and time displayed on the OLED screen for condition 1 and 3

Figure 13: RTC continues running and shows a black screen on the OLED screen for condition 2.

For a real-time clock system, the OLED screen will not display time when there is no lithium-ion battery connected to the bracelet (condition 2) as there is no power supply to Maker Nano. Thus OLED screen cannot function. The RTC is still running, although there is no lithium-ion battery connected because a small battery, CR2032, is embedded in the I2C module. CR2032 will continue to count the time, although the power source cut off. When a lithium battery reconnected, the OLED screen will show the current date and time and will not start from the date and time when the power source is cut off (condition 1 and 3).

The PIR sensors and ultrasonic sensor have a limited coverage area. The accuracy of distance sensing and object detection bound to the limitation of both sensors

4. Conclusion
In this project, a bracelet capable of detecting a distance of 1 meter has been successfully developed and tested with three conditions. These bracelets are also capable of tracking and storing the user's body temperature continuously. This procedure is a practical step to prevent the spread of the Covid19 pandemic as recommended by the WHO

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