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The Creation of a Social Distancing Reminder Armband out of Passive Infrared and Ultrasonic Sensors

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***Abstract*— The ongoing pandemic caused by COVID-19 is one of the biggest global health crisis ever faced by humanity and has spread throughout the world quickly (Chakraborty &Maity, 2020). With the uncertainty of identifying all positive cases, countries have imposed rules such as wearing masks, self-quarantine, and social distancing to reduce the spread of the virus. However, with the rise of COVID-19 vaccines and decrease in cases, people tend to forget the latter. The main objective of the study, which is to create a Social Distancing Wristband out of Infrared and Ultrasonic Sensors. The results showed that the device can accurately detect humans and objects that are up to 1.5 meters away with an average response time of 1.55 seconds, meaning that it quickly makes the wearer aware if someone is near or not. Therefore, the device can be beneficial to workers who work in places that have mass gatherings such as schools, offices, and workplaces since people in crowded places tend to forget the need to socially distance themselves from others. Future researchers may also use this study as a basis to create similar products. It is recommended to use larger sensors to detect a larger population of individuals and so that it could have multiple purposes. It is also recommended to make use of materials that are more durable and comfortable for the wearer. With better design, it can be applied economically and as well in the general public.**

***Index Terms*— Social Distancing Armband, Infrared Sensor, Ultrasonic Sensor, COVID–19.**

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I. INTRODUCTION

The ongoing pandemic caused by COVID-19 is one of the biggest global health crisis ever faced by humanity. COVID-19 has spread throughout the world quickly (Chakraborty &Maity, 2020). It has posed various economic, environmental, and societal problems. The transmission of the deadly virus was known to be through droplet and airborne transmission. With the uncertainty of identifying all positive cases, countries have imposed rules such as wearing masks, self-quarantine, and social distancing to reduce the spread of the virus.

COVID-19 can mutate itself into various types. Different strains of the viruses are being discovered by scientists, which gives even more problems. Scientists constantly need to find new cures for the variants. Thus, giving more reasons why health protocols must be observed. If social distancing methods are ignored, the virus could last for the upcoming generations (Aslam, 2020). It shows how severe the situation can get if people do not follow the rules and how important it is to maintain distance.

With the rise of COVID-19 vaccines and the decrease in cases, people tend to forget to follow the safety protocols, especially social distancing. Several people have become ignorant about the virus, which made them overlook the need for social distance. A mentality like this could lead to another wave full of COVID-19 cases. Even if multiple vaccines are developed to protect people from the virus, there are still high risks of obtaining the disease. Thus, social distancing policies and rules still need to be maintained throughout places containing risks of transmitting the virus. Due to strict implementation of social distancing rules, the country could avoid 84 percent of the potential COVID-19 cases and 66 percent of potential fatalities (Glogowsky, 2021). The study proved that social distancing is effective and could lead us to freedom from the pandemic.

Social distancing is not maintained because some people are not aware of the safe distance of at least one meter. From a study that was conducted by Moore et al. (2020), work responsibilities, as well as mental and physical health issues, were the main reasons why people did not follow social distancing. The same study also explained that young people ages 18-31 have the lowest compliance rate (52.4%). This

means that younger people are less compliant with social distance, meanwhile, older people have a better understanding and are more obedient to the social distance protocol.

This study aimed to create a social distancing reminder armband out of proximity sensors. It is an armband that alarms the user of social distancing from people. As the name implies, it is supposed to be worn on the arm with a band wrapping around it, similar to a bracelet or watch. It has a built-in ultrasonic sensor that can detect nearby people within a specific distance. When the sensor detects someone close, the buzzer located inside will release a sound, therefore alerting the user wearing the armband to step away.
The proximity sensor is a sensor that can identify the location of things within its range without actual contact. It is used to identify the presence of a target within a certain range. This sensor can also be used in vehicles for identifying the physical location of other vehicles and for parking assistance. It functioned by sending out a signal and detecting any significant changes in the signal that could be received again. The type of sensor that was used in this study is an ultrasonic sensor. Ultrasonic sensors depend on the interpretation or absorption of sound waves by objects within the sensor range.

After conducting various tests and trials, the social distancing armband can identify people and objects that are up to 1.5 meters away. Also, it has an average response time of 1.55 seconds, thus, it alerts the wearer immediately whether or not someone is nearby. meaning that it quickly made the wearer aware if someone is near or not. The sensor also has the ability to distinguish between things and people. As a result, the armband will only sound an alert when it is required.

The Social Distancing Armband can be useful for employees who work in settings with large numbers of people. The materials used for the product are affordable and can be even cheaper when it is mass produced. Thus, it can be used in places such as workplaces, companies, and schools, because people who work frequently overlook the necessity of maintaining a social distance from their peers. With such a tool, people wouldn't experience the strain of having to always look around since the armband will alert them.

Furthermore, the Social Distancing Armband can also be beneficial to the public, especially when they are in crowded places such as the market. It can serve as a way to avoid being close to people and being prone to crimes such as robbery. Additionally, it could also be used not only in human detection, but also in animal detection. Thus, the social distancing armband is not only made for social distancing as it can be made for multiple purposes such as maintaining safety.

Lastly, the study can help future researchers be inspired to create similar products with the same functionality. With using this study as a basis, future researchers can make use of better and more accurate sensors to help detect distances and people better. Thus, they could add more features, making the device more useful.

II. Research Questions

The objective of this study is to create a social distancing reminder armband out of proximity sensors. Specifically, this study aims to answer the following questions:

- What is the response time of the armband toward the people detected?
- How accurate is the detection range of the armband in terms of meters?
- How accurate is the armband in detecting humans?

III. Methodology

The study utilized the experimental research design. Tanner (2018) stated in his study that experimental research is a method used to determine the cause-and-effect relationship between the variables. In this study, the independent variables are the PIR sensor and ultrasonic sensor, while the dependent variable is the social distancing reminder armband. The researchers aimed to know whether proximity sensors can be used to make the study feasible. According to Bhandari (2020), the process of analyzing and collecting numerical data is called quantitative research. It is mainly utilized in identifying averages, making predictions, and testing causal relationships. The quantitative method was used in order to organize the experiment properly and to ensure that the right type of data is available to answer the research questions as clearly and efficiently as possible.

A.Research Locale

The research study was conducted in Philippine School Doha, Bldg. 01, St. 1008 Zone 56, Mesaimeer Area, P.O. Box 19664, Doha, Qatar. The location holds the facilities which enable the authors to make the product. It is also the optimal location where the researchers meet and discuss.

IV. Results

This study aimed at creating a Social Distancing Armband reminder out of Passive Infrared and Ultrasonic sensors. Below are the results and interpretation of data that were collected during the testing of the product.

1.) The average response time of the armband toward the people detected.

Table I
The Response Time of the Social Distancing Armband Towards Humans

Trials	1	2	3	Average
Photos				
Response Time in Seconds	1.48s	1.88s	1.30s	1.55s
Distance	1m	1m	1m	1m

Table 1 shows the response time of the armband detection towards humans. For this test, a stopwatch on a phone was used to record the response time of the armband detection. The response time for the first trial was 1.48 seconds, 1.88 seconds during the second trial and for the third trial, the response time was 1.30 seconds. To ensure fairness throughout all trials, the distance was set at one meter. Given the data of the three trials with their respective response time, it is shown that the third trial got the fastest response time having the same distance with the first and second trial.

Based on the data, the average time the sensor took to respond once a person came closer than 1 meter is 1.55 seconds. The results show that the sensor has a short delay in response time. Ultrasonic sensors function by sending out ultrasonic waves at around 40 KHz. After it is sent out, the sensor waits for a pulse to echo back so that it could send feedback to the microcontroller. The sensor can send and receive a pulse as quick as 20 times a second towards objects as far as 3 meters away (Latha Anju N et al., 2016).

2.) The accuracy of the detection range of the armband in terms of meters.

Table II
The Accuracy of the Social Distancing Armband Range

Trials	1	2	3
Distance in Meters	1m	0.6m	1.5m
Pictures			
Range Detected	100cm	60cm	150cm

Table 2 shows the accuracy of the armband in object detection. In the first trial, the distance of the person from the sensor was 1 meter and it was accurately detected. On the second trial, the distance that was measured was 0.5 meters and the distance detected was also accurate. On the last trial, it detected a measurement of 1.5 meters and the sensor was also able to detect a distance of 1.5 meters. It is important to have an accurate measurement since infection attack rates are highly alleviated when all available social distancing measures are imposed and followed (Milne &Xie, 2020).
As presented in the table above, the device can successfully detect up to 7 people. The results show that the device is not capable of detecting all masks from the past 7 participants. The lighting in the room proved to be an issue when testing the Face Mask Detecting Alarm System's ability to detect the masks of the participants. Illumination as a factor progressively worsened the performance in face identification under incongruent lighting conditions (Lim et al., 2022).

3.) The Accuracy of the Face Mask Detecting Alarm System in identifying if face mask is properly worn

Table III
The Accuracy of the Social Distancing Armband in identifying if face mask is properly worn

Trials	1	2	3
Distance	1m	0.5m	1.5m
Pictures			
Detected	NO	NO	NO

Table 3 shows the accuracy of the armband in object detection. In the first trial, the distance of the object from the sensor was 1 meter and the object was not detected. On the second trial, the distance that was measured was 0.5 meters and the object was not detected. On the last trial, it detected a measurement of 1.5 meters and the object was still not detected. The results show that the armband sensor is capable of detecting an object or human within the 1 meter range. This was made possible by the Infrared sensor which detects human presence through the radiation of body heat and movement (Narayana et al., 2015).

V. Discussion

The COVID-19 outbreak and the spread of other illnesses such as influenza still remains a problem in the present. It is known that such diseases can easily scatter primarily through contact when an infected person coughs or sneezes (Agusi et al., 2020). Thus, various countries imposed rules such as mandatory face masks and social distancing. However, with the decrease of COVID-19 cases, people have begun to overlook the need to socially distance themselves from each other in public despite knowing the dangers. Rising levels of ignorance within the community waste efforts to contain the virus result in more cases and deaths (Shewamene et al., 2021).

With the use of a PIR and Ultrasonic sensor to detect distance and motion, this study aimed to create a social distancing armband that reminds people to separate themselves from people in public when they tend to forget or ignore. Once the device detects that a person is within a 1 meter radius, a buzzer sounds to alert the wearer to move away to a safer distance.

Based on the results from tests and trials, the social distancing armband has the ability to detect humans and objects that are up to 1.5 meters away. It also has an average response time of 1.55 seconds meaning that it quickly makes the wearer aware if someone is near or not. Furthermore, the sensor is also capable of differentiating objects and humans. Thus, the armband will only alert people when it is necessary.

Results showed that the Social Distancing Armband can be beneficial to workers who work in places that have mass gatherings such as schools, offices, and workplaces since people who work usually tend to forget the need to socially distance themselves from their peers. With such a device, they would not feel the pressure of having to always look around them since the armband will alert them.

Additionally, this study can inspire future researchers to create products that have a similar use. Future researchers could make use of better and more accurate sensors in detecting distances and people and they could also add more features to the device. They may use vibrations so that it may be applicable for people who are handicapped.

To further enhance the performance of the Social Distancing Armband, it is recommended to add and make use of bigger sensors to detect a wider area of people. It is also advised to make use of more durable materials to enclose the breadboard and sensor to make it more stable and comfortable for the wearer. By adding more sensors, and making use of more affordable and comfortable materials, the social distancing wristband could be used for multiple purposes. For example, it can be applied in detecting not only humans, but also animals. For it to be even more practicable, it is recommended that future researchers think of a better design so that it may be used commercially and in the public. It can aid in avoiding crimes such as robbery in crowded places, since it would alarm wearers to avoid being close to people. Lastly, it is also suggested to remove the breadboard by soldering the wires and compressing it into one spot such as the waist to avoid long and messy wires.

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