BATTERY-POWERED DEVICE FOR MONITORING PHYSICAL DISTANCING THROUGH WIRELESS TECHNOLOGY

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Abstract
One method for preventing the spread of the coronavirus and other contagious diseases is through social distancing. Therefore, creating a tool to measure and quickly discover the precise distance is necessary. In order to prevent physical contact between individuals, this study aimed to detects individuals' physical distance, through an inaugurated battery-powered device that monitors physical distance through wireless technology. Specifically, in public or crowded areas, to lessen the spread of the virus. This study focuses on detecting people's physical distance in the region of interest utilizing an Ultrasonic and VL53L0X sensors and determining the significant difference between the two sensors in monitoring physical distance. This study employs an applied experimental research design. The efficiency of both sensors in measuring physical distance was evaluated through analysis. The Ultrasonic and VL53L0X sensors underwent 15 tests. Furthermore, the researchers effectuated a t-test to determine the significant difference between the two sensors. Data gathered revealed that the sensors' combined mean in terms of measuring physical distance indicates that the ultrasonic sensor performed better than VL53L0X, measuring 134.7 cm, notwithstanding 99.8 cm for the VL53L0X sensor. Complementary to this, the results of the t-test show that the VL53L0X sensor and Ultrasonic sensor have a significant difference in terms of distance precision.

Keywords: *Social Distancing, Ultrasonic Sensor, VL53L0X Sensor, Battery-powered device*

INTRODUCTION

People are affected differently by the COVID-19 pandemic, which is still spreading worldwide; COVID-19 is an infectious respiratory disease that originated in Wuhan, China, in December 2019 (Zhu et al., 2020). As of November 10, 2020, there are approved but with emergency approval COVID-19 therapies or vaccinations, despite the success stories of recovered cases. The current approaches focus on containment, surveillance, and prevention as the pandemic spreads. This makes the use of cutting-edge technologies to combat COVID-19 inevitable. Nowadays, social distancing is one of the most effective methods for avoiding COVID-19, but sustaining at 1.5 meters is tough, it is difficult to implement because people often need to remember to maintain this distance in a public place (Malik, 2020). World Health Organization and the Centre for Disease Control have recognized social distancing as the most effective way to slow down the spread of the coronavirus (Painter, 2020) since it allows people to maintain a certain distance from one another, thereby minimizing physical contact with virus carriers. Physical distancing helps limit the spread of COVID-19 (COVID-19, n.d.-c). By practicing social distancing, one is not only protecting oneself but other companions as well.

Although the signs and symptoms of coronavirus may appear 2-14 days after exposure (COVID-19 and Your Health, 2020), one could still bring the virus and pass it to others without noticing it. Any person of any age can end up being infected with the coronavirus which could be mild to severe; According to Chatterjee (2020), Older people are more susceptible to the disease and vulnerable to psychological pressure. By distancing oneself socially, one saves those most prone populations of individuals (Care, 2022).

The concept of social distancing may be more challenging than physical distancing, given the rising complexity of viruses and the fast expansion of social interaction and globalization. It encompasses numerous non-pharmaceutical activities or efforts to reduce the spread of infectious diseases, including monitoring, detecting, and alerting people. Different technologies can assist in maintaining a safe distance (i.e., 1.5 m) between individuals. In real-time, several wireless technologies can monitor people and public locations (Murad, 2022). Despite strong recommendations to maintain at least a one-and-a-half-meter distance between the persons, physical distancing has an adverse effect if not carefully followed since COVID-19 is an easily transmitted virus. Due to COVID-19, the world faces unprecedented challenges, and to address these challenges, many digital tools have been explored and developed to contain the spread of the virus (Jahmunah et al., 2021). Various scholars conducted studies that explored aspects of stationary technologies that help reduce the contagious spreading of the COVID-19 virus through Wi-Fi and Cellular technologies using chest Computed Tomography (CT) or X-ray images and three mobile apps. In some studies, wireless technologies, such as Bluetooth and global navigation satellite systems, were used. This technology can be used for COVID-19 contact tracing activities, especially crowd detection, especially in public places and to maintain a safe distance between two or more people to enhance social distancing. However, this technology requires most of the population to use smartphones and permanently activate Bluetooth to allow social distancing apps to collect proximity data and close contacts, which has security and privacy implications. Also, this technology can only be used by people with smartphones IEEE Access (Nguyen et al., 2020). Similar studies also used tools that provide people with social distancing alerts. Hence, a wrist-worn tool vibrates to notify the wearer about the distance between him/her and the next person wearing a similar device.

Social distancing is an effective means of containing the spread of COVID-19, but only if we all participate (Pedersen, 2020). However, there are still instances when many people forget to maintain physical distancing in public. To overcome this situation, a battery-powered device technology is proposed in this paper to maintain physical distancing. The device will help to maintain physical distancing for every individual. The device has an alarm which indicates the user is violating approximately a 1-meter distance. This project uses an ultrasonic sensor and VL53L0X sensor to assist social distancing procedures. The ultrasonic sensor and VL53L0X sensor are two distinct kinds of micro-sensors. This method of social distancing through a battery-powered device is a convenient way to follow physical distancing. It is also accessible to the users and it will not harm everyone near the users. This study aimed to determine the effectivity of a battery-powered device in measuring physical distancing in the community using an Ultrasonic sensor and VL53L0X sensor. The researchers and this study intended to help the community be provided with a device to help them do physical distancing. A device that they can easily attach and will make them aware of placing themselves at the proper distance to avoid contagious diseases.

Objectives

The general objective of this study was to create a battery-powered device that can measure physical distancing through wireless technology.

Specifically, this study aimed to:

1. develop a battery-powered device using;
   a. ultrasonic sensor,
   b. VL53L0X sensor, and
2. determine the effectivity of the battery-powered device in terms of distance precision using;
   a. ultrasonic sensor,
   b. VL53L0X sensor, and
3. determine the significant difference in the effectivity of the battery-powered device in terms of distance precision using;
   a. ultrasonic sensor, and
   b. VL53L0X sensor?

METHODS

Research Design

This study mainly focused on robotics and the electronic circuitry of a device that aims to ensure and monitor social distancing between individuals. This study did not extend to the more advanced features like detecting diseases, heart rates, clocks, etc. Yet, it only focused on detecting the distance between individuals, developing an electronic battery-powered device, determine the effectivity and the significant difference of the effectivity of an electronic battery-powered device in terms of distance precision using ultrasonic sensor and VL53L0X sensor.

RESULTS and DISCUSSION

Effectivity of battery-powered device in terms of distance precision using ultrasonic sensor and VL53L0X sensor

Table 1. Shows the Effectivity of battery-powered device in terms of distance precision using ultrasonic sensor and VL53L0X sensor.

No. of attempts	Ultrasonic Sensor	VL53L0X Sensor
1	135 cm	96 cm
2	134 cm	94 cm

3	131.5 cm	105 cm
4	135.2 cm	104 cm
5	131.6 cm	98.3 cm
6	134.4 cm	92.5 cm
7	136.5 cm	94.6 cm
8	132.4 cm	98 cm
9	133.5 cm	104 cm
10	132.5 cm	92 cm
11	135.5 cm	107 cm
12	133.5 cm	100 cm
13	132.5 cm	100.5 cm
14	131.4 cm	100 cm
15	131.8 cm	101 cm
Mean	133.42 cm	99.13 cm

Table 1 presents the data obtained during 15 attempts to determine the effectiveness of the two sensors in terms of distance precision. The two sensors are both effective because they can both sense a motion or object. However, it varies when it comes to distance precision. The VL53L0X sensor only got its highest distance at 107 cm on the 11th attempt and 92 cm is the approximate distance on the 10th attempt. On the other hand, in the ultrasonic sensor, it got its highest distance at 136.5 cm on the 7th attempt, while it got 131.4 cm approximate distance on the 14th attempt.

Out of the 15 attempts, the ultrasonic sensor got a mean distance of 133.42 cm while the VL53L0X sensor had a mean of 99.13 cm. It is evident that ultrasonic is more effective than the VL53L0X sensor in terms of distance precision, based on the results VL53L0X has a lesser mean score than the ultrasonic sensor which indicates that ultrasonic can read long distances as compared to the VL53L0X sensor.

Significant difference in the effectiveness of the battery-powered device in terms of distance precision using Ultrasonic Sensor and VL53L0X Sensor

Table 2. Shows the Significant difference in the effectiveness of the battery-powered device in terms of distance precision using Ultrasonic Sensor and VL53L0X Sensor.

	Mean	**SD**	**p-value**	**t-value**	**Interpretation**	**Decision**
Ultrasonic sensor	133.42	1.63				
VL53L0X sensor	99.13	4.66	<0.0001**	26.89862	Significant	Reject **Ho_1**

** significant at a= 0.05

Table 2 shows the t-test on the significant difference in the effectiveness of the battery-powered device in terms of distance precision using an ultrasonic and VL53L0X sensor. The results revealed that the computed p-value of the VL53L0X sensor is equal to 0.00001. Since it is lesser than the 0.05 level of significance, Ho_1 is therefore rejected. This implies that there is a significant difference between the ultrasonic and VL53L0X sensor in terms of distance precision. It is because the ultrasonic sensor offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package from 2 cm to 400 cm (TutorialsPoint, 2). On the other hand, VL53L0X sensor is useful for estimating the distance directly in front of it since it uses a very narrow light source (VL53L0X, nd). Therefore, the ultrasonic sensor is significantly more effective than the VL53L0X sensor in terms of distance precision since there is a significant difference in the t-test done.

CONCLUSIONS

Based on the results of the study, it is concluded that in terms of distance precision, ultrasonic sensors are more effective compared to the VL53LOX sensor. Ultrasonic sensors can provide highly accurate measurements and good range information. Therefore, the utilization of ultrasonic sensors is more effective in creating a battery-powered device that can measure physical distance through wireless technology.

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