Contactless Doorbell with the Use of an Ultrasonic Sensor

Barañao, Elmerson L., MAEd [a], Darleen F. Alayon [b],
Sofia Gabrielle V. Pelaez [c], Reese David P. Larrauri [d]

a,b,c,d *Philippine School Doha, Doha, Qatar*

a,b,c,d Research Development, Accreditation and Publication Office, PSD, Doha,

Abstract: The objective of this study is to create an improvised contactless doorbell with the use of an ultrasonic sensor to detect the person and give alert using a buzzer which could be used for distance measurement without physical contact for small distances. The output of the study will help reduce the virus transmission and promote household secure safety and convenience of usage since this type of doorbell does not need to have a button for someone to press in order for it to chime instead, the only thing needed for the device to work is the visitor's movements. Its unique features used ultrasonic sensors to emit and receive ultrasonic pulses that relay information about the proximity of an entity. The Arduino Nano will be used to interpret signals detected by the sensor. Results of the study showed that a contactless doorbell has proved its consistency in terms of the function's efficacy during the time interval for the command to be executed after the object is detected. It also revealed that an average of 0.29 seconds that the contactless doorbell was able to establish its consistency. Further, the contactless doorbell has shown its efficacy in its ability to detect things at distances of one centimeter, two centimeters, and five centimeters. Transforming our traditional doorbells into a contactless doorbell is indeed an innovation that is timely in helping mitigate the spread of virus.

Keywords: Ultrasonic sensor, Contactless doorbell, Arduino Nano, Function efficacy

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1. Introduction

One of the essential things needed in your humble abode should be a doorbell. A doorbell is a signaling device that is often installed near a building's entrance door. When a visitor hits the button, an internal bell rings, alerting the occupants to the visitor's presence. It works louder and clearer rather than just knocking. A doorbell before consisted of an actual bell that one had to pull with a rope in order to hear it chime, but today, a doorbell now is mechanical and with just one push of a button, it announces your arrival. However, with this ongoing pandemic, we shouldn't be touching anything from outside of our house as we contribute more to the spreading of germs everywhere around us, which is not what we want right now. Thus, the making of a contactless doorbell. A contactless doorbell is a type of doorbell that does not need to have a button in order for it to chime. Instead, the only thing needed for the device to work is the visitor's movements. Movements such as waving one's hand at a certain distance in front of the doorbell would be enough for the device to start working. With the motion from the visitor detected, it activates the alarm, and the alarm notifies the owner of the house of your arrival. This research will be utilizing the use of ultrasonic sensors due to their effectiveness. An ultrasonic sensor is a device that uses ultrasonic sound waves to determine the distance to an item. A transducer is used in an ultrasonic sensor to emit and receive ultrasonic pulses that relay information about the proximity of an entity. The Arduino Nano consists of a Digital and Analog pin. These pins have a variety of functions, but their primary purpose is to be set as Input/Output. When you link Arduino Pins with sensors, they work as Input Pins, but when you're driving a load, you'll need to utilize them as Output Pins. Most control actuators move in response to analog inputs from sensors that measure natural parameters like temperature, pressure, and flow rate. Computers, on the other hand, can only process digital signals. As a result, a device that can bridge the

analog signal and the digital signal handled by the computer is required in order to enter a signal from a sensor using a computer or to output a signal to an actuator, which is where the Arduino Nano comes in. The Arduino Nano will be used to interpret signals detected by the sensor.

1.1 *Background of the Study*

How often are we aware of the objects that we touch in a day? Just how many germs and bacteria are on these said objects? Research shows that an average person makes contact with 140 objects and counting in a day. With those objects come many germs and bacteria. It is said that people come across 60,000 types of germs daily. You would be surprised by the number of germs that our daily objects have. It is reported that the dirtiest objects people use daily are wallets, remote controls, laundry machines, cutting boards, phones, purses, buttons, shopping carts, and so much more. Though it is not only objects that people touch, it is also their faces. Citroner (2020) indicates that people touch their faces 16 times a day. This action is done naturally, without our conscience. However, with the pandemic, one should be mindful of the objects they interact with. The most obvious yet helpful way to help end the spread of the pandemic is to always wash your hands. CDC (2021) states that a person should wash their hands for 20 seconds or more, and to use a hand sanitizer with at least 60% alcohol in it. According to studies, the virus can stay on plastic and stainless steel for up to three days. In the span of three days, the virus is certain to be caught by someone. Our study aims to help solve this issue with the contactless doorbell as it is a device that would help reduce and prevent the disease, which results in saving more lives.

1.2 Statement of the Problem

The objective of this study is to create a contactless doorbell using an ultrasonic sensor. Specifically, this study aims to answer the following: (1) How long is the time interval for the command to be executed after the object is detected? (2) What distance can the Ultrasonic Sensor successfully detect the object to activate the contactless doorbell in terms of the following distances: (2.1) 1 centimeter; (2.2) 2 centimeters; and (2.3) 5 centimeters?

1.3 Significance of the Study

The results, recommendations, and implications of this study may help different sectors along with significant contributions to the following:

A. Philippine School Doha (PSD) Community

This study will benefit the Philippine School Doha (PSD) community as the aim of the research is to contribute in the lessening of the ongoing virus, Covid-19, which undoubtedly affects us all.

B. Philippine and Qatar Community

Our research will help the Philippine and Qatari community since it will encourage people to always be safe and follow safety precautions. The contactless doorbell will protect individuals from spreading diseases and from touching needless objects, which worsens the situation.

C. Home Owners

Through this contactless doorbell, home owners can limit the transmission of viruses thus reducing public health threats. In addition, home visits and deliveries will be safer for everyone.

D. Future Researchers

The findings, data, and material presented in this study can be utilized as references for future researchers relating to contactless doorbell research. They might utilize this study to check the validity of other studies in the field. Errors in their studies will be reduced as a result of this research, as will the usage of similar factors and procedures to produce higher-quality products.

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1.4 Related Literature and Studies

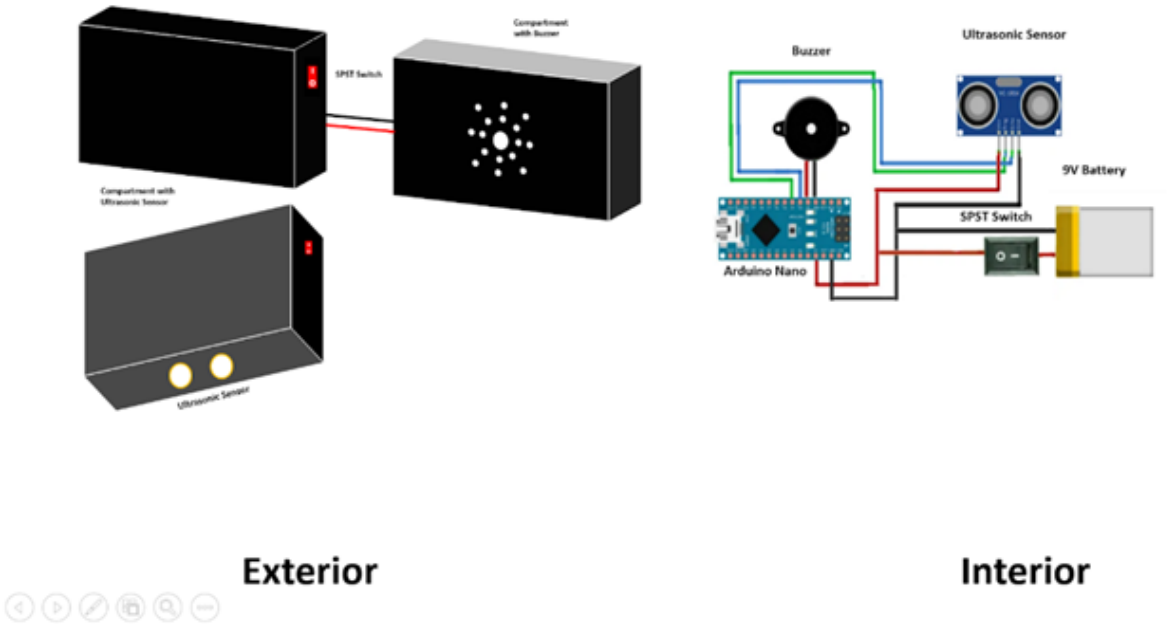
Ultrasonic Sensors An ultrasonic sensor is a device that uses ultrasonic sound waves to determine the distance to an item. A transducer is used in an ultrasonic sensor to emit and receive ultrasonic pulses that relay information about the proximity of an item. Aman & Soni (2018) conducted research titled “Distance Measurement of an Object by using Ultrasonic Sensors with Arduino and GSM Module ", they used a device to calculate the distance between two points. It can identify things between the dimensions of 2cm and 450cm (.78" and 14'9"). To convey the distance found, the instrument uses two digital pins. The Ultrasonic Range Detection Sensor sends out a 40 kHz ultrasonic pulse, then waits and listens for the pulse to return, computing the time in microseconds. We can send out a pulse as rapidly as 20 times per second, and it can detect objects up to 3 meters away and as close as 3 centimeters away. A 5V power supply is required to run the sensor. The trigger input requires a 10uS pulse to initiate the ranging process, after which the module will send out an 8 cycle burst of ultrasound at 40 kHz. The module will give out an 8cycle burst of ultrasound at 40 kHz and raise its echo after receiving a 10uS pulse on the trigger input to start the ranging. An echo is a distance object that is proportional to pulse width and range. Then, using the time gap between transmitting the trigger signal and receiving the echo signal, figure out the range. Additionally, Arun (et al., 2019), stated in their research titled “Object Detection Using Ultrasonic Sensor” that the Ultrasonic Sensor's transmitter emits ultrasonic waves in a specific direction, and the timing begins when the waves are emitted. Ultrasonic waves travel through the air and are quickly returned when they come into contact with any item in their path. The ultrasonic sensor's receiver interrupts the timing that was initiated by the transmitter when the reflected wave is received. Because the velocity of ultrasonic waves is 340m/s, the distance between the intended target and the transmitter is computed using the formula s=340t/2. The time difference distance measurement principle is what it's called. To add to that, Aguila (et al., 2019) said in their research entitled "Development of Smart Waste Bin with Integrated Volume and Weight Sensor" that Solid waste is a problem that keeps on increasing as the population of a country grows. Proper waste management is one solution that would help maintain our green environment. The proposed system will alert the municipality through the application when the measured waste level is at a certain point. The proposed system consists of an ultrasonic sensor to measure the volume of the bins, the load cell to measure the weight of the bin, and an Arduino Uno which controls the system operation. As soon as it reaches a certain point the Arduino will send a notification to the person in charge, so that the waste can be collected immediately.

Arduino Nano Remot & Silverio (2020) expressed in their research titled “Low-Cost Elderly Healthcare Monitoring System.” The Arduino Nano is a microcontroller with 14 digital 1/0 pins, 6 analog inputs, and an l0-bit analog to digital converter based on the popular ATmega328P processor. Arduino may use the Global System for Mobile Communications (GSM)/General Packet Radio Service (GPRS) module to call, send, and receive text messages." In addition to that, Adlaon (et al., 2019) said in their study entitled "Microcontroller-based Vessel Passenger Tracker using GSM System: An Aid for Search and Rescue Operations" The Philippine Maritime Transport business has grown through time and has been a driving force behind the country's economic growth. Even though marine transportation is one of the country's main businesses, the safety equipment and technology employed are in a slow period of change. When a vessel is in peril, the study's goal is to design and create a system that will detect an overboard passenger. For search and rescue operations, the system includes a Global Positioning System (GPS) for location data, Global System for Mobile (GSM) communications for transmission and reception of emergency messages, an Arduino-Nano

microcontroller for processing, an inflatable life jacket with signal light, and a rescue update display using an organic light-emitting diode (OLED).

Contactless Doorbell The study's main goal is to create a contactless doorbell with the use of an ultrasonic sensor. As stated by Ursan (2020), The doorbell is a frequently touched surface, and with a contactless doorbell, we can decrease the danger of infection. A contactless doorbell works when we place our hand near the sensor, the buzzer will sound, indicating that someone has rung. He also stated that whenever a person arrives at our home, instead of pressing the bell, the person can raise their hand at a distance of around 10cm so that the ultrasonic sensor can sense the presence of a person and the bell will ring automatically.

1.5 Schematic Diagram



This schematic diagram shows what the final exterior and interior views look like. Additionally, it shows the passage of how everything is connected from the Junction Box with Lid to the Ultrasonic Sensor.

2. Methodology

2.1. Research Design

The study will use the experimental method of research in order to make a motion presence alarm using an ultrasonic sensor. According to Questionpro.com, Experimental research is a scientific approach to research, where

one or more independent variables are manipulated and applied to one or more dependent variables to measure their effect on the latter. The effect of the independent variables on the dependent variables is usually observed and recorded over some time, to aid researchers in drawing a reasonable conclusion regarding the relationship between these 2 variable types. The characteristics of this method will be used as a tool to determine if the contactless doorbell can be made using an ultrasonic sensor. This method also includes a hypothesis, a variable that can be manipulated by the researcher, and variables that can be measured, calculated, and compared.

2.2. Research Locale

The study will take place in Philippine School Doha, Qatar. The researchers selected the place for the reason that the researchers spend the majority of their time there since it is their school. Moreover, most of the research will be done in the said setting. Philippine School Doha is located in Al Khulaifat Al Jadeeda St. (St. 1011) Messaimeer Area.

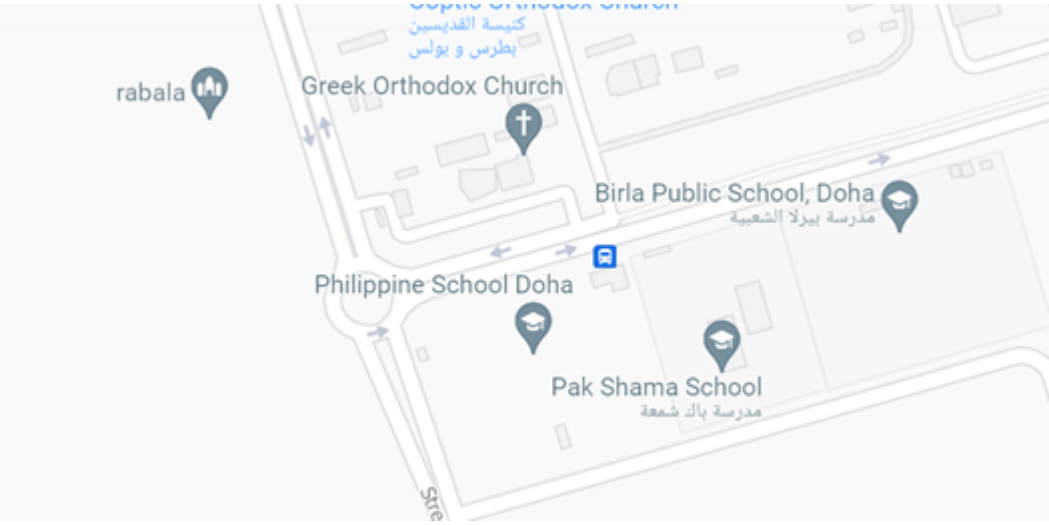


Figure 1: Map of Philippine School Doha
Retrieved from: Google Maps (2021), Map of Philippine School Doha

2.3. Research Procedure

The procedure shows the step-by-step process that shows and instructs how to make a contactless doorbell with the use of an ultrasonic sensor. Some of the steps listed in the process down below are referenced from a video by Awesome Inventive (2020).

Ensuring protection and maintaining safety: (1) Wear personal protective equipment such as safety goggles, safety gloves, safety shoes, and a laboratory coat while performing the procedures below to avoid hazardous conditions. **Creating holes in the junction box:** (1) On one junction box compartment, create a hole on the left side of the compartment, this is where the SPST Switch will be placed. (2) On the same junction box compartment, create two holes on the bottom, this is where the Ultrasonic Sensor will be placed. This

compartment will be compartment 1. (3) On one junction box lid, draw two circles, one bigger than the other. (4) Place marks on both circles. (5) Create holes from where the marks were placed on the junction box lid. This compartment will be compartment 2. **Spray painting the junction box:** (1) Prepare newspapers and lay them out on a flat surface, this is where you will spray paint the junction boxes. (2) Separate the junction box lids and compartments. (3) Sandpaper the junction box parts. This is to ensure that the spray paint will stick to the junction box parts. (4) Lay the lids and compartments of the junction boxes, face down. (5) Spray the parts of the junction box with black spray paint. (6) Wait for them to dry. **Connecting the wires:** (1) Cut one end of an orange female to female pin connector wire. (2) Pass the orange female to female pin connector wire from one of the holes of the junction box in compartment 1 and connect it to the D6 pin of the Arduino Nano. (3) Solder the cut end of the orange female to female pin connector wire to the red wire of the buzzer. (4) Cut one end of a white female to female pin connector wire. (5) Pass the white female to female pin connector wire from one of the holes of the junction box in compartment 1 and connect it to the GND pin of the Arduino Nano. (6) Solder the cut end of the white female to female pin connector wire to the black wire of the buzzer. (7) Solder the black wire of the 9V battery connector to the connection of the white female to female pin connector wire and the black wire of the buzzer. (8) Place the SPST switch to the hole that is located on the left side in compartment 1. (9) Solder the red wire of the 9V battery connector to the input plate of the SPST switch. (10) Cut one end of an orange female to female pin connector wire. (11) Solder the cut end of the orange female to female pin connector wire to the output plate of the SPST switch. (12) Connect the other end of the orange female to female pin connector wire to the VIN pin of the Arduino Nano. (13) Connect one purple female to female pin connector wire to the GND pin of the Arduino Nano. (14) Connect the other end of the purple female to female pin connector wire to the GND pin of the Ultrasonic Sensor. (15) Connect one yellow female to female pin connector wire to the 5V pin of the Arduino Nano. (16) Connect the other end of the yellow female to female pin connector wire to the VCC pin of the Ultrasonic Sensor. (17) Connect one blue female to female pin connector wire to the D3 pin of the Arduino Nano. (18) Connect the other end of the blue female to female pin connector wire to the Echo pin of the Ultrasonic Sensor. (19) Connect one green female to female pin connector wire to the D4 pin of the Arduino Nano. (20) Connect the other end of the green female to female pin connector wire to the Trig pin of the Ultrasonic Sensor. **Programming the Arduino Nano:** (1) Attach one end of the data cable to the Arduino Nano. (2) Attach the other end of the data cable to a laptop. (3) Open the Arduino Software. (4) Input the program, verify it, and upload it to the Arduino Nano microcontroller using the USB cable. **Organizing the compartments:** (1) Place the lids on top of their respective containers. (2) Place the flathead screws in the screw terminals. (3) Screw the flathead screws in the screw terminals.

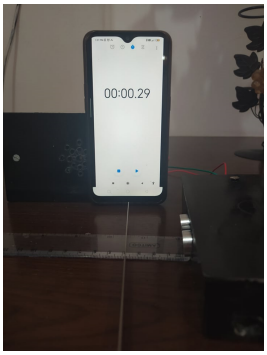
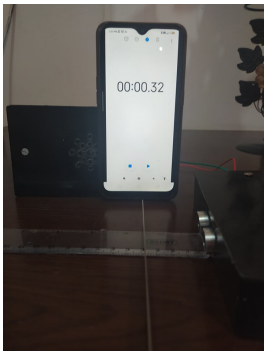
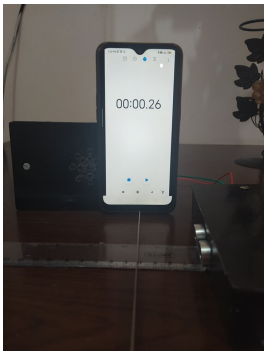
2.4 Research Testing Procedure

The following is the testing procedure to measure the time interval it takes for the command to be executed after the object is detected. (1) Measure the time interval for the command to be executed after the object is detected by following these steps: (1.1) Connect a 9V Battery to the 9V Battery Connector. (1.2) Once connected, switch it on from compartment 1 with the SPST switch. (1.3) Place an object, such as your hand, in front of the sensor of the contactless doorbell. (1.4) Measure the time it takes for the buzzer of the contactless doorbell to be set off by using a stopwatch. The following is the testing procedure to measure the distance the Ultrasonic Sensor can successfully detect the object to activate the contactless doorbell. (1) Test whether the Ultrasonic Sensor of the

contactless doorbell can successfully detect the object within 1 centimeter, 2 centimeters, and 5 centimeters of its radius to activate the contactless doorbell by following these steps: (1.1) Place a ruler on a flat surface. (1.2) Place an object, such as your hand, within 1 centimeter, 2 centimeters, and 5 centimeters in front of the sensor of the contactless doorbell. (1.3) Wait for the buzzer of the contactless doorbell to set off. (1.4) Listen to the buzzer of the contactless doorbell if it sets off for distances 1 centimeter, 2 centimeters, and 5 centimeters.

2.5 Interpretation of Data

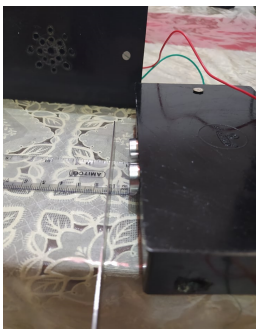
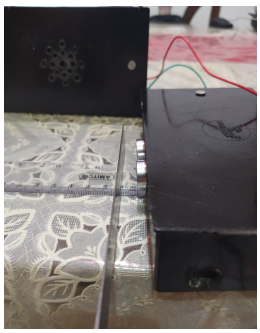
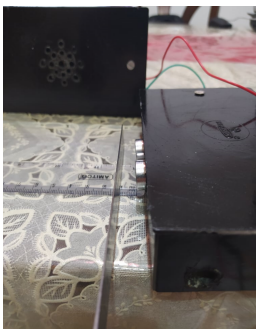
(1) How long is the time interval for the command to be executed after the object is detected?

Trials	First Trial	Second Trial	Third Trial
Time Interval	0.29 seconds	0.32 seconds	0.26 seconds
Photos			

The researchers assessed the time interval for the command to be executed by the contactless doorbell after the object is detected by placing an object in front of the Ultrasonic sensor and monitoring how quickly the sensor responded to the object by using a stopwatch application to measure the time. The first data shows the time interval for the command to be executed after the object is detected. Furthermore, the first data depicts the product's various trials, which were used to determine its accuracy. On the first trial, the command was executed 0.29 seconds after the object was detected. On the second trial, the command was executed 0.32 seconds after the object was detected. Lastly, on the third trial, the command was executed 0.26 seconds after the object was detected. Further investigation of the findings shows that there are slight changes in the time interval for the command to be executed after the object is detected. The average time interval for the command to be executed after the object is detected is between 0.29 seconds.

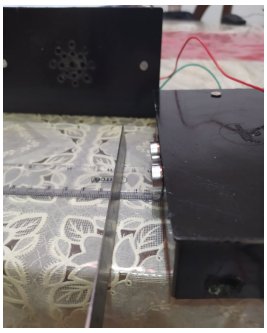
(2) What distance can the Ultrasonic Sensor successfully detect the object to activate the contactless doorbell in terms of:

(2.1) 1 centimeter?

Trials	First Trial	Second Trial	Third Trial
	Object Detected	Object Detected	Object Detected
Photos			

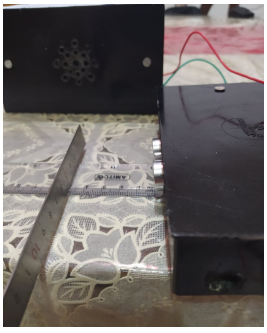
The researchers tested the distance that the Ultrasonic Sensor can successfully detect an object to activate the contactless doorbell by placing an object in front of the Ultrasonic sensor and checking if the contactless doorbell turned on. The second data reveals the successfulness of the Ultrasonic Sensor in detecting an object within 1 centimeter of its radius. In the first trial, the object was detected successfully, thus activating the contactless doorbell. In the second trial, the object was detected successfully, which turned on the contactless doorbell. In the third trial, the object was detected successfully, thereby triggering the contactless doorbell. Aman and Soni (2018) stated that the Ultrasonic Sensors can detect objects as close as 3 centimeters but based on the findings, the Ultrasonic Sensor can detect objects at 1 centimeter.

(2.2) 2 centimeters?

Trials	First Trial	Second Trial	Third Trial
	Object Detected	Object Detected	Object Detected
Photos			

By placing an object in front of the Ultrasonic sensor and seeing if the contactless doorbell switched on, the researchers were able to determine the distance at which the Ultrasonic Sensor can effectively identify an object to trigger the contactless doorbell. The third data illustrates the Ultrasonic Sensor's effectiveness in detecting an object within 2 centimeters of its range. The object was successfully recognized in the first trial, resulting in the contactless doorbell being activated. The object was successfully spotted in the second trial, leading to the contactless doorbell being triggered. The object was successfully detected in the third trial, prompting the contactless doorbell. An article made by Frenzel (2018) said that “The frequency determines range and resolution; the lower frequencies produce the greatest sensing range. At 58 kHz, a commonly used frequency, the measurement resolution is one centimeter (cm), and range is up to 11 meters.” The results are backed up by the article as the ultrasonic sensor can detect objects that are 2 centimeters away.

and **(2.3) 5 centimeters?**

Trials	First Trial	Second Trial	Third Trial
	Object Detected	Object Detected	Object Detected
Photos			

The researchers were able to assess the distance at which the Ultrasonic Sensor can successfully recognize an object to trigger the contactless doorbell by placing an object in front of the Ultrasonic sensor and examining if the contactless doorbell switched on. In the fourth data, the Ultrasonic Sensor's ability to detect an item within 5 centimeters of its range is shown. The contactless doorbell was activated once the object was correctly detected

during the first trial. The contactless doorbell was actuated after the item was properly identified in the second trial. The contactless doorbell was sounded when the object was correctly spotted in the third trial. In conclusion, the ultrasonic sensor can successfully detect an object that are 1 cm, 2 cm, and 5 cm away from the ultrasonic sensor. According to tutorialspoint.com, the HC-SR04 ultrasonic sensor provides outstanding non-contact range detection with high precision and reliable readings in an easy-to-use design as it can detect ranges from 2 cm to 400 cm (1" to 13 feet). But what the study has discovered is that the ultrasonic sensor can detect objects that have a range of 1 cm. Additionally, the distance covered by the ultrasonic sensor that can successfully detect the time interval for the command to be executed is inversely proportional to the convenience of the consumers. This means that the higher the distance and the lower the time interval, the more it is convenient to the consumers.

2.6 Conclusions

The findings based on the statistical analysis of data lead to the following conclusions: (1) The contactless doorbell has proved its consistency in terms of the efficacy of its function based on the data gathered during the time interval for the command to be issued after the object is detected. (1.1) As it showed an average of 0.29 seconds, it can be said that the contactless doorbell was able to establish its consistency. This means that after testing the product in terms of time interval, the results in trial one, trial two, and trial three are the same. The result positively affects the product's importance because no matter the distance of the object, the contactless doorbell does not fail to react right away. 0.29 is a good time for reaction as it is fast and effective. (2) The contactless doorbell has shown its efficacy in its ability to detect things at distances of one centimeter, two centimeters, and five centimeters in order to activate it. Testing the product to detect motion at various distances is beneficial as we can know if the contactless doorbell can still work the same even if the object was detected at either one centimeter, two centimeters, or even five centimeters. Additionally, the contactless doorbell is more favorable than other ones from the store as the doorbell can detect motion efficiently, and can detect the object successfully at various distances.

2.7 Recommendations

Based on the experimental findings of the study, the following are recommended: (1) **Qatar community** especially the households may consider transforming their traditional doorbell to a contactless doorbell as it showed functions efficacy, and could detect motion and presence at various distances, thus it promotes a safe practice relevant to the present time. (2) The **Philippine School Doha** may consider the results and findings of the study in making other initiatives or modifying precautionary practices turning it into a contactless mode which will help secure a safe environment needed in these trying times. (3) **Future researchers** may do more testing procedures focusing on the detection of objects in other distances to generate data crucial in the further development of the study.

References

[1] Aguila J. M. U., Dimayuga H. S., Pineda K. O. F. and Magwili G. V., *"Development of Smart Waste Bin with Integrated Volume and Weight Sensor*," 2019 IEEE 11th International Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment, and Management (HNICEM), 2019, pp. 1-5, doi: 10.1109/HNICEM48295.2019.9072885.

[2] Aman A. & Soni A., (2018) *Distance Measurement of an Object by using Ultrasonic Sensors with Arduino and GSM Module.* Retrieved from https://www.academia.edu/37657821/Distance_Measurement_of_an_Object_by_using_Ultrasonic_Sensors_with_Arduino_and_GSM_Module?from=cover_page

[3] Arulselvan M., Arun G., Elangkumaran P., Keerthivarman S., Vijaya K. (2019). *Object Detection Using Ultrasonic Sensor.* Retrieved from https://www.academia.edu/43763657/OBJECT_DETECTION_USING_ULTRASONIC_SENSOR

[4] Burnett, R. (2021, March 3). *Understanding How Ultrasonic Works.* MaxBotix: https://www.maxbotix.com/articles/how-ultrasonic-sensors-work.htm

[5] Brownstein, J., Chitale, R. (2008, September 17). *10 Germy Surfaces You Touch Everyday.* ABC News. https://abcnews.go.com/Health/ColdandFluNews/story?id=5727571&page=1

[6] Cañedo, S. B., Dangcal, R. D. A., Empig, E. E., Gaw, A. R., Mendoza O. S., Miano, J. I. & Sumalpong, A. S. (2019). *Microcontroller-based Vessel Passenger Tracker using GSM System: An Aid for Search and Rescue Operations.* (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 10, No. 9.

[7] Citroner, G. (2020, March 9). *You Probably Touch Your Face 16 Times an Hour: Here's How to Stop.* Healthline. https://www.healthline.com/health-news/how-to-not-touch-your-face

[8] Centers for Disease Control and Prevention. *When and How to Wash Your Hands.* https://www.cdc.gov/handwashing/when-how-handwashing.html

[9] Frenzel, L. (2018). *Ultrasonic Sensors: A Smart Choice for Shorter-Range Applications.* Electronic Design. https://www.electronicdesign.com/industrial-automation/article/21806202/ultrasonic-sensors-a-smart-choice-for-shorterrange-applications

[10] Gupta, D., Jha, P., Tiwari, M. & Varshney, V. (2018). *A Solar Powered Smart Travelling Bag With An Embedded Video/Audio Player.* International Journal of Recent Trends in Engineering and Research, 4(7), 148–157. https://doi.org/10.23883/ijrter.2018.4369.bn8v5

[11] Islam, T. & Meshel, O. (2018) *Construction of Dual Axis Solar Tracker Device System.* Daffodil International University.

[12] Karvinen, K. & Karvinen, T., (2011). *Make: Arduino Bots and Gadgets: Six Embedded Projects with Open Source Hardware and Software (Learning by Discovery)* (1st ed.). Make Community, LLC.

[13] Nano, A. (2018). Arduino Nano.

[14] QuestionPro. *Experimental research – Definition, types of designs and advantages.* https://www.questionpro.com/blog/experimental-research/

[15] Remot, A. M. & Silverio, A. A., (2020). *Low-Cost Elderly Healthcare Monitoring System.* Journal of Physics: Conference Series, 1529, 032061. https://doi.org/10.1088/1742-6596/1529/3/032061

[16] TutorialsPoint. *Arduino - Ultrasonic Sensor https://www.tutorialspoint.com/arduino/arduino_ultrasonic_sensor.htm*

[17] Ursan, R. (2020). *Contactless doorbell*. Hackster.Io. Retrieved October 22, 2021, from https://www.hackster.io/robert-ursan/contactless-doorbell-143390

[18] Wikipedia. (2021, June 20). *Doorbell.* https://en.wikipedia.org/wiki/Doorbell

Biographical Sketch

Darleen F. Alayon is from Rosario, Batangas. Some of her achievements include being a Bronze Medalist in S.Y. 2019-2020 and S.Y. 2020-2021. During Grade 8 in S.Y. 2019-2020, she had been in the top 10 in her class on a quarterly basis. In 2014, she was a member of the PSD Glee Club. She joined the PSD Intermediate chorale in 2016. In S.Y. 2017-2018 and S.Y. 2018-2019, she was a member of the PSD Guitar Club and PSD Rondalla, respectively. She believes that the speed of improvement doesn't matter, what matters is that we're still growing even at that pace. She thinks that anyone is capable of doing what they desire to accomplish as long as you believe in yourself and work towards that goal.

Sofia Gabrielle V. Pelaez is from Quezon City, Manila. Some of her achievements include being a Bronze Medalist in S.Y. 2013-2014 and S.Y. 2016-2017. She had been a consistent top 10 student in her early school years. During Grade 7 in S.Y. 2018-2019, she had been Best in TLE. She participated in clubs such as Dance Club, Arts Club, and Swimming Club. She believes that success is earned, rather than given. Working hard only means you are one step closer to reaching and achieving the goal that you have been striving for.

Reese David P. Larrauri is from Imus, Cavite. Some of his accolades include being a varsity basketball player during S.Y. 2016-2017, and a volleyball varsity player in S.Y. 2017-2018 representing the PSO Patriots of Philippine School Oman. He also participated in the Gulf College Ministry of Sports Chess Tournament that took place in Gulf College Oman on November 13, 2017, as he placed 4th out of 6 schools. He also participated in the Sports Club and Boy Scout Club. He thinks that striving for excellence is key to success. Failure is part of the adventure of being successful. He thinks that learning from your past mistakes is what makes you grow and progress into being a better person and will help you reach your goals in life.