Automatic Sanitizer Dispenser

Github: janviig

TABLE OF CONTENTS:

PAGE

Description of The Report:

The basis of my project is an automatic sanitizer dispenser. Given the world we are living in today, hygiene is a concerning aspect for ongoing diseases, infections, and overall health safety. Living in a global pandemic, hygiene has been a true concern especially relating to transmission. Every place we go; there are hand sanitizers necessary in order to stay safe and follow protocols. According to the Department of Health, sanitizer as we know is a means to prevent transmission from occurring within Coronavirus and ensures good hygiene. Sanitizer is a vital tool which enables us to be safer and more cautious when travelling or when encountering with others. According to the FDA, hands should be thoroughly washed with soap and water after eating, coughing, or sneezing and if soap and water are not present than a hand sanitizer that has minimum 60% alcohol is a sufficient way as well. Hence why I chose an automatic sanitizer dispenser for my project – the purpose of my project is that even though people use sanitizer everywhere they go they still have to use a physical pump which ultimately can end up being ineffective due to the germs that have been spread, causing cross-contamination. Therefore, an automatic dispenser, enabled through a sensor is a better option, especially for daily use in the household, saving time and facilitating towards better health. Using it daily in household, members can use sanitizer as soon as they return home, sometimes due to being tired one may lack the energy but something that is operated through a sensor and automatic may be better suited for a household lifestyle especially.

The sense-think-act paradigm within my project would be implemented in the following way. The sense act of the project would be the ultrasonic sensor sensing movement, after which will think what to do next. It's important to note that it will not sense any motion if it is greater than 10 centimetres. Less than 10 centimetres is what it will be able to detect. The think requirement would be the sensor sending a signal back to the Arduino Uno board, which is connected to the servo motor, and thinking to pass that message onto the motor. The act requirement would then be the servo motor acting and rotating causing the pump of the sanitizer to also move as it rotates letting out sanitizer. This is then also reversed as the motor is programmed to go back to a 0-degree angle and therefore the pump will stop sanitizing, till the sanitizer recognises movement again. Essentially, the reversed part is the equivalent of a human holding the pump down and letting go so no more is let out.

Hypothesis:

I hypothesise for the ultrasonic sensor will recognise movement when there is movement in front of it and to activate the attached servo motor, allowing it to rotate pulling the sanitizer pump down and executing the sanitizer.

Detailed Description of Approach:

The ultrasonic sensor I am using for my project is the HC – SR04 Ultrasonic sensor. Although there is a plethora of more sensors available for Arduino projects, time and cost was a constraint for the development of my project. I needed to use the HC – SR04 sensor in another unit and hence I already withheld this piece, making it a lot more convenient to use. The one problem however was that this sensor is very common to be faulty, so I did make sure to test run it with the help of a breadboard and LED light to ensure it works. This sensor approximately costs around $4. Another sensor that can be considered is the Zio Ultrasonic Sensor – HC SR04 (Qwiic) which is a more complicated version of the HC-SR04. I chose not to go with this sensor because not only does it retail for around $25, a significant increase from the HC-SR04 but more importantly, to use the Zio Sensor, you must be able to master the HC -SR04 as the hardware within this sensor is more complicated to comprehend. Another sensor that can be used is the Infrared Sensor. This sensor would be a highly suitable choice for my project as it is able to detect heat meaning temperature which would allow it to detect humans and base the motion of the dispenser around that rather than any object being able to result in movement which is observed in the HC-SR04 sensor. However, again the downside for this would be that it would be the additional cost.

In terms of the motors used. The servo motor is what can control the position of the dispenser pump and the position to which it will rotate, by how much and the position it will rotate back to. I chose to use the MG995 High Speed Digital 12Kg Metal Gear Servo. This servo is considered to be a high torque servo withholding high engine rotational force. At 4.8 volts, its torque is 1.3KG/cm and at 6V, the torque is 1.5KG/cm. In my project, this servo is programmed to rotate at a 90-degree angle and return to 0 degree. The other servo motor I attempted to use prior to this servo which also would have been an appropriate choice for my project is the SG90 Micro-servo motor. I however chose to not choose this motor as it is significantly smaller as opposed to the MG995, therefore holding smaller voltage and torque – especially when comparing to the size of my sanitizer itself, the MG995 was the more appropriate choice. The MG995 motor retails for around $14.95 while the SG90 motor would be about $11.95. As I already owned the SG90 motor, I attempted to use that one first once that was difficult to work with – I purchased the MG995 which did work significantly better.

There are several different types of Arduino boards within Arduino. In terms of a sanitizer dispenser, the boards that could be used was the Arduino Nano. With a Nano board however, due to the nature of its size and portable advantage I would not have been able to use the MG995 motor with that due to the current rating in this motor being too high for the Nano board. The only way to be able to use this with a nano board would be to give the motor separate power, which would have increased costs for my project as well as more time. The Arduino Uno board is what I used as it was easily accessible for myself and I've had experience using it allowing me to be able to operate it smoothly. In terms of prices, the Arduino Uno retails for around $25 while the

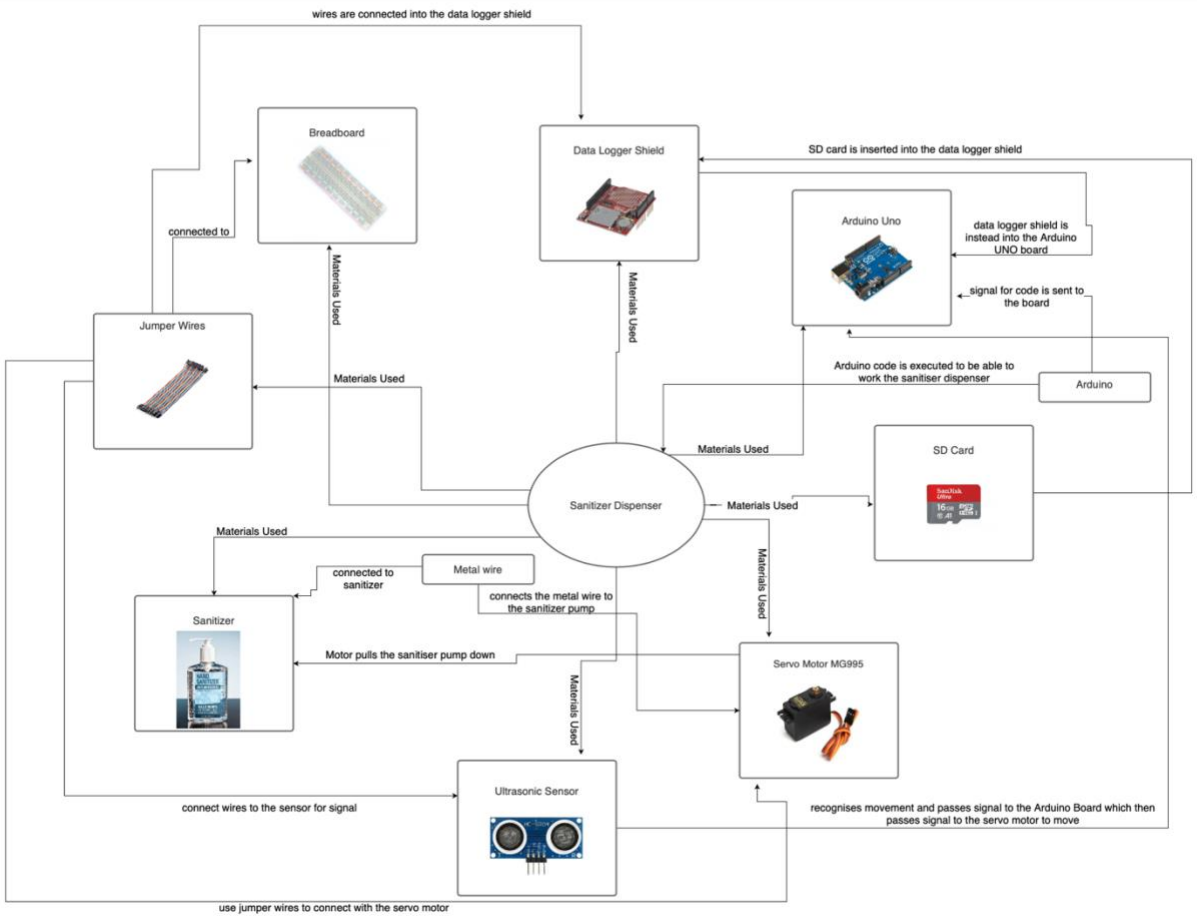
Arduino Nano is around the $18 mark. Although the Arduino Nano is cheaper, it wasn't a necessity in this project hence why I chose to go with the Arduino Uno.

Other materials used in my project include a breadboard which acts as the testing of my circuit design, helping me ease my result and was able to make things run more smoothly. A data logger shield was also used, although the SD card was unable to create a new file within my code, it was still used. For the manual pull from the pump of the sanitizer to the servo motor, I used a metal hanger to attach it and assist me in the movement of the pull. The wire from the hanger was strong which facilitated towards this. The sanitizer bottle itself is showcased to be placed on the base with metal wiring around it for support and for it to remain balanced in line with the servo motor.

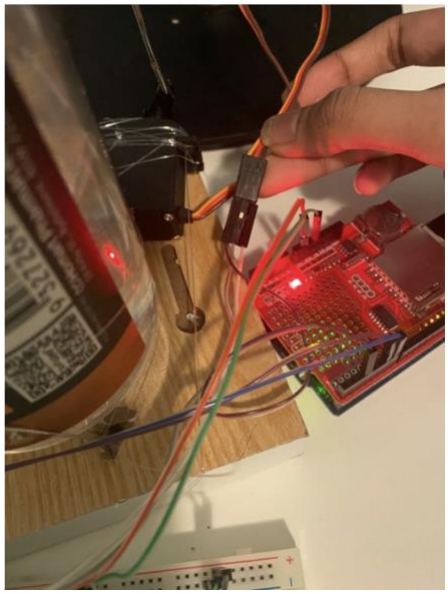
Interconnection's Diagram:

The following diagram represent the interconnections of my project to a higher standard as well the materials used explicitly stated with images of the materials used and how each material connects with the other within the project:
This diagram will be attached to my submission file so that it can be viewed in a higher resolution if needed.

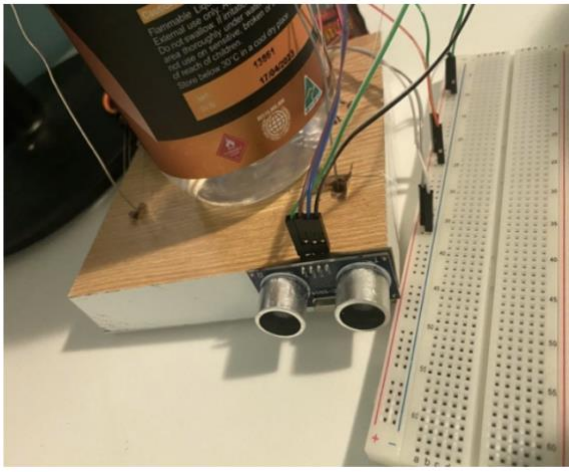
Diagram made through Draw.io (Flowchart Maker & Online Diagram Software, 2021).



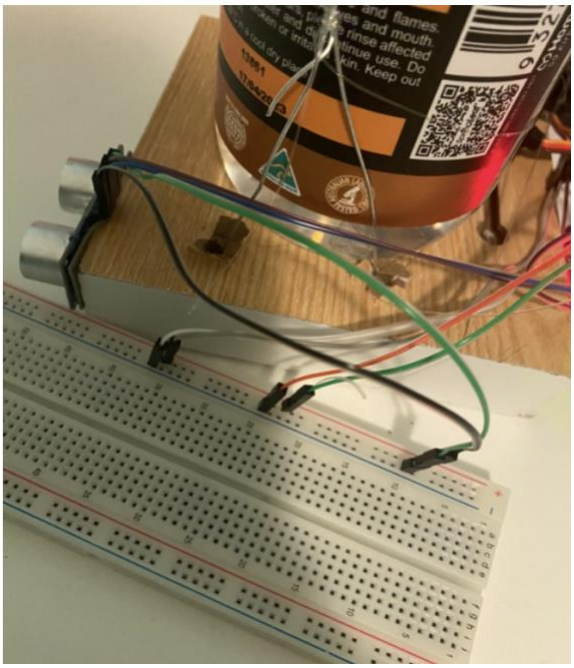
Photos of Setup:



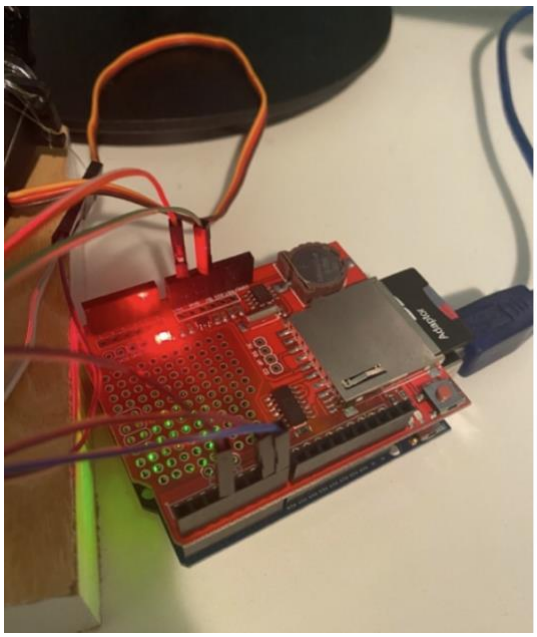
This picture represents the servo motor wiring connected to jumper wires as an extension way and to be able to have the correct jumper wires ie) male to female to incorporate into the breadboard and Arduino board.



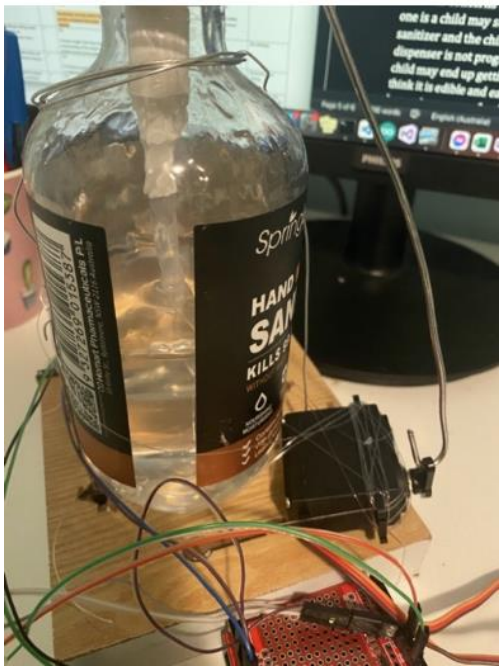
This image displays the ultrasonic senor and how it was connected to the wooden base.



This image is to display the breadboard wiring which is a mix of the ultrasonic sensor wiring ending there as well as the servo motor.



This picture is of the data logger shield in the Arduino Uno board and the SD card in the data logger shield for data collection.



This image represents the metal wire used from the motor and how it was pierced through it.

This is the image of the full setup of the sanitizer dispenser.

Data Collection Process:

The data collection process was fairly challenging. I made multiple attempts to record collected data onto an SD card, after this ultimately failed and didn't work I decided to use the results collected on the serial monitor to export into excel. Every day, (from 19/9-23/9) I would test out my project and copy the results from the serial monitor into an excel file manually inserting the date on the different days. There was cleaning of data involved once the csv file had gathered results over the period of 5 days. I then deleted the cells with the numbers that the serial monitor had displayed which was the

distance if the motion was activated. Of course, doing this manually was more time consuming, however with the help of knowing how to use excel to clean data and previous experience it became easier to export the results. Once that data was cleaned it was time to put it in a graph. I also had to ensure that the inactive columns were listed with 10 for distance, I attempted to do > 10 however, I couldn't create a graph with this hence why it changed to 10. There was also some data duplicated in the raw file which had to be analysed properly to clean it. In terms of creating the graphs there are different sheets opened in the file, where I refined the data to cater to the graphs I was going to create. This is again reiterated within the results and discussion.

Ethical Concerns:

Ethical concerns regarding to this project would encompass safety concerns. The first one is a child may see this as a toy and continue to use it for fun which would be wasting sanitizer and the child could hurt themselves due to the wiring. In addition, as the dispenser is not programmed on different amount it is going to execute based on age, a child may end up getting a lot that is unnecessary. The second concern is someone may think it is edible and eat it which is dangerous and can cause severe health issues. In addition, something may get left in front of it without realising and that will cause the sensor to keep sensing something and pumping out sanitizer, which will waste the sanitizer, but eventually will all fall onto the sensor and the wiring of the base – causing hardware damage and possibly even damage to devices associated. Another concern is also someone who has no prior experience with Arduino may play around with the wiring on the Arduino board which could cause malfunctions and technical issues in the circuit and could lead to harm.

Results:

Discussion:

My hypothesis for the ultrasonic sensor to detect movement in front of it and sending a signal to the servo motor to rotate and pumping out sanitizer was achieved. Although in the process of building the prototype there were many challenges faced, the result did end up being achieved to a high extent.

From the results exhibited above, there are 2 graphs from the results that have been split into different forms of information. The first graph exemplifies how many times there were active and inactive readings within the 5-day period the data was collected from. It can be observed that overall, the majority of readings were inactive and only a fraction of the results were active over the data collection period. Each day there were 31 readings which were taken into consideration for the results. This is so the data can be accurately compared. The second graph portrays the distance the sanitizer was able to pick up movement from. It can be examined that at 0-2 cm's, on any day the sanitizer did not detect any movement, at 3 cm's it detected movement on 3 days. For 3-5 cm's it

also recognised movement, however, did not at 6 cm's. The most distance the sensor was able to detect movement at was 7 cm's, there was no movement detected past the 7 cm mark. This could be because this sensor as mentioned above is one of the basic sensors within Arduino that can be used if I had used the Zio Ultrasonic Sensor – HC SR04 (Qwiic) it may have been able to detect movement past 10 cm's.

The SD card not being able to write a new file was also something that caused a lot of problems, I tried to implement the SD card within my project for results collection however this ultimately did not work which made it difficult to be able to decide on how to record data. But the serial monitor and exporting things became very handy to gather results.

In terms of the hardware of the project, it was difficult to be able to find equipment that wasn't technical. The metal wire connecting the servo motor to the sanitizer pump was a difficult one to find, I was unable to find something online that would work and at last, settled on a metal hanger which I took apart and this seemed to be the perfect match. Once, that hurdle was crossed, the next problem was attempting to find a solid base that would prevent the materials from moving. Due to the power of the servo motor, it was difficult to pin it down to the board, so some fishing wire was used to wrap the servo motor with the help of some holes drilled into the wooden base which acted as the threaded loops. These loops then also assisted in being able to place the wire around the sanitizer to hold the bottle down as well. In the process of attaching the wire to the pump and the servo motor, when the top half of the pump was detached, so some blue tac acted as a quick fix. I was also hoping to have the ultrasonic sensor stuck below the pump of the sanitizer so that it can recognise movement from there instead of the corner of the base, however this was proved to be difficult as the wiring was not able to stretch so far.

Overall, after facing some hardships during the completion of my project – I was successful in the movement of the servo motor as well as the setup.

Challenges and Lessons Learnt:

The challenges I experienced during my project was being able to determine the correct equipment to use. There were a range of options for the sensor, motor, and Arduino board

choices. I ultimately narrowed my choices down to the ones as discussed above, however some of the main things I ensured before choosing my equipment was ease of use, experience, and cost. Another challenge included attempting to enable the SD card to write a new file that the results would be recorded into. This part was challenging and unfortunately even after several attempts and further research, I was unable to

perform this. Although I was able to initialise the SD card as learnt in week 3, recording data inside was not done. My submission will be included with two separate codes one with my SD card code, and the other one without. Although I was still able to gather results, it was just a more time- consuming process due to the manual involvement. Setting everything up on a base physically was also a hurdle. While the Arduino and breadboard were not concerned with this, the servo motor was tricky to attach to a base. Given the power of the motor, it's torque and high rotational force, simply placing it on a board was not sufficient. Therefore, I had to drill my wooden base and pull wires through holes to secure the motor so it can connect to the servo motor perfectly.

Future Extensions for Project:

If I was to do this project again, I would use the Infrared sensor as it is able to detect temperature, and this would hence prevent the ethical concern of something being left in front of it. I would also in future want to try this with a spray bottle instead of a pump as the consistency of the spray would be more flowy. I would also really like to be able to make the SD card work in the future, as this would save plenty of time for the data collection process. I think trying this project with an Arduino Nano board would also be a more unique option as the nano board would make the project a lot more portable.

References:

(Analog), M., 2021. MG995 Servo Motor (Analog) Servo Motors TowerPro | JSumo.com. [online] https://www.jsumo.com/. Available at: https://www.jsumo.com/mg995-metal-gear- rc-servo-motor-towerpro\\ [Accessed 23 September 2021].

(Qwiic), Z. and value, G., 2021. Zio Ultrasonic Distance Sensor - HC-SR04 (Qwiic) - SEN-15171 - SparkFun Electronics. [online] Sparkfun.com. Available at: https://www.sparkfun.com/products/retired/15171 [Accessed 23 September 2021].

2021.[online] Available at: https://www.allaboutcircuits.com/projects/servo-motor-control- with-an-arduino/ [Accessed 23 September 2021].

Arduino Project Hub. 2021. Data Collection System with SD Card and Arduino. [online] Available at: https://create.arduino.cc/projecthub/157863/data-collection-system-with-sd- card-and-arduino-f2792c [Accessed 23 September 2021].

Aus Electronics Direct. 2021. MG995 High Speed Digital 12kg Metal Gear Servo. [online] Available at: https://www.auselectronicsdirect.com.au/mg995-high-speed-digital-12kg-metal- gear-servo?gclid=EAIaIQobChMIssiR7vGS8wIVSAQrCh1EbQD_EAQYASABEgJaLfD_BwE [Accessed 23 September 2021].

App.diagrams.net. 2021. Flowchart Maker & Online Diagram Software. [online] Available at: https://app.diagrams.net/[Accessed 24 September 2021].

HowToMechatronics. 2021. Arduino SD Card and Data Logging Tutorial - HowToMechatronics. [online] Available at: https://howtomechatronics.com/tutorials/arduino/arduino-sd-card-data-logging-excel- tutorial/ [Accessed 23 September 2021].

Jaycar.com.au. 2021. Arduino Compatible 9G Micro Servo Motor | Jaycar Electronics. [online] Available at: https://www.jaycar.com.au/arduino-compatible-9g-micro-servo-motor/p/YM2758?gclid=EAIaIQobChMIhcXd-fGS8wIV55lmAh3g5QbLEAYYASABEgKBqvD_BwE [Accessed 23 September 2021].

Youtube.com. 2021. [online] Available at: https://www.youtube.com/watch?v=5Dp-XatLySM [Accessed 23 September 2021].

Youtube.com. 2021. [online] Available at: https://www.youtube.com/watch?v=R2wdP4XZUp4 [Accessed 23 September 2021].

Aus Electronics Direct. 2021. Nano Arduino Development Board. [online] Available at: <https://www.auselectronicsdirect.com.au/nano-development-board-for-arduino-

projects?gclid=EAIaIQobChMI4bWo1vGS8wIV_5JmAh0w3A3vEAQYASABEgKTd_D_BwE > [Accessed 23 September 2021].

Arduino Project Hub. 2021. Arduino with IR Sensor. [online] Available at: <https://create.arduino.cc/projecthub/Raushancpr/arduino-with-ir-sensor-1579b6>[Accessed 23 September 2021].

Youtube.com. 2021. [online] Available at: https://www.youtube.com/watch?v=sxqBbkhozYM&t=74s [Accessed 24 September 2021].

[online] Available at: <https://www.health.gov.au/news/health-alerts/novel-coronavirus- 2019-ncov-health-alert/how-to-protect-yourself-and-others-from-coronavirus-covid- 19#:~:text=How to slow the spread to your home or workplace.> [Accessed 24 September 2021].

U.S. Food and Drug Administration. 2021. QAs Hand sanitizer and COVID-19. [online] Available at: https://www.fda.gov/drugs/information-drug-class/qa-consumers-hand-sanitizers-and-covid-19 [Accessed 24 September 2021].

Youtube.com. 2021. [online] Available at: https://www.youtube.com/watch?v=VWahHsUMWaA&t=186s [Accessed 24 September 2021].

Youtube.com. 2021. [online] Available at: https://www.youtube.com/watch?v=Zkya3y1EPbE&t=392s [Accessed 24 September 2021].