Project Idea: Health and Safety - Auto Door Sanitizer

Problem Statement

“Through an experiment conducted by WKYC Studios, it was determined that door knobs are one of the most germ-gathering locations, beating cell phones. This is because our dirty hands are being put on a commonly used surface. This makes a single door knob easily able to infect everyone in a household, office building, and even health-care facilities. Our product aims to prevent the spread of viruses, bacteria, and germs by creating an attachable hand sanitizer product above door knobs. This is a world-wide problem as wherever there is a door, there exists a large potential to spread germs.”

Research

Attachment System

https://www.youtube.com/watch?v=gE5JaFh2krY

The problem with Purell’s hand sanitizer mount is that it involves a lot of work to set up, and holes have to be drilled into the door.

Sticky Adhesive: By applying a nice coat of sticky adhesive to the back face of our product, it would allow for easy installation and a lower manufacturing cost. The only problem with this is that the adhesive will wear over time.

Plastic Attachment: At the top of doors, there is a small gap. With this idea, a flat long line of plastic can be fed all the way up to the door and end on the other side. Product wear would not be a concern for this idea.

Types of Sensors

https://www.safewise.com/resources/motion-sensor-guide/

https://www.automation.com/en-us/articles/2014-1/fundamentals-of-photoelectric-sensors

Basic Motion Sensor: Detect moving objects outside or even inside your home. Motion sensors are integrated into other products to detect and trigger a response/mechanism such as the light turning on or the camera commencing recording. Basic motion sensors are slightly unreliable as they occasionally activate when not intended.

Passive Infrared Motion Sensor: Detect body heat (infrared energy) by looking for changes in temperatures.

Microwave (MW): Sends out microwave pulses and measures the reflections off of moving objects. They cover a larger area than infrared sensors but are more expensive and vulnerable to electrical interference.

Dual Technology Motion Sensors: Combination of microwave and passive infrared sensors. Harder for mechanism resulted from the sensor from falsely activating as it requires two sensors to be activated.

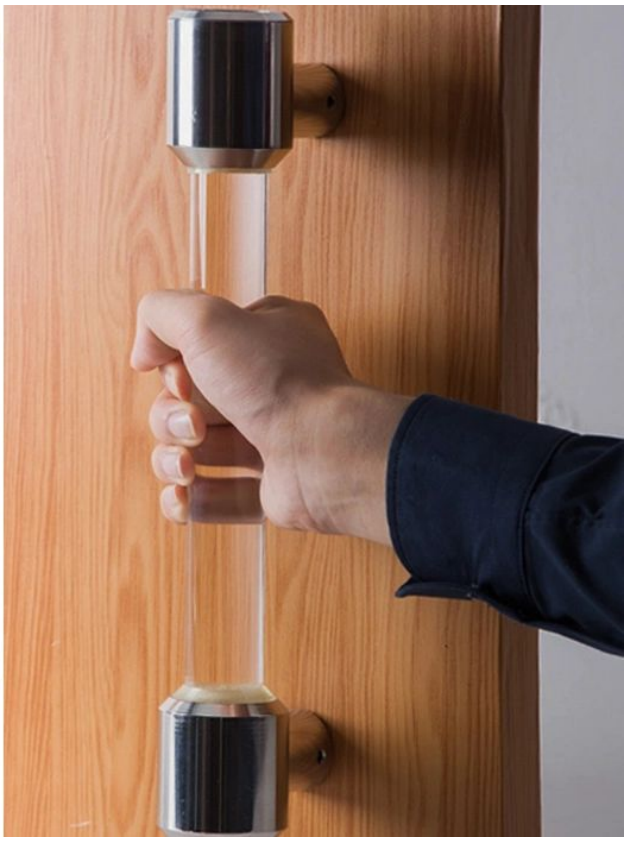
Area Reflective Sensors: Emit infrared rays from an LED and use the reflection of those rays to measure the distance to the person or object, allowing for detection when the subject moves within the designated area.

UV Light

https://www.healthline.com/health/does-uv-kill-coronavirus#uvc-light-and-coronavirus

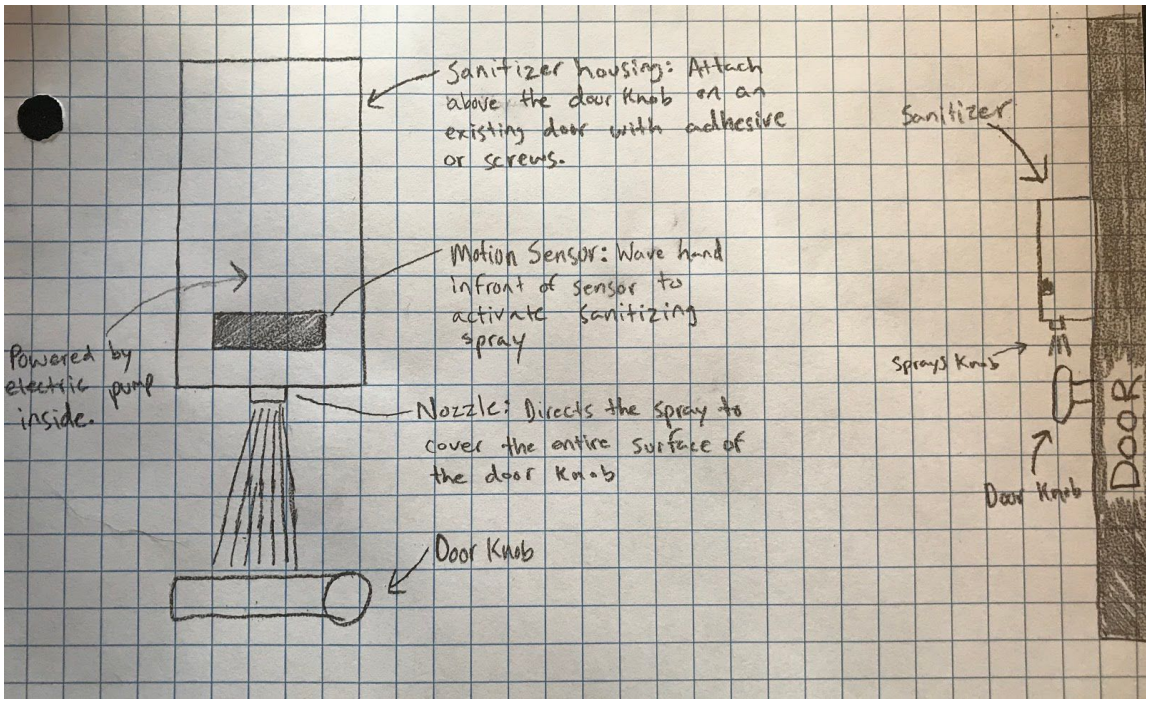
“A recent study in the American Journal of Infection Control (AJIC) investigated using UVC light to kill large amounts of the new coronavirus in liquid cultures.
The study found that UVC light exposure completely inactivated the virus in 9 minutes.”

Existing Solutions

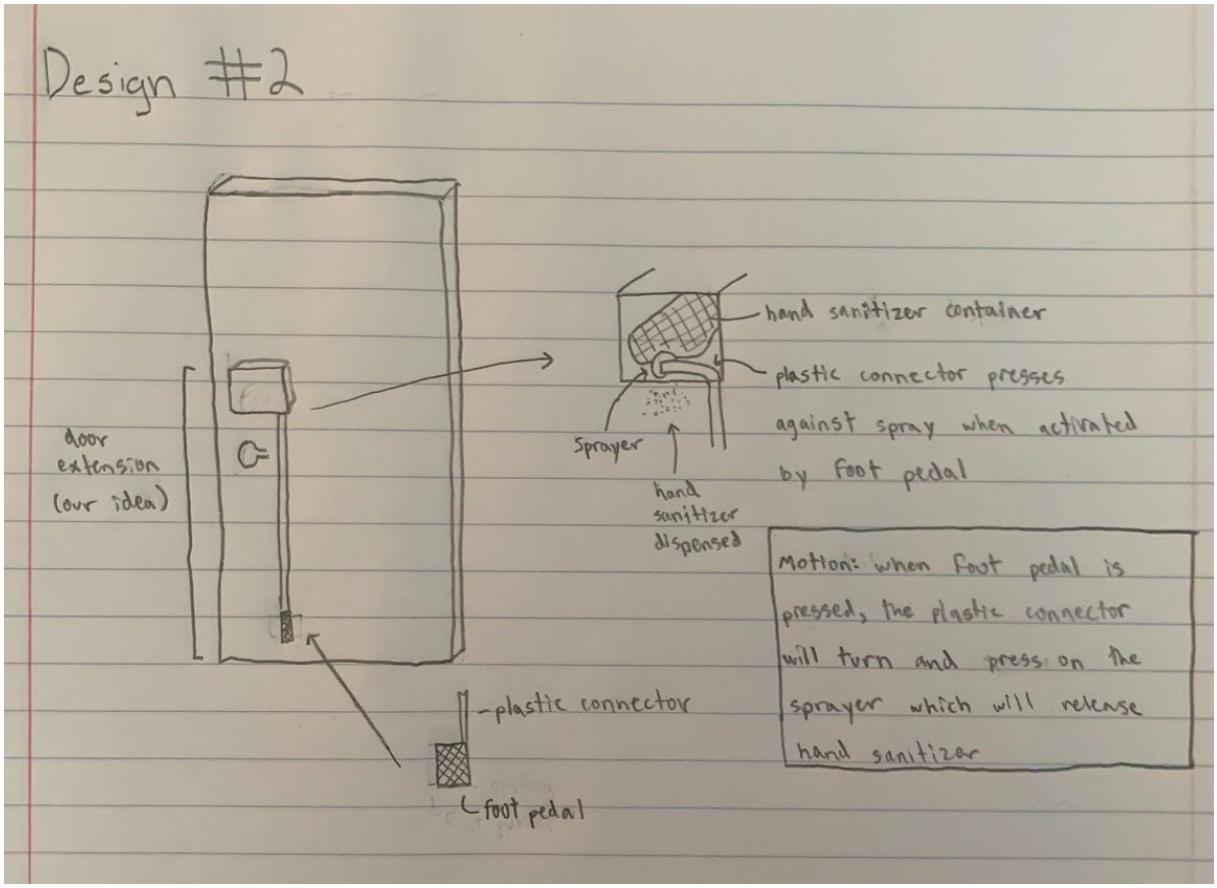


Brainstorming Sketches

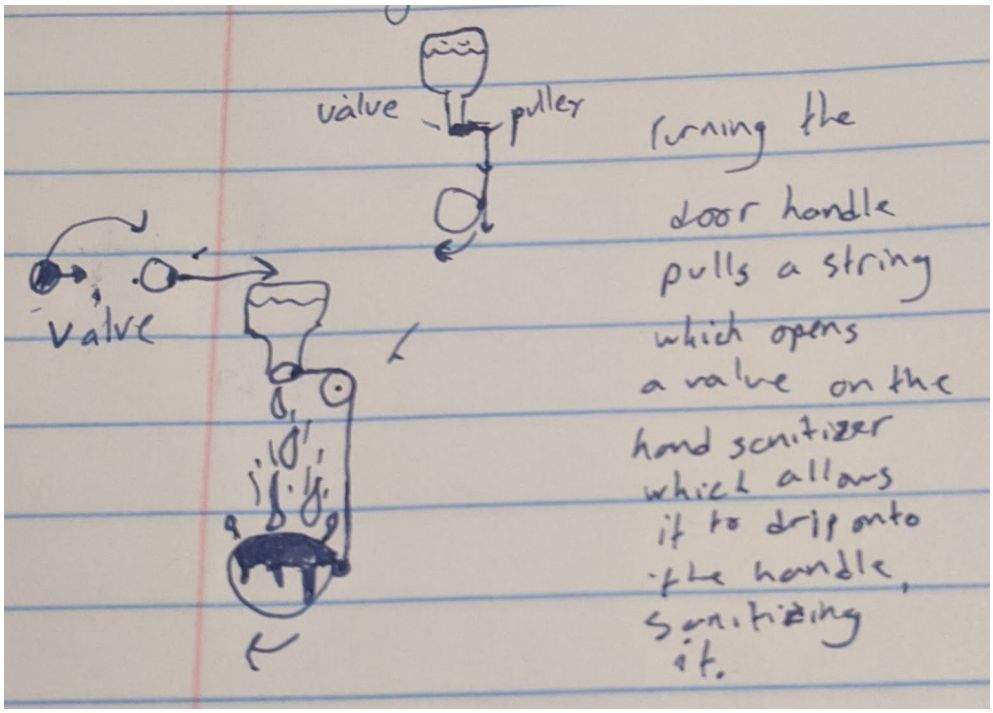
Design #1



Design #2


Design #2
door extension (our idea)
hand sanitizer container
plastic connector presses against spray when activated by foot pedal
Sprayer
hand sanitizer dispensed
Motion: when foot pedal is pressed, the plastic connector will turn and press on the sprayer which will release hand sanitizer
plastic connector
foot pedal

Design #3


valve
puller
valve
turning the door handle pulls a string which opens a valve on the hand sanitizer which allows it to drip onto the handle, sanitizing it.

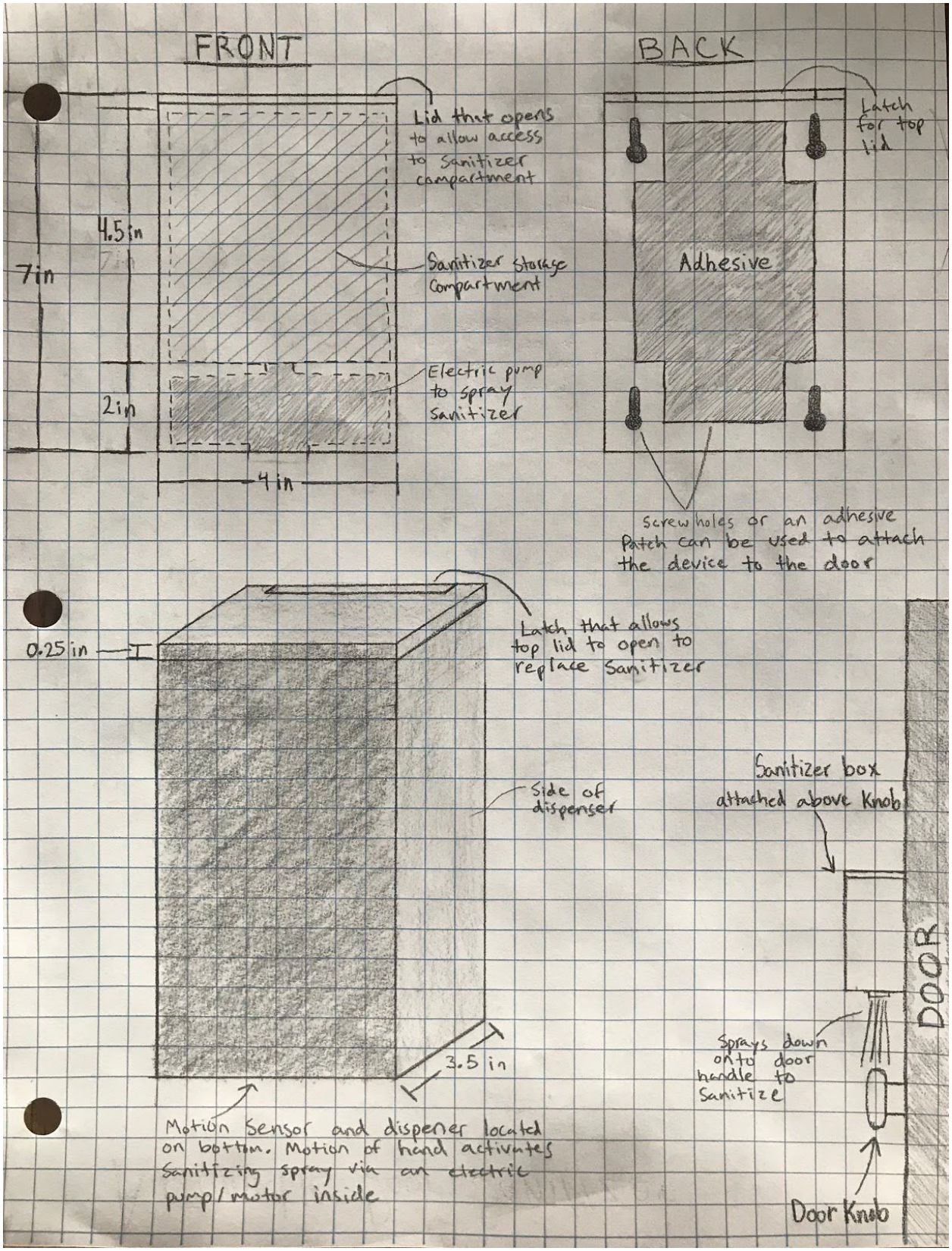
Decision Matrix (scoring 1 to 5, worst to best)

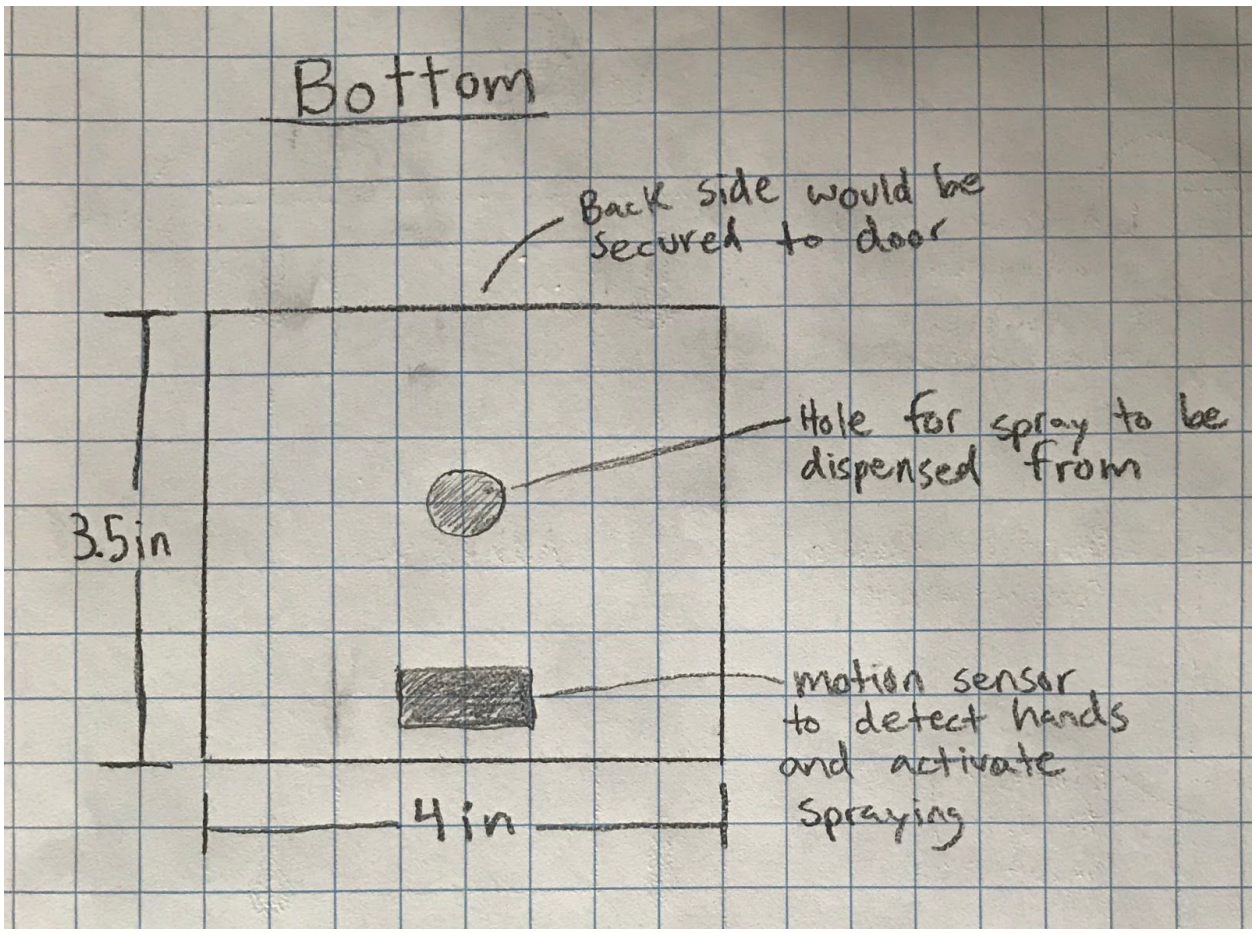
Designs	Effectiveness	Contact required for operation	Cost	Build Complexity	Ease of use	**Total**
#1	4	5	3	4	5	**21**
#2	3	4	4	4	4	**19**
#3	3	3	4	4	3	**17**

Winner and Justification

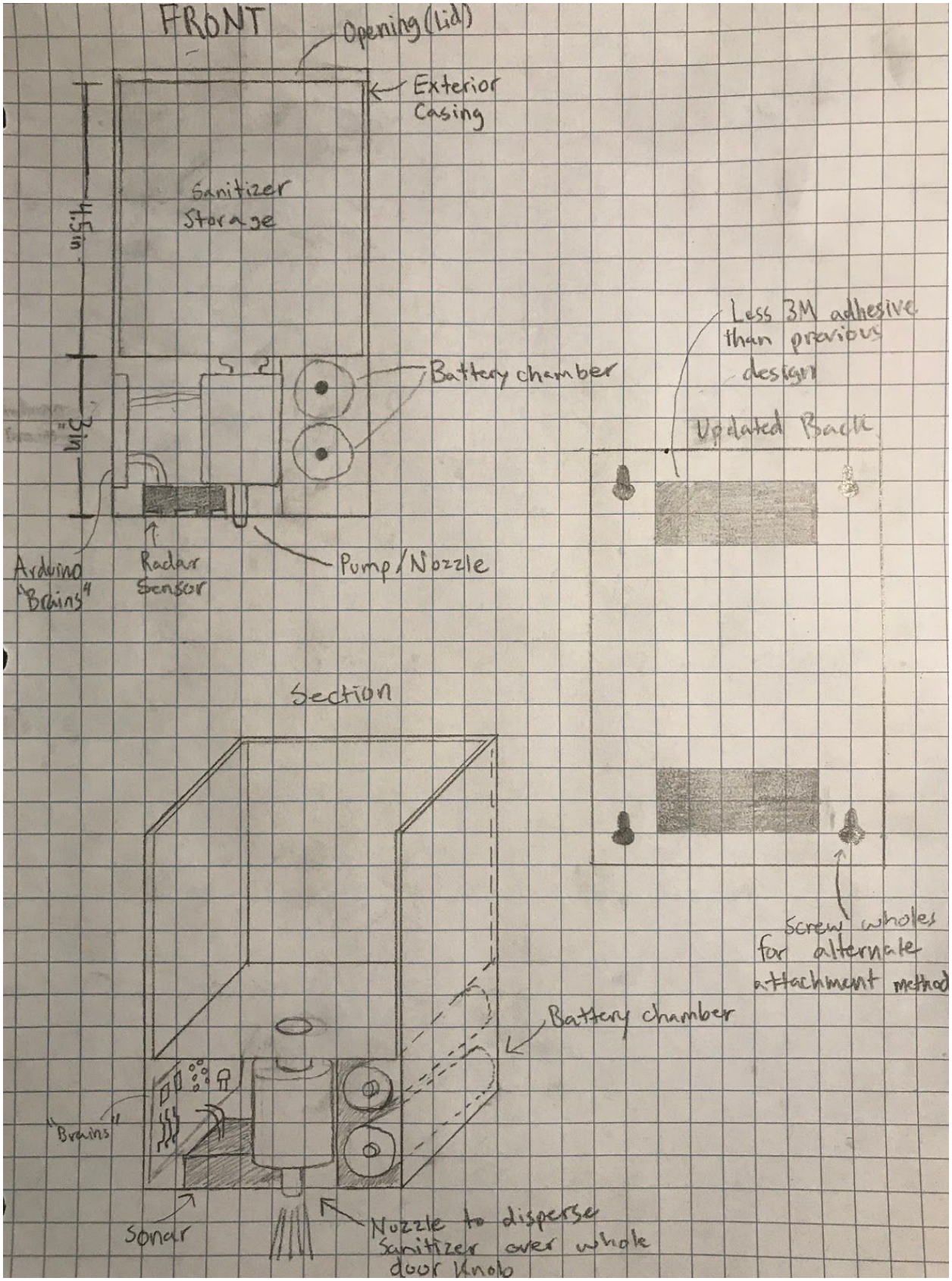
After testing our three designs against the criteria in the decision matrix, Design #1 won with a score of 21. Design #1 outscored both of the other designs in effectiveness, contact required for operation, and ease of use. Design #1 scored highest in effectiveness because it uses an aerosol spray to thoroughly sanitize the doorknob, ridding it of bacteria/disease without having to soak the knob. Furthermore, Design #1 is activated via a motion sensor, which eliminates any extra contact surfaces and keeps the user safe. Lastly, we thought that Design #1 was the easiest to use because it only requires the wave of a hand (or any body part really). Both of the other designs could be difficult for disabled or impaired users given their need for physical input to operate. Similar to the other designs, Design #1 would need sanitizer refills every so often, and occasional maintenance if its electric motor or sensor malfunctioned.

Final Sketches

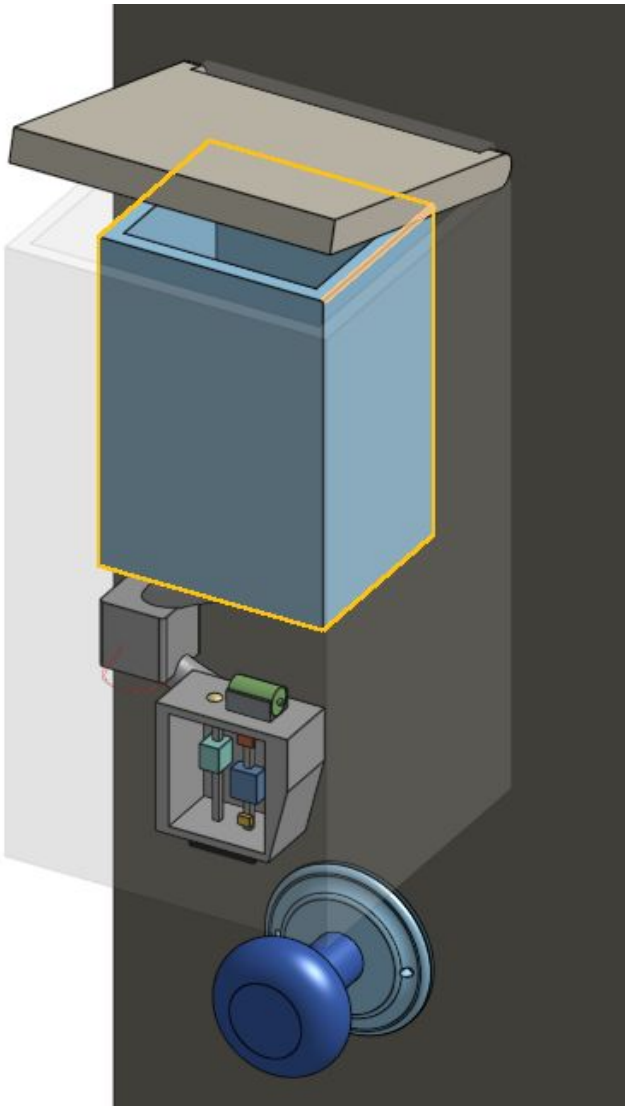

FRONT
BACK
Lid that opens to allow access to sanitizer compartment
Latch for top lid
4.5 in
7 in
Sanitizer storage compartment
Adhesive
Electric pump to spray sanitizer
2 in
4 in
screw holes or an adhesive patch can be used to attach the device to the door
0.25 in
Latch that allows top lid to open to replace sanitizer
Sanitizer box attached above Knob
Side of dispenser
DOOR
Sprays down onto door handle to Sanitize
3.5 in
Motion sensor and dispenser located on bottom. Motion of hand activates sanitizing spray via an electric pump/motor inside
Door Knob



Updated Interior Sketches


FRONT
Opening (Lid)
Exterior Casing
Sanitizer Storage
5 1/2"
3 1/4"
Battery chamber
Arduino "Brains"
Radar Sensor
Pump/Nozzle
Less 3M adhesive than previous design
Updated Back
Screw wholes for alternate attachment method
Section
Battery chamber
"Brains"
Sonar
Nozzle to disperse Sanitizer over whole door knob

CAD



Prototype Exterior



SURVEY RESULTS:
[Automatic Door Sanitizer Survey Results]

Working illusion Planning

For our working illusion, we decided to use an arduino to be the controller in the arrangement, but if this were to be mass produced, another cheaper and more task-specific board would be used. The board will take input from the sensor, and be told to wait 5 seconds, which we tested to allow enough time to pass for your hand to be out of the way. After the 5 second wait, the arduino will flip a relay on then off, which then allows for the pump to spray hand sanitizer relatively quickly. The use of a relay will allow the pump to be powered by a separate power source, allowing more power compared to the arduino's 5V output.

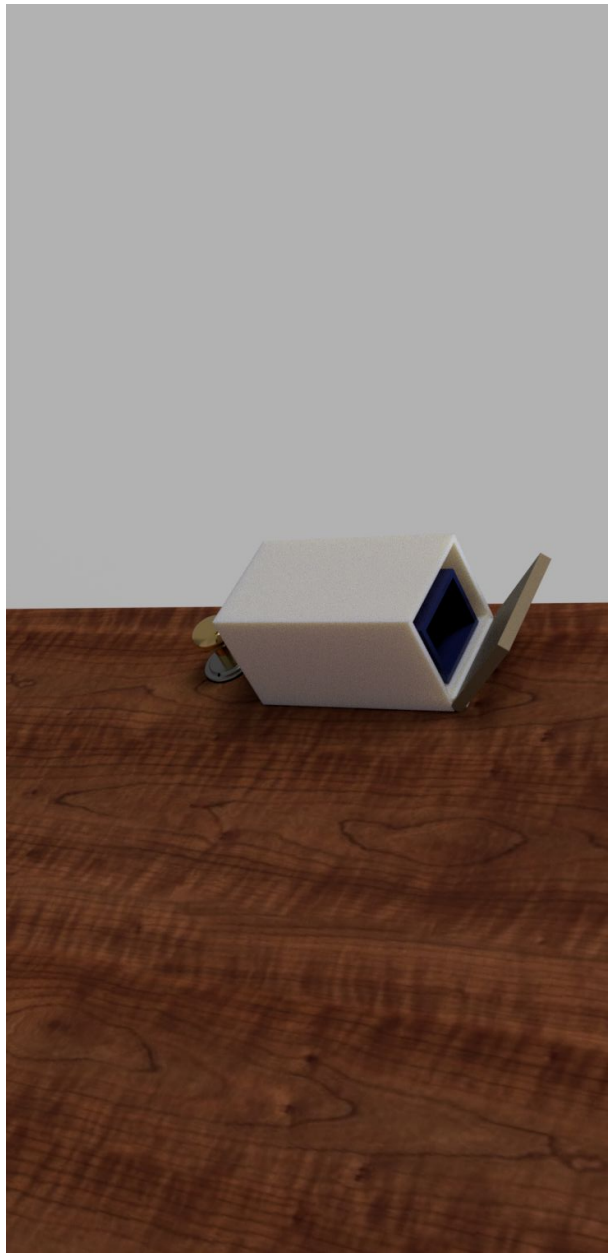
BOM

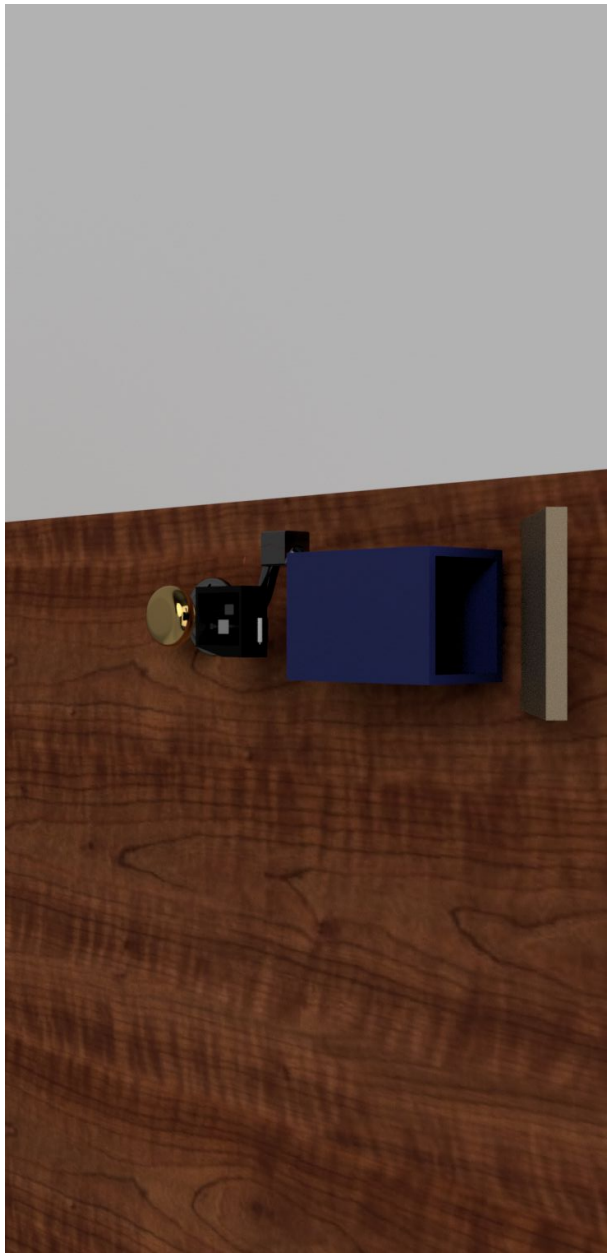
Part Name	Part number	Description	Price	Links
uxcell DC 12V 2P Self Priming Diaphragm Pump Motor for Water Dispenser	ASIN: B01KYA4AS8	Water pump for **Thing**	$13.99	link for the pump
1/4" Slip-Lock, Outdoor Mist Tee Nozzle, Water Brass Misting Mister Nozzle, Misting Nozzles Kit, With Thread 10/24 UNC Tees 10pcs and 0.4mm Orifice Nozzle 12pcs, For Outdoor Cooling System	ASIN: B07BFVGZGN	The nozzles and their fittings	$11.59	link for the nozzles
CNZ 1/4" Flexible Clear Vinyl Airline Tubing, 25-Feet	ASIN: B0186KV716	The piping between the pump and the nozzles	$6.61	link for the 1/4in pipe
General Purpose Relays PCB Power Relay Compact 16A, 12 VDC	Mouser #: 653-G5PZ-1ADC12	The relay switch	$1.97	link for relay- have to look for 16A, 12VDC
ARDUINO UNO R3 [A000066]	ASIN: B008GRTSV6	The Controller for most of the electrical components	$23.00	link for arduino uno
microtivity IB400 400-point Experiment Breadboard	ASIN: B0084A7PI8	Allows us to connect the electrical components	$4.99	link for breadboard

Fermerry 22 Gauge Electrical Silicone Stranded Wire Spool 5ft Each Black and Red Flexible 22 AWG Hook up Wire Tinned Copper (Black and Red 5ft Each, 22AWG)	ASIN: B089CJ7NPN	Allows us to connect the electrical components	$5.79	link for 22awg wire
ElecFreaks EF03085 HC-SR04 Ultrasonic Distance Sensor with 4 m Range 5V DC Jumper Wire for Robotics - Blue	ASIN: B07284347K	Sensor to detect when the door handle is being operated	$3.39	link for ultrasonic range sensor
AmazonBasics 23A Alkaline Battery - Pack of 4	ASIN: B07GNMFLKH	Battery to power pump	$6.19	link for A23 battery

Pictures of Parts

Rendered CAD





Product Testing

1. Test product attachment system by attaching it to a door (both with stick and screws) and kind of just slapping it a bunch
2. Test the sanitization method, circuitry, pump, and all moving parts by placing hand under and making sure sanitizer comes out
    a. Check that the amount that comes out is right, the speed it comes out is right
    b. Make sure the handle is accessible and the sanitizer doesn't get in the way
3. Test the timing of the system by using it as intended on the door, then fine tune the seconds where the program waits
    a. The product should spray on the door handle after the user is completely out of the way
4. Open the system and quickly check the sanitizer replacement method, also make sure nothing is shorting, melting, overheating, or smelling like burning plastic/sanitizer

Value Proposition and Target Audience

The target audience for this product is very broad. Small and large businesses, hospitals, and schools are all target consumers. They would prefer our product over existing solutions as it is cheaper to purchase and easier to implement.

Market Potential

This product has high market potential because it would lower the transmission of viruses and illness. Health and wellness has become a huge priority in recent times making this product very valuable to consumers.

Social Value

Positives:

- The product would reduce the spread of COVID-19 and other germs
- Cheap and easy alternative to other methods (UV door knob)
- Helps society through the creation of new jobs (manufacturing work)

Negatives:

- Product is not recyclable despite certain parts being recyclable (chemical waste)