Hand Sanitizer Machine

FINAL PROJECT REPORT

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Abstract

This document is the final report on the project 'Hand Sanitizer Machine'. The project is undertaken for the final project of course CS 207 but has the potential to be perfected into a finished product which can be used at public spaces to increase and promote frequent disinfection. The report briefly explains the purpose, need and inspiration of this project. Followed by the technical specifications including the design process, implementation and hardware details. The machine has been created using easily available devices which can be programmed and customized to work as per need. The next topic introduces to the device and its usefulness.

Introduction

The year 2020 has brought humongous changes in the world. The entire population of planet is facing a dangerous pandemic which has taken many lives. The Covid-19 virus is a deadly virus and can cause severe health problems to patients recovering from it. It has become a dire need to fight it, reduce and eventually stop its spread amongst the people. During these times, engineers play a vital role for inventing devices that make everyone's lives easier and safer. Starting from something as basic as infrared thermometer leading up to highly efficient life support systems, all of it was designed to help patients recover. However, following the ancient saying "prevention is better than cure", measures to prevent the spread of Covid-19 extremely important. One of the most effective measures is to regularly disinfect hands with help of soap or sanitizer. This has been the inspiration of this project.

The Hand Sanitizer Machine is effective way of disinfecting hands, without touching the bottle or the container, preventing the spread of infection much more effectively. The concept is to obtain the sanitizer liquid without coming in physical contact with any surface. The device holds a large container of disinfectant liquid

which can be easily refilled. A sensor, more specifically ultrasound sensor has been embedded in the device to detect presence of object, in this case a person's hands. When a person bring their hand over the sensor, the liquid in poured onto their hands. It's a simple yet safe way of making sure that hands are free of the virus.

These devices can be easily installed in public places, will not require any heavy maintenance and will be affordable enough to cover large structures such as offices, schools and universities. Another way of making sure that the virus does not get onto one's hands is wearing gloves, although the virus can stick to the gloves, resulting in the spread of it from once surface to the other. Therefore, even if a person is wearing gloves it is highly advised to disinfect them frequently.

Inspiration & Background

The initial inspiration of the project was to design a device helpful in fighting against Covid-19. While staying with roommates, there was a constant usage of the sanitizer bottle. This lead to a question, whether it is safe for people to share a bottle amongst them. The bottle itself will become a highly touched surface which will have to be disinfected frequently. Considering an apartment, this turned out to be a tedious process, there was no question it would be a major issue at public places. Thus, the process of designing a device that dispenses sanitizer without touching it was started.

While looking around for ideas over the internet, a mechanical device popped up that would dispense sanitizer liquid by pressing a pedal. As a person would press the pedal with his leg, the lever over the bottle would be pulled down leading to the bottle nob being pressed and dispensing of the liquid. An image of the same is provided after this paragraph. However, after reading reviews about this device, it was concluded that there are several issues. They are:

- The pedal becomes a surface everyone comes in contact with.

- If the pedal is pressed to hard, the sanitizer bottle gets pushed away from its position and is required to be set in place again.
- People frequently hold on to the device making sure they do not lose their balance while standing on one leg and pushing the pedal with another.
- If the device was not made using good quality materials and if its' not lubricated well, the pedal gets jammed.

Thus, it was clear that a more sophisticated and equally simple solution was required.

Source: https://jaganhardware.com/bkrr-foot-pedal-hand-sanitizer-stand-without-bottle-hm0575.html

While travelling internationally, I had noticed at the London airport that they had automatic water taps. Where in a person would bring their hand under the tap and water flow would start. There was a possibility of making a similar thing for the hand

sanitizer liquid as well. The next step was to figure out how to make such a device. The following section explains the design process in detail.

Design process

The following tasks were to be achieved and design to be figured out:

- Sense the presence of hand
- Find out the distance of the hand from the sensor
- Decide upon a threshold to dispense sanitizer
- Dispense the sanitizer
- Control the flow and quantity of it.

The sensor to identify an object in close surrounding is known as proximity sensor. There are 2 very common proximity sensors used with Arduino: 1) IR sensor 2) Ultrasonic Sensor. Infrared sensor or commonly known as IR sensor works on Infrared waves whereas the ultrasonic sensor works on ultrasonic waves.

- IR sensor

2) Ultrasonic sensor

Both the sensors serve the purpose of sensing the presence of the hand. However, along with the detection, there was a need to know how close the hand is. It becomes difficult to calculate this with IR sensor, but very easy with the ultrasonic sensor. The ultrasonic sensor provides a very accurate value of the distance between the

sensor and the object in the proximity. It also has a sensing ability with a span of 180 degrees, whereas the IR sensor works efficiently when the object in the light of sight. Thus, ultrasonic sensor was decided upon as the proximity sensor of this project.

The next task was to dispense the sanitizer liquid, the only way to push a liquid into a flow is by using a liquid pump or water pump. These water pumps are small motors which can be submersed into the liquid. Submersible water pumps compatible with Arduino are available in 2 variants, 5V Dc Motor and 9V Dc motor. The amount of liquid to be dispensed is small and the length of the pipe is not too long. So, a 5V motor is sufficient and would consume less power. Consumption of less power ensures that the battery lasts longer.

To run the motor an external power source is required, since the GPIO pins of Arduino do not supply sufficient voltage for the motor to run. There is also a 5V output pin on Arduino, but it is a fulltime power supply pin and cannot be controlled like a GPIO. To control the motor(which would be powered an external power source) a relay switch is required.

This concludes the selection process for devices need for this project. These are:

- Arduino Uno
- Ultrasonic Sensor
- 5V submersible pump
- External Power Source
- Relay Switch
- Jumper wires(cables)

Now that all the parts for the device has been finalized, the building process starts

Building Process

When a device comprises of more than one sensor or actuator, the best way to begin development is to program and test individual components and then combine all of it. The most crucial part of the project to sense the presence of hands in proximity of the sensor. Thus, that was under taken first.

There are 4 pins on an Ultrasonic sensor:

- VCC
- Ground
- Trigger pin
- Echo pin.

The VCC pin is connected with the 5V pin on Arduino and the ground pin is connected with the ground. The Trigger pin and echo pin are connected to GPIO pins 9 and 10 in order to communicate with the Ultrasonic sensor. To test the working of it, a simple code was tried which gave the distance of an object in the proximity of the sensor.

On the other hand, the motor is connected with the relay switch and power source. The ground of motor is connected to the ground of battery. The positive wire of the motor is connected to the relay switch. The relay switch is also connected to the Arduino in order to control it through GPIO. Just as done with Ultrasonic sensor, a basic code was used to test the motor, in this case just turning it on and off.

In the end, both the sensor and motor were simultaneously connected. A combined code for both, including conditions and delays to control the system was written. Corrected with trial and error, in the end a perfectly working code was obtained. The next section explains how the code and device works.

Working & Logic

There are 2 main components of the device apart from Arduino, that Ultrasonic sensor and the motor. The process consists of 3 steps:

- Getting a reading from Ultrasonic sensor
- Evaluating the value
- Switching on and off the motor

In order to get a reading from the sensor, the Trigger pin needs to be toggled. It is set to LOW, then HIGH and again LOW. Once this toggling is done, the reading from the sensor is read from Echo pin. The sensor sends out ultrasonic waves and waits for them to return by bouncing off the nearest surface. The Echo pin basically returns the time duration in which the ultrasonic waves reached back to the sensor. A simple formula (Time Duration * (0.034/2)) provides with the distance from the nearest object.

If the distance is less than a threshold, the relay is sent a HIGH signal which in turn switches ON the motor. As soon as the distance of the object goes over the threshold the motor turns OFF. This process is done in an infinite loop, making sure that at any point of time if hands come near to the sensor, the sanitizer is dispensed.

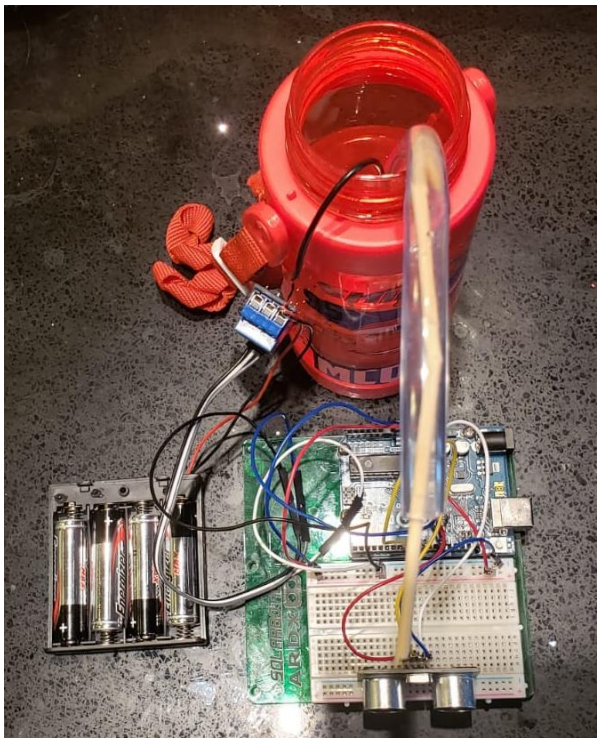
Conclusion

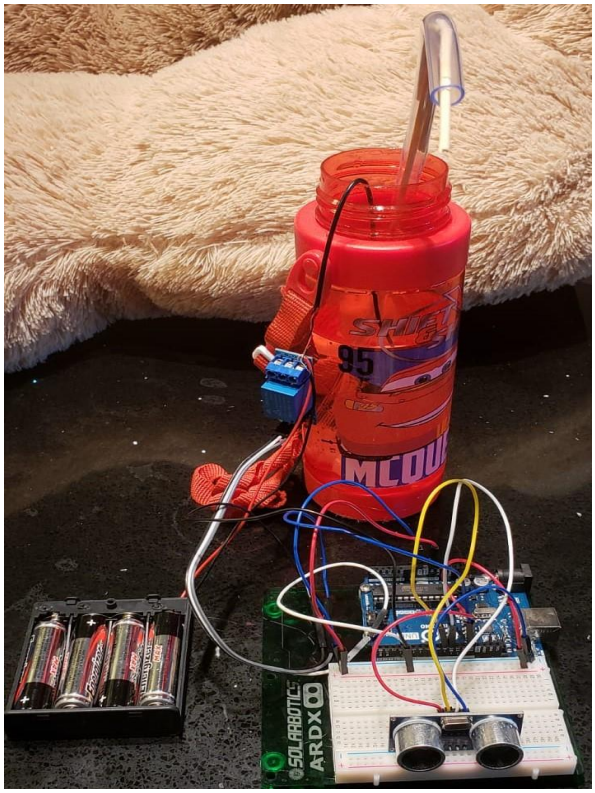
To conclude, during this pandemic it is crucial to take severe safety measures. The only way to stop this virus is to stop its spread. Disinfecting frequently touched surfaces and hands is important. This is difficult in public spaces, thus, simple yet effective provisions are required to be made. A publically available hand sanitizer is must. However, this should be a device where in a person can obtain the sanitizer without any contact. This device turns out be very useful. It dispenses sanitizing liquid as soon as the presence of hands is detected near the device. If this prototype is converted into a product, with better packaging, it can be deployed at public places ensuring health safety of everyone present.

References

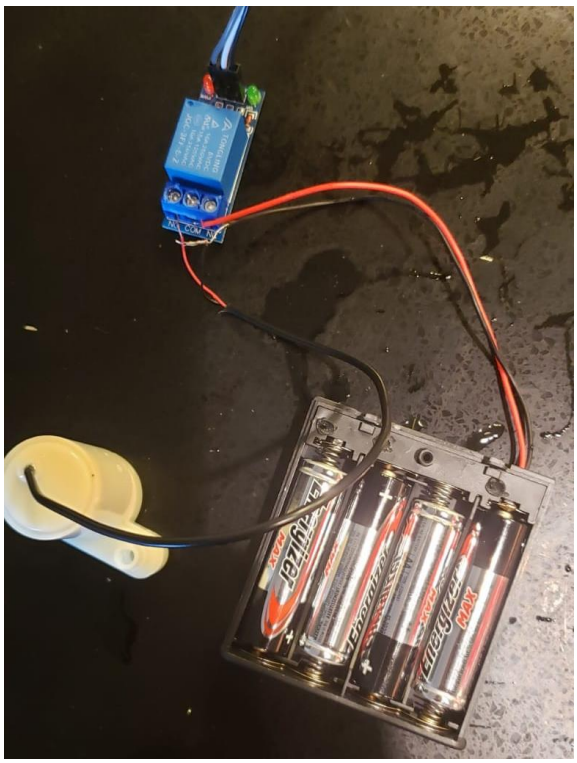
- https://www.youtube.com/watch?v=HynLoCtUVtU
- https://youtu.be/gWDzS5guXzk
- https://en.wikipedia.org/wiki/Ultrasonic_transducer
- https://en.wikipedia.org/wiki/Relay
- https://en.wikipedia.org/wiki/Arduino_Uno

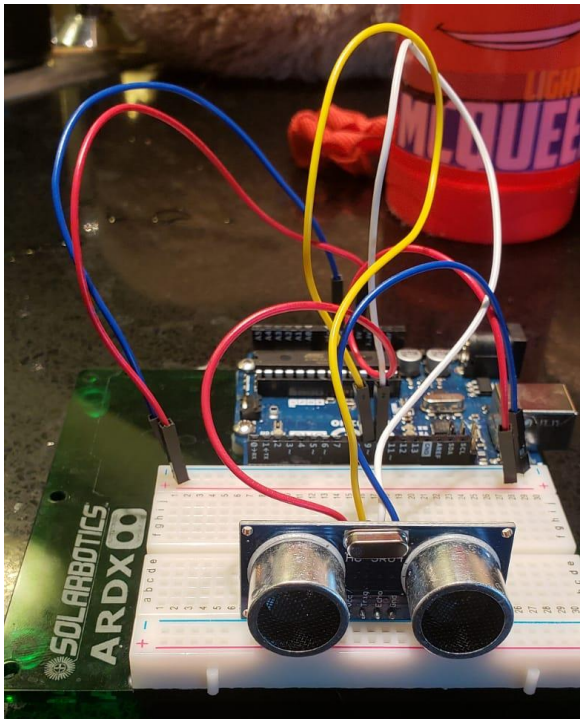
Appendix A





Appendix B



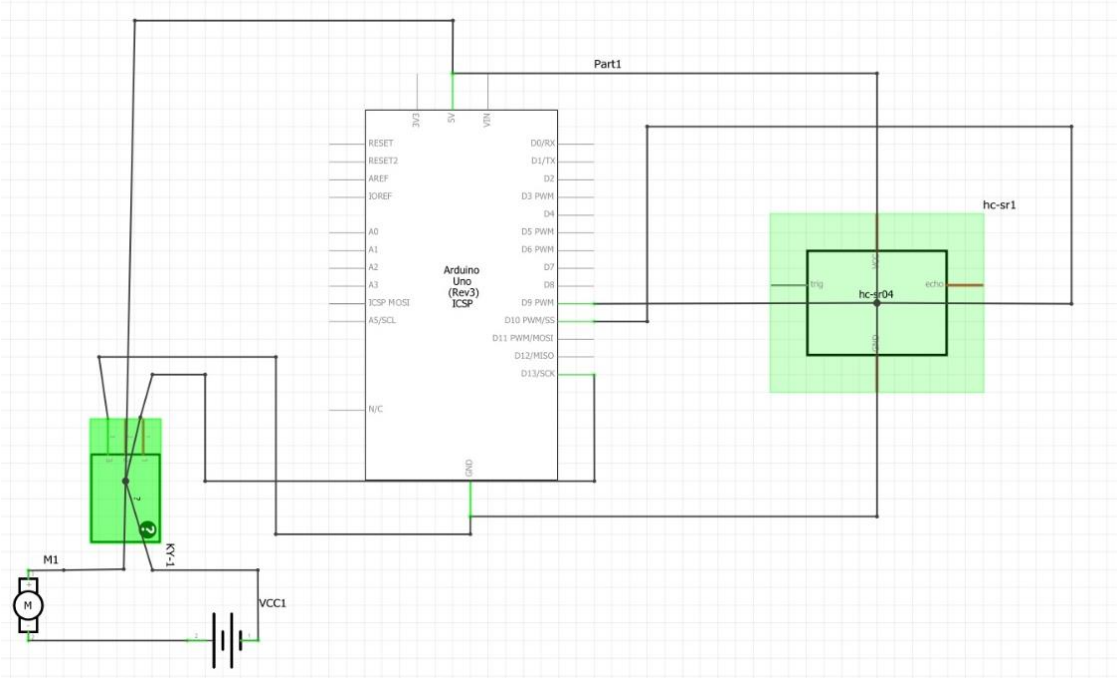


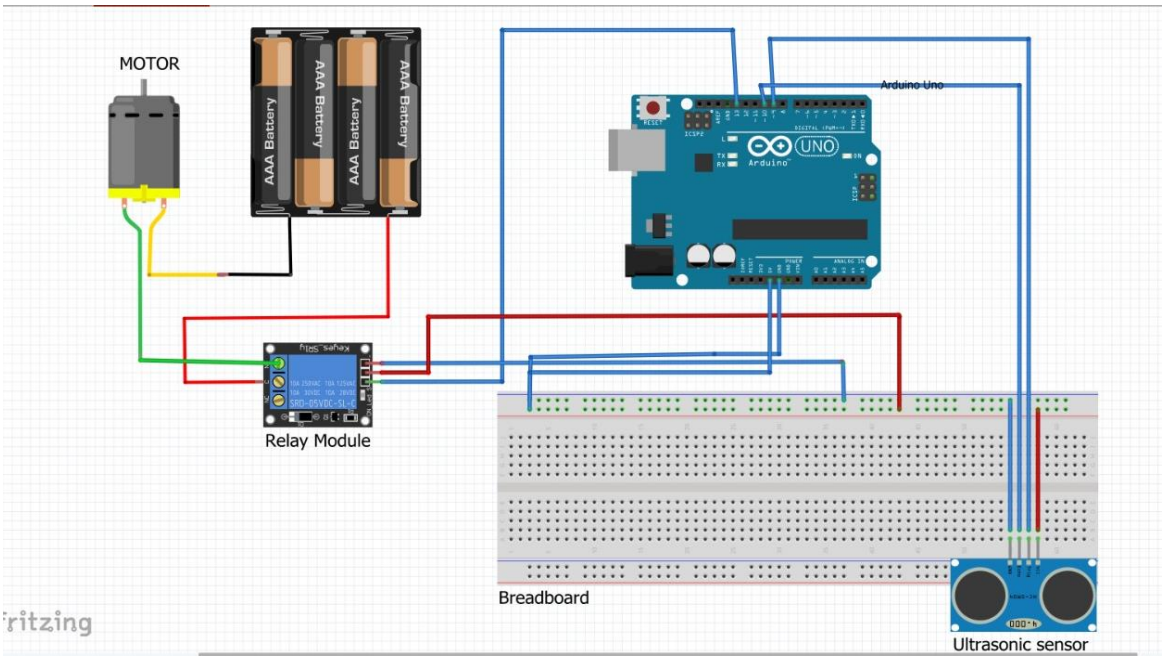
Appendix C

```
int pinTrig = 9;
int pinEcho = 10;
int waterSens = 8;
int distance,duration;

void setup() {
        pinMode(pinTrig, OUTPUT);
        pinMode(pinEcho, INPUT);
        pinMode(waterSens, INPUT);
        pinMode(waterSens, OUTPUT);
        Serial.begin(9600);
}
void loop() {
        digitalWrite(pinTrig, LOW);
        delay(200);

        digitalWrite(pinTrig, HIGH);
        delay(200);
        digitalWrite(pinTrig, LOW);

        duration = pulseIn(pinEcho, HIGH);
        distance= duration*0.034/2;
```

```
        Serial.print("Distance: ");
        Serial.println(distance);

        if(distance < 3) {
                digitalWrite(waterSens,HIGH);
        }
        else {
                digitalWrite(waterSens,LOW);
        }
}
```

Appendix D


Part1
Arduino
Uno
(Rev3)
ICSP
hc-sr1
hc-sr04
trig
echo
M1
K-K1
VCC1


MOTOR
AAA Battery
AAA Battery
AAA Battery
Arduino Uno
Relay Module
Breadboard
Ultrasonic sensor
fritzing