# COVID-19 Contact Alert Hat

COVID Solution Design Competition Spring ‘21

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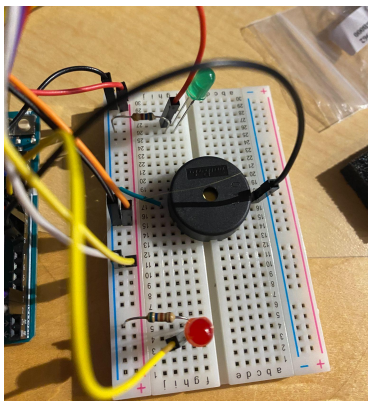
*Introduction*

A study [1] from 2015 reveals that on average people touch their faces 23 times an hour. With the epidemic of SARS-CoV-2, this could be destructive in containing the spread of the disease. Our product aims to stop this unconscious action of touching your face by projecting a sound in a person's ear and flashing lights near their eyes when they are about to touch their face. In doing this, our device will change an individual's habits with the hope that after a period of continuous use, the number of times a person touches their face will drastically decrease. This is particularly important because SARS-CoV-2 enters the body through the eyes, nose and mouth, all areas of the face. Additionally, the hands come in contact with many surfaces throughout the day. These surfaces, such as elevator buttons, are particularly risky when it comes to the spread of COVID-19. Thus, reducing hand-face contact can significantly decrease the likelihood of spreading the virus. This is particularly important in densely populated areas, such as dormitories, where some buttons and handles are touched thousands of times a day. By deterring the user from touching their face, our reusable device will aim to stop the spread of COVID-19 while remaining fashionable and easy to use.

*Methodology*

The design process began with a brainstorm of ideas, with the decision to make a device which would prevent people from touching their faces. Mechanical and non-mechanical methods of preventing face touching were considered. Ultimately, it was decided to build a wearable device which would not prevent physical touch but catalyze a change in behaviour. Thus, helping the wearer even when they are not wearing the device. We then contemplated what type of sensor to use to detect if someone is touching their face. We looked at an IR motion sensor which can measure in the range of 10 - 80 centimeters as well as an Ultrasonic Distance Sensor (HC-SR04) which can measure in the range of 2 -200 cm. The Ultrasonic sensor was cheaper, has a better range (measurement angle range restricted to 15˚), and easy to use with the arduino IDE, with sample code publicly available so we chose to buy this one from amazon [2]. To notify the person that they are touching their face, we wanted the indication to be annoying and bothersome to ensure the person will be conditioned to avoid touching their face, also known as operant conditioning. A piezo capsule was decided on to make the noise. The benefit of the piezo was that it was easily available, had a built-in arduino function, and is affordable. In addition, two red LEDs were added to provide a visual alert that an object is too close to the sensor. For the sound duration and pitch many options were tested within the piezo's range and it was decided that a duration of 2 seconds and pitch of 300Hz was appropriately



annoying and aggressive. We then connected everything to the breadboard (figure 1) and coded it accordingly using an Arduino Uno (see figure above). After ensuring the circuit and code works, we attached the LEDs, piezo, and sensors using dupont wires so we can attach it to the hat in the right places. We then made the decision to use an Arduino Nano instead so it would be easier to condense everything onto one breadboard and fit it in the hat. Then, using a drill, we created holes in the hat to put the wires through and secured the pieces where we wanted using electrical tape. We chose to put the sensors right under the brim on both sides of the hat for the greatest range in detection and to point towards the nose and mouth. We attached the LEDs under the brim, closer to the peripheral so it is closest to the eyes and the piezo next to the right ear. Once we tested the device, we adjusted the sensor distance threshold values to ensure that objects could be detected in the correct fields. Testing determined that 35cm or less was a good value to detect hands and objects near the face.

*Results*

Our resulting device is shown below. The breadboard rests on the top of the head of the person and can be tightened in the back. The LEDs and ultrasonic sensor are on both sides in the underside of the brim and the piezo is located above the right ear.

*Future Work*

In the future, we could have this device be powered by a battery and a switch instead of the computer by using a smaller watch battery with the arduino. We could also improve the design by integrating the pieces into the hat in a more fluid manner so the wiring is part of the hat. Additionally, we would condense everything and use a smaller breadboard to make the hat less chunky.

If manufacturing facilities were available, we would develop our own integrated circuit that contains the resistors and controller. This, along with the wires, LEDs, piezo capsule, battery, and distance sensors would be more integrated with the material of the cap so that it does not impact wearability or aesthetic appeal. Additionally, a more compact distance sensor would make the design more wearable.

*Appendix*

Table 1: Bill Of Materials

| | Part Name | Quantity | Price ($EA) |
|---|---|---|---|
| 1 | Arduino Uno Rev3 | 1 | 23.00 |
| 2 | Red LED | 4 | 0.20 |
| 3 | Green LED | 1 | 0.20 |
| 5 | Male-Female Jumper Wires | 17 | 2.00 |
| 6 | Piezo Capsule | 1 | 0.73 |
| 7 | 560 Ohm Resistor | 2 | 0.29 |
| 8 | Ultrasonic Distance Sensor | 2 | 3.95 |

Figure 1: Sketches and dimensions of the parts

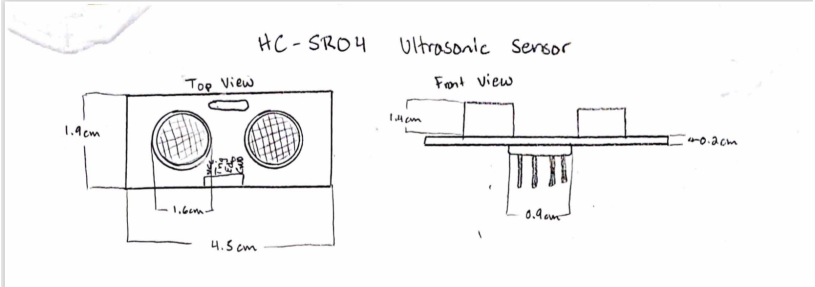



Figure 1: Sketches and dimensions of the parts (continued)

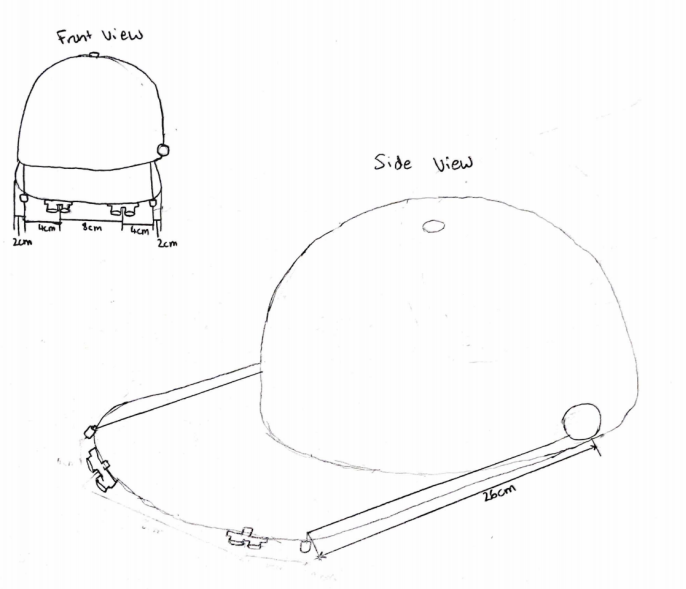
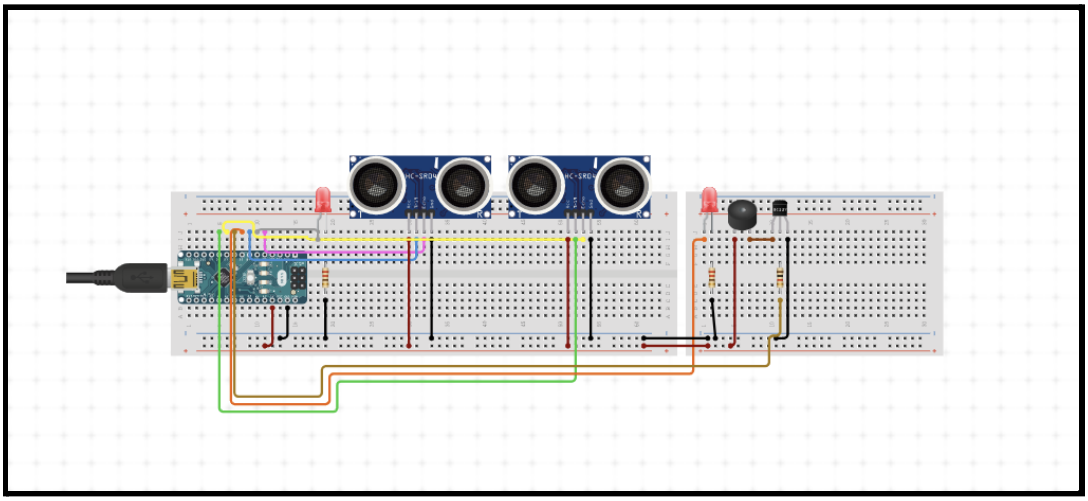



Figure 2: Schematic of the circuit design



[1] Link to study: https://pubmed.ncbi.nlm.nih.gov/25637115/

[2] Link to sample code:
https://www.instructables.com/Simple-Arduino-and-HC-SR04-Example/