A Functional COVID -19 Mask Which Monitors and Predicts Illness

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Engineering Goals

The problem that needs solving is COVID-19 and not knowing if someone may be sick leading to it's spread. In order to solve this, the engineer will create a mask that predicts illness by detecting symptoms. Then the data will be stored in a file and be read. Here are the goals:

1. Create the app.
2. Fit the sensors into the mask
3. Sew the mask
4. Code the sensors with efficient and correct code
5. Create a program to transfer data to a file

Project Design

The engineer created a mask with a temperature, distance, and Bluetooth module and sensors compatible with the app via Bluetooth. The steps used are the following:

1. Create a circuit and code for the sensors.
2. Code the app.
3. Sew a mask and fabric together with the sensors
4. Create a program to get the data to a file and read it.

Testing was done by wearing the mask seeing results.

Design Evolution and Results

The first version made was not even sewn and did not have a Bluetooth module. It was two cotton masks which were taped together, but this changed in the second version where it was sewn yet no Bluetooth module. Finally, in the third design it had a Bluetooth module and tighter stitches and an app with it, and it also had the file program which the others lacked. Testing was done by turning on the mask and seeing what happens when symptom limits are set lower. A light was turned on and text was displayed by notification when this happened.

Conclusion

All design goals were met, here is how:

1. The app was a goal met by learning and coding Java.
2. Fitting sensors was a goal met by using space scarcely and sewing sensors sticking out the mask.
3. The sewing goal was met by learning sewing and doing over again
4. This coding goal was met by looking over the code and testing the sensors to see if anything went wrong.

This can help people by making the danger of spreading sickness or being sick will be lower. To make this better, bulkiness could be solved, and A.I. could be added making it better by a great amount.

Introduction

Background:

We all have a common enemy today: COVID-19, the cause of 2.72 million deaths worldwide and counting. We all want to just get rid of the masks and have the vaccine come out, but in the meantime we can make it better on ourselves. People like me have seen the dangers, teachers and students from my school were scared. Teachers took temperature constantly, and both parties had to keep wearing masks. Teachers could not possibly manage checking temperature of a whole class especially in places like my school where there is one teacher and thirty. I asked, how can I help? I wanted to create a device to predict illness, but how? Can I possibly alert the central office of my school to report illness? What if the answer was on my very face? Masks. They can help.

Introduction

Background (continued):

I created a data system which helps solve the problem of spread, but in form of a mask. This mask looks out for symptoms, which indicate illness, when put on. It can predict and report illness by using signs of illness as an indication. The mask itself will collect data through its sensors, which are electrical parts that measure specific things like temperature, then will decide whether someone is sick or not and transfer this data to a file. If any of this is abnormal, it will send a signal to the wearer. In order to make this, I used a motherboard called Arduino and other parts of the same company. This mask will be in touch with an app via Bluetooth or signals sent from device to device by encoding and decoding the signals.

This mask is new and different from the rest. There is a mask similar to this which monitors illness, but this was only for hospitals not for daily use, unlike this prototype. This mask is new and innovative, and it can change the lives of many.

Introduction

Engineering Goals: The hope is to make an electronic mask which will come with challenges. Here are the goals:

1. The first goal is to create a mask which fits all the sensors and modules inside it. The sensors must work properly and in an efficient environment. In other words, the sensors must fit and work
2. The second goal is to create an app which functions with Bluetooth and can pair with the mask itself. The app should be able to notify someone immediately. The engineer will use MIT App Inventor to create the app.
3. A notification system that lies within the mask must be built because it cannot be expected for the wearer to automatically see the notification. The system will be made by an LED which turns on.
4. Efficient and correct code must be written in the Arduino IDE which is a software or program that allows anyone to write code. IDE stands for Integrated Development Environment.
5. A program to transfer the data to a file and determine if someone is sick will make this more organized for users

Introduction

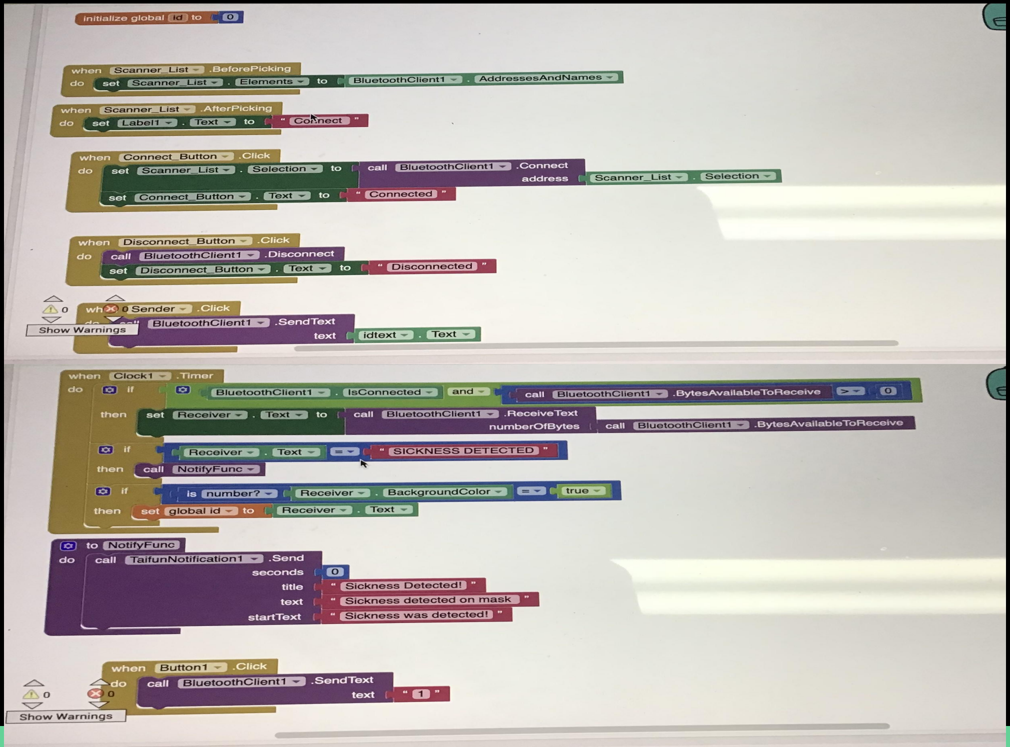
Anticipated Challenges:

1. The engineer must learn how to code the Arduino coding language. The code must be efficient and correct as well.
2. The working environment of some sensors is not ideal while inside the mask. For instance, the distance sensor, which checks if someone is too close to another, cannot be inside the mask to check distance. Some sensors may be outside the mask or touching the wearer while actually fitting. Organization is necessary.
3. The coding language Java must be learned to create the app. The app must be efficient with correct coding.
4. The engineer must learn to sew the mask together. Compact sewing is required, this can be achieved through sewing it twice over.
5. File programming must be learnt to ensure the file which contains the data can determine sick or not. Transferring data to the file will be done with Arduino, but the rest will be done with a language called Python.
6. The engineer must learn Python in order to make the file program. This needs correct coding as well.

Materials

The materials used are the following:

1. An Arduino (the one used for the project is an Arduino Uno R3).
2. Any type of computer that has the Arduino IDE downloaded on it as well as MIT App Inventor, CoolTerm, and Pycharm.
3. A breadboard
4. 12 Male to Female wires or jumper wires
5. Two LEDs of any color
6. Two 330 Ohm resistors
7. Two 10k Ohm resistor
8. One 100k Ohm resistor
9. A 10k Ohm thermistor
10. An HC-SR04 Ultrasonic sensor
13. An HC-05 Bluetooth module
14. A 9-volt battery
15. A 9-volt battery clip to power the Arduino
16. A USB cable
17. Any cloth mask
20. A sewing needle
21. Thread



Images Taken By Student Pictures of app code

Methods

The mask was created by using a thermistor, an ultrasonic sensor, HC-05, and more. The sensors were first placed in a circuit then coded. When everything was complete, the mask was created and everything was put in it. Here are the steps:

1. Create a circuit and code the thermistor.
2. Create a circuit and code the ultrasonic sensor.
3. Create a circuit and code the HC-05.
4. Find a cloth mask and some fabric.
5. Put all the circuits on the mask.
6. Test if all the sensors work. Add some LEDs also to notify if someone is sick. Use a 9-volt battery for power.
7. Add the fabric. Surround and cover the circuits, make sure it is not interfering. Sew.
8. Create and code the app using MIT App Inventor.
9. Connect the mask to the app via Bluetooth and test to see if it works. Make sure the Serial Monitor is connected
10. Create a final program where the data is transferred to a file, and to then determine sick or not. Use Pycharm and Arduino IDE.

Design Evolution and Results

Design 1:

Design: This version was just two cloth masks which were taped together. This design did not have the Bluetooth module, and it was not a very good design. Yet, it was a good starting point. It only contained the temperature and distance sensors with an Arduino. It was taped and that lead to problems which were frustrating. Frustration lead to a new design which fixed.

Outcomes: This mask has many things wrong with it. The pros are that it worked well, and that everything worked out with minimal problems. The cons were that the thermistor kept slipping in and out of its hole, and that it was messy with sometimes the tape failing. Overall, it was not the best design. Testing was done by wearing and testing sensors by putting something hot on the thermistor and something in front of the ultrasonic sensor. The data collected was printed on the screen.

Image Taken by student. First Design

Design Evolution and Results

Design 2:

Design: The second design was better than the first in many aspects. This design was actually sewn together with the ultrasonic sensor and thermistor, but no Bluetooth module. The stitching instead of tape and the comfortability were both improved. The mask has to notify someone. With Bluetooth this can happen and that is how the next design was made.

Outcomes: The design has improved much than its previous state. The pros are that everything was fit tightly without slipping, this solved the problem with the thermistor, the whole mask was strongly sewn together. The cons were that this did not yet work with Bluetooth, it was missing the module, and the sewing was not perfect either. Testing was done by just turning it on then wearing. Testing the sensors was done by putting something in front of the ultrasonic sensor and something hot on the thermistor. Both sensors were fairly accurate as the data collected from them was printed on screen.

Image Taken by student. Second Design

Design Evolution and Results

Design 3:

Design: This design added more. This design also had more compact sewing than the previous design. The design, of course, also has the ultrasonic and temperature sensors like the previous two designs. This design improved the stitching and the internal design, adding the Bluetooth module, the data system, and the app.

Outcomes: The design is a major improvement than the first. The pros of this design was that it could efficiently work with Bluetooth, it was sewn tightly, and has functioning sensors. The cons were that the Bluetooth module required pins on the Arduino that do certain things, but the pins that it needs are already busy doing other things. The solution was to assign it to different pins. Testing was done the same as the last, wearing the mask then placing something hot on the thermistor and something in front of the ultrasonic sensor, but this time the app and the Bluetooth module were tested by setting up the app then connecting Bluetooth and seeing what happens. Everything was outputted via the app or the screen. This design also added the file data program.

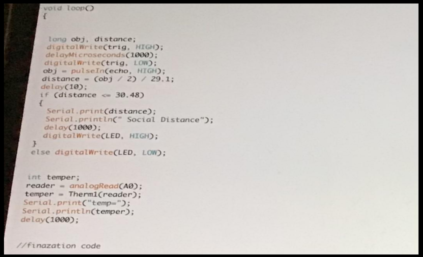
Design 3. Image taken by student

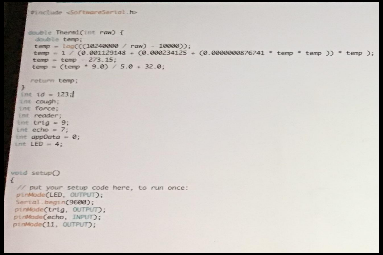
Discussion

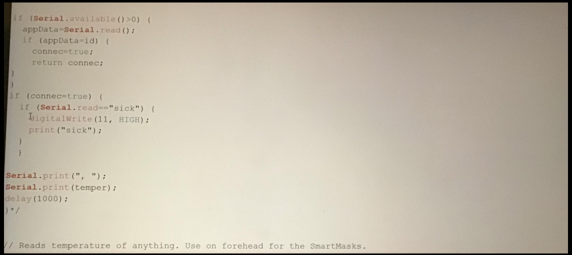
1.The challenges that arose were the sewing was at first done by a hand sewing machine, but the machine got stuck and locked in some fabric. This was solved by just learning to sew by hand.

2. Adding to this, the Bluetooth module was using pins on the Arduino, pins are just places to attach wires. However these pins were busy doing other things. The solution though is to attach the wires after the pins were done with the previous activity. This may be an inconvenience for the wearer, but this can be configured before the use of the mask.

4. The third design was a major improvement over the first design by being much more neat and having more electronic components, hence making it better and efficient. The final design actually included the app and Bluetooth unlike the other two which only had a couple of sensors. Overall, it was a great succession over the last two.







All images taken by student. Photographs of Arduino code.

Conclusion

The design was a good design, but it is still far from perfection. The design met many design goals. Here are the goals:

1. This goal said that the engineer must design the mask properly so that each sensor is in it's designated work environment. Sewing the mask made it so there could be space, and space was used scarcely.
2. The next goal says an app must be made compatible with Bluetooth. MIT App Inventor created a simple and easy environment to add Bluetooth and code.
3. The third goal is to create a notification system inside the mask. The circuit to make it was an LED blinking, and the whole system was not too hard.
4. This goal says to make an efficient code. Coding corrections were made when the mask did not work. Arduino IDE notifies what is wrong and where.
5. The next goal is to create a file program. This program was made and and tested using Arduino and feeding it data.

Real World Connections

In the world today with COVID-19, people are scared of getting sick. Sickness is bad for everyone, this can spread, and people could die. My school fortunately only had two cases of COVID-19, but other schools had as much as 30 cases. This mask tells if someone is sick, so this can predict and prevent spreading. This will allow other schools to decrease their cases and allow schools like mine to reduce fear and constant checking of sickness. This mask could definitely help. However it could not only help schools, but businesses and offices too. Anyone could use this. People who are at risk, who if they get disease have a bigger risk, especially could use this. Teachers and parents, also, have the problem of not knowing when kids are sick because the kids might be scared to say or want to play.

In the future this could grow cellular. It could look for problems that might be biological. A.I. also is something growing big today. A.I technology along with my mask could be used to predict illness and outbreaks when humans could not. Improvement is necessary in order to grow this into something that can help people around the world.

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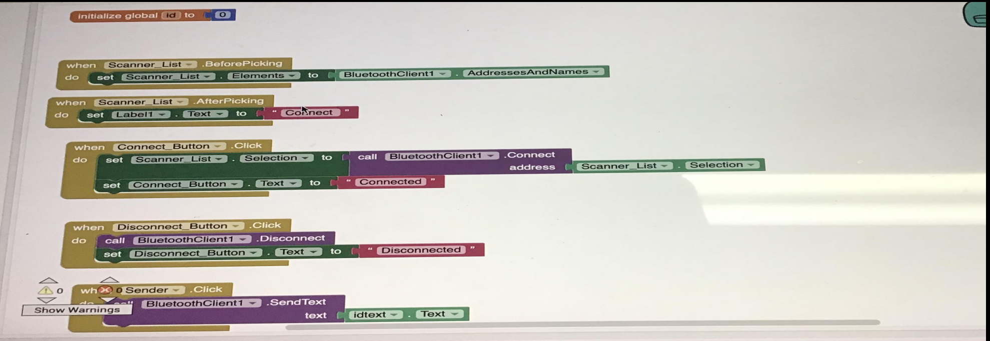
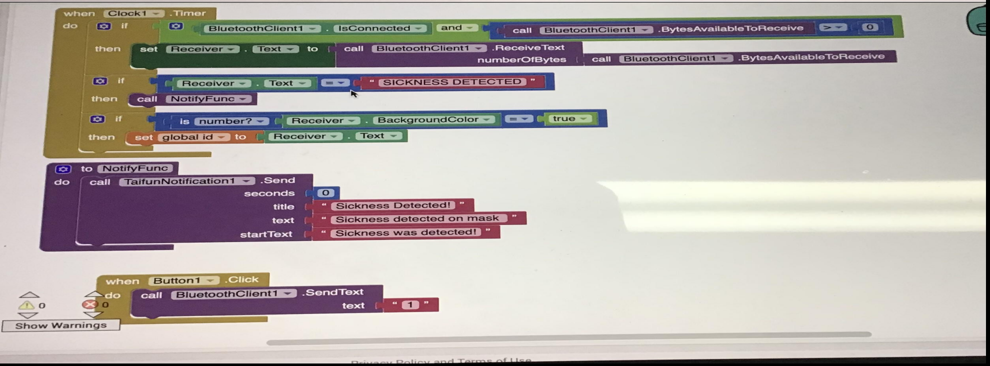
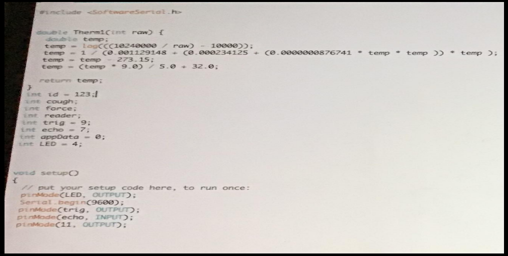
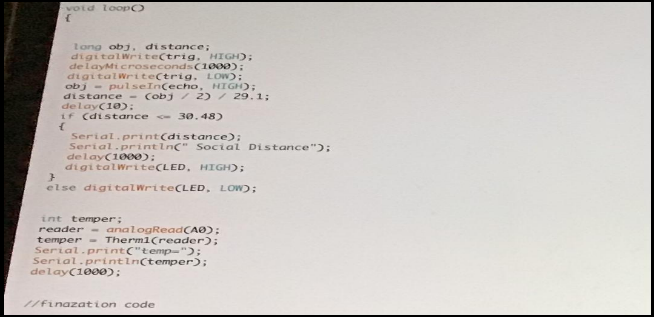
Thank you!

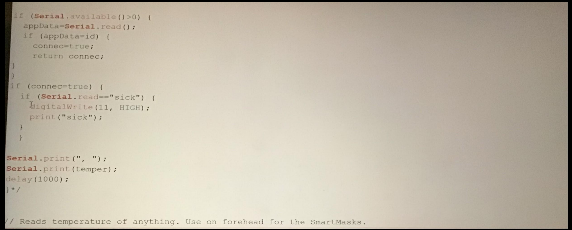
Photos











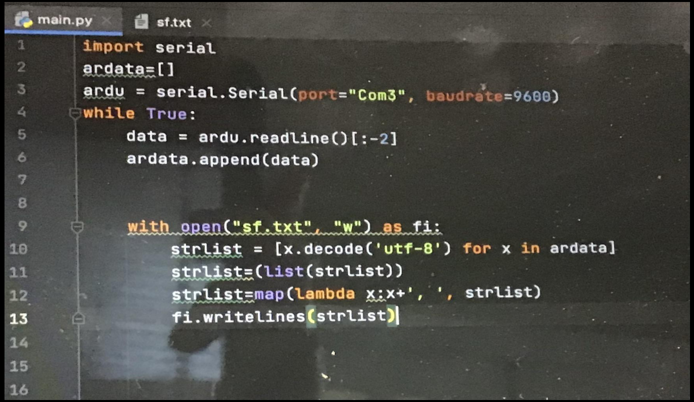
All photos taken by student. These are the pictures from the previous slides. These are of code

Photos

Design 1

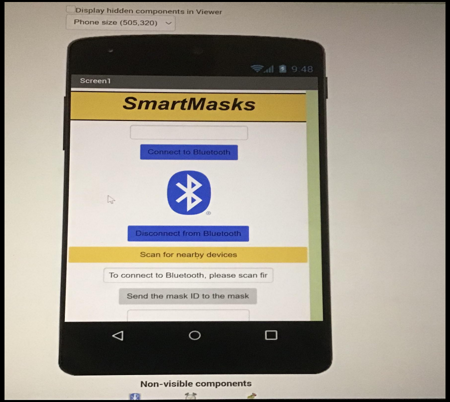
Design 2

Design 3



File Program

App



Demo

https://youtu.be/o7xcsKwDYro