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P5: Project Report

Project title

Don’t Burn Me Detector: A Smart Solution for the Visually Impaired.

Description

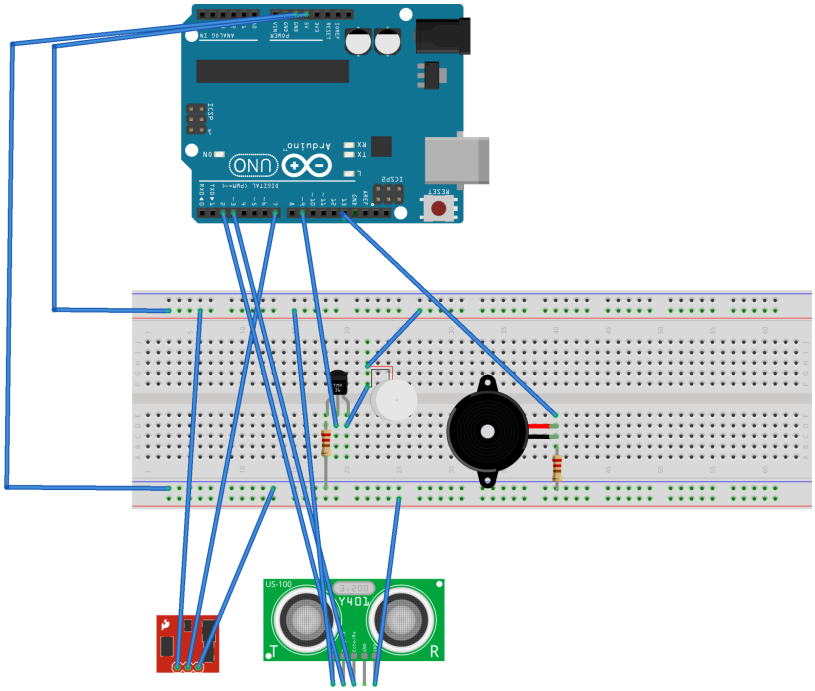
The use of this system is to guide users with visual impairment to properly target the containers such as a cup or mug before the liquid is poured, without using a finger to detect where the mug is or where the liquid line is and to avoid possible burning issues. Don’t Burn Me Detector: A Smart Solution for the Visually Impaired is a sensor that can 1) indicate when the object, the bottle is approaching the cup glass so that the user can know when it is safe to pour, 2) indicate when the liquid has reached the level that has to be stopped or it will spill or overflow.

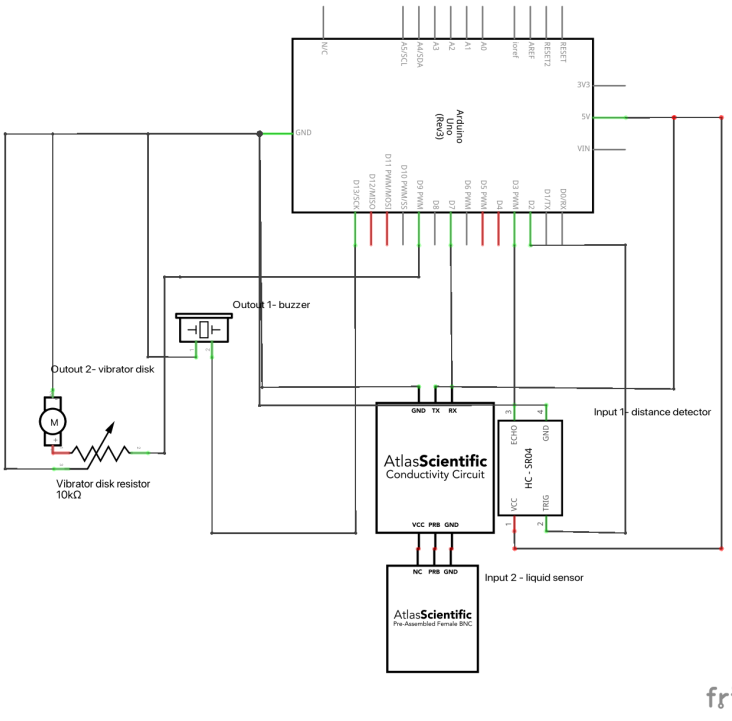
System Diagram

Implementation

Catherine is visually impaired and tends to burn herself while she pours hot water into a mug. She uses her fingers to detect where the mug is and whether the liquid has been poured into the mug. When she uses the *Don’t Burn Me Detector*, the signals such as buzzes and alarms can easily guide her to pour and help her avoid the dangers she has. *Don’t Burn Me Detector* is made up of a liquid detector, attached to a 3D-printed clipper, which is clipped onto the edge of the cup. When the liquid is poured into the cup where the limit is, the system will buzz to indicate stop pouring. The distance detector is tied to the bottle in which the liquid is filled. When the bottle is approaching the targeted cup, around a distance of 20 cm, the proper working distance to pour, the system will vibrate, indicating stop and ready to pour.

Circuit Diagram





Software

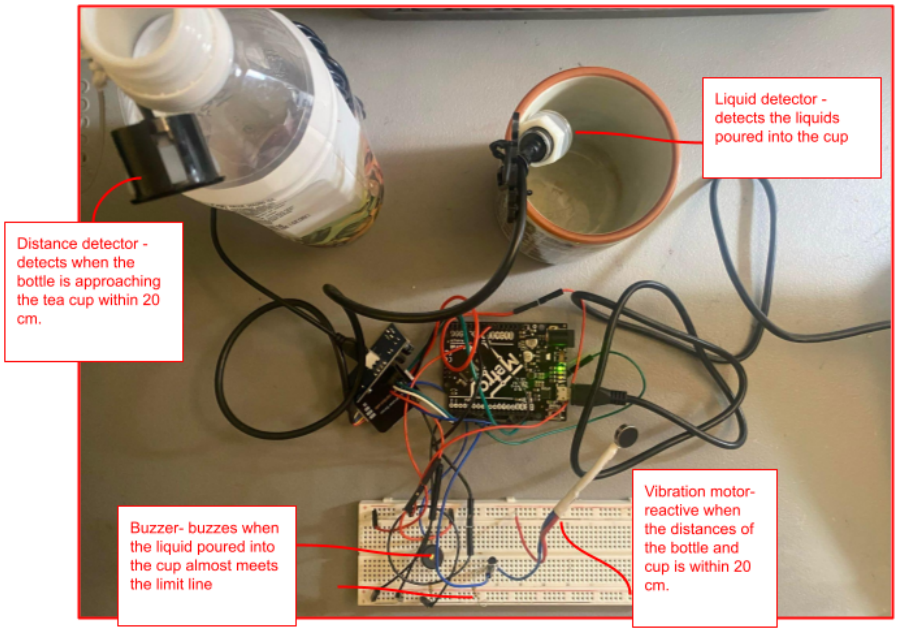
The inputs are a distance detector and a liquid-level detector. I started with defining pins for trig and echo at pins 2 and 3 for the distance detector and initialized pin 7 for the liquid level

detector. I then initialized the pins for the outputs, a buzzer pin 13, and a vibrator, pin 9. Then, I set up inputs and outputs with pinMode in the loop void setup().

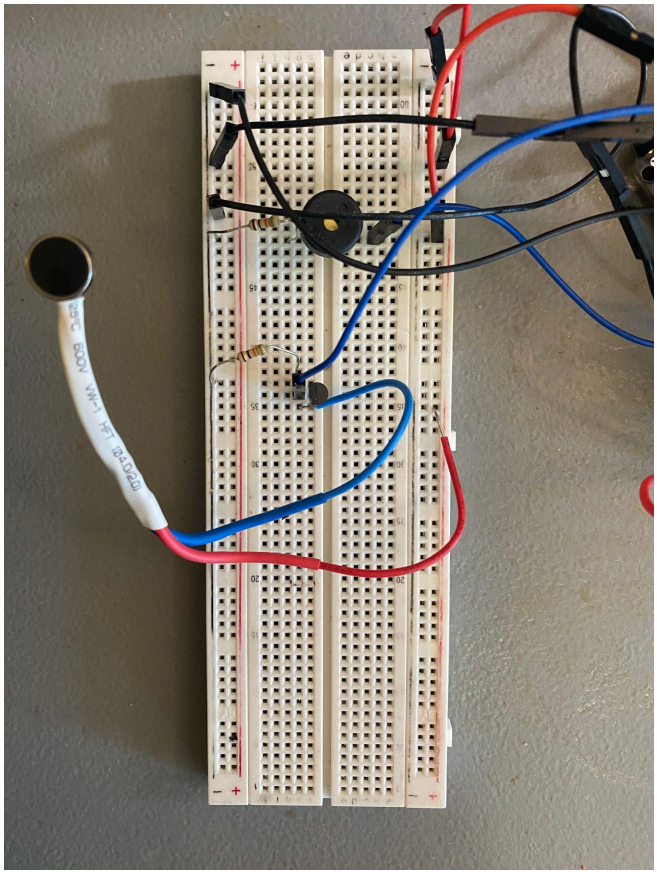
In the loop of void loop(), I used digitalRead to read the value of pin 7, the liquid level sensor, if the value is low, meaning the liquid is not detected, the buzzer will not buzz. If the value is not low, the buzzer will buzz for the frequency of 0.5 Hz.

And then, I wanted to know the distance between the object and the sensor, so I triggered the sensor by setting the trigPin high for 10 microseconds and used pulseIn() to read the echoPin on HIGH and know the duration in between them. I calculated the distance in centimeters with duration*0.0343/2. Lately, if the distance is less than 20 centimeters, meaning it is safe to pour the liquid, the vibrator will vibrate, or else it won't vibrate.

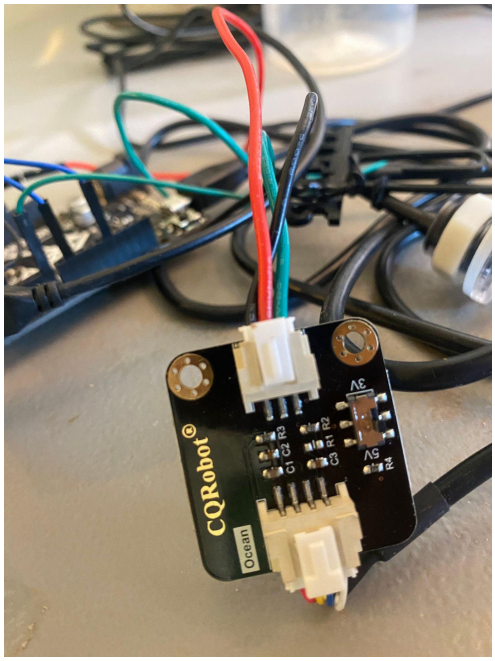
Gallery

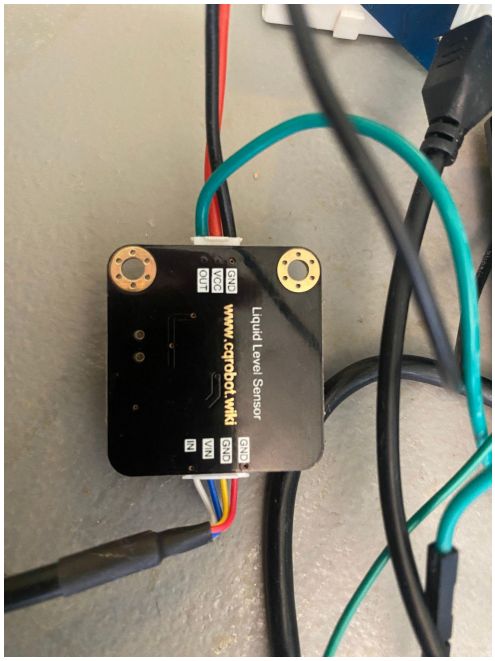


Overview

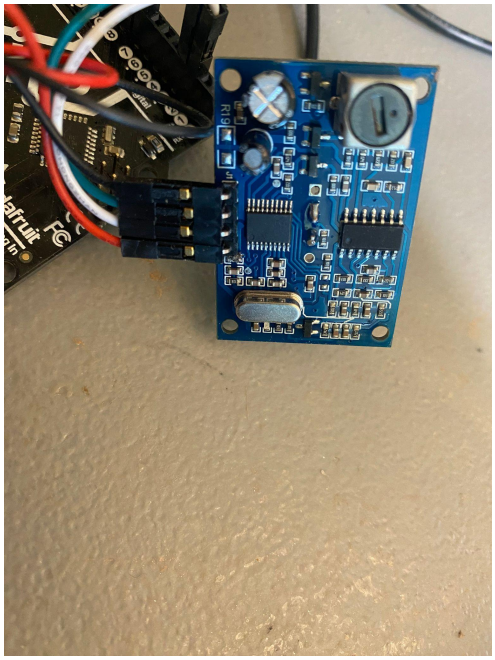


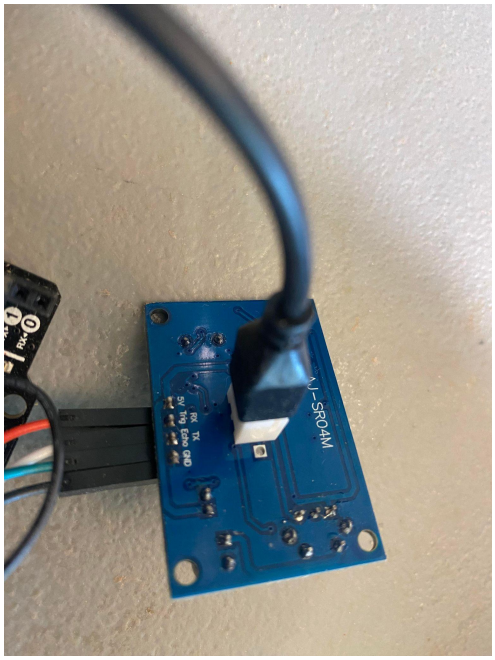
Buzzer and vibrator are sitting on the breadboard.





Liquid detector with GNC, VCC, OUT, initialized by pin 7.





Distance detector with 5V, Echo, Trig, GND. Trig and Echo are initialized by pins 2 and 3.

Liquid detector is attached with a 3D-printed paper clip in the shape of “HELP”. Where the detector sits indicates the line the liquid will be filled.

Distance detector is attached to a bottle's cap or neck, around the distance where liquids come out to indicate the distance between the bottle container and the cup.

Demo video: https://vimeo.com/833133296?share=copy

Process

Successes

The vibrator disk came with two thin wires and could not be stuck into the breadboard. After the soldering and extensions of the wires into larger wires and sheathed into a singular head (to avoid damage), it can now stand on the breadboard and function well.

Challenges

The main challenge of this design is the ultrasonic distance detector—the one provided in class, whose shape is hard to attach to the bottle. The four pins of it need to be inserted on a breadboard or soldered to be lengthened to insert. The shape, two circular structures on a rectangular board, and the size of it are hard to make it tied to my bottle with water in it, so I purchased another liquid detector for easier design. However, this distance detector cannot detect the range below 20 centimeters. The working distance of pouring water is not a big range. 19 is quite suitable for pouring it. While I can limit the system to not vibrate beyond 20, the distance within 20 is hard to detect. Sometimes I can imagine the need to pour within 20 centimeters. The future direction of this design is to find a distance detector that is workable with a distance range shorter than 20 centimeters.

The physical prototype part still needs to be renovated because now I use a 3D-printed shape “HELP” to clip onto the edge of a cup. It is squishy and not stable. And the liquid detector is still very big. If the goal is to manufacture, the sensor should be at least half the size of the current one. The same condition applies o the distance detector. Now it is too big to be attached to a teacup. The wires are too long and had to connect to a breadboard. Ideally, the system will be wireless and the sensor incorporated into the teapot and the cup, to minimize usability issues. The vibrator used is ideally not situated on the breadboard but held by the user either in the hand or with a mobile device. Also, this system has never been tested by the target users, the visually impaired, it is unknown how usable it can achieve with the current design. Future tests may be needed to ensure that it meets the needs.

Reflection on the impact of salon and speakers Please share briefly what (if any) impact did the salon readings and speaker presentations have on any aspects of your project? (e.g., focus on specific practical applications or on privacy issues)

The ones that I was inspired by are the articles I shared. The ones I shared were about the visually impaired in the accessibility fields. Since most technologies that provide the solutions for visually impaired have been with the white cane and sensor working with the white cane outside of the door I was thinking to create solutions for the users in the home environment where they perform tasks other than walking or crossing the street. One major inspiration was from this article which mentioned that “The Internet of Things (IoT) has long been hailed as a tool that will help people across all disability categories to lead better lives by helping them to more easily benefit from technologies.”

I learned in class that a vibration disk I used as one of the outputs is originally used in the mobile phone to vibrate when messages are received. Though my prototype doesn’t incorporate this vibrator into an IoT or phone device, it is doable to include it in the future to signal on a wireless system while the user is not needing to rely on a big breadboard and wires that connect to it. Also, integration of the IoT with the system like smart homes (i.e. thermostats, lights) has the potential to enhance the overall quality of life of the visually impaired [1]. Nevertheless, challenges in IoT for accessibility, such as requesting a piece of information and setting up or changing credentials, and interoperability will require attention in the disabled communities [2].

References

[1] https://www.stratospherenetworks.com/blog/how-the-internet-of-things-iot-can-make-life-easier-for-people-with-disabilities/

[2] https://www.inclusionhub.com/articles/designing-accessible-iot-experiences