Sustainable Symphony (SuSy)

Team 0D-Hypercube
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Project Instructions

Building the housing

We used cardboard to build the housing around the electrical components. We used two rulers, two cutting tools, pens, tape, and a lot of math to produce cardboard rectangles to construct what looks like an upright tissue box with holes cut at one set of opposite horizontal sides. This is specific to our implementation of a solution to the problem posed in the Inspiration section.

Motion: The Arduino and the servo

We created a simple Arduino program to instruct a servo to rotate 60 degrees in either the counterclockwise or clockwise direction. Because of the design of the housing, waste items roll off of the platform in the sorting chamber into their respective containers.

FFT and sound analysis

The Fast Fourier Transform (FFT) converts a single waveform into a graph of signal frequency versus frequency of each separated waveform. We can use the FFT to compare recorded sounds to a database of known sounds of recyclable materials. The system then determines which known sound is closest to the recorded sound, then returns the name of that sound and bins the material as recyclable. Otherwise, the system returns "trash" and bins the material as such.

Putting it all together: the DragonBoard

We used Python to code all the necessary FFT files and the main program that manages the servo and the analysis. The DragonBoard is also connected to an audio mezzanine board, which is connected to a microphone to pick up the sounds.

Project Information

Abstract (100 words)

Sustainable Symphony, or SuSy, uses DragonBoard's sound-recording capabilities to sort recyclable materials from trash. SuSy is ideally placed over a bin which is split between trash and recycling. In order to make waste management easier for the user, whenever a user throws a waste item into this waste container, the device will determine whether an object is recyclable or not based on the sound the object makes hitting the bottom of the sorting chamber. From this analysis, SuSy will tilt toward either trash or recycling to dispose of the waste properly.

Description (500 words)

SuSy consists of an acoustic sorting chamber. A tray connected to a servo motor is responsible for the tilting and sorting of waste. When tilting, the motor will rotate either 60 degrees clockwise or counterclockwise based on the content of the waste. The DragonBoard features an audio mezzanine board connected to a built-in audio jack. A microphone is plugged into this audio jack to record the sound of waste when it collides with the tray. When an object hits the tray, the sound is recorded and (through Linux functionality) turned into a .wav file that is analyzed by our software and compared against our library of sounds corresponding to objects that are recyclable. If the waste item is determined to be recyclable based off of this analysis, the waste item is deposited into the recyclables chamber. In addition, it can also determine the type of recyclable material, such as paper, plastic, and metal. Both methods sort the waste based on sound wave analysis, namely the use of a Fast Fourier Transform (FFT) to evolve frequencies from single waveform. After the analysis, the DragonBoard sends either a HIGH or LOW signal to an Arduino that, based on the input waveform, operates the servo motor to rotate in the appropriate direction in order to store the waste item. The Arduino, DragonBoard, and servo are all mounted to one wall of the device, powered by a battery and covered in casing.

Inspiration (500 words)

One year ago, our freshmen collective genius procured a plan to collect recyclables to sell to the Miramar Recycling Center. And so we hoarded our shiny plastics, glass, and metal like dragons. Eventually, one corner of our common area disappeared under a mountain of garbage; for 13 guys living together, that took a substantial area out of our everyday living space. Had we a machine to assist us in our sorting, our living area could have been more organized.

People often forget which materials are recyclable and which are not. As a result, countless food waste and other trash is thrown in recycling bins, while clean cardboard and plastic bottles are disposed of in trash bins bound for landfills. For this project, our vision is to ensure the correct disposal of various materials, and our mission is to use the sounds produced by the object to identify the object.

Expectations (250 words)

We expect two outcomes: SuSy can determine whether the waste item is recyclable, and the FFT analysis is able to determine the identity of the waste item if it is recyclable.

Assumptions

- One item at a time
- Empty containers

Video of Demo

DEMO: Sustainable Symphony (SuSy)

Pictures!

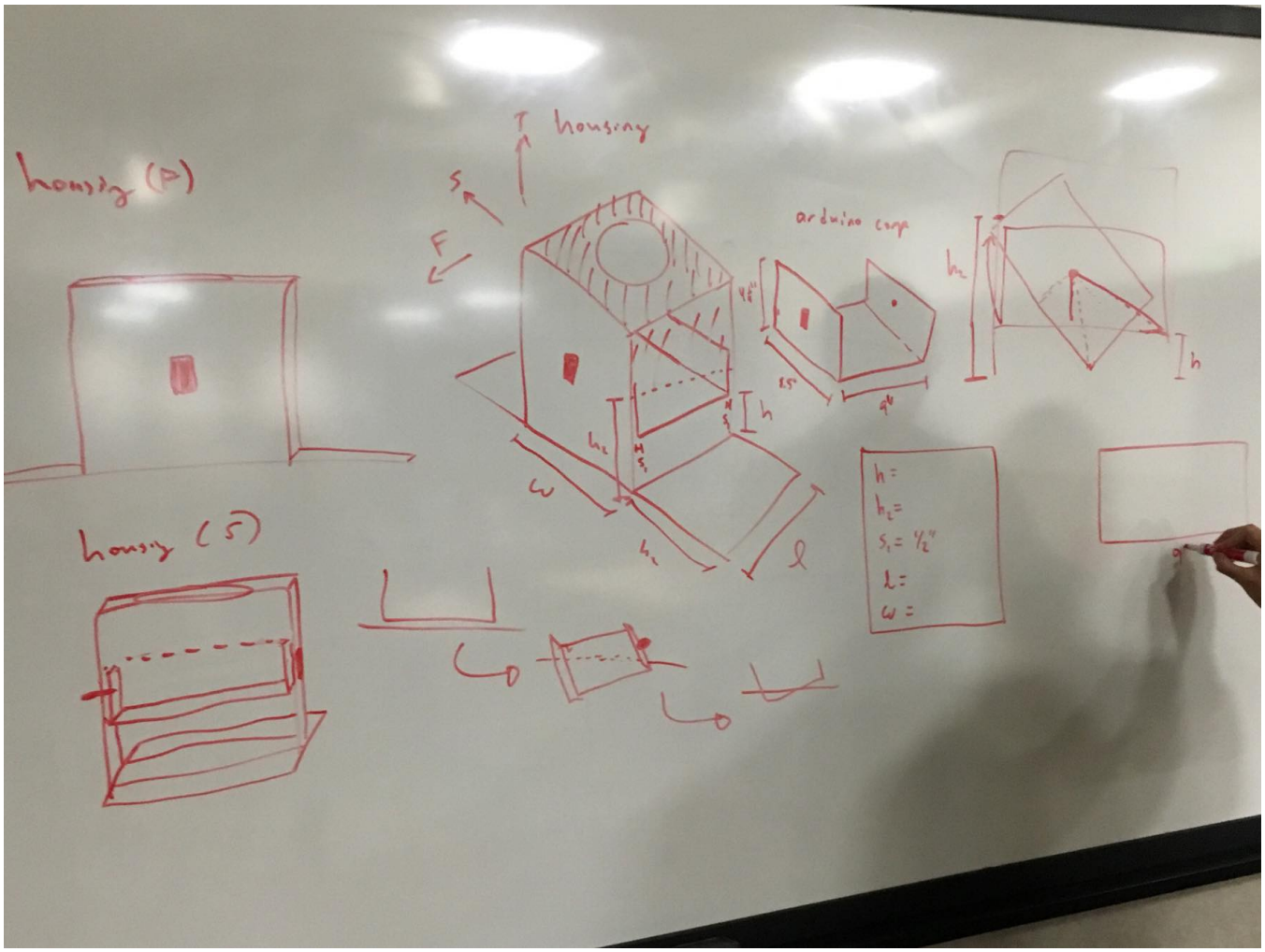

Figure 1: Our work for determining the dimensions of the housing

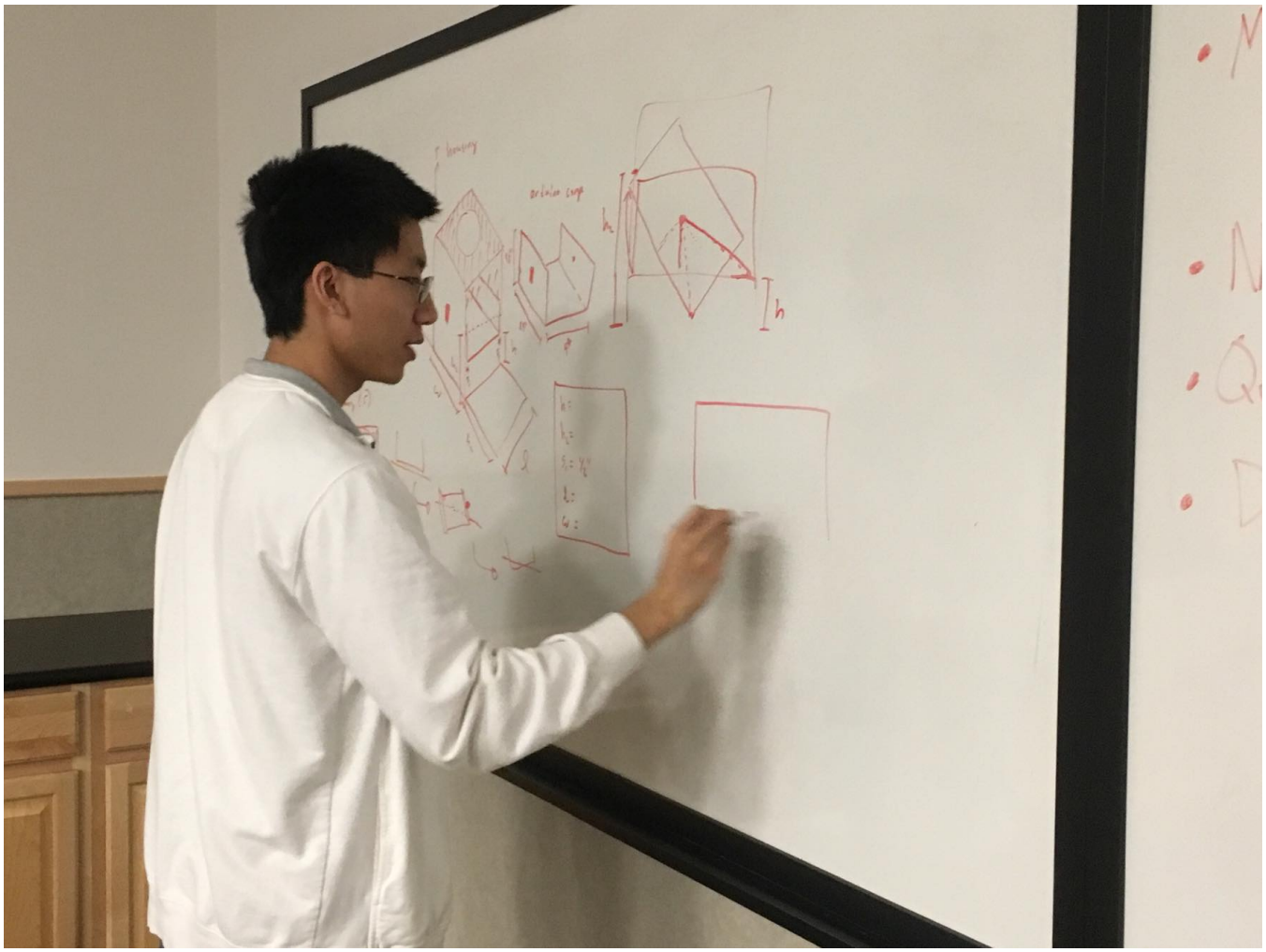

Figure 2: Michael (center) works on the math

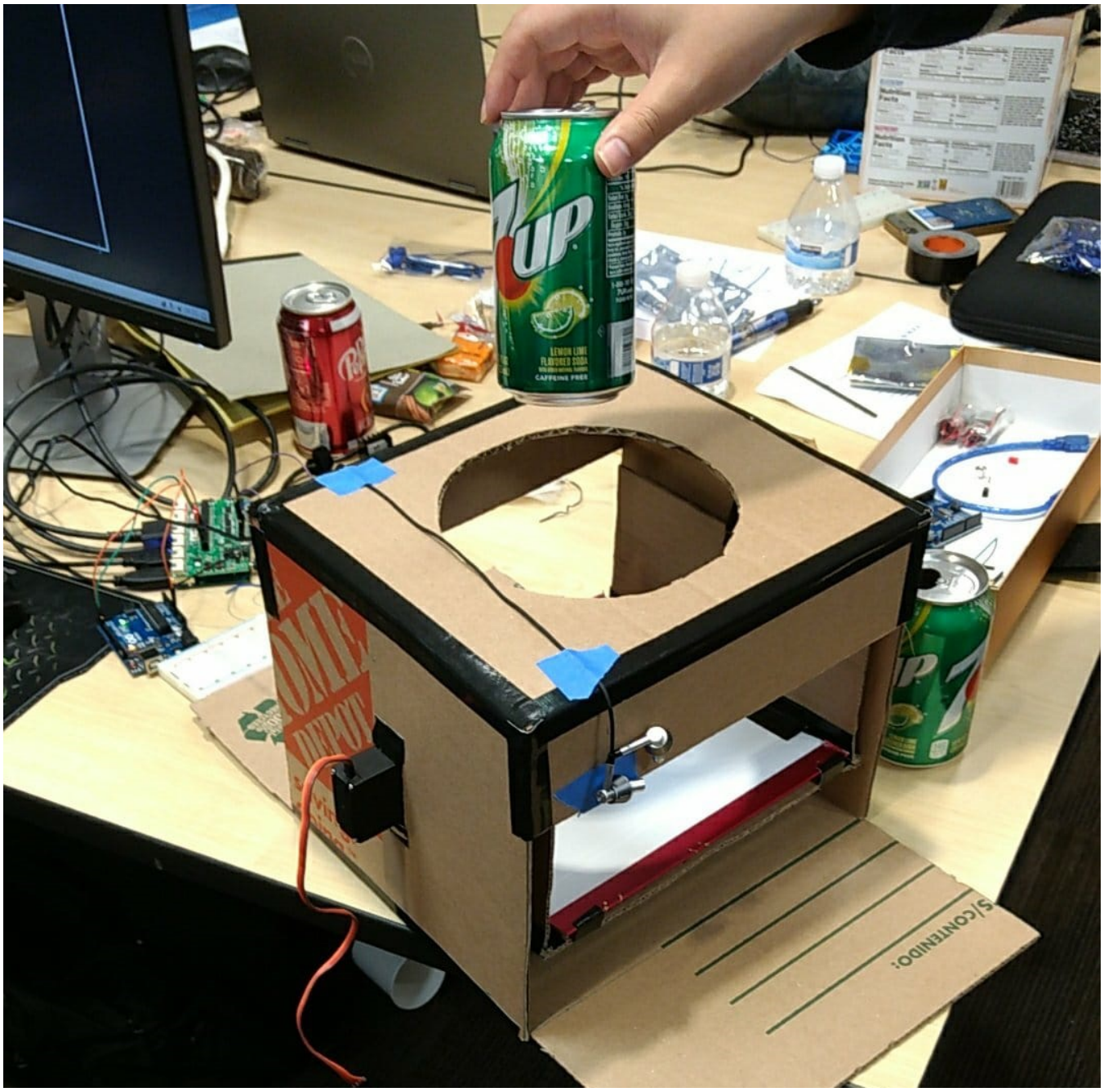

Figure 3: Our sound-sorting sustainability symphony. Soda can for scale.

Figure 4: Godwin (left) and Our Supreme Leader and Fuhrer Geeling (right back) working on the final touches of SuSy

Figure 5: We got honorable mention and these awesome shirts! Left to right: Geeling, Godwin, Tammy, Jacob, Andrew, Michael