University of Ottawa

Fall2021 - GNG2101

Deliverable C: Conceptual Design, Project Plan and Feasibility Study

Lab Section A04 Team_18

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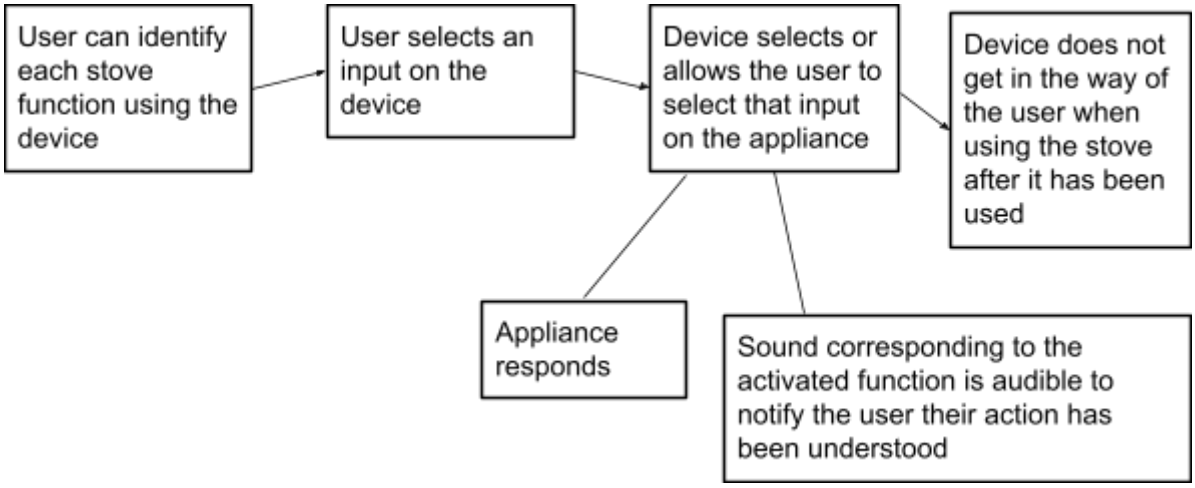
Introduction

After our completion of Deliverable B, as a team, we understand the goal of our project much better and we have cleared up the last of our lingering confusion after originally reading the description. Our problem statement is as follows: a need exists for a device that operates an appliance with a heat-based touch screen interface. The device can be engaged without any visual component, is durable, usable under kitchen conditions and has an audio aspect to aid the visually impaired. Below, we have each separately ideated three concepts for potential options on a device to aid the visually impaired in using a heat-sensitive touch screen. These concepts can either be global (for the functionality of the entire process of cooking with a stove) or can be specifically for a subtask within the process. Finally, as a team we created a decision matrix where we evaluated each concept against our translated needs. The highest ranked concept/the concept showing the most promise after discussion will be developed further. As well, its benefits and drawbacks are considered. These concepts outline the purpose of this document being to define our chosen solution from our ideation stage.

1. Functional Decomposition

- The succession of processes needed in order for the product to be satisfactory to the client.
    - Note: this does not include HOW we as a team will fulfill these needs. Please see Figure 1-15 for our ideation.



2. Product Concepts (3 per team member)

Below, we have laid out our ideation where each group member independently came up with three global concepts to potentially solve this problem. All the methods include some subtasks with some overlap as well, however because the range of our potential solutions was

so wide, we all ideated for an overall solution and not for one specific component. Our chosen design displayed in **Figure 16** is split into its primary components. These subsystems outlined briefly in **Figure 17** and **Figure 18** are the main aspects as of today. External subsystem boundaries will include the size and dimensions of the stove we will be modeling for. As of right now, the client has provided the specific stove in question that we discussed during our first interview on September 21. This is the stove we had in mind when ideating and eventually choosing our concept upon which we will build throughout the term. However system components depend on this appliance specifically and a more generalized solution would need to be reconsidered. Another subsystem boundary is visual components. Our client is fully blind and so any visual components included in a component of the solution will be effectively useless (unless someone is helping the client to set up - however a need is independence when using the device so we will not bank our solutions on this).

The Stove In Question:

https://www.badboy.ca/frigidaire-30-5-4-cu-ft-induction-range-with-air-fry-in-stainless-steel-gcri305caf.html?gclid=CjwKCAjwhaaKBhBcEiwA8acsHLmFUjmUbgqnKnPZt6M4ZXsf-Vbg01RRcV0Ve43bziHzKiLp22PO0hoCFyYQAvD_BwE

Kyle (Concept 1)

- Low tech glove that doesn't allow heat to go through but it can feel locator dots through it with holes on the side that lets you rotate finger to actually push button. Requires use of locator dots

Figure 1

Kyle (Concept 2)

- High tech screen device using app/wireless keyboard

- 

Figure 2

Kyle (Concept 3)

- Siri-stove

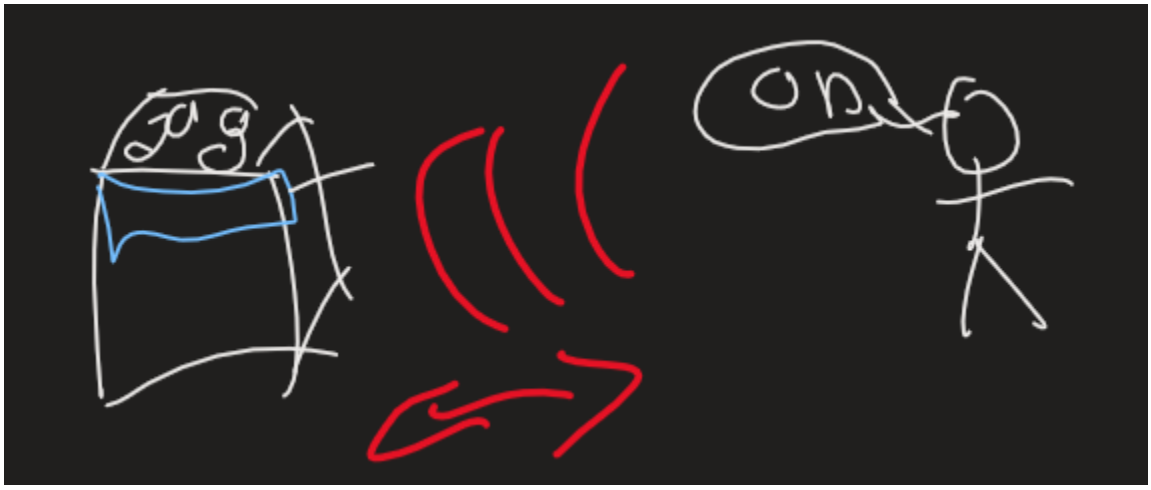
- 

Figure 3

Muiz (Concept 1)

- Raised grid above the control panel that has braille saying what the button directly below says and then when the user finds the button they want it swings open and they can push the button below it, with guides to ensure they push the right button

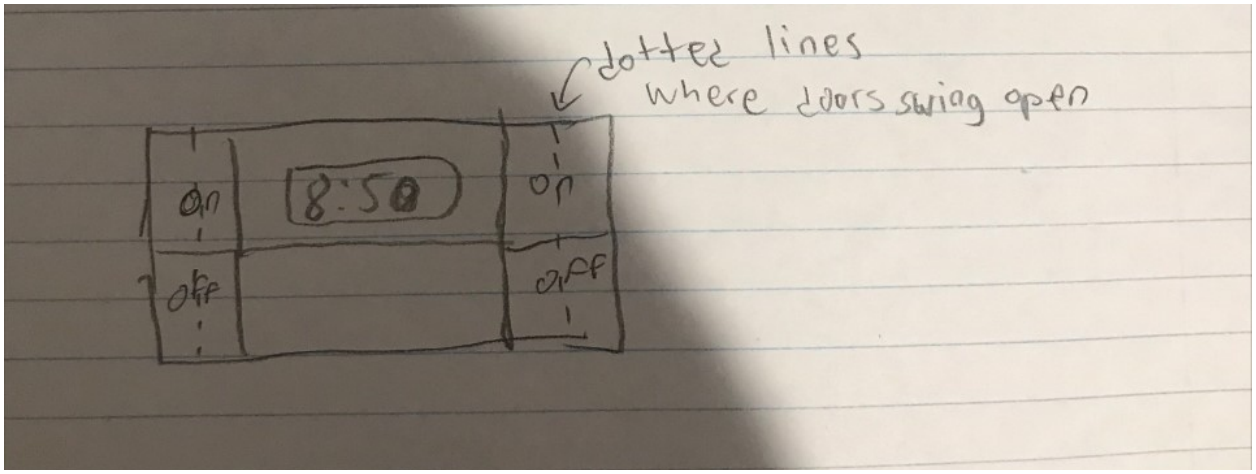


Figure 4

Muiz (Concept 2)

- Toy poppers with braille on top indicating the button they are placed above so the user can then push down to select the button

Figure 5

Muiz (Concept 3)

- Stylus guide that says the button it's sitting on and then the user can use the guide to determine where to put their fingers

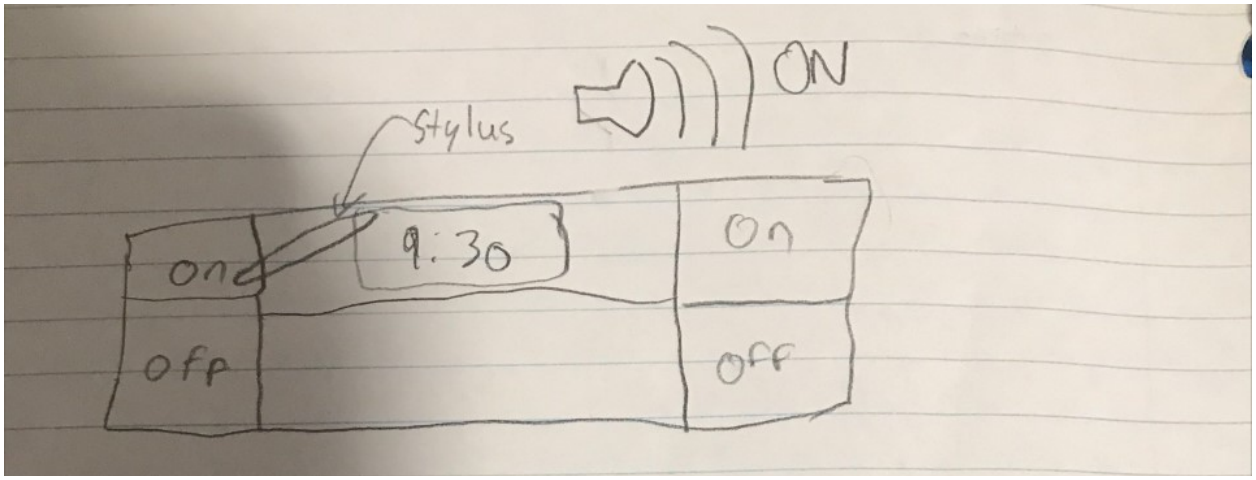


Figure 6

Azan (Concept 1)

- Thicker tactile dots, so that when the user feels for each button, they would not trigger the function by accident

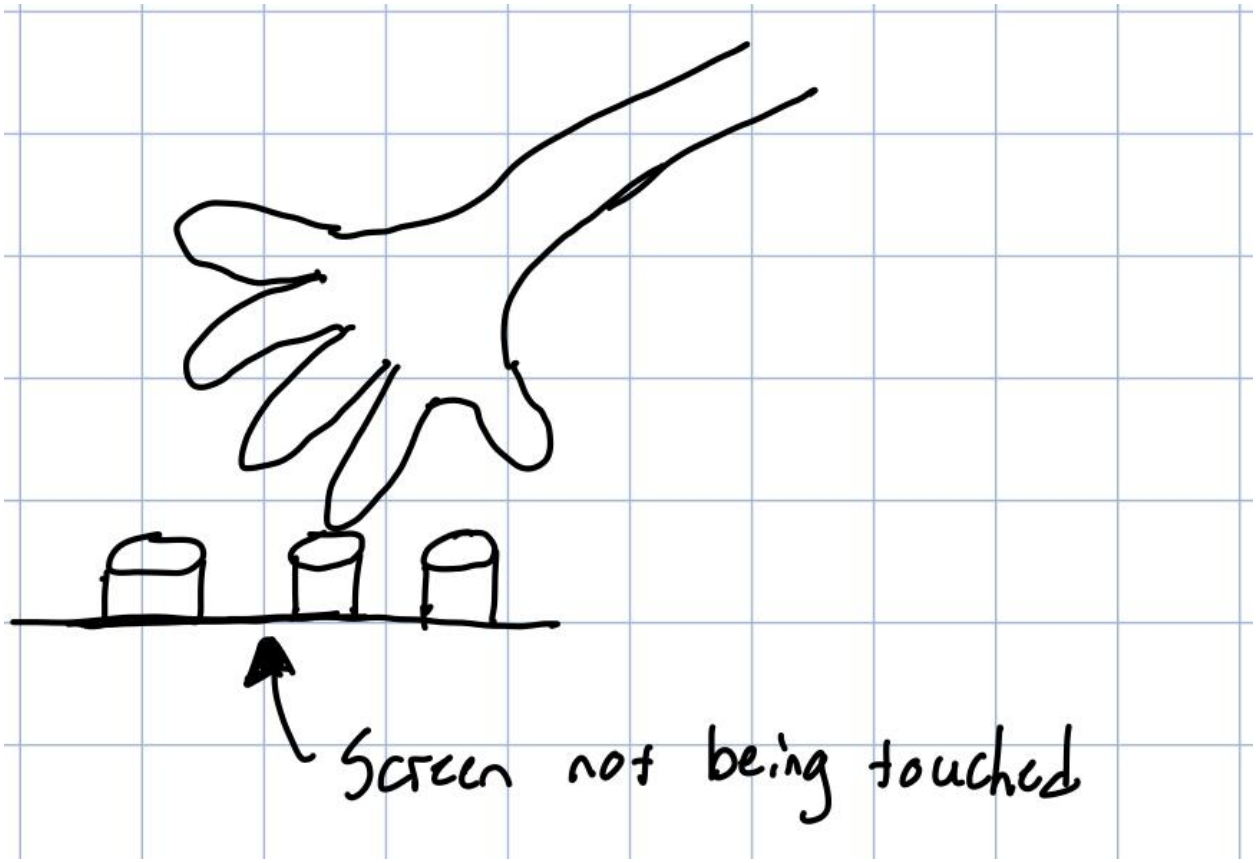


Figure 7

- Stylus with a screen reader app so that when they hover over each button, the screen reader would let them know which function it is without them accidentally triggering it.

Azan (Concept 2)

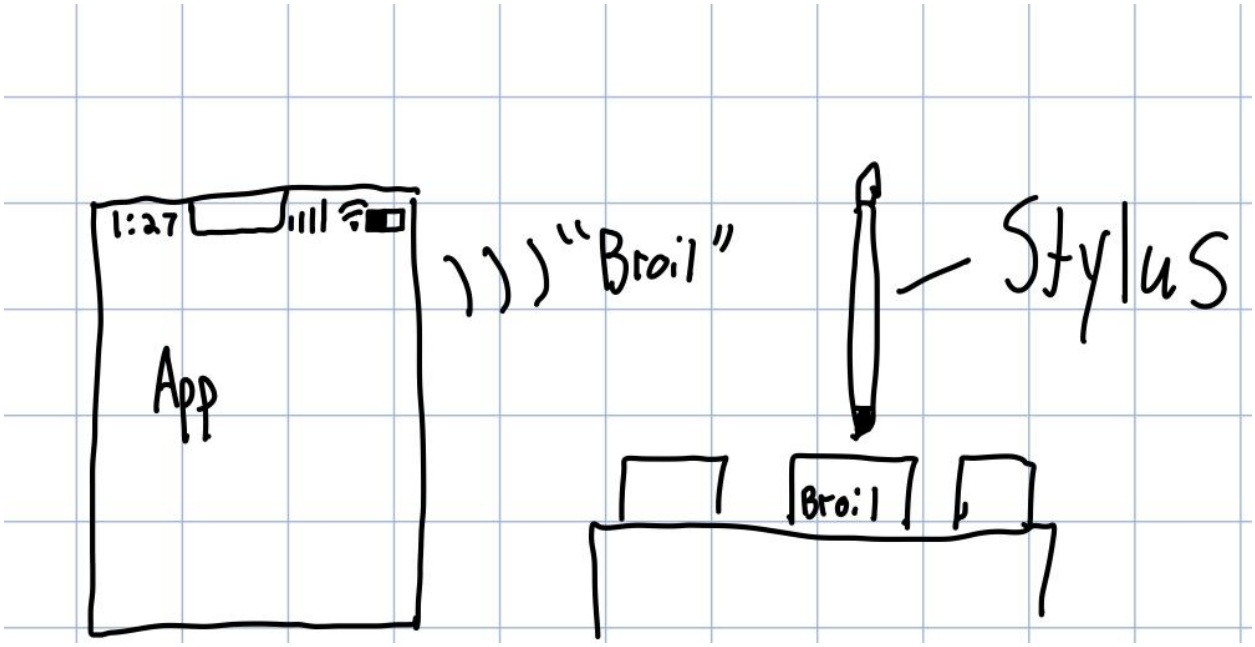


Figure 8

Azan (Concept 3)

- A form of tape over each button to desensitize the touch interface of the buttons. The user would then place the tactile dots over the tape so that they can feel for the button, and then press it harder for it to register

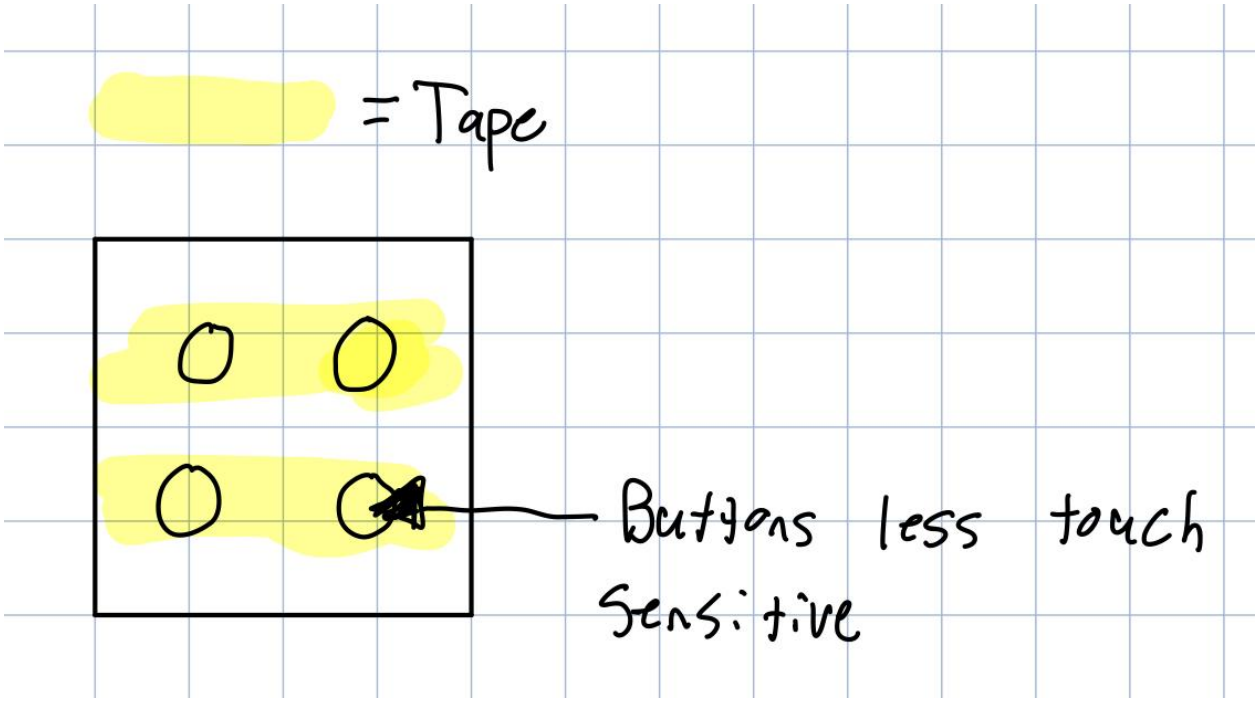


Figure 9

Lauren (Concept 1)

- This is a global concept encompassing the entire process from start to finish of operating a heat-sensitive appliance
- Braille locator dots placed on the stove buttons
- Glove is made of thin material that allows braille to be felt through
- The client would wear a heat-transmitting glove on their preferred hand with pads on each of the fingers that allow braille to be felt and read
- Once tap would localize the screen and the button would be said aloud to the client knows what they are looking at
- A double tap would select a button which is activated with a beep from the glove corresponding to the task to notify the client the desired action is being applied

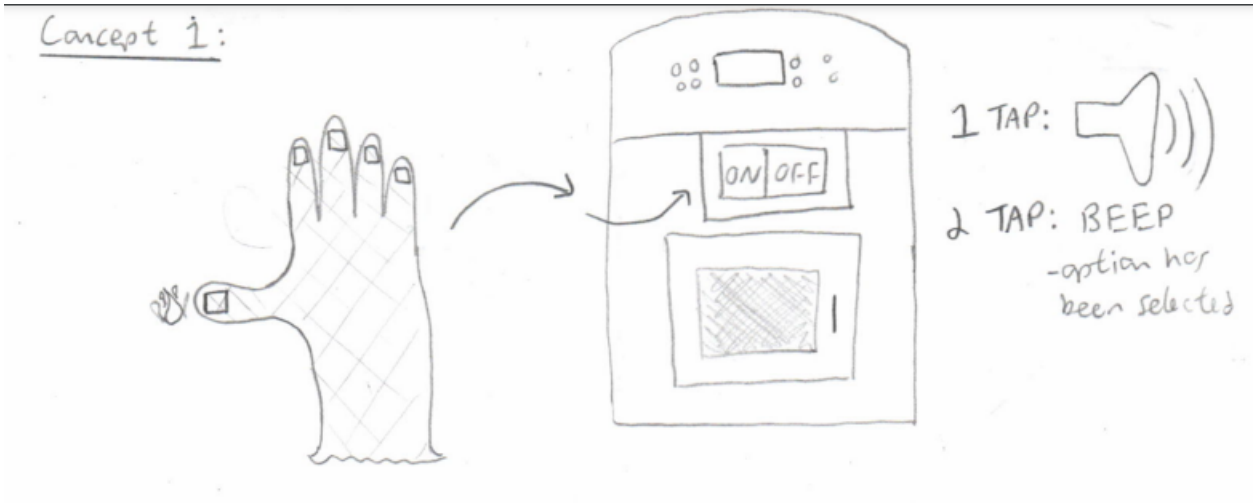


Figure 10: Heat-transmitting glove, numbered taps and sound signals

Lauren (Concept 2)

- This is a global concept encompassing the entire process from start to finish of operating a heat-sensitive appliance
- Braille-capped columns would be secured into a board presented to the user as they stand in front of the appliance
- By moving the columns into position and pressing, the user can get the desired behaviour from the appliance
- Note: the columns would not be as thin as presented in the picture - they would have adequate surface to allow braille to be read at a reasonable dot size

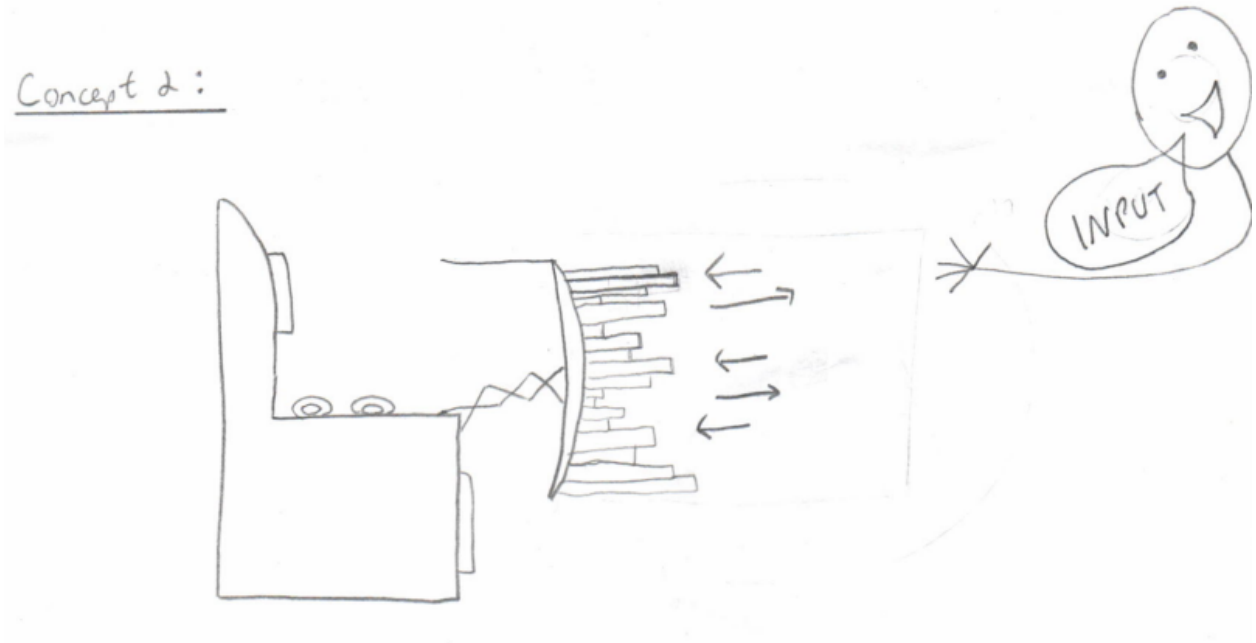


Figure 11: Moveable braille dot columns to formulate desired operation of the appliance

Lauren (Concept 3)

- This is a global concept encompassing the entire process from start to finish of operating a heat-sensitive appliance
- A remote control is held by the user with a feature to listen or to speak
- Each button has braille so the client can understand which is which
- The listen button allows to user to understand what the current display of the appliance is saying
- The speak button allows the user to convey their actions required of the appliance

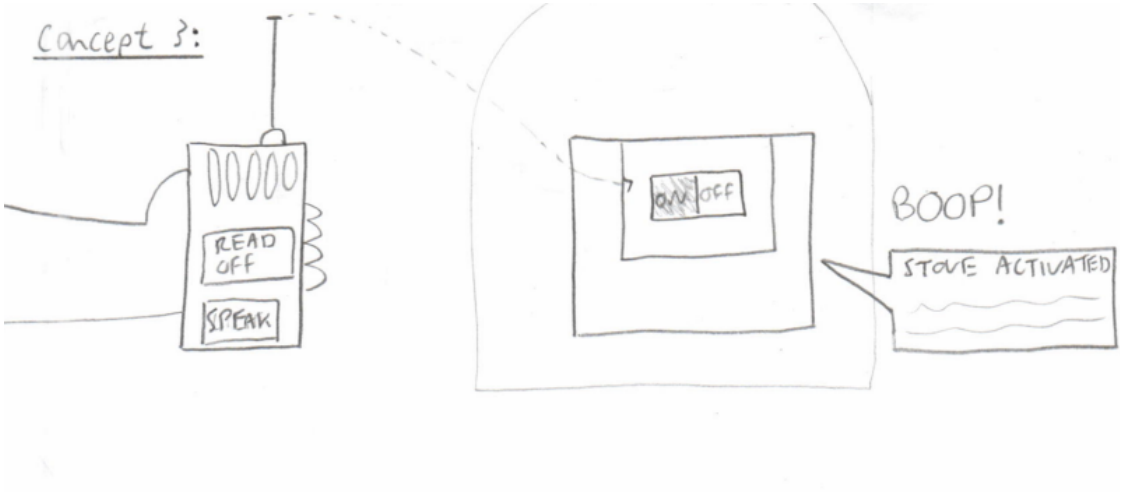


Figure 12: Remote controlled device to allow strictly audio communication with the appliance

Patrick (Concept 1)

- Develop a screen reader-type app that will audibly tell the user what is in front of the scanner. This will help the user know what button they are about to select.

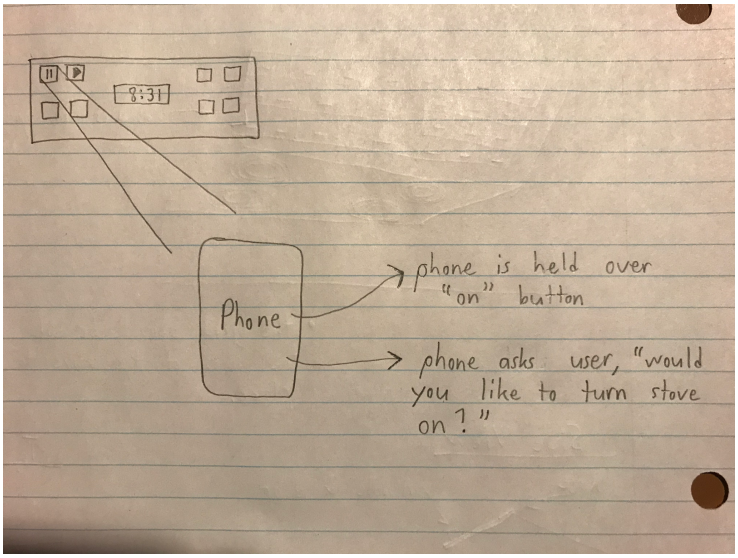


Figure 13

Patrick (Concept 2)

- Adapt screen to make it possible to tap screen once to receive an audible cue as to what is being touched, and then double-tap screen to select setting.

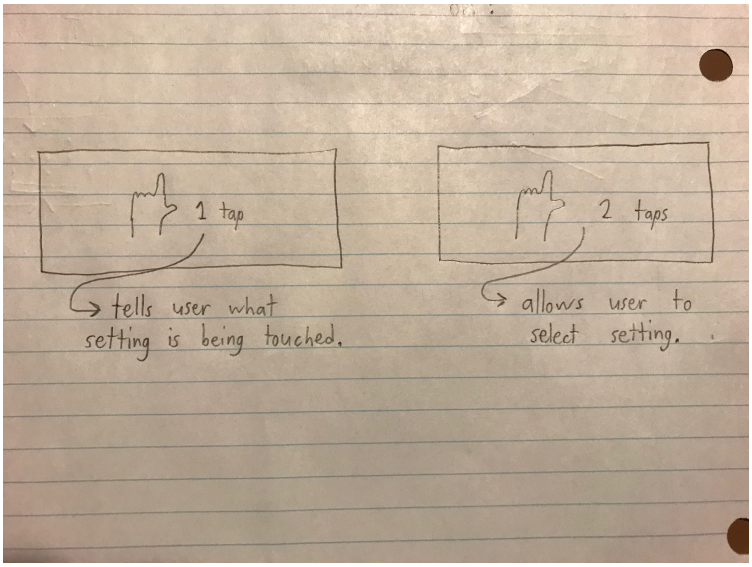


Figure 14

Patrick (Concept 3)

- Use locator dots that are collapsible. In their uncollapsed form, the locator dots are long enough that the heat sensor on the touch screen will not recognize the client's hand. When wishing to select a setting on the touch screen, the client can push on the locator dots, collapsing them, and thus being able to touch the screen.

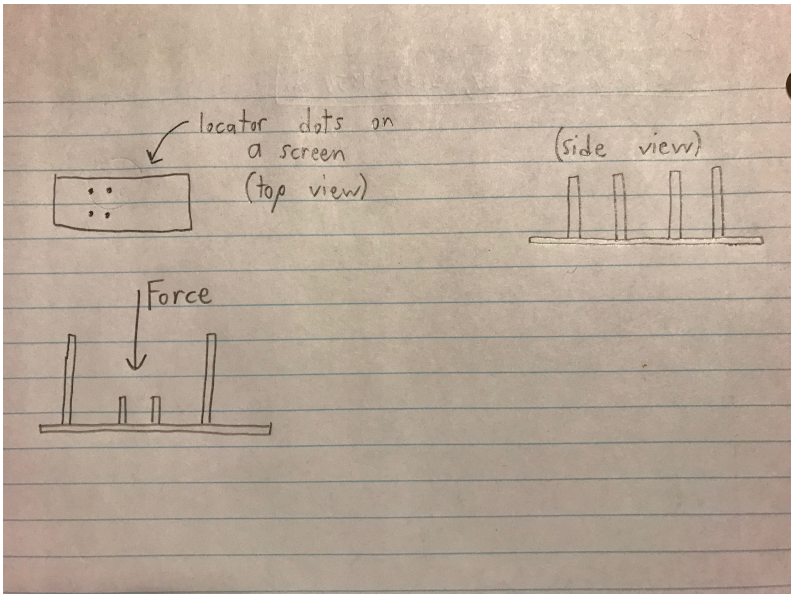


Figure 15

3. Analyze and Evaluate all Concepts

We will use a decision matrix to determine which of our concepts from the ideation stage will best suit the needs of our client. This method also allows us to see all concepts and criteria arranged together. Finally, by ranking our criteria as is done below, we were able to get another look at our evaluation of the design criteria importance.

Note: Since each idea is very different and not all metrics apply to each one, the final score of each concept is based on an average of the applicable metrics specific to that device. The following calculation is applied.

The total will be calculated by multiplying the rating by the criteria importance and dividing it by the amount of applicable criteria.

Table 1: Selection Matrix and Ranked Concepts

Criteria	Criteria Importance	Name and Concept Number														
		Muiz 1	Muiz 2	Muiz 3	Azan 1	Azan 2	Azan 3	Kyle 1	Kyle 2	Kyle 3	Patrick 1	Patrick 2	Patrick 3	Lauren 1	Lauren 2	Lauren 3
Cleaning time	**2**	5 5*2 =10	3 3*2 =6	4 4*2 =8	4 4*2 =8	5 5*2 =10	2 2*2 =4	5 5*2 =10	5 5*2 =10	5 5*2 =10	n/a	5 5*2 =10	3 3*2 =6	3 3*2 =6	1 1*2 =2	4 4*2 =8
Usability A)	**5**	4 4*5 =20	4 4*5 =20	2 2*5 =10	4 4*5 =20	1 1*5 =5	4 4*5 =20	4 4*5 =20	3 3*5 =15	n/a	1 1*5 =5	4 4*5 =20	4 4*5 =20	3 3*5 =15	3 3*5 =15	n/a
Usability B)	**5**	5 5*5 =25	5 5*5 =25	5 5*5 =25	5 5*5 =25	5 5*5 =25	5 5*5 =25	5 5*5 =25	5 5*5 =25	5 5*5 =25	5 5*5 =25	5 5*5 =25	5 5*5 =25	5 5*5 =25	5 5*5 =25	5 5*5 =25
Usability C)	**5**	5 5*5 =25	5 5*5 =25	3 3*5 =15	3 3*5 =15	3 3*5 =15	3 3*5 =15	4 4*5 =20	5 5*5 =25	2 2*5 =10	1 1*5 =5	4 4*5 =20	5 5*5 =25	4 4*5 =20	4 4*5 =20	2 5*2 =10
Usability D)	**4**	1 1*4 =4	1 1*4 =4	5 5*4 =20	1 1*4 =4	5 4*5 =20	1 1*4 =4	1 1*4 =4	2 2*4 =8	2 2*4 =8	5 5*4 =20	1 1*4 =4	1 1*4 =4	1 1*4 =4	1 1*4 =4	5 5*4 =20
Set up Time	**2 (one time only)**	2 2*2 =4	1 2*1 =2	5 2*5 =10	1 2*1 =2	5 2*5 =10	1 2*1 =2	1 2*1 =2	1 2*1 =2	3 2*3 =6	5 2*5 =10	5 2*5 =10	1 2*1 =2	1 2*1 =2	1 2*1 =2	1 2*1 =2
Surface Area	**1**	5 5*1 =5	3 1*3 =3	n/a	3 1*3 =3	n/a	3 1*3 =3	3 1*3 =3	n/a	n/a	n/a	n/a	3 1*3 =3	4 1*4 =4	5 1*5 =5	n/a
Mass	**1**	n/a	n/a	5 5*1 =5	n/a	5 5*1 =5	n/a	5 5*1 =5	5 5*1 =5	n/a	5 5*1 =5	n/a	n/a	5 5*1 =5	n/a	5 5*1 =5
Lifespan of device	**4**	5 5*4 =20	2 2*4 =8	3 3*4 =12	2 2*4 =8	5 5*4 =20	2 2*4 =8	3 3*4 =12	3 3*4 =12	3 (lots of updates) 3*4 =12	5 5*4 =20	n/a	2 2*4 =8	2 2*4 =8	5 5*4 =20	4 4*4 =16
Resistance	**3**	3 3*3	2 3*2	4 3*4	2 3*2	4 3*4	2 3*2	2 (locator	2 3*2	2 3*2	4 3*4	n/a	2 3*2	2 3*2	3 3*3	2 3*2

to spills		=9	=6	=12	=6	=12	=6	dots is weakest link) 3*2 =6	=6	=6	=12		=6	=6	=9	=6
Functional Temperature	**3**	5 3*5 =15	2 3*2 =6	4 3*4 =12	2 3*2 =6	5 3*5 =15	3 3*3 =9	2 3*2 =6	5 3*5 =15	4 3*4 =12	4 3*4 =12	n/a	2 3*2 =6	3 3*3 =9	5 3*5 =15	4 4*3 =12
Comfort	**4**	3 4*3 =12	2 4*2 =8	4 4*4 =16	4 4*4 =16	1 (both hands) 4*1 =4	4 4*4 =16	4 4*4 =16	5 4*5 =20	5 4*5 =20	2 4*2 =8	4 4*4 =16	3 4*3 =12	4 4*4 =16	3 4*3 =12	3 4*3 =12
Price	**3**	5 5*3 =15	5 5*3 =15	2 2*3 =6	5 5*3 =15	5 5*3 =15	3 3*3 =9	2 2*3 =6	1 1*3 =3	1 1*3 =3	5 5*3 =15	1 1*3 =3	4 4*3 =12	1 1*3 =3	3 4*3 =12	1 3*1 =3
Total Score:		164/ 12= 13.7	128/ 12= 10.7	151/ 12= 12.6	128/ 12= 10.7	156/ 12= 13	121/ 12= 10.1	135/ 13= 10.4	146/ 12= 12.2	112/ 10= 11.2	137/ 11= 12.5	108/ 8= 13.5	129/ 12= 10.8	123/ 13= 9.5	141/ /12= 11.8	119/ 11= 10.8
Rank:		**1**	**10**	**4**	**10**	**3**	**12**	**11**	**6**	**8**	**5**	**2**	**9**	**13**	**7**	**9**

4. Promising Solutions

-Muiz 1: Grid (highest ranking, feasible and based on simple principles with the potential for complexity as we iterate)
-Kyle 1: Low tech glove (simplest option, physical)
-Azan 2: App with stylus (next highest ranking unique option)

5. Group Design Concept

After deliberation we decided on the grid solution because it has the simplest base design with the most potential for complexity. As well, from our decision matrix that we evaluated as a group, in comparison to our design criteria, the grid solution was ranked first place.

Below is an explanation of the design followed by a subheading and pictures of the overall solution and the main individual subsystems.

Preliminary prototypes will show the base grid of the design composed of plastic (3D printed?) however our final design material requires further investigation and research before a decision. A metal composite is likely as this device will be kept in the kitchen where it must be

easily cleaned. However we do not want the device heating up too much when things are cooked over the stove. Further research is required for this point.

The grid will be composed of many interlocking boxes with hinged doors on the face pointing outwards from the control panel of the stove. The other side of the grid will be open. As of right now, our client has provided a specific stove with which they are experiencing this problem and so this grid will be designed with this particular stove in mind. Measurements and dimensions come from there.

The resting state of each door would be in the closed position. Braille dots on top of each panel would allow our client (who is fully blind) to read what the function of each button underneath and contained in its sub-box does. When the client finds the desired button, they can lift the door via a small hook located on the right side of the door panel. Inserting their finger into the sub-box will allow them to press the button with their bare finger activating the heat-capacitance touch screen and getting the desired function from the stove. By having the door panel raised above the touch screen, the accidental pressing of unwanted buttons is negated.

As stated by the client, a sound specific to each button function will be audible to notify the user that the button has been pressed. Once the user becomes acquainted with the sounds, this can also act as a verification that the correct button has been activated.

The device will likely be attached to the stove by means of retaining straps which hook into the wall behind the appliance. With this design, we will be focusing on hearing and touch to use the device while avoiding anything visual.

6. Visual Representation of the Chosen Concept

We are not quite ready to formalize a CAD model yet so we have provided sketches of our chosen concept below. However a CAD model will likely be our next step in developing prototype 1, our proof of concept.

GLOBAL CONCEPT:

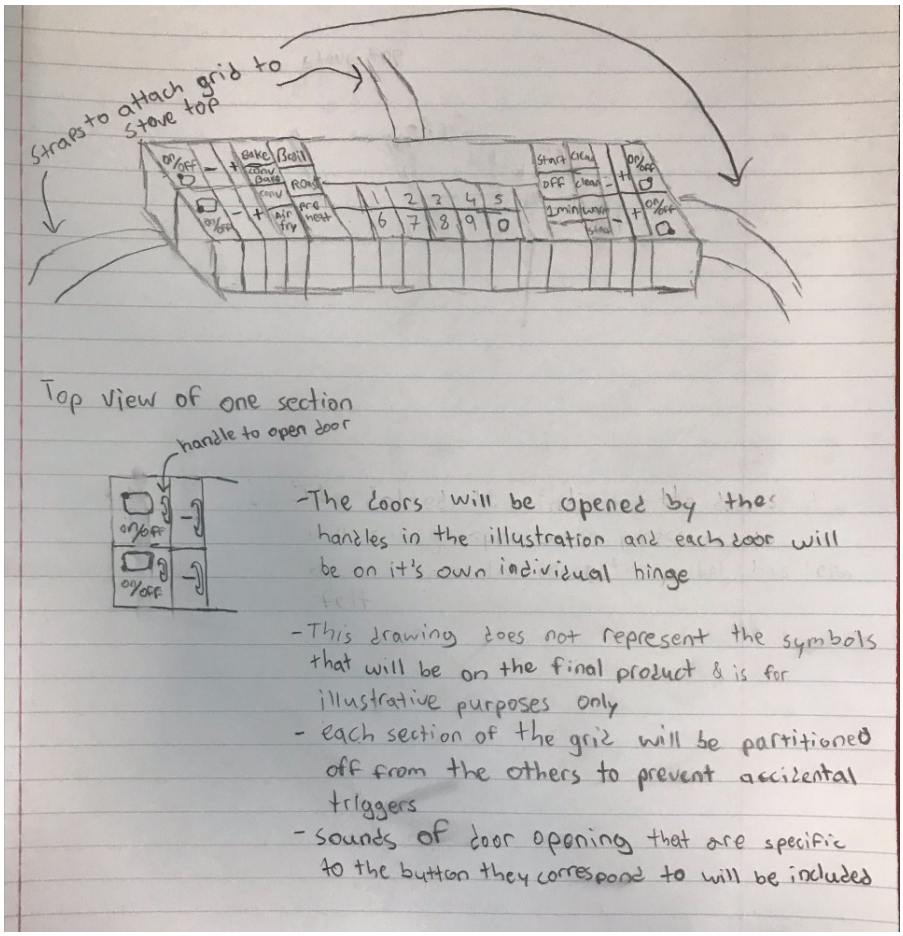


Figure 16: General diagram of the global concept solution

Main subsystems presented below.

SUBSYSTEM 1: Hinge mechanism for each grid button box with braille on the door panel to allow the client to read the function of the button below.

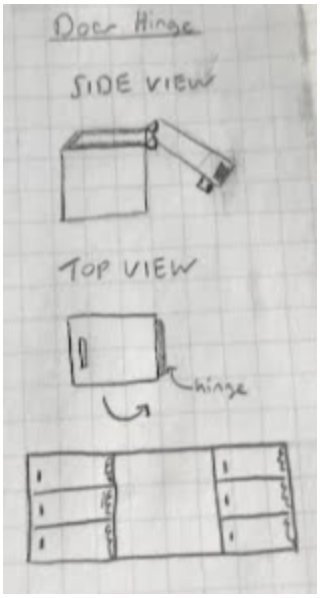


Figure 17: Subsystem depicting the door hinge mechanism for each stove function

SUBSYSTEM 2: Specific sound system for the activation of each button. Two metal panels placed on the underside of the door panel and on the matching rim of the grid respectively will be in contact while the panel is closed to complete a circuit. However when the user reads the correct braille on the door panel and lifts the hatch via a small hook on the left side, the circuit is broken and a sound is emitted which is unique to the function that was just activated. This ties back into our subsystem boundary of limiting the visual aspects of each component.

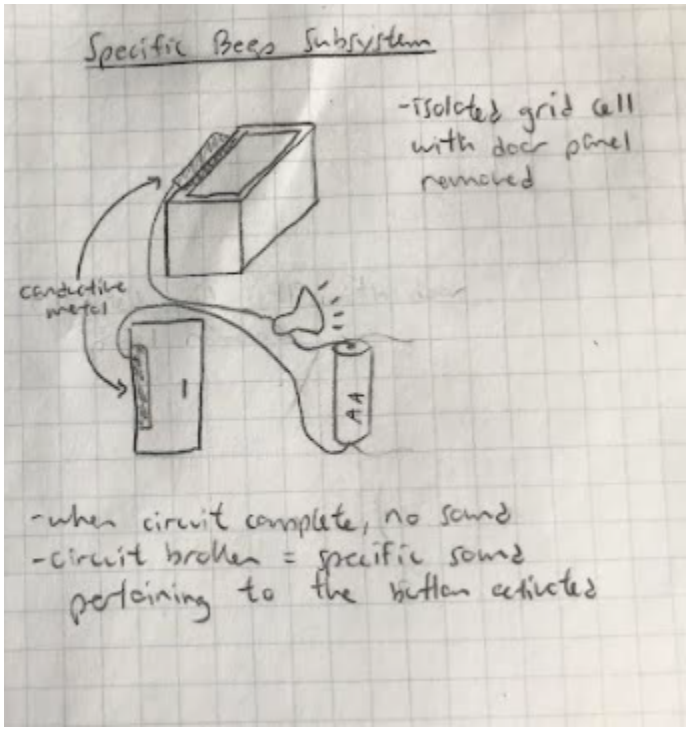


Figure 18: Subsystem depicting the sound system for each stove function

7. Relation to Target Specifications, Benefits, Drawbacks

We believe our concept will work well for our client since it ranks very high with regard to our target specifications. It will include braille which the client is already familiar with as well as audio cues which was specifically stated are helpful to the client. It is user friendly and does not take an excessive amount of time or assistance to set up for use or to use on a day to day basis. This was another target specification relating to independence.

Benefits of our concept:

- The top surface of the grid is easily cleanable.
- It can be designed using a durable material that will have a good lifespan in a kitchen environment.
- Easy to use.
- Easy to set up.
- Uses audio signals to assist client.
- Uses braille which is familiar to the client.

Drawbacks of our concept:

- It would need to be adapted for different models of stoves and/or other appliances (if this design were to be used across appliances - microwaves etc. some major factors like size would need to be considered).
- There may be problems with dirt/food debris collecting in the hinges of the openings.
- It may be difficult to clean the inside of the grid if dirt/food debris were to get inside.

Conclusion

In our ideation and thought process for a method to solve this problem, we dug deeper into the user's needs and our design criteria and we feel we understand the problem a lot better than in previous deliverables. We now have our decision matrix and as a group have selected a design to pursue further. Priorities in the design include a specific sound corresponding to the press of a specific button to let the user know they have activated the desired feature of the stove, hinged grid doors with braille on the top to allow the user to read the functionality of the button beneath and retaining straps to hold the grid to the back control panel of the stove. For future deliverables and client meetings, it becomes increasingly important to keep the client's needs in mind. We, as visually abled people are able to see and understand our designs and how they work. However the client can only understand via explanations/sound (and possibly touching the prototype should there be an in person meeting). Designing with their statements and needs in mind will ensure everyone is on the same page and we as a group will not have to backtrack far if the design turns out to be not what is expected. Ultimately, we will continue to work towards client satisfaction for the end of the term.