

# A Better User Interface for the Visually Impaired

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**Abstract.** As a Visually Impaired (VI) person, I find challenges in many tasks that a fully sighted person may not. Therefore, there is a large problem-space for task selection for my context. However, although the problem-space is extensive, it's not necessarily rich. That is, some of the tasks are simply out of scope for my condition, e.g., multi-tasking two or more visually intensive tasks. In selecting a task for this research, consideration was given to audiences that have a visual disability as well as those that do not. My research will involve evaluating an interface that offers users more than just pure visual interaction. This will include the interplay of haptic<sup>1</sup> and audible technologies for interface design.

## 1 BRAINSTORMING PLAN

The objective of the brainstorming task is to explore a wide-range of ideas and concepts. A significant portion of this ideation may appear unrelated to the core problem or my initial thoughts on a design concept. These items will form the structure of the brainstorming activity:



Figure 1: Microwave Interface

- **Identify the core problem.**

*User interfaces for microwave ovens are challenging for Visually Impaired (VI) user to operate. That is, the interface presents a large gulfs of execution and evaluation for VI users. See figure 1 for reference.*

- **Don't call brainstorming complete after a single, unbroken session.**

*I plan to spread the brainstorming activity out over hours within a day, as well as at least two days.*

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<sup>1</sup>Haptic Technology

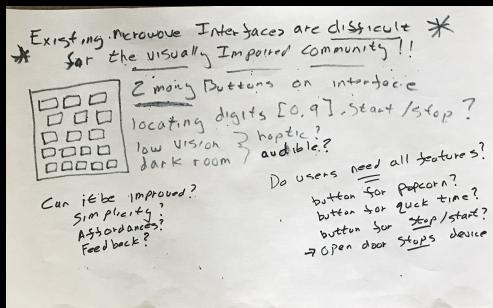
- Aim for twenty ideas.

- Constraint.

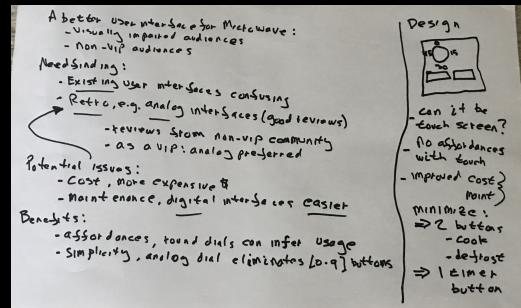
*To keep the thought process from deviating too far from center, I'll incorporate Personas, User Profiles and Scenarios into the brainstorming activity.*

## 2 IMPLEMENT BRAINSTORMING PLAN

The brainstorming plan discussed in BRAINSTORMING PLAN was accomplished over a two day interval with day one depicted in figure 2 and the second day in figure 4.

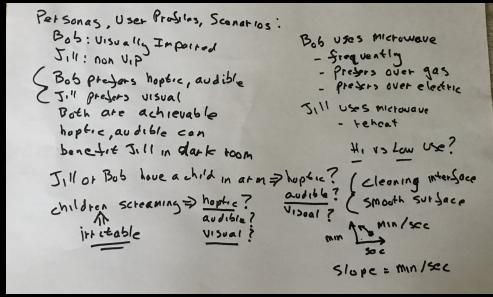


(a) Brainstorming Day 1: State the Problem

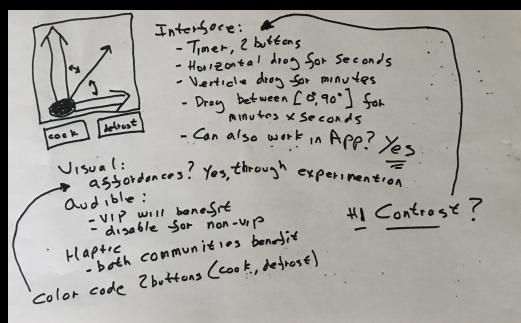


(b) Brainstorming Day 1: Refactor Problem Definition

Figure 2: Brainstorming: Day 1



(a) Brainstorming Day 2: Personas, User Profiles, Scenarios



(b) Brainstorming Day 2: Prototype

Figure 3: Brainstorming Day 2

## 2.1 Design Lifecycle: Revisit Needfinding

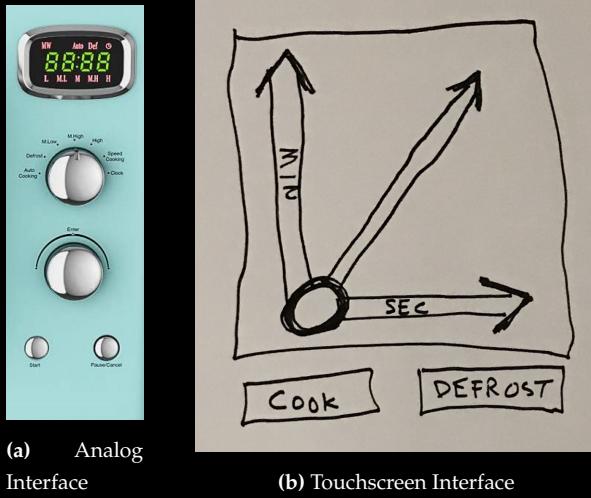


Figure 4: Design Alternatives

Needfinding, which is part of the *Design Lifecycle*<sup>2</sup> shown in figure 5, led to design alternatives, see figure 4a and figure 4b as well as a concept<sup>3</sup> for a smartphone application to support a microwave interface.

While considering design alternatives, some additional needfinding questions arose. These may be utilized in future needfinding activity involving user focus groups to refine the data inventory for this design:

- Do users rely on an exact time when using a microwave?
- Do users program for a certain amount of time, then call it done before the time expires?

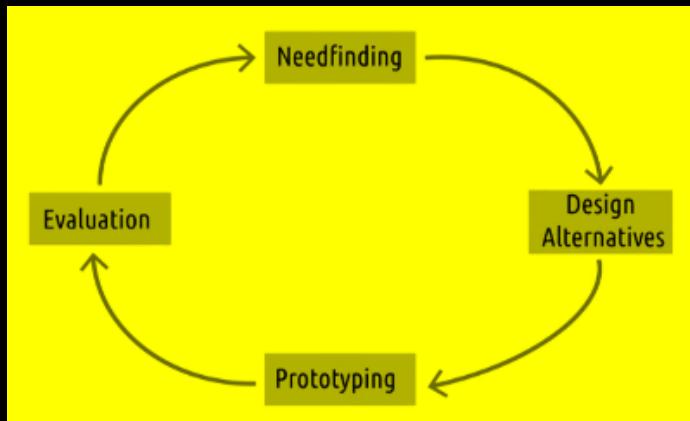


Figure 5: Design Lifecycle

<sup>2</sup>Joyner

<sup>3</sup>Microwave Wireframe

### 3 SELECTION CRITERIA: PROTOTYPE METHOD SELECTION

Selecting a design to move to the prototype phase of the design lifecycle was briefly discussed in Design Lifecycle: Revisit Needfinding. There were three concepts that came out of brainstorming:

1. An analog concept shown in figure 4a.
2. A novel touchscreen shown in figure 4b.
3. A smartphone application for the touchscreen microwave interface <sup>4</sup>.

All of these designs meet the Data Inventory shown in figure 6.

- Cook/heat/defrost food.  
*Options for COOK, DEFROST.*
- User dissatisfaction with programmable microwave interfaces.  
*Conversely, some reviews preferred a simpler interface.*  
*The interface is simple with a way to enter time and COOK, DEFROST buttons.*
- User preference for visual interaction.  
*The design of the interface can port to an application on a users smartphone.*

Data Inventory	Needfinding 1	Needfinding 2	Needfinding 3
Who are the users [age, gender, hobbies]?	Survey response show that most users prefer to visually interact with microwave interfaces: Visual: 16, Haptic: 9, Audible: 0 and have an average age of 33.88 ± 8.86485194462	I was not able to observe enough participants to qualitatively answer this question	This was not part of the data inventory for this needfinding plan
Where are the users?	This was not part of the data inventory for this needfinding plan	This was not part of the data inventory for this needfinding plan	This was not part of the data inventory for this needfinding plan
What is the context of the task?	From the survey responses, the user context is to Re-Heat or Cook food using the Microwave control panel as their preferred interface	This was not part of the data inventory for this needfinding plan	I was not able to observe enough reviews to qualitatively answer this question
What are the user goals?	User goals are to cook/heat/defrost food by interacting with the "native" microwave interface	This was not part of the data inventory for this needfinding plan	I was not able to observe enough reviews to qualitatively answer this question
What does the user need?	The survey response did show some level of dissatisfaction with existing microwave interfaces. From this data, I can cycle through additional needfinding requirements and prototyping	I was not able to observe enough participants to qualitatively answer this question	User reviews corroborated dissatisfaction with programmable microwave interfaces. Conversely, some reviews preferred a more simplistic interface.
What are the user tasks?	Data from the survey show user tasks: Cooking: 14, Defrosting: 10, Re-heating: 21, Timer: 4	This was not part of the data inventory for this needfinding plan	This was not part of the data inventory for this needfinding plan
What are the user subtasks?	NA for this needfinding plan	NA for this needfinding plan	NA for this needfinding plan

Figure 6: Data Inventory

<sup>4</sup>Microwave Wireframe

The candidate for prototype development is the touchscreen shown in figure 4b. This interface design realizes most of the data inventory, while exhibiting potential portability to a smartphone application.

#### 4 PROTOTYPE 1: VERBAL

A verbal prototype is a low-fidelity prototype for exploring the feasibility of the concept. The objective of this prototype is to evaluate the relative function of the interface early in the design lifecycle in order to verify we are resonating with the user expectations. The evaluation will answer the question: *Does the interface have the potential to meet user goals?*

Verbal prototypes are susceptible to:

- **Social desirability bias:** During evaluation, users tend to be overly-positive about the prototype in the presence of the designer.

*To foster constructive criticism during evaluation, designers need to make the user feel comfortable when describing the concept. User disagreeing with the concept can be productive in identifying potential disconnects between the user and the prototype.*

- **Expert blind spot:** Designers cannot assume that knowledge gained during their participation in the design lifecycle is known to novice users.

*Designers can use analogies to describe the prototype. For example, describe the prototype in terms of interfaces the user may already be familiar with.*

##### 4.1 Verbal Prototype: Questions for User Evaluation

The following questions will be used to provide definition and get feedback from the user about the prototype:

1. I'm looking for feedback on a design for a microwave interface. This interface will be used to program the microwave for cook and defrost and have a way to set the time duration for either of those two options. Do you feel like those two options are enough to accomplish your needs for using the microwave?

*If "NO", then ask: What additional features would you like to see added to the interface?*

2. The concept for setting the time is novel. It will not use digits [0-9] to enter the duration. Think about setting the volume on a YouTube video.

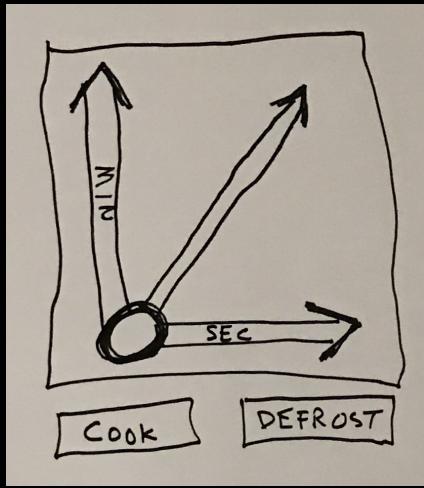
You drag the volume button left or right to decrease or increase the volume respectively. Similar to setting the volume on a YouTube video, this interface will have a button that can be dragged to set the time. However, where the YouTube volume selector only moves in the horizontal plane, this interface will have a button that moves both horizontally and vertically, as well as any angle between 0 and 90 degrees. Consider your high school math class, the Cartesian coordinate system. This application will have a button at the origin [0, 0] which can be moved:

- In a positive horizontal direction to increase the time by seconds.
- In a positive vertical direction to increase the time by minutes.
- In a negative horizontal direction to decrease the time by seconds.
- In a negative vertical direction to decrease the time by minutes.
- With a positive slope to increase the time by minutes/seconds. The steeper the slope, the greater the increase by the minute.
- With a negative slope to decrease the time by minutes/seconds. The steeper the slope, the greater the decrease by the minute.

**Would this concept meet your expectations in setting the time?**

*If "NO", then ask: How can this concept be modified to meet your needs?.*

## 5 PROTOTYPE 2: PAPER



(a) Paper Prototype: Touchscreen Interface

A hand drawn paper prototype was created to evaluate user interaction with the interface. When conducting user evaluation, this paper prototype has the potential to also serve as a card based prototype. Note that the current design of the interface is static, thus there would only be one card for this prototype.

Using this paper interface, I conducted an informal user evaluation with a couple of users, asking them:

- **"What do you think this interface would control"?**  
*Both users responded correctly, "a microwave".*
- **I then asked: "How would you operate the microwave using this interface"?**  
*Both users touched the button to set the time.:*
  - One user did drag the button.
  - The other user repeatedly "hit" the button.

## 6 PROTOTYPE 3: WIREFRAME

A wireframe<sup>5</sup> was developed to evaluate user readability of the interface. In addition, this type of prototype ports well to users in a virtual setting, e.g., not physically present for the evaluation process. This prototype may also be considered as a low fidelity physical prototype for a **smartphone application for the touchscreen microwave interface**. User feedback can be realized from a broader audience. Another benefit is that, based on user feedback, this prototype can be modified quickly.

This is a **horizontal** prototype, designed to evaluate the overall application. Further **vertical** prototyping may include more specificity for evaluating particular features.

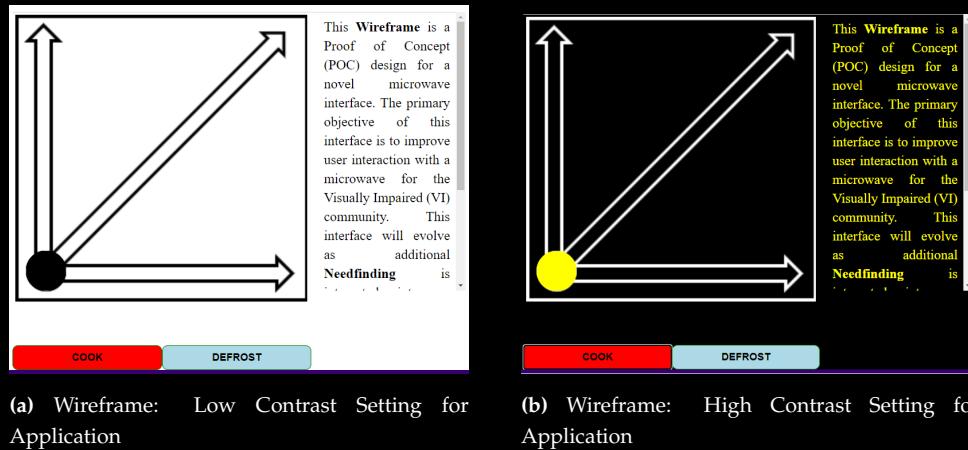


Figure 8: Prototype: Wireframe

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<sup>5</sup>Microwave Wireframe