LoudProof

Tariq Amireh: Problem Statement + Final Discussion
Monique Mahony: Digital Prototyping
Steven Miller: Usability Testing
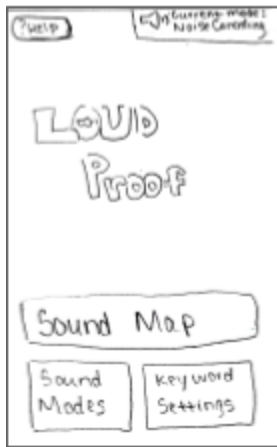Bryan Sungmin Rhee: Paper Prototypes

Problem and Solution Overview:

Individuals with Autism Spectrum Disorder (ASD) often experience accompanying audio-visual and tactile sensitivities, making a large number of environments overwhelming. In particular, travel hubs and stations such as airports and subways are flooded with excessively loud and irritating noises, making them and, more generally, long-distance travel virtually inaccessible to a significant portion of the autistic community. In response to this problem, we have designed a hearing-aid like device to cap decibel levels in different environments. With such a device in hand, users will be able to avoid auditory overload by "lowering the volume" on their environment and avoiding periods of auditory overload. The device will be supplemented by a mobile application that will allow users to edit and create caps for different environments, enable auditory cues for user defined keywords, and view a "SoundMap" to find and navigate to quieter areas.

Initial Paper Prototype

The application part of the initial prototype consists of three main functionalities: sound map, sound mode, and keyword setting. The user can use the sound map to find nearest quiet area in case he/she needs to retreat from noisy environment. The user can create and customize different sound modes that filter the noise in different environments. The user can also add keywords using voice recording, which are used to notify the user of important auditory information.
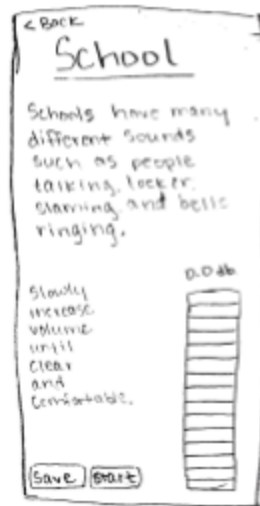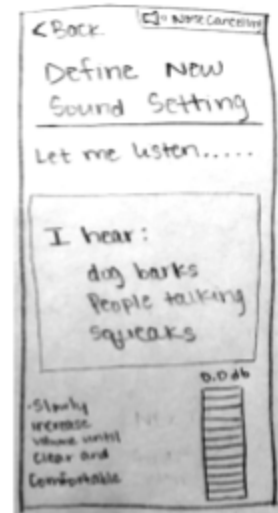
Task 1: Filter and Reduce Noise

LOUD Proof

Sound Map

Sound Modes | Keyword Settings

User can modify different sound modes by going to "Sound Modes"

< BACK
MY MODES

Adjust different Sound modes to determine comfort level.

TRAIN 80db | BUS 50db
PLANE | SCHOOL
Boat | Dog barks
+

User can adjust the volume setting on presets or define a new sound mode

< Back
School

Schools have many different sounds such as people talking, locker slamming and bells ringing.

Slowly increase volume until clear and comfortable.

0.0db

Save | Start

If user chooses to adjust one of the presets, the device will play common sounds in the preset environment and user can adjust the volume to comfortable level

< Back
Define New Sound Setting

Let me listen......

I hear:
dog barks
People talking
squeaks

0.0db

Slowly increase volume until clear and comfortable

If user chooses to define a new mode, the device will listen to the environment and define the sounds in current environment. User can then adjust the volume to comfortable level
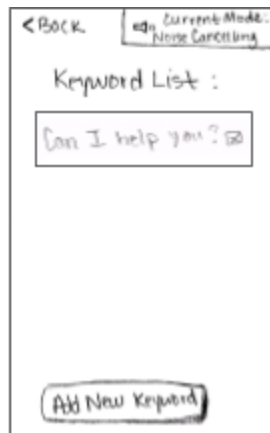

User can cycle through the modes using buttons on the headphone piece

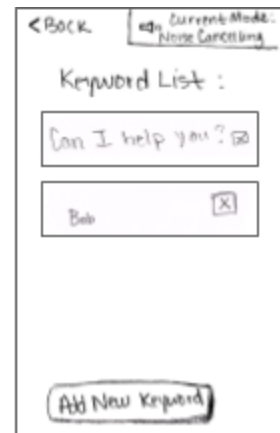# Task 2: Enable two-way communication

User can modify keywords by selecting "Keyword Settings" on the home screen

User can view currently used keywords. User can delete an existing keyword by clicking "x" button or add a new keyword by selecting "Add new Keyword" button

Application uses the phone's microphone to listen to the user for the new keyword

Once the new keyword is successfully added, user can modify it from keyword setting screen

Device always listens for these keywords in the environment and notifies the user when the keyword is detected

Testing Process

We started by working with two different groups who gave heuristic evaluations of our paper prototype. These evaluations gave us a starting point on things to consider when redesigning the prototype. It helped us uncover some of the details we overlooked in our initial design and helped better prepare us for usability testing.

We conducted an in-person usability testing session with an adult with ASD who travels short and long distances. This individual has no auditory sensitivities, but their autism does affect the way they communicate with people and makes traveling daunting and difficult. The interview was conducted in the lab of one of our group member, that was both convenient and quiet for our participant to best simulate application usage. We described the motivations and backgrounds of the design solution and guided him through a series of tasks. Monique sat in person with the participant and guided him through the different tasks and Tariq sat in via Skype to take notes and ask reflection questions. This testing session, while productive, was not as fluid as would have liked. Perhaps allowing more user exploration rather than guiding them through a task will allow for a less choppy experience. Tasks we had our test subject perform include:

- Adding modes from a preselected list
- Editing modes
- Creating new environments
- Adding keywords via text and recording

Our second participant was a man in his late twenties who has very mild auditory sensitivities and who frequently travels independently. This time we allowed the participant to do more independent exploration instead of trying to walk them through it. We received feedback that differed from our first usability test, which helped us recognize that we had design decisions to make. We faced a few issues of complexity and feasibility, since we wanted to make the application customizable yet user friendly. Our users at this point has mainly interacted with the application, and not the device, so our goal was to get some feedback on that in the third usability test.

Our third usability test was conducted with an individual outside of our target group due to time constraints. We received helpful feedback on both the device and the application this time around. The session was completed in a quiet empty classroom as to provide some form of consistency between our user group. We asked the user to complete some of the same tasks as the previous two usability tests, with an additional task of changing the preset modes using the headset. One critique he gave about changing modes was that if there are multiple preset modes, it might get tedious switching to the next one if he has to repeatedly click the button and listen to hear what mode he just switched to. He suggested instead that we include voice recognition.

Regarding the application he thought the sound map seemed a bit futuristic, and questioned the reliability of the feature itself, wondering how the data would be gathered. He also mentioned creating a more

minimalist version of pairing the device with the phone, adding a button on the home screen to pair the device and the phone, which we then revised.

Testing Results

Throughout the process of receiving heuristic evaluations and doing usability testing, we created and revised multiple parts of our paper prototype, and also made changes as we created our digital mockup. Here we discuss the most important changes made to the design, but more detail can be found in the appendix.

Heuristic Evaluations: One of the major issues uncovered from this was that there is a really high learning curve to the application that comes with the device. Our goal for LoudProof is to provide a product that is customizable for anyone using it. This requires feature richness, but poses problems with ease of use. Other complaints had to do with unexpected behaviors and lack of communication to the users about the status of the application. Here are some of the main issues found from this exercise:
- Help and Documentation: Given so many options at the main screen of the application, and having no idea where to start was challenging for those evaluating the prototype. As a result, we ended up adding a help/documentation page (we eventually got feedback about users often ignoring these types of resources, and came up with a different solution instead).
- Error Prevention: When adding keywords, the user is locked into the "recording" state, which was unclear to the evaluator what the behavior was like when given bad input. To fix this, we changed the recording button to record the sound only when the user presses and holds the button, so that it won't lock the application in that state. We also gave users the option to type in a keyword.

Usability Test 1: Takeaways from this session include a pretty comprehensive overview of the lack of clarity that our interface provided. Things like the creation of new environments and additions of new keywords were unclear. Also the coupling of the device and app seemed very difficult to explain to the user without a more immersive demonstration. It seems that device usability testing requires the creation of a visceral experience to best demonstrate the functionality of the design solution. We found the following issues with our design and made corrections accordingly:
- The user was confused when creating new sound modes. He thought he could adjust individual sounds (voices, brakes, engines, etc.) rather than an overall volume cap. We considered implementing this as a feature but decided there were too many holes in that approach. Instead, we decided that the application will only show the user that it is listening and allow the user to name this sound/environment.
- Although the user did not have any issues accessing or using the "Sound Map," he did suggest that it would be helpful to be able to switch to a different mode while looking at

the map because the user can see if really loud noises are coming up in their route. To address this, we added the "Current Mode" feature to the "Sound Map" so that a user can take note of auditory environments up ahead in their route, and change modes accordingly.
- The user also noted that it would be beneficial to have manual volume controls to the ear piece to allow the user to adjust volume more immediately. The purpose of our app setup is to cut out having to adjust volume in real time, but we agreed that this feature would allow human correction for any potential device error. Our solution was to add a small volume wheel that the user can access to adjust volume in real time if necessary.

Usability Test 2: After being asked to complete the same subtasks as the participant from the first usability test, we received the following feedback from the user:
- The "Sound Mode" icon and screen did not clearly convey that it is only used for adjusting/ editing sounds, not switching between them. So, we changed the text to "Edit Sound Modes" as to clarify that this feature is just for adding and editing sound modes.
- The "Current Mode" icon/ button was too small and obscured on home page. In order to fix this, we switched the logo with the "Current Mode" icon on the home screen for easy access when needing to switch to a new mode. When navigating to a new screen, the "Current Mode" button will go to the top right of the screen as in previous iterations of this prototype.
- "Keywords" usage unclear: will keywords be universal or mode specific? So instead of having the keywords appear and only having the option of deleting them, we now allow for all saved keywords to be enabled or disabled with the switch of a button. Similar to the iPhone alarm screen, this feature allows users to choose when they want certain keywords enhanced.

Usability Test 3: There were a few points made during this usability test that had a big impact on some of the changes we had moving from our paper prototype into our digital mockup. Some of the feedback given involved making changes that would go against our main focus: to create a feature rich product that was customizable and easy to use. Though he brought up some concerns that people may find valid, the solutions he recommended (along with the solutions we tried to come up), introduced more problems and increased the learning curve and complexity of the application. To keep our design as simple as possible and to create the best user experience, we had to pick and choose what we would change. Here are the main critiques:
- Pairing the device with a popup asking you to pair seems a little odd. It seems more reasonable to have a "pair" button on the home screen, which is what we decided to do.
- The other critique was that some of the screens had an overwhelming amount of instructional text, which is annoying to look at especially if you are familiar with the application. This applied to the "Creating New Sound Mode" screen, and the other preset screens with the descriptions of the modes. To fix this, we added one-time coach marks for new users on how to set the volume properly.

Design Critiques: One main critique received after conducting these usability tests was in regards to the help/documentation page. We thought we could fully address the learning curve issue by adding this page, but it was pointed out to us that not many users will actually utilize these kinds of resources. Instead, we added a lot of instructional coach marks/tooltips throughout the application for first-time users. This provides an extensive tutorial for each page and can help the user get started. We decided to keep the help/documentation page as a last resort for users, and there they can go through the tutorials again as if they are opening the application for the first time.

Final Paper Prototype
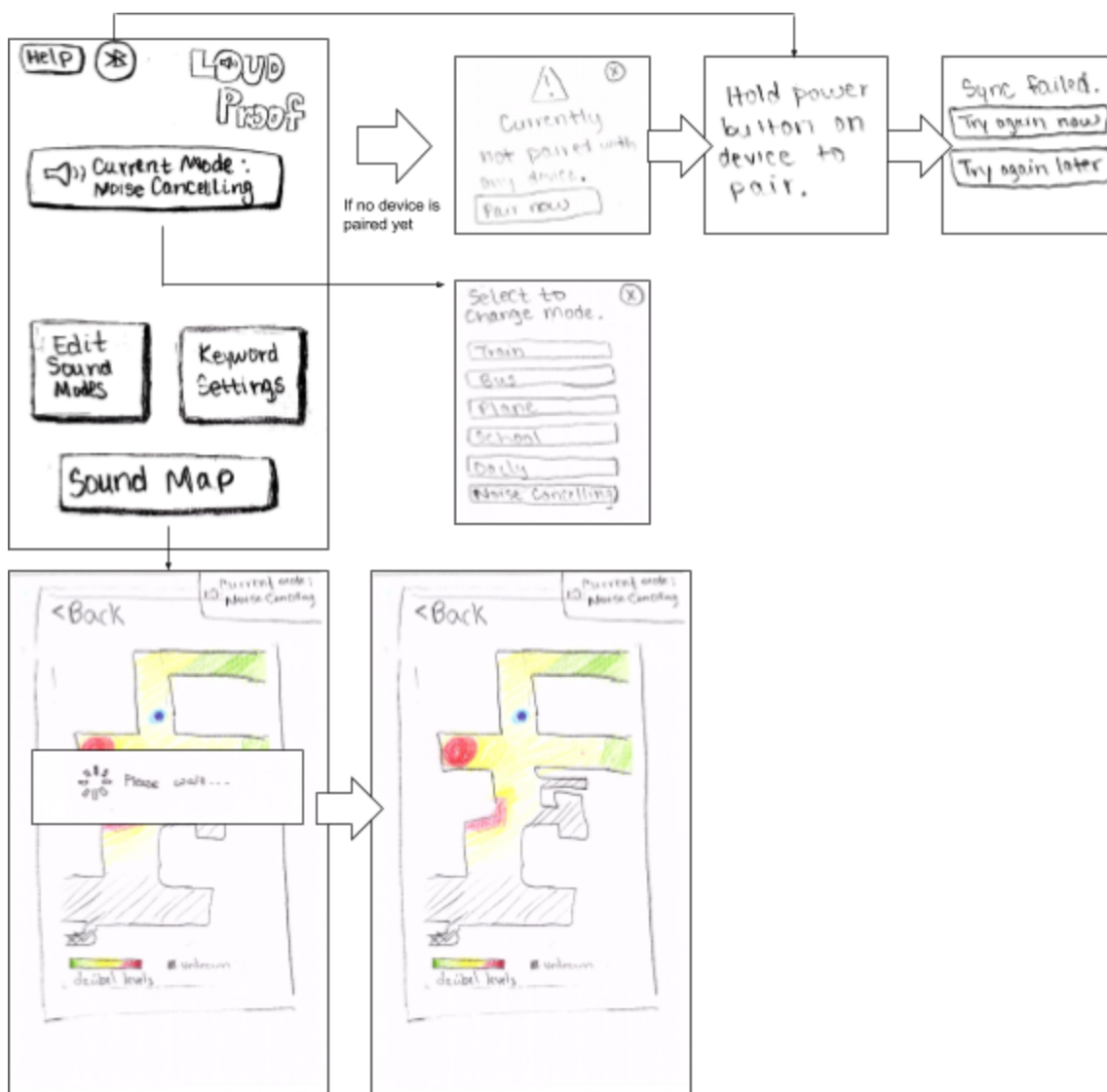
Screen 1 (Home)

Help (✳) LOUD Proof

🔊)) Current Mode: Noise Cancelling

Edit Sound Modes

Keyword Settings

Sound Map

Screen 2 (Bus)

< Back

Bus

Common bus sounds include vehicle breaks, people talking, feet shuffling, and PA systems reading next stop.

00.0 db

SAVE   Replay

Screen 3 (My Modes)

< BACK   Current Mode: Noise Cancelling

MY MODES

Adjust different sound modes to determine comfort level.

TRAIN 30db	BUS 50db
PLANE	SCHOOL
Boat	Dog barks

+

Screen 4 (Record/Choose)

☐ Record new mode from Current Environment

☐ Choose from Preset List of Sound modes

Screen 5 (New Mode)

< Back

New Mode

~ System Listening ~

50.0 db

Use Volume 🔊 buttons on phone to increase Volume until clear and comfortable

Save

Screen 6 (Presets)

< Back   Current Mode: Noise Cancelling

Choose from Presets

Subway
Nursery
Trolly
Cruise Boat
Party
Bus
School

Screen 7 (About)

< Back

About LoudProof

LoudProof is a product for those with ASD, Autism Spectrum Disorder and auditory hypersensitivity.

Features:

Sound Map

Keyword Recognition

Preset Modes

Full Noise Cancellation

Screen 8 (Home duplicate)

Help (✳) LOUD Proof

🔊)) Current Mode: Noise Cancelling

Edit Sound Modes

Keyword Settings

Sound Map

Screen 9 (Keyword List)

< Back   Current Mode: Noise Cancelling

Keyword List :

Excuse me   ⊂⊃
Are you lost ⊂⊃
Bob   ⊂⊃

Add New Keyword

Screen 10 (Record Keyword)

< Back   Current Mode: Noise Cancelling

Press and hold the button to record.

🎤

or

Type in your Keyword.
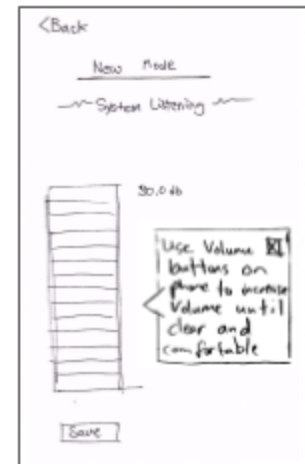
Save

Task 1: Filter and Reduce Noise
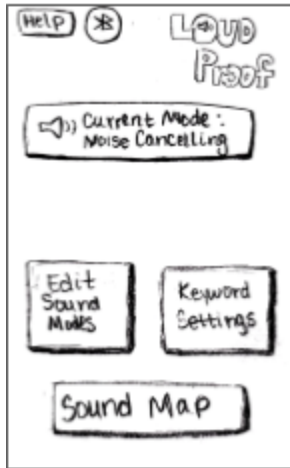
User can click "Edit Sound Modes" button to proceed to the settings page

User can modify an existing mode by clicking one of the buttons, or add a new mode by clicking the "+" button
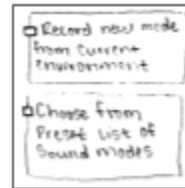
If user chooses to add a new mode, then a pop-up message asks if user wants to use a preset sound or record a new sound from current environment

If user chooses to record the sound in the environment. User can adjust the volume using the phone's volume button. A tooltip guides the user on the first try.
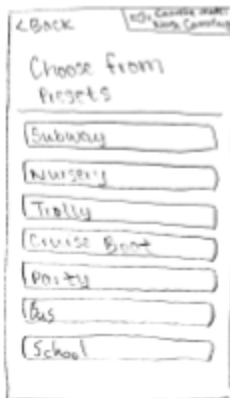
If user chooses to use a preset sound, the app shows the list of preset sounds the user can choose from.

The device will play the preset sounds. User can use the volume button to adjust the volume and press the "save" button when finished. User has option to replay the sounds. Tooltip does not appear if user already has tried the functionality

User can switch modes at the home screen by clicking "current mode" button at the center.
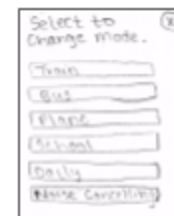
A pop-up menu shows the list of sound modes the user currently has. User can switch to the mode they want by clicking it.

Task 2: Enable two-way communication

(Help) (✳) LOUD Proof	< Back ◀ Current Mode: Noise Cancelling	∠ Back ◀ Current Mode: Noise Cancelling	< Back ◀ Current Mode: Noise Cancelling
◀)) Current Mode: Noise Cancelling	Keyword List:	Press and hold the button to record.	Keyword List:
	Excuse me ⊂⊃	🎤	Excuse me ⊂⊃
Edit Sound Modes Keyword Settings		or	Bob ⊂⊃
Sound Map		Type in your Keyword.	
	Add New Keyword	Save	Add New Keyword
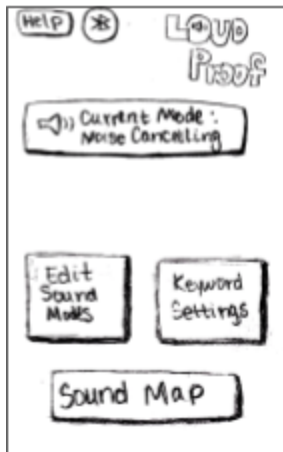
User can click "Keyword Settings" button from the home screen to modify keywords used for keyword recognition functionality.

User can look at what keywords are currently used. User can enable/disable a keyword, or add a new keyword by clicking "Add New Keyword" button
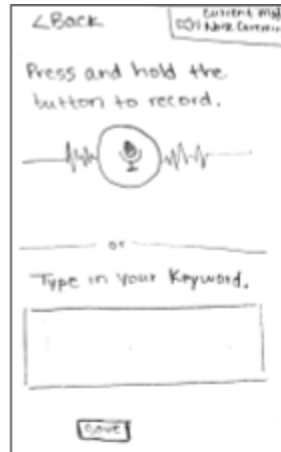
User can add a new keyword by either using voice recording or typing. User can press and hold the microphone button at the top to use voice recording, or click on the box at the bottom to type in keyword. Once keyword has been input, user can press save button to save the keyword
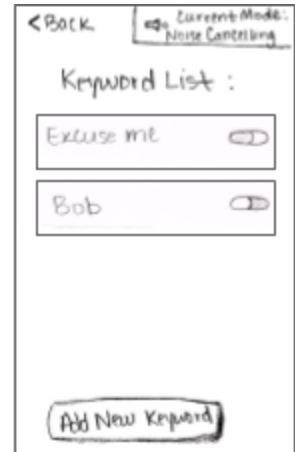
The newly add keyword can be seen at the keyword list screen.

The device will notify the user when it detects one of the enabled keywords.
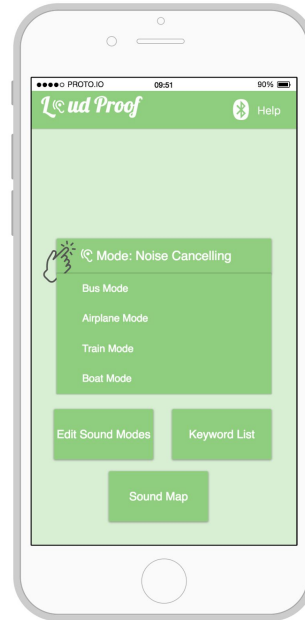
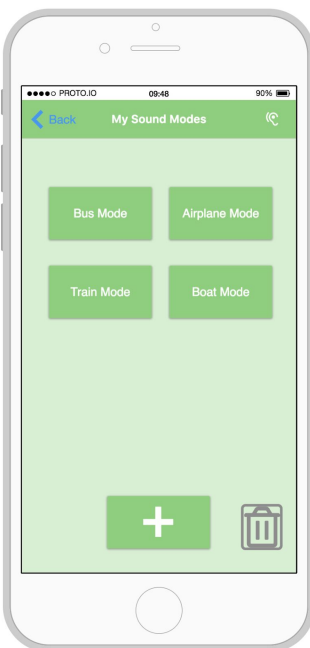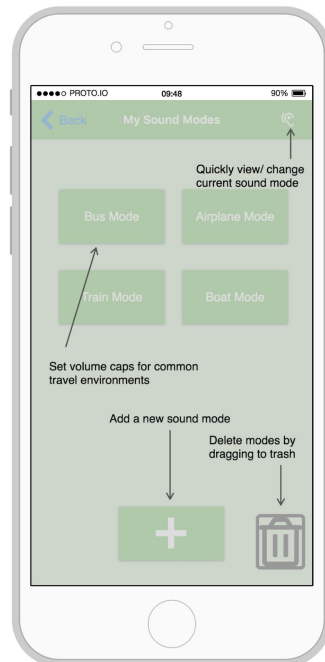# Digital Mockup

Task 1: Filter and Reduce Noise
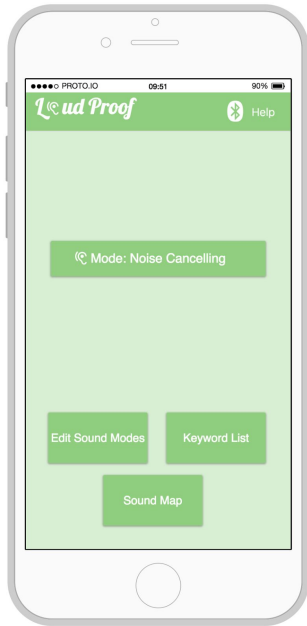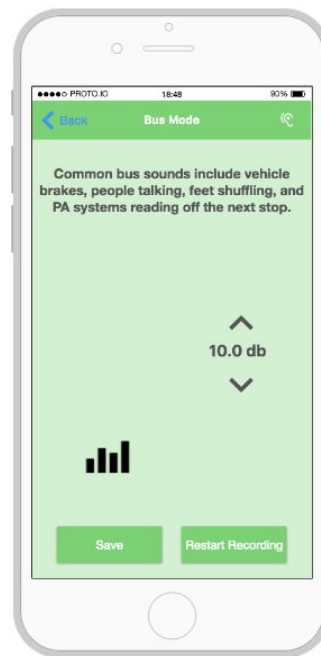

Home screen
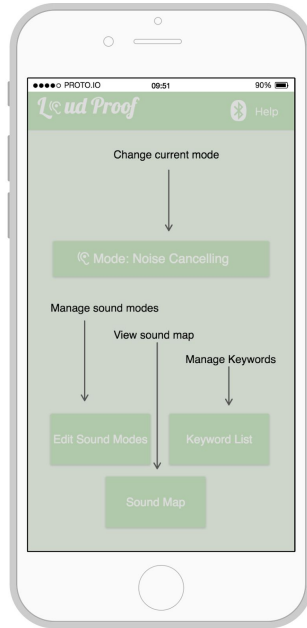
Tooltips shows functionality
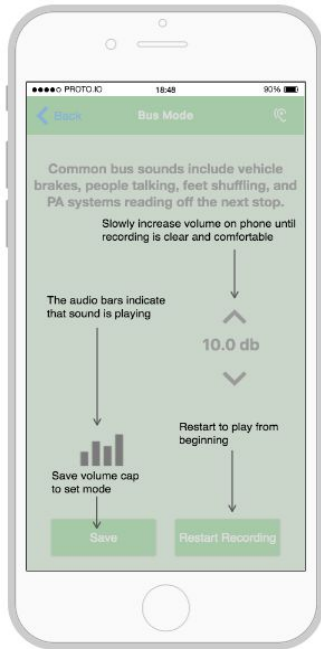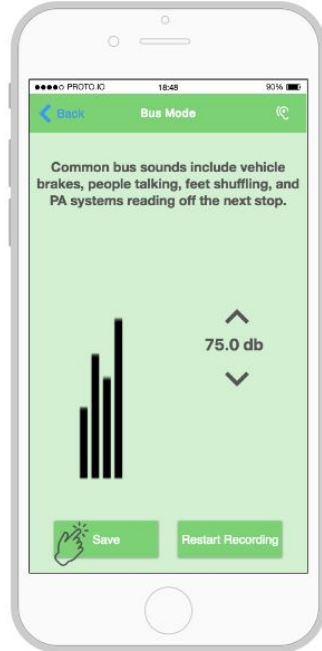

Current mode drops down

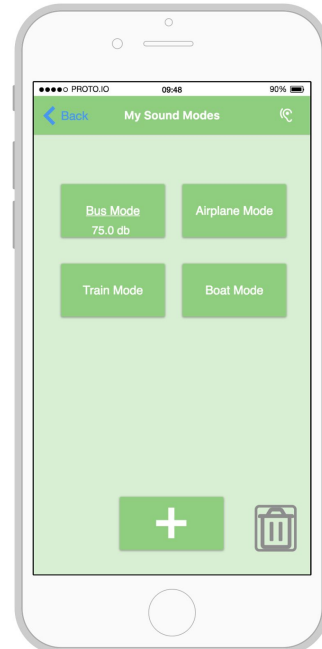

Sound Mode screen

Sound Mode tooltips
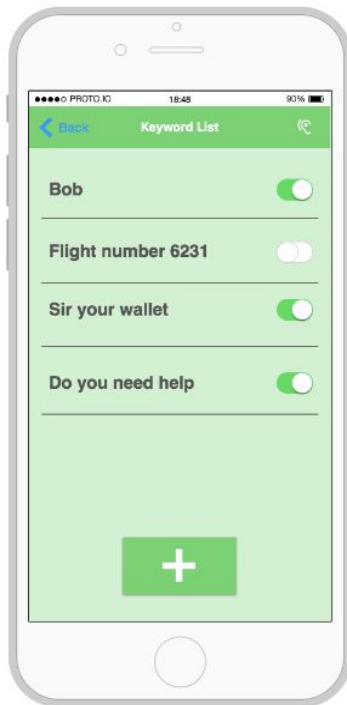

Bus Mode layout

Editing a mode tooltips
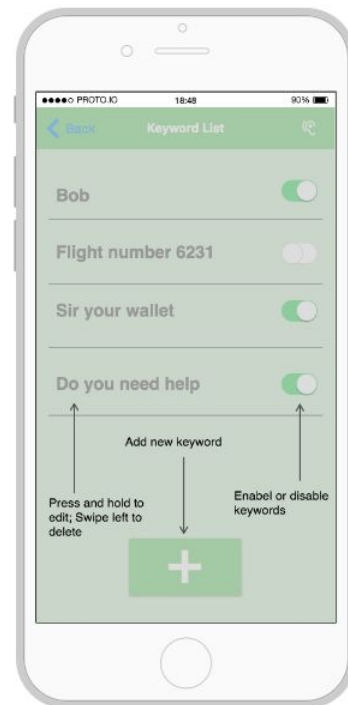
Audio bars indicate sound playing
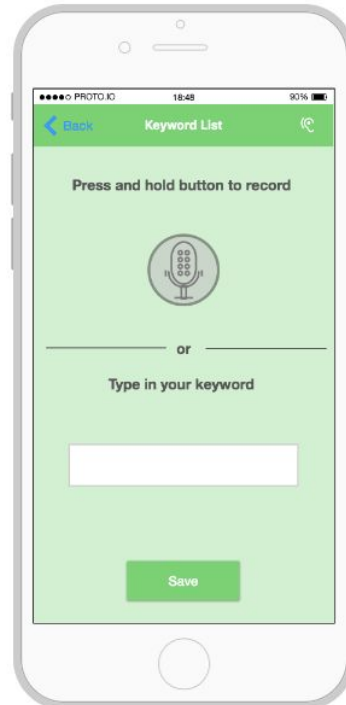
Volume cap shows modes that have been

Task 2: Enable two-way communication

Keywords screen

Keywords with tooltips

Record new keyword screen

Discussion

The process of iterative design has taught us quite a bit, both about our specific design solution and more generally the skills required for thoughtful design. The notion that quantity, in many cases, defeats quality in the early stages of iterative design displayed itself quite prominently. In fact, we were left disappointed by the number of design ideas we had at the time of deadlines. It was not so much an issue of the feasibility or quality with any of these designs, it was a feeling that more variation and additional iterations of design early on would have steered us towards a path less conventional and obvious then the one we have traveled down so far. Furthermore, all three of our nominated design solutions were perhaps a bit too similar and more iterations may have allowed our design solutions to diverge.

The process as a whole resulted in a solution that we are confident in. Some steps in this process have shaped our design more than others. Particularly task analysis/selection and user research had the clearest impact on the final design. The user research period consisted of interviews leading to lots of insight into a user base that in some respects is hard to build empathy for because their problems are unlike anything we have ever faced. It was the reiteration of obvious things like loud noises being especially bothersome in combination with anecdotes and unique tidbits (like melodies being helpful) that drew us towards a hearing aid/headphone like device. Task design provided us a more concrete division of subproblems and even non-primary tasks influenced many of our design decisions. For instance one generated task was "avoiding discomfort", this led us to consider the possibility of a hearing aid like design to reduce pressure and tactile sensitivity around the ear.

Nothing through this process has remained stagnant. That is everything has been subject to change. Some of the changes that are perhaps a little more nuanced have to do with our tasks. We've maintained the primary tasks of "filtering and reducing noise" and "enabling two-way communication" throughout most of our design process. However, the ideal manifestations of these tasks have changed greatly over time. At this point, "filtering and reducing noise" could be reinterpreted as "setting decibel level caps for different environments". Similarly, "enabling two-way communication" is merely code for "alerting a user that someone is trying to communicate with them".

Ultimately, there are many lessons to be taken away from the whole experience of designing a solution to a problem in an 8-9 week "sprint". The one that has revealed

itself near the end and seems to be the most profound is that there is a certain balancing act that must be done between feature richness and learning curve. How an interface juggles these diametric notions is a great indicator of its success.

Appendix

Add and Edit Different Sound Environments
- Adding modes from a preselected list
- Editing modes
- Creating new environments

Adding Keywords to a Keyword Detection List
- Via text
- Via voice recording

Other Tasks
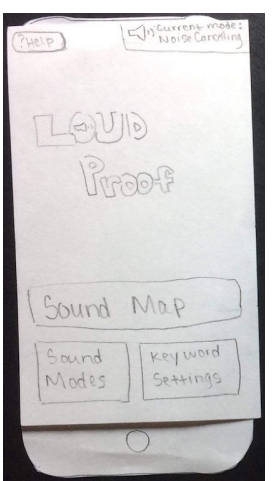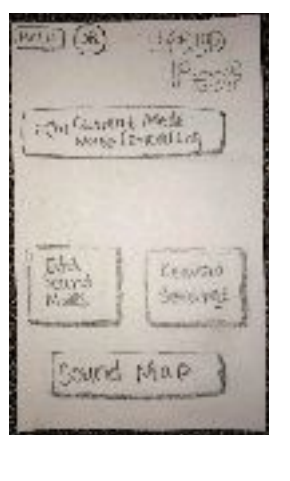- Explore the sound map
- Switch modes and adjust volume on the device
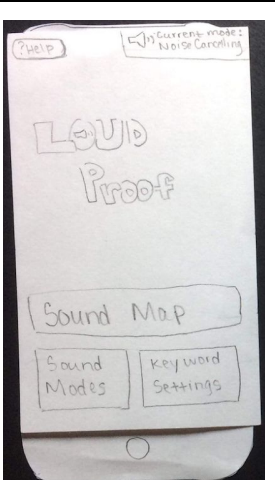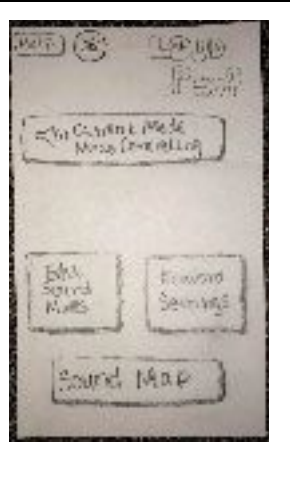
Usability Test 1

Image	Issue	Severity	Revision	Revision Image
	User was confused when creating new sound modes; thought he could adjust individual sounds rather than combined sounds in environment.		Instead of having the device try to recognize specific sounds in environment, the app will only show the user that it is listening and allow the user to name this sound/ environment.	
	Although the user did not have any issues accessing or using the "Sound Map," he did suggest that it would be helpful to be able to switch to a different mode while looking at the map because the user can see if really loud noises are coming up in their route.		We added the "Current Mode" feature to the "Sound Map" so that a user can take note of auditory environments up ahead in their route, and change modes accordingly.	
	The user also noted that it would be beneficial to have manual volume controls to the ear piece to allow the user to adjust volume more immediately. The purpose of our app setup is to cut out having to adjust volume in		We added a small volume wheel that the user can access to adjust volume in real time if necessary.	

Image	Issue	Severity	Revision	Revision Image
	real time, but we agreed that this feature would allow human correction for any potential device error.			

Usability Test 2

Image	Issue	Severity	Revision	Revision Image
	The "Sound Mode" icon and screen did not clearly convey that it is only used for adjusting/ editing sounds, not switching between them.	3	We changed the text to "Edit Sound Modes" so that it is clear that this feature is just for adding and editing sound modes.	
	"Current Mode" icon/ button was too small and obscured on home page.	3	We switched the logo with the "Current Mode" icon on the home screen for easy access when needing to switch to a new mode. When navigating to a new screen, the "Current Mode" button will go to the top right of the screen as in previous iterations of this prototype.	

Image	Issue	Severity	Revision	Revision Image
	"Keywords" usage unclear: will keywords be universal or mode specific?	2	Instead of having the keywords appear and only having the option of deleting them, we now allow for all saved keywords to be enabled or disabled with the switch of a button. Similar to the iphone alarm screen, this feature allows users to choose when they want certain keywords enhanced.	

Usability Test 3

Image	Issue	Severity	Revision	Revision Image
	Too much instructional text, overwhelming to look at, especially if you are familiar with the application	3	Added one time coach mark for first time users on how to set the volume properly	
	Same as above	3	Same as above	

< Back **BUS** Bus stations have a lot of automobile sounds, such as brakes and honks from cars passing by. Use volume buttons on Phone to slowly increase volume until clear and comfortable. 0.0 db [Save] [Start]	Same as above	3	Same as above	< Back Bus 0.0 db Use Volume ⊠ buttons on phone to increase volume until clear and comfortable [Save] [Start]