



## Team

- **Chris Jung:** storyboarding; design mockups
- **Gerrick Li:** ideation; storyboarding; design mockups
- **Luyi Lu:** ideation; user studies; writing
- **Grant Neubauer:** ideation; usability testing; writing

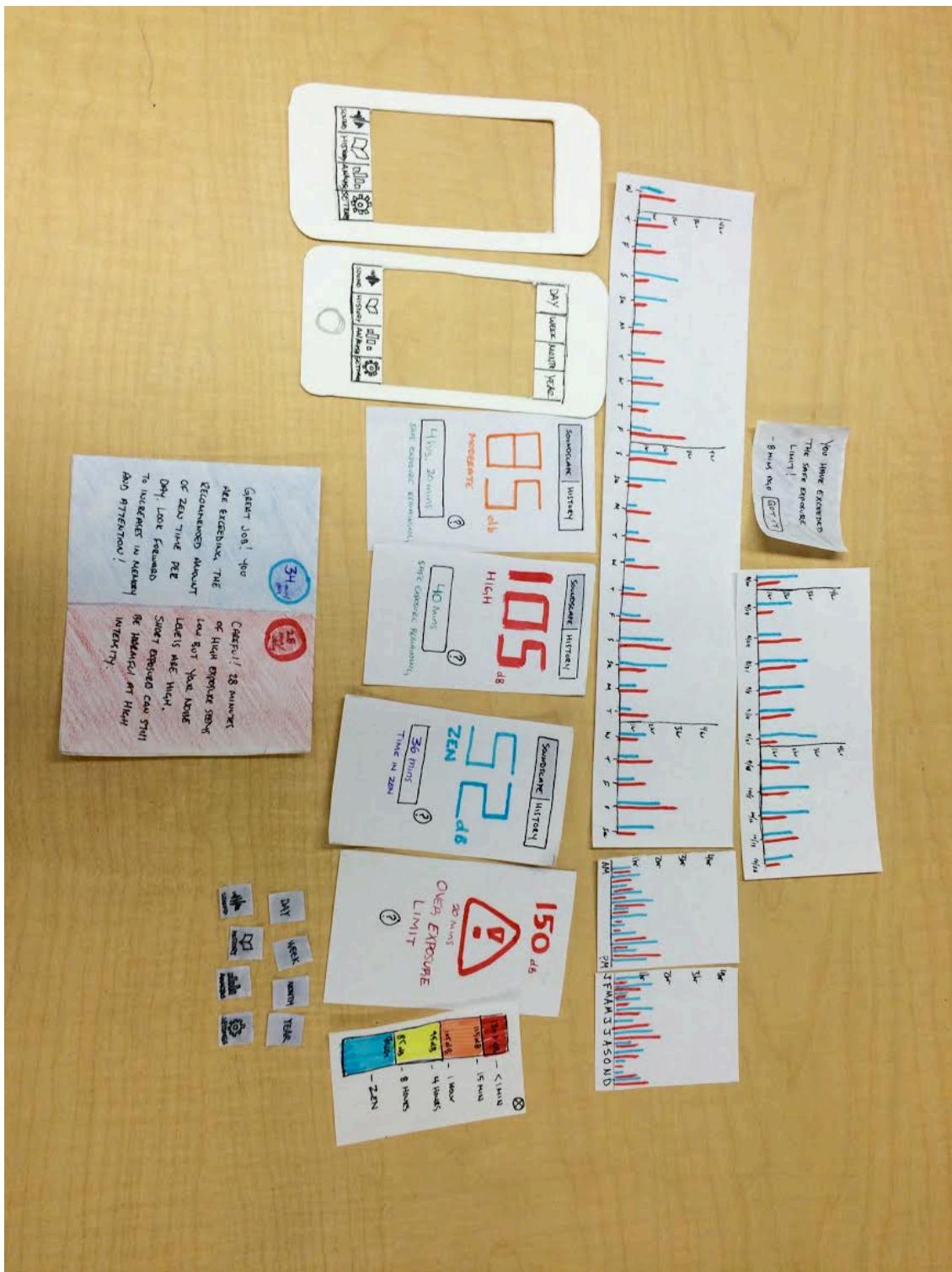
## Problem and Solution

Leaves blowing, the sounds of traffic, our radios, the construction workers down the street—they all contribute to our soundscape, the combination of sounds that make up our acoustic environment. When this environment reaches excessive levels that affect the balance of our health, we call it noise pollution. Recently, studies have shown that noise pollution can cause stress related illnesses, high blood pressure, hearing loss, sleep disruption, a loss of productivity, and even an increased risk of heart attacks. Most people know when things *feel* too loud, but many are unaware that consistent exposure to seemingly innocuous sounds can cause some of the adverse health effects listed above.

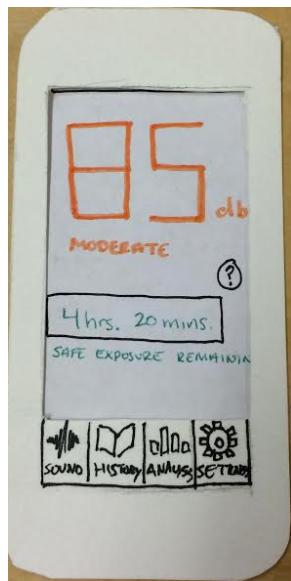
We propose a smartphone application that will constantly monitor, track, and display sound exposure using the built-in microphone on the device. By allowing users to see objective data on the sounds in their life they can then make conscious decisions regarding their personal soundscape. This app will seek to raise awareness of the dangers of noise pollution at “Risk” sound levels, and emphasize the health and psychological benefits of quieter “Zen” spaces.

# Initial Paper Prototype

## Overview



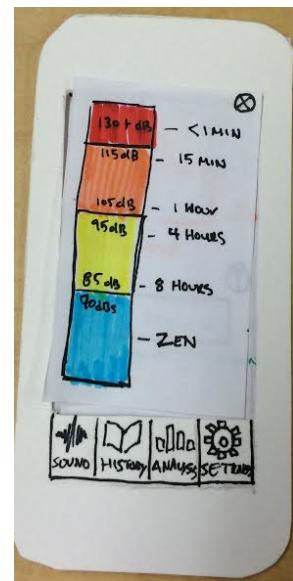
### Task 1: Perform Soundscape analysis of the current environment



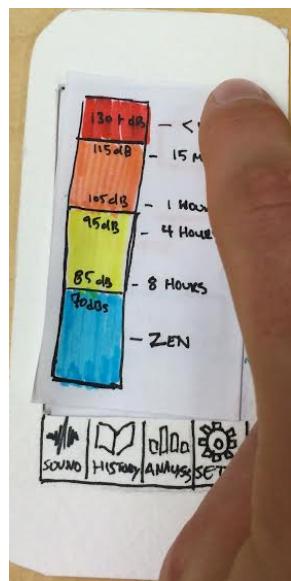
1.a – default screen. User is in moderately loud environment. Essential soundscape details are displayed. (Decibel information will be live updating)



1.b – User can tap the question mark icon to gain more information regarding the “safe exposure remaining” timer.



1.c – information related to time limits in various exposure levels is shown.



1.d – close icon tapped and user returns to main soundscape screen.



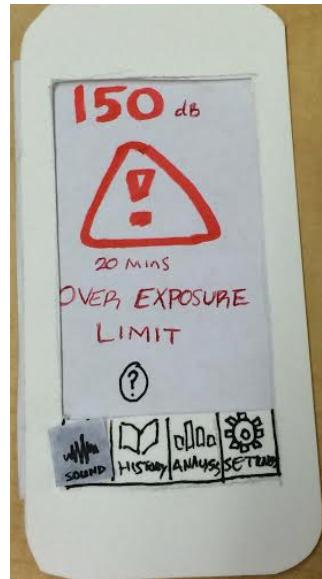
1.e – user moves to louder environment and looks at the soundscape. New information is shown.



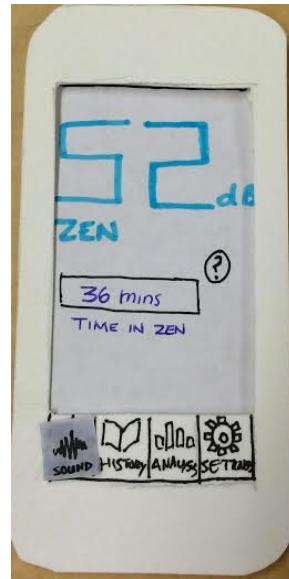
1.f – after the 40 minutes elapses, user is shown this push notification that they have exceeded their safe exposure levels.



1.g – user acknowledges the push notification.

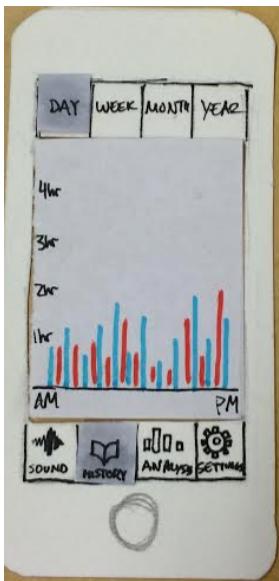


1.h – once the exposure level is reached, the screen changes to reflect the urgency of the conveyed information.

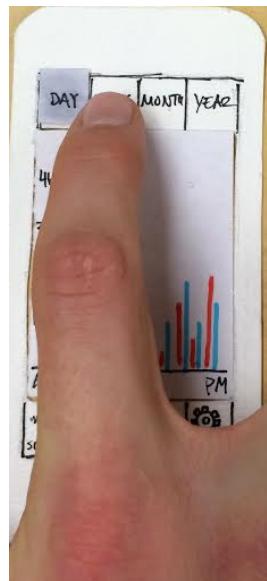


1.i – user moves to quieter location and zen stats are shown. Note the changed interface with the cooler colors and positive connotations. Timer window is counting up.

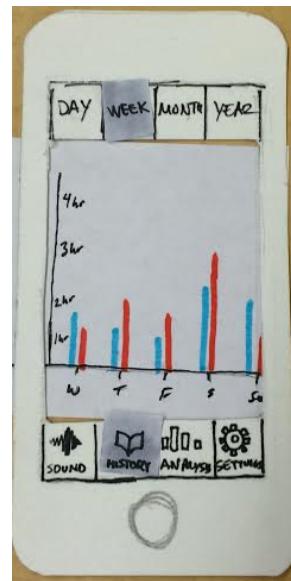
## Task 2: View past noise exposure



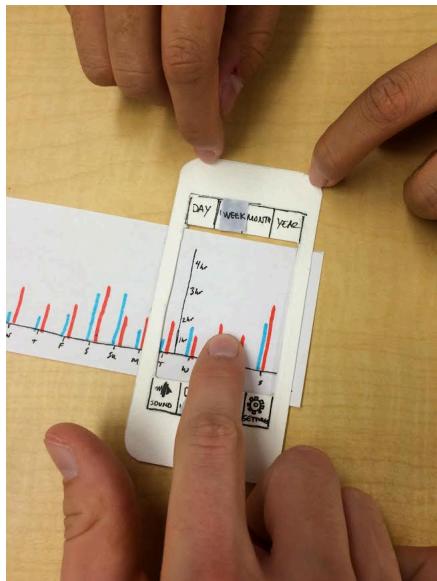
2.a – user clicks the history tab. The default view shows the data from the past day.



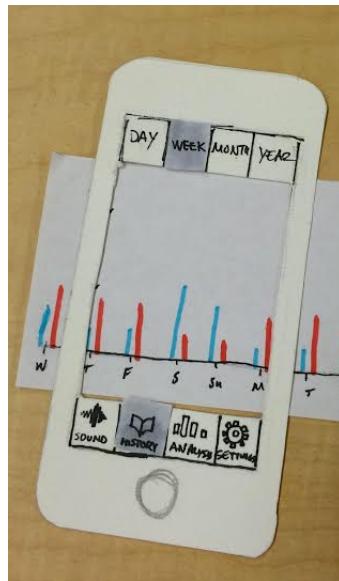
2.b – user enters the week view.



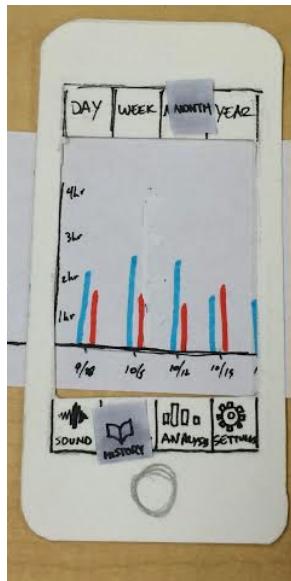
2.c – information from past weeks is shown. The bars represent daily exposure.



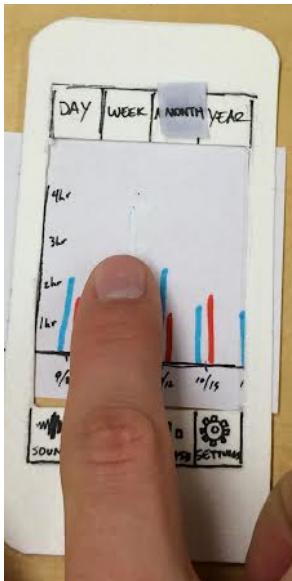
2.d – this window is scrollable. Here we see the user scrolling to see past data.



2.e – older data is now shown.



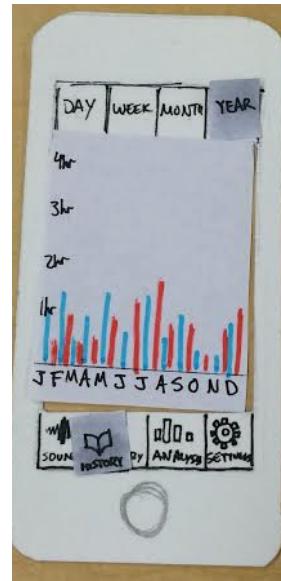
2.f – user now enters the month view. The bars represent weekly exposures.



2.g – Once again, this window is scrollable to see older data.



2.h – older data is now shown.



2.i – user enters year view. Bars represent exposures for each of the past 12 months.



2.j – user enters the analysis view from the bottom toolbar. This split screen recap of zen data and noise data is shown.



2.k – user swipes to see zen recap information.



2.l – user swipes the other direction to view the noise recap.

# *Testing Process*

## ***Heuristic Evaluation:***

Like the other groups, our heuristic evaluation was done during the in-class period on Tuesday, November 4<sup>th</sup>. During this session, Garrick acted as the facilitator and Luyi as the prototype “computer” to simulate app functionality. Because this was our first run through with the testing procedure, it was not as practiced and precise as some of the later tests. Good feedback was still received, however, and these comments (as well as our refinements) are summarized in the following *Testing Results* section.

## ***Usability Test 1:***

Our first usability test was done with Glenn, a UW student, and took place in the HUB cafeteria. We chose Glenn as a participant because we wanted a student who frequents loud environments on a daily basis. The HUB cafeteria was chosen as the location because it is a loud environment visited daily by Glenn and many other students. The test protocol was a cognitive walkthrough in which the test subject was told to accomplish several tasks while Garrick acted as a facilitator and Luyi as the prototype “computer”. For the first task the subject was told to analyze the soundscape of the current environment and make a decision based on the presented information. For the second task the subject was told to review past data recorded by the app and view the detailed analysis.

## ***Usability Test 2:***

Our second usability test was done with Allen (name changed), an older gentleman who self-describes as “technologically semi-literate”, and took place at his office. We chose him as a participant because we wanted to ensure our design made sense to people of various age ranges and experience levels with smartphones. Interviewing at his office was chosen for convenience. The test protocol was a cognitive walkthrough in which Allen was told to accomplish the two tasks of 1. Gather information regarding your current soundscape, and 2. View an analysis of past data. Grant acted as the facilitator and Chris as the prototype “computer”.

## ***Usability Test 3:***

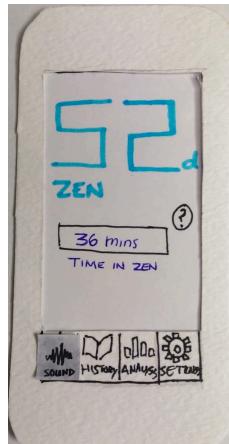
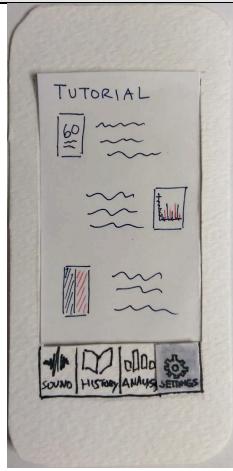
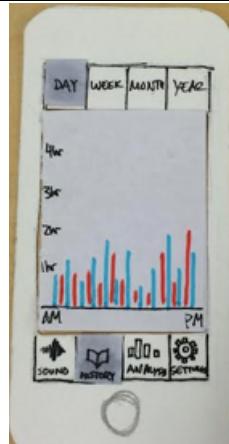
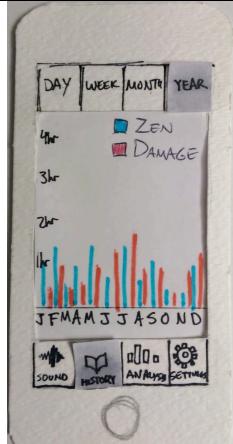
Our third and final usability test was done with Dr. Jane (name changed), a professional Radiologist, and took place at her home. We wanted a physician for a usability test in the hope that they could provide us with some feedback regarding how our medical information is presented in the interface. Interviewing at her home was done for her convenience. The test protocol was a cognitive walkthrough in which Dr. Jane was told to accomplish several tasks while Grant facilitated and Garrick acted as the “computer”. For her tasks, she was instructed to gather information regarding her current soundscape, and view her past data in various timescales.

# Testing Results

## Version 1.0

Looking back at our paper prototype testing and subsequent refinements, it is clear that our design moved through three distinct phases: Version 1.0, Version 1.1, and Version 2.0. Version 1.0 was our initial Paper Prototype design from Assignment 3.a. It was rough and unpolished, but was a strong initial design approach to our problem space. Version 1.0 (shown in the prior *Initial Paper Prototype* section) was our prototype during our first two critiques: the heuristic evaluation done in class, and our first usability test with Glenn. The comments we received from these first two examinations dealt almost exclusively with cosmetic changes to our design, and not a single issue received higher than a Severity 1 rating (From Lecture 12: “Severity 1 - Usability blemish. Mild annoyance or cosmetic problem. Easily avoidable”). At the time, this was great news, as it appeared that our design had largely escaped the more critical Severity 3 and Severity 4 issues. With only minor changes to fix, we quickly refined the design based on the comments and moved on to Version 1.1. Some of the revisions are shown again below, but a full results table can be found in the Appendix along with a Version 1.1 overview image.

## Version 1.0 Revisions

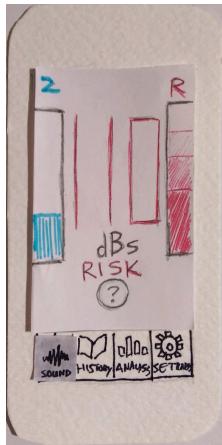
Complaint	Before	Fix	After
Current design lacks information regarding application purpose, a noise overview, and explanation of basic metrics. Include an information page.		Added tutorial page that shows when users first open the app. This tutorial gives a brief overview of the application functionality and is also accessible via the Settings page.	
Charts of data need to include a legend. Users were confused on the onset about what the red and blue bars meant.		Legend was added and the bar graphs are much clearer.	

## Version 1.1

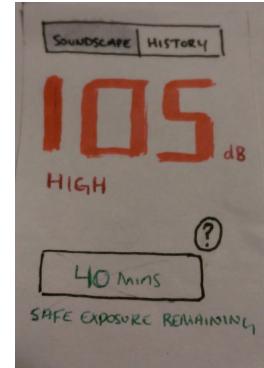
After making the recommended cosmetic adjustments, we had a slightly more polished paper prototype and moved into the second phase, Version 1.1. With this design in hand, we proceeded with our remaining two usability tests and TA design critiques. Fortunately, these tests did not go nearly as smoothly as the first two and we were able to identify some high-severity design flaws that were missed during the first round. The following section identifies the major revision, but the full results tables can be found in the Appendix.

### Version 1.1 Revisions

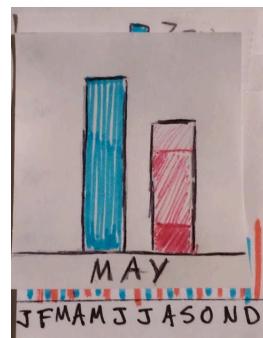
Following issues identified in inspection, usability testing, and critiques, we made one major revision to our design, and this in turn sparked numerous smaller revisions throughout our prototypes. After our final two usability tests and design critiques we completely redesigned the way in which our design measures and emphasizes noise and zen tracking. The old “homepage” is shown to the right. The major pieces of information are the current dB level of the space, and the “Safe Exposure Remaining” timer that we based loosely off of OSHA noise standards. We posited that we could track the current noise level, make estimates



regarding safe exposure, and then alert the user when they exceeded these limits. Our last two usability tests as well as our TA design critiques raised concerns with this layout, ranging from confusion to what the timer represented to even doubting that “safe exposure” could be accurately tracked and monitored. With this in mind, we scrapped the idea of a live updating and algorithm-based timer in favor of a more objective and data-oriented interface. The redesign is shown on the left. We kept the large and color-coordinated digits of the decibel meter and replaced the timer with a centralized information button (question mark). On the side we placed bars that show the data of the current day. Note how the Risk ('R') bar shows different shades of red depending on the severity of the exposure. If the environment is either a zen or risk environment, the corresponding bar will flash to show live updating. In this case, the Risk bar would be flashing. This is a much cleaner interface, and we believe it more strongly communicates need-to-know information to the user.



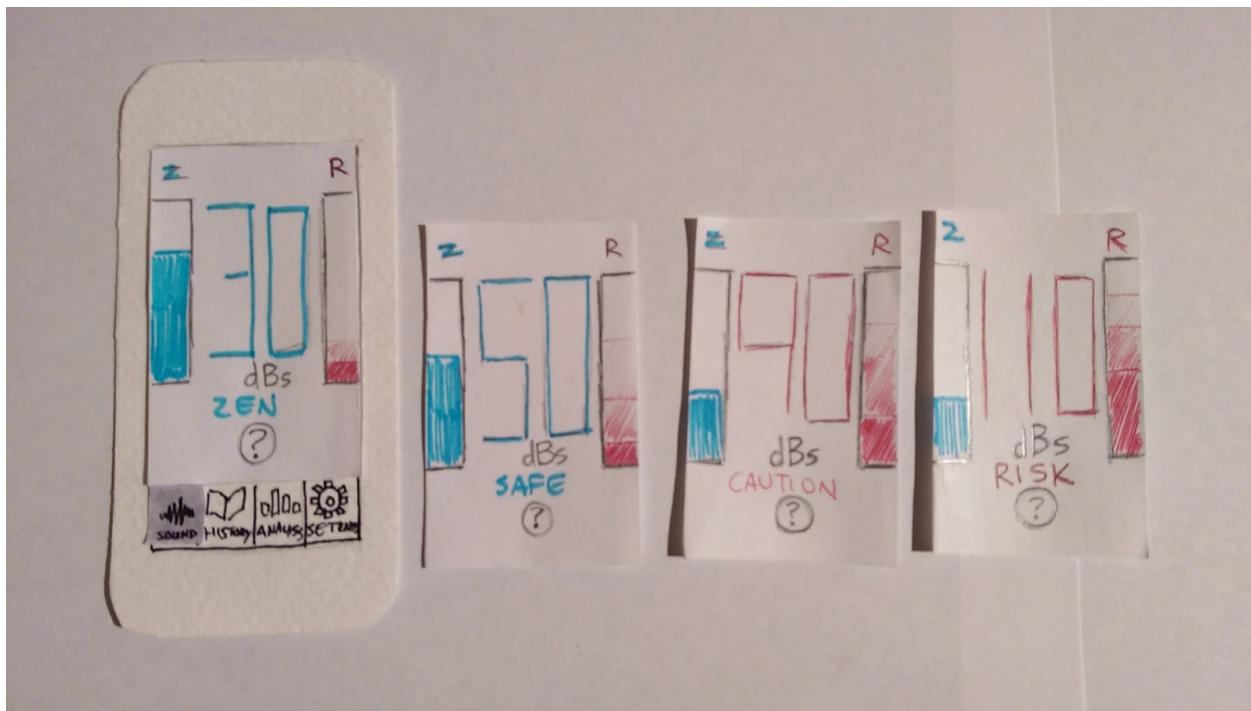
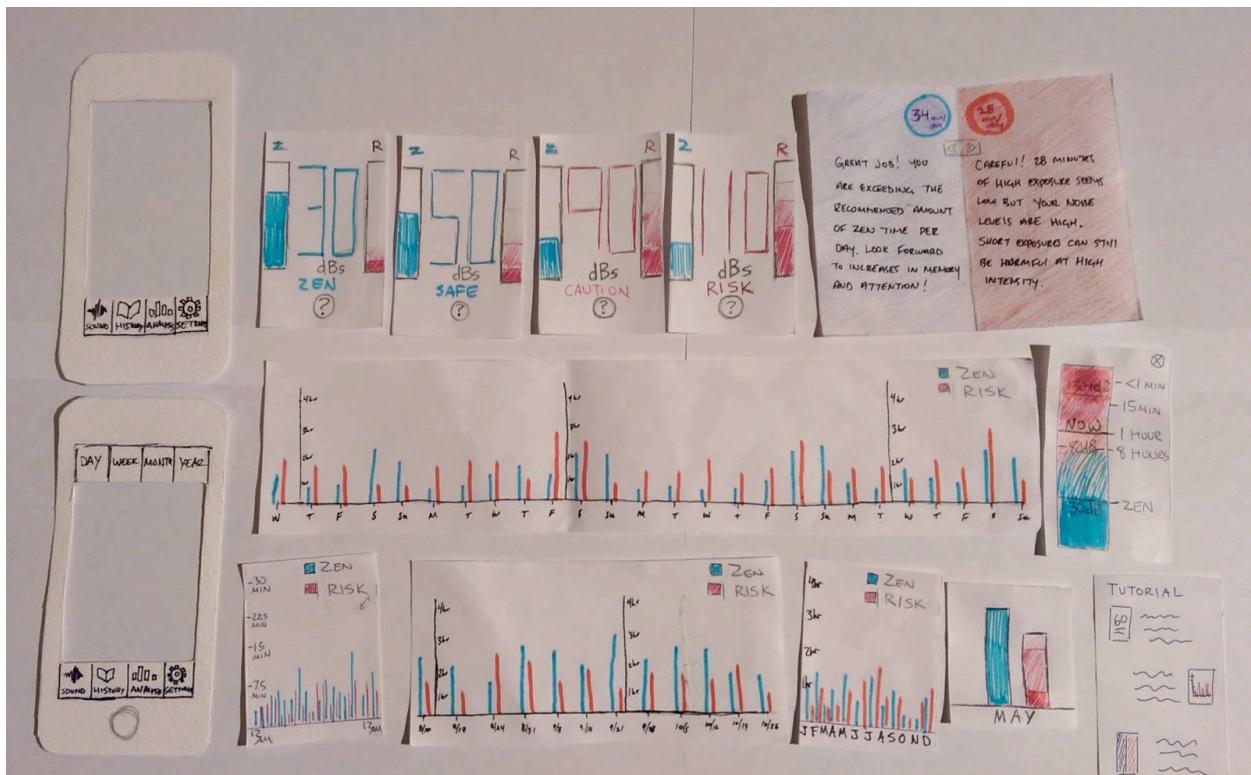
This redesign prompted several other revisions, most notably in the History portion of the prototype. The first change you may notice is the use of the word “Risk” instead of “Damage”. Our usability testers (and several TAs) disliked the word Damage and its connotations. Risk better communicated the information--these are the noises that could put you at *risk*-- and seemed to fit better with our Zen term. The more notable change is our addition of a detail page that is accessed when users click on the timescale bars. While our basic design still only shows solid blue and red bars for past data, we now give users an option to view this information in much more detail (see right) if they click the individual bars. Doing so provides them with a breakdown on the severity of their risk levels (shown) and more detailed metrics regarding average noise exposure, loudest days, etc. (not shown). This “zoomable” interface will bring more detailed information to the power users but will still maintain the clarity and simplicity of the original blue/red design for more “at-a-glance” feedback.



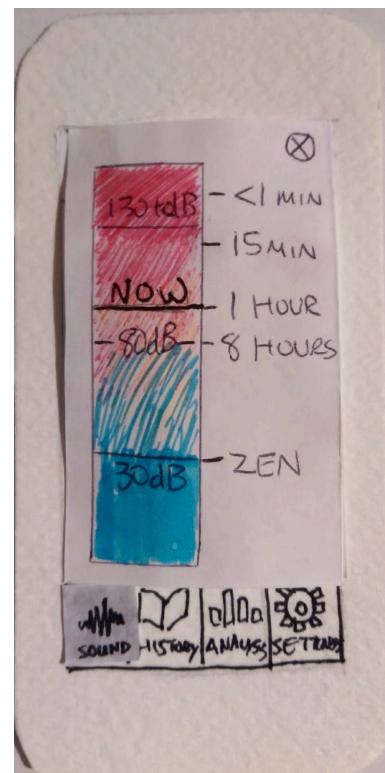
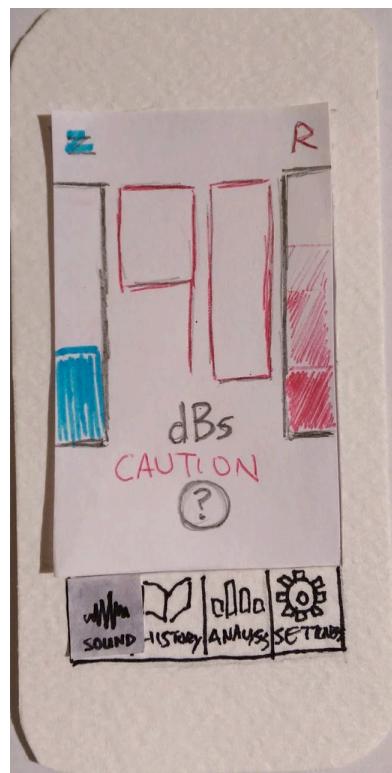
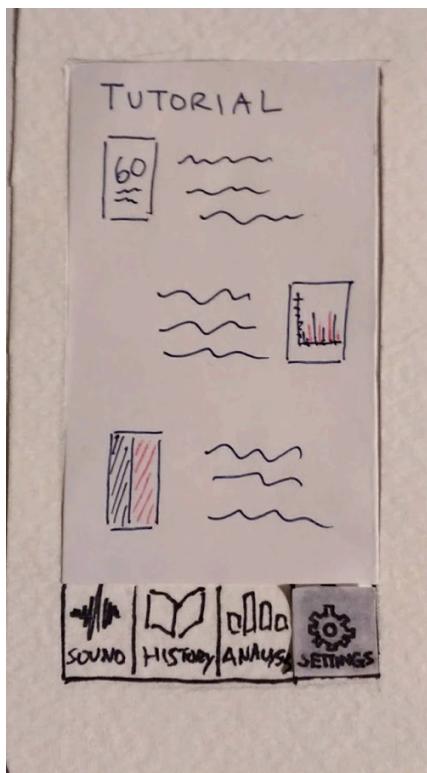
With these major changes completed and sketched, our paper prototype moved into its third and final design, Version 2.0, as shown in the following section.

# Final Paper Prototype

## Overview



**Task 1: Perform Soundscape analysis of current environment**

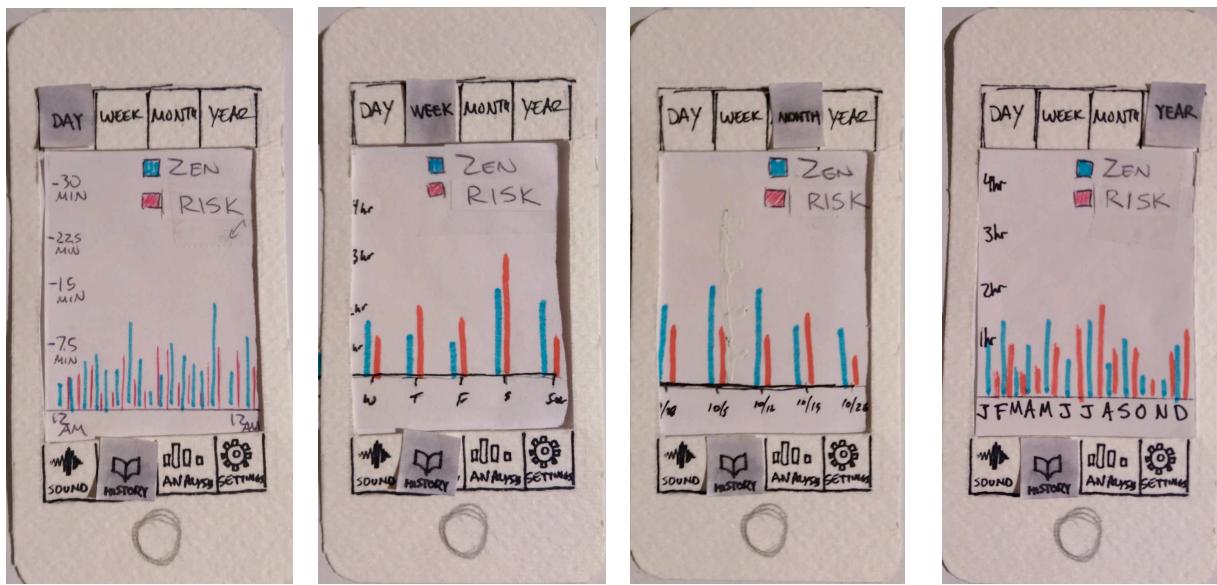


1.a. First time default screen users are presented with a mini-tutorial / instructions page.

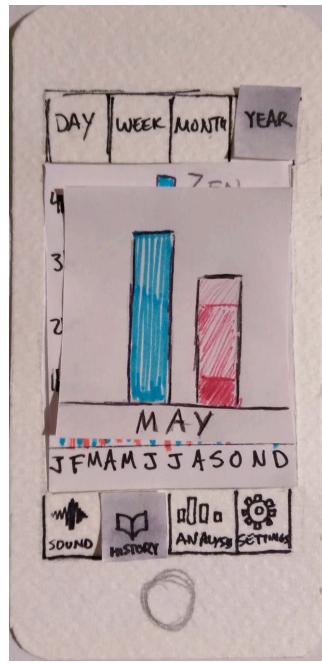
1.b. The blue bar provides information on Zen time for that day. The red bar shows noise data (which is shaded depending on past severity). The large middle numbers show current dB levels and the text below it offers worded feedback (in this case, 'Caution'). Users can click the question mark for more information on the text.

1.c. Clicking the question mark brings you this dialog, which provides more detailed feedback regarding recommended exposure times for various dB levels. In this case (90 dB), users are told that they should limit their time to about an hour.

## Task 2: View past noise exposure



2.a. User clicks the history tab. The default view shows the data from the past day but users can easily move between different views using the tabs on top (from left to right: day, week, month, year). All of these screens are horizontally scrollable if past data is needed.



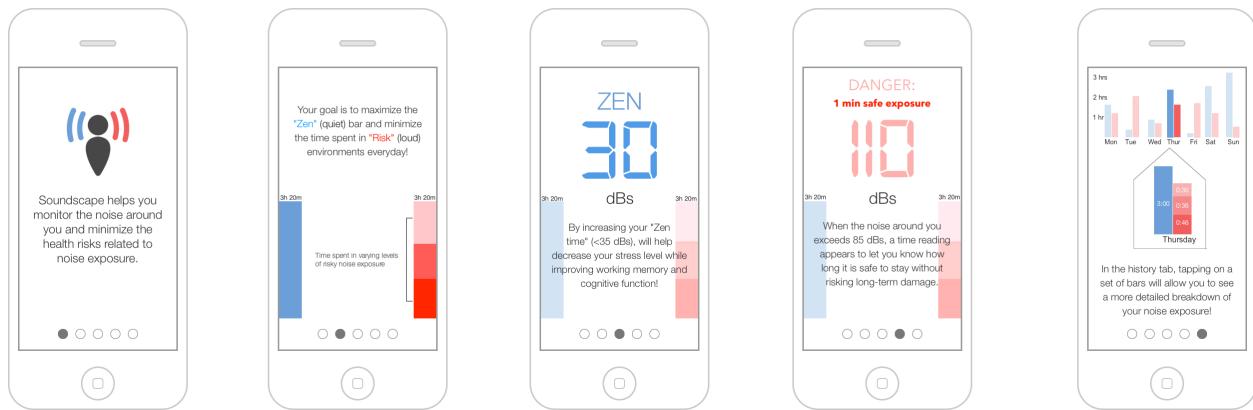
2.b. All of the bars are clickable, and doing so brings you to a detail screen. In this case, May has been selected from the Year view, and the information for the month is presented. Note the shaded bars of the Risk section that shows which percentage of the red bar is “high risk”, “medium risk”, and “low risk”. This page is currently limited by the paper prototype medium and future versions of this page will show more information.

# Digital Mockup

## Overview

See Appendix.

## Task 1: Perform Soundscape analysis of the current environment



1.a. At first time startup, users are presented with a mini tutorial page explaining the features. A more detailed overview is available via Settings.



1.b. Here are four potential screens in the default Soundscape view. The blue bar provides information on Zen time for that day and the red bar shows Risk exposure (which is shaded depending on past severity). The large numbers in the middle of the screen represent the high-precision sound meter and show the dB level of the current Soundscape. Above the numbers is a one-word description of the relative safety of the area and a recommended time limit for higher exposures.

## Task 2: View past noise exposure

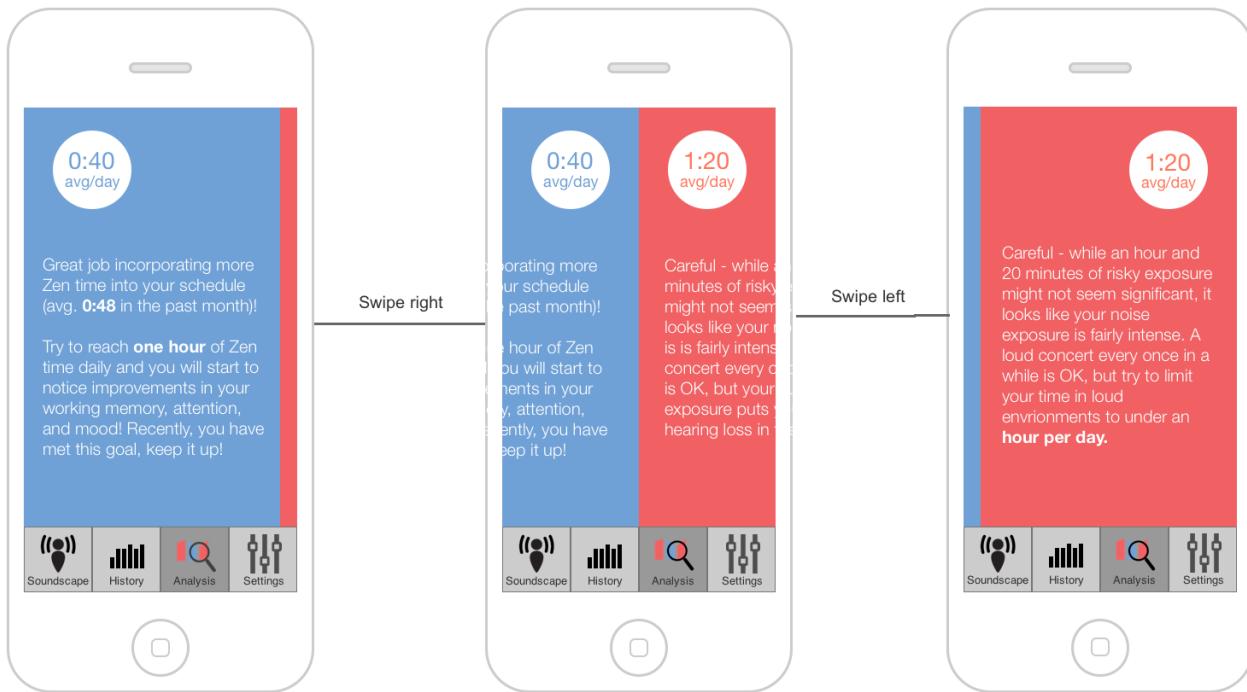


2.a. User clicks the History tab. The default view shows data from the past day (top left) but users can easily move between different views using the Day/Week/Month/Year toolbar. These screens are also horizontally scrollable if past data is needed.

2.b. Clicking on any of the bars brings you to a detail screen, where more information over the selected interval is shown (bottom). In this case, Friday has been selected from the Week view, and the detail page for that day is now shown. The risk bar shows individual totals for high risk, medium risk, and low risk exposures, and the text underneath gives total exposures for that time period.

## ***Other Screens (not part of main tasks)***

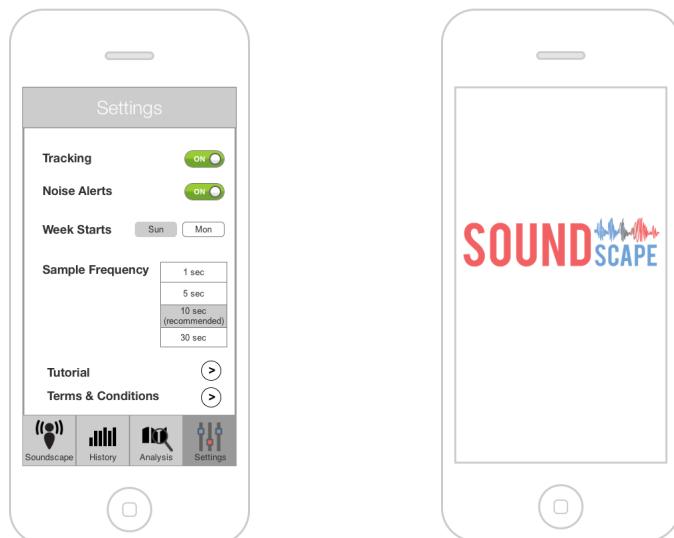
### Task 3: Analyze sound data and communicate the effects of past exposures



*3.a. User clicks the Analysis tab. They are presented with the side-by-side view shown in the middle image. Lifetime stats regarding daily averages for Zen and Risk at the top of the page.*

*3.b. Swiping on the screen either direction takes you to the full recap portion of the analysis as shown (left to Zen, right to Risk).*

### Settings Page Mockup & Startup Logo



## Moving from Paper to Digital

Most of our major design changes were done in our paper prototype testing, when we shifted to a simpler interface that emphasized zen tracking and eliminated the timer. As such, there were no significant changes during the switch from a paper to digital format. There were only several smaller ones, including adding actual text to the tutorial page (instead of the squiggles we had before), adding more information to the detail page with smaller text, and eliminating the More Info question mark as this information was covered in the tutorial slides.

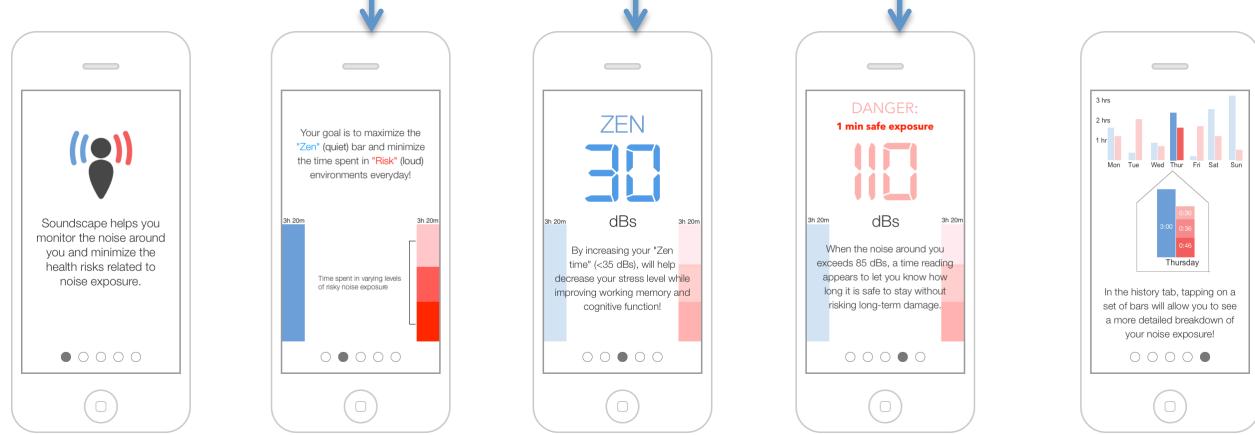
### Critiques & Changes:

The major critiques that surfaced during the Digital Mockup review on Friday November 14<sup>th</sup> were 1) reducing the amount of text in the tutorial screens, 2) changing the Soundscape icon to better reflect the purpose of the app instead of just implying location, and 3) adding an icon to help users close out of the Detail screen. We have addressed all of these critiques. The changes we made were visible in the previous task descriptions, but we have isolated them below:

#### Old Tutorial



#### New Tutorial



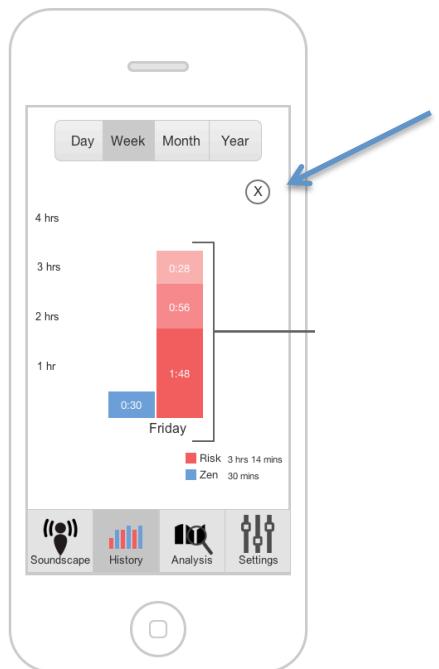
(Note the more succinct wording in pages 2-4)

*New Icon:*



Following feedback from the TA, we believe this new icon better represents current location and ambient sounds, the two main facets of Soundscape analysis.

*Close Button on Detail Page:*



We have added a “Close” (X) button to help users return to the previous screen.

## *Discussion*

### ***What did you learn from the process of iterative design?***

There are many conclusions to be drawn from our mini iterative design process these past several weeks. First and foremost, it was immediately apparent just how useful one usability test (and subsequent design iteration) can be. Without the feedback from our second two usability tests and critiques from the T.A., we never would have isolated the major flaw in our original paper prototype. It was also clear that you do not need to do an excessive amount of usability tests to identify problems in your design. Most issues showed up in almost every case. That said it is important to do a *minimum* number of usability tests. If we had simply done our one heuristic evaluation and first usability test and called it good, we would have never identified the issue with the timer in our interface.

### ***How did the process shape your final design?***

This was touched on in the previous section, but our design saw significant changes through this process of iterative design. Without the feedback-revision-feedback cycle between ourselves, our usability tests, the TA critiques, and other sources—in essence, the *iterative* part—we never would have moved beyond our original (and clearly flawed) design. Additionally, though some critiques were more useful and groundbreaking than others, the success of iterative design comes from the cumulative feedback over time. Nearly every single piece of criticism made its way into our design in some form or another. Every comment, no matter how seemingly insignificant or off-hand, is valid and important.

### ***How have your tasks changed as a result of your usability tests?***

There were no drastic changes in our main tasks following feedback from the usability tests. The changes made were very minor, as our task descriptions were distilled into more basic forms. While a previous task description for Soundscape analysis included noise alerts, live-updating timers, and health feedback, our new design focuses more explicitly on data tracking and acquisition, and less on the warnings and lifestyle recommendations. Weather apps don't tell people to drink more water when it's hot or to bundle up when it's warm, they simply provide the forecast and let users make their own decisions from that information. We found ourselves quickly moving toward this hands-off model during our usability tests and it is reflected in later designs.

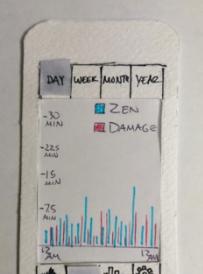
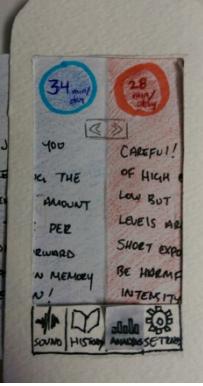
### ***Do you think you could have used more, or fewer, iterations upon your design?***

While doing as many iterations as possible seems like the obvious choice, there is always the risk of over-designing something and never reaching a finished product. At some point, you have to make sure that the perfect does not become the enemy of the good. We feel as though our iterations focused on important details, went into depth as necessary, and showed a logical progression from the first prototype to the current. Though our application is not perfect, we are very happy with the path our iterations took, and we feel very confident about the robustness of our design.

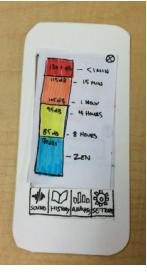
# Appendix

**Heuristic Evaluation Results Table**

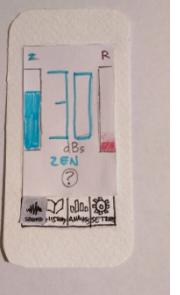
Prototype Image	Identified Issue	Heuristic & Severity	Revised Image	Revised Explanation
	Current design lacks information regarding application purpose, a noise overview, and explanation of basic metrics. Include an information page.	H.10 S.1  Would be useful given the nature of the problem, but not critical.		Having a tutorial/information page in the settings will allow the user to find out how to use the app without forcing them to view it (i.e. intro tutorial).
	Help screen of decibel levels uses multiple colors but should be only blue and red to maintain consistency.	H.4 S.1  Minor complaint, but an easy fix.		Using a blue/red gradient gives the design a more consistent look as well as giving more direct feedback to the type of noise levels.
	Charts of data need to include a legend.	H.2 S.1  Bar graphs that include a legend is a real-world convention. A relatively easy fix.		Users were confused on the onset about what the red and blue bars meant. With a legend, this distinction is clear.

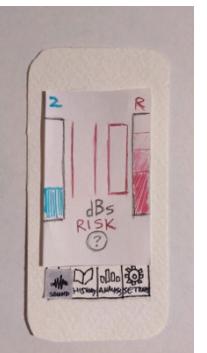
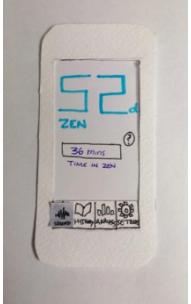
	<p>Charts of week/month/year data should not have same scale</p>	<p>H.4 S.0</p> <p>This is essentially a typo. The final design will not have this issue.</p>		<p>The units need to scale when different time views are selected. Day view data is scaled to minutes instead of hours.</p>
	<p>The swipe mechanic to move between zen and noise on analysis page needs to be clearer.</p>	<p>H.6 S.1</p> <p>Actions available to the user must be clear. Easy fix.</p>		<p>The arrows in the middle are used to show that the screen is swipeable.</p>

*Usability Test 1 Results Table*

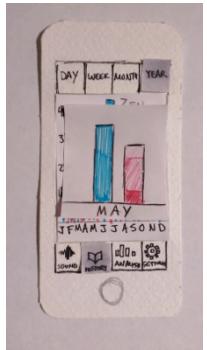
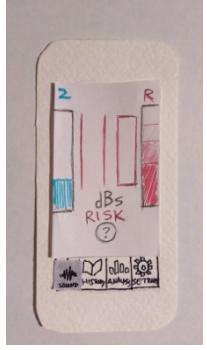
Prototype Image	Incident Description	Issue Severity	Revised Image	Revised Explanation
	User tried to click on the bars in the graphs	N/A	N/A	N/A
	User wanted more (different?) information in Info screen.	S:0		In addition to the sound chart, more detailed text is provided and we have also included a tutorial page on initial startup.

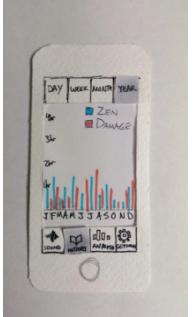
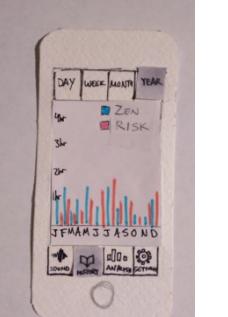
*Usability Test 2 Results Table*

Prototype Image	Incident Description	Issue Severity	Revised Image	Revised Explanation
	User did not like the location for the question mark “more info” icon	S:1		We moved the question mark to the middle of the screen so that it is now more obvious to users. And it also better fits our new symmetric interface.
	User was initially confused with swiping mechanism on Analysis page	S:0	N/A	User was only momentarily slowed by this layout. The mechanism will be much clearer in the digital form. A minor issue.

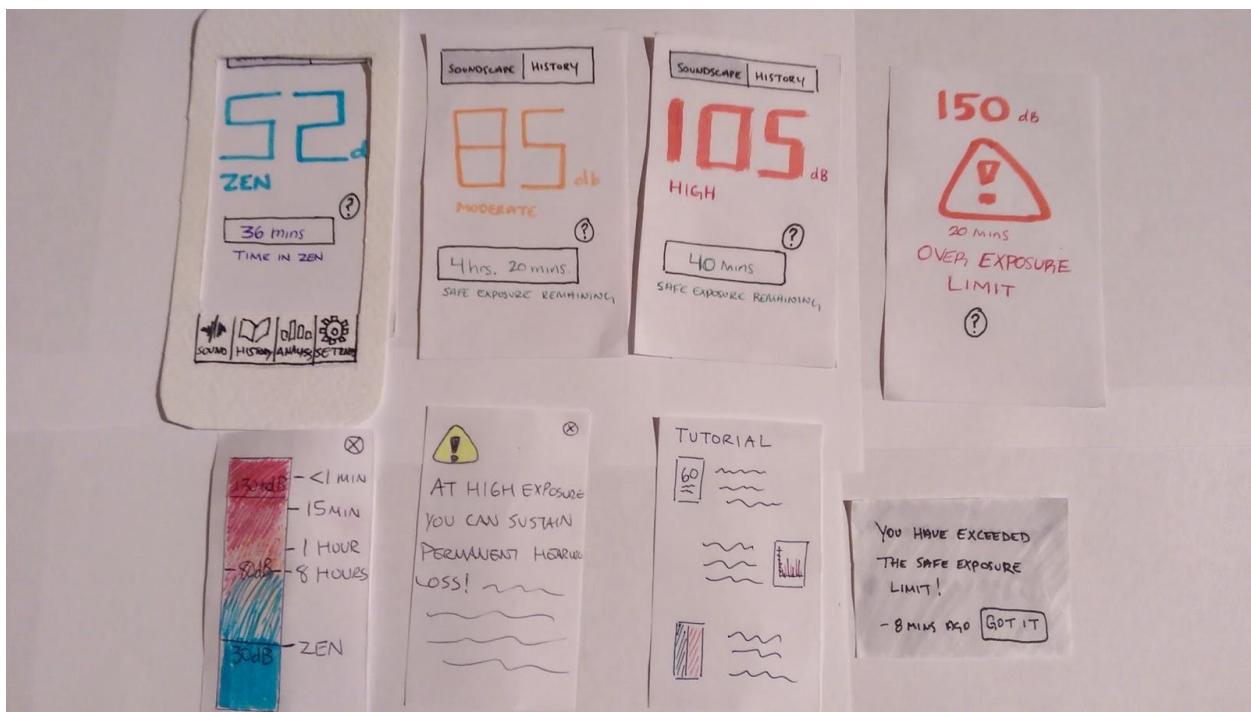
	<p>User did not like the word "Damage" for graph. He pointed out "no guarantee the sound will 'damage' hearing"</p>	<p>S:5 also mentioned in usability test 3</p>		<p>We agree that "Damage" is not the best wording. We changed the word "Damage" to "Risk".</p>
	<p>User found the timer in loud environment very confusing</p>	<p>S:5 also mentioned in usability test 3</p>		<p>We also had a hard time figure out the best way to display the timer. After the usability test, we found there is no need to keep the timer because of its erratic and confusing behavior (e.g. user frequently stepping in and out environments with different noise levels will have trouble interpreting the timer). We replace the timer with a goal-setting and live-review feature.</p>
	<p>User found "Zen" timer made much more conceptual sense.</p>	<p>N/A</p>	<p>N/A</p>	<p>N/A</p>

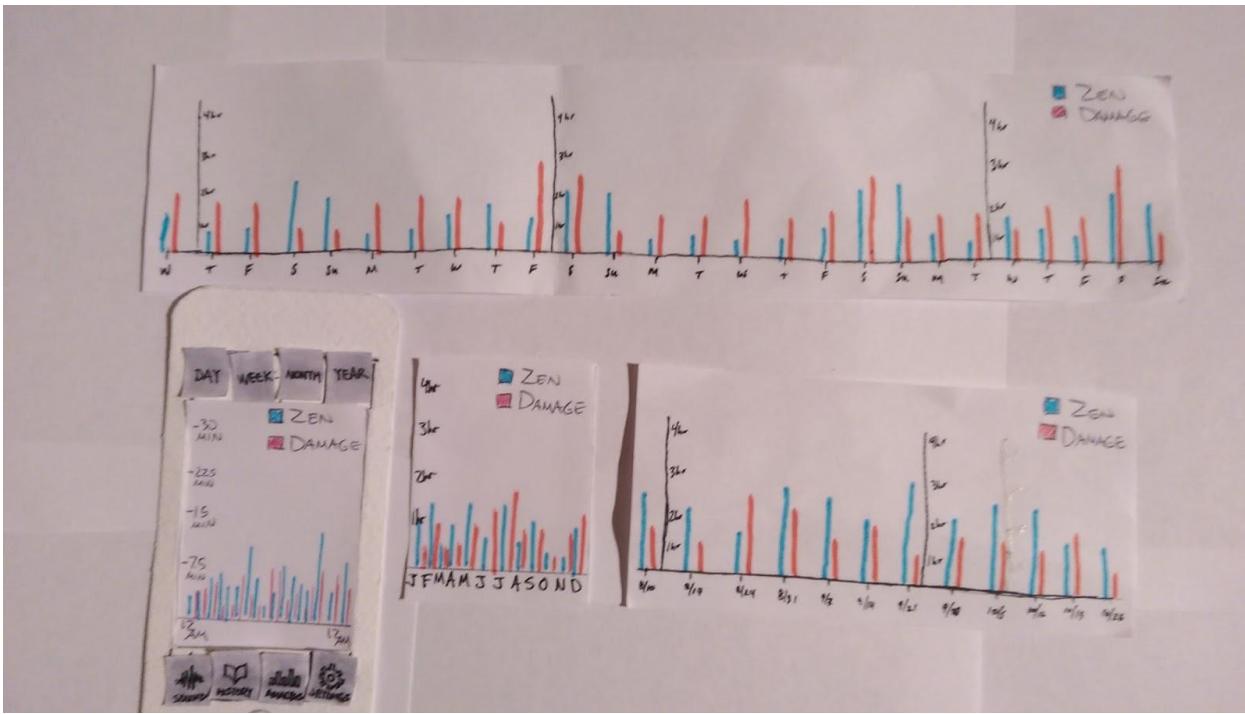
*Usability Test 3 Results Table*

Prototype Image	Incident Description	Issue Severity	Revised Image	Revised Explanation
	User did not figure out the graph is scrollable	N/A	N/A	Minor issue primarily related to drawing limitations. (will be clearer in digital mockup)
	User tried to click on the bars in the graphs	S.1		We now allow user to see detail of each bar when clicking on them. The pop-up will show detail information with different granularities of noise levels. This will also match our redesigned soundscape screen.
	User liked our Day / Week / Month / Year layout. "I liked viewing the data over different times"	N/A	N/A	N/A
	User found the timer is highly confusing	S:5 (also mentioned in the second usability test)		Same as test 2

	<p>User did not find analysis for past day as useful</p>	<p>S.1</p>		<p>We now change the analysis page to show average zen/risk time throughout the app's lifetime. This change would distinct analysis with history, where history represents the trend and analysis shows the summary of data.</p>
	<p>User did not like the word damage in the graphs</p>	<p>S:5 (also mentioned in the second usability test)</p>		<p>Same as test 2</p>

## Version 1.1 Overview





GREAT J ARE EXCE RECOMMEND OF ZEN - DAY. LOOK TO INCREASE AND ATTE

YOU THE AMOUNT PER REWARD N MEMORY U!

CAREFUL! OF HIGH LOW BUT LEVELS ARE SHORT EXPO BE HARMF INTENSITY

MINUTES SEEMS NOISE IGH. CAN STILL T HIGH

SOUND HISTORY ANALYSIS SETTING

## Digital Mockup Overview

