

Sound Barrier

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The Problem

People using earphones face accidents in the roads and railways due to carelessness. They frequently use their phones while walking in public places, which dramatically increases risks of injury. These risks are mostly related to divided attention. Most of them fail to notice car horns or train whistles and bring about their own demise. Such an overuse of earphones by pedestrians needs to be kept in check to keep them safe. The motivation behind "Sound Barrier" is to guide earphone usage to help users remain safe and sound in day to day life.

Current Works and Research

People unaware of their surroundings when walking in the streets fall victim to road accidents. People should not be using earphones during driving at all because the sensory deprivation is too costly, the lack of external sounds and warnings and the distraction a cause for accidents.

According to the study conducted in the US, published online in the journal Injury Prevention [1],

"There were 116 reports of death or injury of pedestrians wearing headphones. The majority of victims were male (68%) and under the age of 30 (67%). The majority of vehicles involved in the crashes were trains (55%), and 89% of cases occurred in urban counties. 74% of case reports stated that the victim was wearing headphones at the time of the crash. Many cases (29%) mentioned that a warning was sounded before the crash."

A 2013 study by researchers at Ohio State University examined the relationship between pedestrian mobile device usage and pedestrian injuries. [2] These authors use data from 2004 to 2010 from the National Electronic Injury Surveillance System (NEISS), a database of hospital data maintained by the U.S. Consumer Products Safety Commission.

They sampled injury reports from 100 national hospitals and produced estimates of pedestrian mobile phone use-related injuries reported at 3,800 hospitals throughout the U.S. They found that the number of pedestrian injuries due to pedestrian mobile phone use had increased from 506 injuries in 2004 to 1506 injuries in 2010. If injuries continue to increase at the same rate, the researchers predicted over 3,000 injuries per year by 2015. Researchers also noted that injuries are likely greater than reported by the NEISS data. "Many people who suffer an injury may not go to the emergency room; they may go to their primary care doctor, not go to a doctor, may not report the cell phone as the cause, or may die (newspapers report incidents of pedestrian mobile phone users getting hit and killed by cars, busses and trains)." Sixteen to twentyfive year olds were most impacted by distracted walking.

A popular road safety app right now is Kruzr [3]. This focuses on vehicle safety, such as automatic activation when using the phone to detect whether the user is driving, a separate user interface while driving and a chatbot that handles messages and calls by responding to the other end itself.

Similar to this Harman Kardon announced a headset centered on feeding input from the mic straight to the earphone whenever certain noises are detected [4]. They have the upper hand of the fact that they are directly making the hardware for it as well.

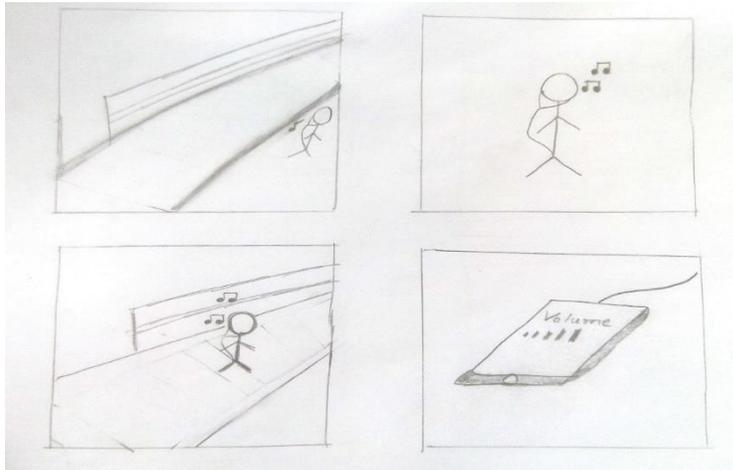
WalkSafe [5] is an Android smartphone application that aids people that walk and talk. It uses the back camera on the phone to detect incoming vehicles. By using image processing technology the phone will detect cars approaching the user. It uses phone API's that cause it to activate only during calls.

Our Solution

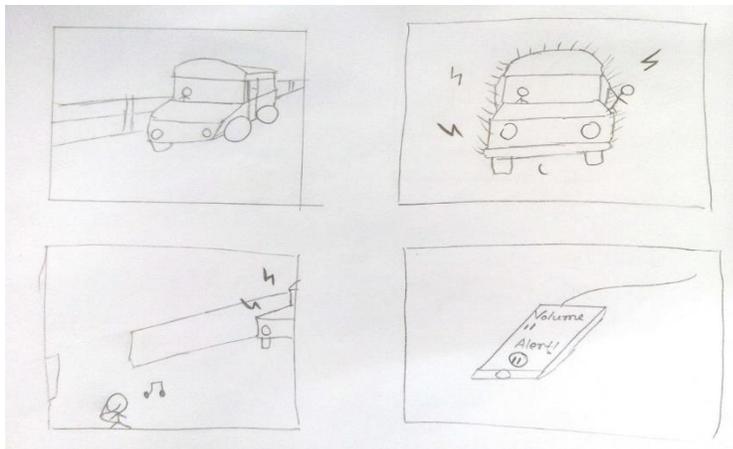
Sound Barrier will be a music player that listens to the environment for the user. When the user has headphones on and is listening to music, the app will constantly listen for sounds exceeding normal safety levels. Whenever such a noise is detected, the player will pause the music so that the user becomes alerted to his surroundings. So whenever

a car horn or a train whistle or any sort of loud noise that requires the users attention is detected, the app will pause the music and thus direct the users attention to whatever is happening around him.

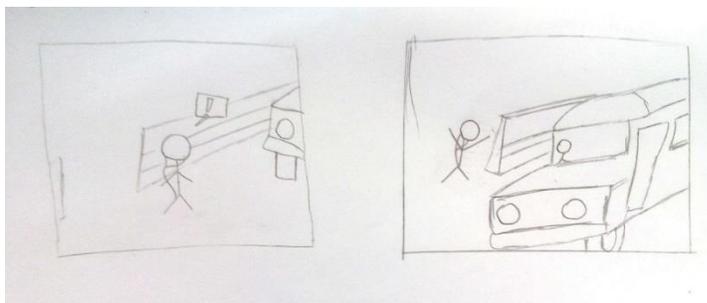
Detailed Storyboard



Scene 1: The user has his earphones on and is jaywalking, unaware.



Scene 2: A bus is approaching the user and is trying to alert him with the sound. Sound barrier is activated automatically.



Scene 3: The user is alerted of the danger and moves to safety.

User Feedback

We reached out to the users in two phases. The first one was an online survey for need-finding and the second one was an one-to-one interview round to accumulate user feedback.

All of the users were in the 18-25 age group with moderate to excessive earphone usage because according to research this group is the most endangered one.

Online Survey: (70 participants)

1. How often do you use your earphones daily?
 - a. Most of My Day 21.4%
 - b. Some specific Times 57.1%**
 - c. Not very Much 21.4%

2. Context of Usage ?
 - a. At Home 57.1%
 - b. As a passenger 64.3%**
 - c. While Walking 21.4%
 - d. In Noisy Environment 42.9%
 - e. While Driving 0%
 - f. All of the above 7.1%

3. How often do you go for a walk with earphones on? (On a scale of 1 to 5)
 - a. 1 35.7%**
 - b. 2 21.4%
 - c. 3 7.1%
 - d. 4 14.3%
 - e. 5 21.4%

4. Do you use your earphones while crossing roads?
 - a. Yes 71.4%**
 - b. No 28.6%

5. Would you mind if your phone volume was controlled for your own safety?
 - a. Yes 35.7%
 - b. No 42.9%**

- c. Maybe 21.4%
6. Would you mind if your phone paused music for your own safety?
- a. Yes 21.4%
 - b. No 57.1%**
 - c. Maybe 21.4%
7. Would you want your phone to alert you while you were using earphones on the road?
- a. Yes 57.1%**
 - b. Alerts would scare me 0%
 - c. Alerts would annoy me 42.9%
8. Would you like to suggest any other way of ensuring road safety for someone using earphones?
- a. My phone should talk to me like a normal person, not like a machine
 - b. Decreasing the volume when necessary
 - c. Some awareness videos should be made to make people aware of the risks of using earphones on the road.
9. Do you think a driver should be allowed to use earphone while driving, if not , how would you prefer his usage to be controlled?
- a. Yes, it's useful for calls 21.4%
 - b. Turn off the music 64.3%**
 - c. No 7.1%
 - d. car's music player could be used, because that wouldn't block the surrounding noise completely 7.1%

One-to-one Interviews:

Method:

We provided 3 users with differing usage level to review the initial prototype of our app. This prototype only had a working UI and the core barrier functionality.

We walked the users through the app and requested them to test it outside in noisy environment. After that we took their feedbacks.

Participants:

The first user, aged 21, is a moderate user of earphones with daily usage ranging from 2-3 hours. He uses earphones mainly in transit and uses loudspeakers at home. He suggested that there should be an option to turn the barrier off as in his case he was the passenger and external noises weren't putting him in any sort of danger, instead he was using earphones to isolate himself from the noise.

The second user, aged 23, rarely uses earphones aside from long journeys. She suggested us to improve the player interface and didn't have much to say regarding the barrier.

The third user, aged 18, is an avid user of earphones who uses earphones almost all the time. He suggested us to try to optimize the battery and memory consumption, as the prototype build was heavily draining his phone. He commended us for the warnings.

Observation from User survey:

1. In case of Pause or volume control, Pause was introduced based on user preference.
2. Users prefer having the ability to turn the barrier on / off
3. No alert because users don't prefer that.

Features

1. Music Player

The app is a normal music player with all the core functionalities.

2. Barrier

The app detects environmental noise when the user keeps the barrier on. The barrier is a feature that detects unusual spikes in environmental noise. If earphones are on, the app pauses the current song and thus the user is forced to take in his surroundings.

3. Customized Warning System

Based on the usage, the app will give different types of warnings and factoids such as facts regarding hearing decay caused by excessive volume or usage over long stretch of time.

4. Usage Statistics

The app will show graphical representation of usage over time so that users feel motivated to control their usage.

Battery and Memory Consumption

Peak RAM Usage : 23.6MB

Battery usage when app runs in background: 3mAh/hour

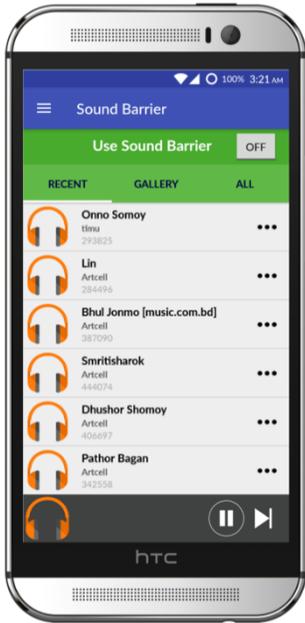
Battery usage when app runs in foreground: 43mAh/hour

Future Scope

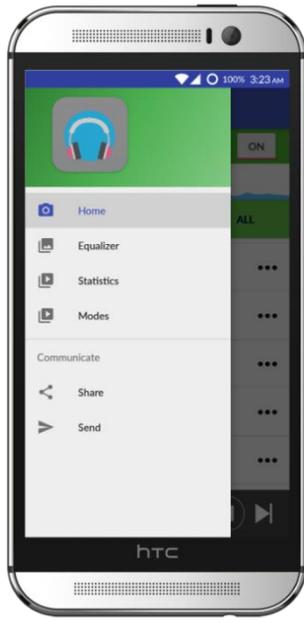
Integrate efficient machine learning API

Currently no feasible solution exists which allows us to detect people shouting. Most machine learning APIs are work in progress and suitable for only high end devices. So it was not possible to keep the memory and battery usage to a minimal level.

Screenshots of App



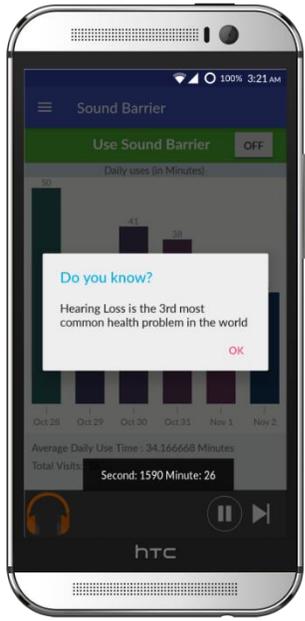
Mockup 1: Playlist Interface



Mockup 2: Navigation Drawer



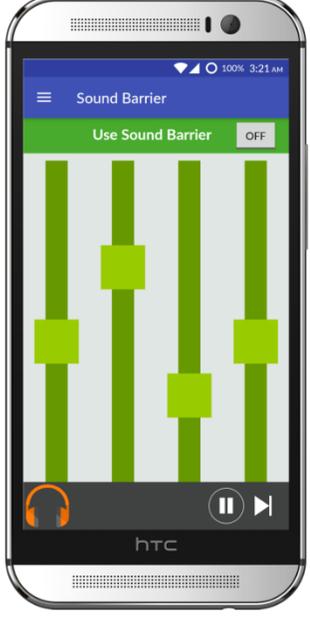
Mockup 3: Player



Mockup 4: Warning Messages



Mockup 5: Statistics



Mockup 6: Equalizer

References

[1] <http://injuryprevention.bmj.com/content/early/2012/01/03/injuryprev-2011-040161>

[2] Nasar, Jack, and Troyer, Derek. "Pedestrian Injuries Due to Mobile Phone Use in Urban Spaces." *Accident Analysis and Prevention* 21 Mar. 2013.

[3] <http://www.kruzer.co/>

[4] <http://www.alphr.com/headphones/1002316/harman-s-new-headphone-tech-could-save-lives>

[5] <https://play.google.com/store/apps/details?id=edu.dartmouth.cs.walksafe&hl=en>