Application and Results

Tin Can: An At Home Tinnitus Solution
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Abstract
The project goal is to create a product that will provide a solution for tinnitus, a condition that causes the patient to constantly hear what is often described as a ringing in the ear. It will disrupt the current market by providing the patient an at-home, self-testing procedure that will (1) diagnose their tinnitus frequency without need of an audiologist and (2) create a personalized audio therapy program for the user to listen to on their mobile device. The team has created a user-friendly Android application for frequency identification with a target accuracy within 1 clinical octave of the testing performed at the Callier Center. The application then produces an audio therapy file using an algorithm that concentrates tones within a certain range centered about the user’s matched frequency.

Project Background
A problem that about 1 in 5 people deal with is tinnitus. Tinnitus is a symptom of a condition more than a condition itself. It’s when a ringing or buzzing type of sound occurs in the ears. Some people hear it in one ear and some people hear it in both. The sound that the patient hears is not external; it is amplified due to abnormal activity in the neurons when hair cells in the inner ear are damaged. It’s usually caused by an ear injury or health condition. Although it can be treated in some instances to alleviate the severity of the tinnitus, there is no cure. The closest thing is to mask the noise utilizing brain plasticity.

User Experience
User downloads app
User follows instructions on screen to find their pitch match
User reports a match
User requests to listen to the audio therapy mp3
User listens to mp3 for 1-2 hours daily as recommended for best results

Result summary
- Five Callier Center tinnitus patients of Dr. Shawna Jackson, AuD, were tested with our frequency matching application.
- Version 1.0 did not include binary search redundancy or detailed instructions.
- Version 2.0 produced 75% of test results within our performance metric.

Result summary table

<table>
<thead>
<tr>
<th>Frequency (Hz)</th>
<th>Audiolist’s result</th>
<th>App result</th>
<th>Closest Clinical Octave</th>
<th>Difference (Number of Clinical Octaves)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8000 Hz</td>
<td>1490 Hz</td>
<td>2000 Hz</td>
<td>2000 Hz</td>
<td>3</td>
</tr>
<tr>
<td>6000 Hz</td>
<td>3740 Hz</td>
<td>4000 Hz</td>
<td>4000 Hz</td>
<td>1</td>
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<td>6000 Hz</td>
<td>6000 Hz</td>
<td>0</td>
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<tr>
<td>500 Hz</td>
<td>8210 Hz</td>
<td>8000 Hz</td>
<td>8000 Hz</td>
<td>7</td>
</tr>
<tr>
<td>4000 Hz</td>
<td>3690 Hz</td>
<td>4000 Hz</td>
<td>4000 Hz</td>
<td>0</td>
</tr>
</tbody>
</table>

Analysis & Challenges
- Tinnitus is a subjective condition that cannot be measured easily. It also has the ability to change in symptoms – pitch, loudness – from day to day. This creates a great challenge to identifying and treating tinnitus.
- 80% of the patients tested mentioned that their tinnitus had a) changed over time and b) was no longer bothering them as much as it used to. This could account for possible sources of error in the pitch matching procedure.
- 40% of the patients tested also had hearing damage, which could affect their ability to hear and distinguish tonal sounds.

Ethics Statement:
All software used to create the testing procedure and tone therapy programs are licensed for UT Dallas student use. Patient testing was conducted in accordance with IRB and HIPAA standards. All patients were tested with informed consent and all personal identifying data is not linked to results.

Acknowledgements:
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