111-1 Medical Computer
Final Project
Tinnitus suppression APP for homecare

Group 7
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Outline

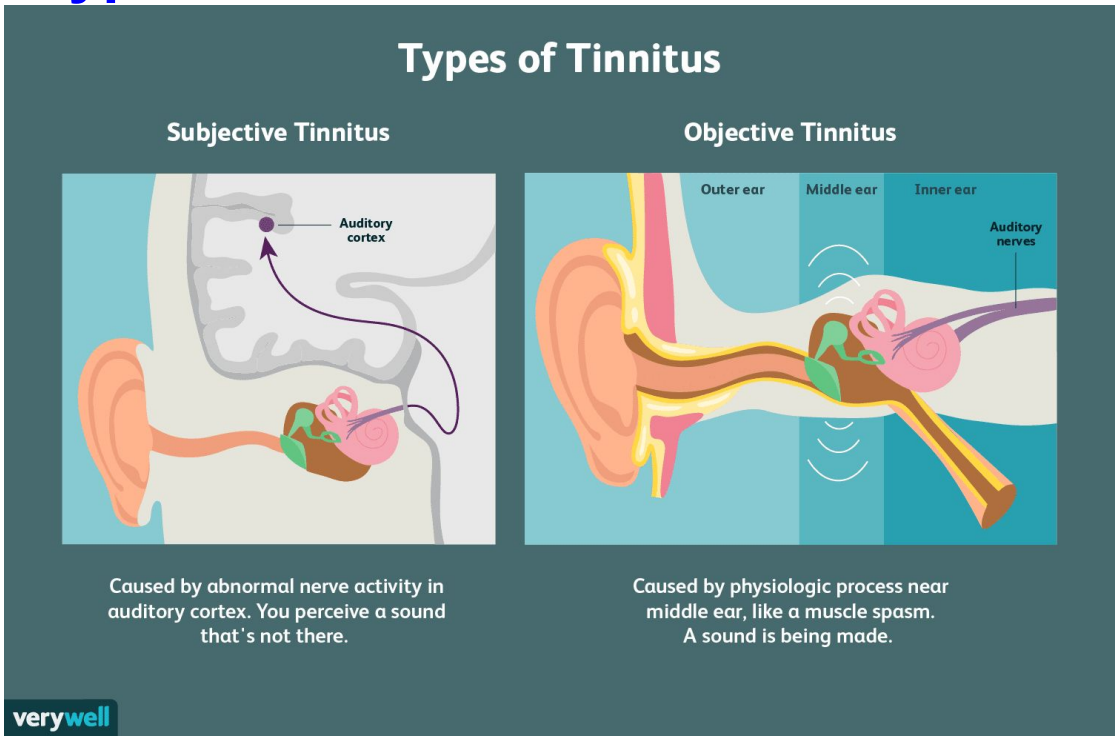
1. Disease fundamental & Existing solution & treatment theory
2. Motivation
3. Project goal
4. Process workflow
5. Illustration
6. Limitation

Disease fundamental

Tinnitus is when you experience ringing or other noises in one or both of your ears. The noise you hear when you have tinnitus isn't caused by an external sound, and other people usually can't hear it.
Tinnitus is a common problem. It affects about 15% to 20% of people, and is especially common in older adults.

Tinnitus is usually caused by an underlying condition, such as age-related hearing loss, an ear injury or a problem with the circulatory system. Tinnitus is most often described as a ringing in the ears, even though no external sound is present.

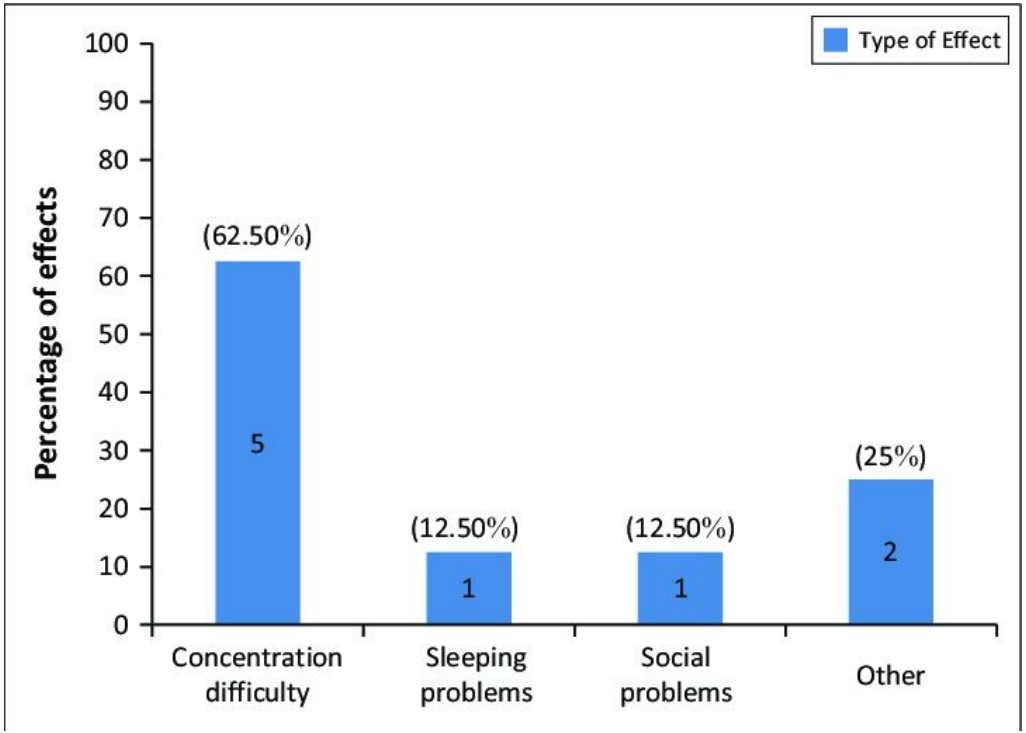
There Are Two Types of Tinnitus



- **Subjective tinnitus** is a type of ear ringing that can only be heard by the sufferer. This is the most common type of ear ringing and can be due to problems with the outer, middle, and inner ear. These are signals entering the hearing center of the brain, which the brain interprets as ringing.

- **Objective tinnitus** may also be audible to the attending physician using special equipment. This relatively rare type can be caused by problems with the blood vessels, the condition of the ear bones in the inner ear, or an involuntary contraction of the muscles

Motivation



Tinnitus impacts the patient's life in many varied ways. Some of the troubles include:

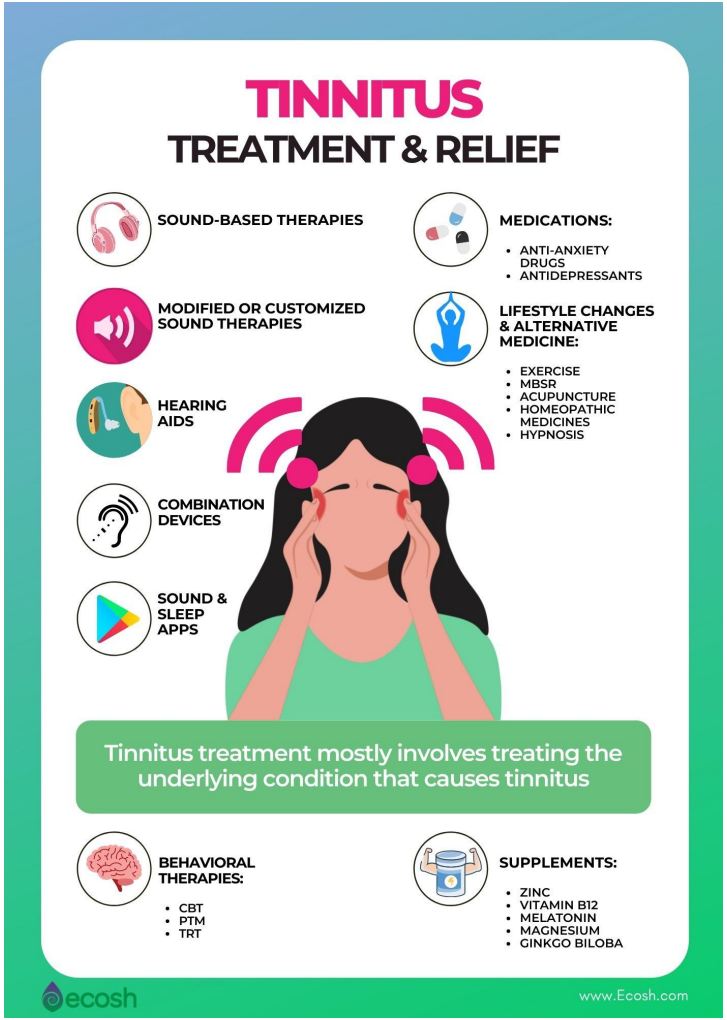
- Poor concentration,
- Difficulty in relaxation,
- Irritability,
- Discomfort in quiet,
- Sleep problems,
- Feelings of depression,
- Interference with work or social activities, and more.

Over two-thirds of our patients came in with multiple problems in these areas. Keep in mind that these patients are devastated psychologically, emotionally, and often socially. They are in bad shape when they show up at the clinic.

Bagwandin, Vedika & Joseph, Lavanithum. (2017). A survey exploring awareness and experience of tinnitus in young adults. South African Journal of Communication Disorders. 64. 10.4102/sajcd.v64i1.545

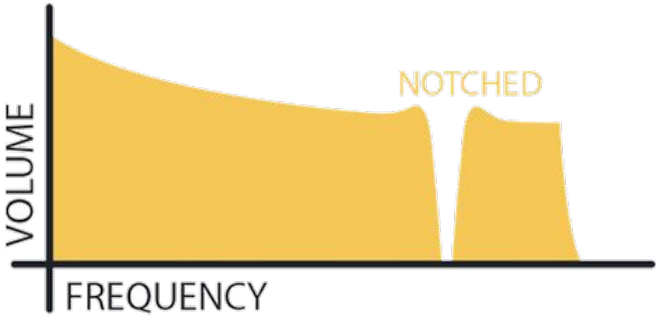
Sound Therapy

Sound therapy were introduced on the principle of distraction: that if a level of noise, usually 'white noise' is introduced it can reduce the contrast between the tinnitus signal and background activity in the auditory system, with a decrease in the patient's perception of their tinnitus.



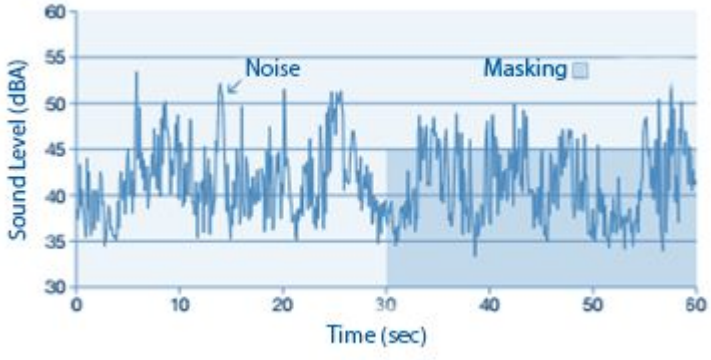
White noise with audio notching

Audio notching is accomplished by first completely removing the exact tinnitus from the sound.
When a notch white noise is played, the tinnitus is the only sound heard at that particular frequency.
When the notched sound is turn off, it tricks the brain to turning off the tinnitus as well following the theropy.
Dramatically decreases the overall intensity and loudness of the tinnitus over time.
Audio notching is a therapy technique to help prevent tinnitus comback after the white noise is turn off.



White noise without audio notching

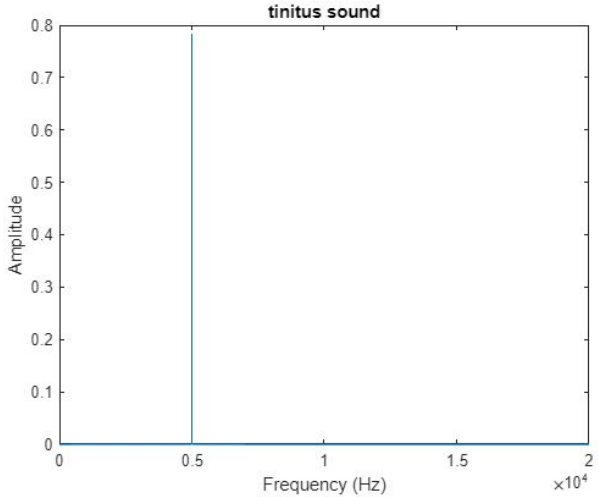
Tinnitus masking was introduced on the principle of distraction - if sound, usually 'white noise' is played it may be sufficient to distract a patient from hearing the noises produced by their tinnitus; the new sound will mask out the patient's tinnitus sounds.
Have the good result immediately.
Easy for implentation.
The tinnitus typically persists when the white noise masking is turn off.

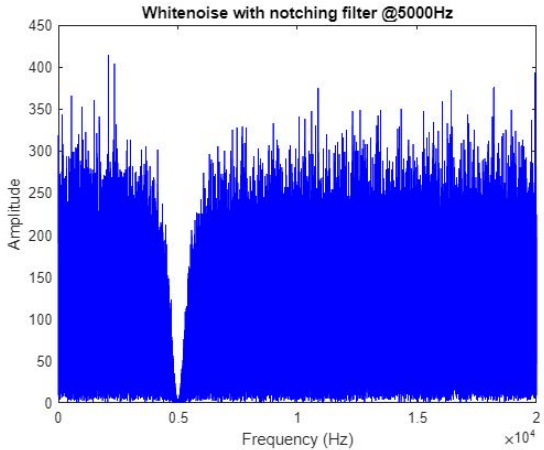


Project Goal

To design the application that can mock volume and frequency of ringing sound that patients underwent through a user interface and customize white noise sounds that resemble natural sounds by using the notching filter concept

Design Concept

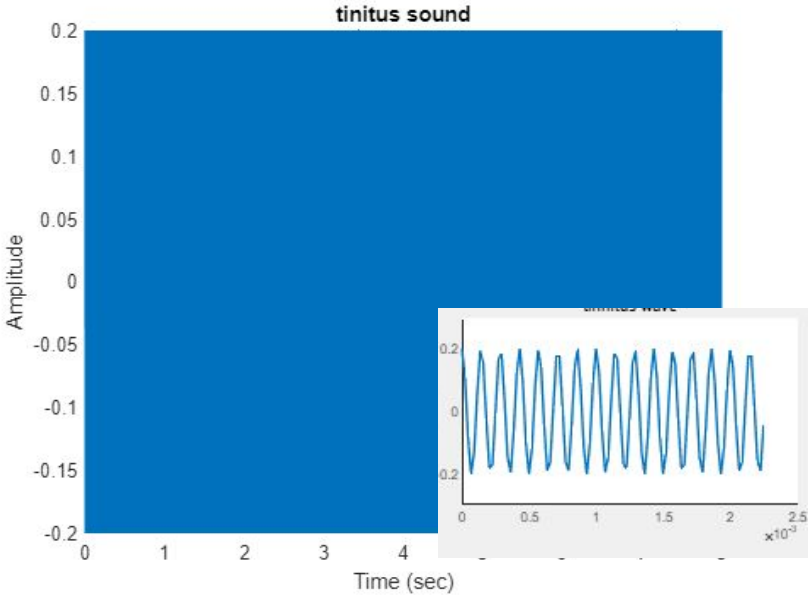


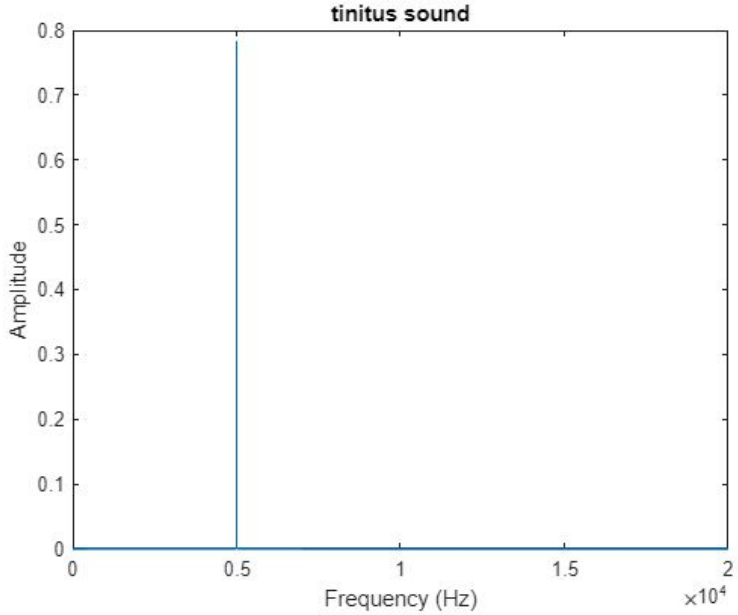


Natural sound
(Ocean sound)

Find out the most suitable whitenoise(resemble natural sound) for one specific frequency

Create Tinnitus Wave

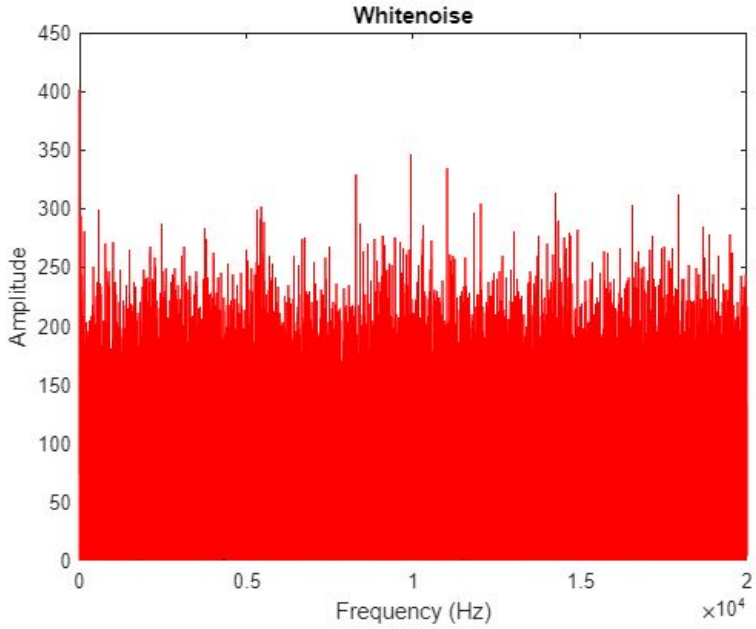


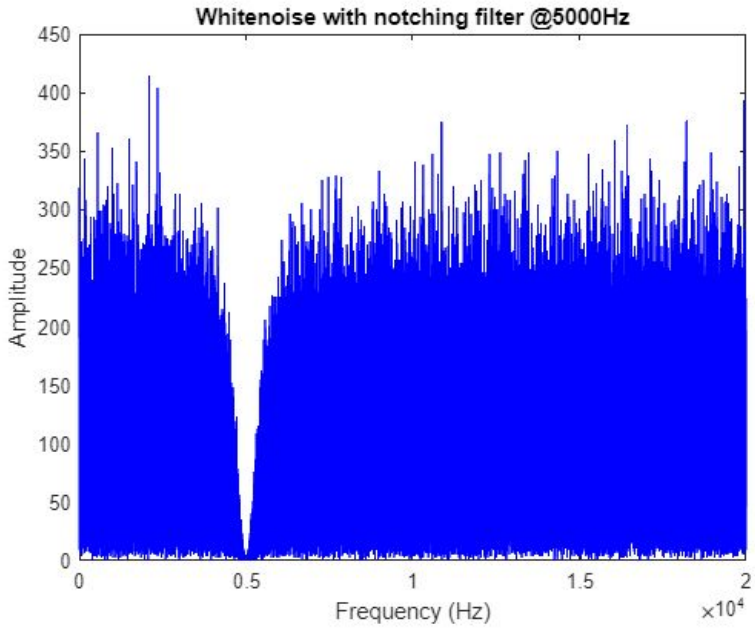


signal = cos(omega1*t)*amp;

S1=abs(fft(signal));

Create Whitenoise & Apply Notch Filter



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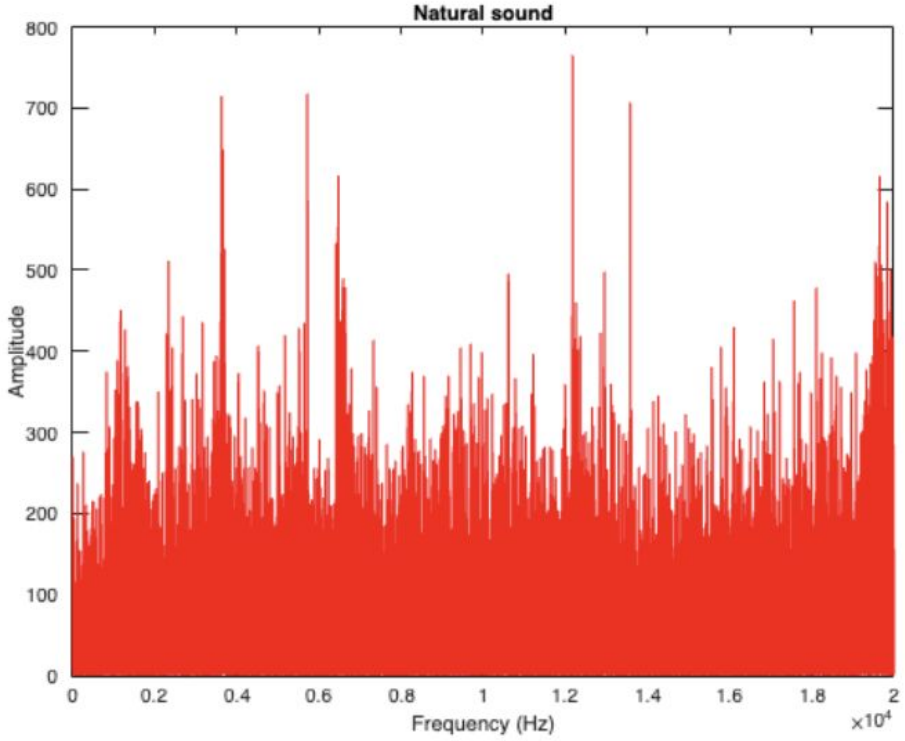
[b, a] = iirnotch(f1/(fs/2), BW/(fs/2));
New = filtfilt(b,a,whitenoise)
```

Import Free Source Natural Sound

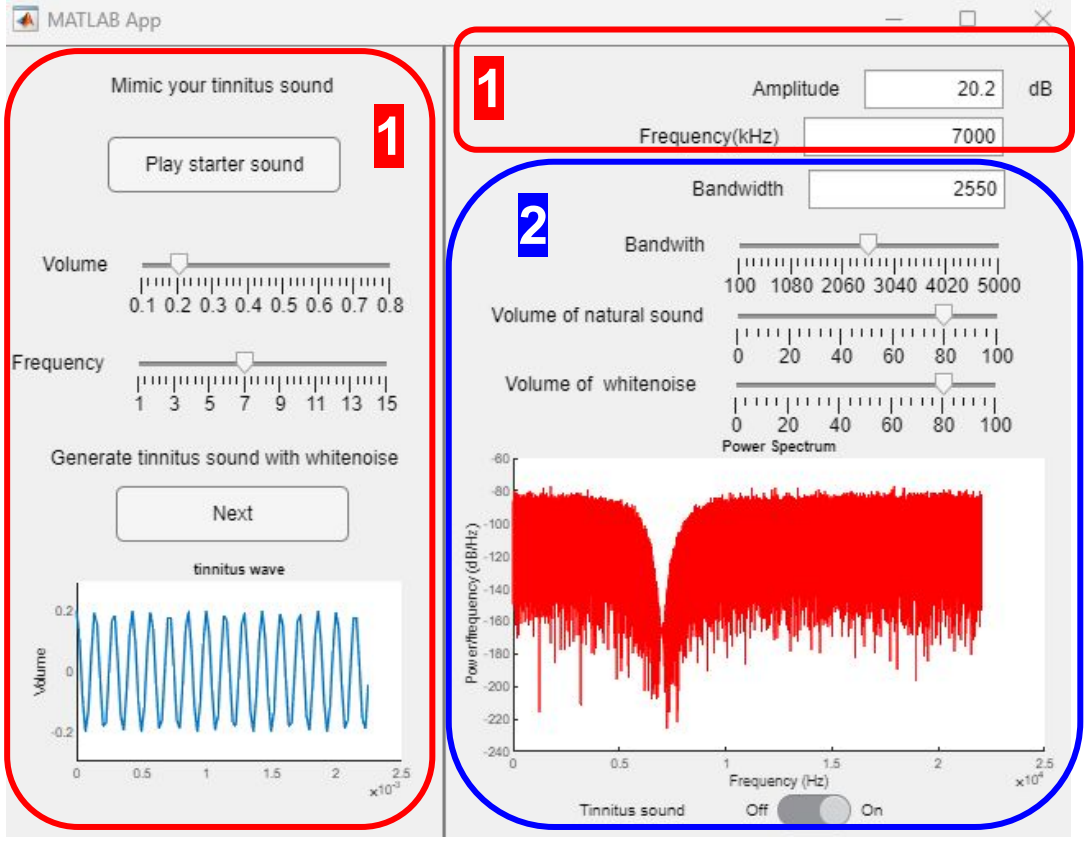


[c,Fsn]=audioread('natural sound.mp3');

Notching Filter with the same frequency as tinnitus frequency

Designing APP

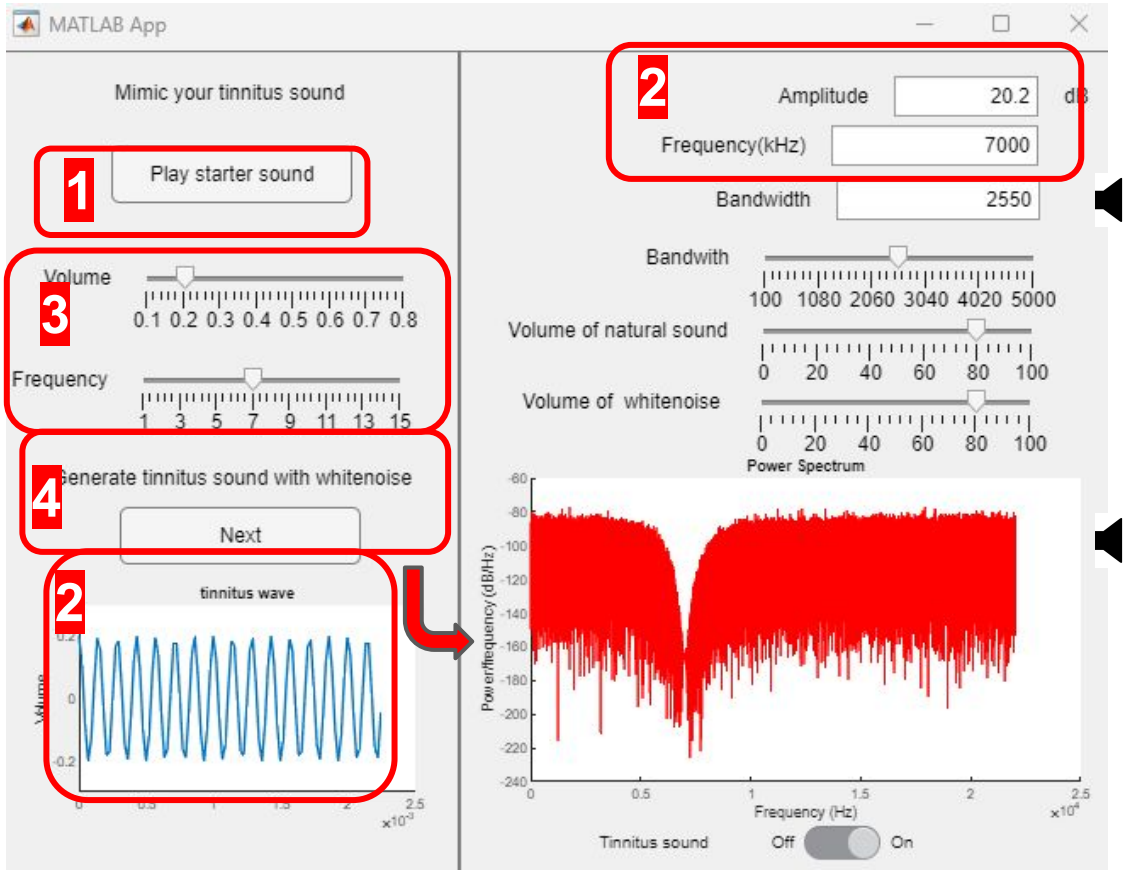
Main Components in APP



1. Mimic the tinnitus sound
   - Pitch (Amplitude) - Loudness
   - Frequency - Sharpness of voice

2. Adjust the notching filter parameter
   - Signal bandwidth
   - Volume of natural sound
   - Volume of whitenoise

APP workflow



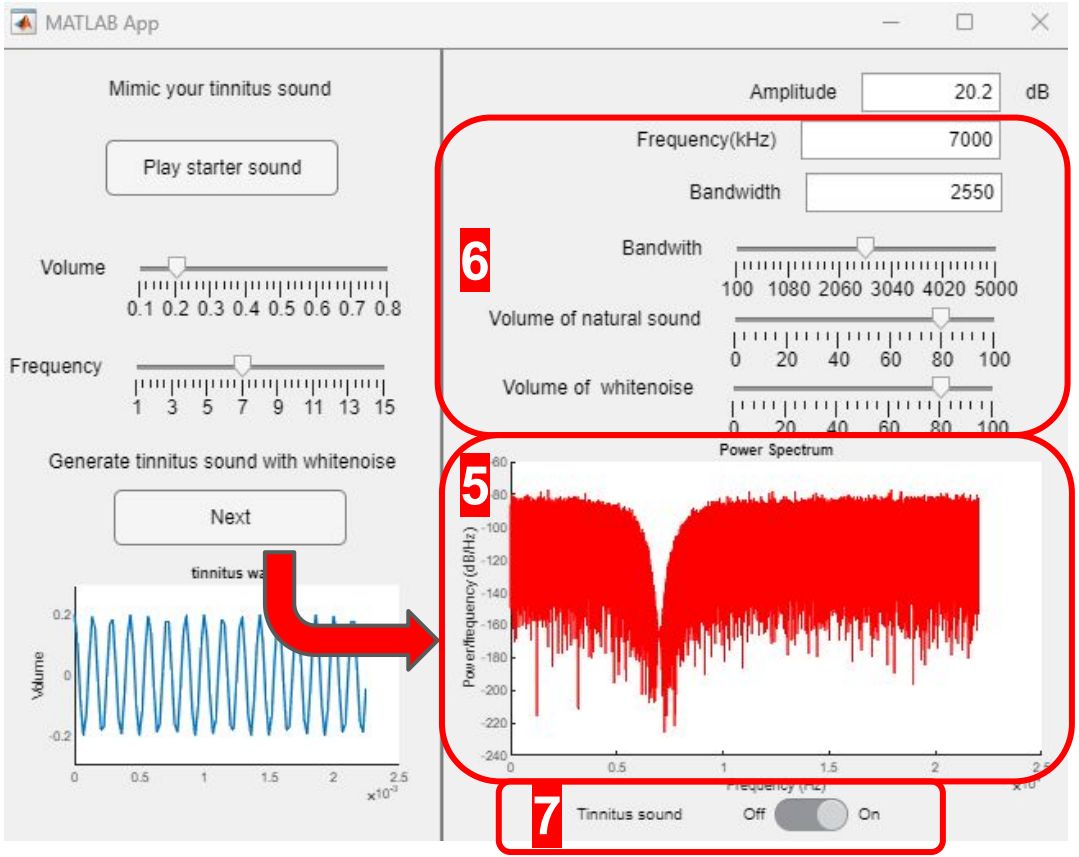
Step 1 Play tinnitus sound with preset parameter

Step 2 See the plot & current parameter of tinnitus sound

Step 3 Mimic the tinnitus sound by adjusting the pitch(amplitude/volume) and frequency

Step 4 Generate tinnitus sound with whitenoise & plot the signal

APP workflow

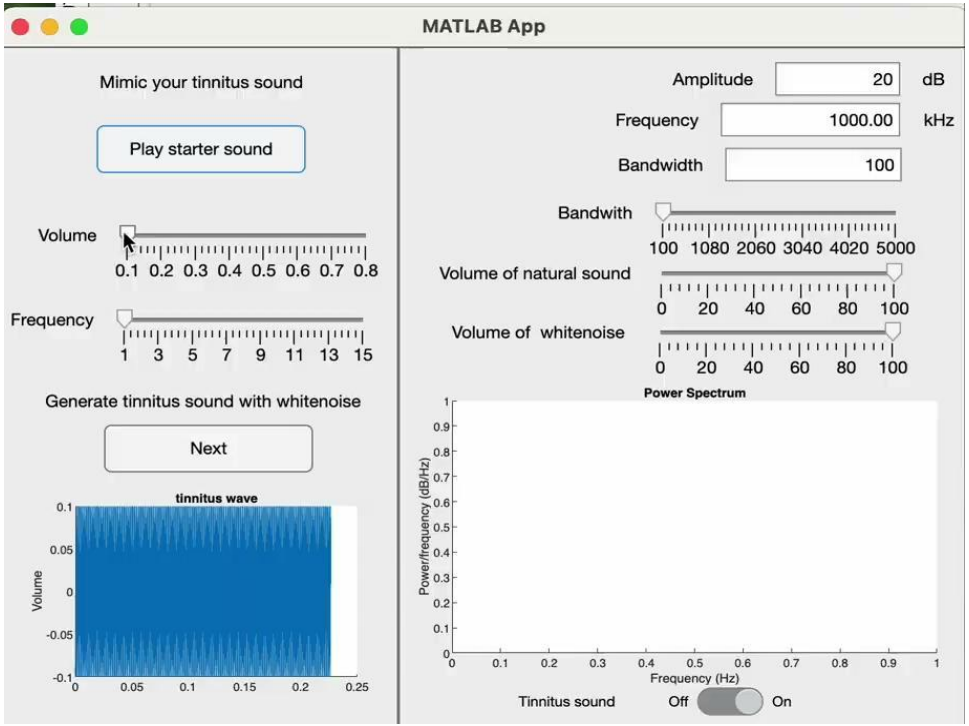


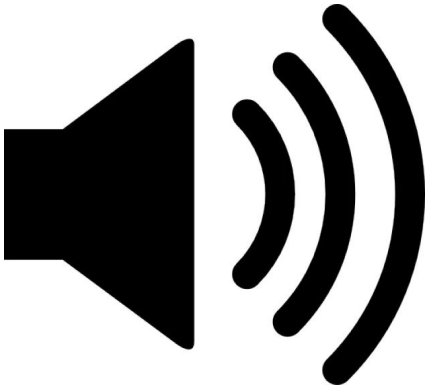
Step 5 See the current
Step 6 Optimize the notching filter parameter

- Notching bandwidth
- Volume of natural sound
- Volume of whitenoise

Step 7 Switch on/off tinnitus sound

Illustration & Results





Limitation

- Can be applied with only 1 constant frequency of tinnitus sound.
- The output sound isn’t continued play for long times we need to provide duration time.
- The project need more clinical trial to evaluate the efficency of the final product

Work Contribution

Karen : P86107207

Generate original sound

Krit : P86117202

Design filter

Kamonpan : P86107061

APP design