

# 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

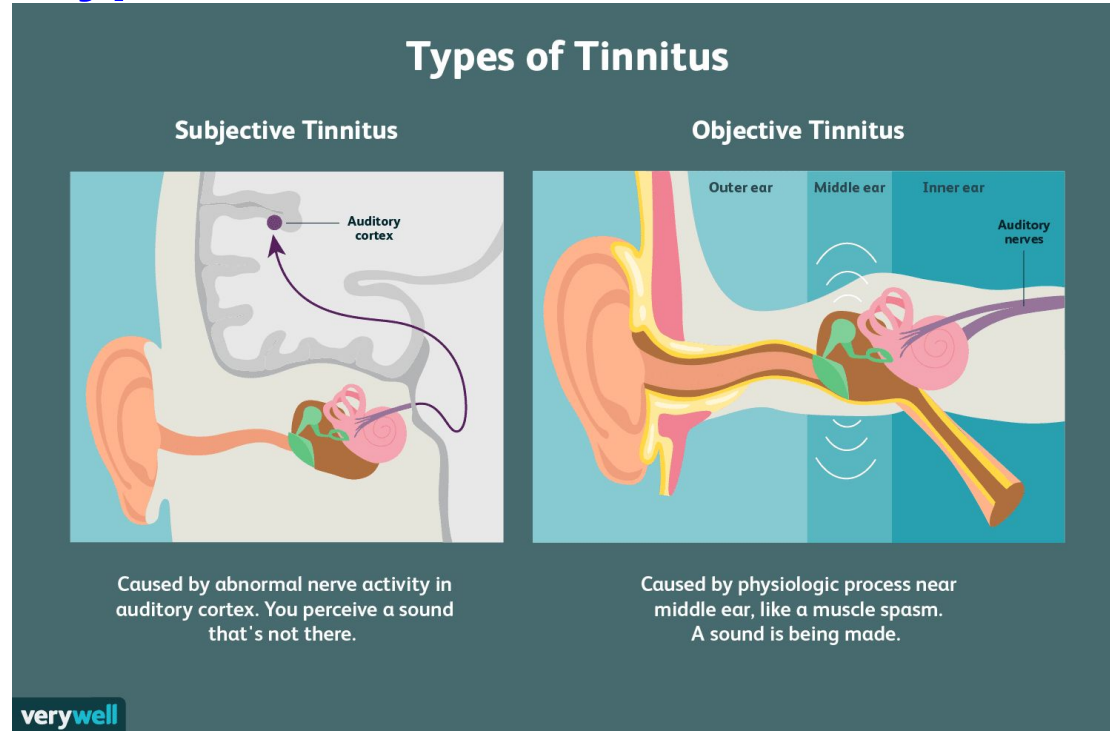
Tinnitus is when you experience ringing or other noises in one or both of your ears. The noise you hear when you have tinnitus isn't caused by an external sound, and other people usually can't hear it.

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.

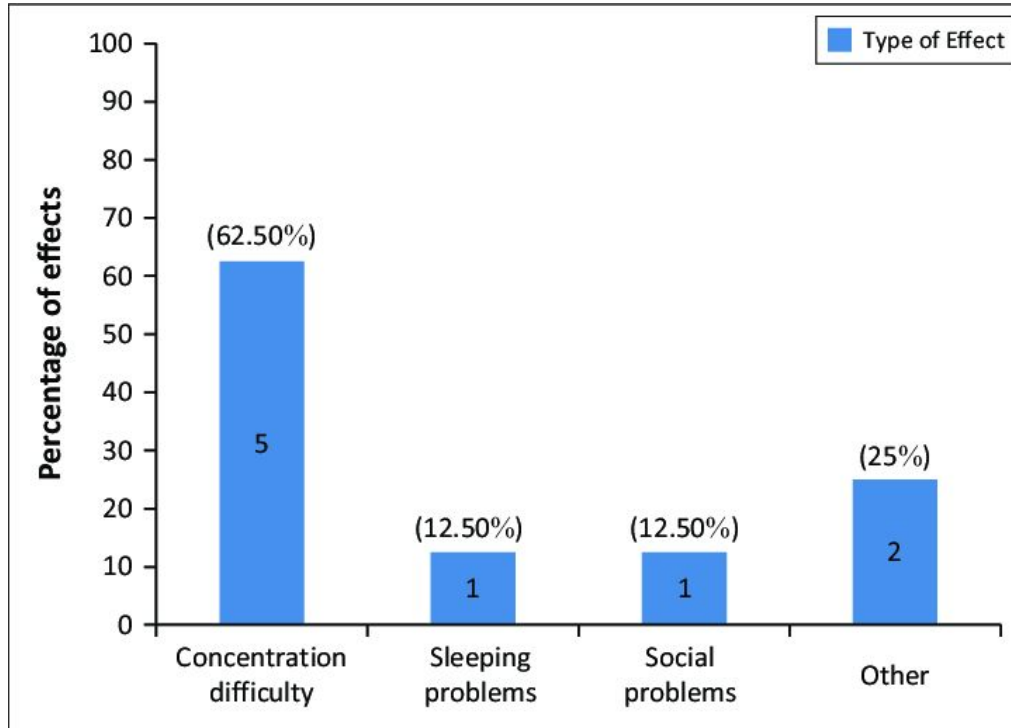


# There Are Two Types of Tinnitus



- **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.

# TINNITUS TREATMENT & RELIEF



## SOUND-BASED THERAPIES



## MODIFIED OR CUSTOMIZED SOUND THERAPIES



## HEARING AIDS



## COMBINATION DEVICES



## SOUND & SLEEP APPS



Tinnitus treatment mostly involves treating the underlying condition that causes tinnitus



## BEHAVIORAL THERAPIES:

- CBT
- PTM
- TRT



## MEDICATIONS:

- ANTI-ANXIETY  
DRUGS
- ANTIDEPRESSANTS



## LIFESTYLE CHANGES & ALTERNATIVE MEDICINE:

- EXERCISE
- MBSR
- ACUPUNCTURE
- HOMEOPATHIC  
MEDICINES
- HYPNOSIS



## SUPPLEMENTS:

- ZINC
- VITAMIN B12
- MELATONIN
- MAGNESIUM
- GINKGO BILOBA

# 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.

## THE SOUND RAINBOW

Some noises, like doors slamming or dogs barking, can interrupt rest or concentration, while other sounds can help you relax, clear your mind, and promote better sleep.

### (( WHITE NOISE ))

White noise is made up of all frequencies that are audible to the human ear. Energy is equally distributed across these frequencies, and this equal distribution creates a consistent humming sound.



### USE IT FOR

- Sound masking
- Managing tinnitus
- Increasing concentration
- Improving sleep and relaxation
- Enhancing privacy

### (( PINK NOISE ))

Pink noise consists of all frequencies that are audible to the human ear, but energy is not equally distributed across them. The energy is more intense at lower frequencies, which makes it deeper than white noise.



### USE IT FOR

- Falling asleep faster
- Staying asleep longer
- Blocking disruptive noises
- Improving memory

YOGASLEEP

### (( BROWN NOISE ))

Sometimes referred to as red noise, brown noise has higher energy at lower frequencies and is deeper and stronger than white noise. However, brown noise and white noise sound similar to the human ear.



### USE IT FOR

- Relaxation
- As a sleep aid
- Noise-blocking
- Improved focus

## White noise **with** audio notching

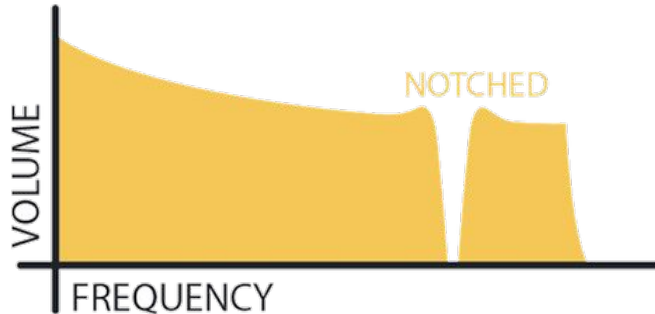
Audio notching is accomplished by first completely removing the exact tinnitus from the sound.

When a notch white noise is played, the tinnitus is the only sound heard at that particular frequency.

When the notched sound is turned off, it tricks the brain into turning off the tinnitus as well following the therapy.

Dramatically decreases the overall intensity and loudness of the tinnitus over time.

Audio notching is a therapy technique to help prevent tinnitus coming back after the white noise is turned off.



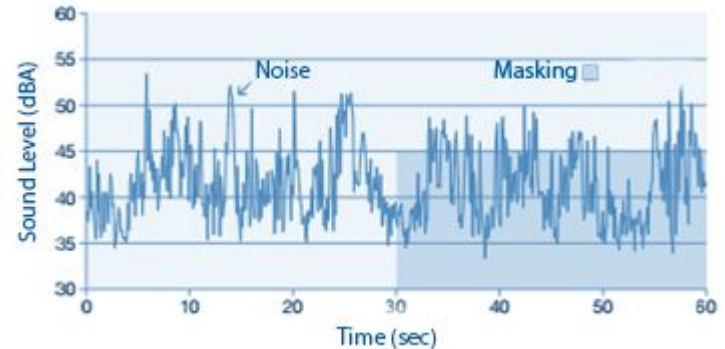
## White noise **without** audio notching

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 implementation.

The tinnitus typically persists when the white noise masking is turned off.

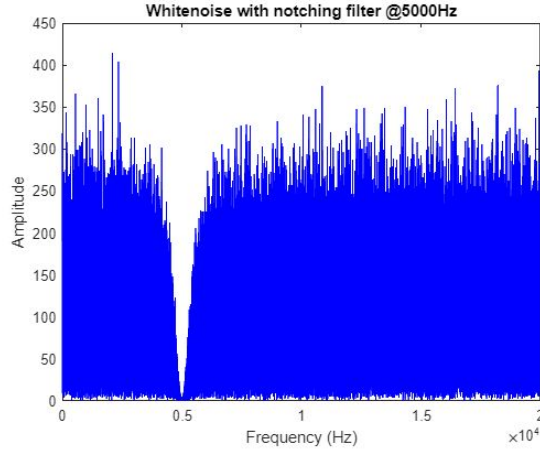
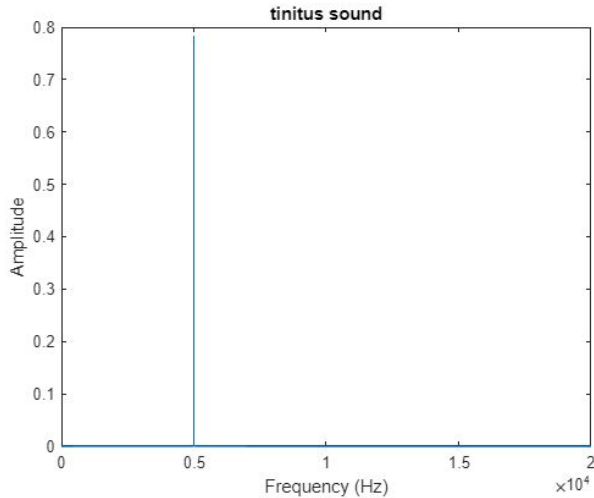


## Project Goal

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



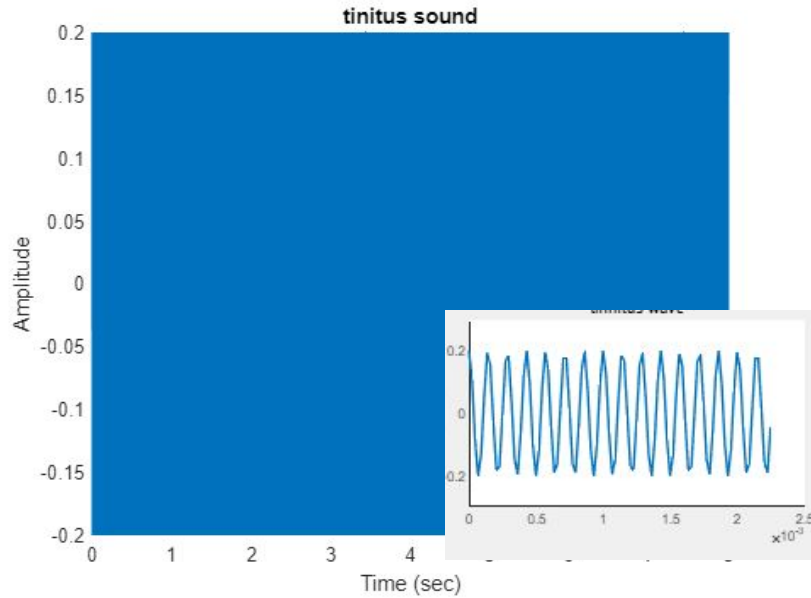
# Design Concept



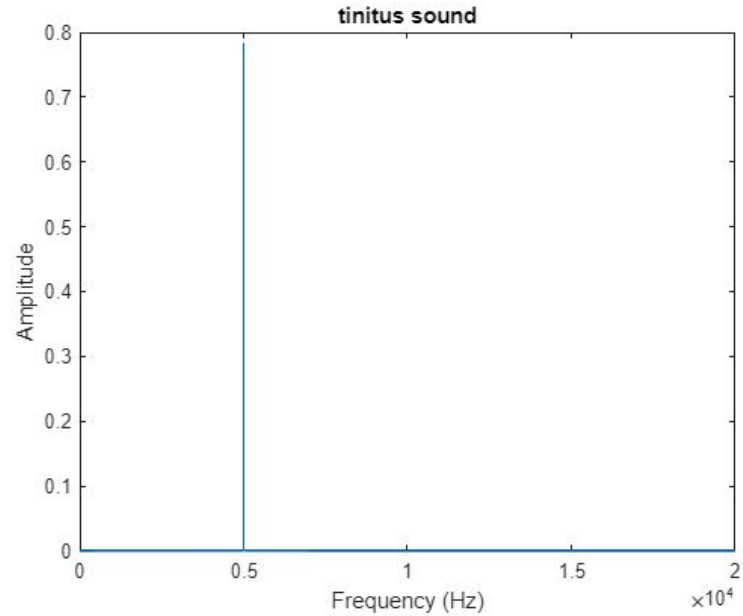
Natural sound  
(Ocean sound)

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

# Create Tinnitus Wave

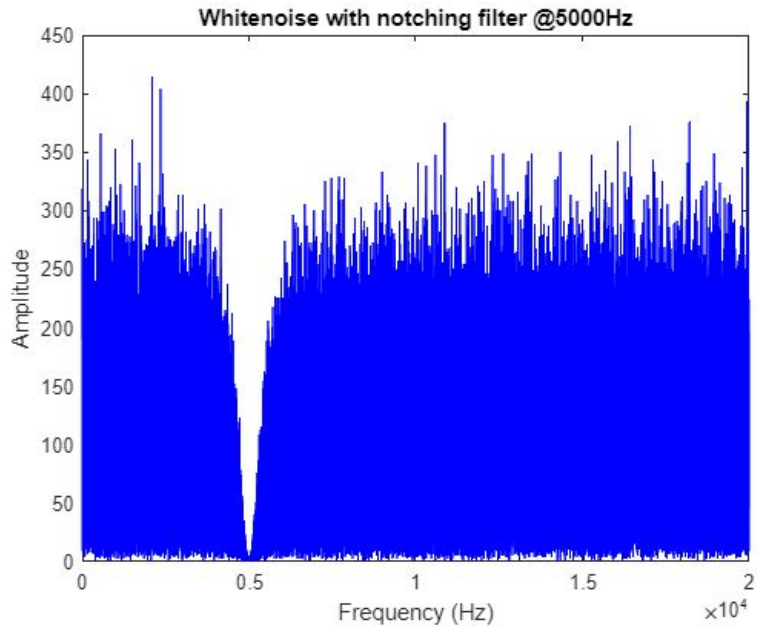
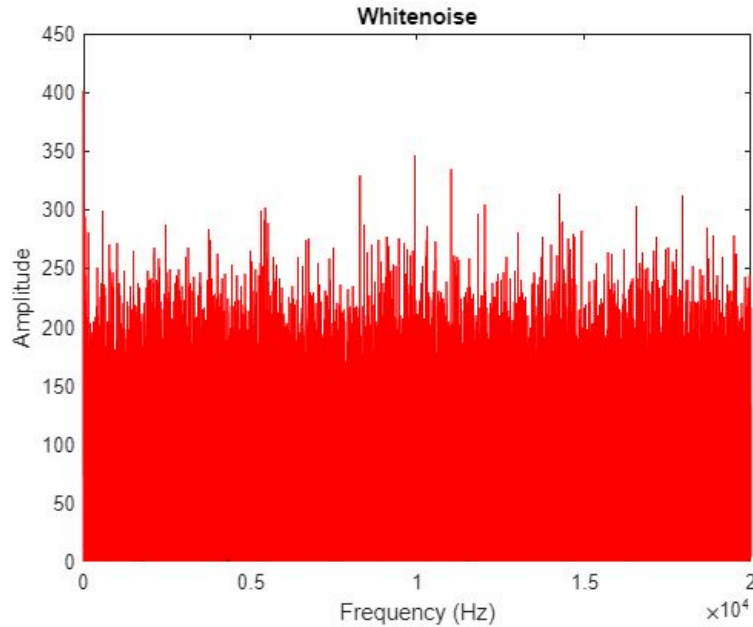


`signal = cos(omega1*t)*amp;`



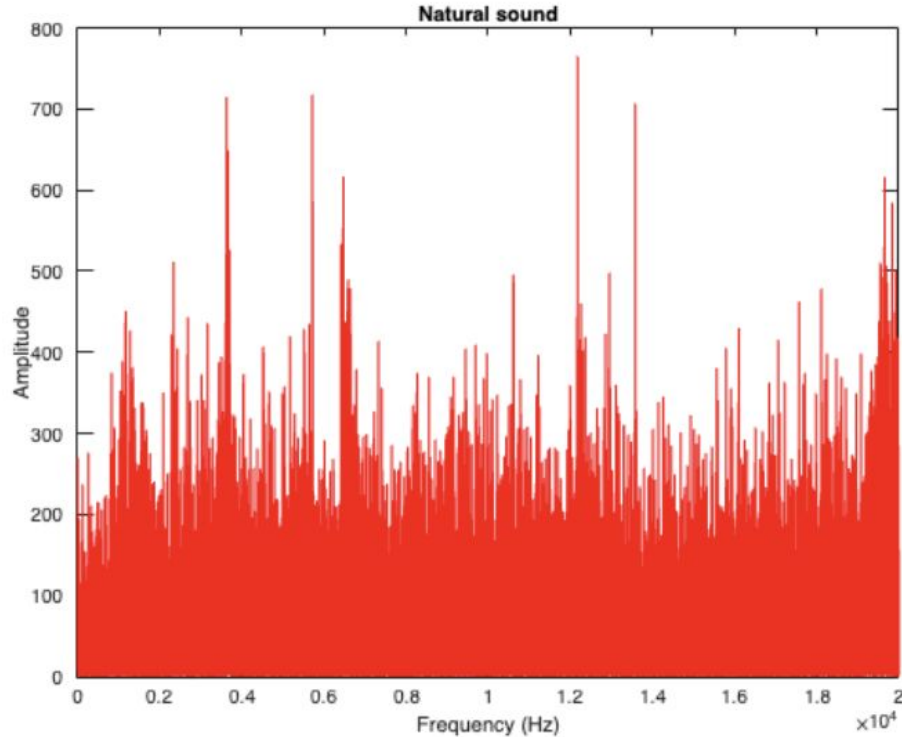
`S1=abs(fft(signal));`

# Create Whitenoise & Apply Notch Filter

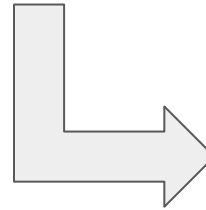


```
[b, a] = iirnotch(f1/(fs/2), BW/(fs/2));  
New = filtfilt(b,a,whitenoise)
```

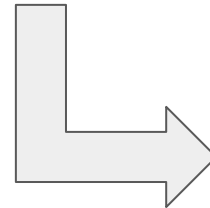
# Import Free Source Natural Sound



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

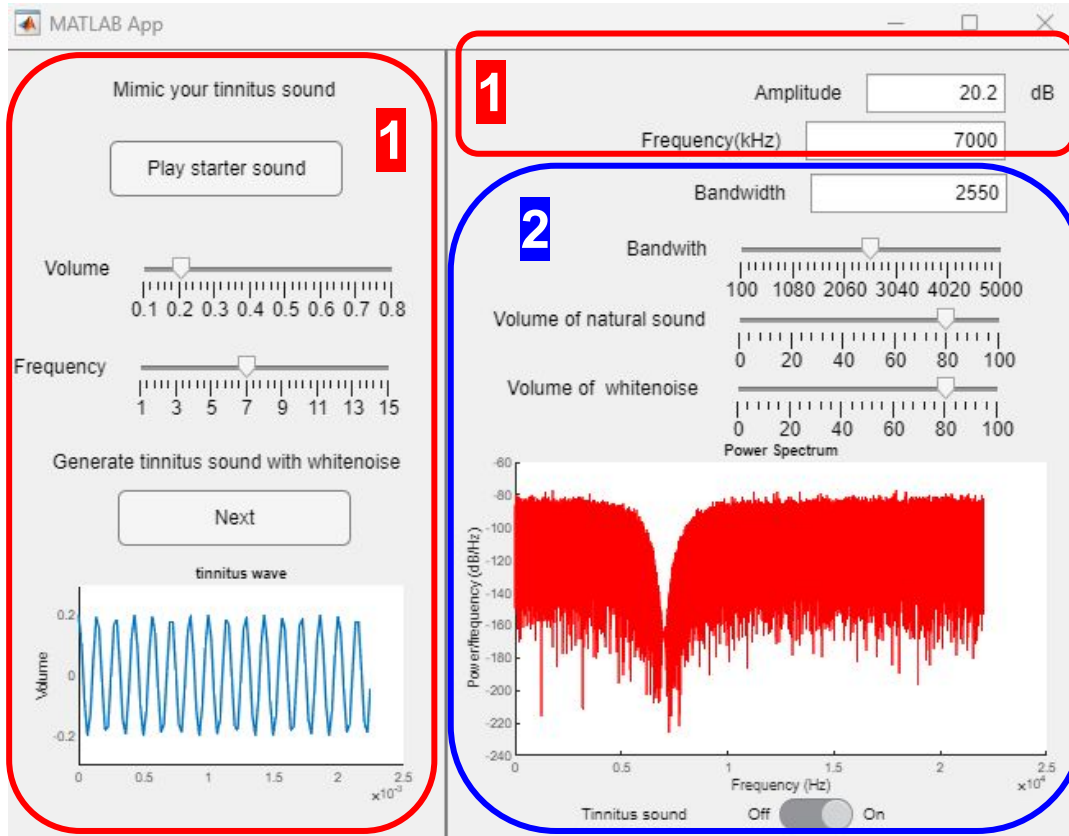


Notching Filter with  
the same frequency  
as tinnitus frequency



Designing APP

# Main Components in APP



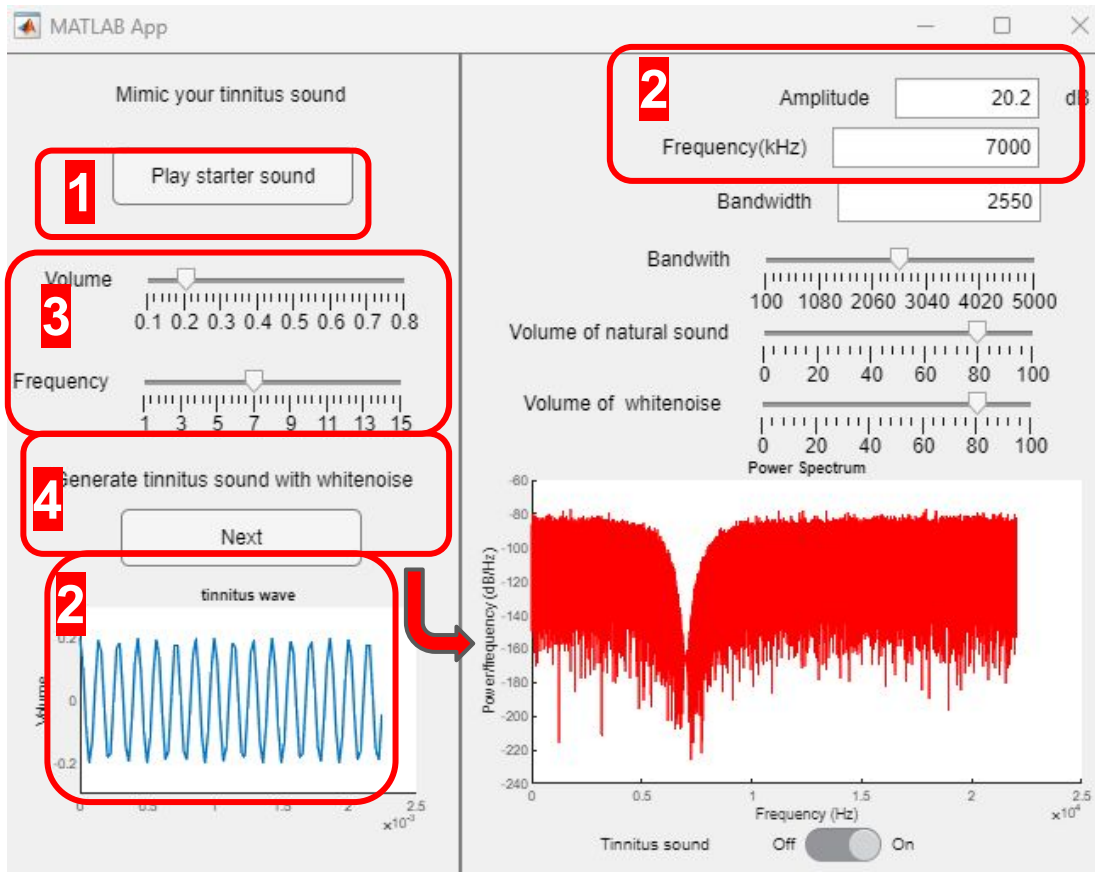
1. Mimic the tinnitus sound

- Pitch (Amplitude) - Loudness
- Frequency - Sharpness of voice

2. Adjust the notching filter parameter

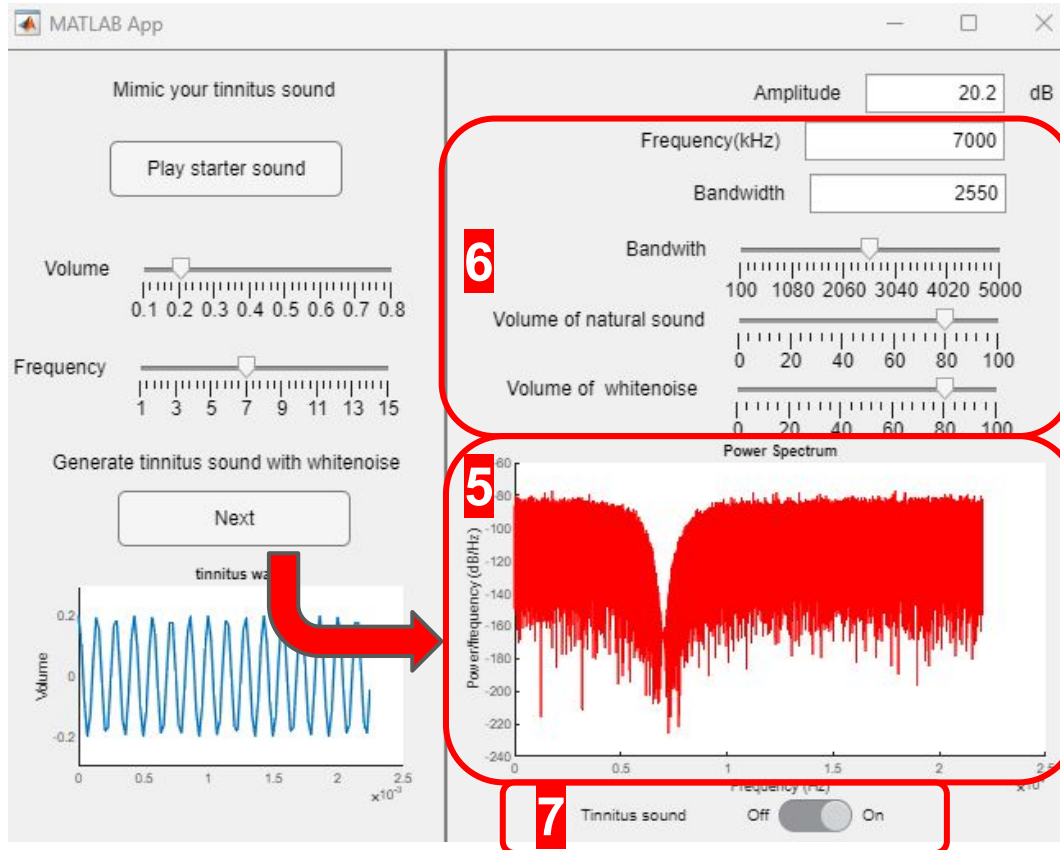
- Signal bandwidth
- Volume of natural sound
- Volume of whitenoise

# 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



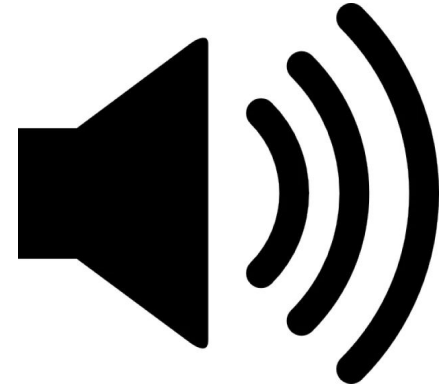
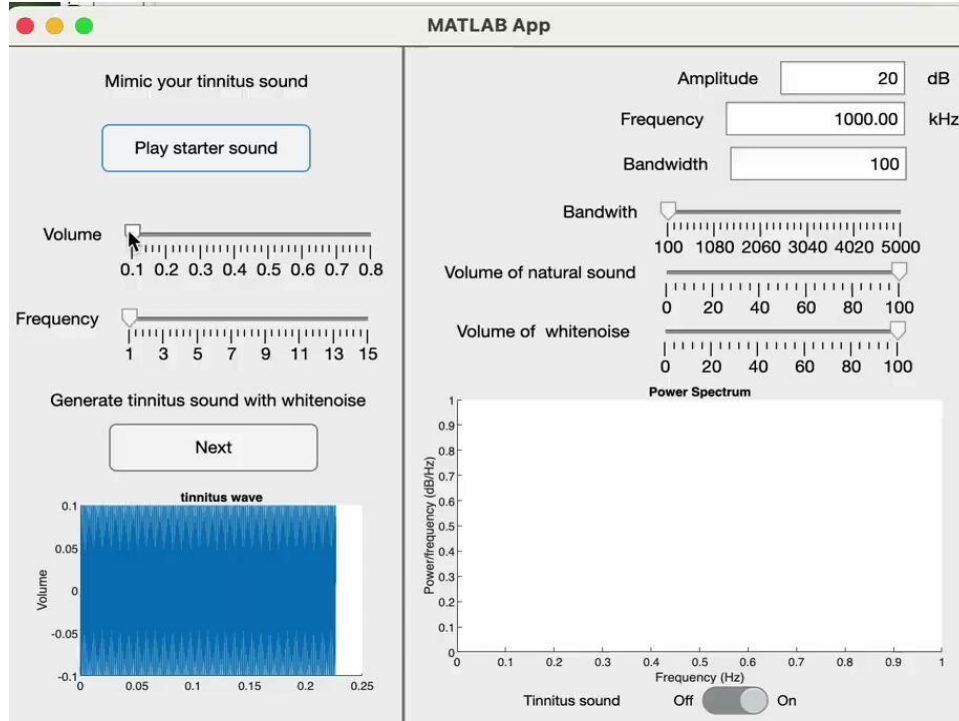
**Step 5** See the current

**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 efficiency of the final product

# Work Contribution



Karen : P86107207

Generate original  
sound



Krit : P86117202

Design filter



Kamonpan : P86107061

APP design