PRESIDENCY UNIVERSITY

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School of Engineering

AProjectReporton

"Ear Electronic Device For Tinnitus Frequency Finding and Adjusting to Provide Relief To Tinnitus Suffering Patient"

Submitted in partial fulfillment of the requirement for the course

Innovative Projectusing Raspberry Pi (**ECE2011**)

Submitted by

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Abstract

The ear electronic device designed for tinnitus frequency finding and adjusting aims to alleviate the discomfort experienced by tinnitus sufferers. Tinnitus, characterized by persistent ringing or buzzing in the ears, can significantly impact quality of life. This innovative device functions by identifying the specific frequency of the tinnitus noise unique to each patient. Once the frequency is determined, the device can adjust and emit counteracting sound waves to neutralize or mask the tinnitus, providing relief. By tailoring the therapy to the individual's precise tinnitus frequency, the device offers a personalized approach to treatment. This method not only helps in reducing the perceived intensity of tinnitus but also enhances overall auditory health and comfort for patients.

Introduction

Tinnitus, often described as a persistent ringing, buzzing, or hissing sound in the ears, affects millions of people worldwide. This condition, which can range from mildly annoying to severely debilitating, significantly impacts the quality of life of those who suffer from it. The underlying causes of tinnitus are diverse, including exposure to loud noises, ear infections, hearing loss, and certain medications. Despite its prevalence, effective treatment options have been limited, leading to ongoing discomfort and frustration for many patients.

In response to this pervasive issue, advancements in audiology have led to the development of innovative solutions aimed at providing relief to tinnitus sufferers. One such breakthrough is the ear electronic device designed specifically for tinnitus frequency finding and adjusting. This cutting-edge technology offers a personalized approach to tinnitus management, leveraging sophisticated mechanisms to identify and counteract the specific frequencies causing distress.

The primary function of this device is to determine the exact frequency of the tinnitus sound unique to each individual. Tinnitus is not a one-size-fits-all condition; the perceived noise varies greatly among patients. By pinpointing the specific frequency, the device can tailor its response to effectively address the unique auditory profile of each user. Once the frequency is identified, the device emits counteracting sound waves that neutralize or mask the tinnitus noise. This process, known as sound therapy or sound masking, can significantly reduce the perceived intensity of tinnitus, offering substantial relief.

Moreover, the device often incorporates advanced features such as active noise cancellation and various sound therapy options. These enhancements further improve the efficacy of tinnitus management by creating a soothing auditory environment that can help distract the brain from the tinnitus noise. Many of these devices are designed to be user-friendly, allowing patients to adjust settings easily through a smartphone app or a simple interface, making them accessible to a wide range of users.

Clinical trials and user testimonials have demonstrated the potential of these devices to improve the lives of tinnitus sufferers. Patients have reported significant reductions in the loudness and intrusiveness of their tinnitus, leading to better sleep, reduced stress, and an overall improvement in well-being. The personalized nature of the treatment ensures that each user receives a solution tailored to their specific needs, enhancing the effectiveness of the therapy.

Related Work

1. **Sound Therapy and Masking Devices**: Sound therapy is a common approach for managing tinnitus, involving the use of external noise to alter the perception of or mask the tinnitus sound. Traditional sound therapy devices include white noise machines, hearing aids with built-in masking features, and specialized tinnitus maskers. Research in this area explores the efficacy of different types of sounds—such as white noise, pink noise, nature sounds, and music—in providing relief from tinnitus symptoms.

2. **Neuromodulation Techniques**: Neuromodulation involves using electrical or magnetic stimulation to alter neural activity. Techniques such as Transcranial Magnetic Stimulation (TMS) and Transcutaneous Electrical Nerve Stimulation (TENS) have been investigated for their potential to alleviate tinnitus by modulating the neural circuits involved in the condition. Studies have shown mixed results, with ongoing research aimed at optimizing these approaches.

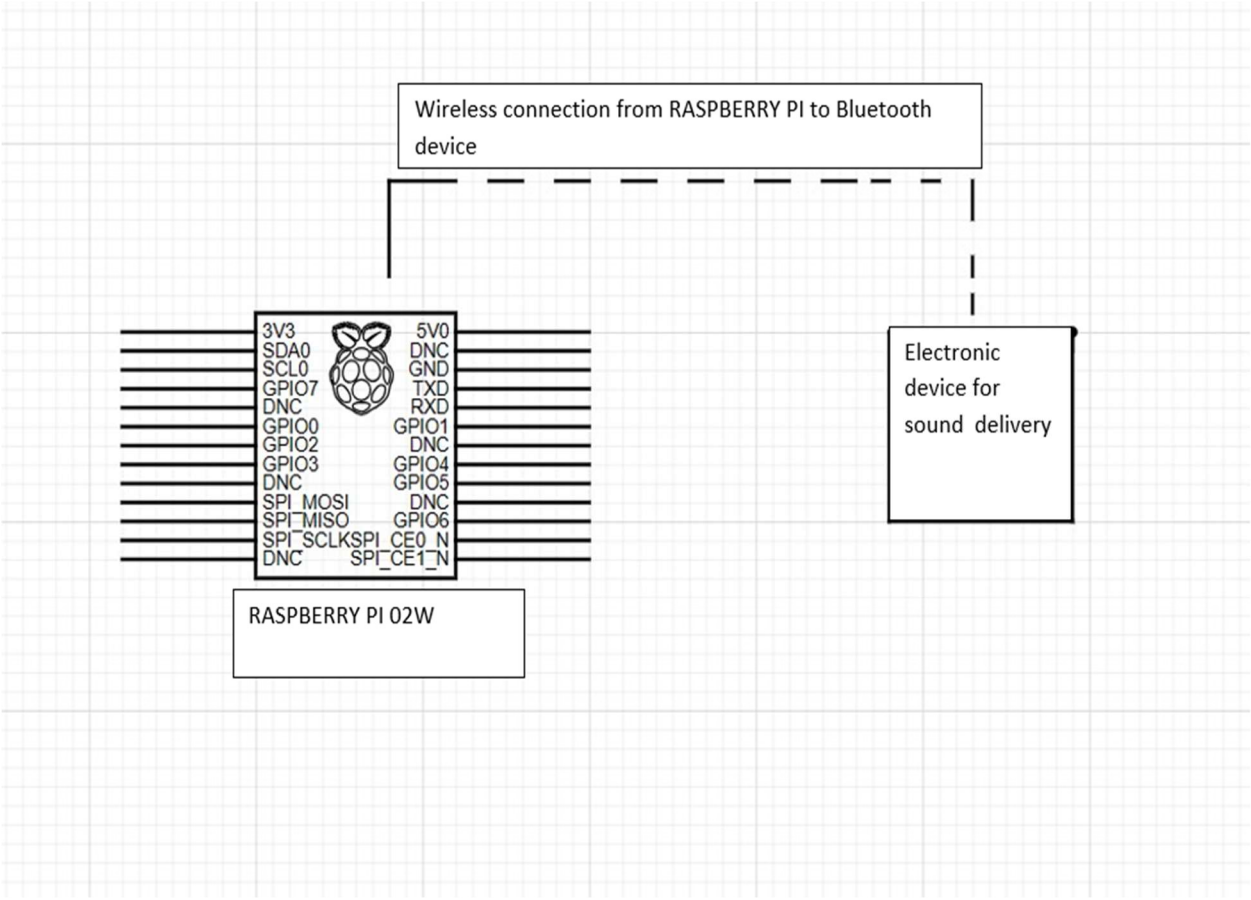
3. **Cognitive Behavioral Therapy (CBT)**: CBT is a psychological treatment that helps patients manage tinnitus by changing the way they think and react to the sound. CBT does not reduce the tinnitus sound itself but helps reduce the distress and negative impact associated with it. Numerous clinical trials have demonstrated the effectiveness of CBT in improving the quality of life for tinnitus sufferers.

4. **Auditory Habituation Therapies**: Tinnitus Retraining Therapy (TRT) is based on the concept of auditory habituation. It combines sound therapy with directive counseling to help patients habituate to the tinnitus sound, reducing its perceived intensity and intrusiveness over time. Research has shown that TRT can be effective, particularly when tailored to individual patient needs.

5. **Pharmacological Treatments**: Various medications have been explored for tinnitus treatment, including antidepressants, anticonvulsants, and anxiolytics. While no drug has been specifically approved for tinnitus, some have shown promise in reducing symptoms for certain patients. Ongoing research is focused on identifying new drug targets and developing more effective pharmacological interventions.

6. **Hearing Aids with Tinnitus Features**: Many modern hearing aids come equipped with tinnitus management features, including sound generators that provide masking sounds and amplification that helps reduce the contrast between tinnitus and ambient sounds. Studies have shown that hearing aids can be beneficial for patients with hearing loss and tinnitus by improving overall hearing and reducing tinnitus perception.

Implementation

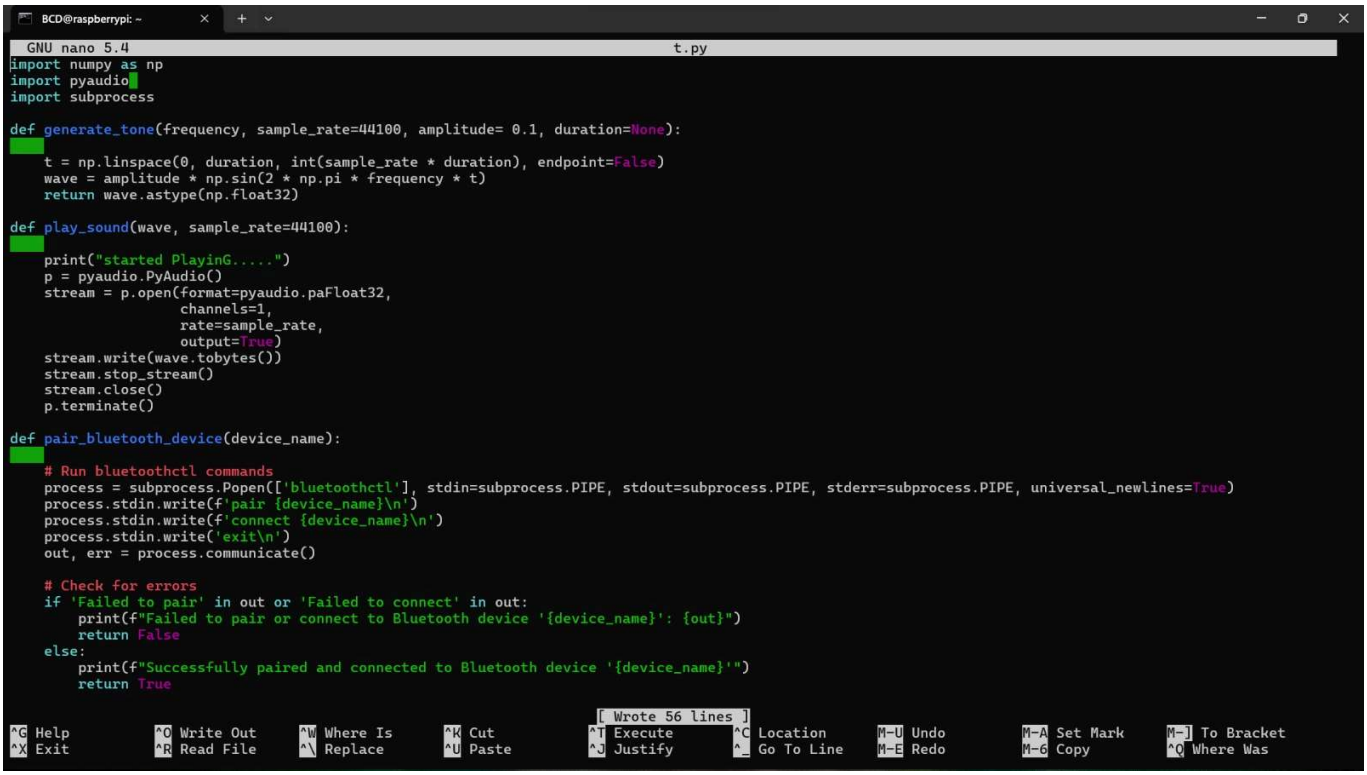


•We have established a configuration of the Raspberry pi along with its coding environment.

•We have established an connection to the raspberry pi to ear electronic device to processing tinnitus relief sounds to generate output.

•We have used code to generate soothing sounds to provide relief to the tinnitus suffering patient with the help of ear electronic device.

•We have analyzed some reports from National Institute of Hearing , British Tinnitus Association , Tinnitus and Hyperacusis Centre London UK , American Tinnitus Association.

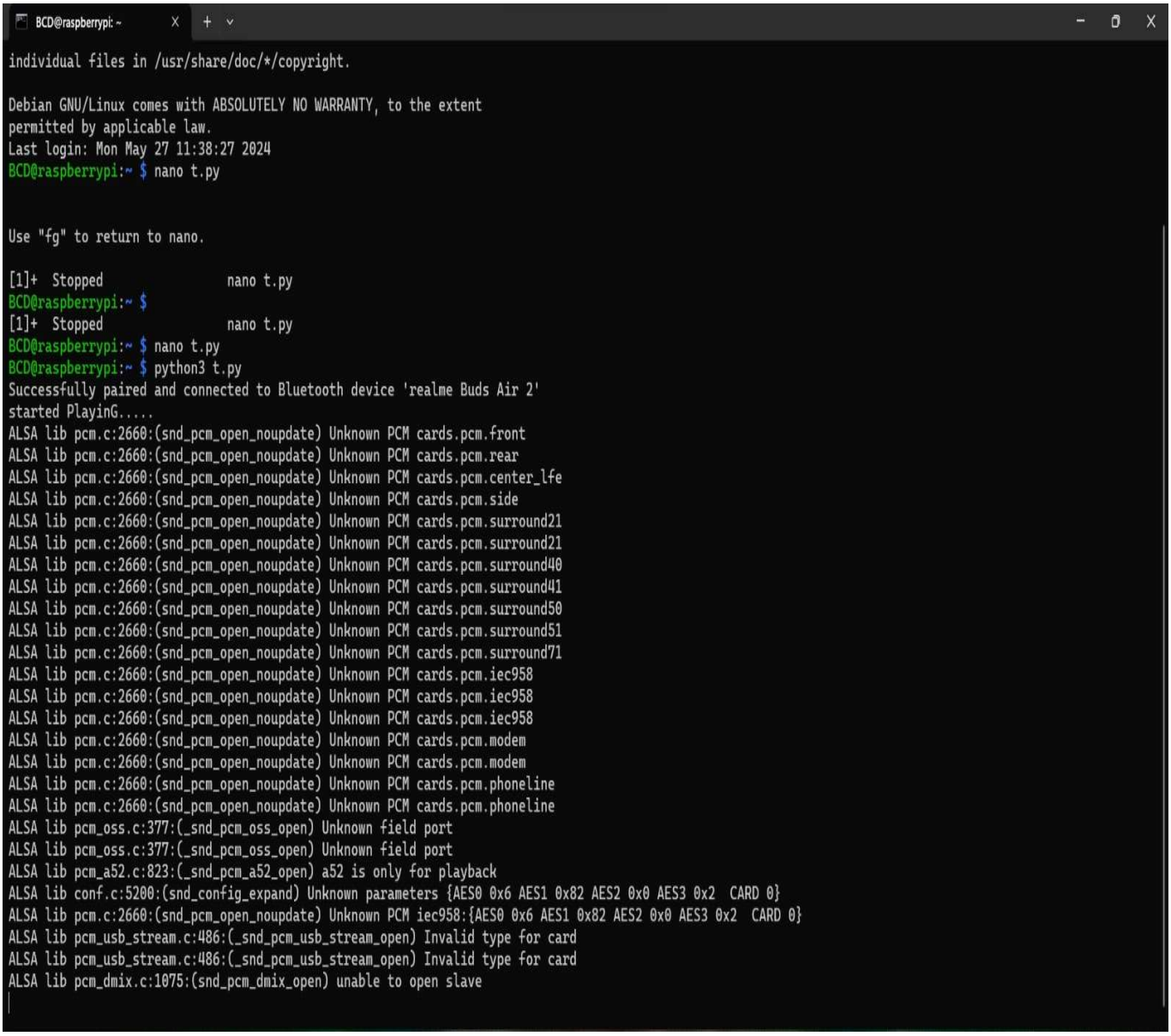



```python
def main():
    frequency = 1000  # Replace with the specific tinnitus frequency in Hz
    duration = 30      # Duration of the tone in seconds
    amplitude = 0.1    # Set the volume level (0.0 to 1.0)
    bluetooth_device_name = "realme Buds Air 2"  # Replace with your Bluetooth device name

    # Pair and connect to the Bluetooth device
    if pair_bluetooth_device(bluetooth_device_name):
        # Generate the tone
        tone = generate_tone(frequency,duration=duration,amplitude=amplitude)

        # Play the tone
        play_sound(tone)

if __name__ == "__main__":
    main()
```



Key Points:

Bluetooth Pairing Commands: Added essential commands to ensure the Bluetooth device is powered on and the agent is set.
Sound Generation and Playback: Ensures the tone is correctly generated and played.
Main Function: Combines Bluetooth pairing, tone generation, and playback.
Ensure Bluetooth Device Address: Make sure bluetooth_device_name is correctly set to match your device's name. If using the device's MAC address instead, modify the name appropriately.

This script should connect to your Bluetooth earbuds, generate the tinnitus neutralizing tone, and play it through the connected Bluetooth device.

System Requirements & Specification

Hardware used:

1. RASPBERRY PI 02 W
2. REALME BUDS AIR 2 (BLUETOOTH) as ear electronic device for sound delivery.

Software used:

1. Raspberry Pi OS (Legacy,32-bit):
2. A port of Debian Bullseye with security updates and desktop environment

Libraries Used:

1. **Pybluez** - Used for Bluetooth connection , Bluetoothctl tool.
2. **Scipy (Scientific python)** – Used for numerical integration optimization , statistics and more.
3. **Numpy (Numerical python)** – Used for mathematical functions for numerical algebra , fourier transform and random number generation technique.
4. **Subprocess** – It is a part of python standard library it interacts with standard input (stdin), standard output (stdout) and returns code of these sub processes.
5. **Pyaudio** – It enables real time audio input and output , it is specifically used for audio streaming such as voicechat , audio synthesis and real time audio effects.
6. **BlueALSA** – It is a linux daemon that provides applications with access to Bluetooth audio streams using the Bluetooth A2DP , HFP and HSP profiles.

   Components:

   Daemon: The core component is the bluealsa daemon, which registers all known Bluetooth audio profiles in BlueZ. It enables audio streaming from/to Bluetooth devices.

   ALSA Plug-ins: BlueALSA includes ALSA plug-ins that hide D-Bus specifics and allow applications to use ALSA PCM and mixer interfaces. Existing ALSA applications can access Bluetooth audio devices through these plug-ins.

   Utilities: BlueALSA provides various utilities for managing Bluetooth audio

Results:

•We have established a configuration of the Rasberry pi along with its coding environment.

•We are working on connecting the rasberry pi to ear electronic device to take audio input and signal processing part to generate output.

•This is just a model , We are still researching about this project as it is a new concept for us our team are trying to solve it.

• By using this device we can make sure that the person who is suffering from tinnitus will get temporary relief by using this device

• As the person who suffers from this condition requires a frequency of 1000hz to 3000hz this device can make sure that the patient gets adjusted to the frequency and adaptto these habits.

• These specialized electronic devices emit soothing sounds, effectively masking or covering up the perceived tinnitus noises.

• They offer a variety of sound options, ranging from white noise, nature sounds, or customized tones to match an individual's preference.

• The ultimate goal is to achieve habituation, not only in regard to the perception of tinnitus but, more importantly, to the emotional response associated with tinnitus.

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