

Binaural Beats Therapy using EEG

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Abstract

Auditory beat stimulation may be a promising new tool for the manipulation of cognitive processes and the modulation of mood states. Binaural beats therapy is an emerging form of soundwave therapy in which the binaural auditory beat that a person hears is the difference in frequency between the left and the right ear and should be at frequencies lower than 1000 hertz (Hz) for the brain to detect the binaural beat. As the brain tries to synchronize itself with the binaural beat frequency. For example, if the left ear registers a tone at 200 Hz and the right at 210 Hz, the binaural beat heard is the difference between the two frequencies — 10 Hz. Electroencephalogram (EEG) is used to detect the brain waves and is interfaced with a microcontroller which processes the signals and send the data to a smartphone and it will select the appropriate binaural beats (audio) and transmit the audio to the auditory device.

Keywords

Binaural beats—Arduino—EEG

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1. Introduction

As we know mental health of people of all age group is affected due to problems such as stress, anxiety, depression which leads too low confidence, low focus, distraction and other problems. This is getting more intense nowadays as stated in THE ECONOMICS TIME 89 per cent of India's population is suffering from stress and many of which are not comfortable talking to medical professionals. The solution we came up to counter this problem is to introduce a system that uses electrodes to track the brain signals and determine the persons mental health. These signals will help an AI based application to select the binaural beats required to improve the mental condition of the user.

2. Market Research

Out of the 89 per cent of people stressed in India nearly 75 per cent of respondents do not feel comfortable to discuss their issues with a medical professional. The cost of per

session with a psychiatrist is also high which is also one of the barriers.[1][2] The solution currently available to deal with such mental health problems are to visit a doctor, get medicines, practice meditation. However people are not very comfortable to share their problems with a new person. In case of medicines available online they cannot be trusted as they may have side effects differing from person to person. [1][2]

3. Brief explanation of the project

3.1 Hardware Required

1. EEG Chips
2. Electrodes
3. Headphones
4. Batteries (Lithium ion)
5. ESP 32

3.2 Software Required

1. Arduino IDE
2. Processing
3. Unity 3D
4. Pycharm
5. Visual Studio
6. Multisim

3.3 Implementation

Electroencephalogram (EEG) is used to detect the brain waves and is interfaced with a microcontroller which processes the signals and send the data to a smartphone and it will select the appropriate binaural beats (audio) and transmit the audio to the auditory device. an EEG system measures the voltage be-

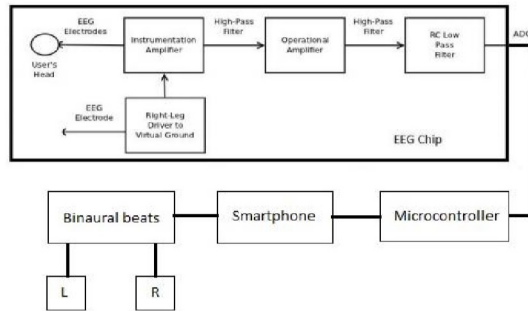


Figure 1

tween its "+" input and its reference (or "-") input. Because of the high-input impedance of the differential amplifier, no current flows into the "-" electrode line, so none of its impedance elements matter (for the purpose of this measurement). Therefore, we can easily measure just the voltage drop across the first three elements – the 5K in-series resistor, the electrode-to-skin impedance, and the impedance of a portion of the human body.[4] $R = (\text{Measured Voltage} * \sqrt{2}) / (\text{Known Current})$ Microcontroller Board Design The microcontroller board contains a voltage divider. Moreover, it contains a +6V DC battery, power supply that provides DC power to the microcontroller and the amplifiers. We constructed an isolated +6 VDC power supply and connected it the microcontroller using the target board. We cut the ground trace connecting the microcontroller ground to the USB ground.

3.4 Smartphone

Smartphone: The signals (Brain waves) detected by the EEG and processed by the microcontroller are then transmitted to the smartphone where the application is designed such that it uses the signals to select the Binaural beats which are stored in the device memory. The binaural beats are segregated with reference to the data received from the microcontroller. The mental states of the user will be identified by the application and according to the data received the application will select appropriate Binaural beats (frequencies) will be used to help improve the person's mental state and will be transmitted to the auditory device (headphones). There will be two modes in the application for the user to choose between, one in which the app will automatically detect the users current state of mind and appropriately play the audio, in the second mode the user will be manually able to select the audio according to his desired mood state.

4. Generation of Binaural Beats

Binaural beats are generated when the sine waves within a close range are presented to each ear separately. For example, when the 400 Hz tone is presented to the left ear and the 440 Hz tone to the right, a beat of 40 Hz is perceived, which appears subjectively to be located "inside" the head. This is the binaural beat percept.

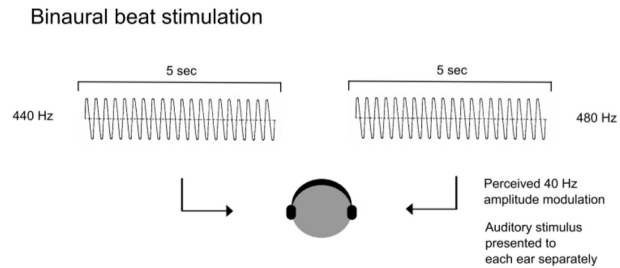


Figure 2

5. Feasibility

The point which is one of the lead-point of our project is that the people of all age groups can use it without any assistance of another human being. People today are in continuous interaction with their mobile phones which is why they can use our application and headphones comfortably without much problem. There is no time constraint as they can use it according to their convenience which in case of psychiatrist is not possible. The user don't need to share any personal information like the reason for being depressed, so they won't feel awkward. They themselves can treat their emotional state. It is also a one-time investment as it won't have limitations to the number of uses once purchased. The application will also consist of an AI which will provide recommendation based on the feedback from the headset.

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