Rodent Auditory and Visual Stimuli Apparatus with Simultaneous Measurements of Brain Activity for Brain Trauma Research

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Abstract

A new possible treatment for detrimental neurological diseases, synchronous 40 Hz auditory and visual stimulation, has been shown to reduce symptoms in rodent models of Alzheimer's. An apparatus was created that can expose rodents to stimulation while they remain in their home cage. An attempt was also made at creating an EEG for measuring brain waves as stimulation occurs.

Introduction

Synchronized auditory and visual simulation has been shown to decrease symptoms of neurological disease in rodents. To further study the effects of stimulation, an apparatus was made that exposes rodents to stimulation while they remain within their home cage. The apparatus is user-friendly, and the frequency of the stimulation is controlled by a dial. The EEG used to measure the brain waves of the rodent is noninvasive, so it does not require surgery to implement. It uses previously engineered components from OpenBCI, and coaxial cables to reduce electrical noise from the environment.

Methods and Materials

User set input from a dial controls the stimulation frequency. The frequency is displayed on an LCD screen. The Arduino Uno controls the LED strip and piezoelectric speaker for stimulation. The device is powered by an electrical outlet. Replacement of individual parts can be achieved if components break.

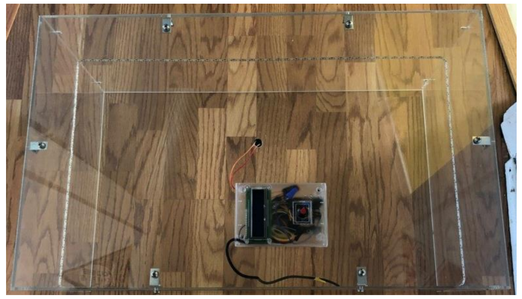


Figure 1. Stimulation Box

The EEG was tested in a human subject. Electrodes were placed near each other on one arm to obtain a small differential voltage and to analyze noise. A coaxial cable was used to reduce noise from the environment. For rats, a suit was made of spandex and Velcro. The circuit board is carried on the rodent back. The electrodes are placed on the head.

Results

The stimulation components perform as expected, which was verified with an oscilloscope. The intensity of the audio stimulation increases due to echo within the box.

Electrical noise was reduced by replacing the gold cup electrode wires with grounded coaxial cables. The 40Hz peak in Figure 2 was due to noise from the 40Hz stimulation causing a displacement current. After the grounded coaxial cables were used, the noise was reduced (Figure 3).

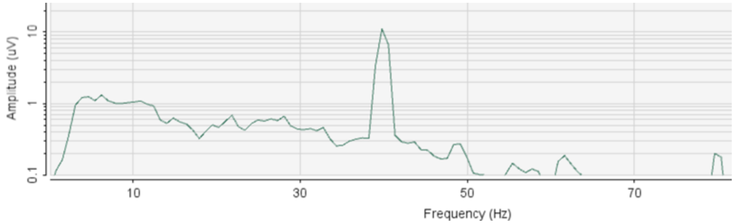


Figure 2. 40Hz Noise on electrodes without coaxial cables

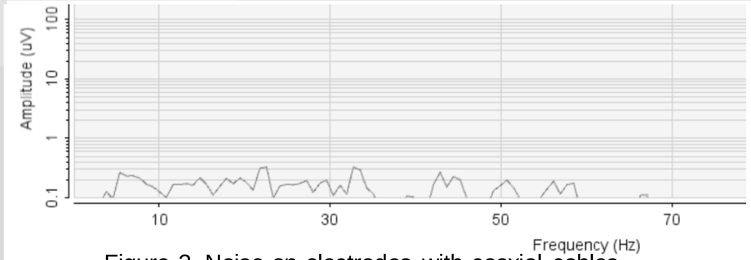
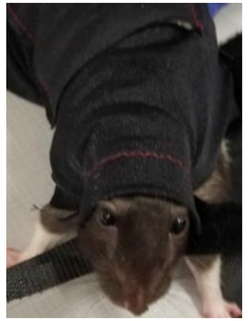


Figure 3. Noise on electrodes with coaxial cables



A prototype rat suit was tested. The rat was able to take off the suit and found it uncomfortable. Another suit was made to be more comfortable but was not tested due to the COVID-19 emergency.

Figure 3. Unfinished rat suit

Conclusions

The stimulation box is ready for use, although the echo may interfere with intended sound stimulation. It may be reduced with acoustic foam along the walls and ceiling of the box. Significant progress has been made towards a rat EEG, but further improvements and testing are needed.

Acknowledgements

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