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EFFECT OF MUSIC THERAPY ON A BRAINWAVE FOR STRESS RECOGNITION

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Abstract— Brain waves are studied, investigated from the last century to detect the psycho-physiological problems, like Epilepsy, Alzheimer, spinal cord injuries and others. But the stress is the common thing which can be recognize with brainwave using EEG (Electroencephalogram) technique, simply by placing the Electrodes on scalp. The musical track is listen to destress a person, this is observed with different Brain waves. The raw EEG signal categorized depending upon frequency ranges from 0.5Hz to 30Hz. After applying the therapy Brainwave changes from one wave to other this is performed and analyze with experimental setup. The objective of this paper is to recognize the stress with non-invasive technique and controlling it with musical tracks results shows the feasibility in developing system.
Index Terms— BCI (Brain computer interface), Brain Wave, EEG (Electroencephalogram), Music Therapy, Stress Recognition.

I. INTRODUCTION

The human stress is the body's reaction which needs to adjustment. Human body is designed such that it can experienced a stress and react on it. A stress can be positive, keeping person to alert and ready to avoid danger. A stress becomes negative when one can feel emotional or mental or physical imbalances [1]. There are various methods to reduce stress depending upon emotional, metal and physical symptoms. It may be a yoga or relaxation therapy or drugs. All mentioned methods are not practical to everyone but the music therapy is one of and easy solution for destress. This is can prove with the help of EEG system and brain computer interfacing (BCI).

The human brain is like command controller of human body. It exchange the data through nerves system with other body parts. Data like movement of eyeball, eye blink, twitch of muscle, concentration, attention, psycho-physiological state, emotions all are originated and feedback to the brain [2]. This paper analyze the musical effect on brain with experimental setup.

II. BRAIN ACTIVITY AND EEG BRAIN RHYTHEMS

A. Brain waves

EEG is abbreviation of electroencephalogram, is a Greek word which means electrical activity emitting from the head and it is generated in graph [2]. EEG denote nerves electrical activity of brain. The origin of thoughts, behavior and emotions are the communication between brain and nerves [3], which produces electrical activity in brain. This electrical activity is arranged in a fixed pattern according to the frequency bands called brain waves are shown in figure1.

- Delta

Delta wave is slowest brainwave having a frequency range from 0.5Hz to 4 Hz. It is observed in deep sleep. The waves can be generated in dreamless sleep or in deep meditation state. Figure 1 shows the delta wave, healing and regeneration stimulate in this stage [4].
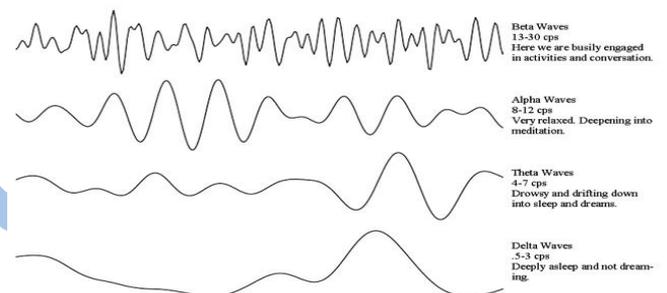

Figure 1: Brainwave Classification

- Theta

Theta wave is difficult to detect without computational methods from recorded raw EEG data set. Theta wave observed in drowsiness stat. it is having a frequency band from 4Hz to 8Hz [5].

- Alpha

This type of wave having a frequency range from 8Hz to 12Hz. It observed in relaxation state. The Alpha wave associates with state of peace. Alpha wave is a 'Power of now' [6]. It helps to overall coordination, mind and body integration, calmness and alertness. Voltage o alpha wave is less than 50 micro volt. This wave plays important role to destress a person [2].

- Beta

Beta wave activity observed in large active thinking, active alertness. Electrical activity of brain in this wave ranging from

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12 Hz to 30Hz and generated voltage is less than 30micro volt. Beta wave enhanced by expectancy states and tension. Beta is a 'fast' activity, present when people are alert, attentive, engaged in problem solving, judgment, decision making, and engaged in focused mental activity [7].

B. Brain Regions

The cerebrum or cortex is a largest part of human brain, associated with higher brain function such as thought and action. The cerebral cortex is divided into four sections, called "lobes": the frontal lobe, parietal lobe, occipital lobe, and temporal lobe. Depending upon brain region the human body part can be controlled. The brain has two hemispheres, right and left. Each hemisphere is formed of four lobes that are shown in figure 2
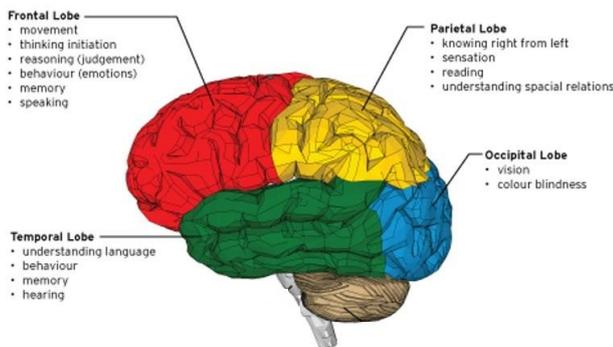

Figure 2 Brain lobes

1. Temporal lobe: contains area of hearing and memory.
2. Frontal lobe: contains motor area.
3. Parietal lobe: contains sensory area.
4. Occipital lobe: contains area of vision

If any action is happen, respective lobe will generate a signal [2].

III. SYSTEM DESIGN

For proposed system first step was to collect the data for normal condition. The purpose of this study is to recognizing and controlling the stress level (like a Blood pressure patients under stressed, they required daily medicine) of a person using music therapy. The stress level of the human will be recognized, based on the brain EEG signals captured and analyzed. Digital filter will be used for noise reduction [8]. Further, based on the stress level status of the person, corresponding music shall be played to reduce the stress level of a person, thereby controlling the stress level of the subject. Process flow of proposed system is shown in figure 3.
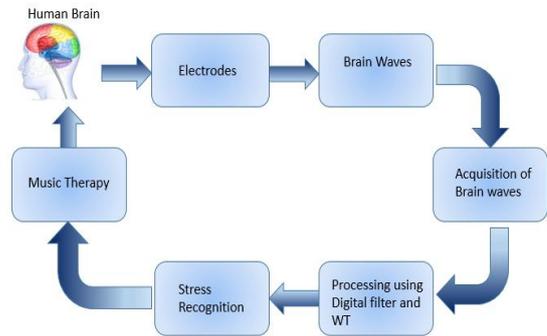
Figure: 3 process flow

The effect of music can be observed from the collected data. These data are collected from various neurology center. After applying the musical tracks one can feel better and gain the Alpha wave

IV. EXPERIMENTATION AND RESULTS

The experiment is carried out with three electrodes Active, Reference and neutral. The electrodes are placed in one of the brain lobe it can be frontal lobe, parental lobe, occipital lobe or temporal lobe.   Weak EEG signals require input preamplifiers (differential type) that have high gain and internal / external noise rejection. Figure 5 shows the placement of electrodes on human scalp. The three electrode gives the differential output resulting in a single channel output.
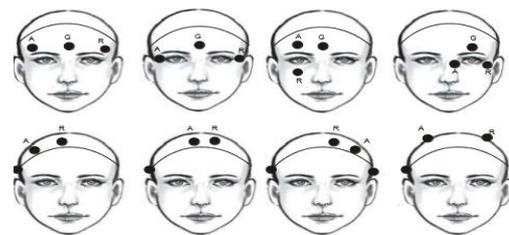

Figure 5: Electrode Placement

The microvolt signal is amplify with two stage of amplifier. Figure 6 is the hardware results of the system. Instrumentation output shown in figure 6a, whereas figure 6b displays the output after low pass filter.
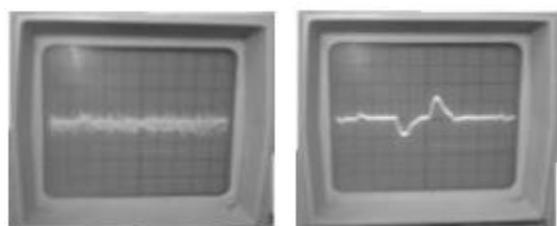

Figure 6. a) Output of instrumentation amplifier b) output of low pass filter

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The gain is adjustable figure 7 displays the EEG output with minimum and maximum gain.
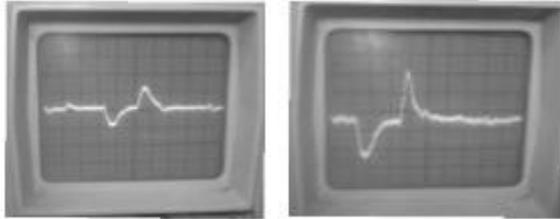

Figure 7 a) EEG output with minimum gain b) EEG output with maximum gain

The amplified EEG is interfaced with computer through DAQ card of Advantech USB4704. The signal processing is done in EEGLAB tool. Fig 8 shows the results of EEGLAB tool.
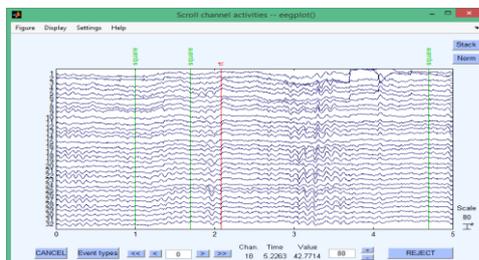

a)
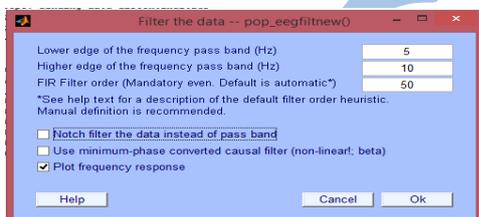
b)
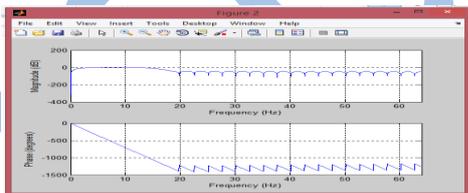
c)

Figure 8: Results a) displaying the Data b) filetring the data set c) filter response.

Figure 9: Experimental setup

Figure 9 shows the experimental setup. The brain wave get changes when anyone is in stressed. After listening the musical track one can gain the Alpha wave which relaxes the body as well as mental state.

V. CONCLUSION

In this Paper, by analyzing the principle and advantages of biomedical signal using EEG technique we found that Brainwaves are related to the human stress. The when a person is in stress the brain wave is Beta so, stressed person gained the Alpha wave to overcome it by the effective musical track. The results of experiment setup shows change in the Alpha wave from the Beta wave.

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