Human Stress Detection and Relief using Music Therapy

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***Abstract*—** Before two-three decades ago there were no cases of mental stress, depression etc. But because of the fast growing technologies since few years and fast life of people there are recurrently occurring cases of mental stress, depression, anxiety. Stress can cause serious problems on human body such as high blood pressure, heart disease, obesity, diabetes and even when a lady is pregnant it can cause abortion. Stress can alter the immune system which leads to reducing the tolerating power of the human [3]. In metro cities this condition is more severe. There must be something to monitor our stress level and regulate it. So by taking this into consideration we have come up with an idea of detecting stress and give relief using Music Therapy. This music is generated in a music composition lab which has the rhythms to normalize the stress. Here we have recorded three sets of readings of 21 students who were about to go for their exam. First set of readings for all 21 students were before going to exam, next we have recorded readings for after finishing exam and third set readings were after listening to music brainwaves were recorded for all 21 students. From this we have calculated the percentage decrease of stress after listening music.

Keywords— Brainwaves, depression, frequency, music, stress, relief.

I. INTRODUCTION

It is well known that the brain is an electrochemical organ that can generate as much as 10 watts of electrical power. This three-pound organ contains a staggering 100 billion brain cells. It can process thoughts at thousands of miles per second. It contains left and right hemispheres, each dealing with specific functions. And its cortical networks can rewire themselves, effectively remapping the mind[4].

When our brain communicates with our nervous system some sensation occur, some electrical pulses flow through our body. These electrical signals are the brainwaves which can be measured through our scalp. This is a non-invasive technique through which measuring stress waves is easy and feasible. Stress detection using brainwave is an easy technique for measuring stress. It does not require any expert supervision to take care. Anyone can place the electrodes on the forehead and can measure their brainwaves. Only we need to know the exact position of the electrode placement. The more number of electrodes the better the accuracy.

There are ranges of brainwave frequencies which are categorized according to nature and behavior of human. Table(1) below shows the brainwave frequency and condition of person in that range. From the table(1) we can see that Beta wave and Alpha wave frequency are of our interest. The Beta wave are conscious brainwaves. In this the person is in stressed condition . Researches have revealed two distinct Beta components; high beta (low gamma) component and low beta component. The beta components are more profound when receiving an unexpected outcome. The Alpha wave are the normal waves. In this the person is calm, alert and in learning state. Alpha waves arise from the synchronous and coherent electrical activity of thalamic pacemaker cells in human body. Firstly they originate from the occipital lobe when the person is wakeful relaxation . Alpha waves are strongest when the eyes of the person is closed. Hence when person is in beta state, our aim is to bring him to alpha state.

II. MOTIVATION FOR THIS PROJECT

According to researchers, a feeling of strain, pressure in human body is stress. Acute stress can be helpful as it may motivate us to complete our work in given period of time. But chronic stress may lead to serious depression. If this condition is left unnoticed it may have serious effects on body[2]. When any person is in stress, the human body releases stress hormones called adrenaline and cortisol. This makes our heartbeats run at faster rate. Other changes in human are body tighten up and blood pressure rises also there can be trouble in breathing. Chronic stress may lower our immune system, digestive system and even our reproductive system and damage them to great extent. It also cause heart attack or stroke. Stress can also speed up our aging process [2].

When we think or do any work, continuously brainwaves are released. We are unaware of the stress and its effects. Hence it is necessary to be aware of the stress and its symptoms before it damages our health. There is no any solution to get rid of stress completely. But we try to minimize the stress level to some extent. So that we can live a healthy

and long life. For this reason we got the motivation of this project.

Table (1) : Classification of Brainwaves

Sr.no.	Types of Brainwave	Frequency	Condition
1.	Infra low	Less than 0.5 Hz	They appear to take major role in brain timing network function
2.	Delta	0.5 – 4 Hz	They are generated in deepest meditation and dreamless sleep. Healing and regeneration are stimulated in this stat
3.	Theta	4-8 Hz	Theta is our gateway to learning, memory and intuition. Our senses are withdrawn from external world and focused on signals originating from within. Deep relaxation and meditation, problem solving state.
4.	Alpha	8-12 Hz	Alpha is a power of now, being here, in the present. Alpha is the resting state for the brain. Alpha waves aid overall mental coordination, calmness, alertness Relax, calm, meditation, creative visualization,
5.	Low Beta	12-16 Hz	They are generated when we are alert, attentive, engaged in problem solving, judgment, decision making, focused, awake, normal, alert, consciousness
	Beta	16-22 Hz	Beta is engaged with high engagement or actively figure out something
	High Beta	22-40 Hz	Hi-Beta waves are generated when a person is in highly complex thoughts, highly anxious or depressed
6.	Gamma	Above 40 Hz	Gamma waves are fastest of brainwaves and relate to simultaneous processing of information from different brain areas

III. EXPERIMENTAL RESULTS

Sr.No.	Before Exam Freq in Hz	After Exam Freq in Hz	After Listening Music in Hz	Frequency difference in Hz	Time for music in min
1	14.11	16.27	11.5	4.77	2.3
2	16.27	14.11	11.29	2.82	3
3	14.15	14.15	9.85	4.3	2.4
4	14.85	14.85	11.29	3.56	2.1
5	14.58	14.88	11.08	3.8	2.9
6	14.54	13.33	11.8	1.53	2.7
7	14.88	13.38	11.88	1.5	2.8
8	13.33	14.34	9.11	5.23	2.4
9	13.38	14.84	10.32	4.52	2.6
10	13.83	13.13	9.36	3.77	2.5
11	13.85	13.13	10.76	2.37	3.1
12	14.34	14.46	9.85	4.61	3
13	14.84	13.9	11.06	2.84	2.8
14	14.37	16.27	10.76	5.51	3.5
15	14.87	16.27	11.31	4.96	2.9
16	13.13	14.34	9.85	4.49	3.5
17	13.88	14.36	9.93	4.43	2.3
18	14.36	16.27	8.18	8.09	2.2
19	14.86	14.34	11.18	3.16	2.2
20	14.36	14.88	8.08	6.8	2
21	13.9	16.27	11.1	5.17	3
Sum	300.68	307.77	219.54		
Mean	14.31	14.65	10.45		

Table (2) : Recorded Brainwave Readings

To find out stress we have taken 21 Engineering students of Dr. D. Y. Patil institute of Technology Pimpri Pune. These students were taken such that they were about to attend there exam. Hence before exam each students readings were taken, then after they finish their exam brainwaves were recorded for each and finally a music was allowed to listen for 2-3 min for each and again brainwaves were recorded. Finally a graph was plot which shows that students who were stressed before and after going to exam, their stress was released.

From the table (2) we got the frequencies of before exam, after exam and after listening music. From which we can calculate the amount of brainwaves dropped after listening music.

Therefore,

% decrease in stress = {(stress freq – No stress) / stress freq} * 100

= 28.67%

Hence it is found that approx. 29% of decrease in stress is obtained.

As we have discussed that stress cannot be eliminated completely but it can be reduced. Hence from our experiment we have tried to minimize the stress level to some extent. We can also increase the timing of music for improved result or if anyone who is about to go in beta state can take deep breaths and concentrate on their breath. This is the instant formula for avoid going into beta state.

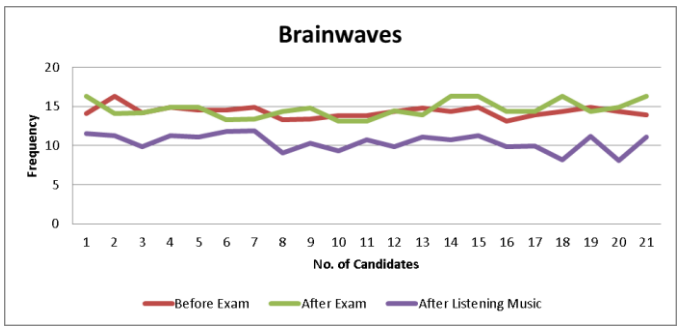

Fig. 1. Brainwave analysis graph

The standard deviation when obtained from the table of observed frequency gives us the graph as shown in figure (3). A practical setup is shown in fig(2)

Table (3): Average observed readings

	Mean	Standard Deviation
Before Exam	14.31	0.69
After Exam	14.65	1.07
After Listening Music	10.45	1.099

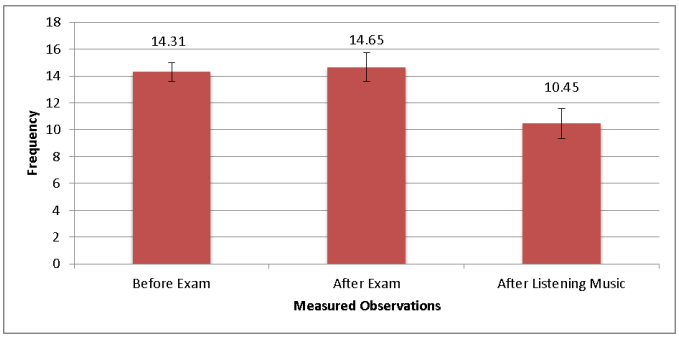

Fig. 2. Standard deviation graph of Observed frequency

The main purpose of finding standard deviation is to understand how spread out a data set is. Hence from the graph it is found out that before exam the data is spread out between 13.62 to 15 Hz, after exam the data is spread out between 13.58 to 15.72 Hz and after listening music the data is spread out between 9.36 to 11.54 Hz.

Figure (1) shows the graph of the readings obtained from the experiment performed. It is observed that students were in frequency between 13.62 to 15 Hz when going to exam. The average frequency obtained is 14.31Hz. This is the range of frequency of Beta wave.

When students came out of exam hall their the range of frequency was between 13.58 to 15.72 Hz. The average frequency obtained is 14.65 Hz. This is the range of frequency of Beta wave.

Now to limit the frequency and to normalize the students a music was allowed to listen to the students for 2 to 3 minutes and then recorded the brainwaves. Hence the range of observed frequency is 9.36 to 11.54 Hz. The average frequency obtained is 10.45 Hz. This is the range of frequency of Alpha wave.

IV. TESTING PROCEDURE

After turning ON the laptop in Linux operating system, the steps are as follows:

Fig. 3. Practical Setup

Step 1 : Connect the USB Dux Sigma i.e. comedi device to the USB port.
Step 2 : Open the terminal by clicking right click of the mouse button on the desktop.
Step 3 : Type "sudo comedirecord" in the terminal and press Enter. Type the password if prompted.
Step 4 : The comedirecord oscilloscope will open, then create the file with the filename.
Step 5 : Attach the leads to the pre-frontal area of the brain.
Step 6 : Start recording the signals for 60 seconds.
Step 7 : Now open MATLAB software and run the code.
Step 8 : Select the .csv file which we have recorded and press OK.
Step 9 : This will show the output window which shows the Brainwave signal and FFT plot of the recorded signal. The FFT plot shows the frequency of the recorded signal. Which helps in identifying the stress.
Step 10 : If stress is detected the suitable music will be played automatically.

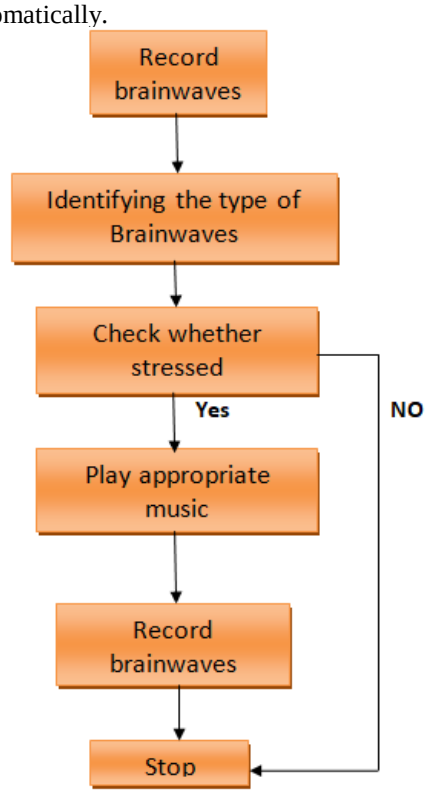

Fig. 4. Flow chart of proposed system

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CONCLUSION

In this paper, real time automated system for stress reduction using EEG signal is proposed by playing proper music. Frequency of EEG signal is estimated using Fast fourier transform which is simple, robust and faster frequency domain transformation techniques. After classification of signal, subjects stress is reduced by playing proper music depending upon stress level. For normal subjects relaxing music is played. Real time experimental results show that after playing music the stress level of subject decreases rapidly.

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