

## Analytical and Comparative Study on effect of Indian Classical Music on human body using EEG based signals

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**Abstract:** Recently, Music is playing dominant role in human life. Due to heavy work load person can listens music to relax. The main aspect of the affective computing is to make computer more compatible to the user and this can be done by "getting into" users head to observe the mental state by using certain physiological device like EEG.

This paper describes now to recognize and percept emotions from brain signals while listening the Indian classical music measured with the electroencephalogram (EEG) device.

**Keywords:** Electroencephalography (EEG); Music; Brain activity; emotion; emotion recognition

### I. Introduction

The music is dominant mood enhancer. Thus, most oftenly people listen a music since early in the morning till late night. Indian Classical Music is the soul of every music. Classical Music greatly affect on brain activity; it may have a positive effect on hormone system that's why people feel relax after hearing the classical music.

India has got the strong historical background of music. Archeological studies and evidence too has validated the presence of music from the ancient time. The 'Samaveda' includes hymns and describes the Indian music. While discussing about the Indian Classical Music, the striking word comes 'Raga'. It is the very heart of Hindustani Classical Music.

Shastra says every Raga impacts on human body and mind. A Raga is characterized by its own particular 'Ras' or 'Mood'. The acknowledged order of these nine sentiments, or emotions, is as follows: romantic and erotic, humorous, pathetic, anger, heroic, fearful, disgust, amazement and peaceful. Each Raga, in addition to being associated with a particular mood, is also closely connected to a particular time of day or a season of the year. Thus through the rich melodies and beat/ matra of Indian music, every human emotion, every subtle feeling and nature, can be musically expressed and experienced. In the ancient era it was difficult to prove the relation between emotion and music due to the lack of development in science and technology.

"Electroencephalography (EEG) is the recording of electrical activity along the scalp. EEG measures voltage fluctuations resulting from ionic current flows within the neurons of the brain. The clinical contexts, EEG refers to the recording of the brain's spontaneous electrical activity over a short period of time, usually 20–40 minutes, as recorded from multiple electrodes placed on the scalp(hair bearing portion of the head). Diagnostic applications

generally focus on the spectral content of EEG, that is, the type of neural oscillations that can be observed in EEG signals. In neurology, the main diagnostic application of EEG is in the case of epilepsy, as epileptic activity can create clear abnormalities on a standard EEG study".[1]

It observed that while listening the music, brain parts are involved in processing music, this include the auditory cortex, frontal cortex, cerebral cortex and even the motor cortex [2].

It is an ancient, and very pervasive, idea that music expresses emotion. Apart from the copious literature to this effect contributed by composers, musicologists, and philosophers, there is also solid empirical evidence from psychological research, that listeners often agree rather strongly about what type of emotion is expressed in a particular piece.[3]

Most of us listen music of choice during leisure time or while working / studying. Music can be used as a tool to relieve tension/ stress, solitude, it also enhance the listeners mood [4]. These changes are reflected clearly in physiological system for human. Most of previous studies are mainly focused on effect of music on brain functions without any mental workload. In the present study, we designed an experimental paradigm to see the effect of music on brain functions rate based on experimenter's choice of like music (Jazz, carnatic and Hard rock) during with / without mental workload.[5]

Emotions are the most important living factor in human body. The need for computer applications which can detect the current emotional status of the user is ever growing [6].In an human communication a lot of research work is done for recognizing the emotions from face and voice with less accuracy.

Using EEG signals for emotion recognition provides a lot of advantages:

- Physiological signals are constantly emitted.
- As sensors are attached directly to the body, a person cannot move out of reach from a camera or a microphone that is placed in a room
- Biosignals are controlled by the central nervous system and therefore cannot be inuenced intentionally.

This research is limited to the those who are kin interested in Indian classical music.

### II. Related Work

Emotions are part of any natural communication involving humans. They can be expressed either verbally through emotional vocabulary, or by expressing non-verbal cues such as intonation of voice, facial expressions and gestures.[7]

Music has significant effect on our body and mind.[8]

'Emotion in Motion' is an experiment designed to understand the emotional reaction of people to the variety of musical excerpts, via self-report questionnaires and the recording of electrodermal activity (EDA) and heart rate (HR) signals.[9]

'Emotion in Motion' is an experiment designed to understand the emotional reactions of people during music listening, through self-report questionnaires and the recording of physiological data using on-body sensors.[10]

### III. Methodology

#### Electroencephalography Techniques

Similarity index(SI) is used to find the interdependency between different brain regions of musicians and non musicians while listening the music and in a condition of rest through EEG signals.

EEG recording was done for 180 seconds with a sampling rate of 128 HZ audio file to the person.

Both musicians and non musicians were asked to listen a raga by vocalist in the form of audio files. After we have find out EEG spectra in different areas of the brain cortex. An experimental study is needed while listening different ragas.

There are 16 persons in the range of 20 to 40 years of age. This has age range observed to have maximum stress in recent era. Who were having the musical knowledge or not, but kin interested in Indian classical music participated in the study and spectral power.

21 channel EEG were recorded simultaneously and the SP of each frequency band (alpha, beta, delta, theta) was calculated.

#### Emotion Acknowledgement (Recognition)

The acknowledgement of types of emotions depends on how the EEG features can be mapped on chosen emotion representation. The emotion representation used in the two dimensional mapping they are valence and arousal, which were already mentioned below

- Valence (Stimulation or brainwave): Valence, as used in psychology, especially in discussing emotions, means the intrinsic attractiveness (Positive Valence) or aversiveness (Negative Valence) of an event, object, or situation. However, the term is also used to characterize and categorize specific emotions. For example, the emotions popularly referred to as "Negative", such as anger and fear, have "Negative Valence". joy has "Positive Valence". positive, happy emotions result in a higher frontal coherence in alpha, while negative emotions result in higher right parietal beta power.

- Arousal (Excitement): One of the main function is to motivate new behaviors. The arousal that accompanies emotions has a significant impact on things such as anxiety, performance stress and ultimately performance. A higher beta power and coherence in the parietal lobe are represented excitation.

If valence will be hard to determine then arousal scale result can be used and the vice versa, both dimensions will have a good spread, and any emotion that can be mapped on the two axes can be recognized.

There are two methods of brain towards study of emotions of interest for representing them theoretically.

1. Method of darwin: basic emotions have evolved through natural selection. It proposed eight basic emotions: anger, fear, sadness, disgust, surprise, curiosity, acceptance, and joy.

2. Method of cognition: In this method emotions are mapped according to their valence and arousal.

Both methods of EEG are widely used, but the second representation is chosen for the purpose of research because of its simplicity and suitability. The following Fig. 1 shows the general indication of the positions of certain emotions based on the emotion labelling .i.e. active, negative, passive and positive. With eight basic emotions: angry, afraid, sad, depressed, calm, content, happy an excited.

#### Emotion Representation



Figure 1: Arousal-valence model, labelled by Danny Qude Bos EEG-based Emotion Recognition[10]

#### Emotions in the Brain

Stimuli enter the brain at the brain stem (medulla oblongata). The limbic system which is like a cortical ring around the brain stem is responsible for initial emotional interpretation of signals from the autonomic nervous system. This part has also been found important for motivation and memory functions. Although motivation and memory also have their influence on the reaction to emotional stimuli; the rest of the text will focus on the limbic structures that are specifically relevant for emotional reactions.

Following are the steps of recognition of emotions from brain signals:

**Step 1** To determine the optimal placement of a limited number of electrodes for any emotion recognizing device.

**Step 2** putting this information into practice measured with the EEG device during the experimental phase.

**Step 3-** Finally analyze what are the results.

### IV. Conclusion

In the present paper, the relationship between emotions and classical music are analyzed. An positive effect on brain after hearing of Indian classical music is more, as compared with other music after capturing the EEG signals.

The Indian classical music is found to be more effective on emotional status as compared to rock music in the state of quiet wakefulness.(open eyes)

Indian Classical Music can be used as a tool to relieve tension/ stress and to relax.

## V. Future Scope

Future work will explore and investigate by means of similar relationship between emotions and different raga's as per the samay chakra.

We can also apply this method with ECG signals. We can apply this method to those people who are not aware of Indian Classical Music. We can apply this method on those people who are not having special musical knowledge.

## References

1. <http://en.wikipedia.org/wiki/Electroencephalography> ite\_note-Niedermeyer-1
2. Kristeva R, Chakarov V, Schulte-Monting J, Spreer J., Activation of cortical areas in music execution and imagining: a high-resolution EEG study, *NeuroImage* 2003 (20), pp: 1872 – 1883
3. Klaus R. Scherer and Marcel R. Zentner, Emotional Effects Of Music: Production Rules, Music and emotion: theory and research, *Oxford ; New York : Oxford University Press, Juslin, P.N. & Sloboda, J.A. (ed.)* (2001)
4. Lonsdale, A. J., & North, A. C., Why do we listen to music? A uses and gratifications analysis, *British journal of psychology London England* 1953,2011 pp: 102 (1), 108-134
5. B. Geethanjali, K. Adalarasu, R. Rajsekaran, Impact of Music on Brain Function during Mental Task using Electroencephalography, *World Academy of Science, Engineering and Technology* 66 2012
6. R. W. Picard and J. Klein, Toward computers that recognize and respond to user emotion: Theoretical and practical implications. *Interacting with Computers*, 14(2):141–169, 2002.
7. Chanel, Guillaume, Emotion assessment for affective computing based on brain and peripheral signals. *Thèse de doctorat : Univ. Genève*, 2009, no. Sc. 4123
8. Dr. K. Adalarasu , M. Jagannath, S. Naidu Keerthiga Ramesh, B. Geethanjali , A Review On Influence of Music on Brain Activity Using signal Processing and imaging System, *International Journal of Engineering Science and Technology (IJEST)*, Vol. 3 No. 4 Apr 2011
9. Javier Jaimovich<sup>1</sup>, Niall Coghlan<sup>1</sup> and R. Benjamin Knapp<sup>2</sup>, Emotion in Motion: A Study of Music and Affective Response, *9th International Symposium on Computer Music Modelling and Retrieval (CMMR 2012)* 19-22 June 2012.
10. Danny Qude Bos EEG-based Emotion Recognition, *Department of Computer Science , University of Twente P.O. Box 217,7500 AE , Enschede*