Study of Indian Classical Ragas Yaman and Todi Structure and its Emotional Influence on Human Body for Music Therapy

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Abstract: Indian classical musical maestros affirmed that, ragas influences emotions of human being by changing the resonance of human body.Ragas like kanada, khamaj and pooriya defuses mental tension. Raga miya-malhar pacifies anger, excitement & mental instability, Raga jaijaivanti have also been pound effective in curing mental disorders and calming the mind. Although it is require to verify this raga correlation systematically. By survey, it has been seen that no schemes have demonstrated yet. The proposed research presented in this paper is aimed to discover the science behind phonetics of raga structure and its effects on nerve system. This research is one step to explore scientifically the ancient way of alternative medicine i.e. raga therapy, which is a need of the day since current advances in technology and rising workload on human being is accompanied by stress. This research focuses on to study the influence of Indian classical ragas structure on human body while person is listening and experiencing an emotion in it by capturing EEG signals. The brainwave signals database will be collected and analyze. This research work addresses these objectives and aims to present a strong case which will help medical practitioners like psychiatrist, to treat patient by injecting music stimulus.

Keywords: Music therapy, Emotion, raga and emotions, EEG, Brainwave Signals.

Introduction

In our daily life human being generally come across stress resulting in various physical and psychological ailments. Ancient Indian tradition provides various therapies such causes like yoga, meditation and raga chikitsa. Raga chikitsa was an ancient manuscript which dealt with the therapeutic effects of raga. Some ragas like darbari kanada, khamaj and pooriya are found to help in defusing mental tension, particularly in the case of hysterics. Raga malhar Pacifies anger, excessive mental, excitement & mental instability, Raga jaijaivanti have also been pound effective in curing mental disorders and calming the mind [1]. Each different raga holds its own set of rules upon which the melody relies and respects. There are rules for upward directions of the scale, “aahroh,” and downward movements, “aavroh”; rules that specify phrases to use and to avoid and which notes to use sparingly and often. The character of the raga is defined by the order and sequence of these notes and, just as importantly, subtle grace-notes called gamakas[2].

Emotions give meaning to our lives. No aspect of our mental life is more important to the quality and meaning of our existence than emotions. They make life worth living, or sometimes ending. The English word “emotion” is derived from the French word ‘emouvoir’ which means ‘move’. Traditionally music is said to evoke seven basic emotions: sadness, romance, peace, strength/courage, anger, dispassion, devotion. Each raag elicits a unique emotional state (rasa) consisting of one or more of these emotions [3].

Emotions and Ragas

Each raga is uniquely defined by its pitch collection and characteristic phrase and has some mood associated with it that can be related to its pitches and their relations one with another. Certain pitch classes commonly occur in ragas conveying a particular kind of emotion. The pitch set of a raga and its characteristic phrase establish the flavor or mood of the raga. It is a well-accepted notion that there are 11 basic moods (based on "Raga, the soul of classical music") in North Indian Classical Music that can be depicted through a combination of music, dance and poetry:1.karuna, 2.shringar,3.shanta4.veer,5.raudra,6vyragya,7.bhakti,8.bhayanak,9.hasya,10.bibhatsa,11.adbhuta.

The ten parent classes are:

1. Bhairav - An early morning raga usually played at daybreak,2. Bhairavi - A morning raga often played at the finale of any musical performance,3. Asavari - A morning raga popularly known as a romantic raga,4. Todi –A morning raga meditative in nature,5. Kafi - This raga does not have a performance time, known for its shringar (romantic) mood,6. Marwa - A raga

played around dusk bringing about an ascetic mood,7. Purvi - An afternoon raga conveying a mood of serenity,8. Khamaj - An evening raga, often used in semi-classical and folk music owing to its lilting character,9. Kalyan - An evening raga used to convey descriptions of beauty,10. Bilawal - A morning raga that conveys joy [4].

Raga and Time Association

One of the unique characteristics of Indian music is the assignment of definite times of the day and night for performing Raga melodies. It is believed that only in this period the Raga appears to be at the height of its melodic beauty and majestic splendor. There are some Ragas which are very attractive in the early hours of the mornings; others which appeal in the evenings, yet others which spread their fragrance only near the midnight hour. There are Ragas associated with the rainy season (Raga Megha and Raga Malhar), the autumn season (Raga Basant) and the spring season (Raga Bahar). Seasonal Ragas can be sung and played any time of the day and night during the season allotted to them. The obligation of time in case of such melodies is relaxed. The ancient musicologists were particularly interested in the effects of musical notes, how it affected and enhanced human behavior. Music had the power to cure, to make you feel happy, sad, disgusted and so on. The Ragas and Raginis emerge as the suggestive sound images of these sentiments, emotions and passions[6].

Raaga Structure

1)Raag Yaman for Peace ,Happiness is traditionally performed only during the early evening. It conveys a mood that is serene, calm,and peaceful and at the same time joyful and lively. In the South Indian music tradition, the counterpart of Raag Yaman, with the same melodic structure, is called Raag Kalyani.The notes in a Raag Yaman roughly correspond to the following notes in the western scale, in the key of D:

Thaat : Kalyan, Aaroha : Sa Re Ga Ma(Kori Ma/trivra Ma i.e. Ma#) Pa Dha Ni Sa,Avroha :Sa Ni Dha Pa Ma((Kori Ma/trivra Ma i.e. Ma#)) Ga Re Sa,Pakad : Ni-Re-Ga-/Re-Ma(Kori Ma/trivra Ma i.e. Ma#)-Pa- /Ma(Kori Ma/trivra Ma i.e. Ma#-Pa-Dha/Dha-Ni- Sa'(upper octave),Vaadi :Ga,Samvaad:i Ni,Prahar (Time): Night (Pratham Prahar)

2)Raag Todi is mostly pervaded by a pensive, mournful mood.

Arohana:S r g M^+ d N S' or 'd 'N S r g M^+ d N S' orS r g M^+ d P, M^+ d N S' or S r g M^+ P, M^+ d N S',Avarohana:S' N d P M^+ g r s or S N d P M^+ d M^+ g r g r S,Vadi: Komal Dha ,Samavadi: Komal Ga,Pakad:r/g-\r\S,Prahar(Time):late morning.

The first step in modeling any phenomenon is data collection, we need to design experiment methodologies that successfully induce emotions in a laboratory settings where in we can record and collect psychological data. The objective of this research work is to study the effect of Indian classical raaga on brain activity during normal relaxing conditions using electroencephalography (EEG).

Literature Survey

Indian music is based on the raga system. when we go through the literature related to acoustic and carnatic music, very little is available about the physics of raga. In acoustic we come across terms like frequency, amplitude, loudness, pitch, velocity, timbre, quality etc. Musical sound has three identifying characteristics, loudness, pitch and timbre(quality).Loudness is power as it depends on the amplitude or the intensity of the corresponding wave and is measured in decibels. The pitch of a sound is determined mainly by its frequency and is measure of how “high” or “low” a tone is and is measured in hertz(Hz).The third identifying feature ,timbre stems from the fact that musical sound are made up of many different sound waves..The part of the brain that is most commonly associated with emotion is the amygdala. There is actually a system, consisting of three different parts of the prefrontal cortex that are connected to the amygdala that is thought to be responsible for emotions. The parts of the brain that are involved the dorsolateral, the medial, and the orbitofrontal cortex are thought to regulate decision-making and negative emotions, as well assessing the appropriate emotional response to a situation[5].Left frontal area is involved in the experience of positive emotions such as joy and happiness. In contrast, the right frontal region is involved in the experience of negative emotions such as fear, angry and sadness. Musical stimuli are considered positive or negative in valence elicited asymmetric frontal EEG activity.

Shown here in concert C, the ten common thaats are:

1. Kalyan: C D E F# G A B,2. Bilaval: C D E F G A B,3. Khamaj: C D E F G A Bb,4. Bhairav: C Db E F G Ab B
5. Poorvi: C Db E F# G Ab B,6. Marva: C Db E F# G A B,7. Kafi: C D Eb F G A Bb,8. Aasavari: C D Eb F G Ab Bb
9. Bhairavi: C Db Eb F G Ab Bb,10.Todi: C Db Eb F# G Ab B.[2]

Linking Emotion, EEG & Music

Recent efforts is using more adequate measures of larger parts of the recorded Electro-Encephalographic (EEG) dynamic information have proved more successful [6]. Emotions are not just what are displayed. In psychology an explicit separation is made between the physiological arousal, the behavioral expression (affect) & the conscious experience of an emotion (feeling) [7].Music at different pitches elicits exceptionally emotions and is capable of reliably affecting the mood of individuals which is turn changes the brain activity [8].

Under the influences of alpha music, great reduction in feelings of stress and or increased sense of physical relaxation was observed. Music evoked emotions can modulate activity in all limbic and para-limbic brain structures[8].
In India, saint musician Thyagaraja is brought a dead person back to life with Bilahari raaga, Pt Omkarnath Thakur is said to have cured Mussolini of his insomnia with a darbari kanada[11] Thakur brought him to tears with rāga chayanat, which is meant to depict pathos[12].

Electro-Encephalogram (EEG)

Electroencephalography (EEG) is a tool for measuring electrical activity generated in the brain, which opens a window for exploring neural activity and brain functioning. The EEG signal is measured using electrodes placed on the scalp, which .record the electrical field generated by the nerve cells Changes in the brain's electrical activity occur very quickly, and extremely high time resolution is required to determine the precise moments at which these electrical events take place. A series of particular responses to a stimulus can indicate the time course of various neural processes invoked in order to process the stimulus, understand it, and decide on the appropriate reaction. In this way, researchers can compare the brain's responses to various types of stimuli, or its activities as we perform certain tasks, and then draw conclusions about the different brain processes involved in each of these situation [10].
EEG rhythms are classified into four basic types:
(i) Beta ,(ii)Alpha ,(iii)Theta and(iv)Deta
The Five Categories of Brainwaves
1.Beta brainwaves(14 to 32 Hz alert, focused)
Features and Benefits of a Beta State: This is the brainwave for,

- Increased concentration and alertness,Feelings of anxiety, stress, scary unfocused thought[9].

2. Alpha brainwaves (7 to 14 Hz relaxed, meditative)

Features and Benefits of an Alpha State: Our brain hemispheres become naturally synchronized, or in-phase with each other.

- Increased vividness benefits creative visualization and triggers imagination,Reduced anxiety[9].

3. Theta brainwaves (3.5 to 7 Hz deep relaxation)

Features and benefits of Theta brainwaves

- Increased sense of inner peace and emotional stability,Deep relaxation,Calms the chatter of your mind[9].

4. Delta brainwaves (0.1 to 3.5 Hz deep sleep)

Delta is the place of deepest relaxation, deepest healing, deepest spiritual connection and deepest connection with the subconscious mind. Each of us can use brainwave entrainment to achieve a variety of results. You may want to target a specific brainwave frequency range to help you relax. On the other hand you may want to increase you creative energy, improve your memory, deepen your sleep or get better results when playing a sport[9].

Wavelet Transform

Wavelets are functions that you can use to decompose signals [13]. The wavelet transform decomposes a signal into a family of wavelets [13].wavelets can be symmetric or asymmetric, sharp or smooth, regular or irregular [13]. The continuous wavelet tools are used for signal analysis time-frequency analysis [13]. In contrast with sinusoids, wavelets are localized in both the time and frequency domains, so wavelet signal processing is suitable for non-stationary signals, whose spectral content changes over time [13].The adaptive time-frequency resolution of wavelet signal processing enables to perform multi-resolution analysis on non-stationary signals [13]. The properties of wavelets and the flexibility to select wavelets make wavelet signal processing a beneficial tool for feature extraction applications [13].
Wavelet signal processing is different from other signal processing methods because of the unique properties of wavelets [13]. Wavelets are irregular in shape and finite in length. Wavelet signal processing can represent signals sparsely, capture the transient features of signals, and enable signal analysis[13].

Objectives

The Goal of this research work is to explore,

a) To collect the database of different Indian classical ragas sung by experts of different age group.
b) To convert time series of raga to frequency domain using time-frequency analysis.
c) To study EEG pattern of human subject listening the raga within a focus on Alpha, Beta Theta and Delta frequency bands.
d) To correlate sequence of notes in raga within frequency deviation of EEG, to understand which raga structure elicit specific emotion such as Peace, Happiness, Cheerful, Sadness and Depressed.

Experimental Protocol

Feasible Study

The research focuses on to study the influence of Indian classical ragas structure on human body by capturing EEG signals. For this purpose we will require to collect brainwave signals database of persons listening to music .By selecting Indian classical ragas, we will ask person to listen and experience an emotion in it.

Input Output Specifications

1) A data of EEG signal samples of different subjects with and without knowledge of music, while listening to different ragas.
2) Extracting brain waves and evaluation.
3) Drawing Experimental Result and Conclusion.

Design

Proposed design

Our brain is made up of billions of brain cells called neurons, which use electricity to communicate with each other. The combination of millions of neurons sending signals at once produces an significant amount of electrical activity in the brain, which can be detected using sensitive medical equipment such as an electroencephalogram (EEG).This electrical activity of the brain is commonly known as a Brainwave pattern, because of its cyclic, 'wave-like' nature. You can train your brain to change your brainwaves by learning meditation and relaxation techniques. However, it can take weeks, and for some people even years to experience the proven and powerful benefits of brainwave entrainment through meditation alone. There is also a short cut to getting the best from your brainwaves by using an audio tone known as binaural beats. Binaural beats effectively entrain and synchronize your brainwaves to enhance any specific brainwave pattern. This allows you to rapidly enter states of relaxation, focus, high-energy, or meditation whenever you want.

Detailed design

Due to the high temporal resolution of EEG, it is possible to study neuronal processes at different time scales, that is, frequency bands that are related to different mental functions and most presumably also to emotional states. The present study aimed to elucidate whether and in which frequency bands EEG would raise reliable correlates of emotion processing [14].With this approach we are performing an experimental study to find out while listening to classical ragas whether emotions are generated and how they get induced in human brain. For this purpose to analyze emotions we are using an EEG signals approach.

Methodology

The Proposed methodology for EEG Signals analysis is based on empirical study to find out the EEG spectra indifferent areas of the brain cortex in the state of quiet wakefulness & listening to classical ragas, subject's emotional responses will be recorded and analyses will be done to find out which emotion is generated by the particular classical ragas structure. Some subjects will be chosen and will be asked to listen to classical ragas for some minutes through earphones & EEG signals will be recorded & the frequency bands (delta, theta ,alpha & beta) with be calculated and result will be drawn depending on the variation in the frequency bands for a particular emotional response.

Conclusion

This Research work aims at finding out correlation between brainwaves and musical notes and by performing laboratory experiment we are trying to find how brain wave reacts to certain classical raagas structure.

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