

Review Paper on Music Therapy

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ABSTRACT

This paper presents a brief review of various effects of Indian Raga music on the human body parameters. Music is a best medicine to maintain the health along with medicines. This study analyses how music helps to control the BP, sugar. Impact of music can be observed through ECG, EEG. This effect depends on individual's perception. Music therapy gives better results for interested people. Some ragas are also effective for IRM ignorant people, which depend on its properties. These properties can be studied through time, spectral, cepstral domain analysis.

Keywords: *Timbre, Komal Svaras (कोमलस्वर) Tivra svaras (तीव्रस्वर), Semitones, Aalap (आलाप), Drutgat (द्रुतगत).*

INTRODUCTION

Indian Classical Music has been used as a therapeutic agent from the ancient times [1]. It has shown positive effects on various diseases. Music therapy has also shown effects on people who do not like the music at all [2]. It has not shown any adverse effects on humans till the date. One question arises how is it possible? The answer is music has parameters which directly affects brain and we all know brain is the king of our body, which controls everything. These parameters can be obtained by time and spectral analysis. There are four waves in our brain alpha, beta, delta, and theta. Music therapy energizes beta cells and increases the quality of protein release of brain chemicals. Music therapy reduces stress. Impact of therapy depends on perception of an individual. By considering the effects of music therapy, use of the minor tones or *komal svaras* (कोमलस्वर) always create positive impact in minimizing the stress of mind. But *tivra svaras* (तीव्रस्वर) are not that much effective especially when applied on IRM ignorant persons [2].

LITERATURE REVIEW

In the paper, authors Bidyut et.al. considered three samples of raga “*Malkauns*” (मालकंस) [3]. These are from classical vocal music, instrument and one from *Rabindra Sangeet* (रबिन्द्रसंगीत). Raga “*Malkauns*” has special impact on human-being. The main purpose is to see whether these types of music have positive impact on human autonomic nervous system (ANS) through Heart rate variability (HRV) signal. If impact is get noticed then next step is to see whether the different types of music have different types of effect on ANS. This is studied through the pattern of the long-term discrete dynamics of HRV signal, which is time independent phase space analysis of the HRV signals. The HRV data was taken from 20 subjects, of two groups – one familiar with rules of music and the other not familiar. The music was of maximum 30 minutes duration in .wav/.mp3 format. Initially HRV-signals of persons under normal conditions were chosen and also when they were listening to selected music tracks. Then Poincare plot for each HRV signals was constructed and quantified the Poincare plots by using ellipsoid fit. Energy of the signal is computed by taking the average of the square of the amplitude, which is root-mean-square (RMS). Energy curve is obtained by frame decomposition. This energy curve is used to get an assessment of the temporal distribution of energy to see if

it remains constant throughout the signal, or if some frames are more different than others. Method used in computation of low energy rate, which is the percentage of frames showing less-than-average energy. This percentage actually shows the degree of loudness or softness. MFCCs (Mel-frequency cepstral coefficients) method is used to describe the timbre. Frame decomposition is done then converted into the spectral domain by using the mirspectrumfunction. By this function, key in a signal can be recognized with respect to its corresponding time. By calculating slope of the curve how one key attack the next one, attack slopes for every keys in a signal are obtained. Timber is defined by attack slope and this measure is able to differentiate two sounds from same instruments. People with no previous exposure to Indian Raga Music (NIRM) included. All the signals are recorded under normal room temperature and least noisy environment. All signals are taken in ten minutes duration. Recorded signals are processed by MATLABR2010asoftware using moving window integration of a digital filter and converted into HRV signals. Results are like Loudness and tempo are high for vocal, then Rabindra Sangeet, and least for instrumental type. Area of fitted ellipse plays an important role to distinguish the pattern of long term dynamics which is studied through Poincare plot of HRV data in post music and pre music stages. In this case, area of the ellipse decreases for Rabindra Sangeet listened by both NIRM and IRM persons. But the area does not decrease uniformly in cases of Classical vocal music and Classical Instrumental music, the effect is better in cases of Classical Instrumental music.

Automatic melakarta raaga identification system [4] proposed by authors B. Tarakeswara Rao et.al. is achieved by identifying the nearest neighbours to a query example and using those neighbours to determine the class of the query. This paper presents an overview of techniques for Nearest Neighbour classification focusing on; mechanisms for finding distance between neighbours using Cosine Distance, Earth Movers Distance and formulas are used to identify nearest neighbours, algorithm for classification in training and testing for identifying Melakarta raagas in Carnatic music. From the derived results it is concluded that Earth Movers Distance is producing better results than Cosine Distance measure. K-NN is used for classification. It is very simple to understand and easy to implement. In some cases where an explanation of the output of the classifier is useful, K-NN is very effective if an analysis of the neighbours is useful as explanation. To improve classification process an EMD approach is used which gives fast convergence. K-NN is very sensitive to irrelevant or redundant features because all features contribute to the similarity and thus to the classification. This can be made better by EMD approach and feature selection. When EMD results are compared with Cosine distance measure, it is observed that EMD gives better results [5].

Reno Bhatia and Swati Gupta discussed various effects of sound on the human brain activity [5]. It is shown through the study of EEG signal recorded. The effect is in the form of variation in either frequency or in the power of different EEG bands. A biomedical signal electroencephalography (EEG) used to verify the influence of music on human brain activity. Time & frequency analysis is used to read the effects. The most widely used method of EEG analysis is based on the Fourier Transform. EEG consists of mainly four basic frequency components. These are Delta - 0.5-4 Hz - associated with the deep sleep, Theta - 4-8 Hz - associated with drowsiness, Alpha - 8-12 Hz - associated with relaxed, alert state of consciousness, Beta - 14-30 - associated with active, busy or anxious thinking. The amplitudes of the EEG signals typically vary between 10 and 100 vs. (in adults more commonly between 10 and 50 vs.). Spectral analyses based on Fourier transform were applied to obtain the α , β , δ and θ frequency bands. The power at each band of each channel was used as the features of EEG. The correlation of the features between different situations and subjects was used to show which channel display the difference of EEG signals. T3 and Pz were the channels with lower correlation. The locations of T3 and Pz of brain plays an important role in feeling music[3]. Only alpha wave has been observed when analysed the effect of nasyid and rock music . Using EEG, the brainwave signal of the sample was captured twice, once before listening to the music and while listening to the music. When both the brainwave signals are compared, it is observed that 60-80% of the samples showed improvement in the alpha band after listening to nasyid while only 56-66% improved after listening to rock music. The maximum value increased in alpha wave was $11.023\mu\text{V}$ and minimum value decreased was $0.755\mu\text{V}$. The alpha power increased when listening to the nasyid music as compared to the rock music. Nasyid music can result in a more relaxing condition as compared to the rock music. Noise affected the fast brain activity by increasing the

magnitude of beta wave and decreasing the magnitude of alpha wave[3]. The magnitude of alpha wave can be used as indicator either the person is in stress or not.

The work of author Rajeswari Sridhar et.al. proposed a method to identify the raga of a Carnatic music[6]. The input polyphonic music signal is analyzed and the instrument and the vocal signal are separated. After extracting the vocal signal segmentation is done. Using singer identification algorithm, the singer is determined to know the fundamental frequency of the singer. The frequency components of the signal are mapped into the swara sequence and the Raga of the particular song is determined. HPS algorithm is used to identify the frequency components in a single segment [6]. Energy is used as the basis for identifying the distinct frequency component in each segment. Highest energy frequency component is a swara. To map this frequency component to swara, fundamental frequency is identified by performing the process of singer identification. The fundamental frequency normally corresponds to S. This system has to be improved with a Hidden Markov Model based approach where the low level features and HMM combined for better and accurate identification. This system's basic disadvantage is the assumption of fundamental frequency and hence fundamental frequency is needed to be determined. The system has to be modified to use the identified raga to index songs and use raga as a query for music information retrieval.

Impact of music on HRV is discussed by author Prof. AR Srinivasan[7]. Music therapy (MT) is a facet of complementary and alternative medicine (CAM). Heart rate variability (HRV) represents the difference between the highest and lowest heart rate. The time series of beat-to-beat intervals from ECG or arterial pressure tracings are analysed and HRV calculated. Music can regulate HRV to our body's advantage [7]. Music and its effect on HRV are like relaxing (slow) music effects a considerable reduction in the heart rate and increase in HRV. Classical music provides greater comfort as against other forms and there is a correlation between the balance of MWSA and RSA components and the psychological evaluation. Generally, variance of MWSA decreases as the comfort increases and vice-versa. The effect of Music therapy on vegetative patients has provided interesting results. As per the study, both standard deviation of all normal RR interval and root mean square successive differences in heart rate variability of the subject increased, which results into enhancement in the activity of cardiovascular system. All of the dementia patients were assessed for neuropsychological functions and ECG recordings were taken prior to and following 15-week treatment. The treatment was of thirty music therapy sessions. Depression significantly decreased. HRV improved considerably in 50% patients. HRV can be improved by music regardless of language and meaning of musical lyrics [7]. Music therapy increased feeling of relaxation and decreased fatigue in cancer patients. HRV parameters showed that parasympathetic nervous system activity increased and sympathetic nervous system activity decreased. Music therapy is clinically useful in promoting relaxation sensation and enhancing parasympathetic nervous system activity in cancer patients.

In the paper, authors Hiteshwari Sharma and Rasmeet S. Bali, raga recognition [8] is performed on a set of ragas which are collected from live performances of these ragas, both vocal and instrumental. Raga recognition is performed using machine learning classifiers. The factors for comparison between these classifiers are average accuracy, precision, recall, kappa statistic. The result shows that K-star algorithm performs better for raga identification with an accuracy of 93.38% [8]. Raga recognition is being performed on the four ragas i.e. Des, Bhupali, Yaman and Todi which are based on variation of ten basic Thaats or musical scale using machine learning classifiers Raga. Feature extraction-The audio performances are converted into .wav (wave amplifier) extension and chroma features are extracted from them using MIR (Music Information Retrieval) toolbox in Matlab. Chromagram is a visual representation of energies in the semitones. They have extracted the semitone exhibiting maximum energy by using max function in MIR for each frame and get semitone sequences corresponding to that raga. To have proper identification irrespective of knowledge of scale they have used absolute frequency scale used by the chromagram to the corresponding scale of the musical piece. Classifiers used are Random forest classifier, C4.5, Bayesian network and K-star. C4.5 classifiers build decision trees from a set of training data using information entropy. Bayesian classifiers are Probabilistic graphical model represented using directed acyclic graph. Random forest classifier is a combination of tree predictors and random selection features; performs well when fewer instances are present.

K star algorithm uses entropic measure based on probability of transforming an instance into another. It performs well when more instances are present.

The author Mr. Avesh Kumar discussed that melody is the key-note of Indian classical Music [1]. The 'Raga' is the basis of melody in classical music. Music therapy is the most expressive therapy. Music therapy is an process in which music is used for the treatment of different physical emotional, mental, social problems. Music therapy not only heals the disabled or ill persons but also helps to improve quality of normal and healthy persons. It is believed that classical Indian ragas can be beneficial for insomnia, high and low blood pressure, schizophrenia and epilepsy. There are other ragas that can help to fight with ageing and pain too. Music therapy stimulates beta cell activities and enhances the quality of protein release of brain chemicals. It enhances the quality of neurotransmitters and conditions the heart.

The timbre model presented by author Kristoffer Jensen is based on a sinusoidal model, and it consists of a spectral envelope, frequencies, a temporal envelope and different irregularity parameters [9]. The timbre model can be used to re-synthesize the sound, with some or all of the parameters of the model. Timbre is defined as the quality which distinguishes two sounds with the same pitch, loudness and duration. Timbre is generally multidimensional. The difficulty of timbre identity research is that many timbre parameters are more similar for different instrument sounds with the same pitch, than for sounds from the same instrument with different pitch that means timbre parameters of a high pitched sitar sound are closer to the parameters of a high-pitched flute sound than to a low-pitched sitar sound.

In the paper, authors Sanjoy Bandopadhyay and K.Bhattacharya noticed raga Malkauns always reduces stress by the dominance of the parasympathetic nerves when subjects (both IRM initiated and IRM ignorant) listen to faster part or drut gat. But it fails when they listen *alap* (आलाप) of Malkauns[2]. In case of Yaman raga stress can be reduced by listening fast portion of raga but it is limited to IRM initiated subjects. *Komal svaras*(कोमलस्वर) always create positive impact in minimizing the stress. But this is not the case with *tivra svaras*(तीव्रस्वर), it fails in case of IRM ignorant people. Now what about renditions? The answer is fast renditions have always positive impact to bring stress level down.

In the paper, authors Joyanta Sarkar and Utpal Biswas presented how a different raga affects the human body. Power of music can cure many diseases. Music has shown its effect on health since ancient times. Indian famous musician, Thyagaraja brought a dead person back to life by singing the composition Naa Jeevan Dhara in Bihari raga. Compositions of raga have a relaxing effect on the mind as well as on the body. Sound vibrations are generated by repeated listening to the specific raga which is chosen for a particular disease. When impulse is given, muscles and nerves get contracted and relaxed during the interval between two impulses. Musical notes promote the blood flow and pressure gets reduced. Blood flow and energy flow get enhanced, makes quick healing. Music with 70-75 beats per minute same as normal heart beat of 72 has a very calming effect. Listener's mood is an important aspect in music therapy. Different raga evokes different state of mind. Kafi Raga evokes calm and deep mood while sweet, heavy, cloudy and stable state of mind is evoked by Raga Pooriya Dhansari. Raga Mishra Mand has a very pleasing sweet touch. Raga Darbari helps to ease tension. For better results raga should be listened during allotted time. Like, Todi should be listen in morning for high blood pressure, malkauns in night before sleep to cure low blood pressure etc. Thus, Each raga has its own property of human treatment.

SUMMARY

From this, it is understood that that Indian Classical music has good impact on health. It helps to control the body parameters like blood pressure, Blood sugar, etc. It is also helpful for normal human being to maintain the regularity in body parameters, to reduce stress, to have sound sleep and so many. "Malkauns" Raga is beneficial for blood pressure control and "Bageshree" is best suited for diabetes patients. Thus, music therapy can be used as an alternative medicine or support to medication to maintain good health.

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