REVIEW OF RESEARCH

EFFECT OF HINDUSTANI CLASSICAL MUSIC ON HUMAN BODY UTILIZING BODY SENSOR NETWORKS

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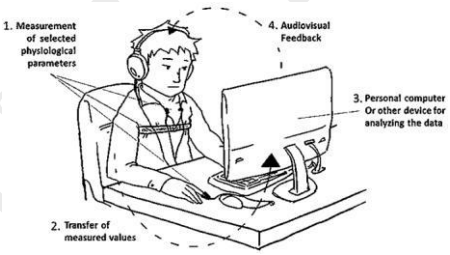
ABSTRACT:

Now a days, music plays an important role in every human life. Due to heavy work pressure, people listen music to relax.In this work, we present the effects of instrumental musicon the human body by using Body Sensor Networks (BSNs). We chose instrumental music because this type of music only uses musical components such as pitch, intensity, rhythm and timbre. It does not use any component such as verbal language (lyric). So, the effects get generated exclusively from the musical components. The simulation results of our approach are validated through sarode recitals.

KEYWORDS: *Body sensor networks (BSNs),Instrumental Music, Brain activity, HVE test.*

1. INTRODUCTION

In public network applications, Body Sensor Networks (BSNs) applications are in awesome interest in different fields, for example, medical care [1-3], games, amusement [4-6], military-industrial sector [7], and the social public field [8-10], and have continuously turned into an examination hotspot [10]. BSN is a sort of WSN which is shaped by physiological parameter sensors placed in the human body, on the body surface, or around the body [10].



BSNs comprise of smaller than expected remote sensors that are sent on a man's body to gather information identified with physiological parameters, for example, temperature, blood glucose level, or heart rate. This information is then transmitted to a central gateway device, for example a cellphone or PDA, which in turn can convey it to a healthcare provider or physician over the Internet. Music has an endless impact over the countries and people groups [35]. Every known culture on the earth has music. Music seems to be one of the basic actions of humans. However, early music was not handed down from generation to generation or recorded. Hence, there is no official record of "prehistoric" music. Even so, there is evidence of prehistoric music from the findings of flutes carved from bones. The influence of music on society can be clearly seen from modern history. According to an ancient Indian text, SwaraSastra, the seventy-two melakarta ragas (parent ragas) control the 72 important nerves in the body. It is believed that if one sings with due devotion, adhering to the raga lakshana (norms) and srutishuddhi, (pitch purity) the raga could

affect the particular nerve in the body in a favourable manner. According to the Vedic Philosophy, yoga and music both are part of Nada Vidya. Yoga deals with realisation of anahata nada the sublime sound (extrasensory vibrations) of the eternal force of cosmic consciousness. Music pertains to the perception and expression of the infinite spectrum of the rhythmic flow of the ahata nada (perceivable sonic currents) pervading in Nature. Both have direct impact on the shat chakras hidden along the endocrine column and hence affect our physical as well as subtle bodies. The seven basic swaras (musical notes) of the musical octave have a one-to-one correspondence with these chakras (nuclei of subtle energy). The lower most (in the kava equina region along the erect endocrine column), viz., the Muladhara Chakra is associated with the swara "sa"; that means, the practice of chanting this particular musical note will have impact on awakening or activation of this particular chakra. Similarly, the chakras successively upwards in this direction namely, the Swadhisthana, Manipura, Anahata, Vishuddha, Agya and the top-most Sahastrara Chakra have correspondence respectively with the swaras "re", "ga" "ma", "pa", "dha" and "ni". Significantly, the order of thecompositions of these swaras in the "aroha" (ascending)and "avaroha" (descending) patterns of the Shastric musical tunes also match with the top-down (from Sahastrara to Muladhara) and bottom-up (from Muladhara to Sahastrara) directions of the flow of energy. Music has been used throughout human history to express and affect human emotion.

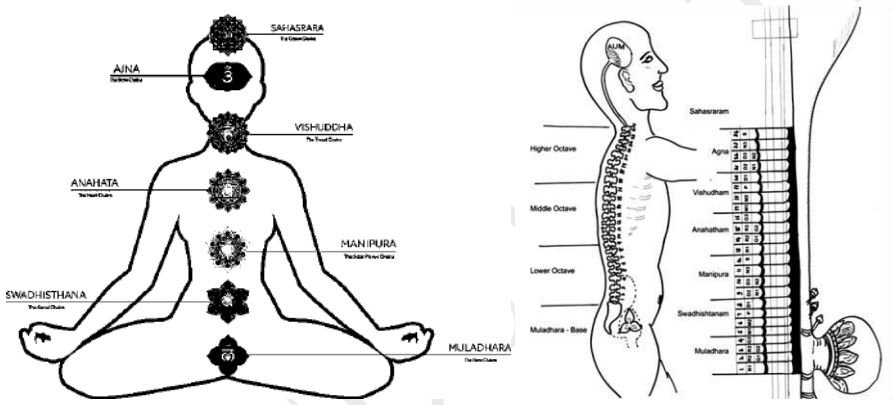


Image: Chakras - Energy Centres In the Human Body Image: Courtesy – Sangeetakalpadrumam

2. LITERATURE SURVEY

Albert Einstein is recognized as one of the greatest scientist who has ever lived. A little known fact about Einstein is that when he was young he did extremely poor in school. His grade school teachers told his parents to take him out of school because he was "too stupid to learn" and it would be a waste of resources for the school to invest time and energy in his education. The school suggested that his parents get Albert an easy, manual labor job as soon as they could. His mother did not think that Albert was "stupid". Instead of following the school's advice, Albert's parents bought him a violin. Albert became good at the violin. Music was the key that helped Albert Einstein become one of the smartest men who has ever lived. Einstein himself says that the reason he was so smart is because he played the violin. In general, responses to music are able to be observed. It has been proven that music influences humans both in good and bad ways. These effects are instant and long lasting. Music is thought to link all of the emotional, spiritual, and physical elements of the universe. Music can also be used to change a person's mood, and has been found to cause like physical responses in many people simultaneously. Music also has the ability to strengthen or weaken emotions from a particular event such as a funeral. Rhythm is also an important aspect of music to study when looking at responses to music. There are two responses to rhythm. These responses are hard to separate because they are related, and one of these responses cannot exist without the other. These responses are –

(1) The actual hearing of the rhythm and
(2) The physical response to the rhythm.

Rhythm organizes physical movements and is very much related to the human body. For example, the body contains rhythms in the heartbeat, while walking, during breathing, etc. Another example of how rhythm orders movement is an autistic boy who could not tie his shoes. He learned how on the second try when the task of tying his shoes was put to a song. The rhythm helped organize his physical movements in time. It cannot be proven that two people can feel the exact same thing from hearing a piece of music. Responses to music are easy to be detected in the human body. Classical music from the baroque period causes the heart beat and pulse rate to relax to the beat of the music. As the body becomes relaxed and alert, the mind is able to concentrate more easily. Furthermore, baroque music decreases blood pressure and enhances the ability to learn. Music affects the amplitude and frequency of brain waves, which can be measured by an electro-encephalogram. Music also affects breathing rate and electrical resistance of the skin. It has been observed to cause the pupils to dilate, increase blood pressure, and increase the heart rate. The Power of Music on Memory and Learning.Music is processed in all areas of the brain and has the ability to access and stimulate areas of the brain that may not be accessible through other modalities. Music beats have a very close relationship with heart beats. Music having **70-75** beats per minute equivalent to the normal heart beat of **72/**minute has a very soothing effect likewise rhythms which are slower than **72** beats per minute create a positive effect on the mind, heart and body. Rhythms which are faster than the heart rate excite and rejuvenate the body. The flow of blood through the heart follows a very deliberate path to ensure that blood oxygenated from the lungs passes through major arteries and delivered to body tissue. This process occurs on an average of 72 times a minute, pumping about 2,000 gallons worth of blood every day.

A Contribution

In this section, we present our major contributions. First we proposed a model where we show the effect of instrumental music on human body. Second, we proposed a High Body Effect Message Algorithm (HBEMA) to generate the message when the effect is exceeded or equal to thethreshold value.

B Motivation

Recently instrumental music plays a vital role for our enjoyment as well as our treatment so there must be some algorithm to detect the effect of various instrumental music on our body.

C Pre-requisites

In this section we describe about body sensor network that we have used in our approach. BSNs are a kind of WSN which is formed by physiological parameter sensors placed in the human body, on the body surface or around the body. The main techniques it covers are sensors, data fusion, and network communication. It is not only a new type of universal health care, disease monitoring, and prevention solution, but also an important component of the so-called Internet of Things. Its main purpose is to provide an integrated ubiquitous computing hardware, software, and wireless communication technology platform, and an essential condition for the future development of ubiquitous health care monitoring systems.

2 Related Work

In [11] author proposed a graphical theoretical analysis of cortical thickness co-variations (as indirect indicatorof connectivity) to examine whether AP musicians differ from relative pitch musicians and non-musicians in small-world network characteristics. In [12] author proposed ashortandlong-term effects of listening to music and making music on functional networks and structural components of the brain. The specific influence of music on the developing brain is emphasized and possible transfer

effects on emotional and cognitive processes. The data on the potential of music making supports and facilitate neurorehabilitation. In[13] author proposed a gray matter volume differences in motor, auditory, and visual–spatial brain regions when comparing professional musicians (keyboard players) with a matched group of amateur musicians and non-musicians. Although some of these multiregional differences could be attributable to innate predisposition and represents structural adaptations in response to long-term skill acquisition and the repetitive rehearsal of those skills. In [14] author investigated the efficacy of music therapy techniques as an aid in improving mood and social interaction after traumatic brain injury or stroke whereeighteen individuals with traumatic brain injury or stroke were assigned either standard rehabilitation alone or standard rehabilitation along with music therapy (3 treatments per week for up to 10 treatments). In [15] author evaluated the effect of a strength training program on anxiety, affect, and mood in a group of older adults (≥ 65 years). Twenty men and women participated in a 12-week strength training program. Participants were randomized to an intervention and a waiting list control group. Trait anxiety showed a decline in both groups. When mood profiles of participant'swereanalyzed across the initial 12-week of the study, a dimension of mood called Vigor-Activity significantly decreasedin the control group while the intervention group'sscores did not change. The affect data showed that negative affect decreased significantlyin the intervention group following the training protocol.

3 Proposed Model

Slno	Description	Raga Kedar	Raga Jayajayanti	Raga Adana
1	Nature	Shaadava-Sampurna	Shadav-Sampoorna	Shadav-SampoornaVakra
2	Arohan	S M P, m P D n D P, m P S	S R G m P m G m P N S	S R m P d n S
3	Avarohan	S N D P,m P D P M, S R S	S n D P m G R g R S	S d n P m P g m R S
4	Thata	Kalyan	Khamaj	Asawari
5	Timing	First Prahar of Night	6pm to 9pm	Last Night !2Pm-3am

BSN plays an important role to detect the internal activity of the human body. The proposed model is shown in Fig.1. In Fig.1.When the instrumental music is generated, the signal is passed to thehuman brain through ear.We used body sensors to detect the internal activity of the human body. The computer interfaceis used to show the signal flow. Based on the different signal flowS= {S_1 ,S_2,...,Sn} different action can be taken.We used Action taking Center (ATC) where ATC takes an intelligent decision. ATC collects the data from the computer interface in a different time slot and checks the different status of the Heart, brain, pressure etc. ATC maintain a threshold value$ATC_{threshold}$. For the different signal the ratio of the variance is computed. If the ratio of the variance is equal or greater than the threshold value then ATC generates High Body Effect (HBE) message. We comparing the variance of the output patterns over one epoch to the variance of the input patterns over one epoch.

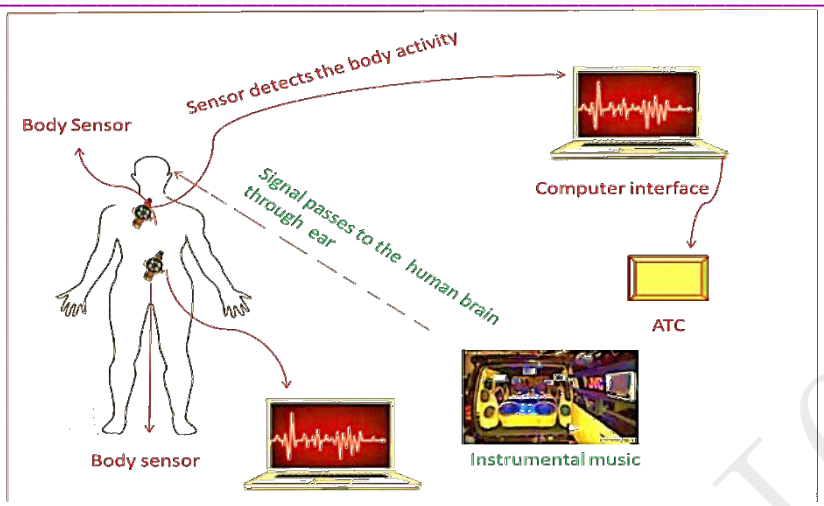


Fig.1. Proposed Model

The variance of the d-th dimension denoted as A^2d in a set of N-D dimensional vectors ,Π^n=[a_1^n ,a_2^n,a_3^n,…….,a_n^n]^{T}where n=1,2,….,n is given by

$$A^2_d = \frac{1}{N-1}\sum_{n=1}^{n}(\Pi_d^n - \mu_d)^2 \quad \text{..... (1)}$$

Where, the mean $\mu_d$is given by

$$\mu_d = \sum_{n=1}^{n}(\Pi_d^n) / N \quad \text{..... (2)}$$

The total variance denoted as V for one epoch is given by

$$V=\sum_{d=1}^{D} v_d \quad \text{.....(3)}$$

The variance ratio is computed as follows:

$$V_{ratio} = V_{out}/V_{in} \quad \text{.....(4)}$$

Based on the value of V_{ratio} ATC generate the HBE message.

3.1 Algorithmto generate the HBE message

In this section, to validate our proposed model, we derived an algorithm named High Body Effect Message Algorithm (HBEMA) to make an intelligent decision of ATC. Where at first generate the instrumental music signal. Sensor detects the different status of the body after listening the music. We compute A^2_d ,V,Vratiohas given in Equation1,3,4.Set the $ATC_{threshold}$ value if $V_{ratio} \geq ATC_{threshold}$then generate HBE message.

1. Generate the instrumental Signal S= $\{S_1, S_2, \ldots, S_n\}$.
2. Set $ATC_{threshold}$ value.
3. Sensordetects the internal activity of the body and pass to the computer interface.
4. For every signal $\{S_1, S_2, \ldots, S_n\}$ do
5. Calculate A^2_d
6. Calculate V
7. Calculate Vratio
8. *end for*
9. Compare $ATC_{threshold}$ and V ratio
10. If $V_{ratio} \geq ATC_{threshold}$
11. Generate HBEmessage

Algorithm 1. The HBEMA algorithm

4 RESULTS AND ANALYSIS

At the point when the instrumental music is produced, the sign is gone to the human cerebrum through ear. We utilized body sensors to distinguish the inner movement of the human body. The PC interface is utilized to demonstrate the sign stream. All the signals are recorded at Tripura Sundari District Hospital, Udaipur under typical room temperature and minimum uproarious environment. Recording has been done in two stages. All signs are taken in ten minutes length of time. At long last, recorded signs are prepared. We used 20patients and for each patient we used same raga for 30 minutes (Raga Kedar for 10 min, Raga Jayjayanti for 10 min, Raga Adana for 10 min) and take the Heart Rate Variability (HRV) test.

Patient Information- 1

Name of the Patient	Disease Suffer From	Profession	Code
AtanuSarkar	Cardiac Patient	Businessman	AS
Partha Biswas	Cardiac Patient	Businessman	PB
Sunil Mandol	Cardiac Patient	Medical Representative	SN
GoutamDey	Cardiac Patient	Teacher	GD
SurendraReang	Cardiac Patient	Farmar	SR
SantanuChakraborty	Cardiac Patient	Gram RojgarSevak	SC
Himangshu Pal	Cardiac Patient	Retired Govt Job	HP
KamatiReang	Cardiac Patient	House Wife	KR
Pratima Barman	Cardiac Patient	House Wife	PB
PadmaLochan Tripura	Cardiac Patient	Teacher	PT

NidhuRnSaha	Cardiac Patient	Farmar	NS
Pankaj Roy	Cardiac Patient	Teacher	PR
JatindraReang	Cardiac Patient	Farmar	JR
MuktajoyReang	Cardiac Patient	Farmar	MR
Mantri Tripura	Cardiac Patient	Farmar	MT
JharnaBibi	Cardiac Patient	House Wife	JB
ArshadMiah	Cardiac Patient	Farmar	AM
LutafaBegam	Cardiac Patient	Farmar	LB
KajalRnBhadra	Cardiac Patient	Farmar	KB
Debasish Das	Cardiac Patient	Farmar	DD

Patient Information- 2

Name of the Patient	Age	Blood Group	Weight	Height
AtanuSarkar	57	B+	66 kg	162.56 cm
Partha Biswas	43	B+	64 kg	160.02 cm
Sunil Mandol	65	O +	57 kg	167 cm
GoutamDey	38	AB+	61.5 kg	161 cm
SurendraReang	64	B+	57.3 kg	156 cm
SantanuChakraborty	73	A+	74 kg	158 cm
Himangshu Pal	29	AB -	63.4 kg	168 cm
KamatiReang	65	O+	76 kg	165.3 cm
Pratima Barman	39	B -	59 kg	164 cm
PadmaLochan Tripura	64	AB+	63 kg	160 cm
NidhuRnSaha	58	B+	76.2 kg	157.56 cm
Pankaj Roy	64	B+	73 kg	160.03 cm
JatindraReang	75	AB -	69.3 kg	155 cm
MuktajoyReang	68	A+	74 kg	156.54 cm
Mantri Tripura	52	B+	67 kg	163 cm
JharnaBibi	34	A+	67.4 kg	161 cm
ArshadMiah	67	B+	70.3 kg	158 cm
LutafaBegam	63	B+	65.3 kg	159 cm
KajalRnBhadra	59	AB+	67.3 kg	168 cm
Debasish Das	62	B+	72.4 kg	162 cm

Pulsebeat of Patient

Name of the Patient	Before Music Pulsebeat	After Music Pulsebeat	Remarks
AtanuSarkar	92 Per Minute	79 Per Minute	Music Therapy Results
Partha Biswas	101 Per Minute	84 Per Minute	Music Therapy Results
Sunil Mandol	97 Per Minute	73 Per Minute	Music Therapy Results
GoutamDey	98 Per Minute	79 Per Minute	Music Therapy Results
SurendraReang	89 Per Minute	74 Per Minute	Music Therapy Results
SantanuChakraborty	104 Per Minute	81 Per Minute	Music Therapy Results
Himangshu Pal	107 Per Minute	79 Per Minute	Music Therapy Results
KamatiReang	91 Per Minute	73 Per Minute	Music Therapy Results
Pratima Barman	89 Per Minute	70 Per Minute	Music Therapy Results
PadmaLochan	99 Per Minute	73 Per Minute	Music Therapy Results

Tripura			
NidhuRnSaha	91 Per Minute	71 Per Minute	Music Therapy Results
Pankaj Roy	89 Per Minute	68 Per Minute	Music Therapy Results
JatindraReang	101 Per Minute	69 Per Minute	Music Therapy Results
MuktajoyReang	95 Per Minute	76 Per Minute	Music Therapy Results
Mantri Tripura	90 Per Minute	73 Per Minute	Music Therapy Results
JharnaBibi	101 Per Minute	81 Per Minute	Music Therapy Results
ArshadMiah	96 Per Minute	74 Per Minute	Music Therapy Results
LutafaBegam	83 Per Minute	74Per Minute	Music Therapy Results
KajalRnBhadra	108 Per Minute	77 Per Minute	Music Therapy Results
Debasish Das	103 Per Minute	71 Per Minute	Music Therapy Results

Blood Pressure of Patient

Name of the Patient	Age	Before Music Blood Pressure	After Music Blood Pressure	Remarks
AtanuSarkar	57	164/78	136/91	Music Therapy Results
Partha Biswas	43	167/81	125/84	Music Therapy Results
Sunil Mandol	65	165/64	134/89	Music Therapy Results
GoutamDey	38	161/63	125/81	Music Therapy Results
SurendraReang	64	153/75	133/87	Music Therapy Results
SantanuChakraborty	73	169/78	137/91	Music Therapy Results
Himangshu Pal	29	157/71	125/83	Music Therapy Results
KamatiReang	65	168/83	135/88	Music Therapy Results
Pratima Barman	39	162/66	127/83	Music Therapy Results
PadmaLochan Tripura	64	151/78	136/87	Music Therapy Results
NidhuRnSaha	58	157/73	134/86	Music Therapy Results
Pankaj Roy	64	148/62	134/90	Music Therapy Results
JatindraReang	75	161/81	139/91	Music Therapy Results
MuktajoyReang	68	162/74	143/89	Music Therapy Results
Mantri Tripura	52	157/69	131/85	Music Therapy Results
JharnaBibi	34	163/74	127/85	Music Therapy Results
ArshadMiah	67	153/78	139/83	Music Therapy Results
LutafaBegam	63	162/73	141/88	Music Therapy Results
KajalRnBhadra	59	168/72	131/86	Music Therapy Results
Debasish Das	62	157/79	134/87	Music Therapy Results

We take the average value of V_{ratio} for each patient and the age limit of each patient's is 29≥age≤75.Before start our experiment we record the initial condition (pulse rate, pressure, sugar label etc.) of every patient. We set the $ATC_{threshold}$value 0.35. If V_{ratio}≥ $ATC_{threshold}$then ATC generate the HBE message. Fig.2shows the first day's results of average $V_{ratio\ for}$ 20patientand we use Raga Kedar, Raga Jaijawanti, Raga Adana [32][34] for different experiments.Fig.3. and Fig.4.for day- 2 and day- 3 respectively.

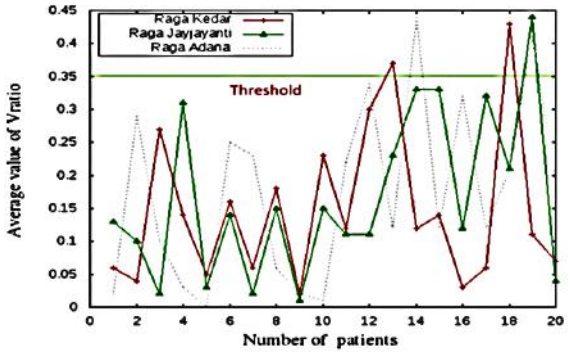


Fig.2. The results of V_{ratio} with respect to different patient's for day-1

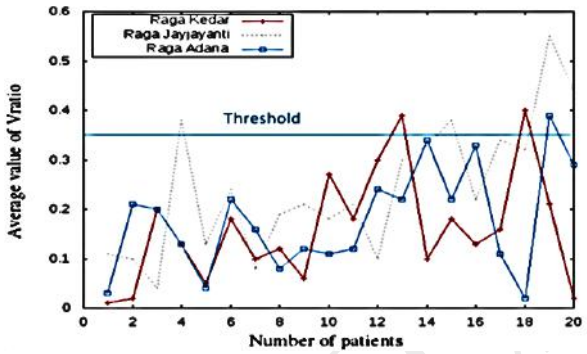


Fig.3. The results of V_{ratio} with respect to different patient'sfor day-2

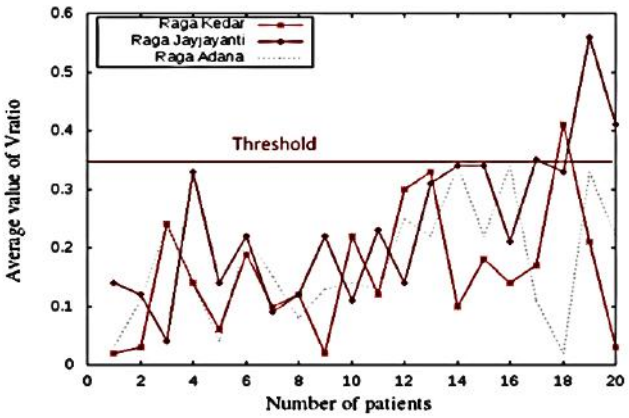


Fig.4. The results of V_{ratio} with respect to different patient'sfor day-3

5 CONCLUSION AND FUTURE WORK

In this work, we analyzed the effect of Instrumental music on human body using BSNs. We used Raga Kedar,Raga Jaijawanti and Raga Adana and we have taken 20 patients in our experimentation and for each patient we took the HRV test and analyze the effect of different Raga for different patients. In our future work, we try to improve the health of autistics patients by using this approach.

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