

The Emotional Effect of Semi Classical Carnatic Music using Linguistic Aggregated Fuzzy Relational Maps

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ABSTRACT

People's primary motivation for listening to music is its emotional effect. Assigning musical emotion to a song segment in a deterministic way does not work well because not all people share the same feeling for a song. The success of becoming a hit song from the same raga song among people is its musical features within the song. The subjective nature of listening knowledge of human to different Carnatic raga perception suggests that fuzzy logic is a more appropriate tool for an unsupervised data. This paper deals with the Linguistic Aggregated Fuzzy Relational Maps which is the combination of the linguistic variables with their aggregation and Fuzzy Relational Maps. LAFRMs method is mostly used for humans' expression or feelings expressed for the causes and its effects in terms of linguistic languages. The process of expressing linguistic knowledge is described as unsupervised data. The problem of musical emotions caused by thirteen Carnatic ragas based Tamil songs were analyzed using LAFRMs. This is the first attempt of using fuzzy tool to analyze this problem. The result shows the effectiveness of the proposed method for the application in this linguistic environment.

Keywords

Linguistic variables, Triangular fuzzy number, Fuzzy relational maps, Carnatic raga, Musical feature.

1. INTRODUCTION

The meaning of the music in terms of emotions is subjective in nature. Several psychological conditions of the Human Beings decide the emotion category of a song or musical excerpts. Representations of musical emotions with the psychology remain a dynamic topic for research. There are several computational models available for mood classification. Music is used in several applications in society that believes its effectiveness in evoking emotions. Carnatic music from Indian tradition has rasas (emotions) and its singing timing of the day. The use of Carnatic ragas in Indian movies and devotional songs are more often utilized by Indian composers. For these compositions, the emotional experiences vary from one person to another in an uncertain manner. The developed Linguistic Aggregated FRM model of Fuzzy Relational Maps is used as a major method to assign the emotional factors to the appropriate Carnatic ragas with musical features through musical excerpts. Fuzzy Relational Maps are introduced by W.B. Vasantha and Yasmin Sultana [7]. Every human being judgments on experiences are described in terms of linguistic language. Moreover instead of having numerical value approach for innermost feelings of human being, linguistic memberships are more sensible in bringing communications more clearly. Linguistic variable assessments are applied in FRMs to develop the model. These FRMs are basically derived from relating two disjoint units of domains by causal relations. The causal relations are alternated by different linguistic level of experiences of an

individual or a group is observed. Further linguistic variables are aggregated with the use of triangular fuzzy numbers. Then the model has been developed to apply in an uncertain linguistic environment. Few ideas about Carnatic ragas and Musical Features are explained in this section.

Rest of this paper consists of three sections. In section 2, the preliminary definitions on the proposed method are given. The problem description and adaptation of the method discussed in section 3. Conclusions are derived in the final section to show the effectiveness of the proposed method.

1.1 Carnatic Ragas

One of the melodic modes used in Indian Classical music is a raga. They use a series of five or more musical notes in which a melody is constructed. These ragas are associated with seasons and emotions in the Indian musical tradition. Indian film and devotional song composers often use non-classical form ragas in their compositions. There are 72 Melakarta ragas and derived sub ragas in the system. Improvisation plays a major role in Carnatic music. Some musical feature ideas used in composition are explained below.

1.1.1 Mode Feature

It can be derived from various scales (ie.) families of pitches where as only thirteen Carnatic ragas structured from these scales are considered for this study.

1.1.2 Rhythm Feature

It is generated by divisions of the beat. Rhythm strength, regularity and tempo are closely related with people's moods or responses (Liu et al., 2003) [4]. It is the phase of time in music. Regular and irregular rhythms are mostly used in compositions.

1.1.3 Harmony Feature

It is the art of combining pitches into chords in which several notes played simultaneously at a time. Chord, progression, consonance, dissonance are its techniques in Western music.

2. PROPOSED METHODOLOGY

The basic definitions of fuzzy relational maps and the developed linguistic aggregated fuzzy relational maps are briefly explained in this section.

2.1 Fuzzy Relational Maps (FRMs)

A FRM is structured as a map by making causal relationships between the domain and range space elements. The elements of the domain space are taken from the real vector space of dimension n and that of the range space are real vector space of dimension m (m in general need not be equal to n). We denote by D the set of nodes D_1, \dots, D_n of the domain space where $D_i = \{x_1, \dots, x_n\} / x_i = 0 \text{ or } 1$ for $i = 1, \dots, n$. If $x_i = 1$, it means that the node D_i is in the ON stage and if $x_i = 0$ it means that the node D_i is in the OFF state. Similarly R denotes the set of nodes R_1, \dots, R_m of the range space, where

$R_j = \{x_1, x_2, \dots, x_m\} / x_j = 0 \text{ or } 1\}$ for $j = 1, \dots, m$. If $x_j = 1$ it means that the node R_j is in the ON state and if $x_j = 0$ it means that the node R_j is in the OFF state.

2.2 Linguistic FRM

A directed graph or a map from D to R is constructed as Linguistic FRM with causes and their effects as nodes and their linguistic causalities as edges. It represents linguistic causal relationship between spaces D and R .

2.3 Linguistic Experience Matrices

Let iD_i and iR_j denote the two nodes of Linguistic FRM. The directed edge from iD_i to iR_j denotes the causality relation of iD_i on iR_j . Every edge in the Linguistic FRM is weighted with the different level of linguistic terms. Linguistic experience matrices are formed with the use of number of experience strength of group for different levels. These level matrices are denoted by $N_{Level-(k)}^{(k)}$ and defined as,

$$N_{Level-(k)}^{(k)} = [b_{ij}^{(k)}] \quad \forall k = \text{low, medium, high...etc, where}$$

b_{ij} is the weight of the edge iD_i iR_j . The weight of the edge from any node iD_i to any node iR_j is described by the linguistic terms $\{0 \text{ (no effect), } vl \text{ (very low), } l \text{ (low), } m \text{ (medium), } h \text{ (high), } vh \text{ (very high)}\}$. According to the problem description, these linguistic term levels can be extended further.

2.4 Linguistic Relational Matrix

Let ${}^iD_1, \dots, {}^iD_n$ be the nodes of the domain space D of Linguistic FRM and ${}^iR_1, \dots, {}^iR_m$ be the nodes of the range space R of an Linguistic FRM. Let the matrix M be defined as

$$M = [e_{ij}]$$

where $e_{ij} = \max \text{linguistic level} \left(\max \left(b_{ij}^{(1)}, b_{ij}^{(2)}, b_{ij}^{(3)} \right) \right)$, and e_{ij} is the maximum linguistic weight of the directed edge iD_i iR_j (or iR_j iD_i), M is called the linguistic relational matrix of the Linguistic FRM with linguistic variable entries.

2.5 Fuzzy Nodes

When the nodes of the Linguistic FRM are fuzzy sets then they are called fuzzy nodes. Here fuzzy sets are defined by converting linguistic terms into fuzzy numbers.

2.6 Triangular Relational Matrix

The matrix M with the linguistic variables is converted with the entries of fuzzy numbers for the corresponding linguistic variables. Triangular fuzzy numbers (a_{ij}, b_{ij}, c_{ij}) for the linguistic variables are considered. Then triangular relational matrix $Tr(M)$ defined as, $Tr(M) = [t_{ij}]$ where $t_{ij} = (a_{ij}, b_{ij}, c_{ij}) \quad \forall i = 1, 2, \dots, n \text{ \& } j = 1, 2, \dots, m$.

2.7 Relational Matrix with Left and Right Values

This triangular relational matrix is aggregated by finding left (ls) and right (rs) values of triangular numbers. The following formulae are used to calculate this:

$$ls_{ij} = \frac{b_{ij}}{1 + b_{ij} - a_{ij}} \quad \& \quad rs_{ij} = \frac{c_{ij}}{1 + c_{ij} - b_{ij}}$$

Then $Tr(M) = [(ls_{ij}, rs_{ij})]$.

2.8 Linguistic Aggregated Relational matrix

Then triangular relational matrix is further aggregated as normalized value to get single number. This is done by,

$$x_{ij} = \frac{ls_{ij}(1 - ls_{ij}) + rs_{ij} \cdot rs_{ij}}{1 + rs_{ij} - ls_{ij}}. \text{ Then } LA(M) = [x_{ij}] \quad \forall i =$$

$1, 2, \dots, n \text{ \& } j = 1, 2, \dots, m$. The entries of $LA(M)$ are called as triangular aggregated vectors.

2.9 Instantaneous stage vector

Let ${}^iD_1, \dots, {}^iD_n$ and ${}^iR_1, \dots, {}^iR_m$ denote the nodes of the LAFRM. Let $A = (a_1, \dots, a_n) \quad a_i \in \{0, \pm 1\}$. A is called the instantaneous stage vector of the domain space and it denotes the *ON-OFF* position of the nodes at any instant. Similarly let $B = (b_1, \dots, b_m) \quad b_j \in \{0, \pm 1\}$. B is called instantaneous stage vector of the range space and it denotes the *ON-OFF* position of the nodes at any instant. Then a_i or $b_j = 0$ if a_i or b_j is *OFF* and a_i or $b_j = 1$ if a_i or b_j is *ON* $\forall i = 1, 2, \dots, n \text{ \& } j = 1, 2, \dots, m$.

2.10 Cyclic and Acyclic

The LAFRM is said to be a cyclic if its edges possess a directed cycle. An LAFRM is said to be acyclic if its edges do not possess any directed cycle.

2.11 LAFRM with Feedback

The LAFRM with cycles is said to be an LAFRM with feedback.

2.12 Dynamical system

The LAFRM is said to be a dynamical system, when the causal relations flow through a cycle in a revolutionary manner with feedback.

2.13 Hidden Pattern

Let iD_i iR_j (R_j iD_i), $1 \leq i \leq n$, $1 \leq j \leq m$. When iR_i (or iD_j) is switched *ON* and if causality flows through edges of the cycle and if it again causes iR_i (or iD_j), the dynamical system goes round and round. This is true for any node iR_j (or iD_i) for $1 \leq j \leq m$ (or $1 \leq i \leq n$). The equilibrium stage of this dynamical system is called the hidden pattern.

2.14 Fixed Point

If the equilibrium state of a dynamical system is a unique stage vector, then it is called a fixed point. Consider an LAFRM with ${}^iR_1, {}^iR_2, \dots, {}^iR_m$ and ${}^iD_1, {}^iD_2, \dots, {}^iD_n$ as nodes. For example, let us start the dynamical system by switching on iR_1 (or iD_1). Let us assume that the LAFRM settles down with iR_1 and iR_m (or iD_1 and iD_n) i.e. the stage vector remains as $(1, 0, \dots, 0, 1)$ in R (or $1, 0, 0, \dots, 0, 1$) in D . This state vector is called the fixed point.

2.15 Limit Cycle

If the LAFRM settles down with a state vector repeating in the form $A_1 \rightarrow A_2 \rightarrow A_3 \rightarrow \dots \rightarrow A_i \rightarrow A_1$ (or $B_1 \rightarrow B_2 \rightarrow \dots \rightarrow B_j \rightarrow B_1$) then this equilibrium state is called a limit cycle.

2.16 Algorithmic procedure of finding Hidden pattern

Hidden pattern

Step 1: Let $LA(M)$ be the dynamical system matrix formed by the linguistic relationship between the nodes iD_i and ${}^iR_j \quad \forall i = 1, 2, \dots, n \text{ \& } j = 1, 2, \dots, m$.

Step 2: Let us find the hidden pattern when iD_1 is switched ON. This is done by fixing the state vector $X_1 = (1, 0, 0, \dots, 0)$ (instead of ${}^iD_1 = (1, 0, 0, \dots, 0)$). When an input is given as the vector X_1 , the data should pass through the relation matrix $LA(M)$ by multiplying X_1 with $LA(M)$.

Step 3: Let $X_1 LA(M) = (b_1, b_2, \dots, b_m)$ be a triangular aggregated vector. Then the threshold operation (\leftrightarrow) on

$X_jLA(M)$ is done by replacing b_j by 1 if b_j is the maximum value in $X_jLA(M)$, otherwise b_j by 0. The thresholded vector is called as Y_1 . ie. $Y_1 = (b_1', b_2', \dots, b_m')$.

Step 4: Then find $Y_1LA(M)^T$ by multiplying Y_1 with $LA(M)^T$. Let $Y_1LA(M)^T = (a_1, a_2, \dots, a_n)$ be a triangular aggregated vector. The threshold operation is done for $Y_1LA(M)^T$ as in **step 3** for the vectors a_i 's. Now the thresholded vectors are called as X_2 .

Step 5: This procedure is repeated till we get a limit cycle or a fixed point as $X_p = X_q$ and $Y_r = Y_s$ (for some $p \neq q$ and $r \neq s$) in both D and R domains respectively. In general, this procedure can be repeated for any vector $iD_i; i = 1, 2, \dots, n$.

3. DESCRIPTION OF THE PROBLEM

The following Carnatic raga based songs are taken for the analysis to assign emotional experiences. Thirteen familiar ragas based totally 78 popular Tamil movie songs and Christian devotional songs were chosen for the survey. For this work, 20 undergraduate students are interviewed and played those songs. Then their opinions are recorded on the emotions level sheet while listening to each raga songs.

The following attributes of ragas based songs are taken as domain space elements of LAFRM.

Each raga musical notes are given in basic C tone. It will be applicable for all notes to form raga.

iD_1 – Sindhu Bhairavi

– Its notes are C, Db, Eb, F, G, Ab, Bb, C

iD_2 – Hindolam

– Its notes are C, Eb, F, Ab, Bb, C

iD_3 – Keeravani

– Its notes are C, D, Eb, F, G, Ab, B, C

iD_4 – Karaharapriya

– Its notes are C, D, Eb, F, G, A, Bb, C

iD_5 – Shiva Ranjani

– Its notes are C, D, Eb, G, A, C

iD_6 – Charukeshi

– Its notes are C, D, E, F, G, Ab, Bb, C

iD_7 – Mohanam

– Its notes are C, D, E, G, A, C

iD_8 – Chalanattai

– Its notes are C, D#, E, F, G, A#, B, C

iD_9 – Suba Panthuvrali

– Its notes are C, Db, Eb, F#, G, Ab, B, C

iD_{10} – Simhendra Madhyamam

– Its notes are C, D, Eb, F#, G, Ab, B, C

iD_{11} – Mecha Kalyani

– Its notes are C, D, E, F#, G, A, B, C

iD_{12} – Hamsadhvani

– Its notes are C, D, E, G, B, C

iD_{13} – Dhira Sangarabharanam

– Its notes are C, D, E, F, G, A, B, C

The following attributes of emotions are considered as range space elements of LAFRM.

Emotional Terms considered for the analysis		
iR_1 – Happy (H)	iR_2 – Amazing (A)	iR_3 – Love (L)
iR_4 – Peace (P)	iR_5 – Nostalgia (N)	iR_6 – Fear (F)
iR_7 – Tension (T)	iR_8 – Heroic (B)	iR_9 – Sad (S)

The group emotion experiences for the songs with different strength of linguistic level matrices are given in the following linguistic level relational matrices.

$$N^{(1)}_{\text{Level-low}} = \begin{pmatrix} 1 & 0 & 1 & 0 & 1 & 1 & 1 & 0 & 0 \\ 0.5 & 0.5 & 1 & 0 & 0.5 & 0 & 0.5 & 0 & 0.5 \\ 0.5 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0.5 & 0 & 0 & 0 & 0.5 & 1 & 1 & 0 & 0 \\ 1 & 0.67 & 0.33 & 0.33 & 0.33 & 0 & 0.33 & 0 & 0.33 \\ 0 & 0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0.5 & 0 & 0.5 & 0.5 & 0.5 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.5 & 0 & 0 & 1 & 0 & 0.5 \\ 0 & 0 & 0 & 0 & 1 & 0.5 & 0 & 0 & 0.5 \\ 0 & 0 & 0.33 & 0.67 & 1 & 0 & 0 & 0 & 0.33 \end{pmatrix}$$

$$N^{(2)}_{\text{Level-medium}} = \begin{pmatrix} 0.2 & 0.6 & 0.2 & 1 & 0.2 & 0.4 & 0.4 & 0.2 & 0.8 \\ 1 & 0 & 0 & 0.67 & 0.33 & 0.33 & 0 & 0 & 1 \\ 0.5 & 0.75 & 1 & 0.5 & 0.5 & 1 & 1 & 0 & 0.5 \\ 0.67 & 0.67 & 0.67 & 0.33 & 1 & 0.33 & 0.33 & 0 & 0.33 \\ 0.75 & 0.75 & 1 & 0.75 & 1 & 0.25 & 0 & 0.25 & 0.75 \\ 0.2 & 0.2 & 0.6 & 1 & 0.6 & 0.2 & 0.2 & 0 & 0.8 \\ 1 & 0.67 & 1 & 1 & 1 & 0 & 0 & 0 & 0 \\ 1 & 0.5 & 0 & 0.5 & 1 & 0 & 0.5 & 0 & 0.5 \\ 0 & 0 & 0.5 & 1 & 1 & 0.5 & 0.5 & 0 & 0 \\ 0 & 0 & 0.67 & 1 & 0.67 & 0 & 0.33 & 0 & 1 \\ 0.5 & 0.5 & 1 & 0.5 & 0.5 & 1 & 0.5 & 0 & 0.5 \\ 0.25 & 0.25 & 0.25 & 1 & 1 & 0 & 0 & 0.25 & 0 \\ 1 & 0 & 0.67 & 0.67 & 0.67 & 0 & 0 & 0 & 0.38 \end{pmatrix}$$

$$N^{(3)}_{\text{Level-high}} = \begin{pmatrix} 0.4 & 0.6 & 1 & 0.2 & 0.8 & 0 & 0 & 0 & 0.2 \\ 0.4 & 1 & 0.8 & 0.8 & 0.8 & 0 & 0 & 0.2 & 0 \\ 0.2 & 0.2 & 0.4 & 0.6 & 1 & 0 & 0 & 0 & 0.6 \\ 0.6 & 0.8 & 0.8 & 1 & 0.6 & 0 & 0 & 0 & 0 \\ 0.6 & 0.8 & 0.8 & 1 & 0.6 & 0 & 0 & 0 & 0.2 \\ 0.5 & 1 & 1 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0.8 & 1 & 0.8 & 0.8 & 0.6 & 0 & 0 & 0 & 0 \\ 0.5 & 0.75 & 1 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0.33 & 0 & 0.33 & 0.67 & 0.67 & 0 & 1 \\ 0 & 0 & 0.67 & 0 & 0.33 & 1 & 0.67 & 0 & 0.33 \\ 0.5 & 0.83 & 0.83 & 0.83 & 1 & 0 & 0 & 0 & 0.17 \\ 1 & 1 & 0.83 & 0.5 & 0.17 & 0 & 0 & 0.17 & 0 \\ 0.8 & 1 & 0.8 & 0.6 & 0.4 & 0 & 0 & 0.2 & 0 \end{pmatrix}$$

The level matrices are formulated from the table below. The movie and devotional (shaded) songs for survey have been selected from each familiar raga which is given in the **Table 1**. Their musical features in terms of mode in western notes, rhythm and harmonization are given in the third column. The felt experience levels such as low (*l*), medium (*m*), high (*h*) are given in last column section

Table 1. Songs and their musical features with experienced emotions level

Raga	Song	Musical Features	Emotion Level								
			H	A	L	P	N	F	T	B	S
Sindhu bhairavi	[1] Valai osai kala	Em-4/4 - V, F, St - Full	<i>h</i>	<i>h</i>	<i>h</i>	<i>m</i>	<i>m</i>	-	-	-	-
	[2] Un thiru yaazhil en	Dm-acc-E-4/4 - Si, St, F	-	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	-	-	-	<i>h</i>
	[3] Aasa adhigam vachchi	Dm-6/8 - F, Hack, G	<i>h</i>	<i>m</i>	<i>h</i>	-	-	-	-	-	-
	[4] Oru naalum unai	Dm-4/4 - Hack, Tabela, St, F - Full	<i>l</i>	<i>h</i>	<i>h</i>	<i>m</i>	<i>h</i>	<i>l</i>	<i>l</i>	-	<i>m</i>
	[5] Ennoda yesuve konjam	Dm-acc-stanza-G# - 4/4 - Na, Hack, V	-	-	<i>h</i>	<i>m</i>	<i>h</i>	-	-	-	<i>m</i>
	[6] Naanoru sindhu	Fm-acc-G-Stan-A-D-B-6/8-V, F - Full	-	<i>m</i>	<i>m</i>	<i>m</i>	<i>h</i>	<i>m</i>	<i>m</i>	-	<i>m</i>
	[7] Aattama thearottamaa	Dm - 4/4 - F, Mendalin, S - Rhythm	<i>m</i>	<i>m</i>	<i>l</i>	<i>m</i>	<i>l</i>	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>
Hindolam	[8] Naanaga nanillai	F#m-acc-stanza-C-A# - 4/4 - F, Si, G	<i>m</i>	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	-	-	-	<i>h</i>
	[9] Maarkazhip poovae	Fm- 4/4 - F - St back	<i>m</i>	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	-	-	-	<i>m</i>
	[10] Iraivan enadhu meetpanar	Gm- 3/4 - F, Si, St, Tab	<i>m</i>	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	-	-	-	<i>l</i>
	[11] Unnaal mudiyum thambi	Gm - 6/8 - F, St, G, Tab - Pu.	<i>h</i>	<i>h</i>	<i>l</i>	<i>m</i>	<i>l</i>	-	-	<i>h</i>	-
	[12] Vilakku vaippoam	Em - 4/4 - Na, F - Rhythm Change	<i>l</i>	<i>l</i>	<i>l</i>	<i>m</i>	<i>m</i>	-	-	-	<i>m</i>
	[13] Pothti vachcha malliga	Bbm-acc- C stanza-A -E-C-A-C - 3/8	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	<i>m</i>	<i>l</i>	-	-
Keeravaani	[14] Kaatriil endhan geedham	Em - 4/4 - F, G, Sax, St, Ha - Pu, Full	<i>l</i>	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>	-	<i>m</i>
	[15] Ennai peyar solli	Em - 4/4 - V, St, F, Piano - Full	-	-	<i>h</i>	<i>h</i>	<i>h</i>	-	-	-	<i>h</i>
	[16] Nenjikulle ennavendru	Fm - 6/8 - F, St, Synth, Ha - Full, Pu	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>	-	-	-	-
	[17] Deivame varum ennilae	Dm-acc-C - stanza-C - 7/4 - St, Sax - Full	<i>m</i>	<i>m</i>	<i>m</i>	<i>h</i>	<i>h</i>	-	-	-	<i>m</i>
	[18] Paadi parandha kili	Dm - 6/4 - St, F, Na - Full	-	<i>l</i>	<i>m</i>	<i>l</i>	<i>h</i>	<i>m</i>	<i>m</i>	-	<i>h</i>
	[19] Deiva tharisanam	Cm - 6/8 - F, Na, St - Rhythm - Full, Pu	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	<i>m</i>	<i>m</i>	-	-
	[20] Engae sellum indha paa	Bm-acc-A - 4/4 - St, F, V - Full	-	<i>l</i>	-	<i>l</i>	<i>h</i>	<i>m</i>	<i>m</i>	-	<i>h</i>
Karaharapriya	[21] Kangal irandaal	Cm-2/4 - F, St, Oboe - Full, Punc.	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	-	-	-	-
	[22] Arppanam arppanam	Dm-3/4 - Si, Na, St, Bell - Punc	-	<i>m</i>	<i>h</i>	<i>h</i>	<i>h</i>	<i>l</i>	-	-	<i>m</i>
	[23] Ilankaathu veesuthe	Dm-4/4 - F, Mand, St, Accor - Full	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	-	-	-	-
	[24] Thaanaa vandha	Dm-6/8 - G, Syn, Tr, St, F - Full, Pu	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>	-	-
	[25] Vinnaga virunthe ennil	Cm-6/8 - St, F, Hack - Punc	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	<i>m</i>	-	-	-	-
	[26] Aanenna pennenna nee	Dm-acc-stanza-F# - 6/8 - G,Sax,St - Full	<i>m</i>	<i>h</i>	<i>m</i>	<i>h</i>	<i>m</i>	-	-	-	-
Shiva ranjani	[27] Adi aaththaadi	C#m-acc-stanza-B-F-2/4-F,St,Na,V-Full	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	<i>m</i>	<i>l</i>	<i>l</i>	-	-
	[28] Varam kaettu varugindre	Gm-4/4 - Si,St,Bell - Punc	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	-	-	-	-
	[29] Kaathirunthu kaathirun	Fm-acc-stanza-D# - A - 6/8 - Na,F- Punc	-	-	<i>m</i>	<i>h</i>	<i>h</i>	<i>m</i>	-	-	<i>h</i>
	[30] Endhan idhaya iniya	Cm-6/8 - St, F, Si, Na - Full	<i>m</i>	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	-	-	-	-
	[31] Kannum kannum kollai	Cm-4/4 - Voice chorus, G - Full	<i>h</i>	<i>h</i>	<i>m</i>	<i>m</i>	<i>l</i>	-	-	<i>m</i>	-
	[32] Maname kalankathiru	Dm-4/4 - Pia, V, F, Sax, St - Full, Pun	<i>m</i>	<i>m</i>	<i>h</i>	<i>h</i>	<i>m</i>	-	-	-	<i>m</i>
	[33] Unnai thaanae thanjam	C#m-acc-F# stanza-B-F#-F-6/8-S,F- Full	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>	<i>l</i>	<i>l</i>	-	<i>m</i>
	[34] Innisai paadi varum	Cm-4/4-ac-F-G#-B- stan-G#-A#-B-F-F - Pu	<i>l</i>	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>	-	-	-	<i>m</i>
Charukeshi	[35] Mayankinean solla	E-4/4 - F, Hack, V - Punc	<i>l</i>	<i>l</i>	<i>h</i>	<i>m</i>	<i>h</i>	-	<i>l</i>	-	<i>m</i>
	[36] Thoodhu selvathaaradi	A - 4/4 - St, F, Chorus	-	-	<i>m</i>	<i>h</i>	<i>h</i>	<i>m</i>	-	-	<i>h</i>
	[37] Thaiyya thaa thaiyya	C-6/8 - F, V, Chorus - Full	<i>h</i>	<i>h</i>	<i>h</i>	<i>m</i>	<i>h</i>	-	-	-	-
	[38] Siriya paravai siragai	Am - 4/4 - St, F, G, Si - Full	<i>l</i>	<i>h</i>	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>	-	<i>m</i>
	[39] Arumbhagi mottagi	C - 4/4 - F, St, Syn - Full	<i>l</i>	<i>l</i>	<i>m</i>	<i>m</i>	<i>m</i>	-	-	-	<i>m</i>
Raga	Song	Musical Features	H	A	L	P	N	F	T	B	S
Charu	[40] Aadal kalayae devan	C# - 4/4 - F, Si, Tabla	<i>m</i>	<i>m</i>	<i>l</i>	<i>l</i>	<i>l</i>	-	-	-	<i>l</i>
	[41] Kanmaniyae kaadhil	E-acc- stanza-Bb-D# -3/4-Si,St,F,Na - Full	<i>m</i>	<i>m</i>	<i>m</i>	<i>h</i>	<i>m</i>	<i>l</i>	-	-	-
	[42] Edhu vaendum unakku	D-3/4 - F, St, Hack, Chorus	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	-	-	-	-
	[43] Ninnukkori varnam	D-4/4 - St, Syn, F - Punc	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>	-	<i>l</i>	-	-
	[44] Iraivan nammai azhai	G#-6/8 - F, St, Syn, Na - Full	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	<i>l</i>	-	-	-	-
	[45] Vellarikkaa pinji	C# - 4/4 - F, V	<i>h</i>	<i>h</i>	<i>h</i>	<i>m</i>	<i>m</i>	-	-	-	-
	[46.a] Iraivanin paliyil inai	C- 2/4 - St, Si, Chorus, F, G	<i>m</i>	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	-	-	-	-
[46.b] Vaan poalae vannam	D# -acc- stanza-B - 6/8 - F, She, G	<i>h</i>	<i>h</i>	<i>m</i>	<i>m</i>	<i>h</i>	-	-	-	-	

Chalanaattai	[47] Iru pookkal - Uyire	E – 4/4 – Rhythm, G – Punc	<i>m</i>	<i>h</i>	<i>h</i>	<i>m</i>	<i>m</i>	-	-	-	<i>m</i>
	[48] Pani vizhum malar	D-4/4 – St, F, Si, V – Punc	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	<i>l</i>	-	-	-	-
	[49] Iyangaaru veettu	D-4/4 – Cla, Swaram, Hack, Si	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	<i>m</i>	-	-	-	-
	[50] Naru mugaiyae naru	D-acc-stanza-B-A#-E-B- 4/4 – F, Si, St	<i>m</i>	<i>m</i>	<i>h</i>	<i>h</i>	-	-	<i>m</i>	-	-
Subha Panthuv araali	[51] Enna enna kanavu	Bm-6/8 – St, F, Pia, Chorus – Full	-	-	<i>l</i>	<i>m</i>	<i>h</i>	<i>h</i>	<i>h</i>	-	<i>h</i>
	[52] Vai karayil vaigai kara	Fm-4/4 – Na, St, Si – Full	-	-	<i>m</i>	<i>l</i>	<i>m</i>	<i>h</i>	<i>h</i>	-	<i>h</i>
	[53] Unnai naan santhithean	G#m-3/4-acc-A#-C#-stanza too-F,Chor-Full	-	<i>l</i>	<i>h</i>	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>	-	<i>h</i>
Simhendra Mathyama m	[54] Thaalaattum poonthendra	Cm-4 /4 – F, Hack, St – Full	<i>l</i>	-	<i>h</i>	<i>m</i>	<i>l</i>	<i>l</i>	-	-	<i>m</i>
	[55] Aanandha raagam	Cm-3/4 – St, F, She, Na – Full	-	<i>l</i>	<i>m</i>	<i>m</i>	<i>m</i>	<i>h</i>	<i>h</i>	-	<i>m</i>
	[56] Idhayamae idhayame un	Bbm-acc-stanza-D#-6/8 – V,St,Cho - Full	-	-	<i>m</i>	<i>l</i>	<i>h</i>	<i>h</i>	<i>h</i>	-	<i>h</i>
	[57] Taji mahal devai illai	Cm – 4/4 – St, V, F, Na - Full	<i>l</i>	-	<i>h</i>	<i>m</i>	<i>m</i>	<i>h</i>	<i>m</i>	-	<i>m</i>
Mecha Kalyani	[58] Amma endrazhaikkaa	D#-4/4 – Si, St, F – Punc	-	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	<i>m</i>	-	<i>m</i>
	[59] Sakthiyanaava	C-6/8 - Si, F, St	<i>h</i>	<i>h</i>	<i>m</i>	<i>h</i>	<i>h</i>	-	-	-	-
	[60] Kaatril varum geethamae	D- 4/4 – St, Hack, F	<i>m</i>	<i>m</i>	<i>h</i>	<i>h</i>	<i>h</i>	-	<i>l</i>	-	<i>l</i>
	[61] Aandarai naan potri	D-4/4 – Si, St, F	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	-	-	-	-
	[62] Vellai puraa ondr	F-acc- stanza-A#- 4/4-F, Na, She,V- Full	-	-	<i>h</i>	<i>l</i>	<i>h</i>	<i>m</i>	<i>m</i>	-	<i>h</i>
	[63] Kalai maangal neer	D- stanza-G-4/4 – St, G, Si	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	-	-	-	-
	[64] Vandhaal mahalakshmi	C#-4/4 – G, Si, F, Swaram - Punc	<i>h</i>	<i>h</i>	<i>m</i>	<i>m</i>	<i>m</i>	-	<i>l</i>	-	-
Hams adhva ani	[65] Vellai pookkal	E-4/4 – G, F	<i>m</i>	<i>h</i>	<i>l</i>	<i>h</i>	<i>h</i>	-	-	-	<i>l</i>
	[66] Iraiyesu azhaippaetru	Ok-C-3/4 – Brass, Si, St, Na, F – Punc	<i>h</i>	<i>h</i>	<i>h</i>	<i>m</i>	<i>l</i>	-	-	<i>h</i>	-
	[67] Iru vizhiyin vazhiye	4/4 – Syn, St, Bell, Tr, F- Punc	<i>h</i>	<i>h</i>	<i>h</i>	<i>m</i>	<i>m</i>	<i>l</i>	-	<i>m</i>	-
Hamsadhvaani	[68] Isaiyil swaram searthu	C-4/4 – St, F, Si, Jathi	<i>h</i>	<i>h</i>	<i>h</i>	<i>m</i>	<i>m</i>	-	-	-	-
	[69] Vaa vaa vaa kannaa vaa	E-acc-C#-stanza-A#-C#-4/4-Sx, F,St,G - Pu	<i>h</i>	<i>m</i>	<i>h</i>	<i>m</i>	<i>m</i>	-	-	-	-
	[70] Tamizhal un pugazh	D-4/4 – Si, V, F, St	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	<i>l</i>	-	-	-	-
	[71] Sri ranga ranga naadha	C#-acc-A#-stanza-A#-4/4-Ha,Si,F,V,St,Na-F	<i>h</i>	<i>h</i>	<i>m</i>	<i>h</i>	<i>m</i>	-	-	-	-
Dhira sangara bharanam	[72] Kanmani anbody kadhala	C#-acc-stanza—G-A - 6/8 – St, F, Si – Full	<i>m</i>	<i>h</i>	<i>h</i>	<i>m</i>	<i>h</i>	-	-	-	<i>m</i>
	[73] Azhaikirar yesu	E-6/8 – St, Brass section, Harmonica – Punc	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	<i>l</i>	-	-	<i>h</i>	-
	[74] Anjali anjali anjali min	D-acc-F-4/4 – Sax, Chorus, St, Hack, F-Full	<i>h</i>	<i>h</i>	<i>l</i>	<i>l</i>	<i>m</i>	-	-	-	-
	[75] Ungalukku samadhanam	D-4/4 – F, Accor, G, St, Si	<i>m</i>	-	<i>m</i>	<i>h</i>	<i>m</i>	-	-	-	<i>l</i>
	[76] Thil paru jaane dhinam	Bb-acc-stanza-C#-6/8 – She,Hack,F,St – Pu	<i>m</i>	-	<i>m</i>	<i>m</i>	<i>l</i>	-	-	-	-
	[77] Kuzhaloodhum kannanu	G-4/4 – F, St, Syn, Hack – Full	<i>h</i>	<i>h</i>	<i>h</i>	<i>l</i>	<i>l</i>	-	-	-	-
	[78] Nandriyaal thudhi paadu	E-4/4 – Si, G, St, Synth – Full	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	-	-	-	-

The combined linguistic relational matrix with the entries $e_{ij} = \max \text{linguistic level} \left(\max \left(b_{ij}^{(1)}, b_{ij}^{(2)}, b_{ij}^{(3)} \right) \right)$ is given as follows.

$$M = \begin{pmatrix} l & h & h & m & l & l & l & m & m \\ m & h & l & h & h & m & l & h & m \\ m & l & m & l & h & m & m & o & h \\ m & h & h & h & m & l & m & o & m \\ m & h & m & h & m & l & l & m & m \\ l & h & h & m & h & m & l & o & m \\ m & h & m & m & m & l & l & o & o \\ m & h & h & h & m & o & m & o & m \\ o & l & l & m & m & h & h & o & h \\ l & l & h & m & m & h & h & o & m \\ h & h & m & h & h & m & l & o & m \\ h & h & h & m & m & l & o & m & l \\ m & h & h & m & l & o & o & h & m \end{pmatrix}$$

Using the triangular numbers for the linguistic variables and from aggregation formula given in 2.7 and 2.8, the above matrix entries are converted into single numerical value.

$$LA(M) = \begin{pmatrix} 0.267 & 0.733 & 0.733 & 0.5 & 0.267 & 0.267 & 0.267 & 0.5 & 0.5 \\ 0.5 & 0.733 & 0.267 & 0.733 & 0.733 & 0.5 & 0.267 & 0.733 & 0.5 \\ 0.5 & 0.267 & 0.5 & 0.267 & 0.733 & 0.5 & 0.5 & 0 & 0.733 \\ 0.5 & 0.733 & 0.733 & 0.733 & 0.5 & 0.267 & 0.5 & 0 & 0.5 \\ 0.5 & 0.733 & 0.5 & 0.733 & 0.5 & 0.267 & 0.267 & 0.5 & 0.5 \\ 0.267 & 0.733 & 0.733 & 0.5 & 0.733 & 0.5 & 0.267 & 0 & 0.5 \\ 0.5 & 0.733 & 0.5 & 0.5 & 0.5 & 0.267 & 0.267 & 0 & 0 \\ 0.5 & 0.733 & 0.733 & 0.733 & 0.5 & 0 & 0.5 & 0 & 0.5 \\ 0 & 0.267 & 0.267 & 0.5 & 0.5 & 0.733 & 0.733 & 0 & 0.733 \\ 0.267 & 0.267 & 0.733 & 0.5 & 0.5 & 0.733 & 0.733 & 0 & 0.5 \\ 0.733 & 0.733 & 0.5 & 0.733 & 0.733 & 0.5 & 0.267 & 0 & 0.5 \\ 0.733 & 0.733 & 0.733 & 0.5 & 0.5 & 0.267 & 0 & 0.5 & 0.267 \\ 0.5 & 0.733 & 0.733 & 0.5 & 0.267 & 0 & 0 & 0.733 & 0.5 \end{pmatrix}$$

The dynamical system effect on each attribute is calculated with the following procedure. The hidden pattern of the dynamical system $LA(M)$ (relational matrix) for each state vector is to be found. Suppose node iD_j is in the ON state and all other nodes are in off state, the causes of the state vector $X_j = (1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0)$ on the dynamical system $LA(M)$ is given as follows:

$$X_1 LA(M) = (0.267\ 0.733\ 0.733\ 0.5\ 0.267\ 0.267\ 0.267\ 0.5\ 0.5) \Leftrightarrow (0\ 1\ 1\ 0\ 0\ 0\ 0\ 0\ 0) = Y_1$$

$$Y_1 LA(M)^T = (1.466\ 1\ 0.767\ 1.466\ 1.233\ 1.466\ 1.233\ 1.466\ 0.534\ 1\ 1.233\ 1.466\ 1.466) \Leftrightarrow (1\ 0\ 0\ 1\ 0\ 1\ 0\ 1\ 0\ 0\ 0\ 1\ 1) = X_2$$

$$X_2 LA(M) = (2.767\ 4.398\ 4.398\ 3.466\ 2.767\ 1.301\ 1.534\ 1.733\ 2.767) \Leftrightarrow (0\ 1\ 1\ 0\ 0\ 0\ 0\ 0\ 0) = Y_2 (=Y_1)$$

$$Y_2 LA(M)^T = (1.466\ 1\ 0.767\ 1.466\ 1.233\ 1.466\ 1.233\ 1.466\ 0.534\ 1\ 1.233\ 1.466\ 1.466) \Leftrightarrow (1\ 0\ 0\ 1\ 0\ 1\ 0\ 1\ 0\ 0\ 0\ 1\ 1) = X_3 (=X_2)$$

The resultant vector is a fixed point given by the binary pair $\{(1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0), (1\ 0\ 1\ 0\ 1\ 0\ 1\ 0\ 1\ 0\ 1\ 0\ 1\ 0\ 1\ 0\ 0\ 1\ 1\ 0\ 1\ 0)\}$. Similarly this procedure is repeated when other attribute is in ON state.

Table 2. Fixed Points

Input	Output
iD_1	$\Leftrightarrow (1\ 0\ 0\ 1\ 0\ 1\ 0\ 1\ 0\ 0\ 0\ 1\ 1), (0\ 1\ 1\ 0\ 0\ 0\ 0\ 0\ 0)$
iD_2	$\Leftrightarrow (0\ 1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0), (0\ 1\ 0\ 1\ 1\ 0\ 0\ 1\ 0)$
iD_3	$\Leftrightarrow (0\ 0\ 1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0), (0\ 0\ 0\ 0\ 1\ 0\ 0\ 0\ 1)$
iD_4	$\Leftrightarrow (0\ 0\ 0\ 1\ 0\ 0\ 0\ 1\ 0\ 0\ 0\ 0\ 0), (0\ 1\ 1\ 1\ 0\ 0\ 0\ 0\ 0)$
iD_5	$\Leftrightarrow (0\ 1\ 0\ 1\ 1\ 0\ 0\ 1\ 0\ 0\ 1\ 0\ 0), (0\ 1\ 0\ 1\ 0\ 0\ 0\ 0\ 0)$
iD_6	$\Leftrightarrow (0\ 0\ 0\ 0\ 0\ 1\ 0\ 0\ 0\ 0\ 0\ 0\ 0), (0\ 1\ 1\ 0\ 1\ 0\ 0\ 0\ 0)$
iD_7	$\Leftrightarrow (1\ 1\ 0\ 1\ 1\ 1\ 1\ 1\ 0\ 0\ 1\ 1\ 1), (0\ 1\ 0\ 0\ 0\ 0\ 0\ 0\ 0)$
iD_8	$\Leftrightarrow (0\ 0\ 0\ 1\ 0\ 0\ 0\ 1\ 0\ 0\ 0\ 0\ 0), (0\ 1\ 1\ 1\ 0\ 0\ 0\ 0\ 0)$
iD_9	$\Leftrightarrow (0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 1\ 0\ 0\ 0\ 0), (0\ 0\ 0\ 0\ 0\ 1\ 1\ 0\ 1)$
iD_{10}	$\Leftrightarrow (0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 1\ 0\ 0\ 0), (0\ 0\ 1\ 0\ 0\ 1\ 1\ 0\ 0)$
iD_{11}	$\Leftrightarrow (0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 1\ 0\ 0), (1\ 1\ 0\ 1\ 1\ 0\ 0\ 0\ 0)$
iD_{12}	$\Leftrightarrow (0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 1\ 0), (1\ 1\ 1\ 0\ 0\ 0\ 0\ 0\ 0)$
iD_{13}	$\Leftrightarrow (0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 1), (0\ 1\ 1\ 0\ 0\ 0\ 0\ 1\ 0)$

4. CONCLUSION

The Linguistic Aggregated FRM brings out the factors of emotions for the Carnatic raga songs. The result derived here are the combined levels of experience of a group.

- **Sindhu bhairavi**

When this raga songs with 4/4 rhythm of music excerpt (iD_1) is in the ON state, amazing and love emotions are felt in high level. Particularly, Devotional songs have got lot of impact in this raga.

- **Hindolam**

When this raga scales with 4/4, 3/4 and 6/8 rhythm of music excerpts (iD_2) is in the ON state, people have felt the emotions such as amazing, peace, nostalgia and heroic. This raga gives best results in emotions when it is mingled with accidental notes.

- **Keeravani**

When this raga songs with 4/4, 7/4, 6/8 rhythm of music excerpts (iD_3) is in the ON state, nostalgia and sad emotions are evoked through this raga. These raga based songs are best suitable for bringing devotional feelings with mercy.

- **Karaharapriya**

When this raga scale with 2/4, 4/4 and 6/8 rhythm of music excerpts (iD_4) is in the ON state, the emotions such as amazing, love and peacefulness are induced through this raga. This is best suitable for love mood in pleasant events.

- **Shiva Ranjani**

When the minor scale with 4/4 and 6/8 rhythm of music excerpts (iD_5) is in the ON state, The emotions amazing and peace are observed. This raga is suitable when one surrenders themselves to someone with their memories.

- **Charukeshi**

When this raga notes with 4/4 and 6/8 rhythm of music excerpts (iD_6) is in the ON state, people have felt the emotions such as amazing, love and nostalgia. The emotion comes as hesitation to show their sentiment feelings.

- **Mohanam**

When this raga with 3/4, 4/4 and 6/8 rhythm of music excerpts (iD_7) is in the ON state, amazing emotion was experienced. This implies that love towards God could be expressed in this raga.

- **Chalanattai**
When this raga scales with 4/4 rhythm of music excerpt (iD_8) is in the ON state, the experienced emotions are amazing, love and peace. This raga creates tremendous imaginations in the mind.
- **Subha Pandhuvarali**
When this raga notes with any rhythm of music excerpt (iD_9) is in the ON state, the emotions such as fear, tension and sad are evoked in the listener. Moreover this raga brings the feel of sadness and misery.
- **Simhendra Madhyamam**
When this raga based music excerpt with 4/4, 3/4 and 6/8 rhythm (iD_{10}) is in the ON state, the listeners mostly felt love, fear and tension emotions. Also these raga songs express sentimental feelings of sadness.
- **Mecha Kalyani**
When these raga based any rhythm of music excerpt (iD_{11}) is in the ON state, the emotions amazing, peace, happy and sentiment which are mostly felt by the listeners. Moreover this raga is used for the auspicious events and to praise God.
- **Hamsadhvani**
When this raga based 4/4 and 3/4 rhythm of music excerpt (iD_{12}) is in the ON state, people have felt the emotions such as amazing, love and happy. This raga fills our mind with peace, a sense of praising God and is used mostly during auspicious events.
- **Dhira Sangarabharanam**
When this raga based 2/4 rhythm of music excerpt (iD_{13}) is in the ON state, the listeners highly felt the emotions such as amazing, love and heroic. Moreover in comparison with the other ragas this particular raga influences positive thinking.

Thus the combination of Carnatic raga with rhythmic pattern, instrumentation, and harmonization are important for promoting emotions through music.

5. ACKNOWLEDGEMENT

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