ANALYSIS OF EMOTIONS DUE TO VARIOUS ASPECTS OF CARNATIC AND WORLD MUSIC

BY

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ABSTRACT

MUSIC AFFECTS EMOTIONS AND THIS IS A UNIVERSAL TRUTH. CARNATIC MUSIC HAS A WIDE REPERTOIRE OF RAGAS AND HENCE HOUSES A WIDE RANGE OF EMOTIONS. IN THIS DISSERTATION, THE EMOTIONS CAUSED BY THE SWARAS AND OTHER ASPECTS OF CARNATIC MUSIC SUCH AS RAGAS ARE ANALYSED, BOTH QUALITATIVELY AND QUANTITATIVELY, SUCH THAT THE EMOTIONAL EFFECT OF ANY RAGA CAN BE GIVEN AS A "PROFILE" CONSISTING OF PERCENTAGES OF VARIOUS EMOTIONS. THEN A NOTATION SCHEME CONVENIENT FOR EMOTIONAL ANALYSIS IS PROPOSED. THE MUSICAL SYSTEMS FROM DIFFERENT PARTS OF THE WORLD ARE THEN CONSIDERED. TECHNIQUES ARE THEN STATED TO APPLY CHORDS TO CARNATIC MUSIC TO ENHANCE THE EMOTIONAL CONTENT. A FOUR DIMENSIONAL THEORY OF MUSIC AND EMOTIONS IS THEN PROPOSED. FINALLY, A UNIVERSAL QUANTITATIVE AND QUALITATIVE EMOTIONAL ANALYSIS PROCEDURE IS SPECIFIED, WHICH CAN BE APPLIED TO ANY MUSICAL PIECE/SYSTEM FROM ANY PART OF THE WORLD.

KEYWORDS

MUSIC; CARNATIC; EMOTIONS; RAGA; RASA; SWARA; COLORS; NOTATION; CHORD; MELODY; HARMONY; KEY; TEMPO; LYRICS; RHYTHM

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INTRODUCTION

WE START WITH THE FACT THAT THE CARNATIC MUSICAL OCTAVE IS COMPOSED OF SEVEN NOTES, THE SAPTHA SWARAS SA, RI, GA, MA, PA, DHA, AND NI. EACH SWARA HAS A PARTICULAR BAND OF FREQUENCY OF VIBRATION WITH EACH OF ITS SUBTYPES OCCUPYING A FREQUENCY. THROUGH MUSIC WE ARE ABLE TO ARTIFICIALLY "SIMULATE" EMOTIONS AND EXPERIENCE THEM. WE WOULD HAVE OFTEN HEARD OF ANGER INCREASING BLOOD PRESSURE OR THE MIND GETTING DEPRESSED WITH SORROW AND SO ON... THIS TELLS US THE EFFECT OF EMOTIONS ON OUR PHYSICAL BODY.

RAGAS AND EMOTIONS:

WHAT IS A RAGA? A RAGA IS A PATTERNED SEQUENCE OF CERTAIN SWARAS. SO EACH RAGA HAS A SEQUENCE OF SWARAS, WHICH WHEN SUNG INVOKES THE CORRESPONDING EMOTIONS HENCE GIVING RISE TO A MORE COMPLEX EMOTION. THERE ARE INFINITE NUMBER OF EMOTIONS IN TOTAL AND HENCE FOR THOSE FOR WHICH WE DO NOT HAVE ENGLISH NAMES WE COULD EXPRESS IT USING EXAMPLES WHERE WE WOULD EXPERIENCE IT. HOWEVER, THE INDIAN SYSTEM LISTS 9 BASIC EMOTIONS; OTHERS CAN BE DERIVED FROM THESE 9. THEY ARE

1. **SHRINGAARA – LOVE,BEAUTY**
2. **BHIBHATSA – HATRED**
3. **HAASYA – LAUGHTER,JOY**
4. **KARUNA – SORROW,SYMPATHY**
5. **RAUDRA – ANGER**
6. **BHAYAANAKA – FEAR**
7. **VIRA – COURAGE**
8. **ADHBHOOTHA – SURPRISE**

9.   SHAANTHA – PEACE

EXPRESSED EMOTIONS AND FELT EMOTIONS

NORMALLY, A SONG OR RENDERING MAY INDUCE AN EMOTION IN US, LIKE JOY. BUT OUR SITUATION ON THAT DAY MAY BE SUCH THAT WE ARE TOO SORROWFUL TO ACCEPT IT AND WE MAY FEEL IT AS SORROW. OR WE MAY REMEMBER SOME PREVIOUS INCIDENT ASSOCIATED WITH THE PARTICULAR RENDERING OR MUSICIAN AND FEEL FEAR OR ANGER.HENCE NOW 2 EMOTIONS ARISE, THE EXPRESSED AND THE FELT. ANYWAY THE FELT EMOTION DEPENDS ON THE LISTENER AND IS HIGHLY STATISTICAL. HENCE ANY EMOTION REFERRED TO IN THIS TEXT REPRESENTS ONLY THE EXPRESSED EMOTION.

CORRESPONDENCE BETWEEN SOLFEGE SYSTEMS:

THERE IS A LOT OF CORRESPONDENCE BETWEEN WESTERN AND CARNATIC SOLFEGE SYSTEMS AND THESE ARE GIVEN AS FOLLOWS ASSUMING INDIAN RAGAM OF SHANKARABHARANAM/BILAWAL:

Letter Name	C	D	E	F	G	A	B
Western Name	Do	Re	Mi	Fa	Sol	La	Ti
Indian Name	Sa	Re	Ga	Ma	Pa	Dha	Ni

GRAHA SWARA AND GRAHA BEDHA:

IN CARNATIC MUSIC, FOR EACH RAGA, THERE ARE PARTICULAR SWARAS FROM WHICH ANY COMPOSITION SHOULD START. THESE ARE CALLED GRAHA SWARAS. THIS IS BECAUSE THESE SWARAS ARE MOSTLY ANUVAADHI OR SAMVAADHI TO GIVE AN INITIAL PLEASING EFFECT AND CANCEL ALL PREVIOUS EMOTIONAL STATES SO THAT THE DIVINITY AND BEAUTY OF MUSIC AND THE GOD'S GRACE CAN BE EXPERIENCED TO ITS FULLEST THROUGH ALL THE 9 EMOTIONS.

SIMILARLY, THE TECHNIQUE OF GRAHA BEDHA IS A PLEASING TECHNIQUE BUT IS USED VERY RARELY IN TODAY'S CONCERTS. IT INVOLVES SINGING IN A RAGA, WITH AN AATHAARA SWARA OF SA. THEN THE SINGER SLOWLY DRIFTS TO RI, GA OR ANY OTHER SWARA, TAKES IT AS AATHAARA SWARA AND USING THE SAME SWARAS CONSTRUCTS ANOTHER RAGA, ELABORATES IT, AND FINALLY RETURNS TO THE PARENT RAGA. THIS INVOLVES AN ECSTATIC AND EXOTIC TRANSFORMATION OF EMOTIONS FROM ONE LEVEL TO ANOTHER.

TUNING AND SCALES

THE FOLLOWING TABLE SHOWS THE FIRST 16 HARMONICS, WITH FREQUENCIES AND LOG FREQUENCIES, THAT FORMS THE BASIS OF THE FREQUENCIES OF THE SWARAS.

NOTE	RATIO	INTERVAL
0	1:1	UNISON
1	16:15	MAJOR SEMITONE
2	9:8	MAJOR SECOND
3	6:5	MINOR THIRD
4	5:4	MAJOR THIRD
5	4:3	PERFECT FOURTH
6	45:32	DIATONIC TRITONE
7	3:2	PERFECT FIFTH
8	8:5	MINOR SIXTH
9	5:3	MAJOR SIXTH
10	9:5	MINOR SEVENTH
11	15:8	MAJOR SEVENTH
12	2:1	OCTAVE

THEORY OF EMOTIONS

AN **EMOTION** IS A MENTAL AND PHYSIOLOGICAL STATE ASSOCIATED WITH A WIDE VARIETY OF FEELINGS, THOUGHTS, AND BEHAVIOR. EMOTIONS MAY MANIFEST THEMSELVES AS SUBJECTIVE EXPERIENCES, OFTEN ASSOCIATED WITH MOOD, TEMPERAMENT, PERSONALITY, AND DISPOSITION. THE ENGLISH WORD 'EMOTION' IS DERIVED FROM THE FRENCH WORD *ÉMOUVOIR*. THIS IS BASED ON THE LATIN *EMOVERE*, WHERE *E-* (VARIANT OF *EX-*) MEANS 'OUT' AND *MOVERE* MEANS 'MOVE'.[1] THE RELATED TERM "MOTIVATION" IS ALSO DERIVED FROM *MOVERE*.

NO DEFINITIVE TAXONOMY OF EMOTIONS EXISTS, THOUGH NUMEROUS TAXONOMIES HAVE BEEN PROPOSED. SOME CATEGORIZATIONS INCLUDE:

- 'COGNITIVE' VERSUS 'NON-COGNITIVE' EMOTIONS
- INSTINCTUAL EMOTIONS (FROM THE AMYGDALA), VERSUS COGNITIVE EMOTIONS (FROM THE PREFRONTAL CORTEX).
- BASIC VERSUS COMPLEX: WHERE BASE EMOTIONS LEAD TO MORE COMPLEX ONES.
- CATEGORIZATION BASED ON DURATION: SOME EMOTIONS OCCUR OVER A PERIOD OF SECONDS (E.G. SURPRISE) WHERE OTHERS CAN LAST YEARS (E.G. LOVE).

A RELATED DISTINCTION IS BETWEEN THE EMOTION AND THE RESULTS OF THE EMOTION, PRINCIPALLY BEHAVIORS AND EMOTIONAL EXPRESSIONS. PEOPLE OFTEN BEHAVE IN CERTAIN WAYS AS A DIRECT RESULT OF THEIR EMOTIONAL STATE, SUCH AS CRYING, FIGHTING OR FLEEING. YET AGAIN, IF ONE CAN HAVE THE EMOTION WITHOUT THE CORRESPONDING BEHAVIOR THEN WE MAY CONSIDER THE BEHAVIOR NOT TO BE ESSENTIAL TO THE EMOTION. THE JAMES-LANGE THEORY POSITS THAT EMOTIONAL EXPERIENCE IS LARGELY DUE TO THE EXPERIENCE OF BODILY CHANGES. THE **FUNCTIONALIST** APPROACH TO EMOTIONS (E.G. NICO FRIJDA) HOLDS THAT EMOTIONS HAVE EVOLVED FOR A PARTICULAR FUNCTION, SUCH AS TO KEEP THE SUBJECT SAFE.

CLASSIFICATION

BASIC AND COMPLEX CATEGORIES, WHERE SOME ARE MODIFIED IN SOME WAY TO FORM COMPLEX EMOTIONS (E.G. PAUL EKMAN). IN ONE MODEL, THE COMPLEX EMOTIONS COULD ARISE FROM CULTURAL CONDITIONING OR ASSOCIATION COMBINED WITH THE BASIC EMOTIONS. ALTERNATIVELY, ANALOGOUS TO THE WAY PRIMARY COLORS COMBINE, *PRIMARY EMOTIONS* COULD BLEND TO FORM THE FULL SPECTRUM OF HUMAN EMOTIONAL EXPERIENCE. FOR EXAMPLE INTERPERSONAL ANGER AND DISGUST COULD BLEND TO FORM CONTEMPT.

ROBERT PLUTCHIK PROPOSED A THREE-DIMENSIONAL "CIRCUMPLEX MODEL" WHICH DESCRIBES THE RELATIONS AMONG EMOTIONS. THIS MODEL IS SIMILAR TO A COLOR WHEEL. THE VERTICAL DIMENSION REPRESENTS INTENSITY, AND THE CIRCLE REPRESENTS DEGREES OF SIMILARITY AMONG THE EMOTIONS. HE POSITED EIGHT PRIMARY EMOTION DIMENSIONS ARRANGED AS FOUR PAIRS OF OPPOSITES. SOME HAVE ALSO ARGUED FOR THE EXISTENCE OF META-EMOTIONS WHICH ARE EMOTIONS ABOUT EMOTIONS., "META-EMOTIONS".

ANOTHER IMPORTANT MEANS OF DISTINGUISHING EMOTIONS CONCERNS THEIR OCCURRENCE IN TIME. SOME EMOTIONS OCCUR OVER A PERIOD OF SECONDS (E.G. SURPRISE) WHERE OTHERS CAN LAST YEARS (E.G. LOVE). THE LATTER COULD BE REGARDED AS A LONG TERM *TENDENCY* TO HAVE AN EMOTION REGARDING A CERTAIN OBJECT RATHER THAN AN EMOTION PROPER (THOUGH THIS IS DISPUTED). A DISTINCTION IS THEN MADE BETWEEN EMOTION EPISODES AND EMOTIONAL DISPOSITIONS. DISPOSITIONS ARE ALSO COMPARABLE TO CHARACTER TRAITS, WHERE SOMEONE MAY BE SAID TO BE GENERALLY DISPOSED TO EXPERIENCE CERTAIN EMOTIONS, THOUGH ABOUT DIFFERENT OBJECTS. FOR EXAMPLE AN IRRITABLE PERSON IS GENERALLY DISPOSED TO FEEL IRRITATION MORE EASILY OR QUICKLY THAN OTHERS DO. FINALLY, SOME THEORISTS (E.G. KLAUS SCHERER, 2005) PLACE EMOTIONS WITHIN A MORE GENERAL CATEGORY OF 'AFFECTIVE STATES' WHERE AFFECTIVE STATES CAN ALSO INCLUDE EMOTION-RELATED PHENOMENA SUCH AS PLEASURE AND PAIN, MOTIVATIONAL STATES (E.G. HUNGER OR CURIOSITY), MOODS, DISPOSITIONS AND TRAITS.

PLUTCHIK'S WHEEL OF EMOTIONS

Plutchik's Wheel of Emotions

[two-dimensional circumplex model]

[three-dimensional circumplex model]
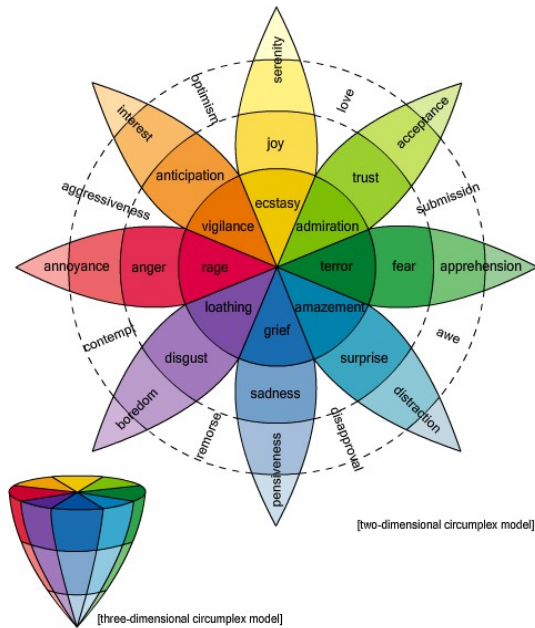
PLUTCHIK'S WHEEL OF EMOTIONS IN 2D AND 3D MODELS.
ROBERT PLUTCHIK CREATED A WHEEL OF EMOTIONS IN 1980 WHICH CONSISTED OF 8 BASIC EMOTIONS AND 8 ADVANCED EMOTIONS EACH COMPOSED OF 2 BASIC ONES.

BASIC EMOTION	BASIC OPPOSITE
JOY	*SADNESS*
TRUST	*DISGUST*
FEAR	*ANGER*
SURPRISE	*ANTICIPATION*
SADNESS	*JOY*
DISGUST	*TRUST*
ANGER	*FEAR*
ANTICIPATION	*SURPRISE*

ADVANCED EMOTION	COMPOSED OF...	ADVANCED OPPOSITE
OPTIMISM	ANTICIPATION + JOY	*DISAPPOINTMENT*
LOVE	JOY + TRUST	*REMORSE*
SUBMISSION	TRUST + FEAR	*CONTEMPT*
AWE	FEAR + SURPRISE	*AGGRESSIVENESS*
DISAPPOINTMENT	SURPRISE + SADNESS	*OPTIMISM*
REMORSE	SADNESS + DISGUST	*LOVE*
CONTEMPT	DISGUST + ANGER	*SUBMISSION*
AGGRESSIVENESS	ANGER + ANTICIPATION	*AWE*

HYPOTHESIS

THIS SECTION GIVES THE VARIOUS HYPOTHESIS AND EXISTING PRINCIPLES BASED ON WHICH THE FOLLOWING ANALYSES REVOLVE.

1.   Any note and its fifth note (like Sa and Pa) or any note and its 4th note(like Sa and Ma) when sounded in concurrence produces harmony. Hence these notes when present in a raga produce joyous emotions.

2.   Each and every swara has a particular emotion such as thivra swaras are happier than komal swaras. It is the combination of these swara emotions that forms the main emotion of a Raga and hence of any musical piece.

3.   Emotions are based on 4 fundamental emotions based on which others can be derived.

4.   Music has essentially 4 dimensions: Melody, Rhythm, Harmony and Lyrics.

5.   The emotions of songs can be obtained, based on the rendering of songs by various artists, and either personally hearing or letting others hear the songs and gathering opinions on how they feel. Also, information can be obtained on various blogs as to how the users feel about the musical pieces.

ANALYSIS OF PJ BASED ON VADITHVA

SAMVAADHI, ANUVAADHI AND VIVAADHI SWARA RELATIONSHIPS:

THE EMOTIONAL CONTENT OF A RAGA DEPENDS ALSO ON THE WAY EACH OF ITS SWARAS IS SUNG. IN SOME RAGAS LIKE BHOULI, ITS SWARAS MAY BE SUNG IN A PLAIN FASHION WHEREAS IN OTHERS LIKE THODI OR KALYANI, IT MAY BE SUNG WITH A SHAKE OR KAMPITHA. THIS SHAKE SLIGHTLY ALTERS THE FREQUENCY OF THE SWARA THEREBY CHANGING THE EMOTION AS WELL. IN FACT, THOUGH THERE ARE ONLY 7 SWARAS, 22 SIGNIFICANT FREQUENCIES ARE IN VOGUE DUE TO THESE KAMPITHAS.

CERTAIN SWARA PAIRS MAY BE PAIRED UP AS SAMVAADHI SWARAS LIKE SA, PA AND SA, MA. THIS MEANS THAT THEY HAVE A PERFECT HARMONIC RELATION BETWEEN THEM AND GIVE AN EXTREMELY PLEASING EFFECT WHEN PLAYED TOGETHER. THIS MAY BE CONSIDERED ANALOGOUS TO THE FOLLOWING FIGURE:

THIS FIGURE SHOWS THAT THE UPS AND DOWNS OF EACH WAVE IS CANCELLED BY THE OTHER GIVING RISE TO AN OVERALL SMOOTH PATTERN.

CERTAIN SWARA PAIRS MAY ALSO BE PAIRED UP AS ANUVAADHI, LIKE SA, GA. THESE COMBINATIONS ARE A BIT LOPSIDED SO THAT THEY MAY BE SOMEWHAT LESS HARMONIC TO HEAR .CONSIDER THE FOLLOWING CASE:
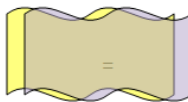
CERTAIN SWARA PAIRS ARE CLASSIFIED AS VIVAADHI LIKE RI, GA. THIS MEANS THAT THEY HAVE EXTREMELY LOPSIDED CHARACTERISTICS, WHICH GIVE A JARRING EFFECT ON HEARING THEM, GIVING RISE TO THE MOST POWERFUL AND VIOLENT EMOTIONS. CONSIDER THIS

BECAUSE OF SUCH LOPSIDED CHARACTERISTICS, RAGAS WITH VIVAADHI SWARAS MAY KINDLE UNPLEASANT EMOTIONS WHEN SUNG. THIS IS ONE OF THE REASONS WHY PEOPLE ALL THROUGH THE YEARS ALWAYS HAD THE SUPERSTITIOUS BELIEF OF "VIVAADHI DHOSHAM", THAT IS, CONSIDERING VIVAADHI RAGAS AS TABOO. THE ANUVAADHI AND SAMVAADHI SWARAS HAVE BEEN SCIENTIFICALY PROVED TO BE IN THE CYCLES OF FIFTHS AND FOURTHS, HENCE ACCOUNTING FOR PLEASING NATURE. THIS IS MENTIONED IN THE BOOK **SOUTH INDIAN MUSIC, VOL 5, CHAPTER 11** BY PROF P.SAMBAMOORTHY.

CLASSIFICATION OF SWARAS:

THERE ARE 72 PARENT RAGAS OR MELAKARTHAS IN CARNATIC MUSIC, WHICH HAVE ALL 7 SWARAS IN BOTH THEIR ASCENT AND DESCENT. THE COMBINATIONS OF CERTAIN VARIANTS OF RI, GA, MA, DHA, AND NI FORM THESE. SA AND PA DO NOT HAVE ANY VARIATIONS.

- THERE ARE 3 VARIATIONS OF RI:- SUDDHA(RA) , CHATHUSRUTHI(RI) , SHATSRUTHI(RU)
- THERE ARE 3 VARIATIONS OF GA:-SUDDHA(GA),SADHARANA(GI),ANTHARA(GU)
- THERE ARE 2 VARIATIONS OF MA:-SUDDHA(MA),PRATHI(MI)
- THERE ARE 3 VARIATIONS OF DHA:- SUDDHA(DHA) , CHATHUSRUTHI(DHI) , SHATSRUTHI(DHU)
- THERE ARE 3 VARIATIONS OF NI:-SUDDHA(NA),KAISIKI(NI), KAKALI(NU)

- TRADITIONALLY, THESE SWARAS HAVE BEEN SPLIT INTO KOMAL AND THIVRA SWARAS.
- HERE, WE WILL BE DEVIATING FROM THE TRADITIONAL METHOD OF CLASSIFYING SWARAS AS KOMAL AND THIVRA; AS SUCH, A DEVIATION IS REQUIRED TO CLASSIFY SWARAS AS BRIGHT AND DULL.
- ACCORDING TO OUR CLASSIFICATION, RA (R1), GI (G1), MI (M2), DHA (D1), NI (N1) ARE KOMAL SWARAS.
- ACCORDING TO OUR CLASSIFICATION, RI(R2),GU(G2),MA(M1),DHI(D2),NU(N2),RU(R),GA(G),DHU(D),NA(N) ARE THIVRA SWARAS.

ANALYSIS OF EMOTIONS BASED ON ANUVADHI AND SAMVADHI SWARA PAIRS:
WE CAN ANALYSE THE EMOTIONS OF A RAGA BASED ON THE NUMBER OF ANUVADHI AND SAMVADHI COMBINATIONS PRESENT IN IT, SINCE THEY ADD TO THE PLEASING NATURE OF A RAGA. CONSIDER THE FOLLOWING VEENA SWARASTHANA PATTERN:-
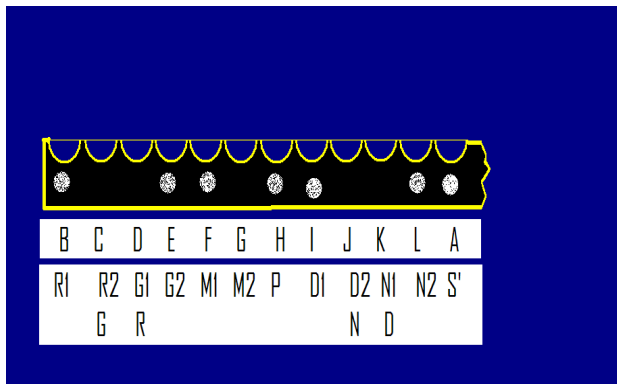
RULES FOR ALLOTING POINTS OF JOY FOR VARIOUS PAIRS:
BASED ON THE CONCEPTS OF KOMAL AND THIVRA SWARAS, AND ANUVAADHI SAMVAADHI PAIRS, POINTS OF JOY (PJ) WERE FOUND USING THE FOLLOWING PONTS:
1. INITIALLY, ALL THE SAMVAADHI AND ANUVAADHI PAIRS OF THE RAGA ARE LISTED.
2. THE PJ OF SAMVADHI SWARAS (SWARA(S) IN A PAIR BEARING A SAMVADHI RELATIONSHIP) WILL HAVE A HIGHER PJ THAN ANUVADHI SWARAS.
3. THIVRA SWARAS, INHERENTLY BEING "HAPPIER SWARAS", HAVE A HIGHER PJ THAN KOMAL SWARAS.
4. SA AND PA CAN BE CONSIDERED TO BE THIVRA SWARAS.
5. SINCE ONLY RELATIVE VALUES OF PJ ARE REQUIRED, THE ABSOLUTE NUMERICAL PJ VALUES OF A SWARA PAIR IS LEFT TO THE CHOICE OF THE READER.
6. FOR THE PURPOSE OF ILLUSTRATIONS, THE VALUES ARE CHOSEN TO BE ODD NUMBERS, STARTING FROM 1 ONWARDS.
7. THE SUM OF THE ABSOLUTE NUMERICAL PJ VALUES OF ALL SAMVADI/ ANUVADI SWARA PAIRS GIVES THE PJ (GIVES POINTS OF POSITIVE EMOTIONS, THOUGH READ AS POINTS OF JOY) OF THE RAGA.
8. TO COMPARE IT WITH OTHER RAGAS, DIVIDE THE PJ BY THE NUMBER OF SWARAS TO GIVE NORMALISED PJ (NPJ). SUCH THAT NPJ=PJ/S WHERE S IS THE NUMBER OF SWARAS IN THAT RAGA.
9. A RELATIVELY HIGHER VALUE OF PJ INDICATES THAT THE RAGA CONTAINS MORE POSITIVE EMOTIONS LIKE HAPPINESS, COURAGE, BEAUTY, AND LOVE AND SO ON.
A RELATIVELY LOWER VALUE OF PJ INDICATES THAT THE RAGA HAS MORE NEGATIVE EMOTIONS LIKE SORROW, FEAR AND SYMPATHY AND SO ON.

WE SHALL SEE HOW TO CALCULATE THIS BY MEANS OF AN ILLUSTRATION.

TAKE MELAKARTHA RAGA 25 MAARARANJANI.

THE FOLLOWING COMBINATIONS ARE SEEN WITH THEIR PJ VALUES:

1. SP
2. R2N
3. M1S
4. PR2
5. NG2
6. SM1
7. R2P
8. G2N
9. PS
10. NR2
11. SG2
12. G2D1
13. M1N
14. D1S

TOTAL = 134 ACCORDING TO THE ODD NUMBER SCHEME SUCH AS THE ONE MENTIONED ABOVE (6TH POINT).

- ALL POINTS THAT ARE ALLOTTED TO A SWARA OR RAGA ARE PURELY ARBITRARY, AS IT IS NOT THE POINTS THAT MATTERS, BUT THE RELATIVE COMPARISON OF POINTS OF VARIOUS SWARAS. USUALLY POINT ARE TAKEN AS 1, 3, 5, 7, OR 2, 4, 6, 8, SO AS TO HAVE A WIDE INTERVAL. THIS AVOIDS OVERLAPPING OF POINTS OF MANY RAGAS.

- IN THIS MANNER THE PJ VALUES CAN BE CALCULATED FOR ALL THE 72 MELAKARTHA (PARENT) RAGAS.

ANALYSIS OF PJ VALUES OF INDIVIDUAL SWARAS:

THE PJ VALUES FOR INDIVIDUAL SWARAS CAN BE FOUND BY TAKING INTO CONSIDERATION THE PJ VALUES OF MELAKARTHA RAGAS CONTAINING THESE SWARAS AND TAKING THE AVERAGE OF THESE.

BEFORE PROCEEDING TO DO THIS, LET US CALCULATE THE PJ VALUES OF VARIOUS RIGAMA AND DHANI COMBINATIONS BY THE ABOVE MENTIONED PROCEDURE. THE VALUES WERE CALCULATED FOR THE 12 RIGAMA COMBINATIONS AND THE 6 DHANI COMBINATIONS. THE RESULTS ARE:

1. **RAGAMA-109.33**
2. **RAGIMA-78.67**
3. **RAGUMA-104.67**
4. **RIGIMA-108.167**
5. **RIGUMA-129.5**
6. **RUGUMA-105.67**
7. **RAGAMI-89.33**
8. **RAGIMI-55.5**
9. **RAGUMI-76.67**
10. **RIGIMI-84.5**
11. **RIGUMI-108.5**
12. **RUGUMI-77.5**

1. **DHANA-93.667**
2. **DHANI-74.58**
3. **DHANU-83.83**
4. **DHINI-95.83**
5. **DHINU-112.4167**
6. **DHUNU-95.58**

HAVING KNOWN THIS, WE CAN FIND OUT THE PJ VALUES OF INDIVIDUAL SWARAS, BY TAKING THE HIGHEST OCCURING PJ OF THAT SWARA IN ALL THE RIGAMA OR DHANI COMBINATIONS CONTAINING THESE SWARAS. FOR EXAMPLE, TO GET THE PJ OF RI(CHATHUSRUTHI RISHABHAM), TAKE HIGHEST OF 4, 5 AND 10, 11 IN THE FIRST SET ABOVE. THE VALUES WERE CALCULATED FOR ALL THE SWARAS. THE RESULTS ARE:

1. RA-109.33
2. RI-129.5
3. RU-105.67
4. GA-109.33
5. GI-108.167
6. GU-129.5
7. MA-129.5
8. MI-108.5
9. DHA-93.667
10. DHI-112.4167
11. DHU-95.58
12. NA-93.67
13. NI-95.83
14. NU-112.4167

- PJ OF SWARAS - HERE THE HIGHEST OCCURING PJ OF THE SWARA COMBINATIONS IS TAKEN FOR A PARTICULAR SWARA. THE REASON IS AS FOLLOWS. THE METHOD OF FINDING THE PJ OF A SWARA AS THE AVERAGE OF ALL COMBINATIONS CONTAINING THE SWARA IS MEANINGLESS BECAUSE SWARAS LKE RA HAVE 6 COMBNATIONS(1,2,3,7,8 AND 9) WITH 2 VIVAADHIS(1 AND 7) WHEREAS SWARAS LIKE RI HAVE ONLY 4 COMBINATIONS(4,5,10 AND 11) TO ITS CREDIT WITH NO VIVAADHI SWARA FEATURING.HENCE IT IS ASYMMETRICAL. SO, INITIALLY, ALL SWARAS ARE ARBITRARILY ASSUMED TO HAVE A PREDOMINANTLY HIGH PJ VALUE. LET US TAKE RIGUMA. SINCE RI, GU AND MA HAVE HIGH PJ THE RIGUMA ALSO HAS A HIGH PJ.BUT A SWARA LIKE GI, ALTHOUGH ASSUMED TO HAVE A HIGH PJ VALUE SHOULD HAVE A VALUE LOWER THAN RI, GU OR MA. THAT IS THE REASON WHY RIGIMA HAS LOWER PJ THAN RIGUMA. SO ALTHOUGH RI AND MA HAVE A HIGH PJ, GI PULLS IT DOWN SO THAT THE PJ OF RIGIMA COMES LOWER.HENCE THE PJ OF A COMBINATION CAN BE VIEWED AS EITHER SUM OR AVERAGE OF THE SWARAS IT CONTAINS, WHERE IF THE HIGHEST PJ COMBINATION IS TAKEN FOR A SWARA, IT FOLLOWS THAT WE CAN FIND THE RELATIVE RANKING OF SWARAS IN TERMS OF THEIR PJ. HERE IT IS TO BE NOTED THAT ALTOUGH PJ WAS CALCULATED WITH SAMVAADHI AND ANUVAADHI PAIRS THAT INVOLVES 2 SWARAS, IT ONLY GIVES A RELATIVE CONTENT OF POSITIVE EMOTIONS. HENCE THE CONCEPT OF PJ VALUE OF AN INDIVIDUAL SWARA IS VALID.

TABLE OF EMOTIONS OF SWARAS AND SWARA COMBINATIONS:

WE KNOW THAT ANY RAGA IS BUILT FROM CERTAIN SWARAS. HENCE UNDERSTANDING OF THE EMOTIONS IF INDIVIDUAL SWARAS IS FUNDAMENTAL TO THE ANALYSIS OF RAGAS.BUT THE INDIVIDUAL EMOTION OF A SINGLE SWARA OR SWARA PHRASE AS SUCH IS TOO SUBTLE TO BE EXPERIENCED DIRECTLY.BUT IT CAN BE FOUND BY COMPARING RAGAS HAVING THAT SWARA ALONE IN COMMON AND TAKING THE EMOTION COMMON TO THOSE RAGAS. FOR THIS PURPOSE, THE 72 MELAKARTHA RAGAS ARE CHOSEN, SINCE THEY COVER THE ENTIRE SPECTRUM OF SWARAS IN ALL POSSIBLE COMBINATIONS. THERE ARE ONLY A FEW COMPOSERS WHO HAVE COMPOSED IN ALL 72 MELAKARTHAS, THE TAMIL COMPOSER KOTEESHWARA IYER BEING ONE AMONG THEM. HIS SONGS ARE MOSTLY BASED ON AN EMOTIONAL THEME AND HENCE HIS SONGS WERE CHOSEN.THE RENDERINGS BY THE MUSICIAN/ARTIST S.RAJAM PROVED TO BE OF GREAT HELP. HIS SONGS WERE HEARD WITH THE LYRICS AND NOTATIONS. THEANALYSIS REQUIRES ONLY AN ESTIMATE OF THE EMOTIONAL CONTENT IN EACH SWARA AS BASED ON THAT EVERYTHING ELSE CAN BE FOUND. THE EMOTION OF EACH OF THE 72 SONGS CAN BE ESTIMATED IN THREE WAYS.

1.   BY LETTING PEOPLE HEAR THE SONGS AND GETTING COMMENTS ON HOW THEY FEEL. HOWEVER, THIS METHOD IS NOT ACCURATE AS THE COMMENTS DEPENDS ON THE PRESENT EMOTIONAL SITUATION OF THE LISTENERS.

2.   BY PERSONALLY HEARING THESE SONGS KEENLY AND WRITING DOWN THE RESULTS. THIS IS ALSO NOT PERFECT SINCE IT INVOLVES INTUITION ALSO.

3.   BY ANALYSING, THE LYRICS OF A SONG WHERE THE COMPOSER REVEALS THE TRUE EMOTIONAL STATUS OF THE COMPOSITION THROUGH THE LYRICS.EVEN THIS IS NOT PERFECT AS SOME LYRICS MAY BE HIGHLY MISLEADING.

THE REASON FOR ALL 3 METHODS BEING IMPERFECT IS THAT THE EMOTIONS ARE A RATHER ABSTRACT AND RELATIVE CONCEPTS. HOWEVER, THIS IS THE ONLY APPROACH TO START. HENCE ALL 72 SONGS OR 72 RAGAS WERE ANALYSED USING ALL OF THE 3 PROCEDURES AND THE RESULTS ARE SUMMARISED IN THE FORM OF A TABLE.THESE EMOTIONS HAVE BEEN SPLIT UP AS BASIC EMOTIONS TO THE MAXIMUM POSSIBLE EXTENT SO THAT ANALYSIS WILL BE SIMPLE. HERE SUBMISSION REFERS TO BHAKTI RASA, WHERE IT CAN BE CONSIDERED IN TWO FORMS

•   CONTAINING MORE OF FEAR, AS IS SEEN WITH RAGAS HAVING KOMAL RI OR DHA.

•   CONTAINING MORE OF TRUST OR SYMPATHY, SEEN IN OTHER RAGAS.

THE WORD LITTLE MENTIONED HER AND IN THE TABLES MEANS THAT THAT EMOTION IS LESS INTENSRE THAN THE OTHER EMOTIONS MENTIONED.

MELA NUMBER	MELA NAME	OBSERVED EMOTION
1	KANAKANGI	SUBMISSION,LITTLE LOVE
2	RATHNANGI	SUBMISSION,SYMPATHY
3	GANAMURTHI	SUBMISSION,TRUST
4	VANASPATHI	LITTLE SUBMISSION,LITTLE JOY,SYMPATHY
5	MANAVATHI	LITTLE SYMPATHY,SUBMISSION
6	THANARUPI	LITTLE SUBMISSION,SURPRISE,LOVE
7	SENAVATHI	SYMPATHY,SUBMISSION,LITTLE SORROW
8	HANUMATHODI	SYMPATHY,SUBMISSION,LOVE
9	DHENUKA	SYMPATHY,SUBMISSION
10	NATAKAPRIYA	SYMPATHY,SUBMISSION,LITTLE JOY ,LOVE
11	KOKILAPRIYA	SYMPATHY,JOY,LITTLE LOVE,LITTLE SUBMISSION
12	ROOPAVATHI	SURPRISE,LOVE,SUBMISSION,SYMPATHY
13	GAYAKAPRIYA	SUBMISSION,TRUST
14	VAKULABHARANAM	SYMPATHY,LOVE,SUBMISSION
15	MAYAMALAVAGOULA	SUBMISSION,SYMPATHY
16	CHAKRAVAKAM	LOVE,SYMPATHY,LITTLE JOY,SURPRISE,SUBMISSION
17	SOORYAKANTHAM	JOY,LOVE,SUBMISSION,SURPRISE
18	HATAKAMBARI	SYMPATHY,LOVE,SURPRISE
19	JHANKARADHWANI	JOY,LOVE,SUBMISSION
20	NATABHAIRAVI	SYMPATHY,SUBMISSION,LOVE,LITTLE JOY
21	KEERAVANI	SYMPATHY,JOY
22	KHARAHARAPRIYA	SYMPATHY,LOVE,SUBMISSION,JOY
23	GOWRIMANOHARI	SYMPATHY,LITTLE JOY
24	VARUNAPRIYA	LOVE,JOY,SURPRISE
25	MARARANJANI	LOVE,SUBMISSION,JOY
26	CHARUKESI	LITTLE JOY,SYMPATHY,LITTLE LOVE,SUBMISSION
27	SARASANGI	JOY,LOVE,SUBMISSION

28	HARIKAMBHOJI	JOY,LOVE,LITTLE SYMPATHY,LITTLE SUBMISSION
29	DHEERASANKARABHARANAM	JOY,LOVE,LITTLE SURPRISE
30	NAGANANDINI	SURPRISE,LITTLE JOY,LOVE
31	YAGAPRIYA	SUBMISSION,LITTLE JOY,LITTLE SURPRISE
32	RAGAVARDHINI	SURPRISE,LITTLE JOY, LITTLE SUBMISSION,LITTLE LOVE
33	GANGEYABHOOSHANI	SURPRISE,LITTLE JOY,LITTLE LOVE
34	VAGADHEESHWARI	SURPRISE,JOY,LITTLE LOVE
35	SOOLINI	JOY,LOVE,SURPRISE
36	CHALANATA	SURPRISE,JOY
37	SAALAGAM	SUBMISSION,SORROW
38	JALAARNAVAM	SORROW,SUBMISSION,LITTLE SYMPATHY
39	JHALAVARALI	SUBMISSION,LITTLE SYMPATHY, LITTLE SORROW
40	NAVANEETHAM	SUBMISSION,LITTLE SYMPATHY,LITTLE LOVE
41	PAAVANI	SUBMISSION,LITTLE SYMPATHY,LITTLE LOVE,LITTLE SURPRISE
42	RAGHUPRIYA	SURPRISE,LITTLE SUBMISSION
43	GAVAAMBODHI	SUBMISSION,SORROW,LITTLE SYMPATHY
44	BHAVAPRIYA	SORROW,SUBMISSION,LOVE,SYMPATHY
45	SHUBHAPANTHUVARALI	SUBMISSION,SYMPATHY,LITTLE LOVE
46	SHADVIDHAMARGINI	SUBMISSION,LITTLE SYMPATHY,LITTLE LOVE
47	SUVARNANGI	SYMPATHY,JOY,LOVE,LITTLE SUBMISSION
48	DIVYAMANI	SURPRISE,LITTLE LOVE, LITTLE SUBMISSION
49	DHAVALAAMBARI	SUBMISSION,LITTLE SYMPATHY,LITTLE SORROW
50	NAMANARAYANI	SYMPATHY,SUBMISSION,LITTLE LOVE
51	KAMAVARDHINI	SUBMISSION,LITTLE SYMPATHY,LITTLE LOVE
52	RAMAPRIYA	SYMPATHY,LITTLE JOY,LITTLE LOVE,LITTLE SUBMISSION
53	GAMANAASHRAMA	JOY,LITTLE SURPRISE,SYMPATHY,LOVE,LITTLE SUBMISSION
54	VISHVAAMBARI	SURPRISE,LITTLE JOY,LITTLE SUBMISSION
55	SHYAMALANGI	SYMPATHY,SUBMISSION,LITTLE LOVE
56	SHANMUGHAPRIYA	SYMPATHY,LITTLE SUBMISSION,LITTLE LOVE
57	SIMHENDRAMADHYAMAM	SYMPATHY,LITTLE SUBMISSION,LITTLE LOVE,LITTLE JOY
58	HEMAVATHI	SYMPATHY,LITTLE JOY, LOVE,LITTLE SUBMISSION
59	DHARMAVATHI	JOY,LOVE,SYMPATHY,LITTLE SUBMISSION
60	NEETHIMATHI	JOY,SURPRISE,LOVE,LITTLE SYMPATHY
61	KANTHAMANI	JOY,LITTLE SUBMISSION,LOVE,LITTLE SYMPATHY
62	RISHABHAPRIYA	SYMPATHY,LOVE,JOY,LITTLE SUBMISSION
63	LATHANGI	SYMPATHY,LITTLE LOVE,SUBMISSION,LITTLE JOY
64	VACHASPATHI	LOVE,JOY,LITTLE SYMPATHY,LITTLE SUBMISSION
65	MECHAKALYANI	JOY,LOVE,LITTLE SURPRISE,LITTLE SYMPATHY
66	CHITRAMBARI	SURPRISE,LITTLE JOY,LITTLE SYMPATHY
67	SUCHARITHRA	SURPRISE,LITTLE SUBMISSION,LITTLE SORROW
68	JYOTHISWAROOPINI	SUBMISSION,LITTLE SURPRISE
69	DHATHUVARDHINI	SURPRISE,LITTLE JOY,LITTLE SUBMISSION
70	NAASIKABHOOSHANI	LITTLE JOY,SURPRISE,LITTLE LOVE
71	KOSALAM	JOY,SURPRISE,LITTLE LOVE

72	RASIKAPRIYA	SURPRISE,LITTLE JOY

QUALITATIVE EMOTIONAL ANALYSIS

qualitative ANALYSIS OF EMOTIONS BASED ON swara COMBINATIONS:

FROM THE EMOTIONS OF MELAKARTHAS ABOVE WE CAN SEE THE EMOTIONS OF EACH COMBINATION OF RI, GA, MA SEPERATELY, AND EACH COMBINATION OF DHA, NI SEPERATELY BY USING THE EMOTION COMMON TO ALL RAGAS THAT HAVE THAT PARTICULAR RIGAMA/DHANI COMBINATION. FOR EXAMPLE, EMOTION OF RAGAMA IS THE EMOTION COMMON TO MELAS 1-6.

RI, GA, MA COMBINATIONS:-
1.   **RAGAMA-**   **FEAR,(SUBMISSION)**
2.   **RAGIMA-**   **SYMPATHY,FEAR(SUBMISSION)**
3.   **RAGUMA-**   **FEAR(SUBMISSION),LITTLE SYMPATHY**
4.   **RIGIMA-**   **SYMPATHY,JOY,LOVE**
5.   **RIGUMA-**   **LOVE,JOY,LITTLE SURPRISE**
6.   **RUGUMA-**   **SURPRISE,LITTLE JOY,LITTLE LOVE**
7.   **RAGAMI-**   **SUBMISSION,LITTLE SORROW**
8.   **RAGIMI-**   **SUBMISSION,SYMPATHY,LITTLE SORROW**
9.   **RAGUMI-**   **SUBMISSION,LITTLE SYMPATHY**
10.   **RIGIMI- SYMPATHY,LOVE,LITTLE SUBMISSION**
11.   **RIGUMI-**   **JOY, LOVE, LITTLE SUBMISSION, LITTLE SYMPATHY, LITTLE SURPRISE.**
12.   **RUGUMI-**   **SURPRISE,LITTLE JOY**

DHA, NI COMBINATIONS:-
1.   **DHANA-FEAR(SUBMISSION)**
2.   **DHANI- FEAR(SUBMISSION),LITTLE SYMPATHY,LITTLE LOVE**
3.   **DHANU-**   **FEAR,LITTLE SYMPATHY**
4.   **DHINI- SYMPATHY,JOY,LOVE,LITTLE SUBMISSION**
5.   **DHINU- SURPRISE,LITTLE JOY,LITTLE LOVE**
6.   **DHUNU-**   SURPRISE,LITTLE JOY,LITTLE LOVE

ILLUSTRATIONS FOR JANAKA RAGAS:

  TO ANALYSE THE JANAKA RAGA EMOTIONS, ONE WOULD USE THE DETAILS ABOUT VARIOUS RIGAMA AND DHANI COMBINATIONS GIVEN ABOVE.

•   CONSIDER HARIKAMBHOJI MELA 28. IT USES RIGUMADHIINI I.E. 5 AMONG RIGAMA AND 4 AMONG DHANI. THIS MEANS A COMBINATION OF JOY WITH SOOTHING HAPPINESS AND SYMPATHY WITH LITTLE HAPPINESS, WHICH MEANS JOY WITH LITTLE SYMPATHY..

•   BHAVAPRIYA-MELA 44-COMPOSITION SARAGIMIPADHANI-SORROW WITH A TINGE OF SYMPATHY

•   CHARUKESI-MELA 26-COMPOSITION SARIGUMAPADHANI-JOY WITH A TINGE OF DEEP SORROW

•   NAAGAANANDHINI-MELA 30-COMPOSITION SARIGUMAPADHUNU-ECSTATIC JOY WITH A TINGE OF SURPRISE.

ILLUSTRATIONS FOR JANYA RAGAS:

   CASE 1: UPANGA RAGAS:-
        THESE ARE RAGAS IN WHICH NO SWARA OTHER THAN THE MELA FROM WHICH IS DERIVED IS PRESENT AND IT MOSTLY DOES NOT CONTAIN ALL THE SEVEN SWARAS.

SINCE IT DOES NOT CONTAIN ATLEAST ONE SWARA, IT CAN BE DERIVED FROM TWO MELAKARTHAS ASSUMING THE ABSENT SWARA TO BE EITHER VERSION.

FOR EXAMPLE, MOHANAM HAS SARIGUPADHISA. MA AND NI ARE ABSENT IN THIS RAGA.

- ASSUMING MA TO BE MA AND NI TO BE NI, WE CAN DERIVE MOHANAM FROM HARIKAMBHOJI.

- ASSUMING MA TO BE MI AND NI TO BE NI, WE CAN DERIVE MOHANAM FROM VACHASPATHI.

- ASSUMING MA TO BE MA AND NI TO BE NU, WE CAN DERIVE MOHANAM FROM DHEERASANKARABHARANAM.

- ASSUMING MA TO BE MI AND NI TO BE NU, WE CAN DERIVE MOHANAM FROM MECHAKALYANI.

THUS, THE EMOTION OF MOHANAM COULD BE VIEWED AS THE EMOTION COMMON TO ALL THESE 4 MELAKARTHA RAGAS. ALTERNATIVELY, MORE PRECISELY, WE COULD TAKE UP MOHANAM AS ANY ONE OF THE MELAS MINUS THE SWARAS ABSENT. IF WE COULD FIND THE EMOTIONS OF THESE SWARAS, WE COULD DELETE THEM FROM THE MELA'S EMOTION. WHAT IS LEFT IS MOHANA'S EMOTION.

THE SAME COULD BE APPLIED TO ALL RAGAS OF THE UPANGA AUDAVA/SHADAVA CATEGORY.

CASE 2: BHASHANGA RAGAS:-

THESE ARE RAGAS WHICH MAY OR MAY NOT CONTAIN ALL 7 SWARAS, BUT CONTAIN SWARAS OTHER THAN THOSE PRESENT IN THE MELA UNDER WHICH THEY ARE DERIVED.

THE ABOVE PROCEDURE APPLIED TO UPANGA RAGAS CAN BE APPLIED HERE ALSO. HOWEVER, IN ADDIION TO IT, ONE SHOULD FIND THE FOREIGN SWARA AND ANALYSE ITS EMOTION. THIS EMOTION PLUS THE PREVIOUSLY FOUND EMOTION WOULD GIVE THE EMOTION OF THE BHASHANGA RAGA.

EMOTIONS OF THE INDIVIDUAL SWARAS:

THE FOLLOWING TABLE SHOWS THE EMOTIONS OF THE 16 SWARAS OBTAINED BY COMPARING RIGAMA AND DHANI COMBINATIONS POSSESSING CERTAIN SWARAS IN COMMON.

SWARA	EMOTION
SA	ATHARA SWARA(FIRMNESS TO THE RAGA)
RA	FEAR,SYMPATHY,SORROW
RI	JOY,SYMPATHY,LITTLE SURPRISE,LOVE
RU	SURPRISE,LITTLE JOY
GA	FEAR
GI	SYMPATHY,LITTLE JOY
GU	HAPPY,SURPRISE
MA	JOY,LITTLE FEAR
MI	SUBTLE JOY,SOOTHINGNESS
PA	NO EMOTION(FIRMNESSTO THE RAGA)
DHA	FEAR,SYMPATHY
DHI	JOY,SYMPATHY,LITTLE SURPRISE,LOVE
DHU	SURPRISE,LITTLE JOY,LITTLE LOVE
NA	FEAR
NI	SYMPATHY, SUBTLE JOY,SORROW,LOVE,LITTLE SUBMISSION
NU	JOY,LOVE,SURPRISE

QUALITATIVE ANALYSIS OF EMOTIONS OF RAGAS:

THE EMOTIONS OF RAGAS CAN BE EVALUATED WITH A PROCEDURE, WHICH IS GIVEN BELOW:

- FIRST, THE EMOTIONS OF THE VARIOUS SWARAS PRESENT ARE ASSIMILATED TOGETHER OR THE EMOTION OF THE PARENT RAGA MINUS THOSE OF THE ABSENT SWARAS IS TAKEN.

- NEXT, THE RAGA IS CHECKED FOR ANY VARJATHVA OR ABSENCE OF SWARAS, IN WHICH CASE PRESENCE OF ANUVAADHI AND SAMVAADHI PAIRS OF CONSECUTIVE SWARAS IN AROHANA OR AVAROHANA

ADD TO JOY AND OTHER SUCH POSITIVE EMOTIONS, THIVRA PAIRS CONTRIBUTING MORE THAN KOMAL ONES.

- NEXT, THE RAGA IS CHECKED FOR THE PRESENCE OF ANYA SWARAS OR SWARAS NOT SEEN IN ITS PARENT RAGA AND THE EMOTION OF THIS SWARA IS ADDED TO THE LIST. IF THE SWARA HAS A SAMVAADHI OR ANUVAADHI PAIR, IT ADDS TO JOY AND PEACE.

- NEXT, THE RAGA IS CHECKED FOR VAKRATHVA, OR DEVIATIONS FROM THE ORIGINAL PATTERN OF ASCENT AND DESCENT. IF A VAKRA IS SEEN IN AROHANA IT DECREASES THE INTENSITY OF ALL EMOTIONS AND IF A VAKRA IS SEEN IN AVAROHANA, IT INCREASES THE INTENSITY OF ALL EMOTIONS. AGAIN, THE PRESENCE OF CONSECUTIVE SAMVAADHI OR ANUVAADHI PAIRS AT ANY VAKRATHVA ADDS TO THE POSITIVE EMOTIONS, THIVRA CONTRIBUTING MORE THAN KOMAL.

EMOTIONAL EFFECTS OF THE 22 SHRUTHIS AND GAMAKAS
LIST OF THE 22 SHRUTHIS:

HERE IS THE LIST OF THE 22 SHRUTHIS AND THEIR RELATIVE FREQUENCIES (IN CYCLES PER SECONDS), ALONG WITH THE RAGAS IN WHICH THEY ARE USED. THE FIRST SHRUTHI IN EACH SWARA IS AN INCREMENT OF THE LAST SHRUTHI OF THE PREVIOUS SWARA BY 5.35%, THE SECOND BY 6.66%, THE THIRD BY 11.11%, AND THE FOURTH BY 12.50%.

1. AADHAARA SWARA(1)
2. FIRST VARIANT = 1+ (1X5.35%)
3. SECOND VARIANT=1+ (1X6.66%)
4. THIRD VARIANT=1+ (1X11.11%)
5. FOURTH VARIANT=1+ (1X12.5%)

SERIAL NO.	NAME	RAGA EXAMPLE	FREQUENCY	POSSIBLE POSITIONS
1	ACHALA SHADJAM	ALL RAGAS	100	1
2	EKASRUTHI RISHABHAM	GOULA	105.35	2
3	DVISHRUTHI RISHABHM	MAYAMALAVAGOULA	106.66	3
4	THRISHRUTHI RISHABHAM	BHAIRAVI	111.11	4
5	CHATHUSRUTHI RISHABHAM	KHARAHARAPRIYA	112.50	51
6	SUDDHA GANDHARAM	THODI	118.5	2
7	SADHARANA GANDHARAM	BHAIRAVI	120	3
8	ANTHARA GANDHARAM	SANKARABHARANAM	125	4
9	CHYUTHA MADHYAMA GANDHARAM	MAYAMALAVAGOULA	126.6	51
1O	SUDDHA MADHYAMA	KHARAHARAPRIYA	133.3	2
11	THIVRA SUDDHA MADHYAMAM	BEGADA	135	3
12	PRATHI MADHYAMAM	KALYANI	140.62	4
13	CHYUTHA PANCHAMA MADHYAMAM	VARALI	142.38	5
14	ACHALA PANCHAMAM	ALL MELAKARTHA RAGAS	150	1
15	EKASRUTHI DHAIVATHAM	SAVERI	158.02	2
16	DVISHRUTHI DHAIVATHAM	MAYAMALAVAGOULA	160	3
17	THRISHRUTHI DHAIVATHAM	SANKARABHARANAM	166.66	4
18	CHATHUSHRUTHI DHAIVATHAM	VASANTHA	168.75	51
19	KAISIKI NISHADHAM	SURUTTI	177.77	2
20	THIVRA KAISIKI NISHADHAM	KHARAHARAPRIYA	180	3
21	KAKALI NISHADHAM	SANKARABHARANAM	187.5	4
22	THIVRA KAKALI NISHADHAM	NEELAMBARI	189.94	5

ANALYSIS OF THE EMOTIONS OF 22 SHRUTHIS:
BEFORE ANALYSING THE EMOTIONS OF THE 22 SHRUTHIS A FEW POINTS NEED TO BE NOTED.

• A VIVAADHI SWARA IS NOT A FULL SWARA AS IT DOES NOT HAVE ANY SEPARATE SWARASTHANA.

• FOR EXAMPLE, CONSIDER DHU, A VIVAADHI SWARA. IT IS A VARIATION OF DHAIVATHAM. BUT IT IS PLAYED IN THE SWARASTHANA OF KAISIKI NISHADHAM. THEREFORE, IT IS CONSIDERED TO BE IN BETWEEN DHI AND NI.

• TO ANALYSE DHU'S EMOTION WE CAN CONSIDER THE FACT THAT ONLY THE LAST MELAKARTHA OF EACH OF THE 12 CHAKRAS USES DHU.

• THEREFORE, THE EMOTION COMMON TO ALL THESE RAGAS WOULD BE THE EMOTION OF DHU. THE SAME APPLIES FOR OTHER VIVAADHIS LIKE RU, GA AND NA.

• THEREFORE, IN THE SCHEME OF 22 SHRUTHIS, VIVAADHI SWARAS DO NOT FIND AN EXPLICIT PLACE.

• THEREFORE, AS TOLD BEFORE, A VIVAADHI IS TO BE SEEN AS IN BETWEEN 2 SWARAS AND HENCE, THE EMOTIONS CANNOT BE FOUND OR BE INCLUDED IN THOSE OF THE 22 SWARAS EXPLICITLY.

• AS FOR THE OTHER SWARAS, EACH OF THE 10 (16 SWARAS MINUS SA, PA MINUS 4 VIVAADHI SWARAS) SWARAS HA VE TWO VARIATIONS IN THE SCHEME OF 22 SHRUTHIS.

• THEREFORE, EACH OF THE 10 SWARA'S MOTION IS SPLIT INTO TWO AND FORMS THE EMOTION OF THESE 20 SWARAS WHEREAS SA AND PA DO NOT HAVE ANY.
THE FOLLOWING ARE THE EMOTIONS OF THE 22 SHRUTHIS.

22 SHRUTHI	SWARA CODE	PARENT SWARA	EMOTION
ACHALA SA	SA*	SA	NIL
EKASHRUTHI RI	RA*	RA	MORE FEAR,SYMPATHY
DVISHRUTHI RI	RI*	RA	MORE SYMPATHY, FEAR
THRISHRUTHI RI	RU*	RI	MORE SYMPATHY, JOY
CHATHUSHRUTHI RI	RE*	RI	MORE JOY,SYMPATHY
SUDDHA GA	GA*	GI	MORE SYMPATHY,LITTLE JOY
SADHARANA GA	GI*	GI	SYMPATHY,LITTLE JOY
ANTHARA GA	GU*	GU	JOY,LITTLE SURPRISE
CHYUTHAMADHYAMAGA	GE*	GU	JOY
SUDDHA MA	MA*	MA	JOY,LITTLE FEAR
THIVRA SUDDHA MA	MI*	MA	JOY
PRATHI MA	MU*	MI	SUBTLE JOY
CHYUTHAPANCHAMAMA	ME*	MI	LITTLE JOY,LITTLE SYMPATHY
ACHALA PA	PA*	PA	NIL
EKASHRUTHI DHA	DHA*	DHA	FEAR,LITTLE SYMPATHY
DVISHRUTHI DHA	DHI*	DHA	SYMPATHY,LITTLE FEAR
THRISHRUTHI DHA	DHU*	DHI	LITTLE JOY,SYMPATHY
CHATHUSHRUTHI DHA	DHE*	DHI	JOY,LITTLE SYMPATHY
KAISIKI NI	NA*	NI	SYMPATHY,LITTLE JOY
THIVRA KAISIKI NI	NI*	NI	SYMPATHY,JOY
KAKALI NI	NU*	NU	JOY,LOVE,LITTLE SURPRISE
THIVRA KAKALI NI	NE*	NU	JOY,MORE LOVE

- EMOTIONS OF 22 SHRUTHIS – THESE WERE OBTAINED FROM THE EMOTIONS OF 16 SWARAS. BUT THE SPLIT UP OF A SWARA SAY RA AS MORE SORROW, FEAR AND MORE FEAR, SORROW AND SO ON WAS PURELY BASED ON THE LISTENING EXPERIENCE.

QUANTITATIVE EMOTIONAL ANALYSIS:

THE NEXT STEP WOULD BE TO CALCULATE POINTS OF VARIOUS BASIC EMOTIONS FOR THE 72 MELA RAGAS. AT THIS JUNCTURE IT IS NECESSARY TO LIST OUT SOME BASIC EMOTIONS. HERE THE PLUTCHIK WHEEL OF EMOTIONS WILL BE FOLLOWED ACCORDING TO WHICH THERE ARE 4 BASIC EMOTIONS AND THEIR OPPOSITES, CONSTITUTING 8 EMOTIONS. THEY ARE:

1. JOY-SADNESS
2. FEAR-ANGER
3. DISGUST-TRUST
4. SURPRISE-ANTICIPATION

BASED ON THESE 8, 4 OTHER EMOTIONS ARE PROPOSED, WITH THEIR OPPOSITES. THEY ARE:

1. ANTICIPATION+JOY=OPTIMISM-DISAPPOINTMENT
2. JOY+TRUST=LOVE-REMORSE
3. TRUST+FEAR=SUBMISSION-CONTEMPT
4. FEAR+SURPRISE=AWE-AGRESSIVENESS

ALL OTHER EMOTIONS ARE CONSIDERED TO BE DERIVED FROM THESE 8. NOW THE PROCEDURE FOR NUMERICALLY FINDING EMOTIONS OF SWARAS ARE GIVEN, WHICH WILL BE USEFUL FOR ANALYSING RAGAS:

1. TO ANALYSE A SWARA EMOTION, SUCH AS JOY, LOOK AT THE TABLE OF EMOTIONS FOR THE 16 SWARAS.
2. IF JOY IS MENTIONED, TAKE THE SWARA UNDER Y (YES) CATEGORY. IF LITTLE/SUBTLE JOY IS MENTIONED PUT THE SWARA UNDER P (PARTIAL) CATEGORY. ELSE PUT IT UNDER N (NO) CATEGORY.
3. THEN CATEGORIES ARE ARRANGED IN THE ORDER OF Y,P AND N. FOR POSITIVE EMOTIONS SUCH AS JOY,IN A CATEGORY, SWARAS ARE ARRANGED IN DESCENDING ORDER OF THEIR PJ VALUES, SINCE MORE PJ INDICATES MORE POSITIVE EMOTION CONTENT AND FOR NEGATIVE EMOTIONS IT IS VICE VERSA. THE FOLLOWING STEPS NOW IMPLY FOR POSIIVE EMOTIONS. REVERSE SHOULD BE APPLIED FOR THE NEGATIVE EMOTIONS SUCH AS FEAR.
4. IF 2 SWARAS HAVE IDENTICAL PJ, THE SWARA WITH HIGHER VALUE OF SECOND HIGHEST PJ VALUE IS TAKEN.

JOY:

- AS MENTIONED ABOVE SWARAS ARE CLASSIFIED AS Y,N OR P. THE CLASSIFICATION YIELDS:
- RA N
- RI Y
- RU P
- GA N
- GI P
- GU Y
- MA Y
- MI P
- DHA N
- DHI Y
- DHU P
- NA N
- NI P

- NU Y
- THEN CATEGORIES ARE ARRANGED IN THE ORDER OF Y,P AND N. IN A CATEGORY, SWARAS ARE ARRANGED IN DESCENDING ORDER OF THEIR PJ VALUES, SINCE MORE PJ INDICATES MORE POSITIVE EMOTION CONTENT. IF 2 SWARAS HAVE IDENTICAL PJ, THE SWARA WITH HIGHER VALUE OF SECOND HIGHEST PJ VALUE IS TAKEN.THEN THEY ARE ALLOTTED CORRESPONDING VALUES WHICH ARE PURELY ARBITRARY. FOR THIS ANALYSIS, NUMBERS IN ASCENDING ORDER, STARTING FROM 2 ARE FOLLOWED. THIS FORMS THE POINTS FOR THE SWARAS. THE ABOVESAID IS DONE AND A FEW RESULTS ARE AS FOLLOWS:
- RI 24
- RU 14
- GU 26
- MA 28
- MI 18
- DHI 22
- DHU 10
- NI 12
- NU 20

FEAR:
- THE METHOD ADOPTED FOR JOY IS FOLLOWED HERE ALSO, EXCEPT FOR THE FACT THAT SWARAS IN A CATEGORY ARE ARRANGED IN INCREASING ORDER OF PJ VALUES, SINCE FEAR IS A NEGATIVE EMOTION.

SURPRISE:
- THE METHOD ADOPTED FOR JOY IS FOLLOWED HERE ALSO.

SYMPATHY:
- THE METHOD ADOPTED FOR JOY IS FOLLOWED HERE ALSO.

NOW THAT THE EMOTIONS OF SWARAS ARE ANALYSED QUANTITATIVELY, ANALYSIS OF THE EMOTIONS OF RAGAS CAN BE DONE.

I.TO ANALYSE A MELAKARTHA RAGA:

FOR QUANTITATIVELY ANALYSING THE EMOTIONS OF A RAGA, THE GRAPH THEORY OF DISCRETE MATHEMATICS IS USED.DETAILS AND FUNDAMENTALS OF GRAPH THEORY CAN BE FOUND IN THE BOOK "**DISCRETE MATHEMATICS**" BY DR.M.K.VENKATARAMAN ET AL. THE PROCEDURE FOR FINDING THE PERCENTAGE OF A PARTICULAR EMOTION, SUCH AS JOY, OF A PARTICULAR MELAKARTHA RAGA, SUCH AS SANKARABHARANAM, IS AS GIVEN BELOW:

1. THE SWARAS OF THE PARTICULAR MELAKARTHA RAGA ARE LISTED
2. THEN A 2 DIMENSIONAL ARRAY, OR MATRIX IS FORMED (IN THIS CASE 7X7) WITH EVERY ROW AND EVERY COLUMN REPRESENTING A SWARA, AND HENCE ITS POINTS.
3. EVERY ELEMENT IN THE 2D MATRIX REPRESENTS A PARTICULAR TRANSITION (SUCH AS GU-MA). HENCE THE VALUE OF THAT ELEMENT WILL BE THE AVERAGE OF THE CORRESPONDING "ROW SWARA" AND "COLUMN SWARA" POINTS (IN THIS CASE AVERAGE OF GU AND MA).
4. IF ONE OF THE SWARA IS SA/PA, THE VALUE OF THE ELEMENT WILL BE THE OTHER SWARA (SUCH AS FOR SANU, IT IS VALUE OF NU).
5. IF BOTH OF THE "ROW SWARA" AND "COLUMN SWARA" IS SA/PA, THEN THE VALUE OF THE ELEMENT WILL BE THE HIGHEST VALUE OF ALL THE OCCURING VALUES. THIS IS BECAUSE JOY IS A POSITIVE EMOTION. FOR NEGATIVE EMOTIONS THIS VALUE WILL BE THE LOWEST. SANKARABHARANAM BEING A MELAKARTHA RAGA, THE SA-PA EDGE SELDOM OCCURS (THIS EDGE OCCURS IF RI,GA,MA OR DHA,NI IS

VARJA OR SAPA OCCURS AS A VAKRA PHRASE) AND HENCE FOR THIS ANALYSIS IS REPRESENTED WITH AN "E". SIMILARLY NO JANTA PHRASES ARE PRESENT AND HENCE EDGES LIKE RIRI, GUGU ARE ALSO GIVEN AS "E".

6. NEXT THIS MATRIX IS USED TO REPRESENT THIS RAGA AS A "GRAPH" (A POLYGON). THE SWARAS ARE THE VERTICES OF THE GRAPH.
7. EACH EDGE REPRESENTS A SWARA TRANSITION. HENCE INITIALLY THE AROHANA GRAPH IS DRAWN AND THE CORRESPONDING EDGES ARE DRAWN (FOR EXAMPLE IF SAMAGU OCCURS THE EDGES USED ARE SA-MA AND MA-GU). NOW SINCE EACH EDGE REPRESENTS A SWARA TRANSITION, THE CORRESPONDING MATRIX VALUES ARE ASSIGNED TO THE EDGE.
8. SIMILARLY THE AVAROHANA GRAPH IS DRAWN. SINCE SANKARABHARANAM, OR ANY OTHER MELAKARTHA RAGA IS SYMMETRIC, THE AROHANA AND AVAROHANA MATRICES ARE THE SAME.
9. NOW, THE POINTS OF JOY FOR THE RAGA IS GIVEN AS THE AVERAGE OF ALL THE EDGE VALUES.
10. NOW THE MAXIMUM POSSIBLE VALUE FOR A MELAKARTHA RAGA, BASED ON THE SCHEME USED HERE IS 23.8571. THIS MAY VARY ACCORDING TO THE QUANTIFYING SCHEME USED. NOW THE OBTAINED AVERAGE IS DIVIDED BY THIS VALUE TO GIVE A NORMALISED PERCENTAGE VALUE.
11. SIMILARLY IT IS DONE FOR FEAR, SURPRISE AND SYMPATHY.

THE MATRIX AND GRAPH FOR SANKARABHARANAM IS AS FOLLOWS:

	SA	RI 24	GU 26	MA 28	PA	DHI 22	NU 20
SA	E	24	26	28	E	22	20
RI 24	24	E	25	26	24	23	22
GU 26	26	25	E	27	26	24	23
MA 28	28	26	27	E	28	25	24
PA	E	24	26	28	E	22	20
DHI 22	22	23	24	25	22	E	21
NU 20	20	22	23	24	20	21	E
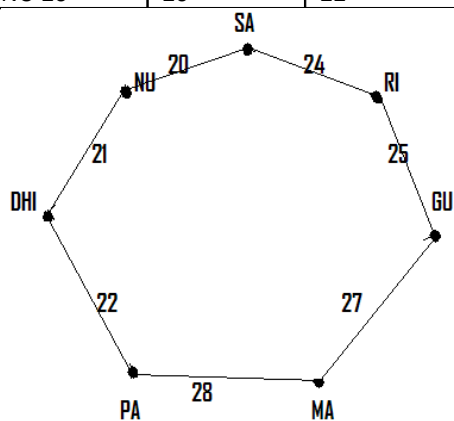
FROM THE GRAPH THE % OF JOY THIS RAGA CAN DELIVER CAN BE STUDIED. TO DO SO TAKE THE AVERAGE OF ALL THE EDGE VALUES. THIS GIVES 23.8571. BUT THE MAXIMUM POINTS A MELAKARTHA RAGA CAN TAKE ACCORDING TO THIS SCHEME IS 26.14. THEREFORE THE POINTS OBTAINED ARE NORMALISED TO THIS VALUE AND THIS GIVES JOY%. SIMILARLY OTHER 3 EMOTIONS MENTIONED EARLIER I.E. FEAR%, SURPRISE% AND SYMPATHY% CAN BE CALCULATED. OTHER EMOTIONS ARE FOUND USING THE FOLLOWING RELATIONS. SYMPATHY=0.75LOVE+0.25 SORROW AND HUMOUR=0.75JOY+0.25SURPRISE.

- JOY%=JOY*100/26.14
- FEAR%=FEAR*100/26.14
- SURPRISE%=SURPRISE*100/26.14

- SYMPATHY%=SYMPATHY*100/26.14
- SORROW%=100-JOY%
- ANGER%=100-FEAR%
- ANTICIPATION%=100-SURPRISE%
- LOVE%=(SYMPATHY%-0.25SORROW%)/0.75
- TRUST%=2*LOVE%-JOY%
- REMORSE%=100-LOVE%
- DISGUST%=100-TRUST%
- OPTIMISM=AVE (ANTICIPATION%, JOY %)
- DISAPPOINTMENT=100-OPTIMISM%
- SUBMISSION%=AVE (TRUST%, FEAR %)
- CONTEMPT%=100-SUBMISSION%
- AWE%=AVE (FEAR%, SURPRISE %)
- AGGRESSIVENESS%=100-AWE%
- HUMOUR%=0.75*JOY%+0.25*SURPRISE%

II.TO ANALYSE A JANYA RAGA:

I.TO ANALYSE A UPANGA RAGA:
THE MATRICES FOR JANYA RAGAS ARE THE SAME AS THAT OF THE MELA FROM WHICH THE RAGA IS DERIVED.
FOR AN UPANGA RAGA, THE SUBTYPE MAY BE AUDAVA (5 SWARAS), SHADAVA (6 SWARAS), SAMPOOORNA (7 SWARAS).
DEPENDING ON THESE, THE GRAPH IS DRAWN. CONSIDER AUDAVA RAGA. LET US TAKE MOHANAM.THE MATRIX IS SAME AS ABOVE. THE EDGES ARE PLOTTED AS SHOWN, AND A GRAPH IS DRAWN FOR AROHANA, BASED ON THE SWARA TRANSITIONS INVOLVED. THE VALUES OF THE EDGES ARE ADDED AND DIVIDED BY THE SUM TOTAL OF SWARAS IN AROHANA. HERE THE SAME EDGE BEING REPEATED MORE THAN ONCE SHOULD BE COUNTED MORE THAN ONCE IN THE SUM TOTAL. THE TOTAL HERE IS 24+25+26+22+22=119 AND THE POINTS ARE 119/5=23.8.

- FOR AN AUDAVA RAGA THE MAXIMUM POINTS THAT CAN BE OBTAINED IS 26.6. HENCE THE OBTAINED POINTS ARE NORMALISED TO 26.6 TO GET THE % OF BASIC EMOTIONS.
- FOR A SHADAVA RAGA THE MAXIMUM POINTS THAT CAN BE OBTAINED IS 26.33. HENCE THE OBTAINED POINTS ARE NORMALISED TO 26.33 TO GET THE % OF BASIC EMOTIONS.
- FOR A SAMPOORNA RAGA THE MAXIMUM POINTS THAT CAN BE OBTAINED IS 26.14. HENCE THE OBTAINED POINTS ARE NORMALISED TO 26.14 TO GET THE % OF BASIC EMOTIONS.

IN A SIMILAR WAY THE % OF BASIC EMOTIONS OF AVAROHANA SHOULD BE CALCULATED. THE AVERAGE OF THE CORRESPONDING VALUES GIVE THE % OF BASIC EMOTIONS OF THE RAGA. FOR A RAGA LIKE AUDAVA AROHANA AND SHADAVA AVAROHANA, THE AROHANA IS TO BE CONSIDERED AUDAVA AND THE AVAROHANA SHADAVA. SAME APPLIES FOR OTHER VARIANTS.
USING THESE AND THE ABOVESAID RELATIONS, THE OTHER EMOTIONS CAN BE FOUND. IT MAY BE NORMALISED USING THE METHOD TOLD EARLIER.
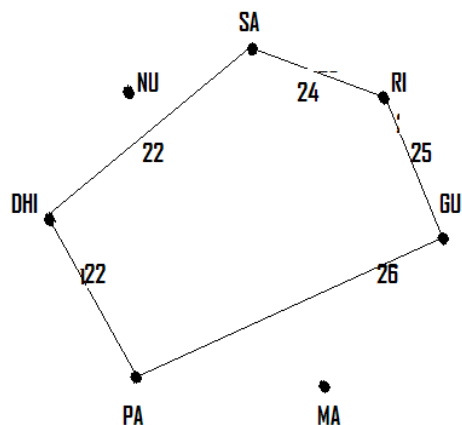
HERE THE AROHANA AND AVAROHANA GRAPH IS THE SAME AND IS SHOWN.

II.ANALYSIS OF NON-UPANGA RAGA.
 FOR VAKRA RAGA THE NORMAL METHOD IS FOLLOWED, THE VAKRATHVA ALSO BEING COUNTED. LET US SEE HOW KEDARA RAGA IS ANALYSED FOR JOY. THE MATRIX IS SAME AS THE ABOVE ONE.
THE GRAPH IS AS FOLLOWS. NOTE THAT THE GUMA EDGE OCCURS TWICE FOR AROHANA (SAMAGUMA) AND ONCE FOR AVAROHANA (PAMAGURISA).
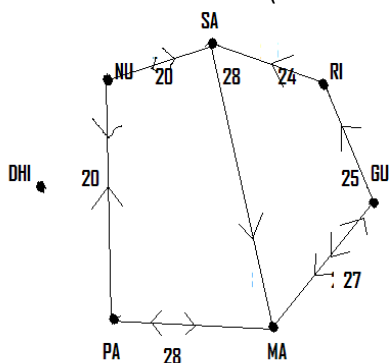
AROHANA IS SMGMPN. POINTS= AVE (28, 27, 27, 28, 20, 20) =25=93.98% NORMALISED TO 26.6
AVAROHANA IS SNPMGR. POINTS=AVE (20, 20, 28, 27, 25, 24) =24=91.15% NORMALISED TO 26.33
HENCE JOY% = AVE (93.98, 91.15) =92.565%

 IN THE CASE OF BHASHANGA RAGAS, THE MATRIX IS REWRITTEN WITH THE ANYA SWARA ALSO INCLUDED. AND THE GRAPH IS ALSO REDRAWN WITH CORRESPONDING VERTICES. OTHER PROCEDURES ARE SAME.

• REASON FOR CALCULATING SYMPATHY AND NOT DISGUST AS THE FOURTH EMOTION – THOUGH DISGUST IS A BASIC EMOTION, THE TABLE OF 16 SWARAS, IN TURN OBTAINED FROM RIGAMA AND DHANI COMBINATIONS, WHICH WAS IN TURN OBTAINED FROM MUSICAL EXPERIENCE, DOES NOT GIVE SUFFICIENT DETAILS ABOUT THE CONTENT OF DISGUST. HENCE AN EMOTION RELATED TO DISGUST, BUT PRESENT IN THE TABLE, SYMPATHY WAS CHOSEN. FROM ANALYSIS OF DAY TO DAY EMOTIONAL SITUATIONS ONE COULD ROUGHLY FIND THAT SYMPATHY=75%LOVE + 25%SORROW. BUT LOVE=50%JOY + 50%TRUST, ACCORDING TO PLUTCHIK, WHERE TRUST IS THE OPPOSITE OF DISGUST. SINCE LOVE AND JOY ARE FOUND, IF WE CAN FIND SYMPATHY, WE CAN EASILY FIND OUT DISGUST. CONSIDER THE FOLLOWING RELATION.
LOVE=50%JOY+50%TRUST

SYMPATHY=75%LOVE+25%SORROW
HENCE LOVE= (SYMPATHY-25%SORROW)/75%
WHERE SORROW=100%-JOY%
NOW TRUST= (LOVE-50%JOY)/50%
TRUST = 2 LOVE – JOY
DISGUST = 100 - TRUST.

SINCE THE % OF A BASIC EMOTION IS CALCULATED FROM A DERIVED ONE, CERTAIN RAGAS HAVE CERTAIN EMOTION % GREATER THAN 100% OR LESSER THAN 0%. THIS IS ACCEPTABLE AS WE ARE CONCERNED ONLY ABOUT THE RELATIVE EMOTIONS OF RAGAS. BUT FOR PRACTICAL PURPOSES WE COULD TAKE THE MAXIMUM POINT AS 100% AND NORMALISE THE OTHERS TO THIS VALUE, IF NECESSARY.

- FORMULA FOR EMOTIONS- THE FORMULA FOR OTHER DERIVED EMOTIONS WERE CALCULATED WITH THE FOLLOWING CONCEPTS. THE POINTS OF BASIC EMOTIONS ARE NORMALISED TO THE POINTS AS MENTIONED. NOW THEY ARE IN %. THE OPPOSITES OF EACH EMOTION ARE CALCULATED AS 100%- THAT EMOTION%. CERTAIN EMOTIONS ARE COMBINATION OF TWO EMOTIONS. HENCE THEY ARE CALCULATED AS 50%EMOTION1+50%EMOTION2, UNLESS THE RATIO IS SPECIFIED.

- THE REASON FOR HAVING AN EDGE CONNECTING SA/PA TO ANY OTHER SWARA AS THE POINT OF THAT SWARA IS THAT WHEN SA OR PA IS CONSIDERED TO BE 0, THE EDGE HAPPENS TO BE AVERAGE OF SA/PA AND THAT SWARA, WHICH MEANS (SA/PA+SWARA)/2 = SWARA/2. BUT IN PRACTICAL EXPERIENCE THIS IS NOT THE CASE, IT IS = SWARA. THEREFORE THIS CAN BE OBTAINED ONLY IF SA=SWARA. AS FOR SA-PA EDGE SINCE THERE IS NO FIXED VALUE, WE CAN COUNT ON THE FACT THAT SA-PA IS A SAMVAADHI PAIR AND SO ADDS TO POSITIVE EMOTIONS. THEREFORE FOR GRAPH OF POSITIVE EMOTION, MAXIMUM VALUE OCCURING IN THE GRAPH IS ALLOTTED AND FOR NEGATIVE EMOTIONS THE LOWEST VALUE OCCURING IN THE GRAPH IS TAKEN.

RELATION BETWEEN BASIC AND DERIVED EMOTIONS

AS PER MATHEMATICAL RELATIONSHIPS, WE CAN FIND THAT

- SORROW DECREASES WITH INCREASE IN JOY
- ANGER DECREASES WITH INCREASE IN FEAR
- ANTICIPATION DECREASES WITH INCREASE IN SURPRISE
- LOVE INCREASES WITH INCREASE IN JOY
- LOVE INCREASES WITH INCREASE IN TRUST
- TRUST INCREASES WITH INCREASE IN LOVE
- REMORSE DECREASES WITH INCREASE IN LOVE
- DISGUST DECREASES WITH INCREASE IN TRUST
- OPTMISM INCREASES WITH INCREASE IN JOY
- OPTIMISM INCREASES WITH INCREASE IN ANTICIPATION
- DISSAPPOINTMENT DECREASES WITH INCREASE IN OPTIMISM
- SUBMISSION INCREASES WITH INCREASE IN FEAR
- SUBMISSION INCREASES WITH INCREASE IN TRUST
- CONTEMPT DECREASES WITH INCREASE IN SUBMISSION
- AWE INCREASES WITH INCREASE IN FEAR
- AWE INCREASES WITH INCREASE IN SURPRISE
- AGGRESSIVENESS DECREASES WITH INCREASE IN AWE
- HUMOUR INCREASES WITH INCREASE IN JOY
- HUMOUR INCREASES WITH INCREASE IN SURPRISE
- SYMPATHY INCREASES WITH INCREASE IN LOVE
- SYMPATHY INCREASES WITH INCREASE IN SORROW
- HEROISM INCREASES WITH INCREASE IN JOY
- HEROISM INCREASES WITH INCREASE IN OPTIMISM

EXAMPLES AND ILLUSTRATIONS
THE FOLLOWING SECTION GIVES ILLUSTRATIONS ON THE ANALYSIS OF EMOTIONS OF A SELECT RAGAS. THE RULES ARE ALL AS EXPLAINED IN THE PRECEDING SECTIONS. ONE WOULD BE IN A BETTER POSITION TO CALCULATE THE RAGA EMOTIONS IF ONE COULD COMPARE THE RULES WITH THE GRAPH AND VALUES GIVEN BELOW.
IN ORDER TO SIMPLIFY THE PROCESS THE MATRIX HAS BEEN OMITTED AND THE CORRESPONDING VERTICES OR EDGE VALUES ARE GIVEN IN THE GRAPH BESIDE THE CORRESPONDING VERTICES OR EDGES. THE GRAPHS OF 4 EMOTIONS ARE DRAWN AS A SINGLE GRAPH WITH EACH EDGE/VERTEX ASSIGNED 4 VALUES IN THE ORDER OF JOY, FEAR, SURPRISE AND SYMPATHY. THE LIGHT LINES DENOTE AROHANA AND THE DARKER ONES AVAROHANA.

1.   RASIKAPRIYA
MELA: 72
AROHANA: SARUGUMIPADHUNUSA
AVAROHANA: SANUDHUPAMIGURUSA
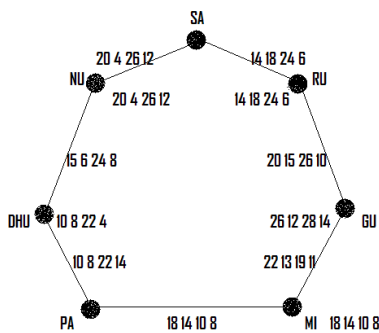
GRAPH:
POINTS:

EMOTION	AAROHANA	AVAROHANA	OVERALL %
JOY	17	17	65.03
FEAR	11.143	11.143	42.63
SURPRISE	21.51	21.51	82.29
SYMPATHY	8.43	8.43	32.25

2.   NATTAI
MELA: 36
AROHANA: SARUGUMAPADHUNUSA
AVAROHANA: SANUPAMARUSA
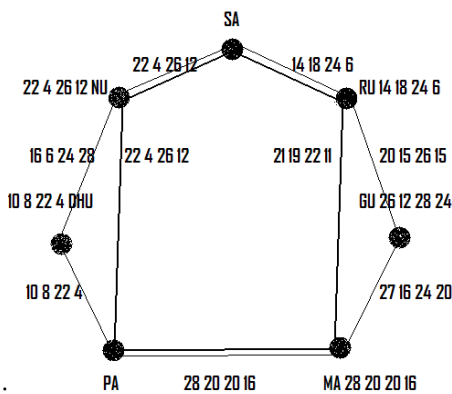
GRAPH:
POINTS:

EMOTION	AAROHANA	AVAROHANA	OVERALL %
JOY	19.57	21.4	77.66

23

FEAR	12.43	13	48.21
SURPRISE	23.71	23.6	89.71
SYMPATHY	11.57	11.4	43.56

3. BEHAG

MELA: 29
AROHANA: SAGUMAPANUDHINUSA
AVAROHANA: SANUDHIPAMIGUMAGURISA
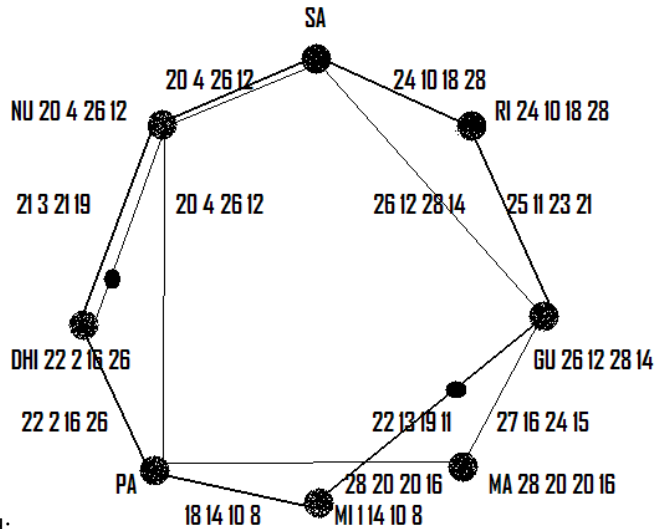
GRAPH:
POINTS:

EMOTION	AAROHANA	AVAROHANA	OVERALL %
JOY	23.28	22.88	87.97
FEAR	8.857	9.88	35.715
SURPRISE	23.71	20.111	83.49
SYMPATHY	15.29	17.222	61.975

THUS USING THESE VALUES OTHER EMOTIONS ARE FOUND USING THE RELATIONS GIVEN. FOLLOWING IS A TABLE OF THE EMOTIONS OF THE 72 MELAKARTHA RAGAS, FOLLOWED BY A TABLE FOR SELECTED JANYA RAGAS.

MELA NO	MELA NAME	JOY%	FEAR%	SURPRISE%	SYMPATHY%	SORROW%	ANGER%	ANTICIPA	LOVE%	ACCEPTAN	REMORSE	DISGUST%	OPPTIMIS	DISAPPOI	SUBMISSI	CONTEMP	AWE%	AGGRESSI	HUMOUR	HEROISM	REDP	GREENP	BLUEP	RED	GREEN	BLUE	COLOUR
1	KANAKANGI	37.16253	91.81331	56.83681	54.65078	62.83747	8.186687	43.16319	51.92189	66.68124	48.07811	33.31876	40.16286	59.83714	79.24728	20.75272	74.32506	25.67494	42.0811	38.6627	55.20745	56.55589	32.77783	55	56	32	
2	RATHNANGI	43.72063	73.77856	40.44158	69.40649	56.27937	26.22144	59.55842	73.7822	103.8438	26.2178	-3.84377	51.63952	48.36048	88.81116	11.11884	57.11007	42.88993	42.90086	47.68007	61.22655	59.30961	23.55449	61	59	23	
3	GAANAMURTHI	50.27872	72.13903	56.83681	62.8484	49.72128	27.86097	43.16319	67.2241	84.16949	32.7759	15.83051	46.72095	53.27905	78.15426	21.84574	64.48792	35.51208	51.91824	48.49984	69.06142	65.48037	31.65066	69	65	31	
4	VANASPATHI	60.11586	54.10427	51.91824	75.96459	39.88414	45.89573	48.08176	87.9914	115.8669	12.0086	-15.8669	54.09881	45.90119	84.98561	15.01439	53.01126	46.98874	58.06646	57.10733	80.04418	73.06897	25.60543	80	73	25	
5	MAANAAVATHI	66.67395	52.46475	68.31348	69.40649	33.32605	47.53525	31.68652	81.43331	96.19266	18.56669	3.807338	50.81976	49.18024	74.32871	25.67129	60.38911	39.61089	67.08383	57.9271	87.87905	79.23972	33.7016	87	79	33	
6	THAANARUPI	56.83681	57.33332	73.23205	71.37173	43.16319	42.61668	26.76795	54.10792	51.37902	45.89208	48.62098	58.19762	41.80238	54.38117	45.61883	65.30768	34.69232	60.93562	49.3196	80.29011	69.81486	43.14064	80	69	43	
7	SENAVATHI	41.53459	87.44125	35.52301	61.20888	58.46541	12.55875	64.47699	62.12337	82.71214	37.87663	17.28786	46.99421	53.07669	85.07669	14.92331	61.48213	38.51787	40.0317	47.27019	52.94696	53.5657	28.06403	52	53	28	
8	HANUMATHODI	48.09269	69.64049	37.16253	75.96459	45.34922	32.23303	62.83747	83.98368	119.8747	16.01632	-19.8747	55.46508	44.53492	94.64058	5.35942	53.28451	46.71549	45.36015	51.77888	64.71464	62.57522	20.20783	64	62	20	
9	DHENUKA	54.65078	67.76697	53.57777	69.40649	45.34922	32.23303	46.44223	77.42558	100.2004	22.57442	-0.20039	50.54651	49.45349	83.98368	16.01632	60.66237	39.33763	54.37753	52.59864	72.54951	68.74598	28.374	72	68	28	
10	NAATAKAPRIYA	64.48792	49.73221	48.6392	82.52268	35.51208	50.26779	51.3608	98.19288	131.8978	1.807119	-31.8978	57.92436	42.07564	90.81503	9.184975	49.1857	50.8143	60.52574	61.20614	83.53227	76.33458	22.32877	83	76	22	
11	KOKILAPRIYA	71.04602	48.09269	65.03443	75.96459	28.95398	51.90731	34.96557	91.63479	112.2236	8.365213	-12.2236	53.00579	46.99421	80.15812	19.84188	56.56356	43.43644	69.54312	62.0259	91.36714	82.50534	30.42494	91	82	30	
12	ROOPAVATHI	61.20888	53.01126	69.953	57.92983	38.79112	46.98874	30.047	64.3094	67.40992	35.6906	32.59008	45.62794	54.37206	60.21059	39.78941	61.48213	38.51787	63.39491	53.41841	83.7782	73.08047	39.86399	83	73	39	
13	GAAYAKAPRIYA	46.99967	85.25522	46.45316	56.83681	53.00033	14.74478	53.54684	58.11564	69.23161	41.88436	30.76839	50.27325	49.72675	77.24341	22.75659	65.85419	34.14581	46.86305	48.63646	59.0412	58.1682	33.83891	59	58	33	
14	YAKULABHARANAM	53.55777	67.22046	48.09269	71.59252	46.44223	32.77954	51.90731	79.97595	106.3941	20.02405	-6.39414	52.73254	47.26746	86.8073	13.1927	57.65657	42.34343	52.1915	53.14515	70.80888	67.17773	26.05271	70	67	26	
15	MAYAMALAVAGOULA	60.11586	65.58094	64.48792	65.03443	39.88414	34.41906	35.51208	73.41786	86.71986	26.58214	13.28014	52.18603	47.81397	76.1504	23.8496	65.03443	34.96557	61.20888	53.96491	78.64376	73.34848	34.14888	78	73	34	
16	CHAKRAVAKAM	69.953	47.54618	59.56935	78.15062	30.047	52.45382	40.43065	94.18516	118.4173	5.814843	-18.4173	55.19182	44.80818	82.98175	17.01825	53.53577	46.44223	67.35709	62.57241	89.62651	80.93709	28.10365	89	80	28	
17	SURYAKANTHAM	76.51109	45.90666	75.96459	71.59252	28.95398	54.09334	24.03541	87.62706	98.74303	12.37294	1.256968	50.27325	49.72675	72.32484	27.67516	60.93562	39.06438	76.37447	63.39217	97.46139	87.10784	36.19982	97	87	36	
18	HATAKAMBARI	66.67395	50.82523	80.88316	53.55777	49.1477	19.11684	60.30167	53.92939	89.26559	34.87886	46.07061	42.8954	57.1046	52.37731	47.62269	65.85419	34.14581	70.22625	54.78468	89.87244	77.68297	45.63887	89	77	45	
19	JHANKARADHWANI	56.2903	77.60411	40.44158	56.83681	53.00033	14.74478	59.55842	71.414	86.53769	28.586	13.46231	57.92436	42.07564	82.0709	17.9291	59.02284	40.97716	52.32812	57.10733	65.23006	63.09304	31.28877	65	63	31	
20	NATABHAIRAVI	62.8484	59.56935	42.0811	79.24363	37.1516	40.43065	57.9189	93.27431	123.7002	6.72569	-23.7002	39.61635	60.38365	91.64379	8.365213	50.82523	49.17477	57.65657	61.61602	76.99774	72.10256	23.5027	76	72	23	
21	KEERAVANI	69.40649	57.92983	58.47634	61.20888	39.88414	42.07017	41.52366	86.71622	104.0259	13.28378	-4.0294	55.46508	44.53492	80.97788	19.02212	58.20308	41.79692	66.67395	62.43579	84.83261	78.27332	31.59874	84	78	31	
22	KHARAHARAPRIYA	79.24363	39.89507	53.57777	85.80173	60.10493	60.10493	46.44223	107.4835	135.7234	-7.48351	-35.7234	62.84293	37.15707	87.80923	12.19077	46.72642	53.27358	72.82217	71.04328	95.81537	85.86192	25.53351	95	85	25	
23	GOWRIMANOHARI	85.80173	38.25555	69.953	69.24363	14.19827	61.74445	30.047	100.9254	116.0491	-0.92542	-16.0491	57.92436	42.07564	77.15233	22.84767	54.10427	45.89573	81.83955	71.86305	103.6502	92.03268	33.64968	103	92	33	
24	VARUNAPRIYA	75.96459	43.17412	74.87157	61.20888	24.03541	56.82588	25.12843	73.60003	71.23547	26.39997	28.76453	50.54651	49.45349	57.20479	42.79521	59.02284	40.97716	75.69133	63.25555	96.0613	82.60781	43.08873	96	82	43	
25	MAARARANJANI	56.2903	75.41808	51.37173	60.11586	43.7097	24.58192	48.62827	65.58458	74.87886	34.41542	25.12114	52.45929	47.54071	75.14847	24.85153	63.39491	36.60509	55.06066	54.3748	68.71122	65.2522	35.17649	68	65	35	
26	CHARUKESI	68.31348	57.33332	53.01126	74.87157	31.68652	42.61668	46.98874	89.26559	110.2197	10.73341	-10.2197	57.65111	42.34889	83.80151	16.19849	55.19729	44.80271	64.48792	62.98229	83.09199	76.70507	29.27745	83	76	29	
27	SARASAANGI	74.87157	55.7438	69.40649	68.31348	25.12843	44.2562	30.59351	82.70849	90.54541	17.29151	9.454585	52.73254	47.26746	73.14461	26.85539	62.57514	37.42486	73.5053	63.80205	90.92686	82.87582	37.37362	90	82	37	
28	HARIKAMBHOJI	84.70871	37.07904	64.48792	81.42966	33.32605	62.29096	35.51208	103.4758	122.2429	-3.47579	-22.2429	60.11039	39.88961	79.97595	20.02405	51.09848	48.90152	79.65351	72.40955	101.9096	90.46443	31.32839	101	90	31	
29	DHEERASANKARABARANAM	91.26681	36.06952	80.88316	74.87157	8.733195	63.93048	19.11684	96.9177	102.5686	3.082304	-2.56869	55.19182	44.80818	69.31905	30.68095	58.47634	41.52366	88.67089	73.22931	109.7445	96.63518	39.42456	109	96	39	
30	NAAGANANDINI	81.42966	40.98809	85.80173	56.83681	18.57034	59.01191	14.19827	69.59231	57.75495	30.40769	42.24505	47.81397	52.18603	50.62848	49.37152	63.39491	36.60509	82.52268	64.62182	102.1555	87.21031	48.86361	102	87	48	
31	YAAGAPRIYA	53.55777	81.97617	56.2903	42.0811	46.44223	18.02383	43.7097	40.62739	27.69702	59.37261	72.30298	48.63373	51.36627	48.63373	51.36627	69.13324	30.86676	54.2409	51.09575	63.99666	59.00368	47.06684	63	59	47	
32	RAGAVARDHINI	60.11586	63.94141	57.92983	56.83681	36.05859	37.69811	42.07017	62.4877	64.83955	37.5123	35.14045	51.09302	48.90698	48.90698	51.09302	60.93562	39.06438	59.56935	55.60444	75.76434	68.0132	39.2826	75	68	39	
33	GANGEYABHOOSHANI	66.67395	62.30189	74.32506	69.40649	33.32605	37.69811	25.67494	55.92961	45.18527	44.07039	54.81473	46.17445	53.82555	53.74358	46.25642	68.31348	31.68652	68.5673	56.4242	83.59922	81.18396	47.37881	83	74	47	
34	VAAGADEESHWARI	76.51109	44.26713	69.40649	63.39491	23.48891	55.73287	14.19827	76.69691	76.88272	23.30309	23.11728	53.5523	46.4477	56.83681	43.16319	56.83681	43.16319	74.73494	65.0317	94.58197	81.77256	41.33358	94	81	41	
35	SOOLINI	83.06919	42.62761	85.80173	56.2903	16.93081	57.37239	14.19827	70.13881	57.20844	29.86119	42.79156	48.63373	51.36627	49.81802	50.18198	64.21467	35.78533	83.75232	65.85146	102.4168	87.94332	49.42975	102	87	49	
36	CHALANATA	73.23205	47.54618	90.7203	38.80205	26.76795	52.45382	9.279703	42.81342	12.23948	57.18658	87.6052	41.25587	58.74413	29.97049	70.02951	69.13324	30.86676	77.60411	57.24396	94.8279	78.51845	58.8688	94	78	58	

RAGA	JOY	FEAR	SURPRISE	SYMPATHY	SORROW	ANGER	ANTICIPA	LOVE	TRUST	REMORSE	DISGUST	OPTIMISM	DISAPPOI	SUBMISSI	CONTEMPA	AWE	AGGRESSI	HUMOUR	HEROISM
CHARUKESI	68.31	57.38	53.01	74.87	31.69	42.62	46.99	82.15667	96.00333	17.84333	3.996667	57.65	42.35	52.185	47.815	62.845	37.155	64.485	62.98
JHALAVARALI	42.08	67.21	48.64	56.29	57.92	32.79	51.36	58.84	75.6	41.16	24.4	46.72	53.28	59.285	40.715	54.645	45.355	43.72	44.4
RASIKAPRIYA	65.03	42.63	82.29	32.25	34.97	57.37	17.71	15.57	-33.89	84.43	133.89	41.37	58.63	30.17	69.83	53.83	46.17	69.345	53.2
BHOOPALAM	27.82	81.95	25.564	78.96	72.18	18.05	74.436	96.75867	165.6973	3.241333	-65.6973	51.128	48.872	78.193	21.807	54.885	45.115	27.256	39.474
RAGESHREE	81.38	36.78	64.36	84.28	18.62	63.22	35.64	90.92	100.46	9.08	-0.46	58.51	41.49	36.21	63.79	59.08	40.92	77.125	69.945
ABHERI	73.43	44.74	47.08	79.37	26.57	55.26	52.92	90.13333	106.8367	9.866667	-6.83667	63.175	36.825	48.83	51.17	59.085	40.915	66.8425	68.3025
BAHUDARI	81.2511	41.546	64.811	78.42	18.7489	58.454	35.189	82.95633	84.66157	17.04367	15.33843	58.22005	41.77995	38.3675	61.6325	61.39855	38.60145	77.14108	69.73558
SHRIRANJANI	75.96	39.23	50.63	86.099	24.04	60.77	49.37	97.922	119.884	2.078	-19.884	62.665	37.335	44.3	55.7	57.595	42.405	69.6275	69.3125
CHAAYAVATHI	74.653	49.06	76.284	70.596	25.347	50.94	23.716	68.7	62.747	31.3	37.253	49.1845	50.8155	36.388	63.612	61.8565	38.1435	75.06075	61.91875
NAATTAI	77.66	48.21	89.71	43.56	22.34	51.79	10.29	28.17667	-21.3067	71.82333	121.3067	43.975	56.025	29.25	70.75	62.935	37.065	80.6725	60.8175
RISHIPRIYA	79.197	50.798	59.16	71.797	20.803	49.202	40.84	76.00933	72.82167	23.99067	27.17833	60.0185	39.9815	45.819	54.181	64.9975	35.0025	74.18775	69.60775
NAVARASAKANNADA	92.085	42.662	78.39	84.797	7.915	57.338	21.61	86.93267	81.78033	13.06733	18.21967	56.8475	43.1525	32.136	67.864	67.3735	32.6265	88.66125	74.46625
KUNTHALAVARALI	82.199	35.85	56.9	78.7	17.801	64.15	43.1	85.96667	89.73433	14.03333	10.26567	62.6495	37.3505	39.475	60.525	59.0245	40.9755	75.87425	72.42425
KAANADA	80.285	43.2	49.45	83.75	19.715	56.8	50.55	95.18333	110.0817	4.816667	-10.0817	65.4175	34.5825	46.875	53.125	61.7425	38.2575	72.57625	72.85125
EESAMANOHARI	84.675	36.305	66.67	79.21	15.325	63.695	33.33	83.39	82.105	16.61	17.895	59.0025	40.9975	34.8175	65.1825	60.49	39.51	80.17375	71.83875
BHAIRAVI	68.965	51.78	45.19	81.69	31.035	48.22	54.81	93.85667	118.7483	6.143333	-18.7483	61.8875	38.1125	53.295	46.705	60.3725	39.6275	63.02125	65.42625
BEHAG	87.97	35.715	83.49	61.975	12.03	64.285	16.51	54.80333	21.63667	45.19667	78.36333	52.24	47.76	26.1125	73.8875	61.8425	38.1575	86.85	70.105

IDENTIFICATION AND SYNTHESIS OF RAGAS

NUMEROUS RAGAS ARE AVAILABLE AND POSSIBLE IN CARNATIC MUSIC. HENCE IT IS DIFFICULT TO CALCULATE THE EMOTIONS FOR ALL RAGAS AND THEN ARRIVE AT A CONCLUSION AS TO WHICH RAGA GIVES A MAXIMUM OF A PARTICULAR EMOTION. HENCE PROCEDURES ARE DESIRED THAT HELPS TO IDENTIFY A RAGA THAT MAXIMIZES A PARTICULAR EMOTION. HERE ARE THE GUIDELINES:

- CHOOSE THE NUMBER OF NOTES YOU WANT IN THE RAGA.
- CHOOSE THE EMOTION TO BE MAXIMISED.
- FIND THE TRANSITIONS THAT YIELD A MAXIMUM IN THAT EMOTION. THIS DEPENDS ON THE 4 EMOTION VALUES FOR THE SWARAS.
- DRAW THE GRAPH AND CALCULATE THE EMOTION VALUE. THUS THE RAGA IS OBTAAINED.

EXAMPLES:

- SUPPOSE THAT WE WANT TO MAXIMIZE JOY . THE EDGE SP HAS HIGHEST VALUE FOR POSITIVE EMOTIONS AND LOWEST FOR NEGATIVE. SINCE JOY IS POSITIVE, INCLUDE SP.
- FOR A RAGA WITH 5 NOTES IT IS SARIGUMAPA.THIS PROCEDURE CAN BE EXTENDED TO ANY NUMBER OF NOTES.
- IF WE WANT TO MAXIMIZE FEAR, THE EDGE SP SHOULD NOT BE USED AS IT DECREASES NEGATIVE EMOTIONS VALUES.
- WHEN A HYBRID EMOTION SUCH AS OPTIMISM IS CONSIDERED, THE AVERAGE OF THE BASIC EMOTIONS SHOULD BE CALCULATED FOR EACH SWARA(LIKE AVE(JOY,SURPRISE)).
- ONLY IF ALL BASIC EMOTIONS OF THE HYBRID EMOTION ARE POSITIVE, PA CAN BE INCLUDED. THE OTHER SWARAS CAN BE FOUND OUT AS ABOVE.
- THUS THE RAGA CAN BE FOUND AND EMOTION(MAX VALUE) CAN BE CALCULATED.

EMOTIONS AND COLOR

BHARATA MUNI ENUNCIATED THE EIGHT RASAS IN THE *NĀTYASĀSTRA*, AN ANCIENT WORK OF DRAMATIC THEORY. EACH RASA, ACCORDING TO [NĀTYASĀSTRA]], HAS A PRESIDING DEITY AND A SPECIFIC COLOR. THERE ARE FOUR PAIRS OF RASAS. FOR INSTANCE, HASYA ARISES OUT OF SRINGARA. THE AURA OF A FRIGHTENED PERSON IS BLACK, AND THE AURA OF AN ANGRY PERSON IS RED. BHARATA MUNI ESTABLISHED THE FOLLOWING:

- **ŚRINGĀRAM** LOVE, ATTRACTIVENESS. PRESIDING DEITY: VISHNU. COLOR: LIGHT GREEN.
- **HĀSYAM** LAUGHTER, MIRTH, COMEDY. PRESIDING DEITY: PRAMATA. COLOR: WHITE.
- **RAUDRAM** FURY. PRESIDING DEITY: RUDRA. COLOR: RED.
- **KĀRUNYAM** COMPASSION, MERCY. PRESIDING DEITY: YAMA. COLOR: GREY.
- **BĪBHATSAM** DISGUST, AVERSION. PRESIDING DEITY: SHIVA. COLOR: BLUE
- **BHAYĀNAKARAM** HORROR, TERROR. PRESIDING DEITY: KALA. COLOR: BLACK
- **VĪRAM** HEROIC MOOD. PRESIDING DEITY: INDRA. COLOR: YELLOWISH
- **ADBHUTAM** WONDER, AMAZEMENT. PRESIDING DEITY: BRAHMA. COLOR: YELLOW
- **SHĀNTAM** DEITY: VISHNU. COLOR: BLUE., OR TRANQUILITY, WAS SUGGESTED BY ABHINAVAGUPTA AND HAD TO UNDERGO A GOOD DEAL OF STRUGGLE BETWEEN THE SIXTH AND THE TENTH CENTURIES, BEFORE IT COULD BE ACCEPTED BY THE MAJORITY OF THE ALANKARIKAS, AND THE EXPRESSION *NAVARASA* (THE NINE RASAS), COULD COME INTO VOGUE.

HENCE, THE NEXT STEP WOULD BE TO CORRELATE THE SET OF NINE EMOTIONS WITH THOSE BASED ON PLUTCHIK'S WHEEL OF EMOTIONS. HOWEVER, THIS IS NOT DIFFICULT EXCEPT FOR TWO EMOTIONS:

- VEERAM: COURAGE, AS SUCH IS NOT PRESENT IN THE WHEEL OF EMOTIONS. BUT FROM DAY TO DAY EXPERIENCE AND ON A LITERARY BASIS, IT CAN BE THOUGHT OF AS A COMBINATION OF OPTIMISM AND JOY IN EQUAL PROPORTIONS.
- SHAANTHAM: THIS, AS MENTIONED IS A LATER ADDITION AND MOREOVER IS CLASSICALLY KNOWN AS "THE ABSENCE OF ALL EMOTIONS".HENCE THIS EMOTION WILL NOT BE DISCUSSED FURTHER AS SUCH AN EMOTION IS DIFFICULT TO BE CALCULATED AND QUANTISED. MOREOVER, THIS EMOTION, WHICH IS TRANQUILITY, OCCURS ONLY WHEN THERE IS A PERFECT BALANCE IN ALL ASPECTS OF THE RENDERING, BE IT SPEED, GAMAKAMS, SHRUTHI, SWARA OR BHAVA.

AS FOR THE OTHERS, THE CORRESPONDENCE IS AS FOLLOWS:

1.   SHRINGAARA : LOVE
2.   HAASYA : HUMOUR
3.   KAARUNYA : SYMPATHY
4.   ADBHUTHA:SURPRISE
5.   RAUDRA:ANGER
6.   BHAYANAKA:FEAR
7.   BHIBHATSA:HATRED
8.   VEERA:JOY+OPTIMISM

EMOTIONAL COLOURS OF A RAGA

AS CAN BE OBSERVED, COLOURS ARE MENTIONED FOR EACH RASA. THIS CAN BE USED FOR FINDING OUT THE COLOUR OF EACH RAGA. THIS WOULD GIVE US A TRUE "VISUALISATION" OF A RAGA FROM AN EMOTIONAL POINT OF VIEW. TO DO SO, CONSIDER THE FOLLOWING ILLUSTRATION OF MELA 29 – DHEERA SANKARABHARANAM.

COLOUR OF SYMPATHY: GREY

PERCENTAGE OF SYMPATHY FOR THE RAGA: 74.87157.

THEREFORE, SYMPATHY SHADE OF THE RAGA=0.7487157*GREY.

EXPRESSED IN RGB COLOUR SCHEME GREY = 808080 IN HEXADECIMAL AND 128 128 128 IN DECIMAL. WE WOULD HAVE TO FIND 128*.7487, 128*.7487, 128*.7487 WHICH WOULD YIELD 95.8336 95.8336 95.8336 AS THE VALUES FOR RED, GREEN AND BLUE.

SIMILARLY, SHADES FOR THE OTHER EMOTIONS HAVE TO BE OBTAINED AND THE AGGREGATE COLOUR IS FORMED BY MIXING ALL THESE SHADES. THIS GIVES THE EMOTIONAL COLOUR OF A RAGA.THIS PROCEDURE APPLIES FOR JANYA RAGAS AS WELL.

•   THE FIRST RAGA OF EACH CHAKRA STARTS ON A DARK TONE AND THIS SLOWLY LIGHTENS UP. THIS EXPLAINS THE EFFECT OF KOMAL SWARAS (ESPECIALLY DHA AND NI) ON THE INITIAL RAGAS AND THE SLOW TRANSITION TO THIVRA SWARAS.

•   THE % EMOTIONS LISTED GIVE A METHOD TO FIND THE MAXIMUM % OF EMOTIONS A RAGA CAN YIELD. THE COLOURS ARE ALSO BASED ON THESE VALUES. SINCE CERTAIN SWARAS ARE RESPONSIBLE FOR CERTAIN EMOTIONS, IT IS POSSIBLE THAT WE CAN ELABORATE A RAGA WITHOUT TOUCHING THESE SWARAS IN DETAIL. CONSEQUENTLY, THE ASSOCIATED EMOTION% FOR THAT RENDERING REDUCES. THUS THE COLOUR ALSO CHANGES. THE ABOVE COLOURS REPRESENT THE MAXIMUM OVERALL CAPABILITY OF THE RAGA WHEN ALL SWARAS GET EQUAL COVERAGE.

•   A RAGA IS MULTI-FACETED. HENCE THE EMOTIONS CAN CHANGE DRASTICALLY. BUT THERE ARE SOME RAGAS, IN WHICH, TO DIMINISH AN EMOTION (AND HENCE MAKE OTHERS LOOK PROMINENT), WE TEND TO AVOID OR OVER STRESS ONE OR MORE SWARAS.BUT THIS SWARA MAY AFEECT OTHER EMOTIONS TOO AND HENCE THE % OF THOSE EMOTIONS ALSO DECREASES. IT MAY COME TO A STAGE WHERE % OF ALL EMOTIONS DECREASE AND THE EMOTION DOMINANT IN THE MAXIMUM BECOMES DOMINANT HERE ALSO. HENCE IT IS DIFFICULT (OR NEARLY IMPOSSIBLE) TO REMOVE THAT EMOTION IN THAT RAGA. SUCH RAGAS ADMIT ONLY OF A SINGLE DOMINANT EMOTION.

MUSIC NOTATIONS

AS MENTIONED EARLIER THE EMOTION OF A RENDERING CAN VARY FROM PERSON TO PERSON AND TIME TO TIME AS DIFFERENT SWARAS AND DIFFERENT FACTORS COME INTO PLAY EACH TIME.HENCE IN SITUATIONS DEMANDING EMOTIONS,EXACT REPRODUCTION IS NECESSARY AND HENCE TO PREVENT ALTERATIONS IN SWARA,RHYTHM ,MELODY,PITCH,KEY ETC... A UNIVERSAL SYSTEM OF NOTATIONS IS A MUST.THIS IS DONE IN 2 STEPS:

1.   THE SYSTEM OF WESTERN AND CARNATIC MUSIC NOTATIONS HAVE TO BE STUDIED WITH ILLUSTRATIONS.WESTERN IS CHOSEN BECAUSE OF THE REMARKABLE PERFECTION OF THE UNIVERSALITY OF NOTATION.

2.   FROM THIS A GRAPH OF TIME VS. FREQUENCY IS DRAWN AND SALIENT FEATURES IF THE SAME ARE STUDIED.

GRAPH NOTATION

FOR THE PURPOSE OF UNIVERSAL NOTATION A SYSTEM IS PROPOSED WHICH REPRESENTS RENDERINGS AS A GRAPH OF TIME VS. FREQUENCY. HERE OCTAVES CAN EASILY BE REPRESENTED AND THE VARIOUS GAMAKAS AND OSCILLATIONS ARE REPRESENTED WITH APPROPRIATE CURVES AND OSCILLATORY PORTIONS. THIS CAN BE WELL UNDERSTOOD WITH AN ILLUSTRATION AS SHOWN BELOW.THAALA CONSTRAINTS CAN BE RELAXED AS THEIR EFFECTS ON EMOTIONS ARE LESS PRONOUNCED.

THE FOLLOWING GRAPH SHOWS THE "PALLAVI" OF "SHIVAKAAMESHWARIM" OF "SHAANTHAKALYANI RAAGAM" SET TO "AADHI THAALAM" BY "SHRI. MUTHUSWAMY DIKSHITHAR".
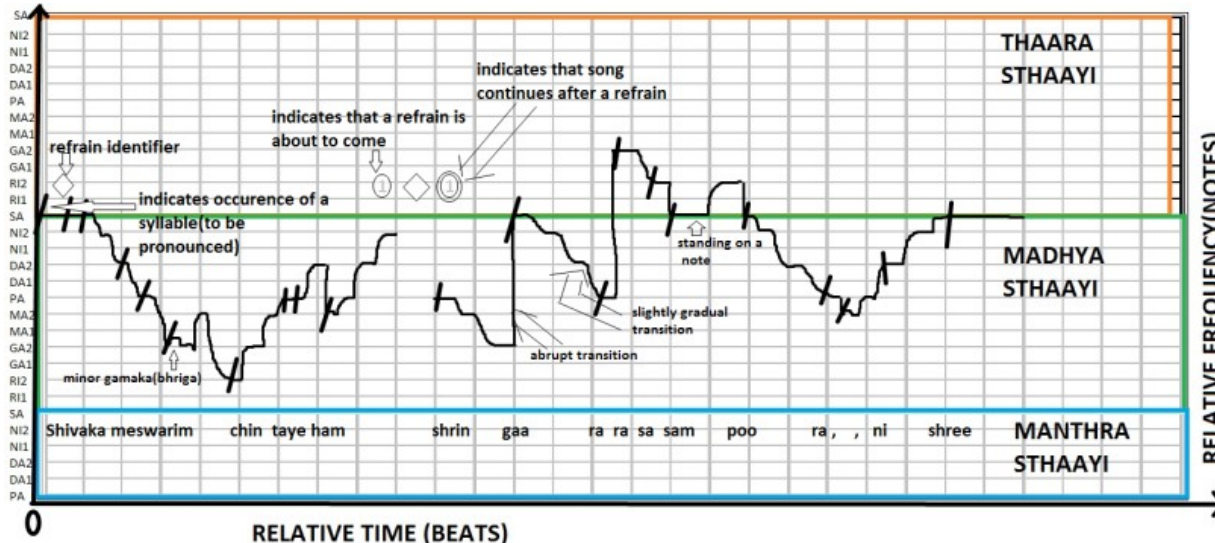
INTERPRETATION OF THE GRAPH NOTATION

AS MENTIONED EARLIER THE GRAPH NOTATION CAN BE USED TO FIND OUT THE EMOTIONS BEING CONCENTRATED IN A PARTICULAR RENDERING.THIS CAN BE DONE ONLY IF THE EMOTION OF THE RAGA IS KNOWN FIRST. NOW THE FEATURES OF THE 4 EMOTIONS AND THE WAY IN WHICH OTHER EMOTIONS DEPEND ON THESE 4 ARE GIVEN.

JOY

FROM PREVIOUS TABLES IT CAN BE FOUND THAT JOY DEPENDS
1.   HEAVILY ON RI,GU,MA,DHI AND NU
2.   PARTIALLY ON RU,GI,MI,DHU AND NI
3.   SLOW MUSIC
4.   LOW KEY
5.   HARMONIC SIMULTANEITIES. HERE 4 AND 5 CAN BE NEGLECTED.
FROM THE GRAPH, THESE ARE RESPECTIVELY
1.   NUMBER OF STANDINGS(HORIZONTAL PORTIONS) IN RI,GU,MA,DHI,NU
2.   NUMBER OF STANDINGS ON RU,GI,MI,DHU,NI
3.   LESS NUMBER OF TRANSITIONS PER UNIT TIME
HENCE ONE CAN GET A VIEW OF HOW MUCH THE RENDERING CONCENTRATES ON JOY.A QUANTIZATION IS NOT REQUIRED HERE AS IT IS JUST AN UNDERSTANDING OF A RENDITION AND OCCURS ONLY AFTER THE RAGA VALUES HAVE BEEN SEEN AND ANALYSED. THIS POINT WOULD BECOME CLEAR IN THE FOLLOWING "VIRTUAL APPLICATION".

FEAR

FROM PREVIOUS TABLES IT CAN BE FOUND THAT FEAR DEPENDS

1.   HEAVILY ON NA,DHA,GA AND RA
2.   PARTIALLY ON MA
3.   FAST MUSIC

FROM THE GRAPH, THESE ARE RESPECTIVELY

1.   NUMBER OF STANDINGS(HORIZONTAL PORTIONS) IN NA,DHA,GA AND RA
2.   NUMBER OF STANDINGS ON MA
3.   MORE NUMBER OF TRANSITIONS PER UNIT TIME

HENCE ONE CAN GET A VIEW OF HOW MUCH THE RENDERING CONCENTRATES ON FEAR.

SURPRISE

FROM PREVIOUS TABLES IT CAN BE FOUND THAT SURPRISE DEPENDS

1.   HEAVILY ON GU,NU,RU,DHU
2.   PARTIALLY ON MA,RI,DHI
3.   SLOW MUSIC

FROM THE GRAPH, THESE ARE RESPECTIVELY

1.   NUMBER OF STANDINGS(HORIZONTAL PORTIONS) IN GU,NU,RU,DHU
2.   NUMBER OF STANDINGS ON MA,RI,DHI
3.   LESS NUMBER OF TRANSITIONS PER UNIT TIME

HENCE ONE CAN GET A VIEW OF HOW MUCH THE RENDERING CONCENTRATES ON SURPRISE.

SYMPATHY

FROM PREVIOUS TABLES IT CAN BE FOUND THAT SYMPATHY DEPENDS

1.   HEAVILY ON RI,DHI,RA,GI,NI AND DHA
2.   SLOW MUSIC

FROM THE GRAPH, THESE ARE RESPECTIVELY

1.   NUMBER OF STANDINGS(HORIZONTAL PORTIONS) IN RI,DHI,RA,G,I,NI,DHA
2.   LESS NUMBER OF TRANSITIONS PER UNIT TIME

HENCE ONE CAN GET A VIEW OF HOW MUCH THE RENDERING CONCENTRATES ON SYMPATHY.

OTHER EMOTIONS

AS PER MATHEMATICAL RELATIONSHIPS, WE CAN FIND THAT

- SORROW DECREASES WITH INCREASE IN JOY
- ANGER DECREASES WITH INCREASE IN FEAR
- ANTICIPATION DECREASES WITH INCREASE IN SURPRISE
- LOVE INCREASES WITH INCREASE IN JOY
- LOVE INCREASES WITH INCREASE IN TRUST
- TRUST INCREASES WITH INCREASE IN LOVE
- REMORSE DECREASES WITH INCREASE IN LOVE
- DISGUST DECREASES WITH INCREASE IN TRUST
- OPTMISM INCREASES WITH INCREASE IN JOY
- OPTIMISM INCREASES WITH INCREASE IN ANTICIPATION
- DISSAPPOINTMENT DECREASES WITH INCREASE IN OPTIMISM
- SUBMISSION INCREASES WITH INCREASE IN FEAR
- SUBMISSION INCREASES WITH INCREASE IN TRUST
- CONTEMPT DECREASES WITH INCREASE IN SUBMISSION
- AWE INCREASES WITH INCREASE IN FEAR
- AWE INCREASES WITH INCREASE IN SURPRISE
- AGGRESSIVENESS DECREASES WITH INCREASE IN AWE
- HUMOUR INCREASES WITH INCREASE IN JOY
- HUMOUR INCREASES WITH INCREASE IN SURPRISE
- SYMPATHY INCREASES WITH INCREASE IN LOVE
- SYMPATHY INCREASES WITH INCREASE IN SORROW

- HEROISM INCREASES WITH INCREASE IN JOY
- HEROISM INCREASES WITH INCREASE IN OPTIMISM

HENCE FROM THESE RELATIONS AN ESTIMATE OF THE OTHER EMOTIONS IN THE RENDERING COULD BE MADE.

GAMAKAS

THE CONCEPT OF GAMAKAS IS UNIQUE TO CARNATIC MUSIC AND ANALYSIS OF GAMAKAS FOR EMOTION CAN BE DONE IN 3 WAYS:

1. FINDING THE ABSOLUTE FREQUENCY OF THE OSCILLATION
2. FINDING THE DEVIATION FROM THE NOMINAL FREQUENCY AND CALCULATING PARAMETERS SUCH AS DEVIATION, AMOUNT OF OSCILLATION AND SPEED.
3. ANALYSING QUALITATIVELY THE GAMAKA TAKING A RAGA THAT USES IT AND THEN APPLYING THIS TO THE OTHER RAGAS/PIECES THAT USE THE SAME GAMAKA.

METHOD 3 IS VERY TEDIOUS AND METHOD 1 AND 2 CAN BE EASILY DONE USING THE ABOVESAID GRAPH NOTATION.

VIRTUAL APPLICATION

THIS SECTION DESCRIBES A VIRTUAL APPLICATION THAT COULD BE CONCEIVED OF WHEN THINKING OF HOW TO USE THE METHODS AND INFORMATION. FOR AN UNDERSTANDING OF AN APPLICATION, LET US CONSIDER THE VIRTUAL CASE STUDY BELOW:

- X. IS AFFECTED WITH A CERTAIN DISEASE 'A' WITH TERRIBLE PAIN AND CONSULTS A DOCTOR.
- THE DOCTOR AFTER TESTING X TELLS THAT A PARTICULAR NERVE IS AFFECTED VERY BADLY DUE TO SOME REASON.
- X THEN DECIDES TO RESORT TO MUSIC THERAPY.
- THE MUSIC THERAPIST LOCATES THE NERVE AND FINDS OUT THE EMOTION THAT IS ABLE TO CONTROL THAT PARTICULAR NERVE. LET THAT HAVE THE FOLLLOWING COMPOSITION: P% OF JOY, Q% OF FEAR, R% OF SURPRISE AND S% OF SYMPATHY.
- THROUGH A DATABASE, THE THERAPIST SEARCHES THE RAGA THAT MATCHES THE SPECIFIED COMPOSITION.LET IT BE RAGA 'H'.
- WHEN THE MATCH IS FOUND, THE THERAPIST THEN DECIDES WHETHER TO DO AN ALAPANA OR RENDER A SONG.
- IF RENDERING AN ALAPANA IS CHOSEN, THE THERAPIST SEES WHICH SWARAS CARRY TRAITS OF THE REQUIRED EMOTIONS AND LAYS STRESS ON THAT SWARA(S).
- IF RENDERING OF A SONG IS CHOSEN, THE THERAPIST THEN ANALYSES ALL GRAPHS FOR ALL SONGS COMPOSED IN THAT RAGA(AGAIN POSSIBLE THROUGH A DATABASE),AND FINDS THE ONE THAT IS CLOSEST TO HIS REQUIREMENTS.
- THEN, THE REQUIRED ALAPANA/SONG IS RENDERED.
- THE PATIENT GETS CURED AND ALL IS WELL.

MUSIC FROM ALL AROUND THE WORLD

THE HIGHLIGHTING FEATURES OF VARIOUS MUSIC SYSTEMS FROM DIFFERENT PARTS OF THE WORLD IS STUDIED. ONLY TRADITIONAL MUSIC, MUSIC BEFORE AND UNTIL 19TH CENTURY IS CONSIDERED, LEAVING OUT THE MORE RECENT POP, JAZZ, ROCK ETC...

CHORDS AND EMOTIONS:

FROM THE STUDIES DONE, AS MENTIONED IN THE PRECEDING SECTION, IT IS OBSERVED THAT THE ONLY FEATURE THAT IS NOT PRESENT IN CARNATIC MUSIC IS THAT OF CHORDS. HENCE, IF AN ANALYSIS OF THE EMOTIONS

ASSOCIATED WITH CHORDS IS DONE, THEN THE THEORIES AND METHODS STATED IN THE ABOVE SECTION CAN BE EXTENDED TO WORLDWIDE MUSIC AS WELL

HERE FOR THE ANALYSIS OF EMOTIONS, ONLY CHORDS CONTAINING 3 NOTES ARE CONSIDERED. SPECIFICALLY, THE MAJOR, MINOR AND SUSPENDED CHORDS(SUCH AS C,CM,CSUS).
THE PROCEDURE OF CALCULATING CHORD EMOTIONS IS SAME AS THAT MENTIONED FOR THE JANAKA AND JANYA RAGAS, BUT WITH THE CONSIDERATION THAT CHORDS HERE ARE EQUIVALENT TO RAGAS WITH THREE SWARAS. HENCE THE GRAPHS OF THESE CHORDS WOULD BE TRIANGLES. THE CALCULATIONS ARE PERFORMED AND RESULTS ARE PRESENTED AS FOLLOWS:

CHORD NAME	NOTES	JOY	FEAR	SURPRISE	SYMPATH	SORROW	ANGER	ANTICIPA	LOVE	TRUST	REMORSE	DISGUST	OPTIMISM	DISAPPOIN	SUBMISSI	CONTEMP	AWE	AGGRESS	HUMOUR	HEROISM	PJ
MAJOR CHORDS																					
C	SAGUPA	92.85714	42.85714	100	50	7.142857	57.14286	0	18.75	107.143	81.25	-7.14286	46.42857	53.57143	75	25	71.42857	28.57143	94.64286	69.64286	90.90909
D	RIMIDHI	76.19048	30.95238	52.38095	73.80952	23.80952	69.04762	47.61905	45.53571	28.5714	54.46429	71.42857	61.90476	38.09524	29.7619	70.2381	41.66667	58.33333	70.2381	69.04762	90.90909
E	DHAGUNU	57.14286	50	66.66667	52.38095	42.85714	50	33.33333	26.78571	76.1905	73.21429	23.80952	45.2381	54.7619	63.09524	36.90476	58.33333	41.66667	59.52381	51.19048	72.72727
F	MADHISA	89.28571	39.28571	64.28571	52.38095	10.71429	60.71429	35.71429	44.19643	39.2857	55.80357	60.71429	62.5	37.5	39.28571	60.71429	51.78571	48.21429	83.03571	75.89286	90.90909
G	PANURI	78.5714		78.5714	71.42857	21.42857	75	21.42857	38.83929	78.5714	61.16071	21.42857	50	50	51.78571	48.21429	51.78571	45.2381	78.57143	64.28571	72.72727
A	RADHIGU	64.28571	42.85714	66.66667	76.19048	35.71429	57.14286	33.33333	44.64286	69.0476	55.35714	30.95238	48.80952	51.19048	55.95238	44.04762	54.7619	45.2381	64.88095	56.54762	72.72727
B	GIMINU	64.28571	40.47619	52.38095	50	35.71429	59.52381	47.61905	27.67857	40.4762	72.32143	59.52381	55.95238	44.04762	40.47619	59.52381	46.42857	53.57143	61.30952	60.11905	54.54545
Db	RAMADHA	42.85714	80.95238	40.47619	69.04762	57.14286	19.04762	59.52381	44.19643	38.0952	55.80357	61.90476	51.19048	48.80952	59.52381	40.47619	60.71429	39.28571	42.2619	47.02381	18.18182
Eb	GIPANI	50	39.28571	25	75	50	60.71429	75	51.5625	0	48.4375	100	62.5	37.5	19.64286	80.35714	32.14286	67.85714	43.75	56.25	36.36364
Gb	RAMINI	42.85714	50	33.33333	61.90476	57.14286	50	66.66667	40.17857	23.8095	59.82143	76.19048	54.76191	45.2381	36.90476	63.09524	41.66667	58.33333	40.47619	48.80952	18.18182
Ab	DHAGISA	32.14286	75	17.85714	71.42857	67.85714	25	82.14286	50.22321	3.57143	49.77679	96.42857	57.14286	42.85714	39.28571	60.71429	46.42857	53.57143	28.57143	44.64286	36.36364
Bb	RIMANI	76.19048	42.85714	52.38095	76.19048	23.80952	57.14286	47.61905	47.32143	28.5714	52.67857	71.42857	61.90476	38.09524	35.71429	64.28571	47.61905	52.38095	70.2381	69.04762	54.54545
MINOR CHORDS																					
Cm	SAGIPA	57.14286	57.14286	28.57143	78.57143	42.85714	42.85714	71.42857	53.57143	0	46.42857	100	64.28571	35.71429	28.57143	71.42857	42.85714	57.14286	50	60.71429	54.54545
Dm	RIMADHI	88.09524	38.09524	64.28571	83.33333	11.90476	61.90476	35.71429	50.44643	40.4762	49.55357	59.52381	61.90476	38.09524	39.28571	60.71429	51.19048	48.80952	82.14286	75	90.90909
Em	GUPANU	82.14286	28.57143	96.42857	58.33333	17.85714	71.42857	3.571429	25.66964	110.714	74.33036	-10.7143	42.85714	57.14286	69.64286	30.35714	62.5	37.5	85.71429	62.5	90.90909
Fm	SAMADHA	53.57143	82.14286	39.28571	60.71429	46.42857	17.85714	60.71429	38.16964	25	61.83036	75	57.14286	42.85714	53.57143	46.42857	60.71429	39.28571	50	55.35714	90.90909
Gm	NIPARI	64.28571	28.57143	42.85714	85.71429	35.71429	71.42857	57.14286	56.25	21.4286	43.75	78.57143	60.71429	39.28571	25	75	35.71429	64.28571	58.92857	62.5	77.27273
Am	SADHIGU	85.71429	25	78.57143	71.42857	14.28571	75	21.42857	38.83929	71.4286	61.16071	28.57143	53.57143	46.42857	48.21429	51.78571	51.78571	48.21429	83.92857	69.64286	90.90909
Bm	MINURI	73.80952	33.33333	64.28571	57.14286	26.19048	66.66667	35.71429	30.80357	54.7619	69.19643	45.2381	54.76191	45.2381	44.04762	55.95238	48.80952	51.19048	71.42857	64.28571	54.54545
Dbm	RAGUDHA	40.47619	71.42857	50	66.66667	59.52381	28.57143	50	40.625	59.5238	59.375	40.47619	45.2381	54.7619	65.47619	34.52381	60.71429	39.28571	42.85714	42.85714	36.36364
Ebm	NIGIMI	54.7619	42.85714	28.57143	59.52381	45.2381	57.14286	71.42857	39.28571	2.38095	60.71429	97.61905	63.09524	36.90476	22.61905	77.38095	35.71429	64.28571	48.21429	58.92857	18.18182
Gbm	RAMIDHI	54.7619	45.2381	45.2381	57.14286	45.2381	54.7619	54.7619	34.375	35.7143	65.625	64.28571	54.76191	45.2381	40.47619	59.52381	45.2381	54.7619	52.38095	54.7619	36.36364
Abm	DHAGINU	45.2381	48.80952	42.85714	61.90476	54.7619	51.19048	57.14286	38.39286	40.4762	61.60714	59.52381	51.19048	48.80952	44.64286	55.35714	45.83333	54.16667	44.64286	48.21429	36.36364
Bbm	RANIMA	54.7619	57.14286	45.2381	71.42857	45.2381	42.85714	54.7619	45.08929	35.7143	54.91071	64.28571	54.76191	45.2381	46.42857	53.57143	51.19048	48.80952	52.38095	54.7619	54.54545
SUSPENDED CHORDS																					
Csus	SAMAPA	100	71.42857	71.42857	57.14286		28.57143	28.57143	29.46429	42.8571	70.53571	57.14286	64.28571	35.71429	57.14286	42.85714	71.42857	28.57143	92.85714	82.14286	100
Dsus	RIPADHI	82.14286	21.42857	60.71429	96.42857	17.85714	78.57143	39.28571	60.9375	39.2857	39.0625	60.71429	60.71429	39.28571	30.35714	69.64286	41.07143	58.92857	76.78571	71.42857	81.81818
Esus	GUNUDHI	80.95238	21.42857	83.33333	61.90476	19.04762	78.57143	16.66667	30.80357	85.7143	69.19643	14.28571	48.80952	51.19048	53.57143	46.42857	52.38095	47.61905	81.54762	64.88095	100
Fsus	SAMANI	71.42857	46.42857	46.42857	64.28571	28.57143	53.57143	35.71429	39.50893	21.4286	60.49107	78.57143	62.5	37.5	33.92857	66.07143	46.42857	53.57143	65.17857	66.96429	81.81818
Gsus	PASARI	85.71429	35.71429	64.28571	100	14.28571	64.28571	35.71429	62.94643	42.8571	37.05357	57.14286	60.71429	39.28571	39.28571	60.71429	50	53.57143	80.35714	73.21429	100
Asus	GUDHIRI	85.71429	28.57143	73.80952	80.95238	14.28571	71.42857	26.19048	46.875	61.9048	53.125	38.09524	55.95238	44.04762	45.2381	54.7619	51.19048	48.80952	82.7381	70.83333	100
Bsus	GUNUMI	76.19048	35.71429	76.19048	40.47619	23.80952	64.28571	23.80952	16.07143	76.1905	83.92857	23.80952	50	50	55.95238	44.04762	55.95238	44.04762	76.19048	63.09524	81.81818
Dbsus	RAMIDHA	30.95238	73.80952	28.57143	47.61905	69.04762	26.19048	71.42857	30.35714	26.1905	69.64286	73.80952	51.19048	48.80952	50	50	51.19048	48.80952	30.35714	41.07143	27.27273
Ebsus	DHANIGI	35.71429	57.14286	19.04762	71.42857	64.28571	42.85714	80.95238	50	2.38095	50	97.61905	58.33333	41.66667	29.7619	70.2381	38.09524	61.90476	31.54762	47.02381	27.27273
Gbsus	RAMINU	52.38095	47.61905	57.14286	40.47619	47.61905	52.38095	42.85714	19.64286	61.9048	80.35714	38.09524	47.61905	52.38095	54.7619	45.2381	52.38095	47.61905	53.57143	50	45.45455
Absus	DHAGIRA	28.57143	76.19048	26.19048	64.28571	71.42857	23.80952	73.80952	43.30357	23.8095	56.69643	76.19048	51.19048	48.80952	50	50	51.19048	48.80952	27.97619	39.88095	27.27273
Bbsus	MANIGI	66.66667	61.90476	40.47619	69.04762	33.33333	38.09524	59.52381	44.19643	14.2857	55.80357	85.71429	63.09524	36.90476	38.09524	61.90476	51.19048	48.80952	60.11905	64.88095	45.45455

IT IS INTERESTING TO NOTE THAT THE PROFILE OF CSUS CHORD (SAMAPA) REPRESENTS THE RAGA THRISAKTHI/SARVASHRI, CONTAINING THE SAME NOTES.

INCORPORATING CHORDS INTO CARNATIC MUSIC:

THERE ARE CERTAIN ISSUES TO BE CONSIDERED WHILE APPLYING CHORDS TO A CARNATIC RAGA OR SONG. THEY ARE:

1.   THE CHORDS CONTAINING NOTES NOT USED BY THE RAGA CANNOT BE USED SINCE THEY SPOIL THE PURITY OF THE RAGA. EXAMPLE, F CHORD CANNOT BE USED WITH MOHANAM AS IT CONTAINS MA.

2.   CHORDS CONTAINING THE SWARAS OF A RAGA THAT CAN BE PLAYED ONLY WITH A GAMAKA CANNOT BE CONSIDERED. THIS IS BECAUSE CHORDS ARE PLAYED FLAT WITHOUT ANY KAMPITHA. IF A SWARA CAN BE PLAYED WITH OR WITHOUT KAMPITHA, A CHORD CONTAINING THAT SWARA MAY BE USED.

3.   FOR APPLYING CHORDS TO A SONG, WE NEED TO CONSIDER THAALA STRUCTURE OF THE SONG AND APPROPRIATELY WE CAN PLACE THE CHORDS AT BEGINNING OF AVARTHANA OR BEAT, ENDING OF AVARTHANA OR BEAT AND SO ON.

UNIVERSAL EMOTIONAL ANALYSIS
FOUR DIMENSIONAL APPROACH

AFTER HAVING SEEN ASPECTS OF MUSIC FROM ALL AROUND THE WORLD, WE CAN INFER THAT FACTORS AND FEATURES OF MUSIC ARE GENERALLY FOUR-FOLD AND THEY ARE CALLED THE 4 DIMENSIONS OF MUSIC:

1.   MELODY
2.   HARMONY
3.   RHYTHM
4.   LYRICS.

FACTORS AFFECTING EMOTIONS

THERE ARE SEVERAL FACTORS AFFECTING EMOTIONS.THEY ARE:

MELODY(SANCHARA/ALAPANA):- A **MELODY**, ALSO **TUNE**, **VOICE**, OR **LINE**, IS A LINEAR SUCCESSION OF MUSICAL TONES WHICH IS PERCEIVED AS A SINGLE ENTITY. IN ITS MOST LITERAL SENSE, A MELODY IS A SEQUENCE OF PITCHES AND DURATIONS, WHILE, MORE FIGURATIVELY, THE TERM HAS OCCASIONALLY BEEN EXTENDED TO INCLUDE SUCCESSIONS OF OTHER MUSICAL ELEMENTS SUCH AS TONE COLOR.

MELODIES OFTEN CONSIST OF ONE OR MORE MUSICAL PHRASES OR MOTIFS, AND ARE USUALLY REPEATED THROUGHOUT A SONG OR PIECE IN VARIOUS FORMS. MELODIES MAY ALSO BE DESCRIBED BY THEIR MELODIC MOTION OR THE PITCHES OR THE INTERVALS BETWEEN PITCHES (PREDOMINANTLY CONJUCT OR DISJUNCT OR WITH FURTHER RESTRICTIONS), PITCH RANGE, TENSION AND RELEASE, CONTINUITY AND COHERENCE, CADENCE, AND SHAPE.

THIS IS A COMPLEX ENTITY AND THE DEPENDANCE OF EMOTIONS ON IT CANNOT BE STATED IN A LINEAR RELATIONSHIP.THE MAIN CONTRIBUTIONS BEING SWARAS ARE TO BE CONSIDERED HERE AND HENCE THE PROCEDURE FOLLOWED TILL NOW HOLDS GOOD IN DESCRIBING THE EFFECT OF MELODY ON EMOTIONS.

RHYTHM (THAALA):- (FROM GREEK Ῥυθμός – RHYTHMOS, "ANY MEASURED FLOW OR MOVEMENT, SYMMETRY") IS THE VARIATION OF THE LENGTH AND ACCENTUATION OF A SERIES OF SOUNDS OR OTHER EVENTS.

THIS AGAIN IS A COMPLEX ENTITY AND CAN BE STATED AS RELATIVE TEMPO. THE EFFECTS ON EMOTIONS ARE NOT STRAIGHT FORWARD BUT AN INSIGHT CAN BE OBTAINED CONSIDERING THE FOLLOWING ILLUSTRATION: CONSIDER A RENDERING IN MISRA JATHI EKA THAALAM(1 LAGHU OF 7 BEATS,0 DHRUTHAM) **.**HERE EACH SECTION WOULD CONSIST OF 7 UNINTERRUPTED MEASURES.HENCE AN EMOTION CAN BE DEPICTED IN ONE SECTION. IF A TRANSITION IS DESIRED A SMOOTH ONE CAN BE MADE AS THERE ARE SEVEN MEASURES WHICH IS A SUFFICIENT TIME TO SWITCH OVER. IF THE SAME RENDERING WAS RENDERED IN THISRA JATHI TRIPUTA THALAM(1 LAGHU OF 3 BEATS, 2 DHRUTHAM OF 2 BEATS EACH), THE TOTAL LENGTH WOULD REMAIN UNALTERED BUT THE TRANSITIONS, OR EMOTION STANDINGS SHOULD BE MADE WITHIN 3,2 OR 2 BEATS, WHICHEVER APPROPRIATE.HENCE THE EFFECTIVE TEMPO RISES. IF THE SAME TEMPO WAS TO BE MAINTAINED,THEN TRANSITIONS WOULD INVOLVE MORE THAN 1 LAGHU/DHRUTHAM SECTION AND THE RENDERING WOULD

APPEAR TO BE SLOW AND DRAGGING.HENCE CHANGES IN THAALA CAN BE EFFECTIVELYANALYSED AS CHANGES IN TEMPO WHICH IS DISCUSSED NEXT.

TEMPO:- IN MUSICAL TERMINOLOGY, **TEMPO** IS THE SPEED OR PACE OF A GIVEN PIECE. IT IS A CRUCIAL ELEMENT OF COMPOSITION, AS IT CAN AFFECT THE MOOD AND DIFFICULTY OF A PIECE.
FOR THIS AND THE FOLLOWING FACTORS EFFECTS WILL BE CONSIDERED ONLY ON 4 EMOTIONS-JOY,SURPRISE,SYMPATHY AND FEAR. OTHERS CAN BE UNDERSTOOD USING THE GIVEN MATHEMATICAL RELATIONS.
IN HUMAN ANATOMY, THE ADRENALINE CAN BE DESCRIBED AS THE "FLIGHT,FIGHT AND FRIGHT" HORMONE. THIS IS CAPABLE OF INCREASING THE EFFECTIVE WORKING SPEED OF AN INDIVIDUAL.HENCE SPEED IS INCREASED DUE TO FIGHT AND FRIGHT. THE CONVERSE ALSO HOLDS.HENCE INCREASE IN TEMPO CAN INCREASE ANGER OR FEAR. BUT FEAR%=100-ANGER%(COMPLEMENTARY EMOTIONS).HENCE IT INCREASES THE MORE DOMINANT OF THE TWO.AS FOR JOY, THE FLAVOUR CHANGES FROM A MORE BLISSFUL TO A MORE ECSTATIC JOY.SYMPATHY AND SURPRISE ARE LARGELY SWARA DEPENDANT AND HENCE BY INCREASING TEMPO STANDING AT THE SWARAS IS LOST AND HENCE DECREASE IS OBSERVED.

**MODE(RAGA):- MODE** IS A TERM FROM WESTERN MUSIC THEORY HAVING THREE DEFINITIONS

1. THE RHYTHMIC RELATIONSHIP BETWEEN LONG AND SHORT VALUES IN THE LATE MEDIEVAL PERIOD;
2. IN EARLY MEDIEVAL THEORY, INTERVAL;
3. MOST COMMONLY, A CONCEPT INVOLVING SCALE AND MELODY TYPE.

IN ADDITION, FROM THE END OF THE EIGHTEENTH CENTURY, THE TERM BEGAN TO BE USED IN ETHNOMUSICOLOGICAL CONTEXTS TO DESCRIBE PITCH STRUCTURES IN NON-EUROPEAN MUSICAL CULTURES, SOMETIMES WITH DOUBTFUL COMPATIBILITY (POWERS 2001, §V,1).[1]
THIS DISCUSSION ADDRESSES THE SCALE AND MELODY-TYPE MEANING.
THIS IS AN ORDERED ARRANGEMENT OF CERTAIN SWARAS AND HENCE HAS SAME EFFECT AS MELODY.

KEY(SHRUTHI):-THIS REFERS TO THE TONIC NOTE OR AATHAARA SHADJA. HENCE SHIFTING THE KEY REFERS TO SHIFTING THE ABSOLUTE FREQUENCY. THE FOLLOWING GRAPH SHOWS THE RELATIVE SENSITIVITY OF THE HUMAN HEARING.
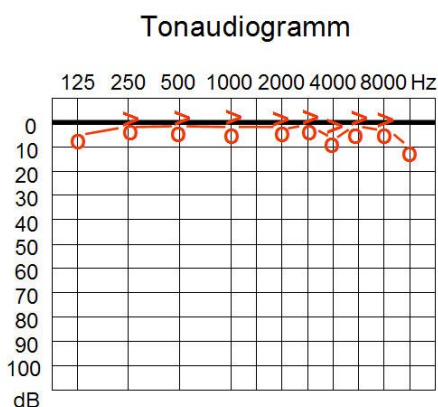
AS CAN BE SEEN, MAXIMUM RESPONSE OCCURS ONLY FOR A PARTICULAR RANGE. IF THE TESSITURA EXTENDS BEYOND THIS RANGE, TENSION IS CREATED IN THE AUDITORY ORGANS AND THIS IS A GOOD PLATFORM FOR THE NEGATIVE EMOTIONS TO SHOW MORE PROMINENTLY.HENCE POSITIVE EMOTIONS JOY AND SURPRISE AS WELL AS SYMPATHY SHOW A DECREASE FOR HIGHER KEYS.

HARMONY(SAMVAADHITHVA): IN MUSIC, **HARMONY** IS THE USE OF SIMULTANEOUS PITCHES, OR CHORDS.[1]
THE STUDY OF HARMONY INVOLVES CHORDS AND THEIR CONSTRUCTION AND CHORD PROGRESSIONS AND THE

PRINCIPLES OF CONNECTION THAT GOVERN THEM.[2] **HARMONY** IS OFTEN SAID TO REFER TO THE "VERTICAL" ASPECT OF MUSIC, AS DISTINGUISHED FROM MELODIC LINE, OR THE "HORIZONTAL" ASPECT. COUNTERPOINT, WHICH REFERS TO THE INTERWEAVING OF MELODIC LINES, AND POLYPHONY, WHICH REFERS TO THE RELATIONSHIP OF SEPARATE INDEPENDENT VOICES, ARE THUS SOMETIMES DISTINGUISHED FROM HARMONY. THIS IS THE CONCEPT OF SOUNDING A NOTE AND ITS FIFTH OR FOURTH SOUNDED IN CONJUNCTION AND IS SELDOM SEEN IN CARNATIC MUSIC.BUT THE EFFECT OF RELATIVE SAMVAADHI AND ANUVAADHI PAIRS WERE ALREADY DISCUSSED EARLIER.

DYNAMICS(LOUDNESS/VOLUME): IN MUSIC, **DYNAMICS** NORMALLY REFERS TO THE VOLUME OF A SOUND OR NOTE, BUT CAN ALSO REFER TO EVERY ASPECT OF THE EXECUTION OF A GIVEN PIECE, EITHER STYLISTIC (STACCATO, LEGATO ETC.) OR FUNCTIONAL (VELOCITY). THE TERM IS ALSO APPLIED TO THE WRITTEN OR PRINTED MUSICAL NOTATION USED TO INDICATE DYNAMICS.
THIS ALSO AFFECTS EMOTION AND A PARTICULAR LEVEL IS PLEASANT. AS THE VOLUME INCREASES THE MUSIC GETS HARSHER AND NEGATIVE EMOTIONS BECOME MORE PROMINENT. HENCE LOUDNESS SHOULD BE AT A MINIMUM, BUT ABOVE THE THRESHOLD OF HEARING AND AT AN ENJOYABLE LEVEL THAT DEPENDS ON THE SENSITIVITY OF THE INDIVIDUAL.
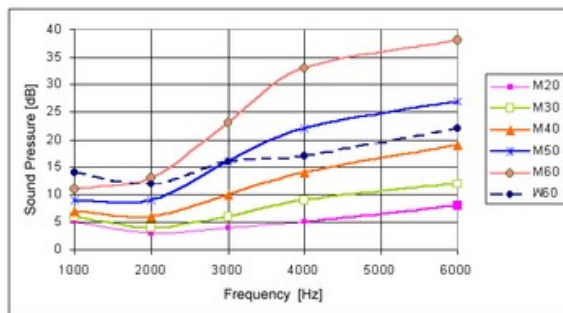
THRESHOLDS OF HEARING FOR MALE (M) AND FEMALE (W) SUBJECTS BETWEEN THE AGES OF 20 AND 60
TIMBRE/TONE COLOR:- IN MUSIC, **TIMBRE** (PRONOUNCED /ˈTÆMBƏR/, LIKE *TAHMBER*, OR SPELLING PRONUNCIATION /ˈTɪMBƏR/; FRENCH: [ŤB]) IS THE QUALITY OF A MUSICAL NOTE OR SOUND OR TONE THAT DISTINGUISHES DIFFERENT TYPES OF SOUND PRODUCTION, SUCH AS VOICES OR MUSICAL INSTRUMENTS. THE PHYSICAL CHARACTERISTICS OF SOUND THAT MEDIATE THE PERCEPTION OF TIMBRE INCLUDE SPECTRUM AND ENVELOPE. TIMBRE IS ALSO KNOWN IN PSYCHOACOUSTICS AS *TONE QUALITY* OR *TONE COLOR*.
FOR EXAMPLE, TIMBRE IS WHAT, WITH A LITTLE PRACTICE, PEOPLE USE TO DISTINGUISH THE SAXOPHONE FROM THE TRUMPET IN A JAZZ GROUP, EVEN IF BOTH INSTRUMENTS ARE PLAYING NOTES AT THE SAME PITCH AND LOUDNESS. TIMBRE HAS BEEN CALLED A "WASTEBASKET" ATTRIBUTE[1] OR CATEGORY,[2] OR "THE PSYCHOACOUSTICIAN'S MULTIDIMENSIONAL WASTEBASKET CATEGORY FOR EVERYTHING THAT CANNOT BE QUALIFIED AS PITCH OR LOUDNESS." I.E, THE 'SHAPE' OF THE SOUND.
THIS AFFECTS THE EMOTION AND AN ILLUSTRATION IS SHOWN HERE. WIND INSTRUMENTS USUALLY PRODUCE A LOW FREQUNCY HARMONIC THAT USUALLY PRODUCES A "BOOING" SOUND. SIMILARLY METAL INSTRUMENTS PRODUCE A HIGH FREQUENCY HARMONIC HISSING SOUND. BOTH OF THESE ARE IRRITATING TO THE LISTENER AND CAN BE ELIMINATED BY PROPER FILTERING USING ELECTRONIC EQUIPMENTS.ANWAY THESE DO NOT AFFECT MUCH OF EMOTION PERCEPTION AND HENCE WILL BE NEGLECTED.

UNIVERSAL MUSIC EMOTION ANALYSIS:
IN THE ABOVE SECTIONS, ALL ASPECTS OF MUSIC AND THEIR EFFECT ON EMOTIONS HAVE BEEN ANALYSED. HENCE WE CAN APPLY THIS TO DIFFERENT PIECES OF MUSIC ALL OVER THE WORLD FOR ANALYSIS. HOWEVER, MAIN IMPORTANCE WILL BE GIVEN TO CARNATIC MUSIC IMPLEMENTATIONS, AS IS THE AIM OF THIS WORK. THE MUSIC ASPECTS CAN BE DIVIDED INTO THE FOLLOWING CATEGORIES IN DECREASING ORDER OF EFFECT: MELODY, DYNAMICS, TEMPO, PITCH, HARMONY AND RHYTHM.

MELODY:

THIS FORMS THE CRUX OF CARNATIC MUSIC. IT SETS THE BASIC EMOTION OF THE PIECE. IN GENERAL, ONLY MELODY AND HARMONY CAN DETERMINE THE EMOTION OF A PIECE. OTHER FACTORS ACT AS MERE MODIFIERS. THE EFFECTS OF MELODY HAS BEEN DISCUSSED IN DETAIL BY MEANS OF SWARA AND RAGA EFFECTS AND THE EMOTION PROFILE OF ALL MELAKARTHA RAGAS HAVE ALSO BEEN GIVEN.

TEMPO:

THE TEMPO OF A PIECE IS EASILY SPECIFIED AS THE NUMBER OF BEATS (SUCH AS A METRONOME BEAT) PER MINUTE. (DENOTED AS BPM) FOR UNIVERSATILITY, WE CAN SET EACH METRONOME BEAT FOR EACH SYLLABLE(LIKE KA) OR A SYLLABLE EXTENSION(LIKE AA). LET US NOW CONSIDER A FEW EXAMPLES:

1. KAMALAMBAM BHAJARE – KALYANI – ADHI - DIKSHITHAR – 60BPM – **A RELATIVELY SLOW SONG**
2. MAHA GANAPATHIM – NAATTAI – ADHI/EKA – DIKSHITHAR – 120BPM – **A RELATIVELY FAST SONG**
3. SHRI VALLI – NATABHAIRAVI – ADHI – PAPANASAN SIVAN – 90BPM – **A MEDIUM PACED SONG**

ALL THESE HAVE BEEN SET TO 1 METRONOME BEAT PER SYLLABLE. HENCE, TEMPO IS INDEPENDENT OF THAALAM. BUT USUALLY, COMPOSERS CHOOSE AN APPROPRIATE THALAM TO MERGE WITH THE TEMPO WHILE COMPOSING A SONG. HERE, FOR THE ANALYSIS, 90BPM IS TAKEN AS THE REFERENCE SPEED AND MOST OF THE SONGS FALL IN THE 3 CATEGORIES OF 60,90 AND 120BPM. AS MENTIONED EARLIER, WITH AN INCREASE IN TEMPO THE MORE DOMINANT OF FEAR AND ANGER INCREASES, SURPRISE AND SYMPATHY DECREASE. SINCE SURPRISE DECREASES, ANTICIPATION INCREASES; HENCE OPTIMISM INCREASES; HENCE COURAGE INCREASES; HENCE THE JOY CHANGES FROM A BLISSFUL ONE TO AN ECSTATIC JOY. THUS JOY ALSO INCREASES. LET US CONSIDER THE FOLLOWING ILLUSTRATIONS:

1. LET US TAKE A SONG AT 100BPM AND LET ANGER BE MORE PROMINENT THAN FEAR.

100 – 90 = 10; 10/90 X 100 = 11.11%. HENCE THERE IS A 11.11% INCREASE IN ANGER, 11.11% DECREASE IN SYMPATHY, 11.11% DECREASE IN FEAR, 11.11% INCREASE IN JOY, AND 11.11% DECREASE IN SURPRISE. SINCE THE TEMPO AFFECTS EMOTIONS TO A LESSER EXTENT THAN MELODY THE FACTOR (11.11%) SHOULD BE HALVED BEFORE APPLYING IT. THUS THE AMOUNT OF INCREASE/DECREASE OF VARIOUS EMOTIONS = (11.11%)/2 = 5.55%. THEREFORE IF THE JOY WAS INITIALLY 90%, IT BECOMES 90+5.55 = 95.55%.

2. LET US NOW TAKE A SONG AT 120BPM WITH FEAR BEING MORE PROMINENT. 120 – 90 = 30; 30/90 X 100 = 33.33%. 33.33/2 = 16.67% THUS JOY AND FEAR INCREASE BY 16.67% AND SURPRISE AND SYMPATHY GET DECREASED BY 16.67%.

KEY:

THE KEY/PITCH COMES THIRD IN DECREASING ORDER OF EFFECT ON EMOTIONS. MOST OF THE WESTERN AND OTHER MUSIC SYSTEMS FOLLOW A FIXED KEY. THE INDIAN MUSIC ON THE CONTRARY HAS A VARIABLE KEY. THE PERFORMER HAS FREEDOM TO CHOOSE THE FREQUENCY OF THE AATHAARA SHADJA. ACCORDING TO THE WORK INVESTIGATION OF THE FACTORS INFLUENCING MUSIC LISTENING EMOTIONS AND MUSIC LIKING FOR TAIWAN UNDERGRADUATE STUDENTS DONE BY CHING-FANG HUANG, SHUN-WENWU1, SIEH-HWA LIN AND SHEAU-YUH LIN, MAJOR KEY, NON HARMONIZED FAST MELODIES ARE HAPPIER AND PRODUCE MORE POSITIVE EMOTIONS. AND ACCORDING TO INTERNATIONAL STANDARDS 440HZ IS TAKEN TO BE THE PITCH OF A. HENCE 261.5HZ IS TAKEN TO BE THE FREQUENCY OF SA OR C. HENCE WHILE CALCULATING , THE PITCH USED IS SEEN AND THE SWARA RANGE IN WHICH THE PITCH BELONGS IS DETERMINED.FOR EXAMPLE A PITCH OF 445HZ AND A PITCH OF 890HZ FALLS IN THE VICINITY OF A(DHI) AND 520HZ FALLS IN B(NU). THEN FOR THE EMOTIONS JOY, FEAR, SURPRISE AND SYMPATHY, IT IS DETERMINED WHETHER THE SWARA FALLS UNDER THE Y,N OR P CATEGORIES. IF Y, A FACTOR OF 12.5% IS ADDED, 6.25% IS ADDED IF P AND 12.5% IS SUBTRACTED IF N. FOR EXAMPLE CONSIDER A PIECE IN A PITCH OF 300HZ. THIS FALLS IN E(GU). IF THE JOY IS 45%, IT WILL RISE TO 45+12.5 = 57.5% SINCE GU IS Y FOR JOY.

HARMONY:

ACCORDING TO THE PAPER MENTIONED IN THE ABOVE SECTION, NON HARMONIZED MUSIC APPEARS HAPPIER. AS WE HEVE ALREADY CALCULATED THE EMOTIONS OF VARIOUS CHORDS, THESE WILL BE TAKEN INTO

CONSIDERATION AND THE VALUES WILL BE ADDED. BUT THE EFFECT OF HARMONY IS LESSER THAN THAT OF TEMPO OR PITCH. HENCE A FACTOR OF 1/6 HAS TO BE MULTIPLIED TO THE CHORD EMOTIONS BEFORE ADDING IT. C MINOR CHORD (CM) HAS THE FOLLOWING: JOY = 56%, FEAR = 56%, SURPRISE = 28% AND SYMPATHY = 78%. THEREFORE, JOY IS INCREASED BY 9.5%, FEAR DECREASED BY 9.5%, SURPRISE INCREASED BY 5% AND SYMPATHTY INCREASED BY 13%.

RHYTHM:

THE ANALYSIS OF RHYTHM IS A COMPLEX ONE. MOREOVER, IT IS HIGHLY DEPENDANT ON TEMPO. INHERENTLY, ANY COMPOSER PLANS THE RHYTHM SEQUENCE ACCORDING TO TEMPO WHILE COMPOSING.HENCE EMOTION CHANGES ONLY WHEN A COMPOSITION CHANGES THALA. MOREOVER THE EFFECT OF RHYTHM ON EMOTION IS THE LEAST, EVEN LESSER THAN HARMONY. HENCEN THIS IS NEGLECTED IN CALCULATIONS.

DYNAMICS:

THIS IS ALSO A VERY VAGUE CONCEPT AND LARGELY DEPENDS ON THE SENSITIVITY OF THE INDIVIDUAL. NORMAL HUMAN HEARING OCCURS BETWEEN 15DB AND 100 DB. HENCE THE ANALYSIS OF DYNAMICS WILL NOT BE INCLUDED HERE.

PROCEDURE OF UNIVERSAL QUANTITATIVE ANALYSIS

- FIRST, CONSIDER MELODY. IF IT IS A RAGA ALAPANA, FIND THE EMOTIONS OF THE RAGA USING THE APPROACH BASED ON GRAPH THEORY DISCUSSED EARLIER. IF IT IS A SONG OR OTHER MUSICAL PIECE, DRAW THE GRAPH FOR THAT PIECE AND FIND THE EDGE VALUES AND TAKE NORMALISED AVERAGE OF THOSE. THIS GIVES THE % OF JOY, SURPRISE, FEAR AND SYMPATHY.
- NEXT, CONSIDER TEMPO. IF NORMAL TEMPO(90BPM) IS FOLLOWED NO CHANGES ARE MADE. IF TEMPO IS HIGHER OR LOWER, CALCULATE THE FACTOR AND APPROPRIATELY INCREASE OR DECREASE THE 4 EMOTION % VALUES CALCULATED
- NOW, PITCH WILL BE CONSIDERED. FIND THE REGION OF SWARA UNDER WHICH THE PITCH OR ATHARA SHADJA FALLS. IF IT IS SA OR PA OR OCTAVES OF SA/PA, NO CHANGES ARE MADE. IF IT IS IN ANY OTHER REGION APPLY THE APPROPRIATE FACTOR OF INCREASE/DECREASE FOR THE 4 EMOTIONS CALCULATED IN THE ABOVE STEP. IN THE ABOVE STEP. FROM THE RELATIONS GIVEN IN PRECEDING SECTIONS, OTHER EMOTIONS % ARE CALCULATED.
- NEXT CONSIDER HARMONY. CONSIDER THE VARIOUS CHORDS USED IN THE SONG/RAGA ALAPANA. TAKE THE AVERAGE OF ALL OF THEM AND DIVIDE THE RESULTS BY THE FACTOR OF 6. THEN ADD THIS VALUE TO THE % CALCULATED IN PREVIOUS STEP. IN PREVIOUS STEPS FACTORS AND VALUES WERE ADDED ONLY TO THE 4 EMOTIONS OF JOY,FEAR, SURPRISE AND SYMPATHY. THIS WAS BECAUSE THERE WAS ONLY 1, OR A MAXIMUM OF 2 FACTORS. BUT IN HARMONY, EACH EMOTION HAS ITS OWN FACTOR TO BE ADDED AND HENCE, THE EMOTION % OF CHORDS NEED TO BE ADDED. FOR EXAMPLE, IF JOY OF SONG IS 45% AND HENCE SORROW = 100-JOY = 55 AND JOY OF CHORD AFTER DIVIDING BY 6 = 1% AND HENCE SORROW = 16%. IF ONLY JOY WAS ADDED, JOY = 45+1=46% OR SORROW = 100-JOY = 54%. THIS MEANS THAT THE SONG HAS BECOME HAPPIER WHEREAS THE CHORD APPLIED SEEMS TO BE A SORROWFUL ONE. HENCE THIS CALCULATION IS WRONG. RATHER, IF BOTHN JOY AND SORROW VALUES OF CHORD IS ADDED, WE GET JOY = 46% AND SORROW = 71%. THIS IS MORE MEANINGFUL SINCE THE SORROW HAS INCREASED. HENCE, WHILE APPLYING CHORD VALUES, ALL EMOTION VALUES OF CHORD SHOULD BE ADDED WITH CORRESPONDING VALUES OBTAINED IN PREVIOUS STEP.
- THE VALUES THUS OBTAINED GIVE THE "EMOTIONAL PROFILE" OF THE MUSICAL PIECE .

CASE STUDIES:

TO ILLUSTRATE THE PROCEDURE OF CALCULATING EMOTIONAL PROFILES, WE SHALL CONSIDER A FEW CASE STUDIES.

CS1: RAGA ALAPANA OF SHUBHAPANTHUVARALI, NORMAL TEMPO, NORMAL PITCH, CHORDLESS

SHUBHAPANTHUVARALI IS MELA NO. 45. THE EMOTION PROFILE IS THE SAME AS THAT CALCULATED FOR MELA RAGAS EARLIER. SINCE THERE ARE NO MODIFICATIONS TO BE MADE FOR THE OTHER ASPECTS, THE VALUE CALCULATED EARLIER IS THE FINAL VALUE. THEY ARE JOY=46.45%, FEAR=62.84%, SURPRISE=45.36%, SYMPATHY=62.84%. EMOTIONAL PROFILE IS GIVEN IN TABLE.

CS2: CHARANAM OF GURUMURTHE – DIKSHITHAR, NORMAL TEMPO AND PITCH, CHORDLESS

ALTHOUGH TEMPO IS MENTIONED AS NORMAL, SEPARATE ANALYSES SHOULD BE MADE FOR THE CHARANAM AT A TEMPO OF 90BPM AND THE MADHYAMA KALA PORTION WHICH IS AT A TEMPO OF 120BPM. BOTH THE GRAPHS ARE GIVEN AND THE MELODY VALUES ARE

CHARANAM: JOY=78.21%,FEAR=48.24%, SURPRISE=82.14% SYMPATHY= 74.39%. PITCH NORMAL, TEMPO AT 90BPM, NO CHORDS. HENCE OTHER EMOTIONS ARE CALCULATED AS IN THE TABLE.

FOR MADHYAMAKALAM, JOY=94.6, FEAR= 40.61,SURPRISE=82.14 SYMPATHY=75.95. PITCH NORMAL, TEMPO = 120BPM. THUS, 120-30=90; 30/90X100=33.33% AND 33.33/2=16.67%. THUS THE EMOTIONAL PROFILE BEFORE AND AFTER TEMPO FACTOR ADDITION IS GIVEN.

CS3: CS1 WITH CHORDS:

THE CHORDS POSSIBLE WITH SHUBAPANTUVARALI ARE B,AB,CM,ABM,DBSUS,GBSUS,ABSUS. THESE CHORDS AND THEIR AVERAGE EMOTION PROFILE IS GIVEN. THIS IS DIVIDED BY 6 AND ADDED WITH CS1 PROFILE. RESULTS ARE GIVEN.

CS4: CS2 WITH CHORDS

HERE THE CHORDS FOR THE CS2 ARE CONSIDERED. THE CHORDS USED ARE G(4 TIMES), EM(2 TIMES), F AND C. THESE ARE GIVEN IN TABLE AND AVERAGE, MODIFIED AVERAGE ALSO GIVEN. FINAL IS ALSO GIVEN.

CS5: CHARANAM OF NAGAGANDHARI- DIKSHITHAR, 120BPM, 300HZ, WITH CHORDS

MADHYAMA KALAM IS OMITTED FOR SIMPLICITY. THE GRAPH OF THE PIECE IS GIVEN. THE VALUES ARE JOY=71.3, FEAR=59, SURPRISE=50.19 SYMPATHY=77.88%. SINCE TEMPO IS 120, 120-90=30; 30/90*100=33.33; 33.33/2 = 16.67%. THEREFORE THIS VALUE IS ADDED . NEW VALUES ARE GIVEN FOR THE 4 EMOTIONS. SINCE PITCH IS 300 IT IS IN REGION OF RI. THUS RI IS Y FOR JOY AND SYMPATHY, P FOR SURPRISE AND N FOR FEAR. THUS, NEW VALUES ARE CALCULATED AND GIVEN. THEN CHORDS (2 CM, 6AB) ARE APPLIED. THE CHORD PROFILES AND AVERAGE AND MODIFIED AVERAGE IS GIVEN. THIS IS ADDED AND FINAL PROFILE IS ALSO GIVEN IN TABLE.

CS6: A NON CARNATIC PIECE

NOW ANALYSIS WILL BE MADE ON FEW NON-INDIAN MUSIC PIECES BASED ON DIFFERENT REGIONS. FOR SIMPLICITY PURPOSES, TEMPO IS ASSUMED TO BE AT NORMAL(90BPM) FOR ALL THESE PIECES.

A.   WESTERN CLASSICAL MUSIC

CONSIDER THE FIRST THEME OF EINE KLEINE NACHTMUSIK OF MOZART K.525. THE ANALYSIS CAN BE DONE IN 2 WAYS.

1.   WITH NORMAL PITCH AND STARTING NOTE AS G. THE VALUES ARE GIVEN IN TABLE. CHORDS USED ARE G AND D7. THE CHORD PROFILE AVERAGE, MOD AVERAGE AND FINAL VALUE ARE GIVEN.
2.   WITH PITCH AT G AND STARTING NOTE AT C. THE VALUES ARE GIVEN IN TABLE. CHORDS USED ARE C AND G7. THE CHORD PROFILE AVERAGE, MOD AVERAGE AND FINAL VALUE ARE GIVEN.SINCE PITCH IS IN VICINITY OF G(PA) NO NEED OF ANY CHANGES.

B.   MIDDLE EAST

CONSIDER THE ARABIC PIECE BELLAZY ASKARA,A FOLKLORE PIECE, SET TO MAQAM BAYATI. THIS IS AVAILABLE AS A MIDI FILE AT http://www.pro.com.eg/melcom/elangExamples.htm HERE, WE FIND A QUARTER NOTE, ie E HALF-FLAT, E-. THUS THE NOTE CORRESPONDS TO THE QUARTER TONE LOCATED IN BETWEEN GI AND GU. HENCE WHILE DRAWING THE GRAPH, THE JOY, FEAR, SURPRISE AND SYMPATHY POINTS OF THIS VERTEX ARE TAKEN TO

BE THE AVERAGE OF GI AND GU. THIS APPLIES FOR ANY QUARTER TONE. OTHER FACTORS REMAIN THE SAME AND THUS THE PROFILE IS CALCULATED.

C. ORIENTAL

FOR THIS 2 EXAMPLES ARE GIVEN.

CONSIDER THE CHINESE TRADITIONAL PIECE, LITTLE SWALLOW (XIAO YANZI) COMPOSED BY WANG LU. THIS IS AVAILABLE AS A NOTATION AT http://www.mamalisa.com/blog/chinese-musical-notation-music-without-a-staff/. THE CHINESE TUNIND SYSTEM IS VERY DIFFERENT TO THE WESTERN/ INDIAN ONE. BUT AS A REASONABLE APPROXIMATION THE SAME TUNING SYSTEM CAN BE ASSUMED FOR THE CALCULATIONS. THE PIECE CORRESPONDS VERY MUCH TO THE PENTATONIC SCALE MOHANAM. HENCE THE PROCEDURE SPECIFIED ABOVE CAN BE EASILY USED TO CALCULATE. THE VALUES.

NEXT, CONSIDER THE FAMOUS JAPANESE PIESE SAKURA. THIS CAN BE VIEWED IN 2 ASPECTS,
1. WITH THE STARTING NOTE AS A. THIS THEN CORRESPONDS TO THE WESTERN MAJOR SCALE OR DHEERASANKARABHARANAM.
2. WITH STARTING NOTE AS C. THEN IT BECOMES A PIECE USING THE NOTES SARIGIPADHASA. THIS IS A MORE SORROWFUL VERSION.
WHICH WAY IT IS SUNG DEPENDS ENTIRELY ON THE PITCH SELECTION. THE FIRST ONE WILL BE USED HERE. VALUES ARE GIVEN.

D. SOUTH EAST ASIA

CONSIDER THE BALINESE GAMELAN PIECE PERMAS – GAMELAN SEMAR PEGULINGAN, THAT CAN BE FOUND AT http://www.ancient-future.com/bali.html. AS PER THE SHEET NOTATION GIVEN IN THIS SITE, THE PIECE CORRESPONDS TO RAGA GAMBHEERANAATTAI. VALUES ARE AS PRESENTED.

E. AFRO- CARIBBEAN

CONSIDER THE CALYPSO PRESENT IN http://gfxc.smpgfx.com/Look-Inside/large/3885508_00-01.jpg. FROM THE SHEET NOTATION WE CAN EASILY COMPUTE THE EMOTIONS. VALUES ARE AS GIVEN IN THE TABLE.

TITLE	COMMEN	NOTES	JOY	FEAR	SURPRIS	SYMPATH	SORROW	ANGER	ANTICIPA	LOVE	TRUST	REMORS	DISGUST	OPTIMISM	DISAPPOI	SUBMISSI	CONTEMP	AWE	AGGRESS	HUMOUR	HEROISM
CS 1		SHUBHAPANTUVARALI	46.45	62.85	45.36	62.85	53.55	37.15	54.64	65.95	85.45	34.05	14.55	50.55	49.45	74.15	25.85	54.1	45.86	46.18	48.5
CS2	CHARANAM		78.21	48.24	67.58	74.39	21.79	51.76	32.42	76.66	75.11	23.34	24.89	55.315	44.685	40.33	59.67	63.225	36.775	75.5525	66.7625
	MADHYAMA		94.6	40.61	82.14	75.95	5.4	59.39	17.86	73.8867	53.1733	26.1133	46.8267	56.23	43.77	29.235	70.765	67.605	32.395	91.485	28.115
	MOD. MADHYAMA		111.27	23.94	98.81	59.28	-11.27	76.06	1.19	46.1033	-19.0633	53.8967	119.063	56.23	43.77	12.565	87.435	67.605	32.395	108.155	28.115
	AVERAGE		94.74	36.09	83.195	66.835	5.26	63.91	16.805	61.3817	28.0233	38.6183	71.9767	55.7725	44.2275	26.4475	73.5525	65.415	34.585	91.8538	47.4388
CS3	B	GIMINU	64.2857	40.4762	52.381	50	35.7143	59.5238	47.619	27.6786	40.4762	72.3214	59.5238	55.9524	44.0476	40.4762	59.5238	46.4286	53.5714	61.3095	60.119
	Ab	DHAGISA	32.1429	75	17.8571	71.4286	67.8571	25	82.1429	50.2232	3.57143	49.7768	96.4286	57.1429	42.8571	39.2857	60.7143	46.4286	53.5714	28.5714	44.6429
	Cm	SAGIPA	57.1429	57.1429	28.5714	78.5714	42.8571	42.8571	71.4286	53.5714	0	46.4286	100	64.2857	35.7143	28.5714	71.4286	42.8571	57.1429	50	60.7143
	Abm	DHAGINU	45.2381	48.8095	42.8571	61.9048	54.7619	51.1905	57.1429	38.3929	40.4762	61.6071	59.5238	51.1905	48.8095	44.6429	55.3571	45.8333	54.1667	44.6429	48.2143
	Dbsus	RAMIDHA	30.9524	73.8095	28.5714	47.619	69.0476	26.1905	71.4286	30.3571	26.1905	69.6429	73.8095	51.1905	48.8095	50	50	51.1905	48.8095	30.3571	41.0714
	Gbsus	RAMINU	52.381	47.619	57.1429	40.4762	47.619	52.381	42.8571	19.6429	61.9048	80.3571	38.0952	47.619	52.381	54.7619	45.2381	52.381	47.619	53.5714	50
	Absus	DHAGIRA	28.5714	76.1905	26.1905	64.2857	71.4286	23.8095	73.8095	43.3036	23.8095	56.6964	76.1905	51.1905	48.8095	50	50	51.1905	48.8095	27.9762	39.881
	AVERAGE		44.3878	59.8639	36.2245	59.1837	55.6122	40.1361	63.7755	37.5957	28.0612	62.4043	71.9388	54.0816	45.9184	43.9626	56.0374	48.0442	51.9558	42.3469	49.2347
	MOD AVERAGE		7.39796	9.97732	6.03741	9.86395	9.26871	10.6293	10.6293	6.26594	4.67687	10.4007	11.9898	9.01361	7.65306	7.3271	9.33957	8.00737	8.6593	7.05782	8.20578
	FINAL		53.848	72.8273	51.3974	72.7139	62.8187	43.8393	65.2693	72.2159	90.1269	44.4507	26.5398	59.5636	57.1031	81.4771	35.1896	62.1074	54.5193	53.2378	56.7058
CS4	C	SAGUPA	92.8571	42.8571	100	50	7.14286	57.1429	0	18.75	107.143	81.25	-7.14286	46.4286	53.5714	75	25	71.4286	28.5714	94.6429	69.6429
	F	MADHISA	89.2857	39.2857	64.2857	75	10.7143	60.7143	35.7143	44.1964	39.2857	55.8036	60.7143	62.5	37.5	39.2857	60.7143	51.7857	48.2143	83.0357	75.8929
	G	PANURI	78.5714	25	78.5714	71.4286	21.4286	75	21.4286	38.8393	78.5714	61.1607	21.4286	50	50	51.7857	48.2143	51.7857	48.2143	78.5714	64.2857
	Em	GUPANU	82.1429	28.5714	96.4286	58.3333	17.8571	71.4286	3.57143	25.6696	110.714	74.3304	-10.7143	42.8571	57.1429	69.6429	30.357	62.5	37.5	85.7143	62.5
	AVERAGE		82.5893	29.9107	83.9286	73.2143	17.4107	70.0893	16.0714	33.7054	85.2679	66.2946	42.4107	49.3304	50.6696	57.5893	63.3929	56.9196	43.0804	82.9241	65.9598
	MOD AVE		13.7649	4.98512	13.9881	10.9871	2.90179	11.6815	2.67857	5.61756	14.2113	11.0491	2.45536	8.22173	8.44494	9.59821	7.06845	9.48661	7.18006	13.8207	10.9933
	FINAL		108.505	41.0751	97.1831	77.8221	8.16179	75.5915	19.4836	66.9992	42.2346	49.6674	74.432	63.9942	52.6724	36.0457	80.621	74.9016	41.7651	105.674	58.4321
CS5	CHARANAM		71.3	59	50.19	77.88															
	TEMPO EFFECT		87.97	42.33	33.52	61.21															
	KEY EFFECT		100.47	29.83	39.77	73.71	-0.47	70.17	60.23	85.0233	69.5767	14.9767	30.4233	80.35	19.65	45.03	54.97	65.15	34.85	85.295	90.41
	Ab	DHAGISA	32.1429	75	17.8571	71.4286	10.7143	25	82.1429	50.2232	3.57143	49.7768	96.4286	57.1429	42.8571	39.2857	60.7143	46.4286	53.5714	28.5714	44.6429
	Cm	SAGIPA	57.1429	57.1429	28.5714	78.5714	42.8571	42.8571	71.4286	53.5714	0	46.4286	100	64.2857	35.7143	28.5714	71.4286	42.8571	57.1429	50	60.7143
	AVERAGE		80.8886	27.8022	68.4556	78.2736	19.1114	72.1978	31.5444	66.4421	91.7277	33.5579	8.27229	56.2165	43.7835	43.959	56.041	54.3454	45.6546	77.7804	68.5526
	MOD AVE		13.4814	4.6337	11.4093	13.0456	3.18523	12.033	5.25741	11.0737	15.288	5.59298	1.37871	9.36942	7.29725	7.32651	9.34016	9.05757	7.6091	12.9634	11.4254
	FINAL		98.8614	37.0137	84.8393	90.0256	17.8052	79.653	31.8274	93.5334	70.0231	27.4297	30.432	65.3444	26.4952	51.1312	65.5335	67.9376	43.9274	95.3559	98.5201
CS6 WESTERN	1 NACHTMUSIK		85.38	32.38	73.43	76.98	14.62	67.62	26.57	78.1633	70.9467	21.8367	29.0533	55.975	44.025	29.475	70.525	58.88	41.12	82.3925	70.6775
	D7	DHISARIMI	83.2058	30.6044	58.3397	85.1186	16.7942	69.3956	41.6603	94.0449	104.884	5.9551	-4.884	62.4331	37.567	36.1324	63.8677	56.9051	43.0949	76.9893	72.8194
	G	PANURI	78.5714	25	78.5714	71.4286	21.4286	75	21.4286	38.8393	78.5714	61.1607	21.4286	64.2857	35.7143	28.5714	71.4286	51.7857	48.2143	78.5714	64.2857
	AVERAGE		80.8886	27.8022	68.4556	78.2736	19.1114	72.1978	31.5444	66.4421	91.7277	33.5579	8.27229	56.2165	43.7835	43.959	56.041	54.3454	45.6546	77.7804	68.5526
	MOD AVE		13.4814	4.6337	11.4093	13.0456	3.18523	12.033	5.25741	11.0737	15.288	5.59298	1.37871	9.36942	7.29725	7.32651	9.34016	9.05757	7.6091	12.9634	11.4254
	FINAL		98.8614	37.0137	84.8393	90.0256	17.8052	79.653	31.8274	93.5334	70.0231	27.4297	30.432	65.3444	26.4952	51.1312	65.5335	67.9376	43.9274	95.3559	98.5201
	2 NACHTMUSIK		96.01	39.56	84.83	67.09	3.99	60.44	15.17	61.1767	70.9467	21.8367	73.6567	55.59	44.41	27.365	72.635	67.785	41.12	93.215	75.8
	G7	MANURIPA	89.9	39.21	82.25	72.69	10.1	60.79	17.75	69.5033	49.1067	30.4967	50.8933	53.825	46.175	28.48	71.52	64.555	35.445	87.9875	71.8625
	C	SAGUPA	92.8571	42.8571	100	50	7.14286	57.1429	0	18.75	107.143	81.25	-7.14286	46.4286	53.5714	75	25	71.4286	28.5714	94.6429	69.6429
	AVERAGE		91.3786	41.0336	91.125	61.345	8.62143	58.9664	8.875	44.1267	78.1248	55.8733	21.8752	50.1268	49.8732	51.74	48.26	67.9918	32.0082	91.3152	70.7527
	MOD AVE		15.2298	6.83893	15.1875	10.2242	1.43691	9.82774	1.47917	7.35444	13.0208	9.31222	3.64587	8.35446	8.3122	8.62333	8.04333	11.332	5.3347	15.2192	11.7921
	FINAL		111.24	46.3989	100.018	77.3142	5.4269	70.2677	16.6492	68.5311	39.3641	48.1356	77.3025	63.9445	52.7222	35.9883	80.6783	79.117	37.5497	108.434	87.5921
MIDDLE EAS	BELLAZY ASKARA		76.511	34.166	52.97	81.99	23.489	65.834	47.03	91.6633	106.816	46.0433	87.0367	61.7705	38.2295	40.598	59.402	55.3385	44.6615	70.6258	69.1408
ORIENTAL	LITTLE SWALLOW		90.225	25.76	78.28	89.45	9.775	74.24	21.72	93.1733	96.1217	6.82667	3.87833	55.9725	44.0275	23.74	76.26	57.9925	42.0075	87.2388	73.0988
	SAKURA		85.29	26.55	89.28	59.91	14.71	73.45	10.72	50.12	14.95	49.88	85.05	48.005	51.995	18.635	81.365	55.92	44.08	86.2875	66.6475
SE ASIA	PERMAS		91.75	39.03	95.26	51.757	8.25	60.97	4.74	37.256	-17.238	62.744	117.238	48.245	51.755	21.885	78.115	65.39	34.61	92.6275	69.9975
AFRO CARRIBEAN	CALYPSO		94.95	43.77	92.05	63.48	5.05	56.23	7.95	53.9567	12.9633	46.0433	87.0367	51.45	48.55	25.86	74.14	69.36	30.64	94.225	73.2

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CONCLUSION

THE EMOTIONS CAUSED BY THE SWARAS AND OTHER ASPECTS OF CARNATIC MUSIC SUCH AS RAGAS WERE ANALYSED, BOTH QUALITATIVELY AND QUANTITATIVELY, SUCH THAT THE EMOTIONAL EFFECT OF ANY RAGA COULD BE GIVEN AS A "PROFILE" CONSISTING OF PERCENTAGES OF VARIOUS EMOTIONS. THEN A NOTATION SCHEME CONVENIENT FOR EMOTIONAL ANALYSIS WAS PROPOSED. THE MUSICAL SYSTEMS FROM DIFFERENT PARTS OF THE WORLD WERE THEN CONSIDERED. TECHNIQUES WERE THEN STATED TO APPLY CHORDS TO CARNATIC MUSIC TO ENHANCE THE EMOTIONAL CONTENT. A FOUR DIMENSIONAL THEORY OF MUSIC AND EMOTIONS WAS PROPOSED. FINALLY, A UNIVERSAL QUANTITATIVE AND QUALITATIVE EMOTIONAL ANALYSIS PROCEDURE WAS SPECIFIED, WHICH COULD BE APPLIED TO ANY MUSICAL PIECE/SYSTEM FROM ANY PART OF THE WORLD.

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