

Raga Identification Using Mel Frequency Cepstral Coefficient

Ms. Kavita. S. Patil¹, Prof. Dr. Pramod J. Deore², Prof. V. S. Kharote³

¹Department of E&TC Engineering, SES's RCPIT, Shirpur, India

²HOD, Department of E&TC Engineering, SES's RCPIT, Shirpur, India
pjdeore@yahoo.com

³Assistant Professor, Pimpri Chinchwad, Polytechnic Nigdi, Pune
sanvisha1617@gmail.com

acoe1.exam@gmail.com

Received on: 19 June, 2023

Revised on: 01 July, 2023

Published on: 03 July, 2023

Abstract – Now a days most of the people wants to listen music but very few people can tell the type of Raga in music. Ragas are the soul of Indian classical music. Raga is most important part in Indian music. Raga plays a key role in the distinctive sound of Indian classical music. It is a melodic sequence that serves as the basis for improvisation and composition in Indian music. Each style of raga has its own scale, distinct set of notes, melodic patterns, and even spiritual associations. With Raga you can explore these styles and dive into the rich history behind them. Swaras are not just about learning the nuances of music. It is a concept which has been designed to blossom and be explored by musical artists. It consists of many features that help provide the best melodies out of any piece. By understanding and using these features, you can take your singing and music to a whole new level. Raga identification was performed on three ragas: Darbari, Khamaj, and Malhar. In this paper, we offer a method for determining the ragas of an Indian music signal. Raga recognition offers a wide range of applications in digital music indexing, recommendation, and retrieval. In this paper, we attempt to solve the raga classification problem utilising MFCC (Mel Frequency Cepstral Coefficient) in a non-linear SVM (support vector machine) framework. We tested the proposed strategy on our own raga dataset and found that using information from features relevant to Indian music improved accuracy by 92.47%.

I-INTRODUCTION

Each music is different. Every music is different with respect to their timing, notes and each music has different raga, but the note of western traditional music relates to the swaras of Indian traditional music. A raga is a unique combination of swara and their substrings. It has a prominent role in Indian classical music. The Indian track begins with seven swaras (notes): Sa, Ri, Ga, Ma, Pa, Dha, Ni (Shadja, Rishab, Gandhar, Madhyam, Pancham, Dhaivatand, Nishad). Indian classical music consists of various features associated with specific raga that are not fluently linked by applying the approach for identifying western music. Raga is a combination of different swaras of different notes that may include different variations. (for example, Arohana, Avarohana, Pakad, Taal, and so on). The notations of a raga arranged in decreasing manner called avarohana of that raga and notations of a raga arranged in increasing order called arohana of that raga. The base of Indian traditional music is its notes the notes are unique. Melodies are the sequence of swaras. The raga identification includes methods for taking notes from the melody and

classifying the ragas into a proper raga. Ragas include an important concept in Hindustani classical song and capture the tone and feeling of performances[1]. It can also be used by inexperienced musicians who find it difficult to distinguish ragas that are actually identical to one another, as well as by newcomers who explore this magnificent artwork. Very few raga features have to be converted into applicable features. This is extremely delicate for Indian music for the following reasons, which must be handled while transforming a piece of music into swara strings.(i) During a performance, a music piece may be composed using various instruments.(ii) Unlike Western music, the notes in Indian music are on a relative scale rather than an absolute scale.(iii) In a raga, there is no definite starting swara.(iv) In Indian music, notes do not have a set frequency, but rather a band of frequency (oscillations) surrounding a note.(v) The ragas' swara sequence is not defined, and coloured extemporisations are permitted. We address the raga classification problem in this study utilising a non-linear SVM and a mixture of two separate characteristics, MFCC and Chromagram. Our method combines MFCC and chroma properties to increase outcomes, making it the ideal choice for any music enthusiast. You can extract features every 10 ms with the MIR Toolbox [3], an open-source toolbox, giving you access to advanced music extraction capabilities.

II-PREVIOUS WORK

With the help of classifier Using a classifier ragas are converted into swaras at regular intervals of time and then arrange the raga with the help of classifier, like K-NN or Support vector machine. In [4], Harit Pandya, Vijay Kumar, and C.V. Jawahar examined the difficulties associated with raga recognition in Indian classical music. By linearly combining the two kernels, they aimed to incorporate the existing approaches, which either depend on pitch-class profiles or ngram histograms of notes, in a multi-class SVM framework. Each of these kernels encapsulates the raga's characteristics based on pitch-class profiles and note ngram histograms. The 'Tansen' system, developed by Pandey, Mishra, and Paul [8], is based on the hidden Markov model and string, Pakad coordination. Their test results only cover Yaman Kali and Bhupali ragas. Since there are few notes and the raga grouping is well-defined, they used the HMM model. The identification of transition and initial state chance is determined by the HMM set of rules using the Baum-Welch learning algorithm. By incorporating learning into the

architecture, the Pakad coordinating method is applied once more to outperform HMM. Chordia and Rae [5] reported the results of their study with the highest scale raga. The basic components of Indian melody are known as ragas, and each raga contains a special set of complex rhythmic movements.

Using pitch-class distributions (PCDs) and pitch-class dyad distributions (PCDDs) derived from audio input, Chordia and Rae developed a method for understanding ragas. A large collection containing 15 hours of audio recordings in 31 different ragas performed by 19 different artists was created to train and test the method. The classification concluded using support vector machines (SVM). By using three raga features—chromagram styles, mel-cepstrum coefficients, and timbre features—into Gaussian mixture model (GMM)-based Hidden Markov Models (HMM), the authors of [6] explore the problem of scale independent automated raga identification. Additionally, they use discrete HMMs and classification trees to analyse chromagrams that represent fully defined swara-based functions. Four ragas—rohini, khamaj, malhar, and sohani—form the basis of their methodology. They were about 97% effective on average. Sridhar and Geetha provide a method to determine the raga of a Carnatic music signal based on [7]. The basic concept behind raga identification is that it may be utilised as a strong foundation for Carnatic song melodies or film songs that are entirely based on different tunes. Instrument and vocal data separation is made simple by our input polyphonic signal separation technique. By implementing the audio signal separation set of instructions, you can be sure that the sound quality of your music is not affected. They recognised the singer by using the artist's basic frequency and their established set of rules for identifying musicians. The audio signal's frequency components were then determined, and these frequency components were mapped into the swara sequence, revealing the song's raga. The following raga and device output are in sync with the raga that is contained in the database. They used 30 samples/tunes in three ragas sung by four musicians, 175 Talam, a database of raga names, and arohana avarohana in a swara phase structure as their testing data. Using the frequency spectrum of the notes, Radhika Venugopala and Prashanth T R [9] set up a method for classifying notes in Carnatic music.

III -CLASSIFICATION

Support Vector Machines are binary classifiers that have

found application in music signal processing for various application. SVM's are supervised classification systems that find a hyperplane to separate two classes of data.

SVM is a linear approach in a high-dimensional feature space that is nonlinearly related to the input space, according to the theory behind it. The SVM performs classification by constructing an N- dimensional hyperplane that separates into two categories. Thus the aim of SVM is to find the optimal hyperplane that separates a given cluster of vectors to the two sides of a hyperplane. We identify a Raga using MFCC features.

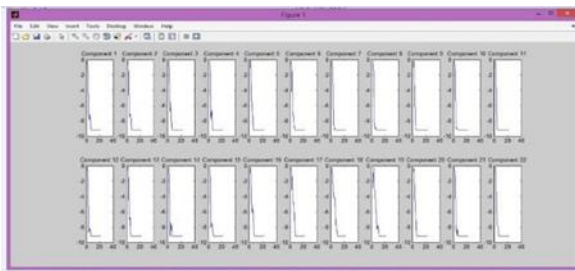


Table I: Performance of our approach on our dataset

IV-EXTRACTION OF FEATURES

Number of Ragas in Data Base	Ragas Checked	Correctly Identified by Proposed Method	Accuracy % (Proposed Method)
5	4	3	75.00
5	5	5	100.00
10	6	5	83.33
10	8	7	87.50
10	10	9	90.00
15	8	8	100.00
15	12	11	91.67
15	14	13	92.86
15	15	14	93.33
20	8	8	100.00
20	12	11	91.67
20	16	15	93.75
20	20	18	90.00

MFCCs, or Mel Frequency Cepstral Coefficients: The Mel Frequency Cepstral Coefficients (MFCC) features are the most often utilized speech characteristics because they accurately predict the speech parameters and produce the best results for speech [9]. The bulk of speaker and speech recognition software use Mel Frequency Cepstral Coefficients (MFCCs),

which are the most frequently used features. The typical process for feature extraction can be seen on Figure, with the assumption that it has been processed digitally and properly quantized. The extraction and pattern matching processes are both involved in transforming speech signals into a number of parameters extracted from the input speech signal. With the advanced technology of a speech recognizer, you can quickly and accurately transform audio into text with ease. A critical phase of the raga identification process is feature extraction. The best method for feature extraction is the MFCC. The MFCC technique involves converting our audio signal from analogue to digital format using either an 8kHz or 16kHz sampling frequency. The main purpose of using MFCC technique is helping to generate 22 features from the audio signal which are used as input for the melody recognition model. Feature extraction is an important step of Raga identification process. Figure 1 shows MFCC features of darbari Raga. In the extraction of MFCC we combined the different features like zero crossing rate, rolloff, centroid, skewness, cepstrum, spectrum, kurtosis, flatness, entropy etc. to get 62 dimensional vector and performed the experiment with Gaussian kernel.

With our own dataset, we assess how well our suggested technique performs. We began with minimal data sets and gradually increased them. The data set now only consists of the three ragas Darbari, Khamaj, and Malhar and uses a few instruments. We developed a dataset with three ragas Darbari, Khamaj, and Malhar—to test our methodology. We chose only instrumental, flute, harmonium, and sitar recordings for the audio files. On our dataset, we ran an experiment first. We followed [4]'s instructions when implementing the raga feature extraction process. Melody extraction software converts polyphonic audio inputs to the dominant melody. According to [4], n- grams and pitch-class profiles are retrieved. In order to construct the database utilised for training and evaluate the chosen raga, we create the dataset and evaluate raga at random. We tested the ragas and generated about 90 tonnes of data, reporting greater accuracy. We identify ragas and results are shown in Table I. It is clear that, our approach using MFCC feature extraction method achieves superior performance. Our approach to using MFCC feature extraction method gives good results for achieving superior performance. MFCC feature extraction allows us to extract meaningful data from the audio tunes that can be used to classify and identify sounds. With this approach, we can accurately predict type of Raga and achieved better results than other methods. Take

advantage of our approach and experience superior performance with MFCC feature extraction. The highest accuracy attained with our method is 92.47%, which is greater than the highest accuracy previously recorded (91.20%).

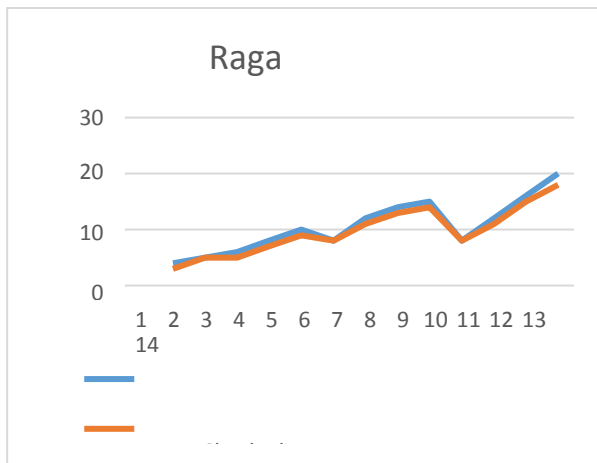


Fig 2. Correctly Identified Ragas

V-CONCLUSION

A Raga Identification system's feature extraction technique has a significant impact on the system's overall effectiveness. We looked through a number of feature extraction methods, but MFCC performs well. This method's goal is to look into the outcomes that can be produced when Mel-Frequency Cepstral Coefficients (MFCC) features are used as feature components for the front-end processing of a Raga Identification. We propose the MFCC feature components to enhance the reliability of a Raga Identification system. Due to its high accuracy and low complexity, the MFCC are often the "de facto" standard for raga identification systems; however, they are not very resistant to the effects of additive noise. Recent investigations have demonstrated the Chroma characteristics' good robustness against noise and acoustic change, although MFCC produces excellent outcomes.

The major goal is to use MFCC elements to boost Raga Identification's overall performance in low signal to noise ratio (SNR) environments. Our accuracy rate on average was 92.47%. They are the most effective outcomes at the moment for scale-independent raga identification, and they closely resemble those of [4]. The MFCC feature set produced the best outcomes overall.

REFERENCES

[1] Ranjani, H.G, Arthi,S. and T.V. Sreenivas, "Carnatic Music Analysis: Shadja, Swara

identification and raga verification in AlApana using stochastic models", *IEEE Workshop on Application of Signal Processing to Audio and Acoustics October 16- 19, 2011, New Paltz, NY.*

- [2] Bruno Nettl, Melinda Russell, *In the Course of Performance: Studies in the World of Musical Improvisation, Chapter 10, Page 219.*
- [3] Bruno Nettl, Melinda Russell, *In the Course of Performance: Studies in the World of Musical Improvisation, chapter 10.*
- [4] Vijay Kumar, Harit Pandya, C.V. Jawahar, "Identifying Ragas in Indian Music" *International Institute of Information Technology, Hyderabad, India, IEEE International Conference 2014.*
- [5] Parag Chordia and Alex Rae, "Raag Recognition using Pitch-Class and Pitch-Class Dyad Distributions", *International Symposium/Conference on Music Information Retrieval, 2007.*
- [6] Pranay Dighe, Parul Agrawal, Harish Karnick, Siddhartha Thota and Bhiksha Raj, *Scale independent raga identification using chromagram patterns and swara based features, IEEE International Conference on Multimedia and Expo Workshops, 2013.*
- [7] Rajeswari Sridhar and T.V. Geetha, "Raga Identification of Carnatic music for Music Information Retrieval", *International Journal of Recent Trends in Engineering, Vol.1, May 2009.*
- [8] Gaurav Pandey, Chaitanya Mishra, and Paul Ipe, "Tansen: A System For Automatic Raga Identification", *In proc. 1st Indian Intl. Conf. on Artificial Intelligence, pages 1- 9, 2003.*
- [9] Prashanth T R, Radhika Venugopala, "Note Identification In Carnatic Music From Frequency Spectrum", *Inproc. of IEEE, page 87, 2011.*
- [10] Pranay Dighe, Harish Karnick, Bhiksha Raj *Indian Institute of Technology, Kanpur, India. 2. Carnegie Mellon University, Pittsburgh PA, USA.*
- [11] Rajshri Pendekar, S. P. Mahajan, Rasika Mujumdar, Pranjali Ganoo "Harmonium Raga Recognition" *International Journal of Machine Learning and Computing, Vol. 3, No. 4, August 2013.*
- [12] Springer, 2011. [D. A. Reynolds, "An overview of automatic speaker recognition].
- [13] H. Sahasrabuddhe and R. Upadhye, "On the computational model of raag music of India." in *Workshop on AI and Music: European Conference on AI, 1992.*

- [14] *J airazbhoy, N.A.-The Rags of NorthIndian Music: Their Structure & Evolution; Popular Prakashan Bombay 1995.*
- [15] *Olivier Lartillot, Petri Toiviainen, "A Matlab Toolbox for Musical Feature Extraction from Audio", International Conference on Digital Audio Effects, Bordeaux, 2007.*