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Effectiveness of various musical parameters in Carnatic raga identification

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ABSTRACT
Raga are vital parts of Carnatic music and offer the performer a musical structure to improvise within them. Raga identification is considered to be a tedious task even for expert music listeners. As of now, we do not know a unique set of parameters which can precisely determine the raga of a Carnatic music. Even though several machine learning techniques are available to perform raga recognition, they all suffer from several issues like less recognition accuracy, poor scalability etc. In this work, we suggest a non machine model which has a high recognition accuracy. The model works on extracting five features of the music and then computing a similarity measure between the feature vectors of the input audio with the corresponding feature vectors stored in the database for raga recognition. Even though our system is not excellent in scalability, it is simple to implement and its recognition accuracy can be increased by increasing the feature vectors stored in the database.
Keywords—Pitch, MFCC, Energy, Similarity Computation

1. Introduction
India is well known since ancient time for the wonderful music contributions. The soul of these music contributions lies in Classical music. There were two types of classical musics, namely Carnatic music and Hindustani music, in India. In our work, we consider the Carnatic music for our research. Raga is considered to be rhythm or the foundation stone for composing a Carnatic music. There are 72 ragas which are commonly known as Melakartha ragas available in Carnatic music. Each raga has its own composition for the seven swaras sa,ri,ga,ma,pa,da,ni,sa and generates different thoughts and feelings in the minds of the listeners. Therefore, raga identification is one of the most important processes for the clear study of Carnatic music. Further, it plays a very significant role in devising music recommendation systems, artificial music synthesis etc. But raga identification from a song seems to be extremely difficult, and hence we often require a system for the accurate recognition of a Carnatic music. In this work, we propose an efficient machine learning model for raga recognition using some elementary features of the input music.

2. Related Works
There were several researches on raga detection in both Hindustani and Carnatic musics. Most of these systems takes some of the features of the input music song as input and perform some kind of processing to recognize the raga. A work due to Devayani and Vandana [1] used a convolutional neural network based and recurrent neural network based machine model for various parameters of the audio input including pitch, MFCC, roll off etc. They had converted the audio input into an image and then use 2-D Convolutional neural networks for the identification of raga. Another work due to Kaimal et al.[2] devises a system for raga identification based on the Arohana and Avarohana pattern. They use Praat as their tool for speech recording and music analysis. Their system identifies the swara sequence in the audio input based on their frequency in the input, which can further be used to identify the raga. Another work due to Sridhar and Geetha [3] introduces another system in which the swara sequence in the audio input is recognized by means of identifying Talam. Talam of an audio input can be identified by detecting the onset (beginning of a musical note) and offset(end of a musical note) of the audio input. Another work due to Joshy et al. [5] focus on finding the raga

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of a Hindustani audio input by using KNN(nearest neighbor algorithm) and SVM classifiers to identify the Yaman and Bhairavi raga.

3. Proposed System

The architecture of the proposed system is shown in Figure 1.

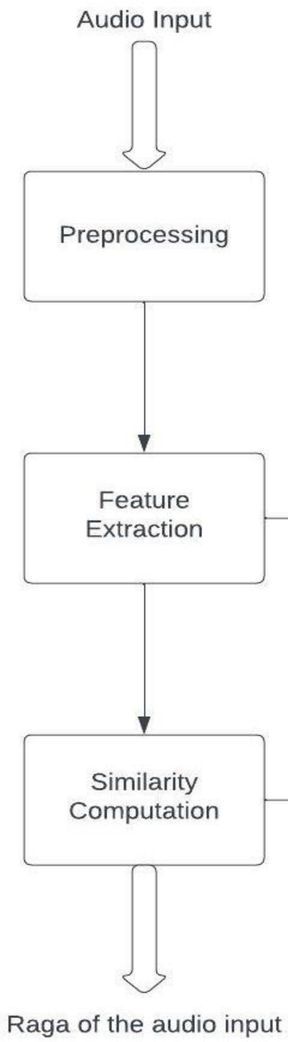

Figure 1: Architecture of the Proposed system

It consists of four modules namely

(a) Preprocessing module
(b) Feature Extraction module
(c) Similarity Computation module
(d) Database module

Now we describe each module in detail.

(a) Preprocessing module:-

In this module, the audio input is preprocessed to convert into a uniform form suitable for feature extraction. First of all, the noise from the given audio input is removed using

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Gaussian Noise filer and then the audio is shortened into a 2-minute duration signal. Any type of conversion such as mp3 to .wav can also be performed in this module so that all the ausio inputs to the feature extraction module are in the uniform format.

(b) Feature Extraction module:-

In this module, various musical features of the output from the preprocessing module are extracted. These features include Pitch, Energy, Spectral Centroid, Mel Frequency Cepstrum Coefficients (MFCC) and the Mel Spectrogram. Pitch refers to the specific position of a sound in a set of musical notes and is the parameter that characterizes whether a sound is high or low. Mel Frequency Cepstral Coefficients is a set of values which describe the shape of the spectral envelope of an audio. The spectral envelope of an audio specifies how the energy of the audio signal is distributed across various frequencies. Energy of a signal refers to the sum of the squares of the amplitudes of the signal. Spectrogram of a signal refers to the spectrum of the signal comprising the fast Fourier transform of various overlapped segments of the signal, and Mel spectrogram refers to the representation of the spectrogram in Mel scale. Spectral Centroid refers to the center of the mass of the spectrum of the signal. We use each of these parameters in our model to recognize the raga of the audio input.

(c) Similarity Computation Module :-

In this module, the similarity of two audio samples is checked by taking the cosine similarity measure computed on the basis of a specified feature. The cosine similarity measure is given by

$$cosinesimilarity = \frac{\sum_{i=1}^{m}\sum_{j=1}^{n} a_{ij}b_{ij}}{\sqrt{\sum_{i=1}^{m}\sum_{j=1}^{n} a_{ij}^2}\sqrt{\sum_{i=1}^{m}\sum_{j=1}^{n} {b_{ij}}^2}}$$

where the each a_{ij} and b_{ij} refers to the components of the feature vector **a** and feature vector **b** respectively. If this value is closer to 1, then there is a close match between the two audio samples. So by setting a tolerance limit, we will be able to identify whether two audio samples match with respect to a specif feature.

(d) Database module

In this module, the feature vectors of several samples of each raga are stored in the database. During recognition these feature vectors are used to compute the cosine similarity measure of each of these samples with the audio input to detect the sample stored in the database which is most similar to the audio input so that the raga corresponding to the sample stored in the database that is most similar to the audio input can be output by the system as the raga of the input audio.

4. Implementation and Experimental results

The proposed system was implemented in Python using the librosa package. We have chosen audio samples of three ragas kalyani, hindolam and Kapi. For each raga, 40 audio samples were collected and 30 of them are used for storage in the database and the remaining 10 are the following are used for the recognition purposes. For each of the 30 samples corresponding to each raga, Pitch, MFCC, Mel Spectrogram, Energy and Spectral Centroid are computed, and the corresponding feature vectors were stored in the database. Following are the results obtained. Table 2 shows the recognition accuracy in percentage for each raga. Table 3 shows the effectiveness of each of the five music feature in recognizing ragas measured in terms of recognition accuracy

Sl No.	Raga	Accuracy(%)
1	Kalyani	82.12

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2	Hindolam	81.57
3	Kapi	81.77

Table 2: Each raga and the corresponding accuracy in percentage

Sl No.	Raga	Accuracy(%)
1	MFCC	82.12
2	Mel Spectrogram	78.74
3	Energy	65.35
4	Pitch	12.38
5	Spectral Centroid	69.04

Table 3: Effectiveness of each music feature in terms of recognition accuracy

From the two tables, we claim that the system has an accuracy of more than 80% if MFCC is used as the feature for similarity computation . It is also seen that pitch is very irrelevanet in raga reacognition while energey, melspectrogram and Spectral centroid are moderatley good for raga recognition.

5. Conclusion

In the preceding sections, we had seen a non machine learning model to perform raga recognition in Carnatic music. The system essentially makes use of the similarity computation using cosine similarity measure as the basis for raga recognition. We also had undergone a study of the effectiveness of some important features of Carnatic music. We can increase the accuracy of the system by incorporating each of these features together as a vector and then use some kind of similarity computation like correlation coefficient.

References

1. Rajeswari Sridhar and TV Geetha. Raga identification of Carnatic music for music information retrieval. International Journal of recent trends in Engineering, 1(1):571, 2009.
2. Rohith Joseph and Smitha Vinod. Carnatic raga recognition. Indian Journal of Science and Technology, 10(13):0974–6846, 2017.
3. V Kaimal and S Barde. Introduction to identification of raga in Carnatic music and its corresponding hindustani music. International Journal of Computer Sciences and Engineering, 6(6):955–958, 2018.
4. Devayani Hebbar and Vandana Jagtap. A comparison of audio preprocessing techniques and deep learning algorithms for raga recognition. arXiv preprint arXiv:2212.05335, 2022.
5. Dipti Joshi, Jyoti Pareek, and Pushkar Ambatkar. Indian classical raga identification using machine learning. In ISIC, pages 259–263, 2021.
6. Rajdeep Routh; Dhruma Bhavsar; Rajiv Patel. "Socio-Economic and Policy Impacts of Heritage Conservation: A Case of Deewanji ni Haveli, Ahmedabad". International Research Journal on Advanced Science Hub, 4, 01, 2022, 7-15. doi: 10.47392/irjash.2022.002
7. Manoj Kumar Baral; Radhakrishna Das; Abhipsa Sahu. "DFIG based WT harmonics Analysis subjected to Diverse Transmission Fault". International Research Journal on Advanced Science Hub, 4, 01, 2022, 16-23. doi: 10.47392/irjash.2022.003
8. Khaled Salem Ahmad Amayreh; Ahmad Taufik Hidayah Bin Abdullah. "Conjunction in Expository Essay Writing by Jordanian Undergraduate Students Studying English as a Foreign Language (EFL)". International Research Journal on Advanced Science Hub, 4, 02, 2022, 24-30. doi: 10.47392/irjash.2022.006

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DOI:10.46647/ijetms.2023.v07i04.021 ISSN: 2581-4621

9. Mohammadibrahim Korti; Basavaraj S. Malapur; Smita Gour; Rajesh M. Biradar. "Shuchi 1.0: Robotic System For Automatic Segregation of Waste & Floor Cleaning". International Research Journal on Advanced Science Hub, 4, 02, 2022, 31-37. doi: 10.47392/irjash.2022.007
10. Bhuneshwari Nayak; Rachana Choudhary; Roymon M. G.. "Isolation, Screening and Morphological characterization of Laccase producing fungi". International Research Journal on Advanced Science Hub, 4, 02, 2022, 38-43. doi: 10.47392/irjash.2022.008
11. Kotte Sowjanya; Munazzar Ajreen; Paka Sidharth; Kakara Sriharsha; Lade Aishwarya Rao. "Fuzzy thresholding technique for multiregion picture division". International Research Journal on Advanced Science Hub, 4, 03, 2022, 44-50. doi: 10.47392/irjash.2022.011
12. Mohammadibrahim Korti; Girish B. Shettar; Ganga A Hadagali; Shashidhar Shettar; Shailesh Shettar. "Voice-based direction control of a robotic vehicle through User commands". International Research Journal on Advanced Science Hub, 4, 03, 2022, 51-56. doi: 10.47392/irjash.2022.012
13. Nagendra Singh; Manoj Kumar Agrawal; Sanjeev Kumar Verma; Ashish Kumar Tiwari. "A Review on Effect of Stress and Strain Distribution on the AA5083 With Respect to Different Channel Angle of ECAP". International Research Journal on Advanced Science Hub, 4, 03, 2022, 57-66. doi: 10.47392/irjash.2022.013
14. Nusrath Unnisa A; Manjula Yerva; Kurian M Z. "Review on Intrusion Detection System (IDS) for Network Security using Machine Learning Algorithms". International Research Journal on Advanced Science Hub, 4, 03, 2022, 67-74. doi: 10.47392/irjash.2022.014
15. Jyotshana Upadhyay. "Digital Marketing Practices Adoption in Micro, Small and Medium Businesses for Inclusive Growth". International Research Journal on Advanced Science Hub, 4, 04, 2022, 75-80. doi: 10.47392/irjash.2022.021
16. Arti Maurya; Kartick Chandra Majhi; Mahendra Yadav. "One Pot Synthesis of Lanthanum Doped Cobalt Selenate Electrocatalyst for Oxygen Evolution Reaction (OER)". International Research Journal on Advanced Science Hub, 4, 04, 2022, 81-87. doi: 10.47392/irjash.2022.022
17. Palash Mondal; Hrittik Dey; Sreetama Paul; Shamik Sarkar; Apurba Das; Amit Karmakar. "Additively manufactured porous titanium alloy scaffolds for orthopaedics: An effect of process parameters on porosity". International Research Journal on Advanced Science Hub, 4, 04, 2022, 88-93. doi: 10.47392/irjash.2022.023
18. Kousik Bhattacharya; Avijit Kumar Chaudhuri; Anirban Das; Dilip K. Banerjee. "A Data Mining based study on Dengue Fever: A Review". International Research Journal on Advanced Science Hub, 4, 04, 2022, 101-107. doi: 10.47392/irjash.2022.025
19. Bharathi M; Senthil Kumaran S; Edwin Samson P. "Influence of Nano Silica Particles on Quasistatic Mechanical and Low Velocity Impact Properties of Carbon-Glass-Sunn Hemp/Epoxy in Intra-Inter Ply Hybrid Composites". International Research Journal on Advanced Science Hub, 4, 05, 2022, 120-133. doi: 10.47392/irjash.2022.032
20. Anukriti Sharma; Navdeep Singh. "Hybrid Modulation for Reduced Switches AC-AC Multi Frequency Converter". International Research Journal on Advanced Science Hub, 4, 05, 2022, 134-142. doi: 10.47392/irjash.2022.033
21. Kousik Bhattacharya; Avijit Kumar Chaudhuri; Anirban Das; Dilip K. Banerjee. "Comparison of Recent Data Mining Algorithms to Identify of the factors and effects of Dengue Fever and Ensemble Random Forest, A new Algorithm". International Research Journal on Advanced Science Hub, 4, 05, 2022, 143-153. doi: 10.47392/irjash.2022.034
22. Ch Yashwanth Krishna; Y Shanmukha Venkata Sri Sai; Muniyandy Elangovan. "Development of Telemetry system for Student Formula Cars and All-terrain vehicles". International Research Journal on Advanced Science Hub, 4, 05, 2022, 154-160. doi: 10.47392/irjash.2022.035
23. Thenmozhi S; Praveen A; Subhavarman S; Jaipriya S; Malathy S. "QoS based Prioritization using Shortest Path and Hamming Residue Method". International Research Journal on Advanced Science Hub, 4, 05, 2022, 161-167. doi: 10.47392/irjash.2022.036

DOI:10.46647/ijetms.2023.v07i04.021 ISSN: 2581-4621

24. Ms. Ritu; Preeti Chawla. "Factor Affecting User Acceptance for Digital Wallets: A Developing Country's Perspective". International Research Journal on Advanced Science Hub, 4, 06, 2022, 168-174. doi: 10.47392/irjash.2022.041
25. Jagandas S.; Mallikarjuna Rao G; Hitesh Kumar M; Srujan Kumar T. "A Scientometric Review of Na2SiO3/NaOH Versus SiO2/Na2O is above 2.85:1 Alkaline solution Activated Geopolymer Concrete". International Research Journal on Advanced Science Hub, 4, 06, 2022, 175-179. doi: 10.47392/irjash.2022.042
26. Muniyandy Elangovan; Mohammed Nayeem; Mohamed Yousuf; Mohamed Nauman. "Energy opportunities for delivery robot during Disaster". International Research Journal on Advanced Science Hub, 4, 06, 2022, 180-185. doi: 10.47392/irjash.2022.043
27. Nagendra Singh; Manoj Kumar Agrawal; Sanjeev Kumar Verma; Ashish Kumar Tiwari. "Study of the effect of ECAPed Method on the Mechanical Properties of AA 5083: An Overview". International Research Journal on Advanced Science Hub, 4, 06, 2022, 186-191. doi: 10.47392/irjash.2022.044