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Automatic Tonic Identification in Indian Art Music

Deeksha Poojary[1*], Ashwith Pinto[2], Abdulla Zahied[3], Anusha[4], Ankitha Shetty[5]
[1,2,3,4]*Student, Department of Computer Science and Engineering, Alva's Institute of Engineering & Technology, Moodbidri, India*
[5]*Professor, Department of Computer Science and Engineering, Alva's Institute of Engineering & Technology, Moodbidri, India*
*Corresponding author: deekshapoojari1111@gmail.com

***Abstract*: The Raga is the core of Indian Classical Music that is used in its composition, performance, improvisation and organization. Automatic Raga identification has potential use in various areas including music information retrieval, teaching music, learning of music, practicing of music, multimedia databases, interactive composition etc. Hindustani raga identification is a standard problem to artist that, over the years, have produced a detailed locution of Hindustani raga. In recent years the identification of Hindustani raga in the field can be made indirectly from its audio recorded tracks, using intelligent recording devices. This is an interesting form to monitor the Hindustani raga and its characteristics.**

***Keywords*: Automatic raga, Music information retrieval, Audio recorded tracks.**

1. Introduction

Human ear can perceive all the sounds and differentiating them from their source. But many times it is difficult to identify the types of a source. The Hindustani raga type is one such audio sound existing in our surroundings which is not easy to differentiate and hence a software-based product will help to overcome this limitation of human ear. Research on different kind's Eco environmental sounds will be beneficial in the study of the music and their development with time. Based on such research, development of an automatic system for Hindustani raga identification from their sample sound made in field conditions could be very useful.

2. Literature Survey

In paper [1] the author Ajay Jayswa, Hetal Guadani, Pranay Patel explains about the Singer Identification Systems which is used to identify the singer of the hindi songs. There are many of Indian Hindi Songs, and hence it is important to devise the system which can efficiently identify the singer from Hindi songs. They have abridge frequently used audio features and classification methods to identify a singer from audio song.

In paper [2] the author Rohith Joseph and Smitha Vinod identify the raga of the Carnatic music. The raga identification report uses the pitch determination, segmentation and the key note mapping technique to identify ragas in a song. Total ten ragas are considered in the dataset, composition of ragas are analyzed and the features are extracted before the classification. The system which is proposed is tested and different algorithms are used for the classification of the ragas. The proposed system used here is to identify the raga from the polyphonic music signal the best results were found to be achieved using K star algorithm with an accuracy of 93.38%.

In paper [3] Music Information Retrieval (MIR) is an active and growing body of research, with most of the music available today on the internet, whether in digital format. There has been a lot of work on Western classical music content analysis in terms of information retrieval, genre detection, and instrument recognition. Although Indian classical music is a major form of music, current literature is very limited compared to its Western counterpart. Indian classical music is known for its technical sound and its fine structure. The original music performance unit is a raga, similar to a song.

While a classical Indian musician can recognize the unique constituent patterns such as swaras, arohan, avarohan and pakad in performance, developing computational models have been the same for music researchers. The independence of Indian classical music to give an artist his / her personal tune makes it difficult for novices to distinguish between two different performances of the same raga. Another major challenge is that swaras are only different in terms of correlation, and decisions must be made by sound patterns rather than their full frequency structure.

Our approach to tune recognition relies heavily on the theoretical grounding of Indian classical music. The whole work has the premise that Indian classical music has a good structure. The whole concept of a complex tune made up of small substructures of Arohan, Avrohan and Pakad is made of vowels, which can be modeled as efficiently if treated and analyzed using these tiers. Splitting the ragas into swaras and a successful identification helps develop more precise applications for automated tagging, raga teaching, music recommendation and perhaps raga production.

Most early methods use tune audios, which are typically used

by artists in controlled environments. In comparison, we have tried raga recognition in performances, without being aware of the frequency of the tonal Downloaded from YouTube videos with a mix of good vocal and instrumental music. Competing with an expert human recognition is final goal in raga identification and it is always possible that professional artists can perform this task with 100% accuracy. We would like to investigate structure discovery by means of minimal entropy or maximum-structure learning methods. Chroma and Swara features can also be tested for classification of genres and stories.

In paper [4] Carnatic music is an oral tradition and therefore not annotated or archived. The purpose of this work is to study and collect this rich heritage using a computational method. There are two main elements in Carnatic music, namely raga and tala. Gamaka commentary with the Defination of Phraseology exemplifies one characteristic. Novel signal processing and machine learning algorithms developed in the Comp Music framework leverage to perform motivational analysis. Tala is another important aspect of Carnatic music. Percussion instruments not only help lead performers to maintain tala, but also lend themselves to improvisation.

3. System Function and Implementation

The proposed system provides information regarding the unknown Hindustani raga by processing audio signals. Admin is provided with authorized access to insert and update the Hindustani raga dataset information. User can use the system to determine the Hindustani raga. User can provide the feedback regarding the system after determining the Hindustani raga. System allows the user to get information about various Hindustani raga. Admin will use web application to login and to manage Hindustani raga information. System has well defined, user friendly interfaces that allow the admin to operate the system very easily. System provides attractive and well-defined interfaces to administrator. Users will also use web applications to know about Hindustani raga information and to know more about the Hindustani raga system provides Graphical interfaces to user. User need to register them self to use our system. Administrator of the system will add, delete and update Hindustani raga dataset. This module is used by every user to do the registration. User need to provide name, mobile no, email-Id, address etc during registration. People other than the admin should not be able to process Hindustani raga dataset. Only the administrator should be able to add new Hindustani raga data. Only the respective User can change their details. Authentication is done during the login. The system searches for the email id and mobile number during User registration. If User already exists with same email id and mobile number, then a message is shown. This module is used by the user and administrator to login into the system. They need to provide username and password to login. This module is used to upload the new Hindustani raga dataset to the local DBMS. This module is used to present the Hindustani raga information to the user. Administrator of the system is responsible for managing the system. User should have the minimum knowledge of accessing the computers and application software. User and Administrator should be authenticated by the system. User should use the application at least once before providing their feedback.

4. General Architecture

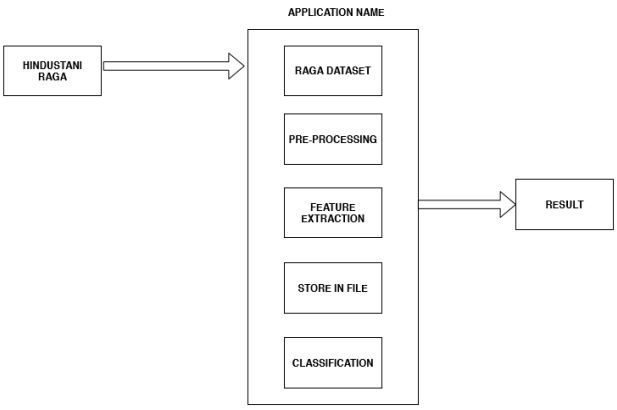

Fig. 1. General architecture of the proposed system

In recent years the recognition of Hindustani raga in the field can be made indirectly from its audio recorded tracks, using intelligent recording devices. This is an interesting form to monitor the Hindustani raga and its characteristics. In this system seven Hindustani ragas are considered in the dataset, were each raga consists of 5 more audio clips in it of the same raga all these are considered in a single dataset. In the training phase of this system this dataset is taken as an input and this data is pre-processed.

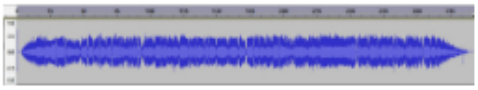

Fig. 2. Audio signal before noise removal

During pre-processing each audio is standardized to .wav format. For the selection of the audio file Signed 16-bit PCM encoding format is used. The audio file is then segmented to the time frame of 30 second. After segmentation of the audio file noise removal is performed to mitigate the unwanted noise, frequencies, using sound processing software, Audacity.

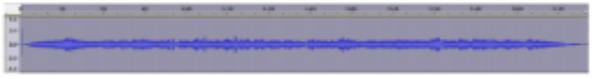

Fig. 3. Audio signal after noise removal

After the pre-processing next step performed is feature extraction of the data and this can be done by using machine learning, python package for music and audio analysis. It gives the necessary building blocks to create music information retrieval system. In this system only seven main features are

going to be extracted those are computing the chromagram from the waveform or the audio signal, Constant-Q chromagram, computing of the chroma variant, "Chroma Energy Normalized" (CENS), Computing the mel-scaled spectrogram, Mel-frequency cepstral coefficients (MFCCs), computation of root-mean-square (RMS) value for each frame, from the audio sample and the spectral centroid. The pre-processing and feature extraction is occurred during the training phase of the system. All the features of the data in the dataset is extracted and all the details of the feature of the raga is stored in a file which is called as weight file. All the information and the features which are being extracted are stored in the weight file, this is how the system is trained in our project. And the last step is classification of the raga's for the classification we need an algorithm that is Support Vector Machine (SVM). First the song is uploaded by the user then it is pre-processed and feature extraction is done and later the comparison of original dataset. After that ragas's are classified and at last if the song matches the raga results are displayed to the user.

5. Methodology

In our proposed system there should be a certain web application which is required for the user to login, upload the song and to extract the results and also for the admin to upload the dataset, update the dataset and for the testing process. We are using a framework called as Django for the development of the web based platform designed by python which follows model template view architecture. It is free web frame work open source and ridiculously fast. It provides additional administrative options such as create, delete, read, update. This Frame work allows us to quickly create the quality web application which is suitable for both frontend and backend this is possible because Django has a collection of python libraries. The components in this framework are reusable. Django minimizes the programming efforts and low coupling.

For the classification of the raga's in our proposed system we are using an algorithm that is support vector machine algorithm. SVM algorithm works well for the smaller dataset and for the comples ones. We have only 7 Hindustani raga's used in the dataset those are Madhukauns, Marva, Abhogi, Yaman Kalyan, Abhirabairav, Puriya dhanasri, Bairagi. SVM algorithm is much stronger and powerful in building machine learning models. Tuning parameter values of algorithm improve model performance. In our system the main features that are going to be classified are pitch class profile and n-gram histogram both are included in the SVM framework by linearly associating two kernels. The pitch class profile is a group of characteristic that a computer program extracts from audio signal. The pitch class is set of all pitches that shove same chroma. Pitch is the cognizance property of sounds that allow their ordering on a frequency related scale. The main purpose of a histogram is to graphically summarize the distribution of a univariate data set. The histogram graphically shows the presence of the multiple data. Similarities are captured by each of these kernels of the raga based on n-gram histogram and pitch class profile which corresponds to the distribution of the pitch value, here n-gram histogram gives information about the occurrence of short sequences of notes. The raga is recognized by using two nonlinear kernels that define similarities of raga based on the pitch classes.

6. Conclusion

This paper presented an overview on automatic tonic identification in Indian art music.

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