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A Study On Feature Selection And Classification Techniques Of Indian Music

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Abstract

In this paper we present the effect of four feature selection algorithms namely genetic algorithm, Forward feature selection, information gain and correlation based on four different classifiers (Decision tree C4.5, K-Nearest neighbors, neural network and support vector machine). The feature sets used in this paper are extracted features from the preprocessed songs using MIR Toolbox in MATLAB, which encompass rhythm based, timbre based, pitch based, tonality based and dynamic features. Feature vectors are extracted from music segments from first 30 seconds and last thirty seconds of the music signal (time-decomposition).Experiments were carried out on the three dominant genres of Indian music : Carnatic, Hindustani and Bollywood. Our dataset is small with 290 songs, trimmed to extract the first and the last 30 second percepts. As pure Carnatic and Hindustani music being more prevalent in traditional settings, have limited work done to make their digital copies available but the collection of music we have used consists of songs of some of the most profound singers contributing to each of these genres.For high-dimensional feature sets, the feature selection provides a compact but discriminative feature subset which has an interesting trade-off between classification accuracy and computational effort. The experimental results have shown that the common features selected by each of the feature selection algorithms with respect to classifiers and percentage of classification accuracies for all the classification algorithms. Furthermore, it can be observed from our experiment that information gain based feature selection gives better and consistent accuracies than other feature selection algorithms and Neural network and SVM classifiers are the best suited classifiers for Indian Song dataset.

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Keywords: Music classification; Feature Extraction; Feature Selection; Music information retrieval.

1. Introduction

Rapid growth of digital technologies, the internet, and the multimedia industry has provoked a huge information overload and a necessity of effective information filtering systems and in particular recommendation systems. In the case of digital music industry, current major internet stores contain millions of tracks, which complicate search, retrieval and discovery of music relevant for a user[1]. The features of music can be divided into three categories namely, low level, middle level and high level features. These features are used for the genre classification of songs[2],

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music recommendations, classification based on textual features etc., usage of any one of these categories might not give best results[3]. Hence optimal set includes features from all the three categories based on the features variance with time, cost and waveform. The limited scope of the range of features selected through domain knowledge can be widened using the feature selection algorithms in machine learning. Here we propose a comparative study to select this optimal set of features for Indian music.

This paper presents the effect of four feature selection techniques on the classification accuracy of four different classifiers. After features are extracted from the preprocessed songs using MIR toolbox, their effectiveness are measured by comparing accuracies of four traditional classification algorithms applied to only the commonly selected features[4]. The four classification algorithms used in this study are Decision tree C4.5, k-nearest neighbor (kNN), neural network, and Support Vector Machines (SVM) and the four feature selection algorithms used for experiment are Genetic algorithm, Forward feature selection, information gain, correlation based.

The organization of this paper is as follows. The background of the work such as feature extraction, feature selection methods are outlined in Section 2. The four classification algorithms are briefly described in Section 3. Section 4 contains details of dataset we used. Our analysis on the results, including the significance of the feature selection methods, are presented in Section 5. Then we provide some conclusions and future work in Section 6.

2. Background

2.1. Feature Extraction

Feature extraction is a process where a segment of an audio is characterized into a compact numerical representation. In our work features are extracted from the preprocessed songs using MIR Toolbox in Matlab. The feature values are represented in the form of matrices and cells in Matlab. The MIRtoolbox is a collection of Matlab functions for extracting audio features such as tonality, rhythm, and pitch from audio files. The toolbox employs a modular framework which includes preprocessing, classification and clustering functionality along with audio similarity and distance metrics as part of the toolbox functionality. Algorithms are fragmented allowing detailed control with simple syntax, but often suffers from standard Matlab memory management limitations[5]. Because many feature extraction processes share the same initial computations, a range of building block functions are included to avoid running the same calculations multiple times. In this paper rhythm based, timbre based, pitch based, tonality based and dynamic features are extracted.

Rhythm based features include event density, peaks and pulse clarity which capture the rhythmic fluctuations along the audio signal. Timbre based features include segment-wise minimum and maximum of attack time and attack slope, number of zero crossings, rolloff, and brightness, centroid, spread, skewness, kurtosis, flatness, entropy and Mel Frequency Cepstral Coefficients(MFCC)[6]. Pitch based features include pitch and inharmonicity. Tonality based features include chromagram, key, mode, key strength and tonal centroid. Dynamic features extracted are RMS energy and low energy. While some of the features like RMS energy, centroid, zero crossings are uni-dimensional, some features like MFCCs, chromagram, tonal centroid are multi-dimensional. All these 26 features are listed in Table 1 extracted over two segments of each of the songs sum up to a total of 120 dimensions.

2.2. Feature Selection

It is the process of selecting the predominant features from the data set and remove the features that are irrelevant with respect to the task that is to be performed. Feature selection can be extremely useful in reducing the dimensionality of the data to be processed by the classifier, reducing execution time and improving predictive accuracy. Feature selection is preferable to feature transformation when the original units and meaning of features are important and the modeling goal is to identify an influential subset[7]. When categorical features are present, and numerical transformations are inappropriate, feature selection becomes the primary means of dimension reduction. Reducing the dimensionality of the data reduces the computational complexity for bigger datasets such as music data and thus results in faster execution time.

In general, feature selection algorithms can be broadly classified into filter based and wrapper based algorithms. Our proposed work uses two wrapper based approaches: forward feature selection and genetic algorithm and two