

Ahsanullah University of Science and Technology



Department of Computer Science and Engineering

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Introduction: Humans develop and utilize musical genres to define and categorize diverse types of music. One of the services used by music content producers to get users to buy their product is automatic music analysis. Here is a framework for the creation and assessment of features that define musical content. For the music, I employed a variety of audio analysis techniques. It examines the accuracies of the various classifiers used for classification and recommends the optimal strategy for categorizing the dataset. I utilized Fast Fourier Transform (FFT) and Mel Frequency Cepstral Coefficients techniques (MFCC). The approaches may be utilized by any application to provide a user with the ability to listen to a music of his choosing.

About Dataset:

GTZAN is the dataset I used for music genre categorization. This dataset includes 1000 music files, each of which lasts 30-40 seconds. These songs are divided into eight genres: blues, classical, country, disco, hip-hop, jazz, metal, and pop. Using an internet converter, all of these files were converted to.wav. The dataset was divided into training and testing data in the ratio 7.5:2.5.

DATA PROCESSING AND NORMALISATION:

I utilized five different algorithms to transform audio data: Support Vector Machine (SVM), Decision Tree, k-Nearest Neighbors (KNN), Random Forest, and Gradient Boosting Classifier. To implement these algorithms on the dataset, the Librosa toolbox was employed.

Methodology: The dataset's architectural structure has been pre-processed. The pre-processed data is utilized to train each of the classifiers. The categorized data is next tested on the basis of the test data.

Algorithm

1. Convert data to .wav format.
2. Preprocess the data using FFT.
3. Feature Extraction using MFCC, Delta, Delta- Delta and rhythmical features.
4. Feature Reduction using Principal Component Analysis.
5. Optimization of hyper-parameters using Cross-Validation.
6. Training the classifier using various classification algorithms.
7. Testing the data and predicting the genre of data files.

FEATURE REDUCTION (PCA)

Principal Component Analysis (PCA) is the most important technique to visualize the data of dataset. It is a statistical procedure that is entirely based on orthogonal transformation, which converts some correlated values in the data set into set of linearly uncorrelated data set. I have used PCA in this work so as to carry out the dimension reducibility. I have reduced from 40 features (13 mfcc , 13 delta ,13 delta-delta , 1 tempo) to 7 important features by applying explained variance to data set.

CLASSIFICATION ALGORITHMS

i.k-Nearest Neighbors

K nearest neighbors is an algorithm that stores all the currently classified new cases based on previous available cases. It belongs to supervised learning domain and is non-parametric. It does not make any underlying assumptions about the distribution of data. A majority vote of the case's neighbors classify it and each of the case being assigned to the class most common among its k-nearest neighbors is computed by a distance function. I have used Euclidean distance for computing distance function. Generally, a higher k value reduces the overall noise

ii. Support Vector Machine(SVM)

The SVM training process creates a model that is a non-probabilistic binary linear classifier that is used for classification. SVM determines the hyperplane that maximizes the decision boundary between two classes. Support vectors are the vectors that define a hyperplane. After establishing the hyperplane, the data is transferred to a higher dimensional space.

iii. Decision Tree

A decision tree builds a tree structure based on regression or classification models. A tree is formed while the dataset is partitioned into smaller sections. The tree's node has two branches. A leaf node reflects a judgment or categorization. A predictor is represented by the root node. CART is the algorithm used to generate decision trees (Classification and Regression Tree). CART takes a greedy approach, constructing decision trees in a top-down recursive divide-and-conquer fashion. The splitting property for the tree in CART is index. The impurity of a data partition is measured by the index. It considers the optimum binary split for each attribute. The split point for an attribute is determined by the point with the lowest index for that attribute..

iv. Random Forest

The random forest algorithm is a supervised classification system that consists of a group of decision trees. A forest has more trees (the dataset is split into smaller segments), making this approach more resilient. To increase performance, it employs a divide-and-conquer strategy. The decision trees are poor learners, but the random forest is an excellent learner. When a new input is entered, it is processed through all of the trees. The outcome might be an average or weighted average of the final nodes reached. Random forest can also deal with uneven and missing data.

v. Gradient Boosting Classifier

A boosting method used in supervised learning to reduce bias and variation. It is a weighted method in which each input class is assigned a weight and the projected output is used to assess it. Important data is given greater weight than low-predictability data. By using a powerful prediction model, this technique improves on the standard bagging algorithm. The learning rate must be kept between [0.00001 and 0.1] so that it can take precise inputs.

RESULTS:

I ran the dataset via many classifiers. Different classifiers provided varying degrees of accuracy. I utilized accuracy, precision, F1 score, and recall to analyze the results of testing data. Using confusion matrices, I attempted to explain the results.

Performance Table :

RANDOM FOREST

CLASSIFICATION REPORT

	precision	recall	f1-score	support
1	0.13	0.13	0.13	30
2	0.69	0.78	0.73	23
3	0.29	0.30	0.30	30
4	0.29	0.41	0.34	29
5	0.71	0.59	0.65	17
6	0.44	0.30	0.36	23
7	0.19	0.13	0.15	23
accuracy			0.36	175
macro avg	0.39	0.38	0.38	175
weighted avg	0.36	0.36	0.36	175

KNN

CLASSIFICATION REPORT

	precision	recall	f1-score	support
1	0.13	0.13	0.13	30
2	0.69	0.78	0.73	23
3	0.29	0.30	0.30	30
4	0.29	0.41	0.34	29
5	0.71	0.59	0.65	17
6	0.44	0.30	0.36	23
7	0.19	0.13	0.15	23
accuracy			0.36	175
macro avg	0.39	0.38	0.38	175
weighted avg	0.36	0.36	0.36	175

3. Support Vector Machine (SVM)

CLASSIFICATION REPORT

	precision	recall	f1-score	support
1	0.46	0.43	0.45	30
2	0.67	0.61	0.64	23
3	0.38	0.50	0.43	30
4	0.44	0.41	0.43	29
5	0.60	0.71	0.65	17
6	0.58	0.65	0.61	23
7	0.36	0.22	0.27	23
accuracy			0.49	175
macro avg	0.50	0.50	0.50	175
weighted avg	0.49	0.49	0.49	175

4 Decision-tree

CLASSIFICATION REPORT

	precision	recall	f1-score	support
1	0.43	0.43	0.43	30
2	0.60	0.52	0.56	23
3	0.42	0.37	0.39	30
4	0.50	0.38	0.43	29
5	0.63	0.71	0.67	17
6	0.31	0.43	0.36	23
7	0.38	0.43	0.41	23
accuracy			0.45	175
macro avg	0.47	0.47	0.46	175
weighted avg	0.46	0.45	0.45	175

5 Gradient Boosting

CLASSIFICATION REPORT

	precision	recall	f1-score	support
1	0.57	0.57	0.57	30
2	0.81	0.74	0.77	23
3	0.46	0.43	0.45	30
4	0.62	0.52	0.57	29
5	0.82	0.82	0.82	17
6	0.64	0.78	0.71	23
7	0.41	0.48	0.44	23
accuracy			0.60	175
macro avg	0.62	0.62	0.62	175
weighted avg	0.60	0.60	0.60	175

Name of algorithm	Accuracy
Random Forest	54.285714285714285
KNN	36.0
SVM	49.142857142857146
Gradient Boosting	60.0
Decision Tree	45.14285714285714

Table1: Performance table

REFERENCES:

<http://marsyas.info/downloads/datasets.html>