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Music Genre Classification using Hybrid Deep Learning Approaches - A Survey

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Abstract

Musical genres are categorical descriptions that are used to describe music. They are commonly used to structure the increasing amounts of music available in digital form on the Web and are important for music information retrieval. Genre categorization for audio has traditionally been performed manually. A particular musical genre is characterized by statistical properties related to the instrumentation, rhythmic structure and form of its members. In this work, CNN and Bi-RNN algorithms for the automatic genre categorization of audio signals are described. More specifically, proposed set of features for representing texture and instrumentation. In addition a novel set of features for representing rhythmic structure and strength is proposed. The performance of those feature sets has been evaluated by training statistical pattern recognition classifiers using real world audio collections. Based on the automatic hierarchical genre classification two graphical user interfaces for browsing and interacting with large audio collections have been developed.

Keywords: Music Genre, Categorization, CNN, Bi-RNN

I. INTRODUCTION

Musical genres are categorical descriptions that are used to describe music. They are commonly used to structure the increasing amounts of music available in digital form on the Web and are important for music information retrieval. Genre categorization for audio has traditionally been performed manually. A particular musical genre is characterized by statistical properties related to the instrumentation, rhythmic structure and form of its members. In this work, algorithms for the automatic genre categorization of audio signals are described.

More specifically, we propose a set of features for representing texture and instrumentation. In addition a novel set of features for representing rhythmic structure and strength is proposed. The performance of those feature sets has been evaluated by training statistical pattern recognition classifiers using real world audio collections. Based on the automatic hierarchical genre classification two graphical user interfaces for browsing and interacting with large audio collections have been developed. Automatic music genre classification is a widely explored topic. However, almost all related work is concentrated in the classification of music items into broad genres (e.g., Pop, Rock) using handcrafted audio features and assigning a single label per item. Even though there has been some developments in this area, the accuracy

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is still an issue in the genre based classification and music recommendation system. Hence it will be easier to use modern deep learning techniques to implement the classification task and recommend better music based on genre.

Everyday more and more people are tuning in to listen to their favorite music. They are especially an audience to the web music where they get access to different types of music at once. Though music has different aspects such as mood based, theme based, genre based it is difficult to classify data this large in a single field. Hence, we use different ML techniques to make this task easier and provide a better service which will also be beneficial to the money makers and service providers.

Librosa [16] is a Python package for audio and music signal processing. Version 0.4.0 is used for the audio processing. This is because librosa provides assistance for implementing multiple common functions used for the retrieval of complex music information. Even though there have been some developments in this area, the accuracy is still an issue in the genre based classification and music recommendation system. Hence it will be easier to use modern deep learning techniques to implement the classification task and recommend better music based on genre.

II.LITERATURE SURVEY

The First chapter tells about the description of this project. It gives an idea about how the project is distributed in parts and the techniques that will be used to implement the project. This chapter includes the related work studied in relation with this project. These papers are close to the objectives of the project and the observations of these research papers are analyzed in the project. The literature survey is divided into 3 main themes. In the first section, traditional methods were analyzed but these methods did not give perfect results. So Ensembled methods were introduced to give better output by combining different traditional methods. In the third section, Deep learning methods gave more enhanced results than previous strategies were studied.

1. Critical Survey on Traditional Machine Learning Approaches

Changsheng Xu,et.al.[5] has studied the `Musical genre classification using support vector machines'. The paper summarizes the automatic musical genre classification is very useful for music indexing and retrieval, because the author feels that the amount of digital music increases rapidly nowadays, to effectively organize and process such large variety and quantity of musical data to allow efficient indexing, searching and retrieval is a big challenge. The authors have studied the multi-layer classifier based on support vector machines (SVM) methodology. The authors claim that it has good performance in musical genre classification and are more advantageous than traditional and other methods. The authors got the results (error rate) using SVM which was 6.86 percent which was very minimum with compares to other methods. But the limitations in that Support vector machines take a long time in the training process, especially with a large number of training samples.

Carlos N. Silla Jr., et.al. [6] Used an ensemble approach according to time and space decompositions: feature vectors are selected from different time segments of the music, and one-against-all and round-robin composition schemes are employed for space decomposition which show that the employed features have different importance according to the part of the music signal from where the feature vectors were extracted.

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Furthermore, the ensemble approach provides better results than the individual segments in most cases. Also, the use of a reduced set of features implies a smaller processing time. This point is an important issue in practical applications, where an adequate compromise between the quality of a solution and the time to obtain it must be achieved

Takuya Kobayashi,et.al.[7] have proposed novel audio features using correlations between sub-band signals and showed its effectiveness for music genre classification. The proposed method demonstrated the best accuracy of 81.5 percent, outperforming the conventional methods. In future, we can use other training/classification method such as linear discriminate analysis for further Classification Accuracy (CA) improvement. We can also reduce the dimension of the features without degrading CA by selecting effective sub-band correlations from all the combinations. Gaussian Processes (GPs) having capabilities to identify nonlinear data relations such as time series analysis and classification tasks.

K. Markov and Tomoko Matsui [8] has tried to use the applicability of GP models for music genre classification and emotion estimation. Here, two systems are operating, one for music genre classification and another for music emotion estimation using both SVM and GP models. The music was processed in the same way and the effect of different feature extraction methods and their various combinations were also observed. It was observed that in both the tasks, GP performed consistently better than SVM. GP produce Gaussian distribution as their output in contrast to SVM which provides sparse solution.

Bob L. Sturm [12] describes the bibliography of work in MGR and analyzes three aspects of evaluation like experimental designs, datasets, and figures of merit. They present summary statistics of each. In the experimental designs they explained ten designs of MGR and their accuracy. They found that classify is the most accurate method for MGR. The author did survey of the datasets that were used for MGR. In this paper, figures of merit have been briefly described. Mariusz et.al. [15] examined the utilization of Sparse Autoencoders (SAE) in the process of music genre recognition. Scattering Wavelet Transform (SWT) has been used as an initial signal representation. The SWT uses a sequence of Wavelet Transforms to compute the modulation spectrum coefficient of multiple order switch was already shown to be promising for this task. The Auto encoder scan be used for pre-training a deep neural network, treated as an features detector, or used for dimensionality reduction. In this paper, SAE's were used for pre-training deep neural network on the data obtained from jamendo.com website offering music on creative commons licence. The pre-training phase is performed in unsupervised manner. Using a simple Sparse Autoencoder, the author improves the result even in the simplest case and even outperforms the best MLP by a little margin. The authors suspect that the normalization of the feature space plays a role in the adaptability of the SA.

Chih-Hsun Chou, et.al [14] have used spectrogram analysis to analyze the characteristics and genre classification of the music. In the proposed method, two important methods were integrated to extract the desired features. The capability of multi resolution analysis of the wavelet package decomposition was integrated with dimension reduction ability of the singular value decomposition. Experimental results with the well-known ISMIR 2004 and GTZAN database were used to verify the performance of the proposed method. Music was transformed into sixty two sub-bands by five levels of WPD so that the spectrogram of each sub-band could be obtained using short time Fourier transformation.

2. Critical Survey on Ensembled approaches

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Paulo Ricardo, Lisboa de Almeida et.al [9] has presented a dynamic ensemble selection method for music genre classification, where two pools of diverse classifiers are created by using different features types. These feature types are extracted from different music pieces. By using the k-nearest oracles method, the classifiers are ensembled to dynamically select the test patterns. As an output the model efficiently gave about 63 to 70 per cent accuracy. Further, the weaker classifiers can be replaced by the pools composed of SVM to test other strategies to select the classifiers from the pool**.**

Gjorgji Madjarov, Goran Pesanski, et.al [10] have explored the task of automatic music genre classification. Multiple features based on timbral texture, rhythmic content and pitch content are extracted from a single music piece and used to train diff erent classifiers for genre prediction. For the classification, two diff erent architectures flat and hierarchical classification and three diff erent classifiers (kNN, MLP and SVM) were tried. .The experiments carried out on a large dataset containing more than 1700 music samples from ten diff erent music genres have shown accuracy of 69.1% for the flat classification architecture (utilizing one against all SVM based classifiers). The accuracy obtained using the hierarchical classification architecture was slightly lower 68.8%, but four times faster than the flat architecture. Future work will involve further analysis of the feature space, genre group dependent selective extraction and combination of diff erent types of features on the second level of the classification hierarchy, examination of alternative classification schemes, and incorporation of more audio classes

Loris Nanni, et.al.[11] studied the Music Information Retrieval (MIR) system. In this work the author, present the novel and effective approach for automated musical genre recognition based on the fusion of different set of features. Both acoustic and visual features are considered, evaluated, compared and fused in a final ensemble, which show classification accuracy comparable or even better than other state of the art approaches. The music genre classification system combines audio and visual features. In this paper 11 different texture descriptors extracted from the spectrogram image and several acoustic feature vectors are evaluated and compared. The combined approach has a main drawback which is the increased computational cost needed for feature extraction. With respect to existing approaches based on audio features the proposed approach introduces a big innovation. It shows that an audio signal can be represented using a visual representation and that visual features have a great discriminant power in music genre classification. This assertion opens new research directions since the number of textural features proposed in the literature that can be tested for this classification problem are very large.

Mckay, et.al[17] find out that lot of expertise and time is required to manually classify recordings and also there is limited agreement among human annotators when classifying music by genre, so they used Gaussian Mixture Models (GMMs), obtaining a maximum of 99% recognition.A database was elaborated to train the classifiers, and an accuracy of 98% was achieved when classifying among four styles. When using eight classifiers, trained to return ‘‘yes’’ or ‘‘no’’ for eight different styles, they got an accuracy of 77–90%

3. Critical Survey on Deep Learning Approaches

Vishnupriya S, et.al [2, 3] had used Convolution neural network for training and classification of Music. CNN classifies music into various genres by extracting the feature vector. Results show that the accuracy level of system is around 76 percent and it will greatly improve and facilitate automatic classification of

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music genres. Also with the use of CNN along with small set of 8 music features having 3 main music dimensions results more efficiency of 89 percent in Music genre classification. The future work will focus on developing the system further to classify the songs based on mood. In addition, it can be possible to increase the accuracy and efficiency of classification by having a Fusion of two different neural network models.

Keunwoo Choi, et.al. [4] Had used CRNN architecture for music classification, which takes advantage of convolution neural networks (CNNs) for local feature extraction and recurrent neural networks for temporal summarization of the extracted features. Overall, they found that CRNNs show strong performance with respect to the number of parameter and training time, indicating the effectiveness of its hybrid structure in music feature extraction and feature summarization. Future work will investigate RNN-based structures and audio input requirements for deep learning approaches.

Sergio Oramas, et.al [13] have proposed an approach to learn and combine multimodal data representations for music genre classification. Intermediate representations of deep neural networks are learned from audio tracks, text reviews, cover art images, and further combined for classification. Experiments on single and multi-label genre classification are then carried out, evaluating the effect of the different learned representations and their combinations. Results on both experiments show how the aggregation of learned representations from different modalities improves the accuracy of the classification, suggesting that different modalities embed complementary information. In addition, the learning of a multimodal feature space increases the performance of pure audio representations, which implies a more fine-grained categorization. In addition, an approach is proposed based on the learning of a multimodal feature space and a dimensionality reduction of target labels using PPMI. Results show in both scenarios that the combination of learned data representations from different modalities yields better results than any of the modalities in isolation.

Hence, from the above literature survey it was observed that the traditional methods had some drawbacks that were improved by Ensembled approaches still it did not give the expected accuracy. When Deep learning approaches were used for Music genre Classification it has shown better accuracy but for expected results we could use hybrid deep learning approach for the classification

III.CONCLUSION

Recently, with the increasing demand in the field of music it is necessary that the functionality of the system must be user friendly and accurate. Genre based music classification and music recommendation system is an important issue where development was necessary, which can be achieved by using different deep learning techniques. Hence, we studied the related literature and drew some conclusions. Different feature sets such as rhythmic content, pitch content, timbre texture were used to classify the genres. From all these papers, the accuracy of the classification and further, recommending music to the users was slightly lower which could have been enhanced by using modern deep learning approaches. To suggest a better recommendation system and music classification based on genre we can use CNN paralleling with Bi-RNN algorithm.

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