A guiding tool for composing popular music

A Music Story: Want your music sell well?

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**1. Introduction**

While common music data mining focus on analyzing existing data, there is little music mining approach that uses the data to guide musicians to compose music that lead to desired performance. Understanding this deficiency, this project attempts to create a tool that predicts the potential popularity/hotness of a piece of music when it is under composition based on published music data. Before completing the composition of a piece of music, the musician can use this tool to predict its hotness. If the prediction yields a desired hotness, the music can be published without modification. Otherwise, our tool provides suggested modifications to existing music features (such as mode, tempo, duration, dance-ability, etc.) that are believed to make the music popular after publication.

Our work in the project is divided into three parts, data prepossessing, data analysis, and data visualization. The objective of **data preprocessing** is to reduce the dimensionality of the data set to run analysis algorithms into a suitably low-dimensional space. The objective of **data analysis** is to predict the potential hotness of a piece of music based on existing data obtained in the foregoing paragraph. The objective of **data visualization** is to visually display the analysis results that show the optimal combination of music features that has the highest potential to be a hot song.

Following sections will present (1) specific problems in music mining and technical limitations, (2) proposed method to achieve our objectives, and (3) experiments and evaluation. Finally, conclusions and discussion will follow.

**2. Problem definition and goals**

This section presents problems related to current music data mining.

Hundreds of pieces of music are released to the market every day. However seldom of them becomes popular. The music market needs a reliable analysis tool to predict a song’s potential popularity in order to save the cost and time. This is the potential opportunity for our project.

The traditional projects about music mining focus on the analysis about the data itself. However, most of them did not attempt to use the data and results of data analysis to assist in composing activities of musicians. Our project provides a way of applying the mathematical analysis. That is to instruct the music composition for a musician and predict the trends in music market. As far as we know, this is one of the first projects about helping compose the music on a mathematical perspective.

The outcome of this project aimed mainly at assisting musicians and producers in the music industry. They want to focus on the pieces of music which have the potential to be popular. Our project will satisfy the needs. The result can help them to predict the hotness of a newly composed song or a song under composition and further help them improve the music. Not only music composers, singers and the entire music industry may be interested in this tool since it can capture the trend of current music and transform the knowledge immediately into guidance for music composers and singers in multidimensional way. So that practitioners in the music industry can have a clear insight about what decision can lead to better financial outcomes. Also, our music hotness visualizer based on the above feature visually give them a guidance what might be good to follow to produce popular music.

**3. Technical survey**

This section presents our survey relevant to the three tasks (data preprocessing, data analysis, and data visualization).

**3.1. Data preprocessing**

One of the most widely used approach in data prepossessing is Principle Component Analysis (PCA) [1][2][3]. PCA discovers a series of best linear approximations to analyze a high dimensional data set. It discovers the maximum variability in the data set. While is one of the most commonly used algorithms that do not required a lot of computation, PCAs performance is restricted by its global linearity similarly as other linear methods. Isomap [4] is an alternative approach that uses shorted paths along the curved surface for nonlinear cases. While this can be useful for solving nonlinear problems that PCA cannot solve, it is computational complexity due to the full matrix eigenvector decomposition.

**3.2. Data analysis**

In the aspect of SVM based prediction, a l1 SVM is developed in [8]. The traditional maximal margin is replaced by a 0-norm term of α. As it is non-convex, the new term is replaced again by a 1-norm term.

By doing this a sufficiently sparse α is obtained. It avoids over-fitting for training examples. However, this linear method can only deal with linear separated data. When the data are with nonlinearity, the method hardly works. The authors in [9] introduces another application of SVM in music mining. Although a standard SVM, it is utilized to predict the lyric of the songs. A particular difference is that except based on the features, it is based on the bag of words. It generates a more accurate result because of the big amount of data (words). However a lot of redundant information increase the computational complexity much. In order to overcome the foregoing problems, an active learning SVM is developed by [10]. In contrast to the conventional method, an active learning SVM requires the user to choose the most informative labels. In this case, the computational complexity is reduced. However, one problem remains. Although it works well with binary classification, the method’s accuracy is relative low when dealing with multi classification.

Unsupervised learning, such as K-means clustering is another way for classification and prediction. A standard K-means method is utilized in [5] and [6]. While [5] only considers two features (pitch and unpitch), [6] extends it to the whole scale. The main advantage is that labels are not required; hence computational complexity is reduced. However the ignored weights for every feature may influence the performance. Clustering in [7] takes features constraints into account. The total distortion function is revised by adding the penalty costs for violating the constraints. Hence an objective of reducing the distortion function is to reduce the penalty costs, besides reducing the distance. However, the strategy makes an assumption that the classification of some features is already known. It is not a mild assumption with two reasons. Firstly this kind of information is hardly obtained by commonly used API. What is more, clustering with the priori knowledge increases the computational complexity.

**3.3. Data visualization**

In the aspect of visualization, almost all the music related visualization works was done falls into 2 broad categories:

Visualization of music archives and genres: [11] Using signal processing and machine learning to extract audio information and mapping them to as visual attributes based on a similarity matrix they design. [12] [13] Based on feature extracted from psychoacoustic rhythm patterns and organized by growing hierarchical self-organizing map, using different island contour that is built upon the different music feature patterns within a map to represent different archives or genres. But they didn’t show the hotness or popularity of the music.

Visualization of music itself: [14] is a programming environment that visualize music while it’s playing in real time. [15] describe a mapping scheme from tune data and instrument data to 3-D space. Both of these have a similar effect like this http ://www:georgeandjonathan.com=#2. Although it visually presents the music, the visualization part still doesn’t take into consideration what is the pattern of the most popular music within a genre within a time period.

**4. Proposed method**

Data collection

We collected existing music data through echonest API (<http://the.echonest.com/>).

Data preprocessing

Data preprocessing has been done using PCA.

Data analysis

Data visualization

**5. Experiments and evaluation**

Data preprocessing

Data analysis

Data visualization

**6. Conclusions and discussion**

First of all, the result will make the musician understand the music quantitatively but not only qualitative. This will give them some hints about what kind of music should be composed. Furthermore, for the producers, knowing the trends of the music can help them make better decision on market. In that case, the music industry will produce more music that people like. The whole industry will get paid more and audience will have more good music to enjoy. Artist and singer have their own taste and specialties, but it’s hard for them to make every track of music in their record the same style. When they want to try something new in their record, they may want to first refer to our tool, getting the sense what is the trend one should follow when one want to try something new in the music record.

“Under construction”

**References**