




Analysis of Musical Multi-Artistic Features Based on Collaborative CAD and Data Mining Technology

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Abstract: Musical is an independent musical drama form that integrates various forms of expression and genres of various arts. The rapid development of digital information technology has had a great impact on the music industry, and the playing and downloading of music has become the main business of many Internet operators. Internet technology has promoted the development of the music industry, and various new music styles emerge endlessly, and users' appreciation preferences vary from person to person. As far as its artistic features are concerned, it integrates many artistic categories, uses a variety of artistic means, draws lessons from and supplements the related arts, and forms its own style of the times, which appeals to both refined and popular tastes and is constantly changing. The author analyzes the current situation of vocal music teaching in colleges and universities and hopes to improve teaching ideas, improve teaching quality, and improve students' comprehensive quality through appreciation and learning of musicals so that musicals can become an effective learning method for vocal music education. Based on the theoretical knowledge of musicology and from the perspective of data mining technology, this paper proposes a style classification method based on music files. This style classification method takes the original harmony and melody information in music as the basis of style classification, uses data mining technology to classify music from bottom to top, segmented and layered, and makes experimental analysis and comparison with other related classification methods. The ideal test results are obtained in the context of Collaborative CAD.

Key words: Data mining technology; Musical play; Pluralistic artistic features; 5G-Enabled Musical

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1 INTRODUCTION

Musical drama is a form of stage play formed on the basis of the development of popular songs and dances in America. On this basis, musicals began to develop slowly in other countries with the help

of different forms of expression [1]. It is no exaggeration to say that musicals are the "national dramas" of the United States. For Americans, dramas and operas are "imported" from Europe, and only musicals are the basis for the popular songs and dances in their home countries. The stage play was created and developed on the [3]. Until the 21st century, the development of musicals in China has a certain foundation. However, influenced by the development of traditional operas, song and dance dramas, and other factors, the development of musicals in China is still in its infancy. The research on this art form of musicals also needs to be deeply analyzed from more levels, and its essence and artistic characteristics are investigated [10]. As a classic art form, music has had a profound impact on people's lives. Music can be used as a form of entertainment to relax; It can also be used as a medium to spread culture; it Can be used as a theme to lead the trend of the new era; It can also be used as a social means to expand people's social network [15]. Vocal singing, a form of musical expression, involves almost all levels of social and cultural activities. Although people have different aesthetic needs, aesthetic levels, and aesthetic abilities in the form, content, and method of singing vocal music, the development of vocal music art is still increasingly prosperous and rapidly popularized in today's diversified and diverse social and cultural life. It has become an art form that can best reflect socialization and popularization [18].

Since the reform and opening up, not only has China changed a lot in terms of economy, politics, culture, and education, but the world is also changing. Political multi-polarization, economic globalization, cultural diversity, and social informatization have become the main development trends of the international community [8]. Under the background of this era, many problems in music major education, especially vocal music teaching, have emerged in China's universities, which are mainly manifested in outdated teaching concepts, single teaching forms, backward teaching methods, and unreasonable teaching structure [14]. From the public's point of view, people's ways of enjoying music are no longer limited to radio and television stations and buying records. They only need a connected multimedia computer to obtain high-quality music[4]. Among them, the main problems are that many people in China don't have a clear understanding of the essence of music, and the research results of musical education theory are quite scarce. Compared with the actual development of musicals, the original education mode of art colleges is too single, and the curriculum content is still lacking in systematicness and perfection, which leads to the defects of general and one-sided teaching content, resulting in some deficiencies in culture, artistic accomplishment, and professional skills in personnel training [7]. In recent years, various musical styles have emerged, one after another, fully demonstrating the personality of the music creators. The diversification of music makes music style an important feature of Internet music retrieval. Most people are used to choosing music they may like according to their favorite style [16]. In this era of network music, music style classification based on computer technology is a promising research field. Therefore, the scope of this research should be in two aspects: the artistic characteristics of musicals and the enlightenment of the teaching of vocal music in colleges and universities.

2 RELATED WORK

Since the introduction of music into China, it hasn't been studied for a long time by music education theorists, and its research status is still in the primary stage. As far as the author can collect the relevant data of musical studies, the history of musical development (including the birth, evolution, development, and maturity of musicals) has been discussed in detail, and the artistic features of musicals (involving music, singing, dancing, drama performance, script creation, stage design, etc.) have also been analyzed layer by layer in different degrees.

Zhong Y proposed a music classification method based on support vector machine and linear discriminant analysis in 2012. The classification method in this article selects a support vector machine and uses the Fourier transform method to extract The feature vector of the audio data source using dimensionality reduction [20]. Yu QL proposed an application of data mining technology

in music classification from the perspective of statistics. In this paper, a support vector machine is also used for classification, and a particle swarm optimization algorithm is applied to solve the parameter selection problem of the support vector machine [19]. Grachten M published "Preliminary Thoughts on the Practice of Musical Theatre Teaching in Ordinary Colleges and Universities." The article takes the ontology and aesthetic characteristics of musicals as the breakthrough point. Under the premise of conforming to the overall goal of artistic quality education in ordinary colleges and universities, the article starts from the perspective of music education in colleges and universities. The purpose, music teaching methods, characteristics of college students' music hobbies, and the construction of university campus culture are analyzed from multiple perspectives, and the teaching purpose, content methods, practical activities of musicals in music education in ordinary colleges and universities, and the impact of musicals on the construction of campus culture in ordinary colleges and universities are analyzed. The role and other aspects have been preliminarily discussed [5]. The complete book of teaching research and professional curriculum of music art teaching, edited by Karydis I, is only an explanatory exposition of the contents involved in music teaching (including music history, music theory knowledge, music common sense, music aesthetics, and methods of music teaching [9]. Yan B proposed a set of algorithms for main melody matching chords and finally used the algorithm to extract classification rules [17]. Qian W proposed a knowledge discovery model for music melody stream data. Based on the literature, this paper extended the file-based classification technology in the literature to the field of streaming media mining and proposed an instant melody structure mining algorithm [12]. Sciarabba, in the preface to his *Alcist*, publicly expresses his reforming intentions to subordinate music to dramatic effects, to restrain the tyranny and vanity of the singer, and to get rid of those ornamental things that have nothing to do with drama and lines. The music of the prelude should be linked with the characteristics of the drama, etc. In an attempt to reject the non-dramatic opera, which was omnipotent in vocal music at that time, the drama and music were truly unified [13]. Based on the research on musicals, Moore shows a more prosperous scene, with more and more paper materials, covering a wider range, but the research on the relationship between musicals and vocal music teaching in Colleges and universities is still very limited [11]. Hammou K. published "A Brief Introduction to the History of American Broadway Musical," which is about the history and development of musicals. There are also articles on ethnic musicals, which have a very new perspective and have made meaningful explorations on the characteristics and relationships between musicals and folk music of all ethnic groups [6]. Chen Z's research on musicals and vocal music teaching in colleges and universities in recent years has provided us with good ideas and broadened our horizons. However, the research on the rich connotation of musicals and its extensive connection with vocal music teaching is far from enough, and there are still many things we need to explore and discuss [2].

Through the theoretical study of musicals, the creation of musicals in my country has been greatly promoted. Many local works with distinctive musical characteristics have been emerging, but most of them received mediocre responses, indicating that the development of Chinese musicals is still in its infancy.

3 METHODOLOGY

3.1 Data Mining Technology Combined With Musical Multi-Artistic Features For Analysis

Musical is a highly comprehensive art form. Compared with other comprehensive art forms, musical is the most comprehensive. For example, drama itself is a comprehensive art, but it is mainly expressed in language and action; Opera is also a comprehensive art, but it is mainly dominated by music. Tracing back to the source, musical drama developed and evolved from opera, so it has an inevitable connection with opera. The most significant common point is that music is the leading factor throughout musical drama and opera. However, musicals have formed their own distinctive characteristics in terms of content, theme, musical style, performance form, and so on, so they are

different from traditional operas. In recent years, the amount of data on the Internet has been increasing exponentially. Therefore, a large amount of information will be submerged in the ocean of data.

Based on this, the algorithm flow of data mining on the multiple characteristics of music: (1) Text data collection. Determining the data source and obtaining the corpus is generally the first step of text data mining. At present, the required data is usually obtained by grabbing the network data. (2) Data preprocessing. Due to the huge number of online reviews and unstructured data, the review data collected by web crawler technology can generally meet the demand of quantity and topic relevance, but the initial data cannot be machine-readable.

3.2 Optimal Design Of Artistic Features Based On Association Rules Mining Algorithm

Since the 21st century, the Internet has become an important channel for people to store, obtain and transmit information. However, with the development of Internet technology and the improvement of storage media, information explosion is an important problem that must be addressed. Artificial intelligence, statistics, and database technology have laid a solid foundation for the birth of data mining technology, as shown in Figure 1.

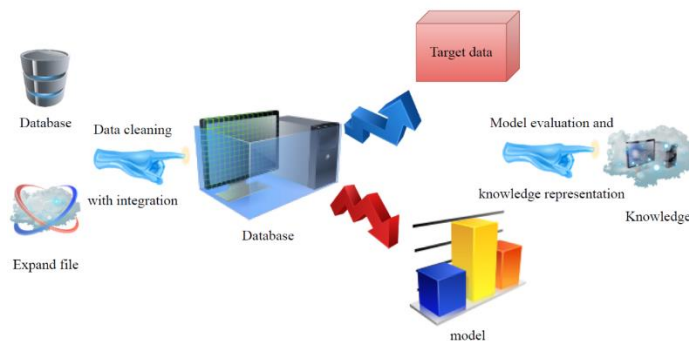


Figure 1: Process of Knowledge Discovery (KDD).

From Figure 1, we can see that the task of data mining is to find patterns from target data. Generally, it can be divided into two categories: description mode and prediction mode. Descriptive mode describes the characteristics and laws existing in the current data in an understandable way, while predictive mode predicts the value of unknown fields by using the relationship between known fields and unknown fields.

According to the different knowledge mined, the tasks of data mining are usually divided into (1) feature rules, which extract the relevant features of this kind of data from the training data set; (2) Distinguishing rules, extracting the unique attributes of a certain kind of data from the training data set, so that this kind of data can be distinguished from other data; (3) Classification: classify the data with the same characteristics into the same category through a pre-constructed classification function. Before classification, training is necessary to create a classification model. Generally speaking, the training data set uses category identification; (4) Clustering: Different from classification, clustering is unsupervised learning, which does not depend on the data training set and the predefined type identification, and the category to be divided is unknown.

The classical Apriori algorithm is a classical algorithm used to mine frequent itemsets from databases. This algorithm is mainly based on the apriori property, which connects and prunes each set in the database. Finally, according to the preset threshold, frequent itemsets and strong

association rules can be obtained. Apriori classic algorithm code is described as follows: algorithm steps:

$$L_1 = \text{find_}L_1(D) \quad (1)$$

For($K = 2; L_{k-1} \neq \emptyset; k++$)

a) $C_k = \text{Apriori_gen}(L_{k-1})$

b) *Foreach*($\text{candidate} \in C_k$)

i. $\text{candidate.support_count}(D, \text{candidate})$

c) *Endforeach*

$$d) L_k = \{C \in C_k \mid C.\text{support_count} > \text{min_sup}\} \quad (2)$$

Endfor (3)

$$L = \bigcup L_k \quad (4)$$

The advantage of the Apriori algorithm is that it is simple, stable, and easy to implement, but the disadvantage is that it scans the transaction database too many times, and the I/O overhead is very high. The Apriori algorithm is a mature algorithm. Because of its simple and stable characteristics, the Apriori algorithm is frequently used for vehicle duplicate record detection, traffic identification feature extraction, search suggestion keyword extraction, etc.

By constructing an FP-TREE to mine association rules without generating a large number of candidate frequent item sets, the algorithm effectively solves the problem of Apriori scanning the transaction database multiple times. This article will illustrate the general idea of the FP-GROWTH algorithm through an example. Suppose a company's small transaction database is shown in Table 1.

<i>TID</i>	<i>Items</i>
<i>T1</i>	<i>11, 12, 15</i>
<i>T2</i>	<i>11, 13, 14</i>
<i>T3</i>	<i>12, 15</i>
<i>T4</i>	<i>11, 13</i>
<i>T5</i>	<i>12, 15</i>
<i>T6</i>	<i>13, 14</i>
<i>T7</i>	<i>11, 12, 13, 15</i>
<i>T8</i>	<i>11, 15</i>
<i>T9</i>	<i>12, 13, 15</i>

Table 1: Process of Knowledge Discovery (KDD).

The first step of the fp-grow algorithm is the same as the Apriori algorithm, which scans the transaction database to obtain a candidate itemset and its corresponding support and determines a frequent itemset by setting a threshold. Different from the Apriori algorithm, after obtaining a frequent binomial set, the fp-grow algorithm starts to build an FP-tree instead of continuing the connection operation to generate a candidate binomial set. The steps of constructing FP-TREE are as follows: (1) Create an empty node and take the secondary node as the root node of FP-TREE; (2) Arrange the items in the frequent item set in descending order of support; (3) Arranging the items

in each transaction in the firm database according to the sequence generated in the second step; (4) Scan the library database, create an FP-TREE branch for each transaction, and "hang up" the FP-TREE. The same transactions can share prefixes in the FP-TREE.

Figure 2 shows the FP-TREE created by the FP-GROWTH algorithm for the transaction database, as shown in Table 1 and in Figure 2.

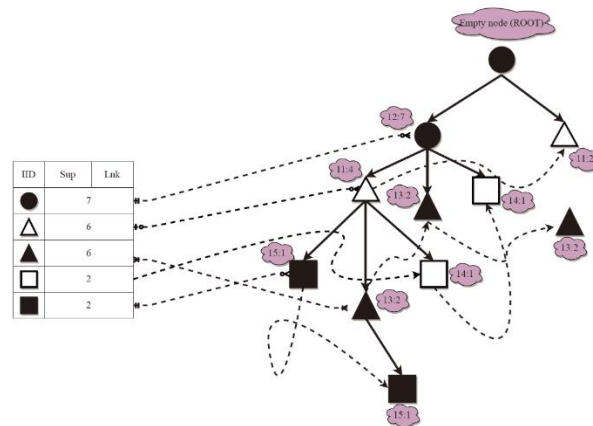


Figure 2: FP-TREE.

In the example in Figure 2, the mining conditional pattern base starts from 15 nodes and the node-link field on the left. There are two nodes in the link field of 15, so two branches are obtained, which are $\langle 15,13,11,12:1 \rangle$ and $\langle 15,14,12:1 \rangle$.

The artistic features of musicals are mainly manifested in the diversity of their constituent elements, the comprehensiveness of their expression forms, the commerciality of their operation process, and the popularity and entertainment of their cultural evaluation. Its detailed description of the essence of musical plays is an important basis for distinguishing itself from other kinds of arts and for its continuous development. The inheritance of musicals to operas is manifested in all aspects of musicals, especially in the inheritance of the vocal genres of operas. Judging from the style of musicals, borrowing vocal genres from classical operas is a constant magic weapon for composers. The most common ones are the use of arias, recitatives, duets, and large choruses. In the 1950s, like Gershwin, Bernstein created the classic musical West Side Story across the two popular classical styles. Duet is an indispensable form of singing in classical opera, but in general musicals, in order to consider the audience's acceptance, the form of multi-part duet is rarely used. For example, when Maria, the heroine, learned that her lover Tony had killed her brother and expressed her complex feelings with great grief, she had a wonderful narrative. Example 1: as shown in Figure 3. In the area of West Side Story, Bernstein's music depicts the complex and changeable emotions of the characters in the play, sometimes happy, sometimes joyful, sometimes angry, sometimes desperate, and shows the complex psychological activities of the characters.

3.3 Midi Music File Introduction And Preprocessing

In this era of digital music, the formats of music files are very diverse. Like MP3, which we are familiar with, and WAV, MID is also a common music file format, and its full name is Musical Instrument Digital Interface. The MIUDI music file format was proposed in the 1980s. It is different from WAV in that MIDI music files are not sound waveform signals but a series of instruction signals, such as notes, timing, performance skills, etc.



Figure 3: Song Score aria of "West Side Story."

These instructions can be directly controlled by MIDI devices for musical performance. The value of tone records the pitch of the note, which is an important attribute value used by the music classification method described in this paper. This attribute takes the minor second interval (semitone) as the unit. For each additional minor second, the value of the tone will increase. In example 1, as in the example of the figure, the second note is the fifth degree in E minor (the sound name is, and the third note is the tonic in minor (the sound name is, and the number of intervals from the fifth degree to the first degree of treble is four degrees, and the distance is equivalent to five times the minor second degree. Therefore, the result of subtracting the tone value of the third note from the tone value of the second note in this matrix is.

It is the soul of the main melody and an important factor in distinguishing musical styles. The analysis of the main melody is a key research link in the music style classification method proposed in this paper. The accuracy of extracting the main melody from music files will directly affect the accuracy of classification results. However, for most music, there are many harmonies and accompaniments besides the main melody.

As shown in formula (1), n_i, n_{i+1} is two adjacent notes in this paper, s_i, d_{i+1} is the start time of the two notes and e_i, e_{i+1} is the end time of the note, if the relationship satisfies formula (5), it constitutes a polyphony.

$$\forall n_i, n_{i+1}; \begin{cases} s_i < s_{i+1} \\ e_i > e_{i+1} \end{cases} \quad (5)$$

In traditional music theory, the four timbres of soprano, contralto, tenor, and contralto, respectively, correspond to the high pitch area, stress area, submediant area, and bass area in the four harmonies. This paper proposes a multi-orbit selection algorithm based on clustering, which is an improvement of the multi-orbit selection algorithm proposed in the document [13], and effectively solves the problems caused by a single orbit selection algorithm. MTSC algorithm performs skyline algorithm on each track after threshold filtering notes and then calculates the average tone height of each track through formula (6).

$$p_i = \frac{\sum_{j=1}^n p_{ij}}{n} \quad (6)$$

After the MTSC algorithm calculates the average pitch height of each track, the pitch value of the notes on each track is divided by modulo twelve and projected into a note statistics table of the dimension shown in the formula,

$$h_i = (h_{i1}, h_{i2}, \dots, h_{i12}) \quad (7)$$

Among them $h_{ij}, j = 1, 2, \dots, 12$ represents the number of times the 12 tones on the chromatic scale appear in the track. For the entire music file, the 12-dimensional statistical table is,

$$\bar{h} = (\bar{h}_1, \bar{h}_2, \dots, \bar{h}_{12}) \quad (8)$$

Among them,

$$\bar{h}_1 = \frac{\sum_{j=1}^c h_{1j}}{c} \quad (9)$$

Where c is the total number of tracks in the MIDI file.

MTSC first calculates the Euclidean distance between each statistical table $h_i = (h_{i1}, h_{i2}, \dots, h_{i12}), i = 1, 2, \dots, c$ and the overall statistical table $\bar{h} = (\bar{h}_1, \bar{h}_2, \dots, \bar{h}_{12})$ for cluster analysis. The calculation method is shown in formula (10).

$$edist_j = \sqrt{\sum_{i=1}^{12} (h_{ij} - \bar{h}_j)^2} \quad (10)$$

Assuming that there are two thresholds $\xi_{edist1}, \xi_{edist2}$ and $\xi_{edist1} < \xi_{edist2}$, if the two tracks satisfy the formula (11), they can be classified into the same cluster.

$$\forall h_i, h_j, \begin{cases} |edist_i - edist_j| < \xi_{edist1}, \text{ or} \\ \xi_{edist1} < |edist_i - edist_j| < \xi_{edist2}, \text{ or} \\ |edist_i - edist_f| > \xi_{edist2} \end{cases} \quad (11)$$

After completing the clustering process, MTSC selects a track in each cluster as a representative, and the basis for representative selection is shown in formula (12).

$$v_i = \bar{p}_i - H(c_i) \cdot w \quad (12)$$

For each cluster after clustering, the audio track with the largest V value is selected as the representative audio track, where \bar{p} is the pitch average. Table $H(c_i)$ shows the information entropy of the audio track c_i , and the calculation method of the information entropy is shown in formula (13).

$$H(h_i) = 1 - \frac{edist(h_i)}{edist \max_i} \quad (13)$$

In formula (9), $p(h_i)$ represents the probability that the note represented by h_i is the main melody note, and the calculation method is shown in formula (14).

$$p(h_i) = 1 - \frac{edist(h_i)}{edist \max_i} \quad (14)$$

$edist(h_i)$ represents the distance between the current track c and the whole in the h_i dimension, as shown in formula (15).

$$edist(h_i) = \sqrt{(h_i - \bar{h}_i)^2} \quad (15)$$

$edist \max_i$ represents the longest distance from the whole in dimension among all tracks of the current cluster. (10) Where w represents a weight, which is usually between 100 and 140. In the MIDI system, the average pitch varies from 0 to 128, and the information entropy ranges from 0 to 1.

4 RESULT ANALYSIS AND DISCUSSION

In this experiment, the main melody extraction algorithm proposed in this paper is compared with the classical algorithm. In the experiment, the standard melody of each test music is extracted by hand labeling, and then two main melody extraction algorithms are run respectively. Finally, the results extracted by the two algorithms are compared with the standard melody. The main performance indicators analyzed in this experiment include melody extraction accuracy and algorithm execution efficiency. The early musical was called musical comedy. Before the birth of West Side Story, American musicals were basically lighthearted comedy stories. Musical theater historian Cecil Smith once emphasized that musical comedy is a form of entertainment for the public, and a musical is different from an opera, so the storyline must also be different. In order to please more audiences, relaxed and humorous comedies are, of course, the best choice. Although many students have made great efforts in singing, from skills to language, it can only be said that imitation is good or bad, and real performance is an expression of true feelings from the heart on the basis of skilled skills rather than deliberate imitation. Many people understand that many aspects of vocal music ultimately depend on performance to interpret, but most of them have gone into a misunderstanding. That is, if the sound technology is not in place, they cannot sing well. With such concern, even in the performance process, they are also thinking about whether they are in place in terms of sound technology. Thus, the voice and expression are stiff or artificial. Through the carrier of music, we can activate the empty theory and turn it into real ability. Ability is the ability of people to complete certain activities in practice successfully or the ability to master and apply knowledge. It is not acquired by external indoctrination like knowledge. Human ability is formed and developed in the activities of knowing and transforming the world. In the study and rehearsal of musicals, students will conduct a series of self-management processes, such as setting goals, making plans, and implementing plans. Compared with the usual teaching situation in which teachers instill knowledge and skills, this is a more effective study and an effective way to improve their comprehensive quality. Good study habits will benefit students for life.

The table lists some of the comparison results in this experiment. The tracks include Tears In Heaven (Eric Clapton), Sun (Chen Qizhen), and Creeping Death (Metallica). Scuttle Buttin (SRV), Qilixiang (Jay Chou), Back in Black, Dranm (The Cranberries), Beautiful Ones (Suede). As shown in Table 2.

<i>Track</i>	<i>Number of tracks</i>	<i>Skyline</i>	<i>MTSC</i>

			<i>Accuracy</i>	<i>Time consuming</i>	<i>Accuracy</i>	<i>Time consuming</i>
<i>Tears</i>	<i>In</i>	<i>6</i>	<i>0.423</i>	<i>0.54s</i>	<i>0.546</i>	<i>3.21</i>
<i>Heaven</i>						
<i>Sun (play and sing version))</i>	<i>5</i>		<i>0.431</i>	<i>0.81s</i>	<i>0.923</i>	<i>1.26</i>
<i>Scuttle Buttin</i>	<i>3</i>		<i>0.345</i>	<i>1.34s</i>	<i>0.874</i>	<i>2.61</i>
<i>Qilixiang</i>	<i>2</i>		<i>0.648</i>	<i>1.26s</i>	<i>0.953</i>	<i>3.02</i>
<i>Back in Black</i>	<i>4</i>		<i>0.852</i>	<i>0.54s</i>	<i>0.882</i>	<i>2.68</i>
<i>Beautiful Ones</i>	<i>5</i>		<i>0.731</i>	<i>1.55</i>	<i>0.874</i>	<i>2.57</i>

Table 2: Partial comparison results of MTSC and Skyline.

From the test results in Table 2, compared with the Skyline algorithm, the MTSC algorithm has the advantage of high accuracy, while the Skyline algorithm is characterized by high execution efficiency, but sometimes its accuracy is very low. As can be seen from the results in the above table, the accuracy of the Skyline algorithm is largely determined by the number of music tracks, and the accuracy of the Skyline algorithm could be better in music with a large number of tracks.

Figure 4 shows the change curve of the accuracy of the Skyline algorithm and the MTSC algorithm with the increase in the number of tracks. In this experiment, the Skyline algorithm processed 300 tracks and the MTSC algorithm, respectively, and the number of tracks in these songs varied from 1 to 8. The accuracy in the figure is the average of the accuracy of the algorithm in the experiment to process the music with the same number of tracks, as shown in Figure 4.

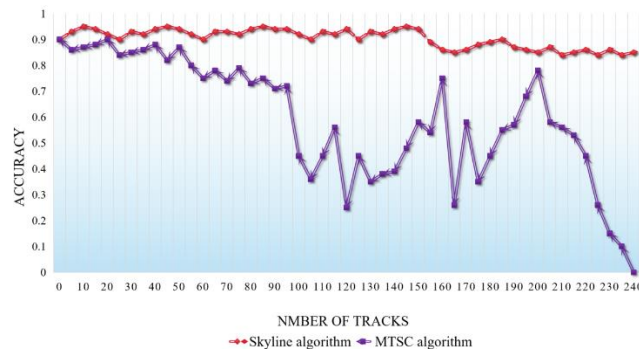


Figure 4: Correspondence between the accuracy of the MTSC algorithm and the Skyline algorithm and the number of tracks.

It can be seen from Figure 4 that the accuracy of the skyline algorithm will change significantly with the increase in the number of tracks, while the accuracy of the MTSC algorithm is relatively high compared with the skyline algorithm. In addition, from the experimental results, it is found that the accuracy of both algorithms is related to the average pitch of the main melody. The higher the average pitch, the higher the accuracy is. The accuracy of the MTSC algorithm is also affected by the average pitch of the main melody. Two obvious experimental examples are JJ Lin's "Night Asks Day" and BigBang's "Blue." The number of tracks for both songs is 4, and the accuracy rates are 0.8888 and 2.556, respectively. Fig. 5 is the tone distribution data of the main melody in JJ Lin's Night Asks Day, as shown in Figure 5. Figure 6 shows the distribution data of note tone values of BigBang "blue."

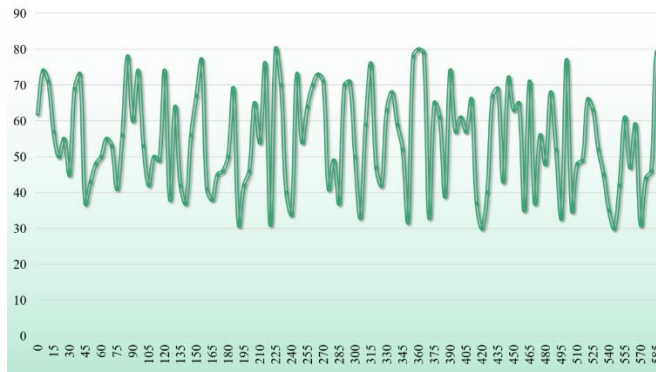


Figure 5: The pitch value distribution of notes in "Night Asks the Day."

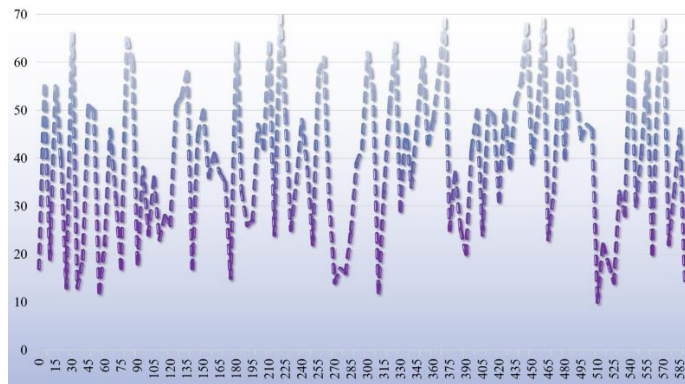


Figure 6: Tone value distribution of blue.

From the comparison results of Figure 5 and Figure 6, we know that the average tone value of notes in blue is higher than that in night to day, and the accuracy obtained in the blue MTSC algorithm is higher. The main problems of the classical Apriori algorithm are the I/O overhead and space-time complexity when scanning the database. In this experiment, 300 songs in the appendix are preprocessed to form a training data set, and classical Apriori, matrix-based Apriori algorithm, and active search Apriori carry out frequent pattern mining. The main performance indicators analyzed in this experiment include data set scanning times and storage space consumption. The experimental results are shown in Table 3.

Frequent pattern	Classic Apriori		Matrix Apriori		Actively find Apriori	
	Time cost	Space overhead	Time cost	Space overhead	Time cost	Space overhead
1 Item	11.6746s	2Cells	11.3456s	0Cells	10.556s	0Cells
2 Item	1.45265s	234Cells	1.246s	513Cells	0.4556s	235Cells
3 Item	11.6762s	276Cells	11.3452s	462Cells	1.3564s	462Cells
4 Item	3.4565s	261Cells	3.2496s	385Cells	16.529s	562Cells
5 Item	2.5645s	249Cells	0.4513s	438Cells	9.4362s	522Cells

6 Item	22.4865s	96Cells	22.1342s	326Cells	0.5965s	23Cells
7 Item	14.7546s	58Cells	0.493s	200Cells	0.0565s	42Cells
8 Item	1.76566s	1Cells	0.476s	462Cells	1.0065s	6Cells

Table 3: Performance comparison of three Apriori algorithms.

Through the comparison of experiments, it can be concluded that the matrix Apriori algorithm and the active search Apriori algorithm are better than the classic Apriori algorithm in terms of time and marketing indicators, as shown in Figure 7.

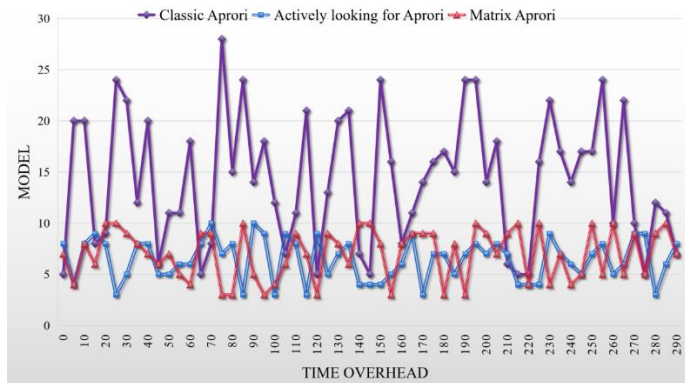


Figure 7: Time cost comparison of three Apriori algorithms.

In terms of storage space overhead, the classical Apriori algorithm has the smallest space overhead. The reason is that the classical Apriori algorithm scans the dataset every time it forms a candidate set, so it does not need to save information about the dataset. The active search Apriori algorithm consumes less storage space than the active search Apriori algorithm. The specific comparison is shown in Figure 8.

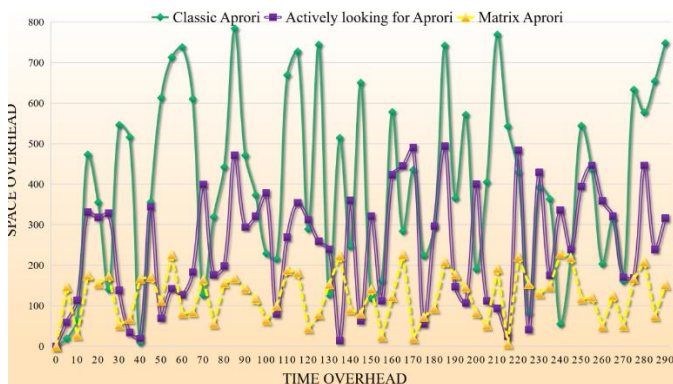


Figure 8: Comparison of space overhead of three Apriori algorithms.

From the above experiments, it can be concluded that the active search Apriori algorithm has better time complexity than the classical Apriori algorithm and has lower space consumption than the matrix Apriori algorithm with the same time complexity.

Musicals show diversified characteristics in entertainment and popularity. It contains profound thoughts, contains numerous singing cultures, and shows various exquisite singing skills. Its tolerance for the meaning of vocal music, singing art, and seriousness of skills deserve our deep thought. The diversified and complex singing style presented by musicals has become the most typical style of musicals. The existence and development of such an art form as musical is closely related to its origin, aesthetic audience, morphological structure, musical style, means of expression, and other factors. The musical is very three-dimensional and holistic. In addition to the singing and performance required in vocal music teaching, it also has elements such as dialogue and dance combined with the modern effects of dance, lighting, and sound on the stage. The plot of the play and the emotions expressed by the characters in the play are presented in front of the audience in the form of a stage, fully showing three-dimensionality and integrity. Therefore, it is necessary for vocal music teachers to enter the world of musicals, slowly experience and taste musicals, and find musicals that are easy to understand and full of various styles and forms, combined with the traditional *bel canto* in vocal music teaching, so as to attract students more, so that they can increase their interest and enthusiasm in music, and also enhance the interest of teachers in vocal music teaching. Therefore, it is necessary to build a three-dimensional integrated teaching model.

5 CONCLUSIONS

Musical drama, as a young comprehensive art, contains various forms and states and is highly free and flexible. As a popular art, it can be accepted and appreciated by a wide audience, and its influence spreads all over the world. Contemporary musicals have planted wings, leaped over barriers, and found the vast sky and earth. If we look at the existence of various artistic styles of musicals from a multicultural perspective, an eclectic vision, and a tolerant heart, we can interpret the diverse stage performances of modern musicals. By appreciating outstanding musical works, the aesthetic ability of vocal music students can be improved; learning the classic arias can not only enrich the content of the textbook but also improve the students' comprehensive singing ability through the creation and rehearsal of small musicals or fragments, give full play to students' creativity, and gradually cultivate students' comprehensive knowledge application, organization and coordination ability, and performance and practice ability. Today, with the continuous emergence of musical styles, the study of musical styles has become a key research field in musicology. This paper combines data mining technology with music theory knowledge, proposes a style classification method based on format music, and has achieved satisfactory results in related experiments.

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