

Analysis and Research on the influence of Music characteristics based on Entropy weight Network Model

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Abstract: Music plays an important role in our lives and affects society in ways that make listeners feel emotionally connected. The purpose of this paper is to study the evolution of music by building network models and quantified indicators' providing evidence on how the previously produced music influences new music and artists. In this paper, a directional relationship network with artists as nodes is established, different colors are used to represent different music genres, and the nodes with high scores are resized to clearly see the interaction between musicians. Next, we use the entropy method to obtain the weight of each music character. The cosine similarity method and Euclidean distance method are used to extract the similarity information and transform it into a matrix.

1. Introduction

Art is a part of humans spirit and an inevitable form of expression for people to prove their self-worth. Music, as an art, can connect people's inner feelings closely, meet people's spiritual needs of empathy, and thus produce the power to change the society. Music originates from culture but is higher than culture. It is an independent form of cultural expression, and its denotation and connotation are constantly changing in the process of formation and evolution. Many factors can influence the evolution of music, but the influence of previously produced music on new music cannot be ignored.

2. Entropy Value Method

In the full_music_data data set, n artists are selected, and each artist has m specific indicators, then the x_{ij} indicator is the j th metric for the i th artist. Since the units of measurement of each indicator are not uniform, in order to facilitate the following calculation, we use Formula (1) to convert the absolute value of each indicator into relative value to carry out normalization. For convenience, the normalized x'_{ij} is still expressed as x_{ij} [1].

$$x'_{ij} = \frac{x_{ij} - \min\{x_{ij}, \dots, x_{nj}\}}{\max\{x_{1j}, \dots, x_{nj}\} - \min\{x_{1j}, \dots, x_{nj}\}} \quad i = 1, \dots, n; j = 1, \dots, m \quad (1)$$

After normalization, in order to ensure that Formula (2) is used to calculate the proportion of each index in the total index for each artist:

$$p_{ij} = \frac{x_{ij}}{\sum_{i=1}^n x_{ij}} \quad i = 1, \dots, n; j = 1, \dots, m \quad (2)$$

Then, the entropy values of each index were calculated by Formula (3):

$$e_j = -k \sum_{i=1}^n p_{ij} \ln(p_{ij}) \quad i = 1, \dots, n; j = 1, \dots, m \quad (3)$$

Next, we calculate the information entropy redundancy: $d_j = 1 - e_j, j = 1, \dots, m$

In order to better compare the similarity between artists, we use Formula (4) to calculate the weight score of each artist's indicators as the final metric:

$$w_j = \frac{d_j}{\sum_{j=1}^m d_j} \quad j = 1, \dots, m \quad (4)$$

3. Cosine Similarity

3.1 Weight coordinate system transformation

An n-dimensional coordinate system is established to convert the weight of each artist's indicators into n-dimensional vectors in the coordinate system. For the vectors A (x_1, y_1) and B (x_2, y_2) in the 2-dimensional coordinate system, we can use the 2-dimensional Angle cosine Formula (5) to calculate their cosines. Generalized to n-dimensional coordinate system, for two n-dimensional sample points A1 $(x_{11}, x_{12}, \dots, x_{1n})$ and a2 $(x_{21}, x_{22}, \dots, x_{2n})$, we can also calculate the cosine of the Angle between them by means of Formula (6) [2].

$$\cos \theta = \frac{x_1 x_2 + y_1 y_2}{\sqrt{x_1^2 + y_1^2} \sqrt{x_2^2 + y_2^2}} \quad (5)$$

$$\cos(\theta) = \frac{\sum_{k=1}^n x_{1k} x_{2k}}{\sqrt{\sum_{k=1}^n x_{1k}^2} \sqrt{\sum_{k=1}^n x_{2k}^2}} \quad (6)$$

	Bob Marley & the Wailers	Astrud Gilberto	Suicidal Tendencies	Barney Kessel	Of Montreal	Sister Nancy
Bob Marley & the Wailers	1	0.140001	0.087103	0.404107	0.147063	0.129781
Astrud Gilberto	0.140001	1	0.138087	0.381461	0.088968	0.175882
Suicidal Tendencies	0.087103	0.138087	1	0.411542	0.128908	0.194094
Barney Kessel	0.404107	0.381461	0.411542	1	0.350835	0.425241
Of Montreal	0.147063	0.088968	0.128908	0.350835	1	0.193775
Sister Nancy	0.129781	0.175882	0.194094	0.425241	0.193775	1

Figure 1: Partial matrix visualization

Since all vectors are in the first quadrant, the value range of cosine of the included Angle is [0,1]. The larger the value, the smaller the included Angle, and the higher the similarity [3].

3.2 Average similarity

The cosine of the included Angle is made into a similarity matrix, of which Figure () is the first part [4-5]. We use artist corresponding to the ID of the data from the data set full_music_data and genres and corresponding classification, according to the calculation above by random within the six schools of the average of the artist's similarity, then select any two schools outside the artists and genres all artists in calculating the average similarity, after getting the table, the final conclusion can be drawn by comparison.

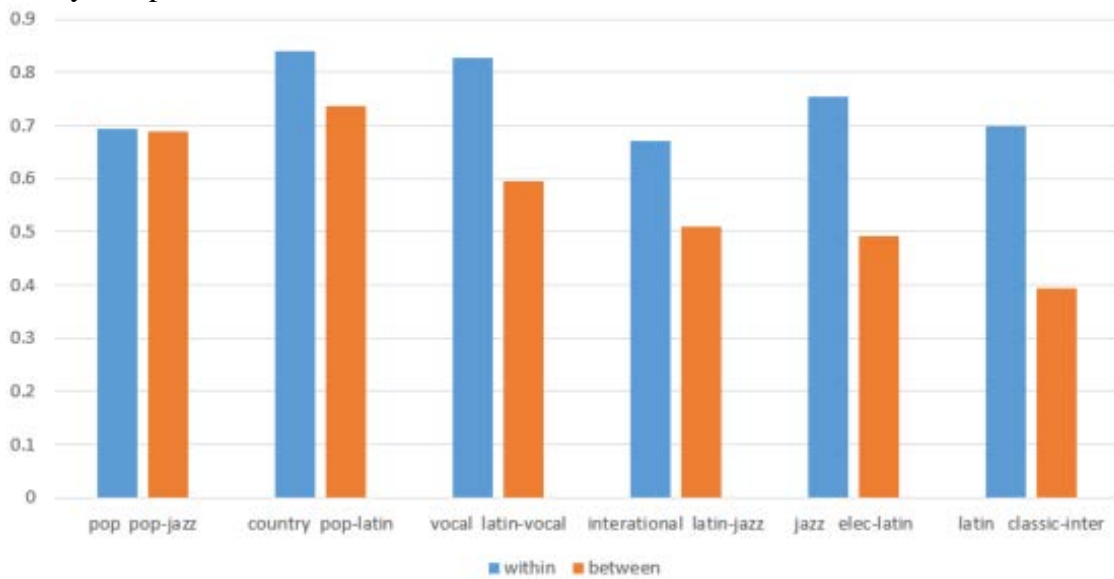


Figure 2: Average similarity between genres and genres

4. Analysis of Genre Changes and Differences

4.1 Differences between Genres

After all indexes of each school are weighted by the entropy weight method, we use the included Angle cosine method again to find the similarity between the two, and get the similarity matrix. From the matrix, we select New Age and Stage & Screen, which have the highest similarity, and Comedy/Spoken and Easy Listening, which have the lowest similarity, and analyze these two groups of genres respectively. The composite graph is drawn according to the weights of two schools in a genre combination. By comparing the two groups of composite graphs, it can be found that the higher the similarity difference is, the smaller the difference in each index is. At the same time, the differences between schools are mainly focused on four characteristics: instrumentalness, liveness, speechiness and explicit.

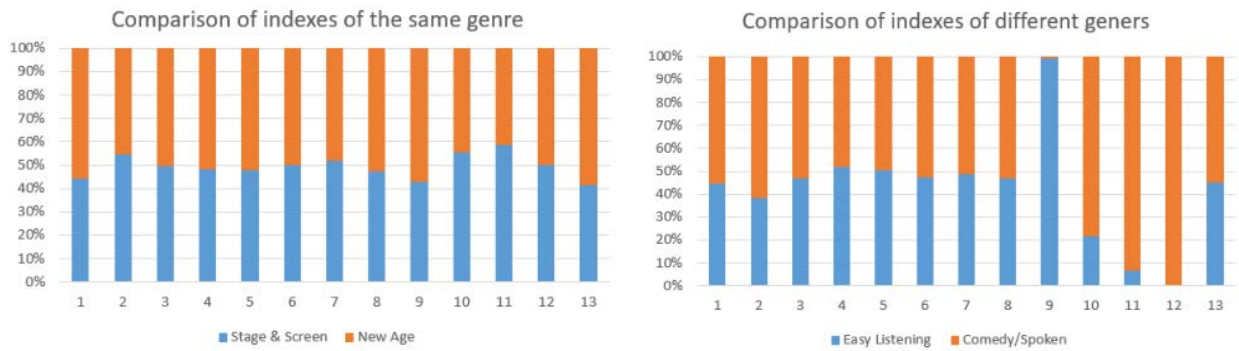


Figure 3: Index ratio of two music genres

4.2 The Variation of Genres Over Time

The Pop/Rock genres with the most relevant data in the dataset were selected to analyze their changes over time. The number of songs released by the genre’s artists relative to the time of release was plotted to give a general picture of the genre’s rise and fall.



Figure 4: Relation between number of songs and time

Next we will affect the number of other genres artist who shunt pie, discovers the R & B genre, the biggest influence on the genre and will all affect the number of the genre of artist after production line chart in time order, we found that affect the genre all 27286 artists have 26955 lives in 1930-1960. As we can see from the chart above, there were almost no Pop/Rock songs during this period, which means the genre had not yet emerged. Therefore, we believe that the music of other genres provided the foundation and guidance for the subsequent growth of the genre.

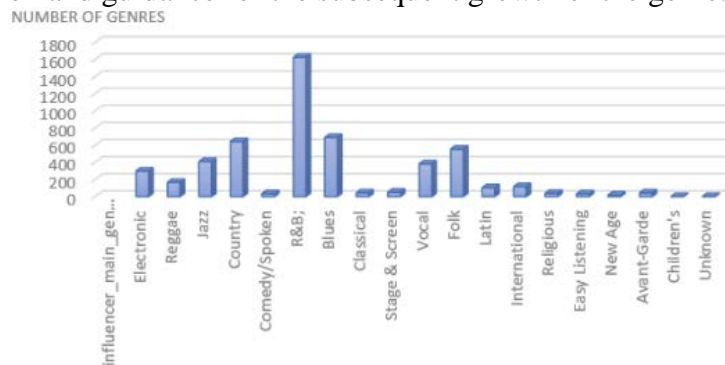


Figure 5: The influence of various genres on Pop/Rock

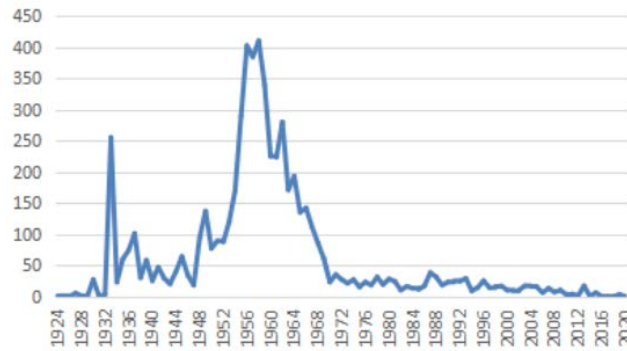


Figure 6: Number of artists from other genres who have influenced the Pop/Rock genre

5. Conclusion

The importance of music in our daily life and the influence of emotional connection. In this paper, entropy method and cosine similarity method are used to establish a network matrix to quantify the evolution of music. The cosine similarity method and Euclidean distance method are used to extract the similarity information and transform it into a matrix. In order to better quantify the relationship between influencers and followers, this paper compares the degree of similarity between pairs with and without influence relationships. The center value of eigenvector is used to represent the force of influence, and the analysis is improved.

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