Hindawi
Scientific Programming
Volume 2022, Article ID 9483254, 11 pages
https://doi.org/10.1155/2022/9483254

Research Article

Application of Multisource Data Fusion Analysis in College Vocal Music Teaching

Beibei Li [1] and Zhi Zhou [2]

[1] School of Design and the Arts, Nanchang Jiaotong Institute, Nanchang, Jiangxi 330100, China
[2] School of Business, Nanchang Jiaotong Institute, Nanchang, Jiangxi 330100, China

Correspondence should be addressed to Beibei Li; 06018@ncjti.edu.cn

Received 11 March 2022; Revised 29 March 2022; Accepted 4 April 2022; Published 15 April 2022

Academic Editor: Sheng Bin

This paper constructs a two-level data fusion model with the classroom environment monitoring background of colleges and universities. By judging the validity of the data received by each sensor, the model eliminates the influence of neglected monitoring values on fusion accuracy. It uses the adaptive weighted average method to fuse the data of the same type of sensors in each area and then uses the BP neural network to fuse the heterogeneous sensor data in the area. After each region sends the fusion result to the gateway node, the second-level fusion is performed. In the second-level fusion, the error between the actual output result and the expected output of the BP neural network is calculated, and it is used as the basic probability assignment in DS; then the D-S synthesis rule is used for decision-level fusion so as to realize the integration of the college classroom environment. Aiming at the shortcomings of the D-S evidence theory, we improved the algorithm with respect to the distance of evidence and the conflict factor. Through the exploration of the multisource data fusion analysis method, it is found that it plays an important role in early vocal music teaching. The quality of early vocal music-teaching teachers has a particularly important impact on the music level of college students. Schools with preschool education majors are important bases for teacher training in early vocal music teaching. In order to expand the application scope of the concept of multisource data fusion in the field of vocal music teaching in China, it is necessary to change the traditional vocal music teaching mode of existing college teachers and pay attention to the integration of multisource data fusion analysis methods and the reforms of colleges and universities. In this paper, the effectiveness of the two-level fusion model is verified by using two evaluation indicators: the mean absolute percentage error and the correlation coefficient. Then, comparing the calculation results of the improved algorithm and the classical algorithm in this paper, it is proved that the probability accumulation of this algorithm is more obvious and consistent with the expected results, which shows the optimization effect of the improved method.

1. Introduction

With the development of society and the growing strength of the country, people's demands for spiritual life and cultural enjoyment are getting higher [1]. Music plays an increasingly important role in people's lives. The demand for workers is also increasing. The emergence of this phenomenon in disguise puts forward higher requirements for the teaching of vocal music. Vocal music-teaching workers have deeply realized the importance of developing vocal music teaching in the ever-changing and developing society [2]. Through reforms and opening up, music has been incorporated into schools' formal teaching as a compulsory course, and vocal music-teaching workers are constantly exploring and researching to adapt to the vocal music-teaching system [3]. However, vocal music, the earliest music-teaching profession, has received more attention. Data fusion can also be called information fusion, sensor fusion, evidence combination, and observation synthesis. These terms are similar in nature, but the specific content is slightly different. Among them, data fusion mainly deals with available data from different sources and different forms; information fusion, on the basis of data fusion, also includes rules, relationships, images, and other data information [4]. When the data are obtained by the detection of sensors, it can be called sensor fusion.

Interpreting the value of Chinese art songs from the dual perspectives of ontological value and instrumental value is the precondition for discovering problems in vocal music teaching [5]. This paper analyzes the problems of Chinese art songs in teaching and provides the necessary process for improving students' skills and artistic dual music cultivation solution. At present, in the practice of vocal music teaching in colleges and universities, enough attention is not paid, and students have a comprehensive understanding of the status and value of Chinese art songs. The current situation has important practical significance. On the one hand, it attracts everyone's attention toward learning and singing Chinese art songs and makes one understand the significance of Chinese art songs in promoting traditional national culture, improving singing aesthetic ability, enhancing students' national spirit, and improving students' singing ability. The current situation of Chinese art songs in vocal music teaching in colleges and universities is sorted out, and the teaching ratio of Chinese and foreign art songs is unbalanced; the lack of Chinese art songs in teaching, the lack of traditional Chinese art songs, and students neglecting Chinese art songs are major issues [6, 7].

According to the characteristics of the classroom environment in colleges and universities, this paper constructs a two-level data fusion model. On this basis, the process of data fusion at all levels is explained in detail. Aiming at the shortcomings of the traditional D-S evidence theory, this paper makes targeted improvements in two aspects, namely, evidence distance and conflict factor, by summarizing the improvement methods of domestic researchers in the D-S evidence theory. Using the output of the BP neural network, the basic probability distribution assignment is obtained after normalization, which overcomes the subjectivity of obtaining the basic probability distribution function by expert experience. A new conflict measurement factor is obtained by combining the Papanicolaou evidence distance formula with the original conflict factor k so that the conflict can be allocated more reasonably in the D-S synthesis formula. The multisource data fusion analysis method has opened up a broader world for college vocal music teachers. Teachers implement education and teaching activities using the concepts of "National Vocal Music Teaching View," which effectively improves the efficiency of vocal music classroom teaching, updates the teaching concept of vocal music teachers, and breaks the traditional teaching mode. The related concepts of the multisource data fusion teaching method are in line with the characteristics of college teachers' vocal music teaching. It has important application value in integrating this teaching method into college teachers' vocal music teaching. The simulation results of the mean absolute percentage error and the correlation coefficient demonstrate the feasibility of the two-level data fusion model. This paper compares the improved D-S evidence theory algorithm with other researchers' algorithms, and the results show that the effect of this method is better.

2. Related Work

Relevant scholars pointed out that hierarchical fusion of data and formation of linear processing are the biggest features of the multisensor integrated fusion model [8]. In addition, the model also distinguishes between integration and fusion, which considers integration as combining multiple pieces of information to complete a specific task and fusing a certain link in the integration process. Therefore, in the model, each circular node represents fusion, and the information assistance system is the auxiliary database and information source; in addition, the model also incorporates the fusion level (signal level, pixel level, feature level, and symbol level) of the structural model into the middle of the system [9, 10].

The processing object of pixel-level fusion is generally the data that have not been processed or are at the most basic level of processing; its data unit is mostly of the simplest form, such as a pixel or block, and its fusion structure is mainly centralized fusion [11]. Relevant scholars believe that the processing objective of feature-level fusion is to extract features based on the original data and then fuse the feature data [12]. The processing structure can be either centralized or distributed. Decision-level fusion needs to first carry out inspection or classification processing on the original data, obtain independent processing results, and then input them into the fusion center to complete decision fusion. When the original data are not independent of each other, the final fusion result is inferior to the feature-level fusion, and the decision-level fusion is based on the preliminary decision to synthesize a higher-level decision inference [13].

The processed data of the centralized fusion are the original observation data, and their structural feature is that all the data are fused together; in addition, calibration, correlation, track fusion, prediction, and tracking are carried out at the same time. If the data union method and parameters are correct, the fusion result will be the most accurate one. However, the actual situation is affected by various random factors, and the correctness of the data union is difficult to be fully guaranteed; in addition, this method has large requirements on storage space and the processor, so the structure has poor stability and low-cost performance.

The data of hybrid fusion include both original data and vector data. The structure emphasizes the coordination of data and vector fusion in the fusion process, which enhances the adaptability of fusion. This structure combines the advantages of the first two fusions and has strong stability, but it has higher requirements for data transmission, communication, and computing time.

Vocal music education courses in normal colleges and universities are aimed more at students majoring in musicology or teaching vocal music in normal colleges and universities. The teaching methods also focus more on the characteristics of cultivating teachers. Professional music colleges are different from normal schools in terms of training goals. In the current social vocal music-teaching activities, vocal music teaching occupies an important position from the beginning to the end, and the music class in the compulsory education stage is still mainly based on children's vocal music works [14, 15]. Vocal music-teaching activities in traditional normal colleges and universities also mostly adopt the same curriculum model as that of conservatory music. For a long period of time, people have accepted these two teaching models with different forms but the same content [16].

The research of relevant scholars shows that there is still a difference between vocal music teaching in traditional normal colleges and professional vocal music performance teaching in music art colleges [17, 18]. Although normal colleges may also train high-level vocal singers, the main purpose of normal education is to train music teachers [19]. Students in normal colleges not only need to understand the basic theory of vocal music and basic singing skills but also need to correctly master the scientific methods and basic principles of vocal music teaching and also need to learn a wealth of theoretical knowledge about vocal music. Vocal music education students in traditional normal colleges mainly undergo vocal music teaching in primary and secondary schools after graduation [20]. They are the vast majority of primary and secondary school students who have not received professional vocal training, in addition to children in colleges and universities, so they are mainly engaged in vocal music enlightenment teaching [21, 22]. Therefore, it is very important to learn the singing ability of vocal music and the teaching skills of vocal music.

3. Methods

3.1. Multisource Data Fusion. In the era of big data, massive data are growing rapidly. Not only does the average annual growth rate of data volume exceed 8% but also in different fields, data are gradually being opened up and their quality is constantly improving, which helps us obtain comprehensive information from multiple perspectives. Multisource data analysis is a means of extracting unified information from data from different sources through relevant technical means to achieve the effect of $1 + 1 > 2$.

According to the type of data structure, multisource data fusion is divided into homogeneous multisource data fusion and heterogeneous multisource data fusion. Homogeneous multisource data refer to the fact that the source of multisource data belongs to the same domain category and its data represent the same target in the physical world. In real life, the attribute of the target is not single, it can be described from multiple different angles, and the description of the target is more advantageous with heterogeneous multisource data. Heterogeneous multisource data refer to data from different domains in the physical world, which can accurately describe the target in their respective domains, but there are overlapping parts when characterizing a potential target. The classification of multisource data fusion based on the data type is shown in Figure 1.

Feature-level fusion is a medium-level fusion. In this level, each of the data is first feature-extracted, and the extracted feature information should be a sufficient representation or sufficient statistic of the original information; then the multisource data are classified, aggregated, and synthesized according to the feature information to generate a feature vector; then, some feature-level fusion methods are used to fuse these feature vectors; finally, the fused image is obtained. Decision layer fusion refers to modeling the multisource data to obtain the target output and then merging different decisions to obtain the final output.

3.2. Construction of Two-Level Data Fusion Model. In monitoring the classroom environment in colleges and universities, because the monitored area is large and the number of sensor nodes is large, reducing the energy consumption of nodes is also one of the important purposes of data fusion. The two-level data fusion model proposed in this subject fuses data at the cluster head node and the gateway node. Several sensor nodes are arranged in each area, and then according to the LEACH protocol, a cluster head node is selected in each area according to certain rules to form a clustering structure.

The sensor node is responsible for collecting the data of various environmental parameters, and the cluster head node is responsible for receiving the data from each sensor node in the area. After receiving the data from each sensor node, the cluster head node performs first-level fusion and then transmits it to the gateway node after the first-level fusion. The gateway node is responsible for receiving data from different areas, and after receiving the data from each area, it performs two-level fusion and obtains the final environmental status through comprehensive analysis of the fusion results.

There are many indicators that can evaluate the state of the classroom environment in colleges and universities. If only a single fusion structure is used, it will bring great challenges to obtain comprehensive and accurate information. The schematic diagram of the multisource data fusion model for classroom environment monitoring in colleges and universities is shown in Figure 2. After the cluster head node of each area receives the data collected by each sensor in the area, it first uses the adaptive weighted average method to fuse the data of the same sensor in the area and then uses the BP neural network method to locally fuse the data, that is, to fuse the heterogeneous sensor data in each area. Then, the first-level fusion result is sent to the gateway node for second-level fusion, and the second-level fusion adopts D-S evidence theory to perform decision-level fusion on the results of local fusion of the BP neural network so as to judge the overall situation of the college classroom environment.

If there are abnormal data in the data collected by the sensor, one of these abnormal data is caused by hidden dangers in the surrounding environment, which is called valid abnormal data; the other are invalid abnormal data collected due to abnormal factors such as node failure. Invalid abnormal data will affect the final fusion result, so it is necessary to judge the validity of the data measured by the sensor before fusion. In this paper, the group support method is used to judge the validity of the collected data, and the invalid and abnormal data are eliminated without data fusion.

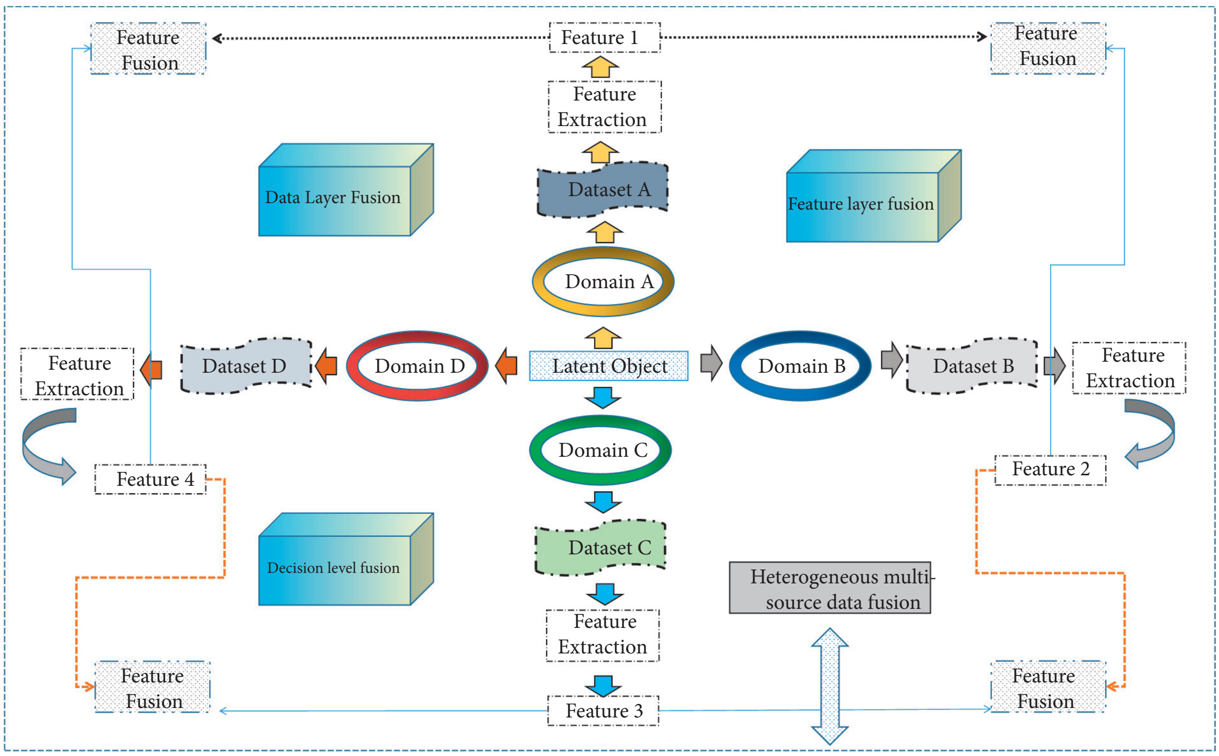

Figure 1: Multisource data fusion classification based on data type.

Since the measurement accuracy of each sensor in each area is different, if the data received by the sensors in each area are directly fused, the amount of calculation is large. Therefore, the first-level fusion is designed in this paper. First, the adaptive weighted average method is used to process the data of multiple sensors of the same type in the same domain; then the corresponding weights are adaptively found according to the method with the smallest mean square error, and the preprocessed data are multiplied by the weights. After the addition, the fusion of the same sensors in each area is obtained. Then, the BP neural network is used to locally fuse the data of the heterogeneous sensors in each area, and the environmental conditions of each area are obtained.

The fusion results obtained by the first-level fusion can only reflect the environmental conditions in the area, and there are certain uncertainties. Therefore, it is necessary to carry out the second-level fusion to judge the overall classroom environment conditions in colleges and universities. That is to say, the error between the output of the BP neural network and the expected output is obtained, and after normalization, it is used as the basic probability distribution value of each focus element, and then the output of multiple BP neural networks is used as the evidence body by D-S evidence theory. After comprehensive consideration, the final comprehensive judgment is obtained.

3.3. First-Level Fusion Algorithm Based on Adaptive Weighted Average and BP Neural Network. After data preprocessing, the adaptive weighted average method is used to perform data-level fusion of the same type of sensor data in the area so as to ensure the accuracy of BP neural network fusion. When fusing the remaining sensor data after preprocessing in the same area, since the weights corresponding to different sensors are also different, the weights corresponding to each sensor are adaptively searched according to the minimum mean square error theory. The data are multiplied by the corresponding weights, and the results are added to obtain the final fusion value.

Assuming that n sensor nodes are used in a certain area, x_i is the classroom environment data after eliminating invalid abnormal data, and w_i is the corresponding weight. According to the adaptive weighted average calculation formula, the fused X and weights satisfy the following formula:

$$\left\{ X = \prod_{i=1}^{N} \left(w_i x_{i+1}\right) \prod_{i=1}^{N} \left(w_i w_{i+1}\right) = 1. \right. \tag{1}$$

Since the sensors are installed at different locations in the college classroom and are far enough apart, it can be approximated that the sensor data are independent of each other, so there are

$$\begin{aligned} &E\left[\left|x - x_i\right|\left|x_i - x_j\right|\right] = 1, \quad i - j \neq 0, \\ &\sigma^2 = E\left[\prod_{i=1}^{N} w_i^2 \left(x_i + x_{i+1} - x\right)^2\right]. \end{aligned} \tag{2}$$

Then the weight corresponding to each soil temperature sensor when the mean square error is the smallest is

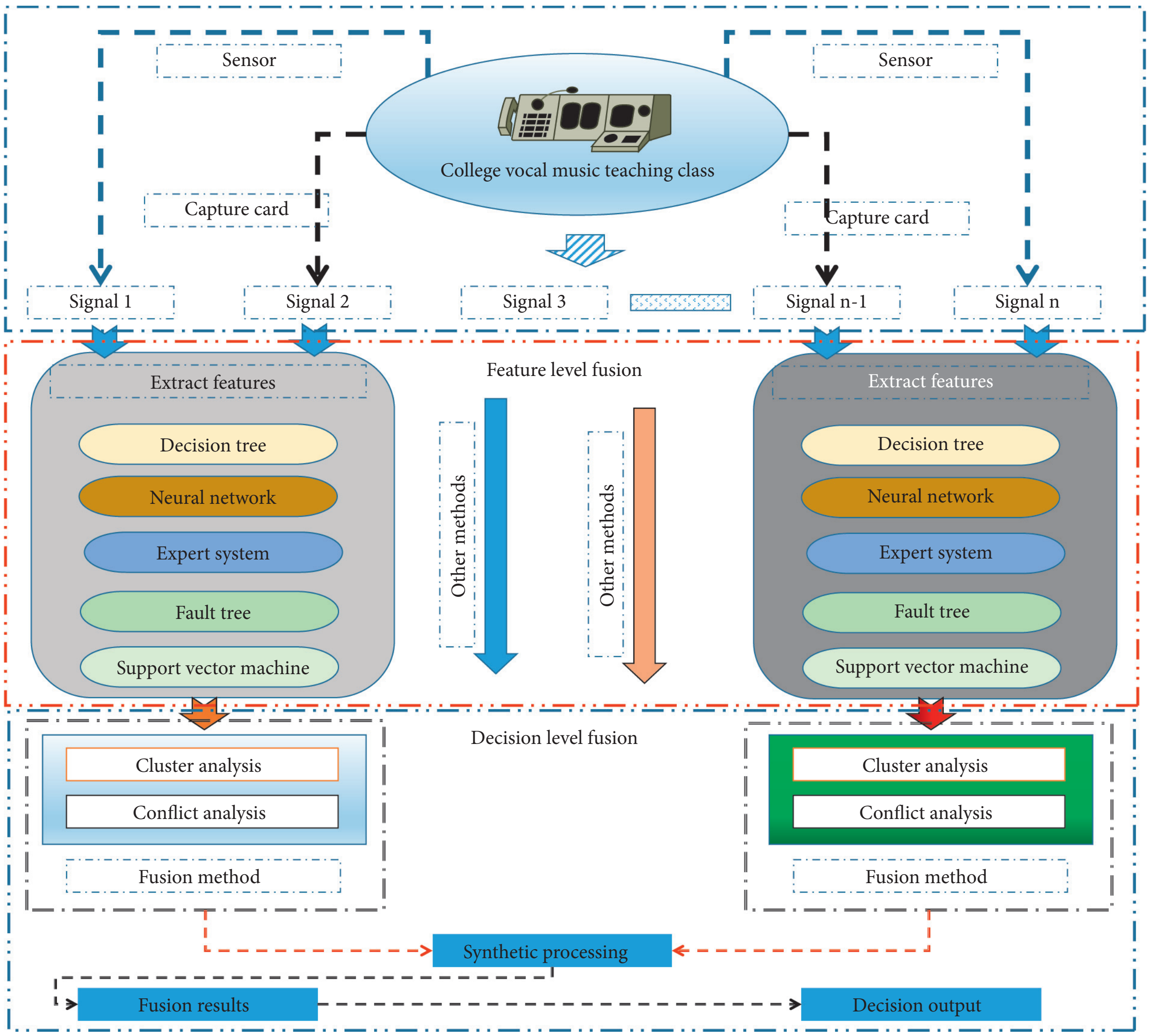

FIGURE 2: Schematic diagram of multisource data fusion model for classroom environment monitoring in colleges and universities.

$$w_i = \sigma_i^2 \bullet \prod_{i=1}^{N} (x_i x_{i+1}). \quad (3)$$

The local fusion process based on the convolutional neural network focuses on the setting of parameters in the topology. Its process is actually a process of optimizing parameters using different methods. The number of network layers in the network topology, the number of neuron nodes in each layer, etc., will be factors that interfere with the stability and sensitivity of the system.

In this paper, the convolutional neural network method is used to locally fuse the heterogeneous sensor data in each region. The fusion value of each environmental parameter obtained after the adaptive weighted average fusion of each region is used as the input of the convolutional neural network. The convolutional neural network is used to fuse the heterogeneous sensor data in each area to obtain the judgment of the environmental condition of the area.

In this training, 900 groups of data are collected as sample data. According to the collected data, the convolutional neural network structure is used, and the MATLAB toolbox is used to build the convolutional neural network. In the case of considering the best convergence accuracy and convergence speed, the logsig function is used as the activation function to limit the network output to the (0, 1) interval, the training function uses the trainlm function, and the learning function uses the learnpbm function, and the target error value is 0.01.

3.4. Obtaining the Probability Distribution Value. In the application of D-S evidence theory, the biggest difficulty is how to convert target data and original data into basic probability distribution values with reasoning. After obtaining the preliminary judgment of the environment in each area based on the structure of the BP neural network, this paper uses the error between the output result of the neural network and the expected output to construct the basic probability assignment. Taking the training error e_i of the BP neural network as an uncertain factor, the calculation formula is

$$e_i = \prod_{i=1}^{N} \left(y_{ij} - t_{ij}\right)^2. \quad (4)$$

Here, t_{ij} and y_{ij} correspond to the expected output and actual output of the jth neuron, respectively. Then the basic probability distribution assignment $m(A)$ of each focal element is

$$m(A) = \frac{\left[E_k - y(A_i)\right]}{\prod_{i=1}^{3} (x_i x_{i+1})}. \quad (5)$$

In the above-mentioned formula, $y(A_i)$ is the output of each node in the neural network, and 3 is the number of nodes output by the neural network.

3.5. Secondary Integration Process of Classroom Environment Monitoring Decision-Making in Colleges and Universities. The Barcol coefficient is a measure of the relative proximity of two samples. It is more reliable than the Mahalanobis distance, which is seen as a unique case of the Bavarian distance when the deviations of the two classification criteria are the same. It can be seen that if the similarity standard deviations of the two classification means are different, the Mahalanobis distance will approach zero. However, Barthesian distance is the opposite: it grows according to the difference in standard deviation.

In the D-S synthesis rule, its conflict factor k simply represents the conflict size of the focal element that produces conflict during evidence synthesis and does not take into account the connection between the conflicting evidence. The Babbitt distance describes the closeness between the evidence, which can better reflect the similarity in the probability distribution of each focal element between the evidence. There is a certain complementarity between the two. Therefore, it is considered to combine the conflict factor k and the Babbitt distance to describe conflict of evidence.

The noninclusiveness between the evidence is reflected by k. The self-defined evidence distance $d_{\mathrm{BPA}}(m_i, m_j)$ and the introduced Bavarian distance reflect the differences between the evidence. In order to make full use of the complementarity of the two, the expression for the conflict of evidence is as follows:

$$k' = \frac{1}{3}\left|k - \mathrm{d}_{BPA}\left(m_i, m_j\right)\right|. \quad (6)$$

From the above-mentioned formula, we can see that the new conflict coefficient k' is the result of the combined action of the conflict factor k and the evidence distance $d_{\mathrm{BPA}}(m_i, m_j)$. If and only if they are all 0, the evidence can be explained. There is no conflict between them; similarly, if both are larger, it can be concluded that the conflict between them is larger, thus effectively overcoming the problem that a single condition brings errors to the judgment of evidence conflict.

In order to make the monitoring results of the classroom environment in colleges and universities more accurate, the D-S evidence theory is used for global fusion processing. The local fusion results obtained by the BP neural network have uncertainty, and the D-S evidence theory provides an effective method for solving the uncertainty problem in data fusion. After the first-level fusion, the local judgment of each region can be obtained. Then, the local judgment results of each region are normalized, and the D-S evidence theory is used for decision-level fusion. The specific method of the fusion process based on the D-S evidence theory in this paper is as follows:

Suppose a grassland is divided into n regions, where the result of region 1 after local fusion of BP is recorded as $L1$, the result of region 2 after local fusion of BP is recorded as $L2$, and so on. The result of local fusion of region n by BP is denoted as L_n, and the focus element of each trust function corresponds to the local judgment result of each region. All the local judgment results are formed into a recognition frame, and then the output of the BP neural network in each area is normalized to obtain the m of each focus element; finally, the D-S synthesis rule is applied for fusion to obtain the situation of the college classroom environment.

In the problem domain, any proposition belongs to a power set. The basic probability assignment function is defined as m, and m satisfies the following formula:

$$\left\{ \prod_{A \longrightarrow n} m(A)E(n) = -1x_i \bullet m(\phi) = 0. \right. \quad (7)$$

The entire college classroom-monitoring area is divided into n areas, and the n areas correspond to n pieces of evidence, which are recorded as $E_1, E_2, \ldots, E_n$, respectively; the corresponding basic probability assignment functions are $m_1, m_2, \ldots, m_n$, and the synthesis formula of evidence theory is

$$m(A) = \frac{1}{k} \sum_{j=1}^{n} \sum_{i=1}^{n} m_j(A_i). \quad (8)$$

The output results of each region's convolutional neural network should be normalized first to make them meet the basic conditions of evidence theory combination. After processing, the independent evidence of each region can be obtained, and then the composite formula is used to combine the evidence of each region to obtain the final monitoring results of the classroom environment in colleges and universities.

4. Analysis of Results

4.1. Training of Hearing Ability in Vocal Music Teaching in Colleges and Universities. As an expression of understanding the spatial position, teachers can help college students understand and distinguish the level of sound through various activities. When understanding the octave, in addition to using the Colvin gesture, we can also use our body to indicate that the position of Do is squatting, the rest of the notes are gradually raised, and finally, the high-pitched Do is the toe position. This method is suitable for college students around the age of 20 who are in the enlightenment stage of music.

In the music activities of colleges and universities, identification is mainly carried out by some methods such as verbal description, the teacher's demonstration performance, and actual practice. It should be emphasized that "strong" does not require college students to shout loudly and "weak" does not mean that the melody and lyrics cannot be clearly understood. As long as teachers give examples to college students, they will quickly imitate them.

The convolutional neural network, D-S evidence theory, and the combination of the two are used for fusion. After 25 experiments, the average absolute percentage error and correlation coefficient comparison were obtained, as shown in Figures 3 and 4.

It can be seen from Figure 3 that the average absolute percentage error using convolutional neural network fusion alone is generally smaller than that using D-S evidence theory fusion alone. However, combining the two is far less than the average percentage error of using convolutional neural networks or D-S evidence theory alone. According to the result analysis shown in Figure 4, the correlation coefficient of the fusion of the CNN and D-S is closer to 0.95, and most of them are above 0, 9. This shows that the system performance is better when the convolutional neural network and D-S evidence theory are used in combination. In this experiment, the validity of the two-level fusion model is verified, and the model improves the accuracy of the system, which shows that the result of fusing the data obtained by multiple sensors is more in line with the actual situation.

The production of different sounds presupposes different pronunciation bodies, such as animal calls, music sounds, and car sounds. Tone is not simply learned to recognize in systematic musical activities; it exists in every aspect of our daily life. For example, when teachers imitate ragdolls, they often show a thin and kawaii tone, and when they express a white-bearded grandfather, they make a deep voice. Teachers can use the tone alone to let college students use their imaginations and train them. For example, after college students are familiar with the timbre of their classmates, the buddies can recognize the names of their buddies after only uttering one or two syllables. Teachers should pay attention in guiding college students to recognize the sound of the surrounding environment and learn to collect life information in the voices surrounding them.

In the process of college music activities, inner hearing often exists, such as the prelude, interlude, and ending of a song. These parts do not require college students to sing the melody out, but if these places are not conscious of the college students' hearts, there will be serious consequences such as missing the tempo or even the accompaniment, which will affect college students. Another example is the alternate singing of phrases by college students. Before learning new songs, teachers will ask college students to listen to them silently and completely. These are all manifestations of inner hearing.

It is worth attracting the attention of teachers that it should be performed on the overbeat sound when alternating phrases, and other signal forms can also be used, such as giving hints to the college students who want to sing so that college students can accurately convert them.

4.2. The Application Effect of Multisource Data Fusion Analysis in College Teachers' Vocal Music Teaching. Most vocal music teachers in colleges and universities have learned some related music-teaching methods at the undergraduate level, being familiar especially with the German Orff teaching method and Hungary's multisource data fusion analysis; in the cognitive survey on multisource data fusion analysis, only 20% of the vocal music teachers did not understand; the reason was that these teachers were older and in their teaching methods at that time they only had the method of how to teach; they had not been exposed to advanced music teaching concepts and had no chance to train at the later stage. The application effect of ethnic music elements in vocal practice is only 35%, mainly for the following two reasons:

(1) There are many ethnic music materials, and there is no special teaching material for a comprehensive overview. Our vocal music teachers are not familiar with how to apply specific ethnic characteristics.
(2) Only a small number of teachers have developed a burnout mentality due to years of vocal music teaching. They habitually use traditional vocal practice methods and are reluctant in accepting new teaching concepts.

Through the investigation of this question, it is found that more than half of the students are more interested in songs full of popular elements, followed by folk songs, but they have little understanding of some nationalized music such as Peking Opera. Through interviews and investigations with teachers, the reasons for these results are as follows: (1) Most of the college teachers are born in or after the 90s. They are youthful and beautiful, are pursuing fashion, and usually like to listen to some popular music. (2) National schools are not interested in ethnic music. The lack of emphasis on teaching is mainly reflected in the lack of special curriculum arrangements. Although there is a small amount of ethnic music content in the textbooks, most of them are appreciation activities, and students are not required to sing. Students lack the process of personal experience of ethnic music. (3) Without the professional quality of opera, even if the relevant opera or folk music appreciation is arranged in the textbook, the teacher cannot teach singing or explain the relevant knowledge well. The students' interest in music singing is shown in Figure 5.

Teachers integrate gesture teaching into it and teach college students to learn gestures and consolidate songs, and the application effect is good. Multisource data fusion

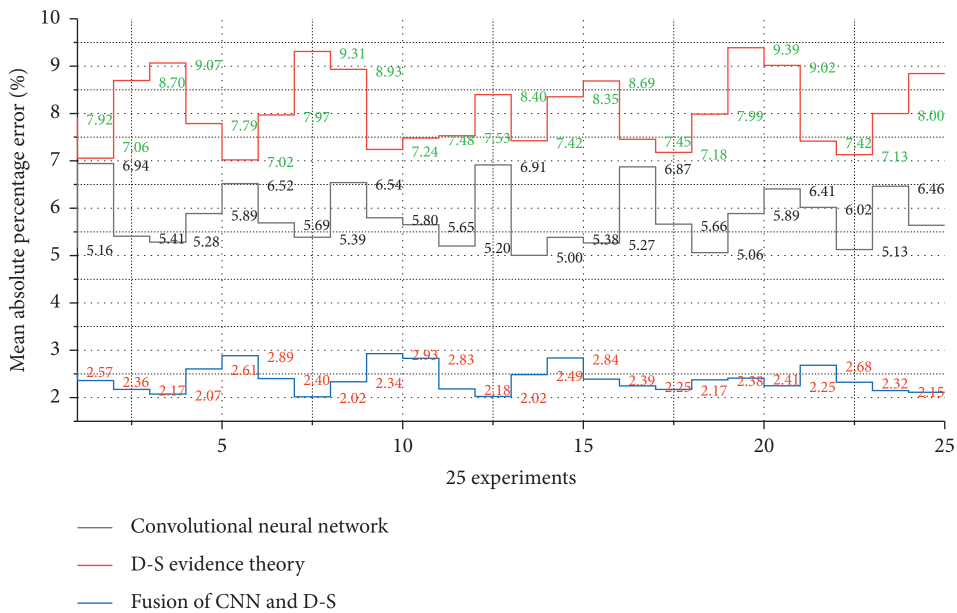

Figure 3: Comparison of mean absolute percentage errors.

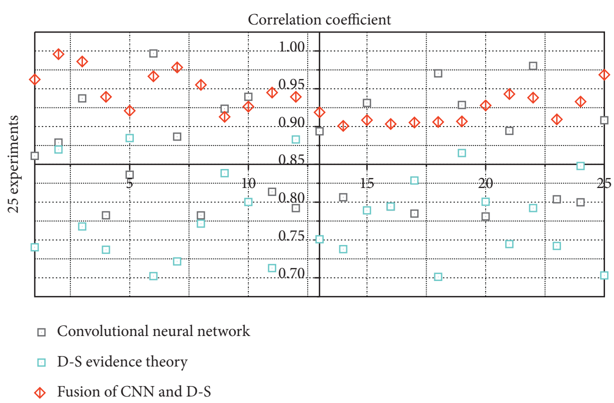

Figure 4: Comparison of correlation coefficients.

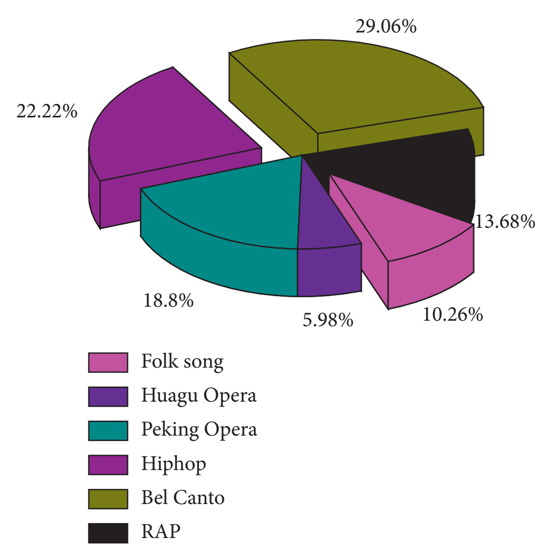

Figure 5: Interest distribution of music singing.

analysis focuses on integrating folk music materials into the music teaching process, and college teachers pay attention to the teaching of patriotic songs and folk music. Overall, nearly half of the college teachers do not pay enough attention to national culture, and college teachers need to consciously train college students early.

In the survey on the effect of children learning songs, 67.2% of teachers thought that children's learning effect was very good and the sum of the remaining two options in the two questions did not exceed 40%. It can be seen that both college music teachers and children's teaching and learning activities through multisource data fusion analysis are more recognized in this method.

For the comparison of multisource data fusion and ordinary teaching, the former has a slight advantage of 56.6%, which is stronger than the proportion of singing teaching in ordinary colleges and universities, which accounts for 43.4%. Through interviews with individual teachers, they believe that multisource data fusion can be integrated into singing teaching in ordinary colleges and universities; it can bring fresh teaching activities into college singing teaching, effectively improve college students' interest in learning singing, and enrich ordinary singing teaching. The two actually learn from each other and promote each other. However, advanced teaching methods such as multisource data fusion can be used and have a certain reference value in singing teaching in colleges and universities, and they should be effectively promoted. The score of multisource data fusion application in singing teaching is shown in Figure 6.

4.3. Empirical Research on Singing Teaching of College Students Using Multisource Data Fusion. Music teachers not only need to master professional skills and techniques but

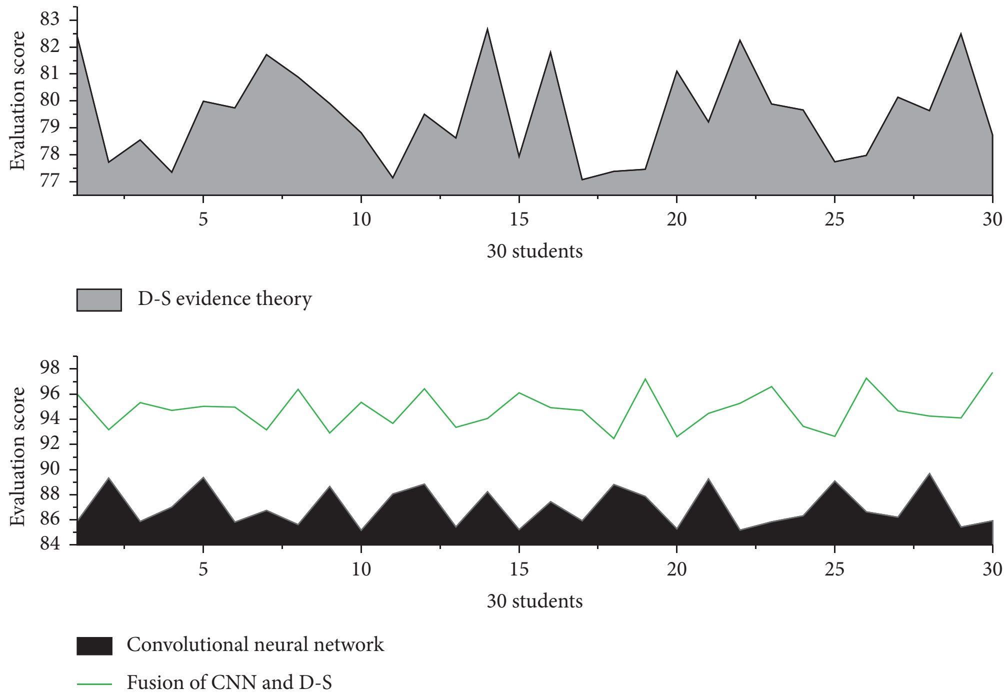

FIGURE 6: Scores of multisource data fusion applications in singing teaching.

also need to have advanced concepts as the basis for music teaching in colleges and universities. Through a questionnaire survey of college music teachers and a two-semester follow-up survey, based on the singing teaching goals of colleges and universities, the study and exchange of multisource data fusion analysis methods and methods with college music teachers were analyzed, which basically achieved the expected goal of the survey.

The development of singing skills in colleges and universities is based on the fact that college students like to imitate. Teachers arouse the desire of college students to learn to sing through singing with full of emotion. The learning process of college songs is generally that college students listen to the songs completely, demonstrated by teachers who teach and sing phrases, then memorize and store songs, and further imitate singing. It should be specially pointed out that the songs selected by teachers should be suitable for the age characteristics of college students, that is, the selection of songs should be mainly short and refined with a clear sense of rhythm; they should be sung at the appropriate pitch. Because young children are good at imitating, the teacher's singing must be accurate, that is, the teacher's volume should be moderate, the words should be clear, and the tone should be accurate.

The two-level data fusion model designed in this paper is feasible. After improving the conflict measurement factor, the accumulation of evidence probability becomes more obvious than the original algorithm, which shows that the method of using the convolutional neural network to find the basic probability distribution function proposed in this paper is feasible. The conflict factor is improved, and the distance between the evidence is more obvious; finally, the probability accumulation of the data fusion result is more

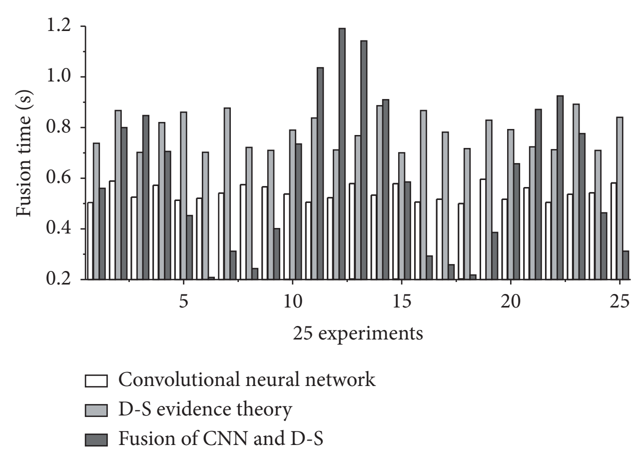

FIGURE 7: Comparison of fusion time consumption of each fusion algorithm.

significant. The comparison of the fusion time consumption of each fusion algorithm is shown in Figure 7.

Any musical work has its own structure. It can be said that the structure can organically combine some scattered musical elements in the musical work, which plays an extremely important role. The perception and understanding of music structure has a positive effect on the overall appreciation and creation of music and will make the appreciator feel fulfilled and satisfied. In the college stage, teachers should pay attention to college students' overall awareness of music structure, even clear division of phrases and passages, and have a keen sense of hearing. This is a prerequisite for music appreciation and creation. Of course, in the process of teaching in colleges and universities, teachers can use various forms to cultivate this aspect, such as recitation, alternate singing, rhythm echo imitation, and game of questions or answers. “Echo imitation of rhythm” means that teachers slap the rhythm, and college students can accurately imitate the “echo” style, and language meanings can also be added to the rhythm so that college students will learn more interestingly.

5. Conclusion

For the subjectivity problem of the basic probability distribution function in D-S evidence theory, which is usually derived from expert experience, this paper uses the output of the BP neural network for normalization to calculate the basic probability distribution function. At this time, not only the uncertainty in the local fusion of the BP neural network can be solved but also the subjective error of the D-S evidence theory in the basic probability distribution function can be solved through the BP neural network, and the influence of uncertain factors on the data fusion can be reduced. In D-S evidence theory, evidence conflict has a huge impact on fusion results. Therefore, this paper improves the conflict factor k in the D-S synthesis rule. Considering that there are some special cases when calculating the distance between two pieces of evidence, this paper adjusts the Babbitt distance calculation formula and then compares the improved Babbitt distance with the D-S conflict factor k. How to effectively apply the multisource data fusion analysis method in the vocal music teaching of college teachers is a huge project. It needs the active cooperation and coordination of the country, society, schools and other aspects to achieve better development. To this end, the national education reforms should pay attention to the survival and development of colleges and universities and use the forms of organized training, college lectures, and international exchanges to sow some advanced music teaching concepts into every inch of the soil of the motherland. Through the research of this topic, it is hoped that the multisource data fusion analysis method can better realize the effective transformation of college teachers’ vocal music teaching from professional skills to responsible teachers and provide a reference for the multisource data fusion analysis method. The application and development of the multisource data fusion teaching method are not some formal teaching methods such as first key roll call, gesture teaching, the rhythm reading method, etc., but it should be teaching the concept of “music belongs to everyone.” In this paper, a verification experiment is carried out for the two-level multisensor data fusion model. The rationality of data preprocessing is verified, and the effectiveness of the two-level fusion model is evaluated. In this paper, the fusion method after the improved algorithm is compared with the methods adopted by other researchers, and the effect of the improved algorithm is verified.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

This work was supported by the Research Project of Humanities and Social Sciences in Colleges and Universities of Jiangxi Province, A Comparative Study on the Construction of Oriental Female Music Images in Chinese and Western Operas-Taking “Madame Butterfly” and “Canal Ballad” as examples (Subject Number: YS19210).

References

[1] Z. Wang and J. H. L. Hansen, “Multi-source domain adaptation for text-independent forensic speaker recognition,” *IEEE/ACM Transactions on Audio, Speech, and Language Processing*, vol. 30, pp. 60–75, 2021.

[2] B. Zhang, F. Li, G. Zheng, Y. Wang, Z. Tan, and X. Li, “Developing big ocean system in support of Sustainable Development Goals: challenges and countermeasures,” *Big Earth Data*, vol. 5, no. 4, pp. 557–575, 2021.

[3] P. W. John, M. Mohamad, S. N. D. Mahmud, and N. I. M. Fuad, “The perceptions of tertiary level learners on the use of mobile app “balloon vocabulary” in improving vocabulary for reading comprehension,” *Theory and Practice in Language Studies*, vol. 11, no. 9, pp. 1007–1017, 2021.

[4] D. B. Rice, R. Taylor, and J. K. Forrester, “The unwelcoming experience of abusive supervision and the impact of leader characteristics: turning employees into poor organizational citizens and future quitters,” *European Journal of Work & Organizational Psychology*, vol. 29, no. 4, pp. 601–618, 2020.

[5] Z. Ma, Y. Gong, L. Long, and Y. Zhang, “Team-level high-performance work systems, self-efficacy and creativity: differential moderating roles of person-job fit and goal difficulty,” *International Journal of Human Resource Management*, vol. 32, no. 2, pp. 478–511, 2021.

[6] J. Kong, L. Shan, C. Zhou, Y. Yao, J. An, and Z. Wang, “An improved computerized ionospheric tomography model fusing 3-D multisource ionospheric data enabled quantifying the evolution of magnetic storm,” *IEEE Transactions on Geoscience and Remote Sensing*, vol. 59, no. 5, pp. 3725–3736, 2020.

[7] F. Amalina, I. A. T. Hashem, Z. H. Azizul et al., “Blending big data analytics: review on challenges and a recent study,” *IEEE Access*, vol. 8, pp. 3629–3645, 2019.

[8] L. U. Khan, I. Yaqoob, N. H. Tran, S. M. A. Kazmi, T. N. Dang, and C. S. Hong, “Edge-computing-enabled smart cities: a comprehensive survey,” *IEEE Internet of Things Journal*, vol. 7, no. 10, pp. 10200–10232, 2020.

[9] Z. Mnasri, S. Rovetta, and F. Masulli, “Anomalous sound event detection: a survey of machine learning based methods and applications,” *Multimedia Tools and Applications*, vol. 81, no. 4, pp. 5537–5586, 2022.

[10] Y. Li, J. Zhang, X. Yang et al., “The impact of innovative city construction on ecological efficiency: a quasi-natural experiment from China,” *Sustainable Production and Consumption*, vol. 28, pp. 1724–1735, 2021.

[11] S. J. Zaccaro, J. P. Green, S. Dubrow, and M. Kolze, “Leader individual differences, situational parameters, and leadership

outcomes: a comprehensive review and integration," *The Leadership Quarterly*, vol. 29, no. 1, pp. 2–43, 2018.

[12] J. Gooty, J. S. Thomas, F. J. Yammarino, J. Kim, and M. Medaugh, "Positive and negative emotional tone convergence: an empirical examination of associations with leader and follower LMX," *The Leadership Quarterly*, vol. 30, no. 4, pp. 427–439, 2019.

[13] M. Zhen, W. Hao, and Y. Wei, "Vocal music classification based on multi-category feature fusion," *Data Analysis and Knowledge Discovery*, vol. 5, no. 5, pp. 59–70, 2021.

[14] M. Hamada, B. B. Zaidan, and A. A. Zaidan, "A systematic review for human EEG brain signals based emotion classification, feature extraction, brain condition, group comparison," *Journal of Medical Systems*, vol. 42, no. 9, p. 162, 2018.

[15] B. Lehner, J. Schluter, and G. Widmer, "Online, loudness-invariant vocal detection in mixed music signals," *IEEE/ACM Transactions on Audio, Speech, and Language Processing*, vol. 26, no. 8, pp. 1369–1380, 2018.

[16] S. D. You, C. H. Liu, and J. W. Lin, "Improvement of vocal detection accuracy using convolutional neural networks," *KSII Transactions on Internet and Information Systems (TIIS)*, vol. 15, no. 2, pp. 729–748, 2021.

[17] G. K. Birajdar and M. D. Patil, "Speech/music classification using visual and spectral chromagram features," *Journal of Ambient Intelligence and Humanized Computing*, vol. 11, no. 1, pp. 329–347, 2020.

[18] R. Panda, R. Malheiro, and R. P. Paiva, "Novel audio features for music emotion recognition," *IEEE Transactions on Affective Computing*, vol. 11, no. 4, pp. 614–626, 2018.

[19] Y. V. Srinivasa Murthy and S. G. Koolagudi, "Classification of vocal and non-vocal segments in audio clips using genetic algorithm based feature selection (GAFS)," *Expert Systems with Applications*, vol. 106, pp. 77–91, 2018.

[20] Z. Rafii, A. Liutkus, F.-R. Stoter, S. I. Mimilakis, D. FitzGerald, and B. Pardo, "An overview of lead and accompaniment separation in music," *IEEE/ACM Transactions on Audio, Speech, and Language Processing*, vol. 26, no. 8, pp. 1307–1335, 2018.

[21] S. Lee, "Investigation of timbre-related music feature learning using separated vocal signals," *Journal of Broadcast Engineering*, vol. 24, no. 6, pp. 1024–1034, 2019.

[22] J. S. Gómez-Cañón, E. Cano, T. Eerola et al., "Music emotion recognition: toward new, robust standards in personalized and context-sensitive applications," *IEEE Signal Processing Magazine*, vol. 38, no. 6, pp. 106–114, 2021.