Hindawi
Mobile Information Systems
Volume 2023, Article ID 7285914, 7 pages
https://doi.org/10.1155/2023/7285914

Research Article

Evaluation of Music Art Teaching Quality Based on Grey Neural Network

Fengqin Liu and Jinhua Wu

Fujian Institute of Education, No. 73 Mengshan Road, Gulou, Fuzhou, Fujian 350001, China

Correspondence should be addressed to Fengqin Liu; i17301102@stu.ahu.edu.cn

Received 11 July 2022; Revised 23 August 2022; Accepted 5 October 2022; Published 25 April 2023

Academic Editor: Santosh Tirunagari

The study and implementation of music art teaching quality monitoring systems as a major teaching management project in Chinese colleges and universities has been in continuation for a decade. An essential challenge in the management of colleges and universities is that how to assess the teaching abilities of music and art professors fairly and objectively. The system is designed and implemented by separating the front end and back end of browser + server to provide examination services in the way of cloud computing. This system primarily gathers the students' multidimensional data including sound intensity, pitch, and beat. Then a grey neural network is used to analyze the students' sound intensity, pitch, and beat. After evaluation process, the scores of the final examination in colleges and universities are uploaded to the backstage server in real-time.

1. Introduction

In the recent decade, the research and practice of music art teaching quality monitoring systems has been studied and implemented as a key teaching management project in colleges and universities in China. In quality monitoring management, the test and evaluation of music art teaching effect and teaching state are important links. The process of gathering a large amount of sample data, processing, summarizing, and assessing it is known as the quality evaluation of music and art training. This work has mainly gone through three stages [1].

(i) The manual operation takes place, in which most teachers and students fill out the evaluation form and the management staff manually compiles statistics and performs calculations.

(ii) The introduction of computer processing and data collection in the form of computer card reading is used. Realizing paperless evaluation using a computer network is the third step.

(iii) The approach will displace the first two and gain popularity.

The evaluation of the teaching quality of music and art course is a routine teaching assessment where every college needs to carry out every academic year. To evaluate the teaching quality of music and art teachers and timely understand the real situation of teaching is an important issue in the management of colleges and universities [2, 3]. It is difficult to manually operate the evaluation questionnaire with the expansion of the school and college. The manual evaluation can no longer meet the requirements of the new teaching situation. It contains several drawbacks including excessive recurring capital expenditure, heavy organizational workload, problematic data statistics, low efficiency, ease of error, lack of intuitiveness in statistical analysis, querying, and browsing. Therefore, from the technical level of evaluation, there is an urgent need to establish a convenient, efficient, reasonable, and scientific evaluation system for the teaching quality of music and art courses. This will play a great role in promoting the teaching quality of music and art and evaluating the teaching quality [4].

At present, the music art teaching quality evaluation system used in colleges and universities still has some limitations and problems that needs to be solved:

(i) The system function is not targeted. Each system is independent;

(ii) The evaluation software only has basic statistical functions. It does not make full use of a large amount of basic data accumulated in the past to carry out comprehensive evaluation of teaching quality;

(iii) Most evaluation systems are relatively closed, with one-way flow of information and lack of information interaction;

(iv) Evaluation systems generally carry out static evaluation, which is difficult to reflect dynamic evaluation information;

(v) Network security and confidentiality are not enough, and the evaluation data are easy to be changed, affecting the authenticity of the evaluation.

The design objectives of the music art evaluation system include the following aspects:

(i) It has a good and clear user interface and is easy for users to use. It can better attract evaluators to participate actively;

(ii) There should be user permission confirmation. Different users should be given different permissions and perform different operations;

(iii) Be able to maintain the database and count the data on the network;

(iv) Provide good help to make users familiar with system operation as soon as possible;

(v) The system design is close to the needs of daily office operation, and the system maintains good compatibility with the educational administration system;

(vi) It has good data portability.

The music art quality evaluation system designed in this paper adopts two modes: c/s and b/s. The users are students, teachers, supervisors, and educational administrators. After logging in, students can see all the course information learned in the current semester and can evaluate the teaching of the courses according to the set evaluation index information. After the evaluation is completed, evaluation information is saved or submitted. The submitted evaluation information cannot be modified. Teachers can conduct self-evaluation and peer evaluation after logging in. After the evaluation results, the students comments can be queried and can be evaluated by evaluation indicators. The administrators of departments can query the evaluation of their teachers. The printout of the evaluation statistical table and evaluation statistical analysis report of all teachers can be taken for archiving and reference. The quality evaluation administrator of the academic affairs office can query the evaluation scores, rankings, and comments of teachers in the college. The administrator can print the evaluation statistics and evaluation analysis tables of teachers in the college.

With the development of computer network [5], it is possible to use web-based technology and new mathematical models to evaluate music and art teaching quality evaluation in colleges and universities. First, B/S mode is used to replace C/S mode making full use of the advantages of the network to meet the needs of students and teachers' geographical dispersion. The web server is used as the B/S application portal. The evaluation system adopts Java, XML, and component encapsulation technology. It adopts a three-tier architecture which makes the developed system more inclusive and extensible. It puts data security in a very important position and interacts with the database server with the web server to ensure data security. At the same time, the system should have an efficient security mechanism, including identity authentication, authority inspection, data confirmation, and other security measures [6–8].

According to the requirements of the ministry of education, we will further deepen the reform of the educational supervision and management system. It includes to strengthen the supervision of schools, guide schools to develop their own characteristics, promote the all-round development of students' morality, intelligence, physique, art, and labor. To carry out supervision, evaluation, and monitoring full use of the Internet, big data, cloud computing is made. However, music evaluation is different from the traditional language, number, and English test as singing is a highly subjective activity. How to achieve subjective activity evaluation through objective quantitative evaluation method is the focus and difficulty of current research. With the vigorous development of mobile digital technology and the improvement of domestic copyright protection awareness, the music streaming media industry has made great progress. A series of music streaming media giants such as Tencent music and NetEase music, and foreign giants such as Spotify and Apple music, have been born at home and abroad. According to the data released by the world record industry association in 2020, the global music-related business revenue increased by 9.7% year-on-year basis. Out of this, the streaming music revenue exceeded US $8.9 billion accounting for 47%. The massive music track library makes users to face great challenges in music information retrieval. Music can be regarded as a kind of voice signal, but it is more diverse and complex. It is composed of different beats, harmonies, and melodies according to certain rules. With the emergence of deep learning, music classification technology has entered a new stage of development. The success of deep learning in speech recognition and image processing makes it a future development goal in the field of music evaluation. At present, the subresearch directions in this field include music genre recognition, music emotion recognition, and music work recommendation. Among them, streaming media (music) recommendation has become an indispensable and important part of the current e-commerce system. The success of Tiktok, Douban, and NetEase cloud music is inseparable from the optimization and application of streaming media recommendation algorithm.

2. Related Work

The improvement of classroom teaching effect is the starting point of classroom teaching evaluation. The research on effective teaching has gone through behavior observation,

psychology research, and comprehensive method research. It mainly focuses on the evaluation criteria of classroom teaching [9]. Foreign researchers first pay attention to the research on whether the teaching process is effective. It includes observing teachers' teaching behaviors under effective teaching situations, summarizing the characteristics of these behaviors, promoting them, improving teaching effectiveness, and further studying effective teaching to evaluate teachers' classroom teaching, so as to change the inefficient situation of classroom teaching. The view of effective teaching holds that the key to teaching is what teachers should do in the classroom, how to make correct decisions, and how to realize these decisions [9].

At the beginning of the last century, western countries evaluated teachers' classroom teaching according to the evaluation grade scale. The evaluation grade scale, which emerged during the European and American educational measurement movement, was the main basis for evaluation at that time which was originated from the decades of prevalence in the early twentieth century. However, the validity of this scale is almost equal to zero because the content of the scale itself is unscientific and lacks systematic development and research, so the results are not reliable and effective [10].

In the 1950s, educational evaluation began to enter the field of classroom teaching which indicates that with the development of modern educational evaluation research, systematic classroom observation methods providing more information have replaced the original teachers' teaching evaluation rating scale that was simply formulated in pursuit of quantification. The influence of observation method in classroom teaching evaluation has gradually increased, and it has been used in classroom teaching evaluation but there are some disadvantages. For example, classroom evaluation is mechanical and rigid, which has become a common trend of classroom teaching evaluation in this period. It overemphasizes objective and verifiable results and requires the objectification and standardization of evaluation results.

Exploring relatively scientific and rational theory and the practice teaching mode, can better [11] discuss the strategy of combining violin theory teaching with practice teaching. The Purpose of Constructing Piano Teaching Innovation Model is that any kind of the education has a certain goal. The success of education must rely on a variety of ways to achieve the established goals [12] and pay attention to playing technique. In our country's piano teaching, teachers often start from the two essences of piano, one of which is to learn the technique [13]. As per reference [14], analyze several problems in current situation, including the lack of information infrastructure construction of music professional production and education integration in colleges and universities under the background of Internet, low modern information literacy of professional teachers in colleges and universities, and low efficiency of cooperation between colleges and enterprises. According to [15], it improves the quality and level of vocal music teaching by reconstructing the teaching model. In [16], the main focus was on the in-depth discussion on the cultivation strategy of music quality for students majoring in preschool education. The work in [17] demonstrates the help of MOOC teaching mode on college vocal teaching and explains the application strategy of MOOC college vocal teaching mode of college vocal teachers. We should constantly strengthen the innovative concept of vocal music education in combination with the actual situation of colleges and universities [18]. It has no bearing on evaluation, feedback, or advancement. Therefore, the superior performance of neural network is used [19] to solve nonlinear problems and construct a music art TQE method based on convolutional neural network (CNN) while other influential works are discussed in [20].

3. Design of Music Art Quality Monitoring System

3.1. Overall System Process. The situation of the grass-roots examination room is complex, and there are insufficient IT technicians with rich practical experience, therefore, there are many risks in the examination organization. The Software as a Service (SaaS) model is quickly becoming a more affordable solution for all businesses, especially small ones to supply business applications. By using SaaS services, we can greatly reduce the risk pressure of customers' IT infrastructure construction and operation costs. The university music and art quality monitoring system adopts b/s architecture. It is deployed in the cloud to provide services to customers (examination organizers) in the way of SaaS. The main development languages used include Java and python. Using relevant technologies and frameworks, candidates sing songs according to the track requirements through the designated examination machine in the examination room (the sound is read in by the sound card). After the data is encrypted, it is transmitted to the university music art quality monitoring system server through the Internet. The algorithm evaluation of the target audio file (student score) is carried out in the background, and the quantitative score is given. The examination room is complex and there are not enough technicians with rich practical experience, so there are many risks in the examination organization. By using SaaS services, we can greatly reduce the risk pressure of customers' IT infrastructure construction and operation costs. The successful online operation of the system has great enlightening significance and broad market development space for the landing practice of artificial intelligence technology, the combination of production and learning, the application of e-commerce music streaming media technology, and the quantitative evaluation and research of other university disciplines(such as art and sports).

Figure 1 is the overall flow chart of the music art quality monitoring system. Teachers/administrators can log in to the teacher system management terminal, upload examination tracks (original sound, score, and accompaniment band), set scoring weights (different requirements for students of different levels), maintain school and student information (taking the school as the unit for examination). Thus, teachers/administrators create examinations and other functions. Under the guidance of the examination room teachers, students can log in to the examination machine and perform vocal music singing according to the requirements of

the examination questions. The system will automatically retrieve the test paper (audio file) and submit the test content, which will be sent back to the server remotely through the Internet. The music art quality monitoring system server will quantitatively score the test content. Teachers can derive test scores and conduct teaching reflection research.

3.2. Application of Grey Neural Network in Music Art Evaluation. The two models require different amounts of data which is the main discrepancy between the grey prediction model and the neural network prediction model. The contradiction between the two can be reduced if the right sample size is chosen, and the benefits of the two can be combined to create a combination model that is more accurate. Therefore, the first problem to be solved is to determine the amount of data when building the composite model. Generally, the fitting accuracy is used to describe whether the model is suitable for this prediction. However, for the neural network prediction model, the fitting accuracy is often very high, even reaching the fitting accuracy of 1, and its prediction accuracy is not necessarily still very high. Therefore, this study considers both fitting accuracy and prediction accuracy when evaluating the model, defines the comprehensive prediction accuracy, and measures the excellence of the model with the comprehensive prediction accuracy. Thus, the optimal data volume of the model is obtained by the grey neural network combination model.

In order to make full use of the historical information and give full play to the advantages of the combined model of grey neural network, this paper first sets the sample number as a dynamic variable value, takes the maximization of the comprehensive prediction accuracy of the model as the goal, and selects the best sample number of modeling data as the sample size of the prediction model. Suppose a total of N statistical values are obtained. The first $n-2$ sample data are used to build the model, and the last two samples are selected to test the prediction accuracy of the model.

Step 1. Level ratio test: for a given original sequence $X^{(0)}$, if you want to establish a GM (1, 1) model with high accuracy, the battery limit coverage of level ratio $\sigma^{(0)}(k)$ of $X^{(0)}$ needs to meet the following conditions.

Suppose $X^{(0)} = (x^{(0)}(1), x^{(0)}(2), \cdots, x^{(0)}(n))$, if the level ratio meets

$$\sigma^{(0)}(k) = \frac{x^{(0)}(k-1)}{x^{(0)}(k)} \in \left(\frac{-2}{en+1}, \frac{2}{en+1}\right), k = 2, 3, \cdots, n. \tag{1}$$

Then GM (1, 1) model can be established for the sequence $X^{(0)}$.

Step 2. Suppose $\{\alpha(1), \cdots, \alpha(t), \cdots, \alpha(N-2)\}$ is the sample data sequence, let $t_o = 1, \cdots, N-6$, and let $\{\alpha(t_o), \cdots, \alpha(t), \cdots, \alpha(N-2)\} = \{x^{(0)}(1), x^{(0)}(2), \cdots, x^{(0)}(n_1)\}^T$ successively.

Step 3. Take different values of t_o, build GM (1, 1) respectively for time series prediction, then take the predicted values under different GM (1, 1) models as inputs and the actual values as expected outputs, build BP neural network for training, and get the final predicted values.

Step 4. Determine the optimal sample number n: set the fitting value of the original data as a $\widehat{X}^{(0)}(k) = (\widehat{x}^{(0)}(1), \widehat{x}^{(0)}(2), \cdots, \widehat{x}^{(0)}(n))$,

Then the residual sequence of the original data sample is $Q^{(0)} = (\widehat{q}^{(0)}(1), \widehat{q}^{(0)}(2), \cdots, \widehat{q}^{(0)}(n))$, where

$$q(k) = x^{(0)}(k) - \widehat{x}^{(0)}(k), k = 1, 2, \cdots, n. \tag{2}$$

Absolute, average absolute percentage error, and precision are defined as follows:

$$\begin{aligned} \mathrm{APE}(k) &= \left|\frac{q(k)}{x^{(0)}(k)}\right| \times 100\% = \left|\frac{x^{(0)}(k) - \widehat{x}^{(0)}(k)}{x^{(0)}(k)}\right| \times 100\%, \\ \mathrm{APE} &= \frac{1}{n-1}\sum_{k=2}^{n}\left|\frac{x^{(0)}(k) - \widehat{x}^{(0)}(k)}{x^{(0)}(k)}\right| \times 100\%, \\ \mathrm{Accuracy} &= (1 - MAPE) \times 100\%. \end{aligned} \tag{3}$$

Assume that the fitting accuracy is prediction accuracy. Therefore, the comprehensive prediction accuracy is defined as follows:

$$P = \alpha \times N\,\mathrm{Accuracy} + \beta \times P\,\mathrm{Accuracy}, \alpha + \beta = 1. \tag{4}$$

The objective is to minimize the comprehensive prediction error, that is, the corresponding sample size under the objective of maximizing the comprehensive prediction accuracy is the number of preferred sample sizes n, so $\{\alpha(N-n), \cdots, \alpha(t), \cdots, \alpha(N)\} = \{x^{(0)}(1), x^{(0)}(2), \cdots, x^{(0)}(n_1)\}^T$ is selected as the sample data, and Steps 2 and 3 are repeated to establish SGMBP (1, 1) for prediction.

In the past, traditional machine learning often used manual extraction of target features for model training [16, 20]. In the field of music, it mainly used basic data such as loudness, frequency, and beat. However, the music of different genres often differs greatly, and it is difficult to design and extract acoustic abstract features such as musical

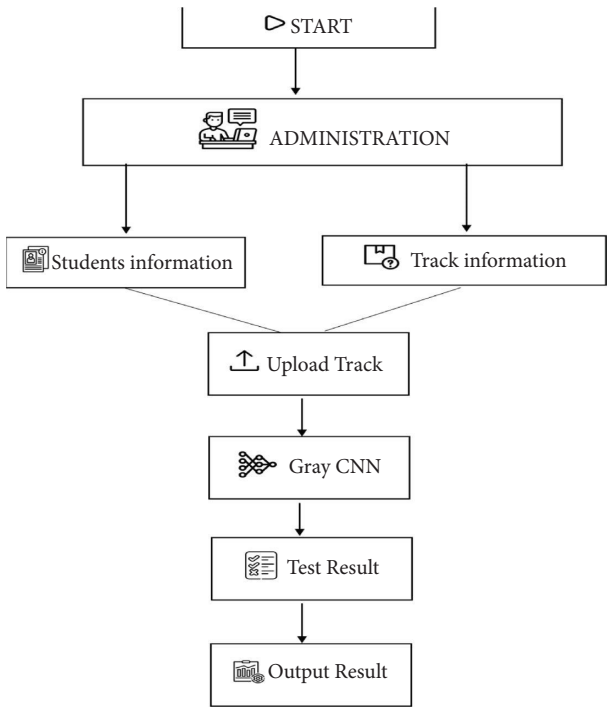

Figure 1: System flow chart.

instruments, rhythm, and harmony by hand. The explosive growth of commercial music streaming media makes it impossible to recommend music through manual annotation in terms of commercial cost. Deep learning can automatically capture the high-level abstract features of the target through the nonlinear relationship generated by the connection of multiple hidden layers. With the great increase in CPU and GPU computing resources, the theory becomes practical and feasible. The grey convolution neural network model group can greatly improve the accuracy of image classification by improving the depth of the convolution neural network. This paper attempts to train a convolution neural network to read the Mel spectrum and judge music style. Figure 2 is the structure diagram of the grey convolutional neural network. The input layer, convolution layer, pooling layer, and complete connection layer make up the network's basic architecture. The input layer is responsible for receiving data, especially high-dimensional data. The convolution layer extracts features through convolution kernels of different sizes to achieve a local weight-sharing effect. Facing the huge amount of computation caused by parameter explosion, the pooling layer is responsible for reducing the dimension of the convolution layer operation results and preventing overfitting operations. The main methods include meaningful pooling and maximum pooling. The full connection layer, also known as the Densen layer, is responsible for mapping high-dimensional data to one-dimensional data. The output layer is responsible for the final result judgment. This paper is a multi-classification design.

In the final examination of a music major in a university in 2021, according to the opinions of the music examination organizers, students of different grades should be differentiated in terms of test difficulty. We have made threshold adjustment intervals for the singing sound speed, sound intensity, and tone of students of different grades. In specific applications, we can provide different criteria according to the nature of different levels of examination.

(i) Sonic control

The rhythm speed of students' singing songs is slightly accelerated or slowed down to the original a times. The value of a is selected within (0.7, 1.3), and the extra or shortened singing time is cut or filled. The motivation for this method is that students' singing speed is often inconsistent, and the standard can be relaxed for students in lower grades.

(ii) Intensity adjustment control

Intensity adjustment refers to a slight change in the loudness of the recorded music which can increase or decrease the loudness of the original music.

(iii) Tone adjustment control

Considering that the vocal cord structure of male and female students is different, the tone of music can be changed because even a small shift would not significantly alter the music's original style. The technique used in this research is to alter the audio by adding or removing C semitones.

4. System Training and Test

The public database is used in this study to train on music classification. This database consist of 10,000 audio clips, which is categorized by musical genres.

The 10 music styles mainly include reggae, metal music, hip-hop, disco, pop music, blues, classical music, rock, country music, and jazz. Each style consists of 1000 segments usually of 30 seconds with a sampling frequency of 22050 Hz and a single channel. The image resolution is $240 * 320$, the activation function is RELU, and the output layer function is softmax for the final classification of music styles. The training cycle epochs are set to 160, the batch size is set to 64, and Adam is used as the gradient optimization descent method in the convergence process of convolutional neural network training. A total of 10000 Mel spectrum diagrams are obtained by using the grey neural network. Each diagram is cut into 30 subgraphs according to the time of 100 seconds, a total of 30000 Mel spectrum subgraphs. Then it is divided into a training set and a verification set by 17 : 6. As a small-scale data training, the convolution layer of the grey neural network is appropriately cut, and the first 5 of 130 are selected. The accuracy changes of the training set and verification set are shown in Figure 3. The basic convergence is achieved at about 40 rounds, and the accuracy of the verification set is close to 95%. The error training is shown in Figure 4.

We can see from Figure 4 that our systematic error is getting smaller and smaller with the increase in the number of iterations. It shows that the effect of our music art evaluation system is very good. After 400 iterations, the system error is stable at 0.15.

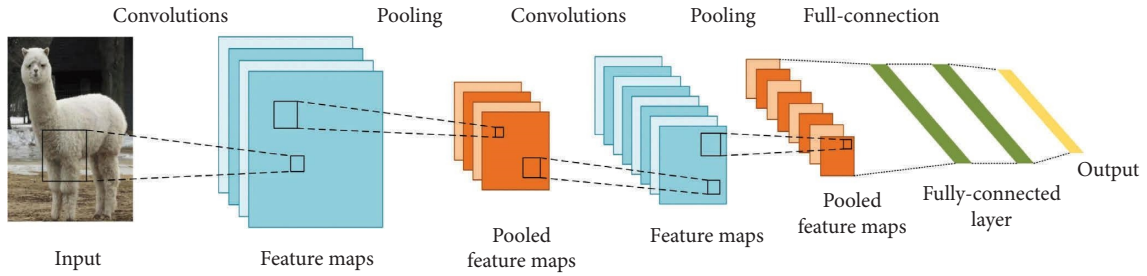

Figure 2: The structure diagram of grey convolutional neural network.

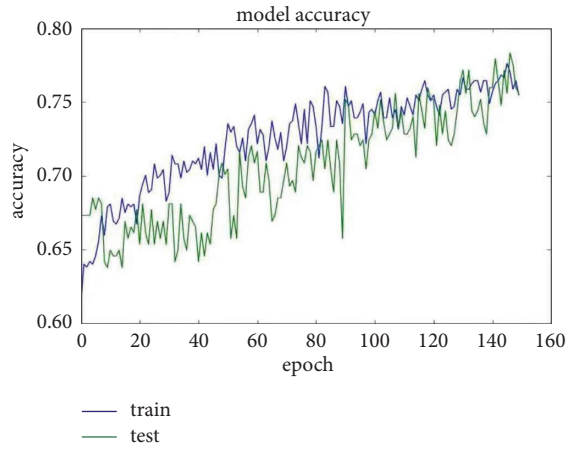

Figure 3: Accuracy variation of training set and verification set.

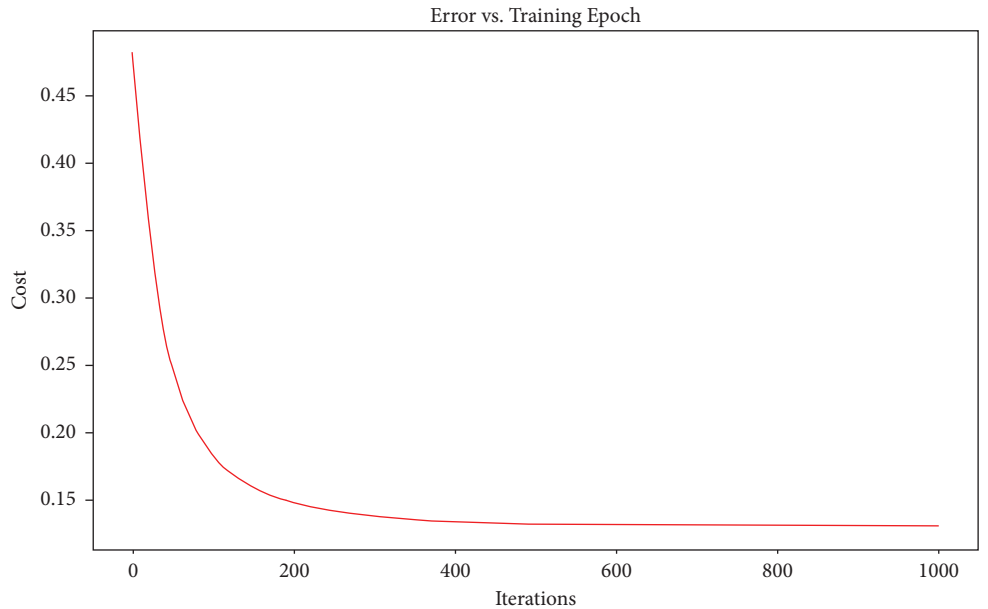

Figure 4: Error training cure.

5. Conclusions

In Chinese colleges and universities, a significant teaching management project has been used over a decade to study and implement quality monitoring systems for music and art instruction. To properly and honestly evaluate the teaching abilities of music and art professors is considered as a crucial task in college and university administration. According to the national guidance on music graduates, this paper requires each university to provide guidance on the quantitative evaluation mechanism of music education art for music graduates. This research develops a cloud-based system for monitoring the quality of university music instruction art based on the national guidance. The main

development languages used are Java and python, as well as *C*. The system reads basic music signal characteristics such as sound intensity, pitch, and beat. The grey neural network is used to assess the music map and conduct a preliminary study of artistic sense. The results of the final test in colleges and universities are uploaded to the backstage server real-time following the review procedure. The successful online operation of the system has reference significance for landing practice of artificial intelligence technology, combination of industry and learning, e-commerce, and music streaming media recommendation. In future, further exploration such as the emotional analysis of vocal singing and automatic music composition, will be made in the analysis of music artistic sense.

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 conflicts of interest.

Acknowledgments

Fujian Province Social Science Planning Fund Project "Practical strategy research on the development path and methods of aesthetic education in rural schools" (Subject No.FJ2020B105).

References

[1] S. Zhao, Y. Zhang, and Y. Liu, "Analysis on the influencing factors of Beijing's GDP," *Journal of Jiamusi University*, vol. 35, no. 4, pp. 681–683, 2017.

[2] J. Niu, "GDP Forecast of Jiangxi Province Based on Neural Network Optimized by Grey Genetic Algorithm," pp. 25–27, Jingdezhen: Master's thesis of Jingdezhen Ceramic University, Jingdezhen, China, 2016, Master's thesis.

[3] W. Assenmacher, "Trend und Zyklus im Bruttoinlandsprodukt der Bundesrepublik Deutschland/Trends and Cycles in the Gross Domestic Product of the Federal Republic of Germany," *Jahrbucher für Nationalokonomie und Statistik*, vol. 217, no. 5, pp. 628–649, 1998.

[4] J. Chen, K. Cao, and Z. Liu, "Research on Jiangsu per capita GDP forecast based on time series," *Journal of Nanjing Institute of Engineering*, vol. 15, no. 4, pp. 74–78, 2015.

[5] R. Mourdaa and M. H. Atyeh, "Multiple regression analysis of diversification effect on GDP per capita:the case of UAE & Saudi Arabia," *Asian Journal of Economic Modelling*, vol. 5, no. 3, pp. 253–265, 2017.

[6] W. Xuyajing, "Yuanzheng application of ARIMA model in GDP forecast of Henan Province and SAS implementation," *China Science and technology information*, vol. 10, pp. 216–219, 2006.

[7] L. Haoxiangzhi, "The establishment and prediction of China's GDP time series model," *Statistics and decision making*, vol. 23, pp. 4–6, 2007.

[8] X. F. Chang, "Analysis and prediction of per capita GDP in Shandong Province Based on time series," *Research on financial education*, vol. 28, no. 1, pp. 57–63, 2015.

[9] J. Shen and Y. Ding, "A new method of forward regression analysis and its application in forecasting Fujian's per capita GDP," *Journal of Jimei University*, vol. 11, no. 4, pp. 375–380, 2006.

[10] W. Huyanguo and G. Jiang, "Application of support vector machine in GDP regression prediction," *Microcomputer information*, vol. 23, no. 33, pp. 17-18, 2007.

[11] W. Wang and Y. Yang, "Research on forecasting method of China's quarterly GDP Based on mixing regression model," *Quantitative economic and technical economic research*, vol. 33, no. 4, pp. 108–12, 2016.

[12] X. Zhang, "Construction and Reflection on the Innovation Mode of Piano Teaching," in *Proceedings of the 2017 7th International Conference on Social science and Education Research (SSER2017)*, Xi'an, China, November 2017.

[13] X. Zhu, "Study on the reform of piano teaching in colleges and universities based on the concept of quality education," in *Proceedings of the 2019 International Conference on Arts, Management, Education and Innovation (ICAMEI 2019)*, Seoul, Republic of Korea, January 2019.

[14] X. Hu, "The investigation and optimization strategy of rural art education," *Arabic Language, Literature & Culture*, vol. 4, no. 2, p. 41, 2019.

[15] X. Zeng, "Research on the integration of production and education of music major in colleges and university based on the internet model," *Destech Transactions on Environment, Energy and Earth Sciences*, vol. 28, 2019.

[16] L. Fu, "Research on the reform and innovation of vocal music teaching in colleges," *Region - Educational Research and Reviews*, vol. 2, 2020.

[17] Y. Xie, *Practice and Exploration of Music Curriculum for Preschool Education Major*, Springer, Nanjing, China, 2020.

[18] Y. Chen, "Research on College Vocal Teaching Model Based on Curtain Class," *Frontiers in Educational Research*, vol. 3, 2020.

[19] L. Xu, "The current situation and new ideas of vocal music education in universities," *Lethaia*, vol. 34, 2020.

[20] F. Xu and Y. Xia, "Music art teaching quality evaluation system based on convolutional neural network," *Computational and Mathematical Methods in Medicine*, vol. 2022, Article ID 8479940, 9 pages, 2022.