Animation Media Art Teaching Design Based on Big Data Fusion Technology

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***Abstract*—Animation, as an ancient art expression form, still has vigorous development, and the need for animation talents in society is increasing daily. This study first introduces the definition of animation and the development of animation at home and abroad. After that, the classification regression tree algorithm's principle and function theorem are described. This study divides the data into original and new animations based on big data fusion technology. It establishes a media art teaching system with search, recommendation, and playback as the three cores. Additionally, iteration is used to calculate the optimal hidden semantic matrix, a comparison is made between the benefits and drawbacks of the Sigmoid, Tanh, and ReLU functions, and lastly, the activation function chosen is the ReLU function. Compared with the loss value in the ideal case, the experimental findings comply with the likely criteria, and the categorical regression tree algorithm model predicts an error rate that falls within acceptable limits. Practically speaking, it is known that when the hidden factor dimension is 12, the system model works best for characterizing animation features. The comparison shows that the non-standard collaborative filtering recommendation system is inferior to the recommendations filtered by the categorical regression tree algorithm model. Following the use of the system, the students' drawing and directing abilities, animation scope, and animation appreciation level all improved significantly. The questionnaire survey concluded that the teachers and students of animation majors in universities were satisfied with the system.**

Keywords—Animation; big data fusion; classification regression tree algorithm; media art teaching system

I. INTRODUCTION

The rapid development of computer technology has generated massive amounts of data, and studying these data has, in turn, driven the development of computer technology. It is the era of big data, and along with the widespread appeal of computer mainframes and mobile phones, the amount of people using the Internet has increased dramatically. The Internet has grown quickly as a result of technological developments as well, and humans today have access to hundreds or even thousands of times more data every day than they did in ancient and modern times [1]. According to an International Data Institute report, the global data volume is anticipated to reach 56 ZB by 2030 [2]. Animation from the generation and dissemination also took advantage of the development of the Internet. They grew up, and the larger bandwidth and more rapid transmission speed both provide a broad and excellent soil for the production and dissemination of animation.

The abundance of information brings about convenience and the issue of information overload, which presents a significant obstacle for information producers and consumers. For information producers, the material they create can easily be submerged in the data of the Internet and cannot distinguish themselves from others. Much information is available to users, and separating the helpful information is challenging, wasting time and energy [3]. Universities and art colleges are particularly affected by this issue, where educators have access to abundant information resources and must exert significant effort to select only those appropriate for their teaching. Students still lack a solid worldview, life perspective, and set of values, and separating the good from the bad is challenging when they receive mixed information [4]. The search, recommendation, and viewing system for teaching animation media art based on big data fusion technology came into being, providing some convenience to users; however, users' needs are different; exceptionally productive students have specific needs for searching, recommending, and viewing animation media data [5]. Throughout human history, animation has evolved to communicate ideas and express feelings. From the eight-legged bison drawn in caves by ancient humans with black charcoal in the late Paleolithic to the continuous wrestling figure on ancient Egyptian frescoes, from the first animated film "Enchanted Pictures" to Disney's first 3D animated film "Toy Story," animation development has now become a spiritual totem for some people [6]– [9]. As the era of Big Data storage began to emerge, revolutionary changes have also occurred in the distribution media. From videotape to CD-ROM until nowadays, online streaming media and animation present accessibility, convenience, and technological development [10]. For art college and university students, especially those majoring in animation-related disciplines, searching, recommending, and viewing animation media data are critical to developing skills and knowledge.

Currently, in daily life, search engines are used extensively to offer consumers both basic and extensive search services in addition to conventional search engines. The integrated search engines of music, video streaming, social media, and knowledge quiz software are also receiving increasing attention, and this software faces a great challenge in delivering more accurate, timely, and convenient search results. The animation art teaching system assisted by big data fusion technology is the search function is the foundation, and only when the animation data is well searched can educators and learners gain from it [11]. Suggestion systems, on the other hand, have evolved from streaming services and are now most frequently applied in e-commerce applications for product recommendations. In the animation market application, incorporating a suggestion system enhances the positive user experience while increasing active product users. User stickiness rises as a result, making users see more different styles of animation works and eventually greatly improving commercial interests [12]. Viewing animation is as important for art students in animation as it is for college students in other majors to read material related to their major, sometimes even watching and analyzing an animation frame by frame, and this way of learning is called pulling a film [13]. In the teaching system of art colleges and universities, with the ongoing advancement and use of computer convergence technology, the animation industry has favored the provision of online streaming media, where teachers and students can easily access resources in a variety of ways, such as online viewing and downloading using video websites and cell phone applications. However, animation databases are becoming larger and larger, and college art students have to spend a lot of time and effort to find the right animation for them. In the past, Users were limited to searching using keywords such as name, director, and style of animation, and the variations among users were not considered in the search results, leading to biased results [14].

The growing volume of animation data and demand from students and faculty in universities and art colleges demonstrates a more difficult task for studying animation search, recommendation, and viewing algorithms. Conventional recommendation systems fall into three main categories: content-based recommendations, collaborative filtering, and hybrid recommendations combining the two. Even so, these three categories of fundamental suggestion methods have been advanced; they have serious issues, like sluggish startup times [15]–[17]. In addition, the recommendation based on sentiment status, which developed along with social media, has also come into view with the public, resulting from the computer industry's deep learning and thorough exploration of the possible interests of users. This paper, based on classification regression tree theory, starts by analyzing the characteristic data of art school teachers and students and their animation preferences to design a motion search system with accuracy, personalized music recommendation, and a virtual reality viewing system, which is the goal of every art college and which can also greatly facilitate teaching and learning for teachers and students daily. Thus, it has significant research implications and a wide range of potential applications.

1) This study innovatively applies the classification regression tree algorithm to preprocess animation data and train models. By replacing the predicted feature coefficients, effective data preprocessing of the animation video library was achieved, improving the prediction accuracy and stability of the model.

2) The research system fully utilizes the advantages of big data to achieve precise satisfaction of personalized needs of students, improving teaching effectiveness and student satisfaction. The construction of this system provides a new teaching mode and method for animation media art teaching.

3) This study compared the advantages and disadvantages of Sigmoid, Tanh, and ReLU functions, and ultimately chose ReLU function as the activation function. This choice effectively improves the training speed and performance of the model, providing strong support for the optimization of animation media art teaching models.

This study establishes a media art teaching system based on big data fusion technology, with search, recommendation, and playback as the three core elements. Section II of the study elaborates on the background of animation media art teaching based on big data fusion technology. Section III elaborates on the analysis of animation and animation applications. Animation has evolved from two-dimensional to three-dimensional, expanding its application scope. The principle and selection analysis of the classification regression tree algorithm were conducted in Section IV. The implicit feature analysis of iterative animation was conducted through a mixed model of user behavior and animation media data information. Section V conducted teaching system practice and effectiveness analysis. It uses the predicted feature coefficients of the input classification regression tree algorithm to preprocess the data of the animation video library. Through animation teaching classroom tests, the abilities of college students in related majors were tested. It shows that animation students have improved their drawing and directing skills, their animation scope, and their appreciation of animation through this system. Section VI summarizes the entire text. Students majoring in animation production have significantly improved their drawing and directing skills, animation scope, and animation appreciation level by using this system.

II. Related Work

Previous research has provided us with the development history of animation media art, from early hand drawn animation to modern digital production technology. These studies help us understand the evolution of anime art and how it combines with technological advancements. Previous research has contributed to the theoretical framework of animation art instructional design. They explore different teaching methods, strategies, and evaluation methods, providing us with a solid theoretical foundation to better design and implement animation media art teaching. With the rapid development of technologies such as big data and artificial intelligence, previous research has explored the application of these technologies in other fields. These studies provide us with valuable experience, enabling us to draw on and apply them to the design of animation media art teaching.

The teaching design of animation media art based on big data fusion technology is expected to bring revolutionary changes to animation education. Through the analysis and mining of big data, we can more accurately understand the learning needs and effects of students, and thus design more personalized and efficient teaching methods. Through real-time data analysis and feedback, we can adjust teaching strategies in a timely manner to ensure optimal teaching outcomes. This will help cultivate students' creative thinking and practical abilities, and provide more high-quality talents for the animation industry. Animation is the art of "tricking" the eye, based on the same principle as film. It is a film technique that uses the visual residuals of the human eye to create the illusion of movement of objects within the image by showing still images at a fixed frequency [18]. From its inception, animation has been an art form, combining many characteristics of painting and film. Because the location and environment do not limit it, it expresses a wild imagination.

It has broadened its application after the development of animation from a two-dimensional to a three-dimensional stage. In contemporary times, animation is mainly used in entertainment, with animated episodes, movies, special effects, games, and animated advertisements being its main battleground [19]. The field of animated episodes has been gaining momentum in recent years, making hundreds of millions of people feel the charm of animation by disseminating online streaming applications such as Netflix, Disney, and HBO. Among them, "Love, Death and Robots" has created high ratings and topics with its mature animation technology, deep thought expression, and amazing picture expression, the masterpiece of American animation in the new century [20]. Digital fusion technology, including virtual reality, augmented reality, mixed reality, etc., has brought unprecedented possibilities to visual art design. These technologies not only enable designers to present artworks in unprecedented ways, but also allow audiences to immerse themselves in them and gain a more profound artistic experience. Therefore, studying the impact of digital fusion technology on visual art design is of great significance for promoting the development of the art and design field [21]. The basic principle of digital fusion technology is to combine digital information with the physical world to create a brand new and immersive experience. For example, virtual reality technology simulates a three-dimensional environment, allowing users to experience the virtual world firsthand; Augmented reality technology adds digital elements to the real world, allowing users to observe the world from a completely new perspective [22]. These technologies provide a new creative medium for visual art design, enabling designers to present artworks in unprecedented ways. The emergence of digital fusion technology has brought about a profound transformation in the form of visual art design. Firstly, designers can utilize these technologies to create more realistic and immersive works of art. Secondly, digital fusion technology allows artworks to no longer be limited to traditional media such as painting and sculpture, but can be extended to various media such as virtual space and mobile devices. In addition, digital fusion technology also provides designers with richer creative tools, such as 3D modeling software, virtual reality editors, etc., allowing them to create art works in unprecedented ways [23].

In contrast, China's animation has been in a disadvantaged position in the world since the peak of "The Greatest Showman" at the beginning of the country's founding. The animation industry is far below Japan and the United States in terms of both artistic value and commercial output. Creating animation with its national characteristics, artistic expression, and commercial value has become the challenge and goal of every animation producer in China. This study aims to use big data fusion technology to create an animation teaching system suitable for university teachers and students and make some contribution to the animation education industry. Fig. 1 shows promotional images for the "Love, Death, Robot" series of animations.

Fig. 1. Promotional image for the animated series from Love, Death, and Robots.

III. PRINCIPLE AND SELECTION OF CLASSIFICATION REGRESSION TREE ALGORITHM

The definite regression tree algorithm is built depending on the prior distribution, the distribution set before the experiment. From there, it extracts the posterior distribution of the sample. So, the regression tree theorem, also known as the posterior probability, is the likelihood that event N will occur under the conditions after event M, which the following equation can express.

$$P(M|N) = \frac{P(M \cap N)}{P(N)} \quad (1)$$

The posterior probability is not the same as the joint or prior probability, which is the likelihood of two occurrences, M and N, occurring simultaneously. And the opposite of the posterior probability is the prior probability. The prior probability can be marginalized to give an alternative expression for the regression classification tree algorithm. That is, according to the equation that follows.

$$P(M|N) = \frac{P(M|N)P(M)}{P(N)} \quad (2)$$

Where $P(M|N)$ denotes the probability of event M occurring in the case of event N.

A. Overall Design of Animation Media Art Teaching System

The recommendation systems for text, photos, music, and videos have extensively used the categorical regression tree algorithm. This study of an animation content search, recommendation, and viewing system for art school college students is a hybrid model of recommendation based on user behavior and animation media data information. Using a classification regression tree algorithm, this search's primary objective and recommendation are to compute the implicit features of the animation media data iteratively and then obtain the data's low-dimensional vector information through marginalization. This low-dimensional vector information can be included in the search to enhance the search results. By merging them with the implicit preference features of college-going users, reasonable recommendations can also be generated. This experiment directly extracts the image and audio features from the animation video files. This can overcome the cold start problem and be as close to the user's innate sense of animation as possible. The conventional matrix-based decomposition model is the basis for this hybrid system and is enhanced algorithmically. Fig. 2 below shows the general flowchart for system design.

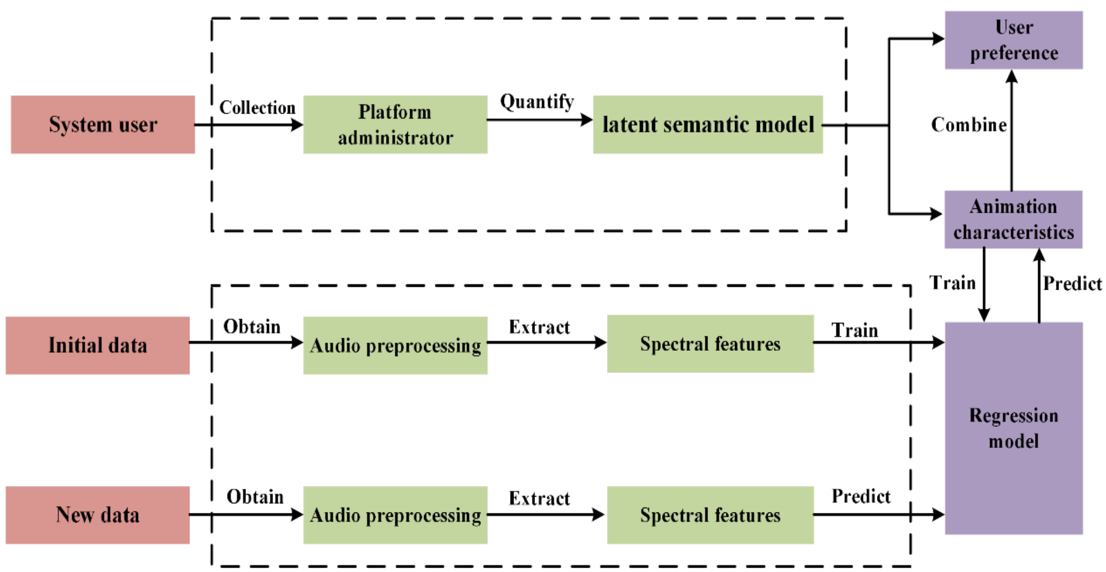

Fig. 2. Flow chart of the overall design of the animation big data management system for college students.

The above figure shows that the model utilizes a covert semantic matrix to map user-hidden traits and animation video data into a common space using a classification regression algorithm, ultimately producing search and recommendation outcomes. The animation media art teaching data system in colleges and universities includes a user features module, animation video information, a search engine module, a recommendation algorithm module, and virtual reality playback equipment. The user features module's primary responsibility is to gather and preserve student users' behavioral history data within the system and then build their preference models. Based on the extracted features, the search engine module generates customized search results for the user. Calculating the degree of matching between student users and hidden features is done through the recommendation algorithm module, and, finally, recommend animations that may be interesting for users dynamically. The two main components of the entire system operation are classification regression tree model training and search recommendation, and the processes of acquisition, prediction, and aggregation are indicated by arrows in the figure. The steps involved in the particular process are as follows: first, the system uses online streaming software to gather historical user behaviors from students and unifies them for analysis using a suitable semantic matrix; then, the raw animation data are reduced and processed to extract image and spectral features; a dynamic model of classification regression tree is constructed using the data collected in the first two stages, and then the resulting data are input and continuously. Finally, if new animation data is added to the system, the same reduction is performed to obtain the image and spectral features. Then, the perfect model is used to determine how interested a user is in the new animation data in combination with the preference of college students and, ultimately, decide whether to advise the user to use it.

The system must also categorize the original and updated animation data. Traditional animation is based on name, director, scriptwriter, Production Company, and file format classification. Certain similarities can be found in the automatic animation classification method based on style and emotion. The classification regression tree algorithm must be run through three steps to extract features, select the best features, and classify training. The two, nevertheless, are very different because the traditional animation classification's qualitative features are not the same as the abstract definitions of style and emotion in animation. The style and emotion of animation are derived from the subjective emotions of humans, which is a high-level way to describe the experience. Style is established by classifying different artists while making animation works by their starting points and common points. It can serve as a condensed synopsis of the works of specific directors. The topic of animation is expressed through emotion, has a decisive role in evoking the viewers' feelings about the work, and can be utilized as a concise overview of the shared aspects of certain animation works according to the plot and character portrayal stereotypes. More animation materials are available now than ever due to the animation business's growth. It is of great importance for the advancement of the animation industry that animation students and teachers quickly connect and enumerate the information using style and emotion classification when searching for the required materials, which determines the merits of a certain database. The animations produced by the same animation director at different times may have different ideas or styles. The subset of features obtained by the categorical regression tree algorithm can be used to form a hierarchical relationship map for the perception of animation works according to style and emotion.

B. *Constructing the Hidden Semantic Matrix*

A Basic Factorization Matrix (BFM) is the hidden semantic matrix used in the animation media art teaching system, which does not break down the scoring matrix into the form of a product of three matrices, in contrast to the traditional singular decomposition matrix. Multiple users and multiple items are broken down into a matrix of hidden factors corresponding to users and a matrix of hidden factors corresponding to items by the hidden semantic matrix. Complementing the original matrix is not necessary, and finally, the matrix is fitted using the obtained hidden factors to obtain the predicted scores. The following equation can express this process.

$$\overline{R}_{\alpha\times\beta} \approx R^2_{\alpha\times\beta} = P_{\alpha\times k} Q^T_{\beta\times k} \tag{3}$$

The variables α and β represent the number of student users and music, respectively, and $R^2_{\alpha\times\beta}$ represent the approximate square matrix resulting from the decomposition of the two matrices, which goes by the name of the estimated rating matrix. The following formula can be used to determine an animation's expected rating by a student user.

$$p_u q_i^T = \sum_{k=1}^{K} p_{uk} q_{ki} \tag{4}$$

The hidden semantic matrix can be well used to represent the student user's preference for the underlying features of the animation using hidden factors and lessening the matrix decomposition's complexity. The next step requires computing the two hidden factor matrices P and, Q initializing them, and then iterating them continuously using the stochastic gradient ascent method until a local optimum is reached. The following equation can define the error in scoring for every student user.

$$e_{ui}^2 = (r_{ui} - \sum_{k=1}^{K} p_{uk} q_{ki})^2 \tag{5}$$

This study uses squared error to lessen the discrepancy between the expected and real scores by first defining the loss function as:

$$arg\, L\, oss = \sum e_{ui}^2 = \sum (r_{ui} - \sum_{k=1}^{K} p_{uk} q_{ki})^2 \tag{6}$$

Then, find the direction of the current value's positive gradient, using two directional variables to differentiate.

$$\begin{cases} \frac{\partial}{\partial p_{uk}} e_{ui}^2 = -2q_{ki} = -2e_{ui}q_{ki} \\ \frac{\partial}{\partial q_{uk}} e_{ui}^2 = -2q_{ki} = -2e_{ui}q_{ki} \end{cases} \tag{7}$$

Update rules are then developed to iterate over the gradient up direction.

$$\begin{cases} p_{uk} + a\frac{\partial}{\partial p_{uk}} e_{ui}^2 = p_{uk} + 2ae_{ui}q_{ki} \\ q_{uk} + a\frac{\partial}{\partial q_{uk}} e_{ui}^2 = q_{uk} + 2ae_{ui}p_{ki} \end{cases} \tag{8}$$

The constant in the above equation a determines the machine learning rate's minimum value, which is a small value. The gradient ascent process is iterative and continuously performed until the smallest possible mistake is made. When the loss function's error is smaller, the iteration comes to an end, then the set threshold e and two matrices are ultimately obtained as:

$$E = \sum e_{ui}^2 = \sum (r_{ui} - \sum_{k=1}^{K} p_{uk} q_{ki})^2 \leq e \tag{9}$$

Hidden Semantic Matrix Decomposition can be done using the simplest formula above, and direct loss function optimization cannot be performed due to the ease with which overfitting may result. In this experiment, the original loss function is subjected to the regularization term, i.e., after introducing regularization, the loss function is expressed as follows:

$$e_{ui}^2 = (r_{ui} - \sum_{k=1}^{K} p_{uk} q_{ki})^2 + \lambda(\|p_u\|^2 + \|q_i\|^2) \tag{10}$$

$$arg\, L\, oss = \sum \begin{matrix} (r_{ui} - \sum_{k=1}^{K} p_{uk} q_{ki})^2 + \lambda(\|p_u\|^2 \\ +\|q_i\|^2) \end{matrix} \tag{11}$$

Systematic experiments can be obtained from the above equation λ, which is the regularization parameter. Eq. (11) is optimized using the stochastic gradient ascent method, where the two matrices are first biased.

$$\frac{\partial Loss}{\partial p_{uk}} = -2(r_{ui} - \sum_{k=1}^{K} p_{uk} q_{ki}) q_{ki} + 2\lambda p_{uk} \tag{12}$$

$$\frac{\partial Loss}{\partial q_{ki}} = -2(r_{ui} - \sum_{k=1}^{K} p_{uk} q_{ki}) p_{uk} + 2\lambda q_{ki} \tag{13}$$

The parameters in the above two equations p_{uk} and q_{ki} are then iteratively optimized along the minimum value of the velocity rise using alternating least squares to obtain the optimal parameter values.

$$\overrightarrow{p_{uk}} = p_{uk} + a(e_{ui}q_{ki} - \lambda p_{uk}) \tag{14}$$

$$\overrightarrow{q_{ki}} = q_{ki} + a(e_{ui}p_{uk} - \lambda q_{ki}) \tag{15}$$

The ideal hidden semantic matrix is thus obtained in this manner for this experiment, after which the parameter selection of the required functions is carried out.

C. *Activation Function of Animation Media Art Teaching System*

Without an activation function, the categorical regression tree model would only be comparable to a linear regression model and be unable to solve logical problems that were more complicated. When activation functions are introduced, a nonlinear processing model replaces the monotonic model in dynamic systems, allowing more complex animated data to be represented and computed. Today, Sigmoid, Tanh, and ReLU functions are the three monotonic functions that are most commonly utilized, and the accompanying function diagrams are displayed Fig. 3 below.

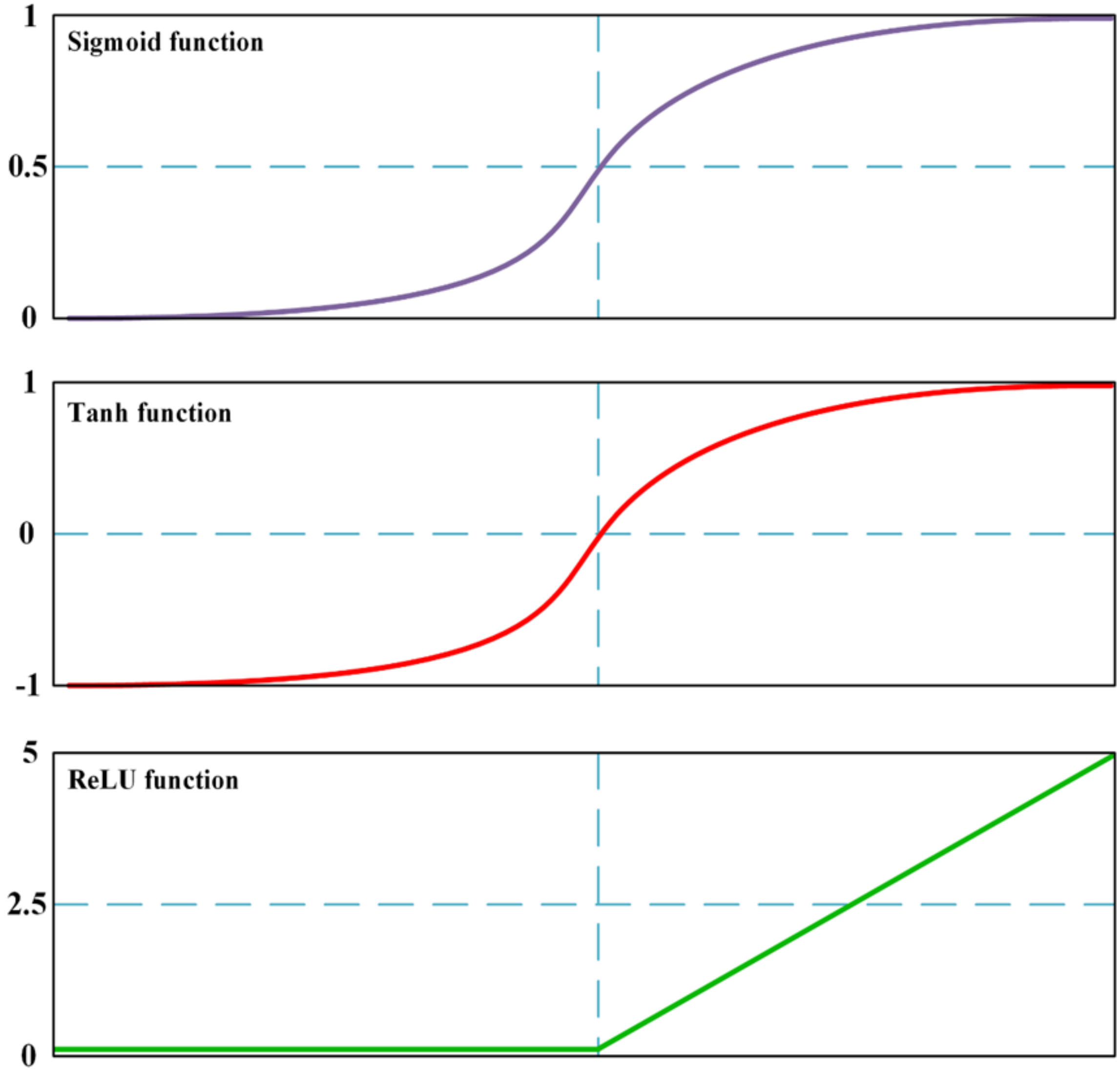

Fig. 3. Schematic diagram of Sigmoid function, Tanh function, and ReLU function.

The selection of various activation functions applied to the animation art teaching system will affect prediction and training, impacting the search and recommendation outcomes. Significant errors are produced when computing large amounts of data using the Tanh or Sigmoid functions; when utilizing the ReLU activation function, convergence can occur rapidly, reducing computation costs and increasing training effectiveness. Additionally, the ReLU function's gradient is constant for the dynamic deep animation art model, and unlike in the case of the Sigmoid function, there is no gradient disappearance. Consequently, as previously indicated, the activation function of this study's animation art teaching system is ultimately chosen to be the ReLU function.

IV. Teaching System Practice and Results Analysis

In computer deep learning, numerous open-source, free benchmark databases are available at home and abroad, but most are text, images, audio, and surveillance videos. In most cases, copyright ownership is involved in the animation data needed for this experiment, so a license was obtained with an online animation video software and applied to practical utilization of the system within an art university. First, data preprocessing is performed on an animation video library using predicted feature coefficients substituted into a classification regression tree algorithm. As previously mentioned in the section, the squared error is the loss function in this experiment. The media art teaching model is trained using the animation video data preprocessed above, and the training outcomes are displayed in the following Fig. 4.

As the resulting graph illustrates, in the early stages of training, the loss error rapidly reduces, and once the iteration round epoch surpasses 20, the function's decreasing trend is moderately delayed. Compared to the ideal case's loss value, the experimental findings align with expectations, and the classification regression tree algorithm model's prediction error falls within allowable bounds.

Then, the epoch was evaluated more comprehensively using the hidden factor dimension, and the animation video media files' number of feature vectors directly influenced the hidden factor's output dimension size. Experimentally, 248 animation students using the animation media data system were selected. When the hidden factor dimension was raised from 4 to 14, it impacted the iteration rounds, and the results are displayed in the following Fig. 5.

The greatest RMSE value can be found using the experimental findings shown in the above figure when the dimension of the hidden factor is 4, either the Epoch number is 20 or 40, which suggests that when the dimension is small, the characterization of animated images and audio features is inadequate. The RMSE value steadily drops as the dimension rises and is at its minimum when the hidden factor's dimension is 12, after which the RMSE value increases again as the dimension increases. Therefore, it can be concluded that the system model performs best for animation features when the hidden factor's dimension is 12.

The system model's accuracy and recall were tested under various recommendations and searches to verify the feasibility of this experimental categorical regression tree algorithm. The obtained results are plotted as shown below.

A comparison of the accuracy rates in the Fig. 6 shows that the accuracy rates of the recommendations using the classification regression tree algorithm model are considerably greater than those of the standard collaborative filtering recommendations after filtering the features of the animated videos and without this method. The results of the recall rate comparison between the two different algorithms are analyzed again. As the figure illustrates, the two algorithms' recall rates progressively rise as the animation search, recommendation, and viewing lists grow. An acceptable recall is attained when the recommendation list is 45, at which point the recall of the animated video data search, recommendation, and watch using the categorical regression tree model is 4.65%, while the recall of the non-standard collaborative filtering animated video data search, recommendation and watch is about 6.31%. The comparison demonstrates the influence of recommendations after filtering by the categorical regression algorithm model is superior to the irregular collaborative filtering recommendation system.

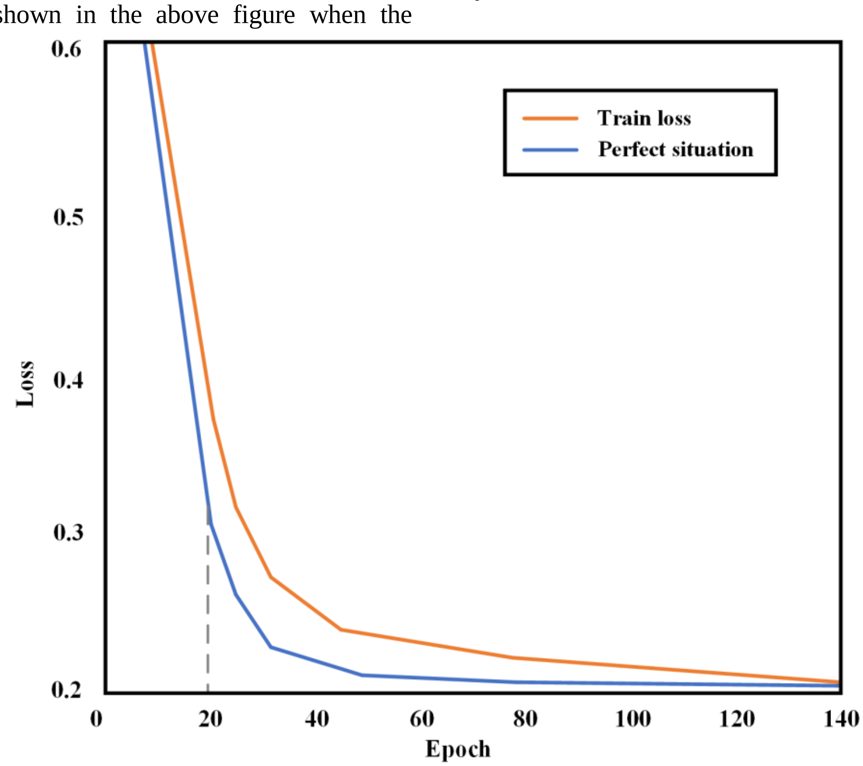

Fig. 4. The relationship between the ideal value and the loss value of the training model.

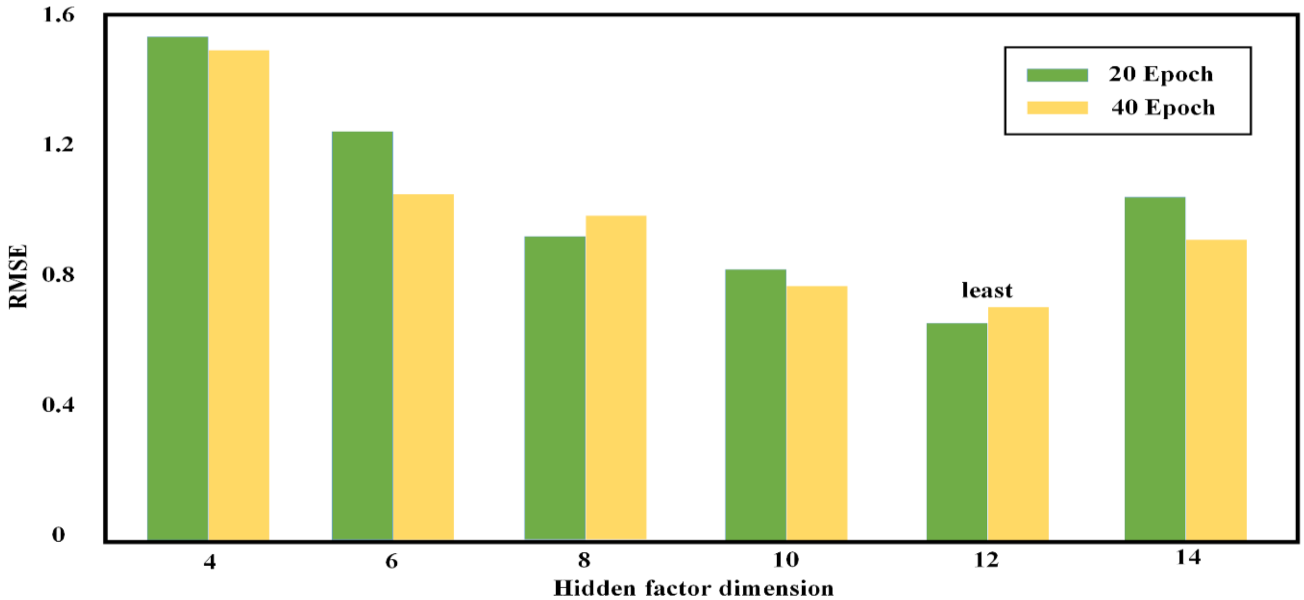

Fig. 5. RMSE of predicted scores at different k and epoch.

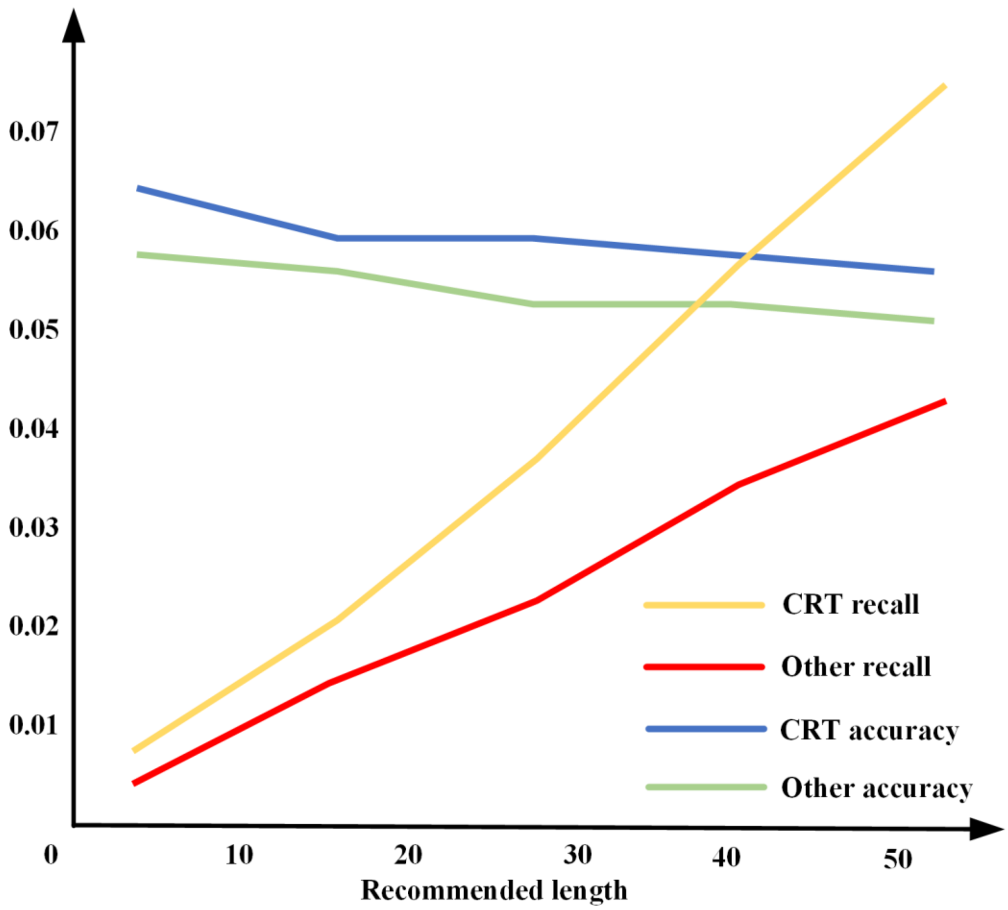

Fig. 6. Comparison plot of precision and recall for two different algorithms.

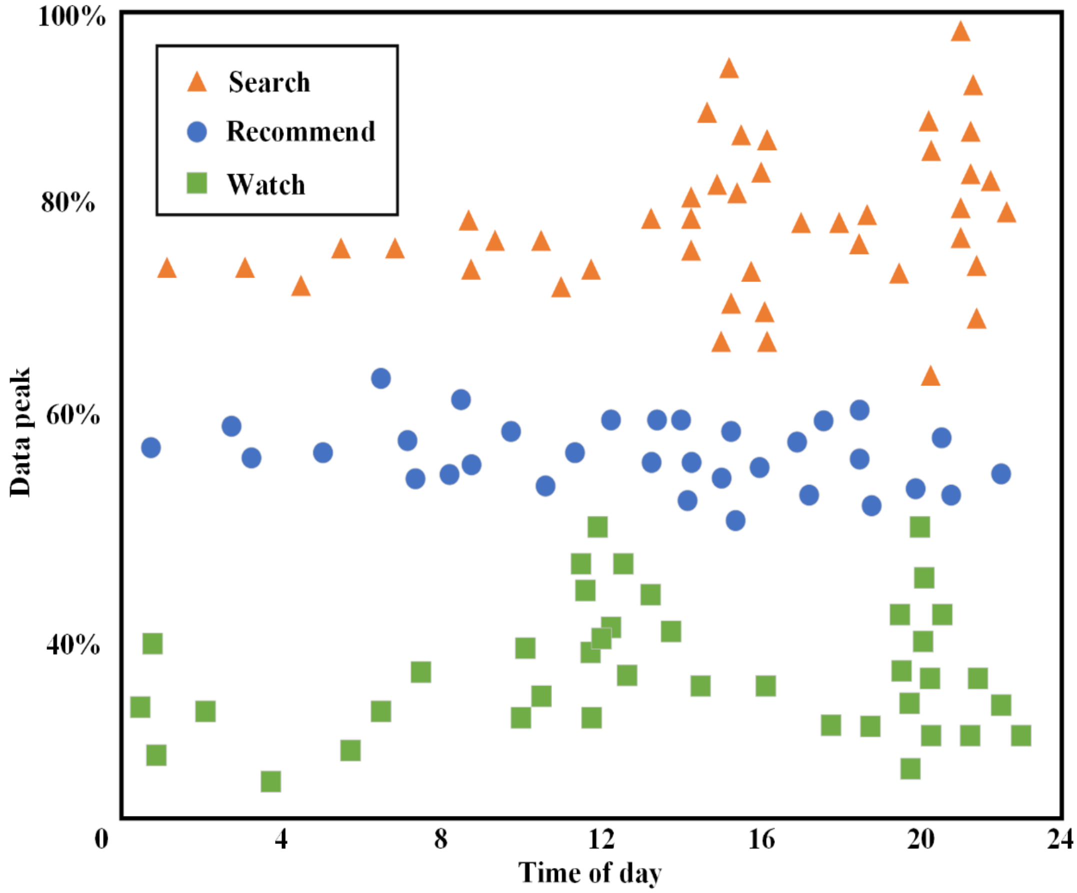

Fig. 7. Graph of peak data searched, pushed, and watched throughout the day.

The animated video data in the system has three-dimensional features. The data is dimensionally reduced to represent the database using low-dimensional data to optimize management. As shown in the Fig. 7 above, the low-dimensional data can accurately reflect the results and has no redundant features, making it faster and easier to calculate search, recommendation, and viewing results for the low-latitude data.

The above figure depicts the data peaks of the animation students searching, pushing, and watching animations during the entire day. The recommendation data peaks of the college students during the day are kept within a reasonable range without abnormal peaks and underestimations. This suggests the experiment's data system is stable and not overly resource-intensive when computing and producing recommendation results, which meets the requirements of faculty and student users. There will be two data peaks during the search, at 15:00 and 21:00. Because these two times correspond to the most frequent demands of students for entertainment and classes, this essay speculates that there might be such search peaks. The average data of the recommendation system indicates that the system makes stable recommendations at each time slot. The viewing behavior peaks at 12:00 and 20:00, which is caused by the analysis that students have the behavior habit of watching animation during lunch break and evening break time. The stability of the peak value of daytime recommendation data indicates that the system can continuously and accurately provide recommendation services to users without excessive resource occupation. The average recommendation data indicates that the system can maintain stable recommendation performance at different time periods. Through classroom testing of animation teaching, it was found that students have improved in painting, directing skills, animation scope, and animation appreciation, proving the effectiveness of the system in teaching.

After implementing the animation media art teaching system based on big data integration technology for seventy days, college students' ability in related majors was examined through animation teaching classroom tests. Fig. 8 below shows that the animation students have improved their drawing and directing skills, their scope of animation, and their appreciation of animation through the system.

The results were used for a while. The feedback from the teachers and students of the animation majors in the universities involved in the experiment was acquired using a survey. Fig. 9 below displays the results.

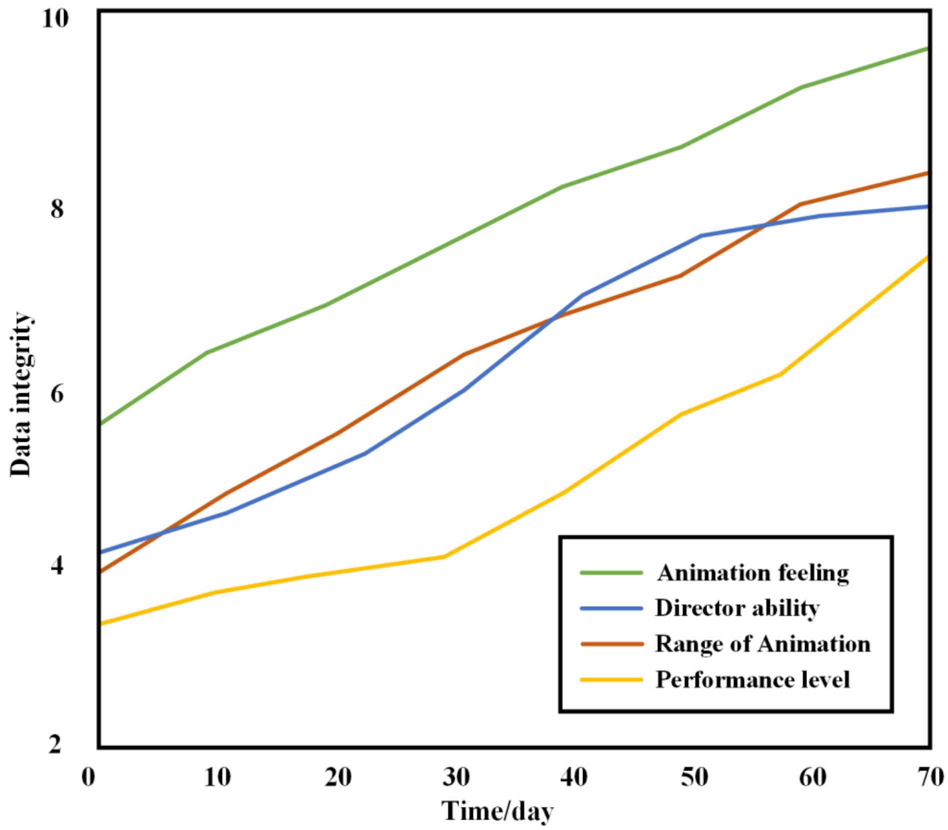

Fig. 8. The relationship between students' animation scores and days under classification regression tree model data mining.

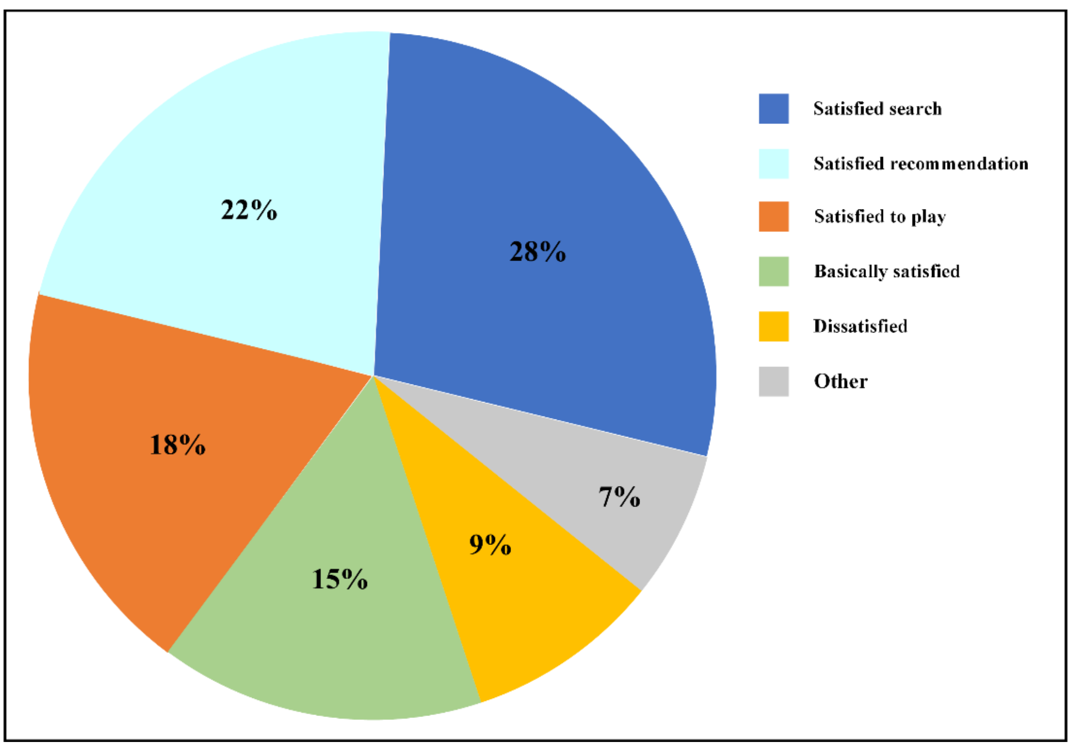

Fig. 9. The results of the teacher and student satisfaction survey of the animation media art teaching system.

V. Results and Discussion

After a series of experiments and practices, the animation media art teaching system based on big data fusion technology has shown significant results. Firstly, by substituting the predicted feature coefficients of the classification regression tree algorithm into the animation video library for data preprocessing, the system can accurately extract and characterize the features of animation data, providing a high-quality dataset for subsequent teaching model training. During the training process, the loss error rapidly decreases and tends to stabilize after a certain iteration period, indicating that the model has a good fitting effect on the data and the prediction error is within an acceptable range.

When evaluating the impact of hidden factor dimensions on model performance, the experiment found that the system performed best when the hidden factor dimension was 12. At this point, the model is able to effectively extract features from animated videos and performs well in search, recommendation, and viewing. This discovery is of great significance for optimizing model structure and improving system performance.

Compared with traditional collaborative filtering recommendation systems, recommendation systems based on classification regression tree algorithms exhibit advantages in accuracy and recall. Especially in the search, recommendation, and viewing of animation video data, the classification regression tree model can more accurately filter and recommend animation content that meets user needs, improving the usability and user experience of the system.

In addition, the system optimizes data management through dimensionality reduction techniques when processing animated video data with three-dimensional features, enabling low dimensional data to accurately reflect results and improving search, recommendation, and viewing efficiency. In practical applications, the stability and performance of the system have also been verified, meeting the needs of teachers and students.

VI. Conclusion

This study is based on big data fusion technology and successfully constructed an animation media art teaching system, which was applied in a practical teaching environment for 70 days. By substituting the classification regression tree algorithm for data preprocessing and model training, the system demonstrated good predictive performance with errors within the allowable range. When evaluating the impact of hidden factor dimensions on model performance, it was found that when the hidden factor dimension is 12, the system performs best on animation features. In terms of recommendation and search, the accuracy of the classification regression tree algorithm model is significantly higher than that of traditional collaborative filtering recommendation methods, and the recall rate also shows superiority. In addition, the system has optimized data management through dimensionality reduction technology, enabling low dimensional data to accurately reflect results and improving the efficiency of search, recommendation, and viewing. In practical applications, the stability and performance of the system have been verified, meeting the usage needs of teachers and students. Through classroom tests and analysis of student grades in animation teaching, it was found that the system can effectively enhance students' painting and directing skills, animation scope, and appreciation of animation. The satisfaction survey results of teachers and students also show that the system has been widely applied and praised in practical teaching.

However, in research based on big data, the quality and completeness of data are crucial. In practical applications, there may be issues such as missing, incorrect, or inconsistent data. This may lead to inaccurate or biased analysis results, thereby affecting the effectiveness of instructional design. Although big data fusion technology has achieved some successful applications in other fields, its application in animation media art teaching design is still in the exploratory stage. Therefore, there may be some uncertainty in the feasibility and stability of the technology. In order to improve data quality, future research will pay more attention to the process of data cleaning, validation, and integration. By adopting advanced data preprocessing techniques, errors and inconsistencies in the data can be identified and corrected, ensuring the accuracy of the analysis results. The system will adopt more robust data storage and backup mechanisms. Meanwhile, by introducing data auditing and monitoring mechanisms, data integrity issues can be promptly identified and addressed, ensuring data integrity and credibility.

References

[1] R. Krishnaswamy, K. Subramaniam, V. Nandini, K. Vijayalakshmi, S. Kadry, and Y. Nam, "Metaheuristic Based Clustering with Deep Learning Model for Big Data Classification," Comput. Syst. Sci. Eng., vol. 44, no. 1, pp. 391–406, 2023.

[2] F. Alassery, A. Alzahrani, A. I. Khan, K. Sharma, M. Ahmad, and R. A. Khan, "Evaluating Security of Big Data Through Fuzzy Based Decision-Making Technique," COMPUTER SYSTEMS SCIENCE AND ENGINEERING, vol. 44, no. 1, pp. 859–872, 2023.

[3] P. Velpula and R. Pamula, "CEECP: CT-based enhanced e-clinical pathways in terms of processing time to enable big data analytics in healthcare along with cloud computing," Comput Ind Eng, vol. 168, p. 108037, 2022.

[4] G. M. Mallow, A. Hornung, J. N. Barajas, S. S. Rudisill, H. S. An, and D. Samartzis, "Quantum computing: the future of big data and artificial intelligence in spine," Spine Surg Relat Res, vol. 6, no. 2, pp. 93–98, 2022.

[5] J. Yuan, S. Wang, and C. Pan, "Mechanism of Impact of Big Data Resources on Medical Collaborative Networks From the Perspective of Transaction Efficiency of Medical Services: Survey Study," J Med Internet Res, vol. 24, no. 4, p. e32776, 2022.

[6] B. Frick, J. B. Boster, and S. Thompson, "Animation in AAC: Previous research, a sample of current availability in the United States, and future research potential," Assistive Technology, vol. 35, no. 4, pp. 302–311, 2023.

[7] U. H. M. Hasri, M. A. M. Syed, and C. Runnel, "Transmedia storytelling in the Malaysian animation industry: Embedding local culture into commercially developed products," Atlantic Journal of Communication. https://www. tandfonline. com/doi/abs/10.1080/15456870.2020, vol. 1835909, 2020.

[8] H. Yuan, J. H. Lee, and S. Zhang, "Research on simulation of 3D human animation vision technology based on an enhanced machine learning algorithm," Neural Comput Appl, vol. 35, no. 6, pp. 4243–4254, 2023.

[9] H. Wang, A. Sharma, and M. Shabaz, "Research on digital media animation control technology based on recurrent neural network using speech technology," International Journal of System Assurance Engineering and Management, vol. 13, no. Suppl 1, pp. 564–575, 2022.

[10] M. H. O. Jaouadi, “Investigating the influence of big data analytics capabilities and human resource factors in achieving supply chain innovativeness,” Comput Ind Eng, vol. 168, p. 108055, 2022.

[11] M. Xiao, “Supervision strategy analysis on price discrimination of e-commerce company in the context of big data based on four-party evolutionary game,” Comput Intell Neurosci, vol. 2022, 2022.

[12] A. Sampathkumar et al., “Internet of Medical Things (IoMT) and reflective belief design-based big data analytics with Convolution Neural Network-Metaheuristic Optimization Procedure (CNN-MOP),” Comput Intell Neurosci, vol. 2022, 2022.

[13] M. Thilagaraj et al., “A novel intelligent hybrid optimized analytics and streaming engine for medical big data,” Comput Math Methods Med, vol. 2022, 2022.

[14] D. Tindall, J. McLevey, Y. Koop‐Monteiro, and A. Graham, “Big data, computational social science, and other recent innovations in social network analysis,” Canadian Review of Sociology/Revue canadienne de sociologie, vol. 59, no. 2, pp. 271–288, 2022.

[15] A. C. Ikegwu, H. F. Nweke, C. V. Anikwe, U. R. Alo, and O. R. Okonkwo, “Big data analytics for data-driven industry: a review of data sources, tools, challenges, solutions, and research directions,” Cluster Comput, vol. 25, no. 5, pp. 3343–3387, 2022.

[16] M. Babar, M. U. Tariq, M. D. Alshehri, F. Ullah, and M. I. Uddin, “Smart teledentistry healthcare architecture for medical big data analysis using IoT-enabled environment,” Sustainable Computing: Informatics and Systems, vol. 35, p. 100719, 2022.

[17] N. L. Bragazzi, C. Bridgewood, A. Watad, G. Damiani, J. D. Kong, and D. McGonagle, “Harnessing big data, smart and digital technologies and artificial intelligence for preventing, early intercepting, managing, and treating psoriatic arthritis: insights from a systematic review of the literature,” Front Immunol, vol. 13, p. 847312, 2022.

[18] A. He, “Application of Artificial Intelligence Elements and Multimedia Technology in the Optimization and Innovation of Teaching Mode of Animation Sound Production,” Wirel Commun Mob Comput, vol. 2022, 2022.

[19] D. Parmar, S. Olafsson, D. Utami, P. Murali, and T. Bickmore, “Designing empathic virtual agents: manipulating animation, voice, rendering, and empathy to create persuasive agents,” Auton Agent Multi Agent Syst, vol. 36, no. 1, p. 17, 2022.

[20] Y. Wei, “Deep-learning-based motion capture technology in film and television animation production,” Security and Communication Networks, vol. 2022, 2022.

[21] Du, Y. (2020). Research on the transformation and innovation of visual art design form based on digital fusion technology. Applied Mathematics and Nonlinear Sciences, 9(1), 1.

[22] Qiu, G., & Zhang, J. (2023). Application of digital technology in painting using new media and big data. Soft Computing, 27(17), 12691-12709.

[23] Ma, Z., Guan, J., & Li, R. (2021). Research on innovative teaching mode of art education in the age of convergence of media. International Journal of Emerging Technologies in Learning (iJET), 16(2), 272-284.