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RESEARCH ARTICLE

Big Data-Driven Intelligent Analysis for Art Design Schemes Based on Grey Correlation

ZHIMING HUANG[1] AND JUNHAO TAO[2]
[1]College of Art, Jiangxi University of Finance and Economics, Nanchang, Jiangxi 330013, China
[2]Arts College, Guizhou Minzu University, Guiyang, Guizhou 550000, China

Corresponding author: Junhao Tao (TJHtjh777@163.com)

ABSTRACT In area of art design, it has been a promising solution to integrate intelligent algorithms to improve working efficiency. However, there still lacks mature solutions that are used for digital evaluation of design works. To deal with such issue, this paper introduces big data analysis to construct prototype for such application. Thus, a systematic research on a big data-driven intelligent system for digital evaluation of design works, is conducted in this paper. Firstly, the grey correlation analysis is utilized to explore the importance of multi-source influential factors. On this basis, a digital evaluation algorithm is developed to output digital evaluation of design works from initial feature data. The grey correlation algorithm is used to optimize the data analysis process, and through preprocessing and accurate data detection, the confidence level of the effectiveness results is improved. Finally, a prototype of the intelligent system in which evaluation algorithm can be embedded, in order to provide a platform for smart operation of such workflow. For empirical analysis, we carry out a case study to verify performance of the proposed technical framework. The traditional methods can have a metric value about 40%, and the proposal can have a metric value about 60%-70%. The results show that the proposal can serve as an available solution to implement digital evaluation of design works, under environment of big data stream.

INDEX TERMS Big data analytics, intelligent systems, digital evaluation, gray correlation analysis.

I. INTRODUCTION

With the rapid development of information society, the amount of data and information generated by people in daily life is also growing rapidly [1]. As a mass oriented data environment, big data includes rich and complex information resources [2]. Data processing and analysis is the technology of potential value mining in massive data resources [3]. How to correctly treat and apply data analysis is the main content and work of national research [4]. All data that can be collected should be used in the analysis process, rather than relying on a small part of information [5]. At the same time, it should be accompanied by content related to certain things, rather than pointless sample data [6]. In the field of art design, the analysis and research of the scheme is the main means to solve the boring design environment and the lack of creativity of the content [7], [8].

According to the ideas and data support provided by big data analysis technology, the problems of design solutions are evaluated and compared [9]. Artistic design scheme plays a vital role in the finished product and quality [10]. From the perspective of design characteristics, a proposal with timeliness, complexity and effectiveness is a complex and uncontrollable process [11]. Especially under the influence of traditional design thinking, art nouveau design is updated and iterated [12]. In the atmosphere of the traditional unsophisticated view, people believe that the need for rational analysis of art design schemes is an act of stifling creative thinking [13]. This greatly hinders people's research on the optimization process of art products [14].

Most art creators always design according to their personal experience, and there are also great differences in aesthetic views brought about by the differences of each individual [15]. This difference will inevitably lead to the disunity of design concept and scheme [16]. Then, in the effectiveness and feasibility analysis of the design scheme, how to compare the advantages and disadvantages of different ideas proposed by multiple individuals is the key object of data analysis [17]. For a long time, the evaluation of design schemes has been derived from a simple model of a few followed by

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the majority. Due to different social development structures, people's cognition of art is also changing. The conclusion of this evaluation of design scheme is not applicable to big data environment, but also reflects the timeliness difference of design scheme evaluation. In order to improve the timeliness and strong personalization of this evaluation effect, people began to collect a large amount of data to help the selection of art design schemes [18].

However, a large number of data processing process is a complex and changeable environment, and the calculation results are multidimensional and multi-dimensional. Therefore, we need to use data analysis technology to form a scientific, accurate and effective art design scheme evaluation model [19]. Try to avoid the influence of fuzzy characteristics such as timeliness and personalization to interfere with the calculation results. This paper is mainly divided into three parts. The first part is to explore the necessity and significance of the research on the effectiveness of mathematical analysis of art design schemes, and conduct literature research and discussion from the development process of art design schemes and the development process of data analysis technology in various countries. The second part first uses the gray correlation analysis method in data analysis to simply evaluate the art design scheme. Secondly, big data-driven and association rule algorithm are introduced to study the factors that affect the effectiveness of art design. Finally, in the same environment, the effectiveness of a design scheme evaluation model is compared to form a visual data interface display. The third part is to analyze the research results of the effectiveness model of art design scheme supported by data analysis technology, and explore the effects, advantages and disadvantages in practical application.

This paper builds a system model for digital evaluation of design works based on Big data technology. The innovation points are as follows:

1) This article constructs a performance comparison effectiveness model based on association rules on the basis of traditional analysis models. At the same time, the feasibility and effectiveness of data analysis technology in artistic design schemes were verified.

2) The study used grey correlation algorithm to optimize the data analysis process, and improved the confidence level of effective results through preprocessing and accurate data detection.

3) This article uses Analytic Hierarchy Process and Multi-dimensional Analysis to evaluate the unstable results caused by differences in audience groups and eliminate subjective factors that affect artistic design schemes.

4) This article uses relevant categories of art and design schemes as evaluation criteria to assess the acceptance and satisfaction of the public under different schemes.

II. RELATED WORK

Big data analysis technology is the main method and research content of processing massive information resources at present. The results of data analysis are affected by the content and method of analysis to a certain extent [20]. Choosing different analysis techniques can be applied in different types of environments. There are differences in rules between complex data analysis technology and traditional text and relationship analysis [21]. This high degree of correlation has dramatically increased the difficulty of data analysis technology. With the application of network data graph and entity data analysis, identifying data analysis has become the mainstream technology [22]. However, from the perspective of data system framework, it mainly adopts the method of model building for theoretical implementation. The development of scientific information technology has provided an excellent platform and environment for big data technology [23]. Data analysis and big data technology have brought new opportunities and challenges to the development of many industries.

The traditional media analysis and strategy analysis are slightly weak in the dynamic mass of data [24]. Therefore, the industrial development in many fields cannot be separated from the data support of data analysis. In the actual process, the distribution of data resources is complex and there are no rules to follow, which increases the difficulty of data analysis. Therefore, we should not only ensure the speed of data analysis, but also ensure the quality of data results. The validity of a calculation result is reflected in the consistency, timeliness, accuracy and integrity of the data [25]. People need to choose the method of screening data, so as to simplify part of the calculation content, evaluate and analyze the effectiveness of the data, and finally put it into appropriate application fields for use.

The development of computer technology in the United States is early, and there are many achievements in big data analysis. With the increasing amount of miscellaneous resources generated by data processing, the processing efficiency and storage cost have been directly affected [26]. Some scholars have added cloud computing technology to data analysis, using cloud storage to provide Internet of things services, and storing massive processing information in containers that do not need users to consider. This kind of data analysis can obtain dynamic information resources at any time, so as to improve the real-time effect of the dimension of their own calculation [27]. At the same time, it provides corresponding guarantee in the production process of complex data, adds and analyzes the calculation process, takes the lead in reducing part of useless information and improving the operation efficiency of the system. The weather changes in Japan are very changeable. They apply big data analysis technology to the analysis of meteorological data. The amount of meteorological data is huge, and it is a long-term cumulative growth [28].

This kind of digital data can be analyzed separately under different meanings. After data collection, relevant departments first analyze the historical data and transmit the results to the back-end accuracy calculation program for recording [29]. It is supposed to continue to mine data content, improve

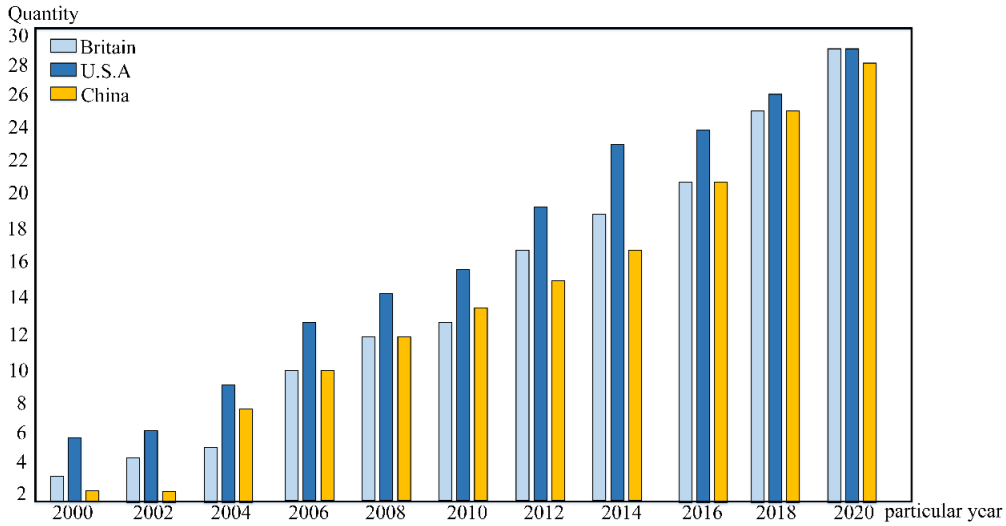

FIGURE 1. Literature development status of data analysis.

the authenticity and effectiveness of data analysis results, and ensure that workers can fully understand the content of data transmission. Finally, it is supposed to compare with the original data information to achieve the purpose of data prediction. Fernández-Caramés et al. introduced the design and evaluation of a drone based system aimed at automating inventory tasks and maintaining traceability of industrial items attached to radio frequency identification (RFID) tags. The system uses blockchain and distributed ledgers to store certain inventory data collected by drones, validate it, ensure its credibility, and provide it to relevant parties. The system can also estimate the position of an item when hovering over it. In addition, the performance of the proposed blockchain based architecture was evaluated in different scenarios [30]. In the new era of Internet of Things, Big data collection and analysis based on widely distributed intelligent sensor technology is particularly important. Luo et al. reported a flexible and durable wood triboelectric nano generator, which is used for self powered sensing in motion Big data analysis. Based on a simple and effective strategy, natural wood can be transformed into a high-performance friction electric material with excellent mechanical properties. Such as increased strength by 7.5 times, flexibility, wear resistance, and processability [31].

From the above research status, this paper finds that data analysis technology can help improve the accuracy and effectiveness of art design schemes. There are also predictive effects in practical application. The traditional art design scheme evaluation model is affected by many factors, including art design experience, selected materials, user satisfaction and so on. These indicators jointly determine whether the design scheme is effective, so we use data analysis technology to judge the association rules between influencing factors, and use the master-slave relationship to improve the feasibility of the scheme.

III. METHODOLOGY

A. PRE-PROCESSING

There are two problems and influences in the study of the effectiveness of data analysis. The first is the lack of data, which is reflected in the random lack of data and systematic lack. Among them, random deletion is the current situation of random distribution of data in this case. The main factor causing this situation is the stability change of individual characteristics. Random deletion affects the measurement reliability in the validity of data analysis. Systematic absence is a systematic rule in the analysis of data, which not only affects the reliability of the evaluation, but also affects the validity. The traditional data analysis technology consists of a part of data mining and algorithms, in which linear interpolation method, curve regression method and other mathematical formulas are used more. However, facing the dynamic information characteristics in the big data environment, we need to add a variety of monitoring models in data processing. As a basic resource, big data cannot provide users with the real situation. Therefore, in the big data environment, we need to remove invalid information and retain valid data for sampling extraction. We analyze the current situation of literature development in data analysis in various countries, as shown in Figure 1:

It can be seen from Figure 1 that the UK and the US have published a large number of documents related to data analysis and started earlier. Since 2004, China has gradually increased its research in related fields. In order to improve the effectiveness of data analysis, this paper takes the effect evaluation as the starting point, and randomly extracts the design scheme information to obtain the distributed evaluation indicators. At the same time, calculate the weight index, and build a gray correlation analysis model. In the evaluation of art design schemes, the effect of each scheme is different, so the calculation unit will be different. We preprocess the

information with the following formula:

$$x_i(j) = \left\{ \frac{x_i - \min(j)}{\max(j) - \min(j)}, \max(j) - \min(j) > 0(1) \right. \quad (1)$$

$$x_i(j) = \left\{ \frac{\max x_i(j) - x_i(j)}{\max(j) - \min(j)}, \max(j) - \min(j) < 0(2) \right. \quad (2)$$

In the formula, $\min(j)$ represents the smallest term of the data sequence, $\max(j)$ represents the largest item of the data sequence. The evaluation index of effective analysis is generated according to the above formula, as shown in Table 1.

It can be seen from table 1 that the influencing factors are divided into two forms: the larger the better, and the smaller the better. Among them, the larger the data is, the better the effect is. After pretreatment, a new sequence of evaluation model can be obtained. According to the evaluation characteristics of art design scheme, a reference sequence is randomly selected in the index, and the formula is as follows:

$$\{x_0\} = \{x_0(1), x_0(2), \ldots, x_0(n)\} \quad (3)$$

In the formula, $x_0(n)$ is the parent sequence. analyze the correlation degree of the sequence calculated above, and the process is shown in Figure 2:

It can be seen from Figure 2 that the corresponding evaluation scale and relationship coefficient are selected according to the purpose, experience and interest of the effectiveness evaluation of the art design scheme. In the multi-level gray correlation analysis model, the data are normalized first, and then the optimal features in the evaluation target group are used to form the reference sequence. The comparison sequence and reference sequence are calculated according to the relationship structure of gray-scale related objects. The gray correlation algorithm is used to sort the relationship and determine the performance impact of each evaluation index. Sum up the effectiveness indicators of different art design schemes, and allocate weight coefficients according to the size of relevance. The determination process of the weight coefficient is first composed of a judgment matrix. The maximum characteristic matrix and the minimum characteristic matrix in the index are known, and the relationship between the two and the optimal sequence is calculated. Suppose multiple design files and evaluation indexes are used to calculate the set weight value by using the judgment matrix of repeated sequence, and the formula is as follows:

$$C_{nj} = \begin{bmatrix} 1 \\ 3 \\ 5 \end{bmatrix}, C_{nj} = 1/C_{nj}(4) \quad (4)$$

On this basis, the characteristic quantity of the judgment matrix is calculated and generalized. Construct the best feature sequence, and each independent influencing factor corresponds to a weighted correlation degree. The formula is:

$$G = \sum_{i=1}^{m} \xi n_i \, gw(k) \quad (5)$$

$$G_0 = \sum_{i=1}^{m} C_{rj} \, gw(k)/n_0 \quad (6)$$

In the formula, ξ represents the index series, $w(k)$ is the correlation degree value of each node, is the weighted value of the grey coefficient. Calculate the related variables according to the above formula to provide data support for the feasibility of the art design scheme. Finally, we need to provide sampling feature parameters for effectiveness. The purpose of sampling is to obtain the internal features in the data set. Generally, the data sampled are divided into continuous and discrete types:

$$\delta^2 = \frac{\sum (x(i) - x)^2}{n - 1} \quad (7)$$

$$\delta_n^2 = \frac{\delta^2}{n}\left(1 - \frac{n}{N}\right) \quad (8)$$

Among them, $x(i)$ is the sample value in the data set, δ_n^2 is the average. Discrete data cannot be calculated numerically, so the above association rules should be selected for mining and calculation. To prove the feasibility of the design scheme, we must compare the error coefficients before and after sampling, judge the error and calculation accuracy in this way, and express the theoretical support and actual support according to the association rules and reliability frequency as follows:

$$\text{sup port}(X \to Y) = \text{sup port}(X \cup Y) = \frac{\text{count}(X \cup Y)}{|D|} \quad (9)$$

$$S(X \to Y) = \frac{\sigma(X \cup Y)}{N} \quad (10)$$

The reliability is expressed as:

$$\text{confidence}\ (X \to Y) = \frac{\text{sup port}(X \cup Y)}{\text{sup port}(X)} \quad (11)$$

$$C(X \to Y) = \frac{\sigma(X \cup Y)}{\sigma Y} \quad (12)$$

Among them, N is the total data coefficient, $\sigma(Y)$ represents the number of possible occurrences, $\sigma(X \cup Y)$ represents the number of common occurrences, so the sampling proportion is theoretically:

$$S_\Delta(X \to Y) = \frac{\sigma(X \cup Y) \times \delta}{N \times \delta} \quad (13)$$

$$S_\Delta(X \to Y) = \frac{\sigma(X \cup Y)}{N} \times \delta_\Delta \quad (14)$$

Among them, the error of representative sampling results is generated because the reliability and support will not be perfect. In order to obtain the sampling of perfect results, we also need to add the calculation of interest to reduce the impact of users on the effectiveness of the design scheme. The formula is as follows:

$$\text{int erest}\ (X \to Y) = \text{confidence}(X \to Y) - \text{sup port}(Y) \quad (15)$$

According to the above formula, the influence of different art design schemes on the effect can be judged in the data analysis, so as to help the designer plan the direction.

TABLE 1. Effective evaluation index.

Bigger and better	Smaller and better	value type
correlation coefficient	Deviation degree	mean value
Art design scheme evaluation information	Standard variance	mean value
influence factor	Mean variance	mean value
Satisfaction	Error coefficient	mean value
standard deviation	data redundancy	mean value

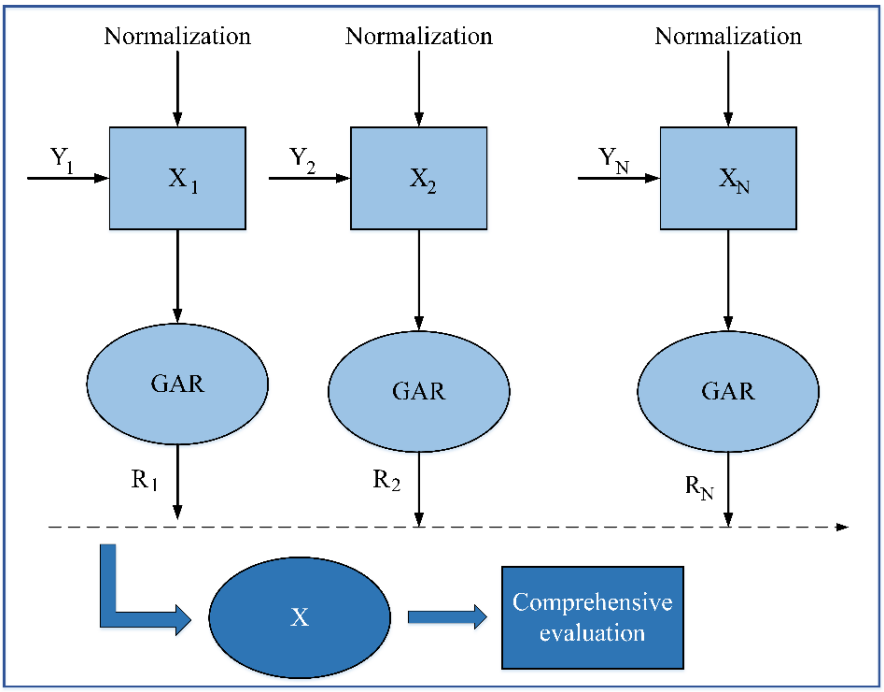

FIGURE 2. Correlation analysis process.

The grey correlation analysis method for digital evaluation of design works involves many calculation steps, and the following is an analysis of its computational complexity:

Firstly, it is necessary to determine the reference sequence and the comparison sequence. The reference sequence is a data sequence that reflects the characteristics of system behavior, while the comparison sequence is a data sequence composed of factors that affect system behavior. These data sequences need to be determined based on the specific digital evaluation needs of design works. Due to the fact that the data in each factor column in the system may have different dimensions, it is necessary to perform dimensionless processing. Common methods include initialization and averaging. On the basis of dimensionless processing, it is necessary to calculate the correlation coefficients between each factor and the reference sequence. The calculation of correlation coefficients requires the use of resolution coefficients, which need to be determined based on specific circumstances. Based on the correlation coefficients between each factor and the reference sequence, the grey correlation degree between each factor and the reference sequence can be calculated. According to the grey correlation degree of each factor, they can be sorted for evaluation. In the calculation process of this method, it is necessary to consider the impact of factors such as the length of the data sequence, data volume, data distribution patterns, data accuracy and reliability on the calculation results. Therefore, the computational complexity of this method is high, and it requires the use of computer technology for efficient data processing and computation.

B. EFFECTIVE EVALUATION AND MODELING OF ART DESIGN SCHEMES UNDER DATA ANALYSIS

The data analysis of the effectiveness of art design schemes is based on the objective needs of improving the content and development of design schemes. Art design needs to be based on material and conveyed to user groups through various carriers. Therefore, the design concept needs to conform to a certain degree of objectivity. The executor of the design scheme should also take the user masses as the main body in the design process, and the evaluator of the effectiveness is also the user masses. Therefore, the subjectivity of design cannot be completely removed, which has a strong impact on

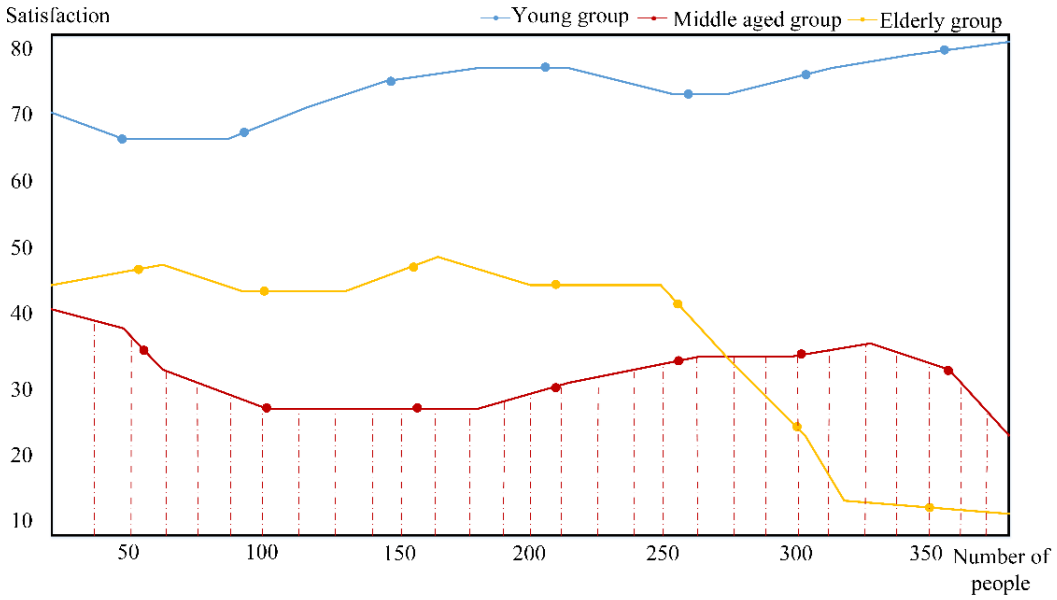

FIGURE 3. Comparison of recognition among different age groups.

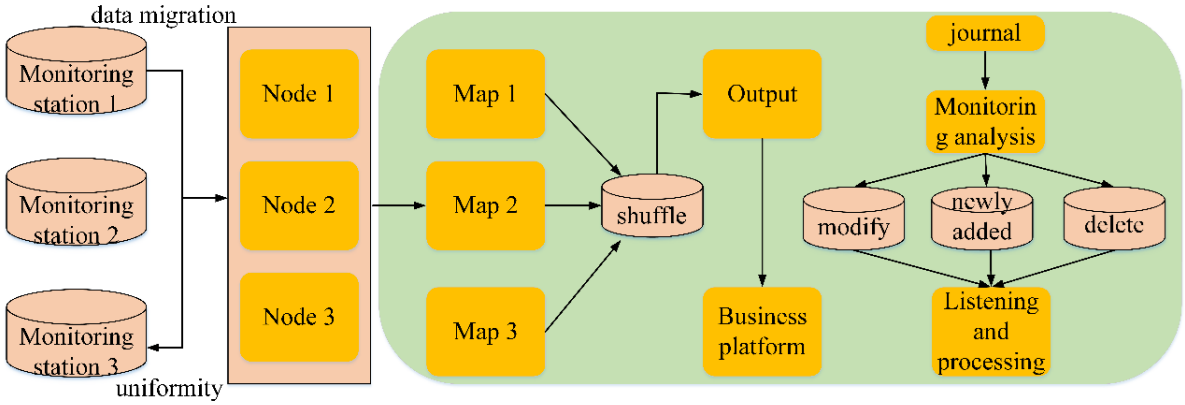

FIGURE 4. Evaluation system structure diagram.

the overall effect evaluation. Art design scheme is a combination of experience and innovative thinking, which requires years of aesthetic ability and creative inspiration to judge.

However, whether the design scheme meets the current needs can only be defined by experience judgment and design quality comparison to a large extent. However, the comparative evaluation of design works needs more reliability data to support. The use of data analysis technology and means can eliminate some non objective factors and provide scientific decision-making for product design. We compare the recognition of the masses to the data analysis of the design scheme at different ages, as shown in Figure 3. It can be seen from Figure 3 that a small number of middle-aged people believe that mathematical analysis of design schemes is an act that destroys creativity and artistry. Most young people support the mathematical analysis of the effectiveness of the design scheme. Starting from the cognitive level of the creator of the art design scheme, this paper makes a statistically effective evaluation of the existing design scheme through three steps: early data collection, adding the calculation statistical model, and obtaining the matrix calculation result analysis.

In the data analysis model, we also need to constantly update and synchronize the information of the database. Maintain consistency between data repositories. We add a monitoring device to improve the timeliness of art design evaluation by adding, modifying and deleting the observation data of the monitor. It can be seen from Figure 4 that the system structure diagram includes data storage module, data calculation module, data migration path and monitoring analysis module. The core content of the whole system is the distributed evaluation program, which classifies the needs according to the actual use of art design schemes after the monitoring data processing. In art design, the main factor affecting users' choice is emotional transmission. People's

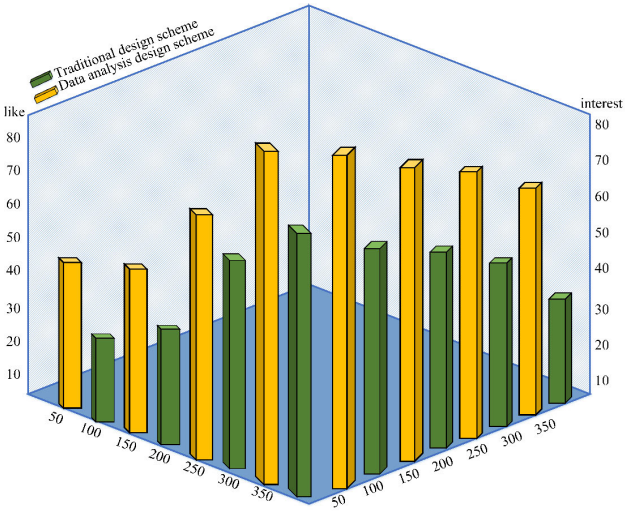

FIGURE 5. Comparison of emotion coefficient between traditional design scheme and data analysis design scheme in three-dimensional diagram.

contact with external things will bring physiological reactions to themselves, and this perception can be transmitted through materials to a large extent. In the actual needs, art design should not only meet the spiritual needs, but also meet the physiological needs.

Therefore, the stimulation brought by art design products will make users evaluate the goal, aesthetics and attitude of the products. From a three-dimensional perspective, we compare the impact of the traditional design scheme and the design scheme after data analysis on the emotional attitude of the same group, as shown in Figure 5. It can be seen from Figure 5 that the same group has a low emotional coefficient for traditional design schemes and a high emotional coefficient for design schemes supported by data analysis. Therefore, data analysis has a practical impact on the feasibility of the design scheme. Combined with analytical thinking, measure users' psychological expectations, such as preferences and interests. In the analysis, the important feature attributes of the design scheme are retained, and each feature is given a different evaluation combination. Assuming that consumers and user groups choose and prefer according to the functionality of art design, then add functional requirements to the outline evaluation of design schemes, and then we can calculate whether such design schemes meet the needs of current users.

IV. SIMULATION AND ANALYSIS

A. BASIC SETTING

The following is a system specification of intelligent system platform for digital evaluation of design works based on Big data analysis: establish corresponding models according to the preprocessed data, including classification, clustering, regression, etc. This article analyzes user data, understands user preferences and needs, and provides personalized recommendations and evaluations for design works. Recommend design works that meet user preferences and needs based on their preferences and needs. Based on user feedback and data analysis results, continuously optimize recommendation algorithms to improve recommendation accuracy. Set various parameters of the system, including data storage, analysis cycle, recommendation algorithm, etc. Manage data analysis tasks, including task scheduling, operational status monitoring, and other functions. Through the above specifications, an intelligent system platform for digital evaluation of design works driven by Big data analysis can be realized, providing users with personalized and intelligent design works recommendation and evaluation services, and also providing data support and guidance for designers and design institutions.

The research data set of intelligent system for digital evaluation of design works driven by Big data analysis can be obtained from the following aspects:

Web crawler: Through web crawler technology, metadata, ratings, comments, tags, and other related data of design works are obtained from design work sharing platforms, social media, online databases, etc.

Open Dataset: Utilize open datasets such as design competition datasets, design work libraries, etc. to obtain relevant data on design works.

Partners and institutions: Collaborate with design institutions, museums, libraries, and other partners to obtain their design work datasets, including digital images, literature, ratings, comments, etc.

User behavior data: Collect and analyze user behavior data to obtain data on user preferences, browsing behavior, interaction behavior, and other aspects of design works.

Expert evaluation data: Through expert evaluation, design works are rated, commented on, etc. to obtain an expert evaluation dataset.

After obtaining the dataset, data preprocessing and cleaning are required to ensure the accuracy and reliability of the data. At the same time, according to specific research purposes and needs, data needs to be classified, labeled, feature extraction and other processing to support subsequent Big data analysis modeling and intelligent system development.

B. ANALYSIS OF RESEARCH RESULTS ON THE EFFECTIVENESS OF DYNAMIC MONITORING AND PROCESSING BASED ON DATA ANALYSIS

In the preparation process of this experiment, windows64 bit system is used to test the randomly selected data set. In the selection of data sets, the standard test database needs to be used as the reference model. This data set should conform to the art and design industry, preferably the internal data of the art and design industry. The data set is a two-dimensional linear relationship data, which records the users' recognition of a scheme. Among them, the sample data volume is 50000, and the relevant attributes include the user's age, work, consumption level, gender and other information. We conduct personal and economic analysis on the participation of such groups in art and design activities in previous years, as well as statistics on the consumption capacity of such art and

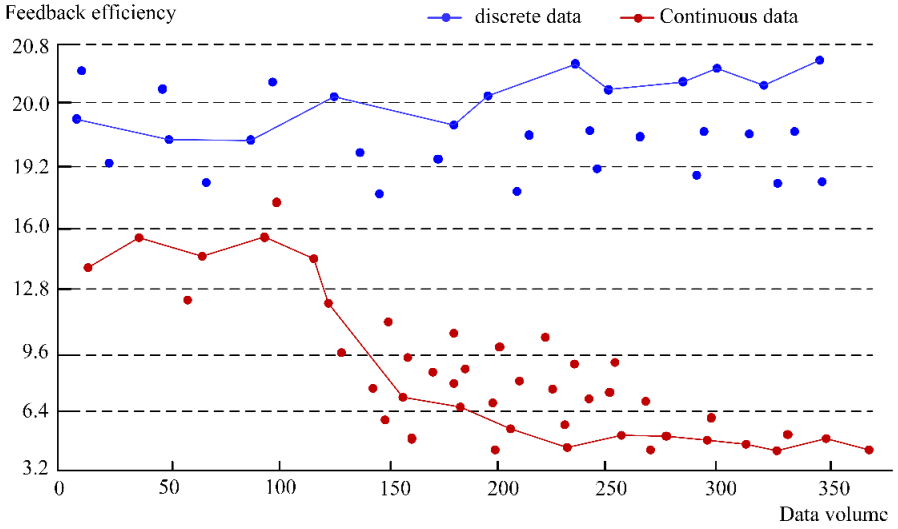

FIGURE 6. Comparison of continuous and discrete data feedback speed.

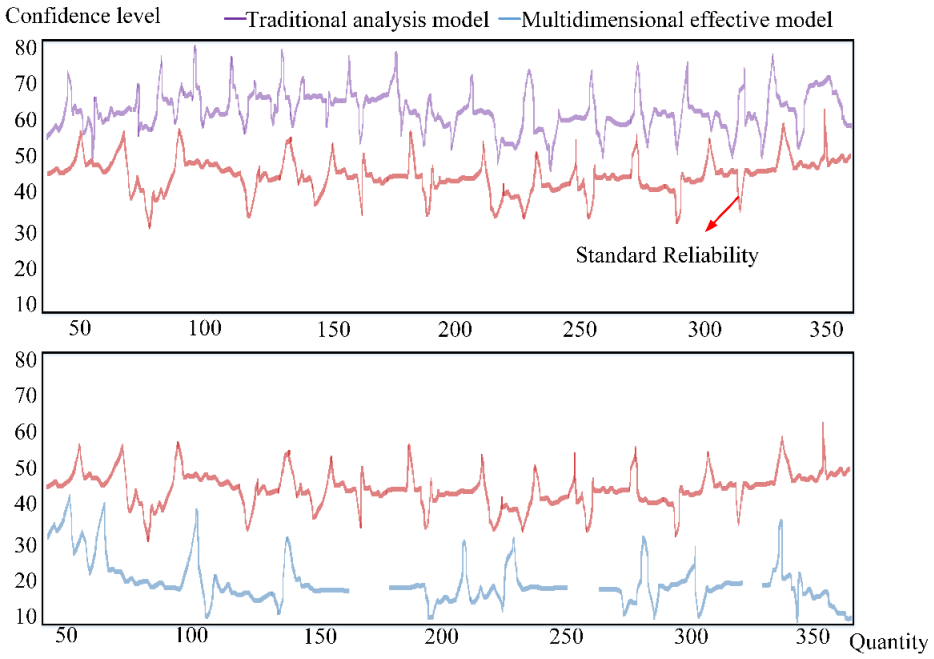

FIGURE 7. Model confidence comparison.

design products. Finally, whether to recognize that the design product is helpful to life and individuals is named as attribute, which is the highest goal of data analysis.

In ML based evaluation algorithms, multiple methods can be used to evaluate the quality and user satisfaction of art and design schemes. The following are some common evaluation algorithms: using decision tree algorithms to classify or regress art and design schemes to predict user satisfaction and confidence. SVM is a commonly used classification and regression algorithm that can be used to predict user satisfaction and confidence in artistic design solutions. Neural networks are a powerful machine learning algorithm that can be used to predict user satisfaction and confidence. The neural network can be trained through the Backpropagation, so that it can learn the mapping relationship between the artistic design scheme and user satisfaction and confidence. Association rule mining is an algorithm used to discover the association relationships between variables. It is possible to explore the association rules between art and design schemes, as well as the association rules between art and design schemes and user satisfaction and confidence.

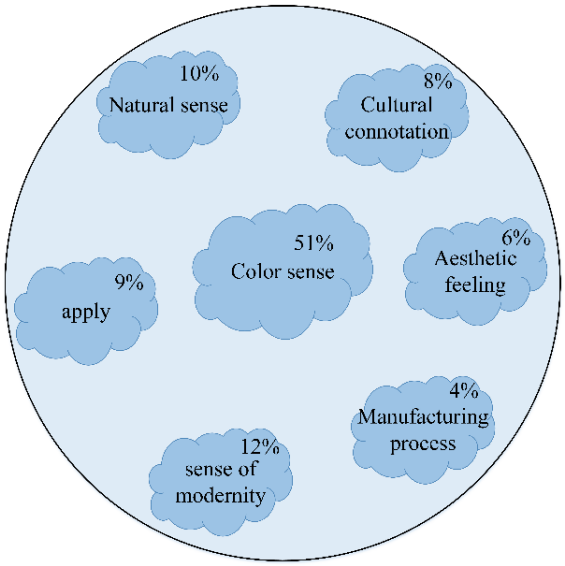

FIGURE 8. Distribution of key words for the evaluation of art design schemes by the masses.

When comparing the results of the evaluation algorithm with the grey correlation algorithm, this article first needs to select the appropriate evaluation algorithm and grey correlation algorithm based on the specific situation. Compare the prediction results of different models, analyze their advantages and disadvantages, and determine the most suitable model. When comparing evaluation algorithms with grey correlation algorithms, it is necessary to consider different application scenarios and data characteristics. If the dataset is large enough and of high quality, the evaluation algorithm may have better performance. However, when dealing with small samples or noisy data, the grey correlation algorithm may be more suitable. Therefore, this article selects appropriate grey correlation algorithm algorithms based on specific situations for comparison and comprehensive evaluation.

Because the grey correlation algorithm is a discrete calculation formula, some attributes of the data set are continuous data, which does not meet the requirements of the operation of association rules. There are subtle differences between a small number of data and sets, which will reduce the accuracy of data processing and feedback efficiency in correlation rule mining, thus affecting the experimental effect. Therefore, before the experiment, we need to discretize the continuous data of the art design scheme. It can be seen from Figure 6 that the feedback response of the discrete data after data analysis is faster in the calculation process of the effectiveness analysis model. Traditional continuous data has more redundant information, which greatly hinders the operation of the effectiveness analysis model. This paper also makes some research on improving the applicability of art design schemes. In order to improve the frequency and interest of users, we should attract more traffic from the publicity, so that user groups have a clearer understanding of art design products.

Each scheme strategy needs to go through the stages of evaluation, online application and so on in the proposing process. The usability evaluation of the scheme is also a very important link, which can improve the design concept in the evaluation index and enhance the user's satisfaction and experience needs. In the effectiveness and feasibility analysis, the calculation of user satisfaction is the main factor affecting the actual results. There are two problems in the comparison between the control group and the experimental group: first, different user groups have great differences in their understanding of art design. The young and the elderly groups have different aesthetic values for art design, and there are also differences in the contents they pay attention to, and the resulting satisfaction indicators have fluctuations. This situation will lead to the instability of accuracy in the process of data analysis effectiveness. Second, it is assumed that the audience of the same design scheme is fixed, but the satisfaction changes dynamically with the applicability. This situation will lead to positive data and negative data, that is, the satisfaction is increased and the satisfaction is reduced.

In view of the above situation, this paper proposes a multi-dimensional analysis method, which adds association rule variables to the multi-dimensional effectiveness model to mine the influencing factors of users' satisfaction and confidence in art design schemes. In order to prove that this model has certain advantages in confidence, the comparison with the traditional analysis model is shown in Figure 7. It can be seen from Figure 7 that the confidence coefficient of the multi-dimensional effectiveness model increases with the increase of the number of user groups, and the fluctuation shows a stable state. The confidence coefficient of the traditional analysis model occasionally appears fault phenomenon, which represents the lack of data in the analysis process. Therefore, the multi-dimensional analysis of data can be more in line with the purpose of effectiveness analysis.

It is expected to collect data on user satisfaction and confidence in art and design solutions through surveys or other means, as well as data on association rule variables. Then, it is supposed to clean, organize, and transform the collected data to ensure its quality and availability. This article uses appropriate statistical or machine learning methods to model and analyze data to determine the relationship between target variables and association rule variables. Simultaneously explain the results of the model and conduct validation and testing. If the model can accurately predict user satisfaction and confidence, then it can be considered effective. Apply the model to practical scenarios, such as predicting user satisfaction and confidence during the design phase, so that designers can adjust and optimize based on the results. It should be noted that the construction process of the model may require multiple iterations and adjustments to ensure the accuracy and applicability of the model. In addition, ethical and privacy issues need to be considered to ensure that the research process complies with relevant regulations and ethical standards.

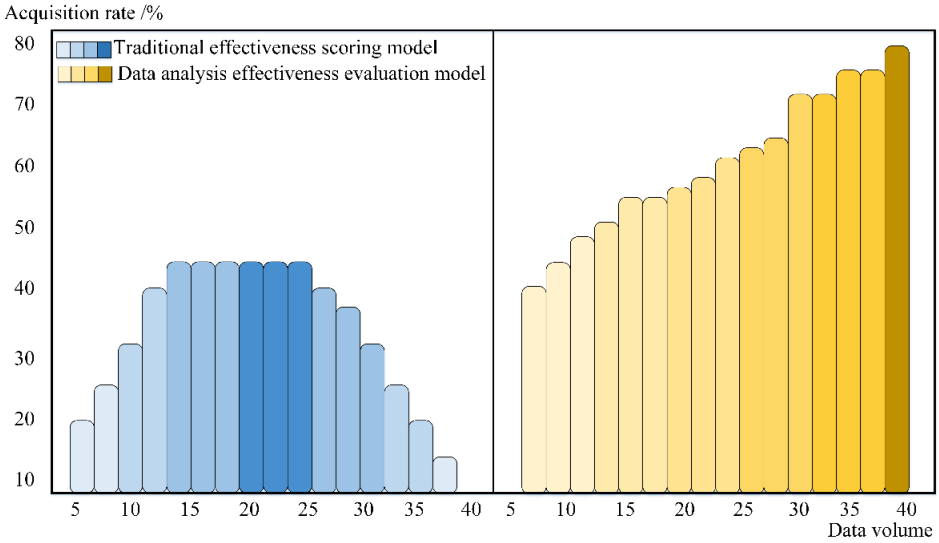

FIGURE 9. The difference between traditional effectiveness scoring model and data analysis evaluation model.

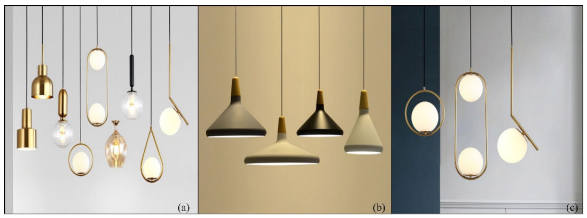

FIGURE 10. Different design examples of the same item.

C. ANALYSIS OF RESEARCH RESULTS OF EFFECTIVE EVALUATION AND MODELING OF ART DESIGN SCHEMES UNDER DATA ANALYSIS TECHNOLOGY

In order to prove whether this experiment can use data analysis to evaluate the effectiveness of art design schemes, a large number of art design schemes need to be compared. It is known that the evaluation scores of art design schemes change dynamically. In order to improve the rigor of comparison, it is also necessary to compare the traditional effectiveness evaluation model with the data analysis model. If the experimental results are similar to the data analysis results, it shows that this method has high accuracy and certain feasibility. Before the evaluation of art design schemes, it is necessary to formulate diversity evaluation index tables and set reference factors. We choose color, production technology and practicality as the index content of evaluating related objects. In order to facilitate statistics, scores are given in the form of numerical values. Randomly search the evaluation keywords of the masses on the art design scheme, as shown in Figure 8.

It can be seen from figure 8 that we selected several high-frequency words as the search objects. From the keyword distribution of public evaluation of art and design schemes in Figure 8, it can be seen that natural sense keywords account for 10%. Cultural connotations account for 8%. Apply account for 9%. Color sense accounts for 51%. Sense of modernity accounts for 12%. Aesthetic feeling accounts for 6%. The manufacturing process accounts for 4%. Color sense keywords appear frequently, and most people describe this scheme as: the contradiction between full and harmonious color and monotonous color. The second is the sense of nature. Some users think that the artificial mark of this design is obvious and not naturally generated. A small number of people are more concerned about the sense of pleasure, and they believe that this design can bring joy and happiness to the body and mind. According to the experimental coefficients set above, we choose practicality and aesthetics as the main objective of evaluation. Explore the differences between the traditional effectiveness scoring model and the data analysis evaluation model, as shown in Figure 9.

It can be seen from Figure 9 that the art design scheme we selected shows different acquisition volume differences in the two evaluation models. Among them, the traditional effectiveness scoring model has less access to practical and aesthetic information, while the data analysis and evaluation model can clearly show the sensory effect of users on art design schemes. It shows that the art design scheme evaluation model based on data analysis has a reliable reliability in judging the effectiveness and applicability of the target. We compare the relevant attributes of different designs of the same article, and the selected design content is shown in Figure 10.

As can be seen from Figure 10, taking household equipment as an example, three items with different functions are prepared respectively. In the relevant attribute set, attribute contents such as appearance aesthetics, design artistry, product performance and operation safety are selected for

TABLE 2. Evaluation comparison of algorithms.

Method	Average accuracy	Standard deviation
Traditional effectiveness scoring model	32.5%	0.68
Data analysis effectiveness evaluation model	67.5%	0.88

evaluation. Finally, formulate relevant questionnaires to collect users' needs and expectations for design according to the combination of art design and physical objects. After data analysis, the effective feedback information is: the physical appearance needs to be improved, the applicability and functionality meet the demand, and the price and cost performance need to be reduced. According to the above experimental process, this paper can use data analysis technology to compare the applicability and effectiveness of art design schemes, and also detect the relevant factors that affect the sensory changes of users on designed objects. It can be seen from Table 2 that the average effectiveness of effective solutions to achieve digital evaluation of design works in the Big data flow environment has reached 67.5%, 35% more than the traditional method of 32.5%. In addition, for the analysis of standard deviation, the digital evaluation input for the scheme in this article is 0.2 more, indicating that the data evaluation level of the method in this article is relatively high.

V. CONCLUSION

With the advent of the information age, big data and data analysis technology have become the main methods used in the development of all walks of life. Most of the traditional art design is based on the experience and ideas of designers, with less reference and more sensory cognition in the production process of design schemes. Some art designers believe that the design scheme formed by data investigation lacks creativity and beauty. However, in the context of big data environment, data analysis technology has become the main means to evaluate the effectiveness of design schemes. Based on the above situation, this paper uses data analysis technology to evaluate and analyze the feasibility and effectiveness of art design schemes, and constructs an effectiveness model under association rules for performance comparison on the basis of traditional analysis models.

Firstly, the gray correlation algorithm is used to optimize the data analysis process, and the confidence of the effectiveness results is improved through preprocessing and accurate data detection. By analyzing the digital evaluation data of design works in large-scale data-driven environments, it can be found that some design works perform outstandingly in certain aspects, while others perform mediocrely. This can help us better understand the differences between different design works and develop more targeted improvement plans. Grey correlation analysis can help us discover potential correlations between different design works, thus providing designers with more comprehensive design references. This helps to improve the practicality and innovation of design works, thereby better meeting user needs. In practical applications, it can help enterprises develop more scientific and reasonable design solutions, improve the quality and competitiveness of products or services. At the same time, it can also help enterprises better understand the market and user needs, providing more reliable data support for enterprise decision-making. Compared with the traditional method, under the Big data flow environment, the average effectiveness of the effective solution for digital evaluation of design works based on gray algorithm has reached 67.5%, 35% more than the 32.5% of the traditional method. The research results show that the artistic design scheme after data analysis can meet the needs of the public, and has significantly improved its applicability and feasibility.

Although the grey correlation analysis method for digital evaluation can effectively handle uncertainty issues, it also has certain limitations. This method is sensitive to noisy data, and if there is a large amount of noise in the data, it may lead to inaccurate calculation results. This method has a high computational complexity and requires a large amount of time and computational resources, making it less suitable for large-scale data processing. In the future, it is necessary to further accurately determine the reference sequence and comparison sequence, as well as select dimensionless processing methods and resolution coefficient values. These will all have an impact on the calculation results. Therefore, when using this method, it is necessary to conduct detailed analysis and judgment based on the specific situation to ensure the accuracy and reliability of the calculation results.

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ZHIMING HUANG was born in Jiangxi, China, in 1976. He received the bachelor's degree from Jiangxi Normal University, in 2000, and the master's degree from the Jiangxi University of Finance and Economics, in 2008. His research interests include big data analysis, intelligent systems, and digital evaluation.

JUNHAO TAO was born in Anhui, China, in 1997. He received the bachelor's degree from Fuyang Normal University, in 2021. He is currently pursuing the master's degree with Guizhou Minzu University. His research interest includes environmental design.