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Research Article

Application Research of Graphic Design Based on Information Resource-Sharing and Big Data Technology

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The field of graphic design is an important industry rising in recent years if a new graphic design solution requires the designer to design from the ground up, it will consume a lot of time and material resources. The information resource-sharing platform already has many element characteristics to provide the designer to carry on the reference, and this will greatly save the designer time and the material resources. The traditional graphic design method will consume some resources only by relying on the designer and the solutions designed by this method may not be innovative enough. This research will design a graphic design system and management method from the point of data and big data of information resource-sharing platform. The results show that the IRM platform can obtain more effective successful cases of graphic design feature data. The clustering method and CNN method can effectively deal with the pattern feature, color feature, shape feature, and character feature of graphic design. It can not only effectively analyze the feature data value of graphic design but also fits well with the trend of data values. This is a valuable research work for graphic designers. The largest prediction error is only 2.34%, and this part of the error mainly comes from the prediction of pattern features of graphic design. All other forecast errors are within 2.03%.

1. Introduction

With the rapid development of the national economy and the improvement of people's living standards, people's aesthetic ability has been greatly improved [1, 2]. For product sales, people gradually began to use the form of advertising to attract people's attention. The theory of graphic design has gradually entered people's lives, which not only involves advertising but also landscape and electronic products' own advertising [3]. Therefore, graphic design has widely entered people's lives. Graphic design involves features such as pattern features, color features, and text. How to deal with these features well is what graphic designers need to think about [4, 5]. A successful graphic design case often needs more patterns and color features to attract people's attention [6, 7]. In today's society, not only people's consumption of products is limited to the quality of the product itself but also people have begun to pay too much attention to the advertising effect of the product. Graphic design mainly includes advertising design and web design. Advertising design is a common graphic design. The advertising effect is a key factor for product sales. For example, with the same product quality and ingredients, a good advertising design will greatly affect the sales of the product. If a graphic design scheme starts from the basic pattern selection, it will greatly waste the designer's time and material resources. Today's society is an era of the Internet, and many successful graphic design cases can be referred to [8]. For the same graphic design theme, designers can make a few changes according to their needs, which can meet the requirements of graphic design. The matching of color features can be designed according to the needs of the product itself and the requirements of the demander [9].

There are many factors involved in graphic design. A successful graphic design case often requires a reasonable combination of pattern features, color features, and text features [10, 11]. It also has a good effect on attracting

people's attention. However, a graphic design project can consume a lot of time and financial resources if it starts from the basics [12]. If an advertising graphic design does not have high requirements for innovation, it will make corresponding references based on successful cases. In the Internet age, information resource sharing is a popular way. The sharing of information resources not only shortens the distance of people's cultural communication but also provides some case references for many designers. In the field of graphic design, more references to successful cases can be obtained by sharing information resources [13, 14]. In real life, there are many advertisement designs and product designs of the same type, and the advantages of information resource sharing can be reflected. Information resource-sharing technology also allows designers to combine different successful graphic design cases, which can create new graphic design cases [15]. Whether it is a graphic design pattern or a text feature, it allows designers to find a suitable graphic design scheme. However, for complex graphic design schemes, it needs to seek more similar patterns and color characteristics, which can meet people's aesthetic needs. More graphic design features not only require more designers to participate in the selection of patterns and colors but also require designers to make reasonable collocations. With the participation of information resource-sharing technology, this is also a tedious task [16, 17]. How to efficiently and automatically match a reasonable graphic design scheme, whether it is a complex graphic design scheme or a simple graphic design scheme, is the focus of this research. Graphic design has played an important role in people's lives. It can promote the sales of products and improve people's aesthetic ability. For a new graphic design task, designers can make relevant designs based on successful cases.

Big data technology is a relatively new data processing method, which can classify and regress complex data. Its advantage is to deal with complex nonlinear data, and it can also find commonalities between complex data. Big data technology has been widely used in many fields, and it has also achieved great success. The pattern features, color features, and text features of graphic design can be transformed into the form of data, and big data technology can find more common data and feature correlations between graphic design data [18, 19]. There are many types of big data technologies, such as neural network methods, machine learning algorithms, and reinforcement learning algorithms. It can not only effectively classify complex data but also efficiently find the correlation between data; it can find some potential relationship between input and output through the method of weight distribution. Like the pattern features, color features, and shape features involved in graphic design, big data technology can input these data into the algorithm in the form of an input layer, and it can find a reasonable output through continuous iteration. The relationship between this input and output can be specified in an artificial way. In other words, big data technology can find the relationship between the input and output required by the technician through the dataset, and this output can be any factor related to graphic design.

The main purpose of this research is to find a reasonable graphic design scheme through information resource-sharing technology through big data technology. Combining big data technology with the characteristics of graphic design, it can find the solutions required by designers, which are derived from the relevant data of the information resource-sharing platform. The application of this big data technology in the field of graphic design is an efficient and accurate method. A designer will spend an amount of time and material resources in the training phase. However, once the model training is completed, which can only provide the input data to the model, it can output the relevant pattern features and shape features. This saves graphic designers a lot of design time and investment in material resources.

This research mainly uses the information resource-sharing platform and big data technology to study the relevant characteristics of graphic design. This research is mainly divided into five parts. Section 1 introduces the relevant definitions and needs of graphic design, and it also illustrates the importance of information resource management and big data technology for graphic design. Section 2 mainly introduces the related research status of graphic design. Section 3 introduces the application algorithm and system design of information resource-sharing platform and big data technology in the field of graphic design. Section 4 introduces the feasibility and accuracy of clustering and CNN methods in the field of graphic design from the perspective of different statistical parameters. In order to better reflect the feasibility of big data technology in graphic design, statistical parameters such as linear correlation coefficient, hot spot distribution map, and error distribution are applied. Section 5 is the summary part of the study.

2. Related Work

Graphic design has had an important impact on people's lives, and a lot of research studies have been carried out on the design scheme and feature design in the field of graphic design. Liu [20] believed that new media technology can promote the development of graphic design, but the traditional design concept can not meet the requirements of the graphic design field. It believes that digital information can help improve student satisfaction with graphic design courses. He analyzed the relationship, between digital media art and graphic design education, and he also studied the relationship between graphic design and mobile digital media, which is important for graphic design education. Zhang [21] sees graphic design as the art of combining visual elements, which he says will take the form of advertising, animation, and web design. He combined the idea of the designer with the concept of the ocean and expressed the idea of the ocean with the theory of plane design. He also used Photoshop and other software images of the concept of the work of the ocean design, which is conducive to raising awareness of the ocean. Zhao [22] understood UGraphic image as a relatively important advertising graphic design, which greatly affects the performance of elements of the marine industry. It uses the UGraphic image software to

study the application effect in print advertisement design. He also analyzed the usage principle and effect of UGraphic image software. He also analyzed the specific application of Photoshop software and the application effect it brings to the field of graphic design in combination with the relevant images in the marine field. Li et al. [23] already believed that modeling layouts are a crucial step in graphic design. He studied the modeling layout relationships in graphic design using the Attribute-Condition Layout GAN method and attributes of the discriminator. The conclusion has proved that this model can visualize the layout of the graphic design. At the same time, this layout facilitates adjusting the new size and order of the original elements. Sheng [24] used AR technology for high-resolution image processing in graphic design. And, he proposed a high-resolution graphic design image processing method based on the maximum entropy model. He used the Otsu method to determine the data cut point in the graphic design scheme. The conclusion shows that BIM software and VR Stereo technology are beneficial to the determination of graphic design scheme and the balance processing of the scheme. Xue [25] believed that big data technology will improve the development of the field of graphic design. He has conducted related research on visual graphic design combined with deep belief neural network DBM. The conclusion shows that the DBM algorithm can accurately obtain the feature points of graphic design, and it can also build a visual graphic design teaching platform. This approach can improve the training speed of the model as well as change the local deformation design problem of the graphic design. Bo [26] believed that graphic design already plays an important role in people's lives. With the rapid development of the computer field, this has promoted the development of color management systems in the field of graphic design. His research takes full account of the unexpected situations in graphic design and the complexity of image processing, and he uses the SVM method to fully study the color processing problem in the field of graphic design. Through the review of the above literature, it can be found that researchers have carried out a lot of research on the related theories of graphic design. They also solve many problems in the field of graphic design.

3. Application Algorithm Introduction and System Design of Big Data Technology in the Field of Graphic Design

3.1. The Advantages of Big Data Technology for Graphic Design. Big data technology has been successfully applied in many fields, which are not limited to classification and regression prediction tasks [27, 28]. The biggest advantage of big data technology is the processing of massive data, which can mine potential information and potential correlations that cannot be found by technicians. For different fields, big data technology will find suitable algorithms and parameter combinations, which requires technicians to effectively train and test the training set. For the field of graphic design, it will involve characteristic data such as patterns, colors, and shapes. The main features of graphic design include pattern features, color features, and shape features, which are more suitable for feature extraction using neural network technology. The data correlation between these data is difficult for graphic designers to discover. Big data technology can rely on the massive data shared by information resources to find the relationship between successful cases and the graphic design scheme to be designed. This will not only save a lot of material and human resources for graphic designers but also save a lot of design time.

3.2. Introduce of Information Resource Management and Big Data Technology for Graphic Design. This study mainly uses the graphic design data shared by information resources to classify and predict the characteristics of advertising graphic design, which is beneficial to the design and management of graphic designers. The application of information resource sharing technology in graphic design mainly means that designers can use successful graphic design cases for learning and reference. These successful cases come from the Internet or other computer equipment. Figure 1 shows the application process of information resource sharing data and big data technology in the feature management of graphic design. First of all, this research needs to collect data from the information resource congratulation system. These data should include pattern features, text features, color features, and shape features. These four characteristics are the most important for graphic design designers, which will determine the success of graphic design solutions. Then, this study uses clustering to classify the collected data, which needs to preprocess the feature data of these flat designs before classification. As a final step, this study needs to make relevant predictions on the characteristic data of these classified graphic designs. In Figure 1, the data of the information resource sharing platform needs to be collected by the designer, and these data will include the relevant data of the successful cases of graphic design. These data will also serve as input data for big data technology. Once the designer obtains the predicted data, the designer can use the data obtained from the information resource sharing platform to carry out the relevant graphic design scheme.

The data collected from the information resource sharing platform is chaotic in terms of features and magnitudes, which is not conducive to the application of neural network methods in graphic design feature prediction. Therefore, effective feature classification is the key to the successful application of big data technology in graphic design feature prediction. Figure 2 shows the application of the clustering method to the classification of graphic design features. The ultimate purpose of clustering is to group a group of data with a strong correlation into the same class. For data with poor correlation, this requires the clustering method to classify these data as far as possible. Through the clustering method, this study can effectively distinguish the data of the same category. Figure 2 is only illustrates the effect of classification, and only the classification effect of 3 features is shown here. And, 4 features are adopted in this paper.

The clustering method is a method of classifying the same type of dataset. The first step of the clustering method

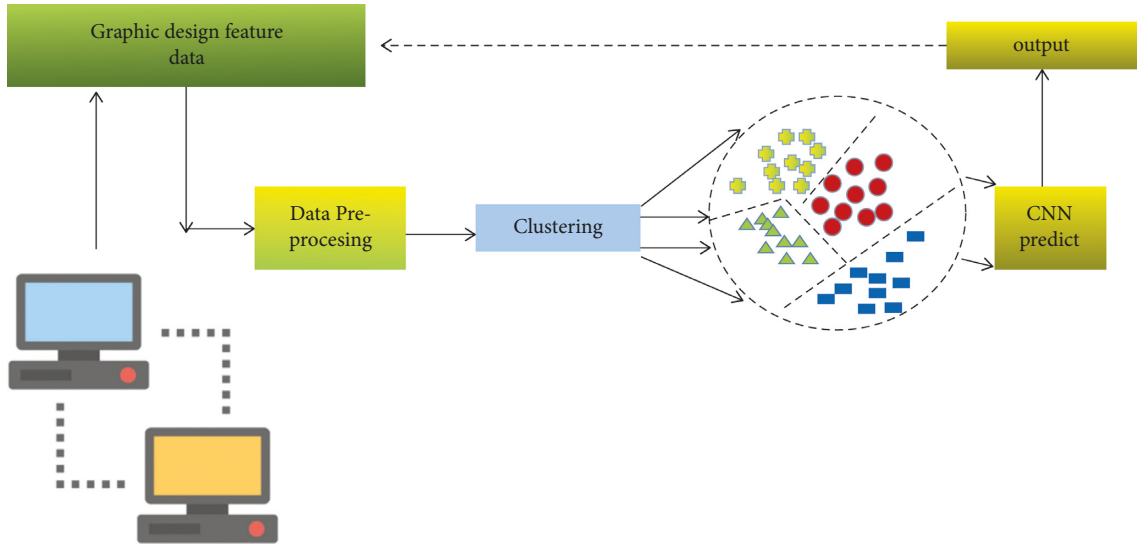

Figure 1: The design of the visual communication teaching system is aided by big data technology.

needs to randomly select n cluster centroid points, which are the average points of the same type of data. Equation (1) shows the equation for selecting cluster centroid points. Here, μ is the data of the centroid point:

$$\mu_1, \mu_2, \mu_3, \ldots\ldots\mu_m, \mu_n, \in R^n. \tag{1}$$

The second step of the clustering method is to calculate the class to which the jth sample belongs and to classify the data. Equation (2) shows how the computation belongs to the category. Here, μ is the data of the centroid point:

$$c^{(j)} = \arg\min_i \left\| x^{(j)} - \mu_j \right\|^2. \tag{2}$$

The clustering method is a process of continuous iterative calculation, and it needs to find the optimal centroid distribution through continuous iterations. Equation (3) shows the calculation method to recalculate the centroid points. Here, c^i represents the ith centroid point and x^i represents the ith data of input data:

$$\mu_j = \frac{\sum_{i=1}^{m} 1\{c^{(i)} = j\} x^{(i)}}{\sum_{i=1}^{m} 1\{c^{(i)} = j\}}. \tag{3}$$

There is also a process of error propagation in clustering methods. The error is reduced by continuously reducing the gap between the actual value and the classified value. Equation (4) shows the calculation process of the error, and the calculation method of the mean square error is adopted in this study. J is the error, x_k is the input data, and χ_r is the mean value of the centroid point:

$$J = \frac{1}{2} \sum_{k=1}^{l} \sum_{r=1}^{o} (x_k - \chi_r)^2. \tag{4}$$

The clustering method adopts a larger distance evaluation index, which is the key evaluation index of clustering. Equation (5) shows how the distance is calculated. Here, x_{ik} represents the ith input data and x_{jk} is the jth mean value of the centroid point:

$$\text{dict}_{ed} = \sqrt{\sum_{k=1}^{m} \left(x_{ik} - x_{jk} \right)^2}. \tag{5}$$

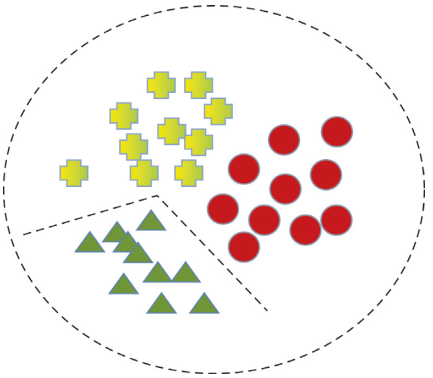

Figure 2: The application process and method of clustering in graphic design.

3.3. The Application of Convolutional Neural Network in Processing Graphic Design Feature Data. Convolutional neural networks have been successfully applied in many fields, such as image recognition and traffic command, and they have played a great role. The biggest difference between a convolutional neural network and a fully connected neural network is that CNN can reduce the amount of parameters in the calculation process [29, 30]. It is precisely because it can reduce the amount of parameters in the calculation process, so it can allow deeper network forms to exist, and it can extract more features of graphic design [31, 32]. Figure 3 shows the application process of CNN in graphic design feature extraction. In

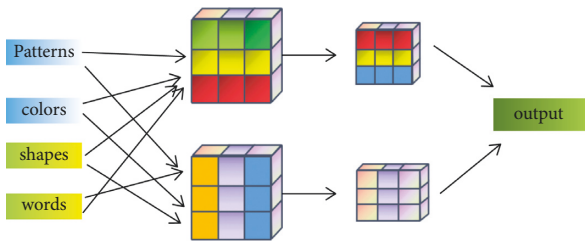

Figure 3: The application of convolutional neural network in processing graphic design feature data.

this study, the patterns and colors obtained from the information resource sharing platform are classified, and these data will be input into the CNN network in the form of an input layer. The four features of the graphic design will be preprocessed into uniformly distributed data, which will be processed into a matrix form. These matrix-form features will be fed into the input layer of the CNN. The pattern features, text features, and color features of the graphic design will be input to the convolutional layer of the CNN in different channels for feature extraction. These data are then downsampled by the pooling layer to reduce the computational complexity of the CNN. Finally, these features will be output through the activation function and output layer. In Figure 3, the learning rate of this paper will be 0.0001. The number of CNN network layers is 4. The step size of the pooling layer is 1.

In the CNN network, the process of model training is the process of iteratively finding the optimal combination of hyperparameters and weights. There are many hyperparameters involved in this process, and the following equation shows how the input of the hyperparameters is calculated:

$$H2 = \frac{(H1 - F + 2P)}{S + 1}. \tag{6}$$

These hyperparameters also need to be initialized. During the initialization process, the hyperparameters must be assigned according to certain criteria. The following eqaution shows how the hyperparameter assignments are calculated:

$$w' = \frac{(w + 2p - k)}{s} + 1. \tag{7}$$

The key part of CNN nonlinear operation is the activation function, which can nonlinearize the output data of the convolutional layer and the pooling layer. The following equation shows the calculation criteria for the activation function chosen in this study:

$$\tanh(x) = 2\sigma(2x) - 1. \tag{8}$$

The operation process of CNN mainly involves two processes: forward propagation and backpropagation. The process of propagation is to find the direction of gradient descent. The gradient descent method involves the calculation of weights and biases. Equations (9) and (10) show the derivation of the weights and biases:

$$\Delta\omega_{ji} = -\eta\frac{\partial E}{\partial \omega_{ji}}, \tag{9}$$

$$\Delta u_{ij} = -\eta\frac{\partial E\partial}{\partial u_{ij}}. \tag{10}$$

Equation (11) shows the operation steps of the convolutional layer of CNN, which is a key part of CNN. The convolutional layer can effectively extract features, and it can also reduce the amount of parameter computation. This is the computational flow of the convolutional layer of CNN:

$$\delta_j^{\zeta} = f'\left(u_j^{\zeta}\right) \circ conv2\left(\delta_j^{\zeta+1}, rot180\left(k_j^{\zeta+1}\right)\right). \tag{11}$$

3.4. The Processing of Graphic Design Data Obtained from Information Resource-Sharing Platform. In the field of big data, pattern features often exist in the form of values ranging from 0 to 255. Text features exist in a binary form. At the same time, color features often exist in the form of a three-channel. It can be seen that there are obvious differences in the characteristics of these four plane designs. Whether it is a neural network method or a clustering method, their operation process often contains a relatively complex weight distribution. The calculation process of CNN will involve the calculation of weight distribution. However, the distribution of these weights tends to be numerical or widely distributed data. Therefore, if the feature data of these plane designs are directly input in the form of the input layer, it will cause the weight distribution error or the weight distribution to be inaccurate. This uneven distribution in turn causes inaccurate predictions by the neural network. Before the feature data of these flat designs are fed into the neural network, the processing of the data is more important. In this study, standard normalized data preprocessing methods were used to process the four characteristic data of graphic design.

4. Result Analysis and Discussion

The datasets used in this study come from a number of graphic design companies in Beijing. These datasets mainly contain pattern information and color information of graphic designs. Graphic design is a complicated task. This paper uses the data shared by information resources to process the data fusion and prediction of graphic design features. This approach helps designers to find the right pattern or text information. Figure 4 shows the classification of graphic design features using clustering methods. The characteristics of these graphic designs come from the sharing of information resources. From Figure 4, it can be clearly seen that the feature distribution of graphic design is consistent with the actual graphic design feature distribution, which shows that the clustering method selected in this paper has certain feasibility in the classification of graphic design features. Only a part of the data is in poor agreement with the actual plane features. This part of the error may be due to the large difference in pattern features, which leads to

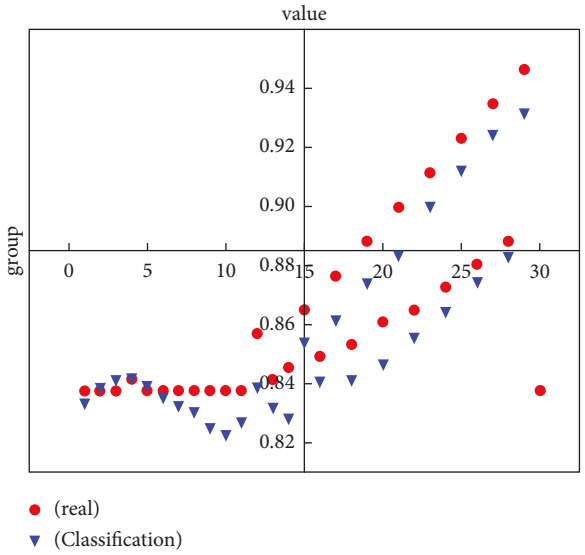

Figure 4: The classification distribution of graphic design features using clustering methods.

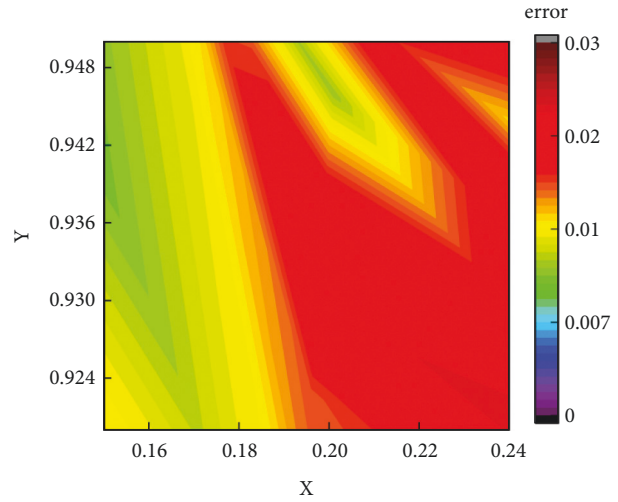

Figure 5: The prediction error distribution of graphic design pattern features.

a poor clustering effect. However, in general, this part of the error is also within the acceptable range for the classification of graphic design features. The trend of graphic design features also agrees well with the actual trend of graphic design features.

For the features of graphic design, the pattern feature is a relatively complex feature, which is also a graphic design feature that allows people to produce the most direct vision. In this study, a pattern feature of advertising graphic design was selected for analysis. Figure 5 shows the prediction error distribution of pattern features for advertising graphic design. It can be seen from Figure 5 that the prediction errors of pattern features are all within 3%, which is an acceptable error for graphic designers. Advertising graphic design patterns often use more brilliant pattern features in the middle of the pattern and use relatively simple background features at the edges of the pattern. The pattern feature prediction error of advertising graphic design is mainly distributed in the middle area of the picture, which is consistent with the distribution complexity of advertising pattern features. In the background area of advertising graphic design pictures, this part of the prediction error is relatively small, most of which are concentrated around 1%. This is due to the relatively small variation of the pattern features in the background area. Only increasing the number of training sets will improve the prediction accuracy of pattern features for advertising graphic design.

To further demonstrate the performance of the CNN method in predicting graphic design pattern features, Figure 6 shows the predicted linear correlations for advertising graphic design pattern features. The linear correlation coefficient mainly uses the linear function $y = x$ to describe the distribution of the predicted value and the actual value. The closer the data points are to $y = x$, the more accurate they are predicted. The linear correlation coefficient exceeds 0.95, which indicates a good linear correlation. Meanwhile, the pattern feature of graphic design is more complex than the color feature, and it needs to be given more weight in the process of data preprocessing, which results in a larger value. It can be seen from Figure 6 that the predicted value of the pattern feature is consistent with the actual distribution of the feature value of the advertising flat pattern because the data points of the linear correlation are basically distributed on both sides of the $y = x$ function. For linear correlation functions, the closer the data points are to $y = x$, the more accurate the predicted value. Compared with the linear correlation of graphic design pattern features, the distribution of color features is closer to a linear relationship. This is because the variation range of color features in graphic design is relatively small, and the CNN method can learn more accurate color features. Overall, CNN can capture the pattern features and color features of graphic design well.

Word information is a feature that can directly convey graphic design content to people, and it is also an important feature in advertising graphic design. Figure 7 shows the prediction error distribution of word features of graphic design. In this study, word information has been converted into the data distribution form of gray value. Different from the pattern prediction error distribution of graphic design, the distribution of word text features is more uniform, and there is no centralized distribution of errors. This is because the word features of advertising graphic design are distributed in various places of the image, which is to show more information in a limited area. There is a relatively large error distribution of word features on the left side of the advertising graphic design image, which may be due to the fact that there are more words in this area when designing the advertising image. This may also be due to the large difference in fonts in this part.

In advertising graphic design solutions, there will be a lot of shape information to attract people's attention. The shape feature is also one of the more important features in graphic design. Figure 8 shows the distribution of prediction errors for the shape features of the advertising graphic design. It

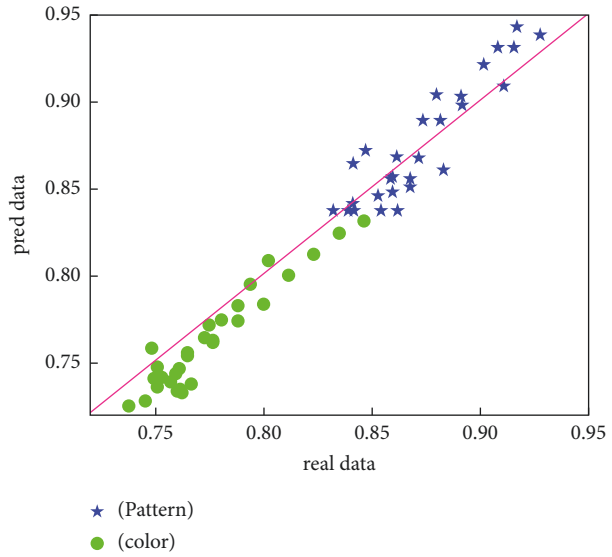

Figure 6: The linear independence of the predicted value of graphic design pattern and color features.

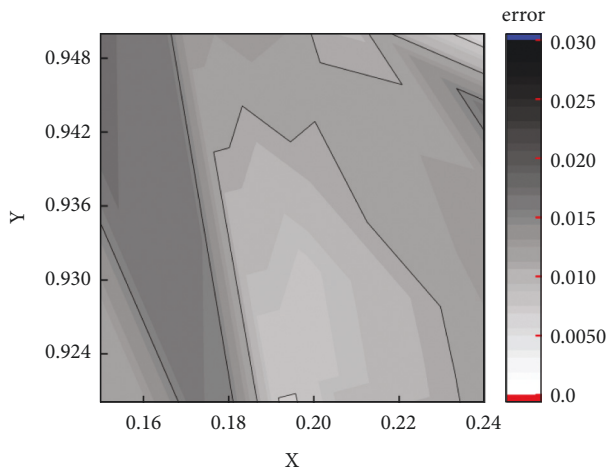

Figure 7: The prediction error distribution of word features in graphic design.

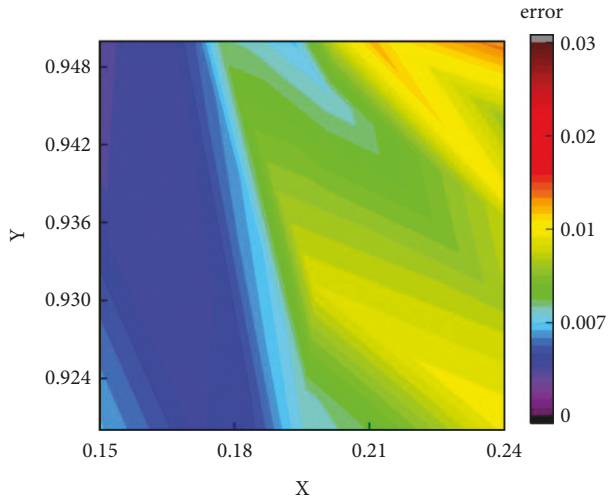

Figure 8: The prediction error distribution of shape features of graphic design.

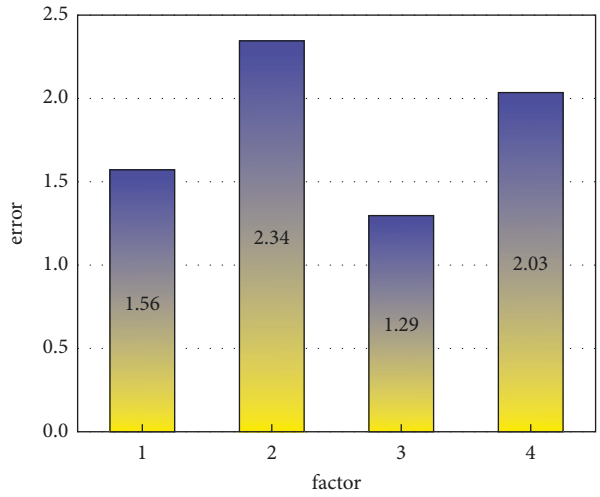

Figure 9: Histogram distribution of prediction errors for advertising graphic design.

can be seen from Figure 8 that the prediction error of the shape feature is much smaller than that of the pattern feature, which is determined by the relatively strong stability of the shape information. The prediction errors of shape information features are also mainly distributed in the middle region of the image, which is consistent with the distribution of prediction errors of pattern features. Figure 9 shows the distribution of prediction errors for four features of advertising graphic design. Overall, all errors are controlled within 2.34%. The largest error comes from the prediction of pattern features, which is consistent with the previous description. For the color characteristics of advertising graphic design, this part of the error is only 2.03%. The feature errors for these two most critical graphic designs are within acceptable limits, which illustrates the excellent performance of CNN in graphic design feature prediction.

5. Conclusions

Graphic design is an important field for satisfying people's aesthetic abilities. However, if a graphic designer starts from the basic design and gradually forms a graphic design scheme with a certain amount of engineering, it is more difficult. With the development of Internet technology and big data technology, this has brought new opportunities for the development of the graphic design field. Information resource sharing can rely on Internet technology to provide real-time successful graphic design cases for graphic designers to refer to. Big data technology can help designers match the design scheme of the appropriate theme, which is a more efficient and accurate way. This paper studies the characteristics of graphic design by combining information resource-sharing technology and big data technology. Clustering methods are used to classify four of the more important features of graphic design. CNN will predict the pattern, color, text, and other feature information they need according to the ideas proposed by designers, which provides a reference for designers to form new graphic design schemes.

For the classification of the four features of graphic design, the clustering method can well classify the distribution and numerical value of pattern features, color features, shape features, and text features of graphic design. The CNN method can predict the four characteristics of graphic design well. The prediction errors of pattern features are mainly distributed in the middle of the image, while the prediction errors of text features are more evenly distributed. The linear correlation of color features outperforms the prediction of pattern features. CNN has successfully completed the prediction task of the four characteristics of advertising graphic design, and the maximum error is only 2.34%. This research can provide a good reference for graphic designers, which uses information resource sharing technology and big data technology. Likewise, this research will provide certain thinking and research value for the research field of advertising design or graphic design.

Data Availability

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

Conflicts of Interest

The author declares that there are no conflicts of interest.

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