



Research Article

Logo Design Process and Method of Intellectual Property Big Data in the Digital Media Era

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Logo design is related to the image of a company, unit, product, etc. A good logo can leave a deep impression on people and intuitively understand the content of the product. With the increasing emphasis on intellectual property protection, the design of logos should also pay more attention to the protection of property rights. It can be said that the logo of some big brands is enough to represent the enterprise itself; for example, seeing the red cross as a hospital. This paper aims to propose a logo design process and method under the background of intellectual property big data, so as to make the logo design more procedural and efficient, and to better focus on the protection of property rights. By introducing the relevant knowledge of logo design and trademark registration, it is indicated that trademark search can be used as an auxiliary tool for logo design. Combined with digital media and big data technology, a logo image recognition and classification method is designed so that the trademark registration and screening stage can avoid the infringement design to the greatest extent, so as to put forward the design process and method to improve the innovation ability of logo design. According to the research, the classification accuracy rate of the algorithm proposed in this paper is 91.5%, and the recognition rate of various defects is also above 95%. In addition, in design practice, the stability of design proposals should be monitored through multiple search methods using trademark search tools. If a high similarity is found in the search results, the design direction should be adjusted in time until the final design scheme is determined.

1. Introduction

A trademark is an iconic symbol of a business or institution that represents the strength and uniqueness of a brand. However, due to the specificity of trademarks, many studies tend to focus on trademark-related tasks in natural settings. Especially in the fields of piracy and infringement detection, brand traceability tracking, commercial advertisement analysis, intelligent transportation, and commodity image search, it has huge application prospects. Logo classification and detection technology have huge application prospects in the fields of product advertisement analysis and product image search. Therefore, a complete electronic product catalog can be constructed to help companies quickly detect relevant brands, complete the detection of piracy and infringement, and personalized recommendation of products.

At the same time, with the rapid development of deep learning and computer vision technology, deep convolutional neural network theory has been widely used in many fields, such as image classification, object detection, behavior recognition, and image retrieval. Convolutional neural networks can train and extract expressive image features, so more and more image classification and detection techniques are applied to real life. Logo image classification and detection have become a key research topic. The research content refers to finding the location of the logo in the picture and judging the category to which the logo belongs by processing the input original image. Therefore, in the new media era, relevant research on the logo design process is of great significance.

The innovations of this paper mainly focus on the following two aspects: (1) For the Logo-2K+ classification

dataset, this paper proposes a fine-grained classification scheme that can learn useful regional features from numerous local features under the supervision of only label information. Combining local features with semantic features finally achieves effective classification. By fusing global and local features, a multifeature set is constructed to describe the target more accurately. Using two sub-components to learn more subtle, diverse, and mutually exclusive local interclass confusing information to achieve two-level effective classification from coarse-grained features to fine-grained features. (2) In this paper, YOLOv3 with three scales is used as the basic framework to solve the problems of multiscale and small targets, and the focal loss, classification loss, CIoU loss, and regression loss are improved and integrated into it. In order to solve the problems of unbalanced positive and negative samples and inaccurate regression, and finally achieve effective logo detection.

2. Related Work

Logo is a unique sign composed of patterns, words, etc., used to identify the products and services of companies, public organizations, institutions, etc. It not only conveys product information but also represents the brand value of the product, so the image of the logo in publicity is particularly important. Ensuring the quality of the logo is an effective means to maintain the image and honor of enterprises and major organizations. In order to maintain the image of the logo, different organizational units have their own specific regulations for the use of the logo. There are many research designs on it. The purpose of Zhu et al.'s study was to explore how features of logo design affect consumer responses based on visual representation. Signs from different regions may have different characteristics that affect the level of logo preference. According to his experimental results, four factors that influence logo preference include modernity, aesthetics, interest, and style [1]. Mahmood et al. proposed a disfluency-based heuristic framework to understand the impact of inefficient visual cues on equity crowdfunding platforms. He used processing fluency theory and visual heuristics to modify logo design [2]. Tessensohn did a study on Japan's revised Unfair Competition Prevention Law (UCPL), which is said to be the world's first law aimed at protecting "big data" itself [3]. Deere is very interested in the world economy and studied the world economic property rights protection laws, aiming to address the maintenance and development of laws in developing countries [4]. Peng et al. echo recent calls for organizing research to address larger, globally relevant issues and focus on history by analyzing key debates on intellectual property rights (IPR) between the United States and China [5]. Kesan J P solves the complex relationship between IPR and the agricultural biotechnology industry. He details the value chain of the agricultural biotechnology industry and its implications for IPR protection [6]. Niculescu et al. explore the strategic decision of incumbents to open up proprietary technology platforms in order to achieve peer-to-peer competition in a market characterized by network effects. He proposes a game-theoretic model

that analyzes the interaction between the degree of openness of a conceptualized peer-to-peer platform, the absorptive capacity of an entrant, and the strength of network effects. His experiments show that models with exogenous network effects may significantly underestimate the range of absorptive capacity values of entrants for whom incumbents should open their platforms, leading the latter to miss out on valuable cooperation opportunities [7]. It can be found that the current research direction of logo design is mainly the depth and acceptance of the design, and there is relatively little research on big data property rights, so the following research is necessary. At the same time, the related research has not programmed the idea of logo design, nor has it really used the artificial intelligence algorithm to optimize the design process.

3. Logo Design in the Age of Digital Media

3.1. Digital Media Era. Today is the era of diversified digital media, and the diversification of design makes various cultural concepts, design concepts, design styles, and expressions collide with each other. Digital media is a variety of media forms extended based on various network technologies and digital technologies, as shown in Figure 1. Digital media has both digital content and digital technology; that is, it not only contains pure digital content but also covers the embodiment of various theoretical, technical, and hardware support for it. The main features include the following two aspects. On the one hand, digital media uses advanced digital technology to improve the quality and efficiency of the collection, production, and transmission of information content. Digital technology also promotes the generation of various digital media carriers. Different from traditional media works, the display methods of digital media works can integrate text, graphics, music, commentary, narration, and other display methods and sensory language into one with the help of computers and other technologies, and ultimately produce interaction with people's vision and even hearing. On the other hand, people's requirements for information presentation have also undergone great changes, which has also led to the emergence of digital media to provide more innovative and personalized content for the public. In the era of digital media, the Internet is ubiquitous, and people's lives and work can be separated from the constraints of real factors such as time and space. Its dissemination is highly intelligent. Work in the digital media era can realize interactive communication in the process of dissemination based on technological advantages. With the help of the Internet to obtain the required information content, different audiences can also shop online, watch live broadcasts in real time, read online, and listen to books [8, 9].

3.2. Digital Media and Art Logo Design. Modern media art is an art form that integrates sound, shape, color, and movement. It is an inevitable product of the rapid development and popularization of electronic technology. Today's young people are particularly fond of electronics, animation, and personal things, and most of them have their

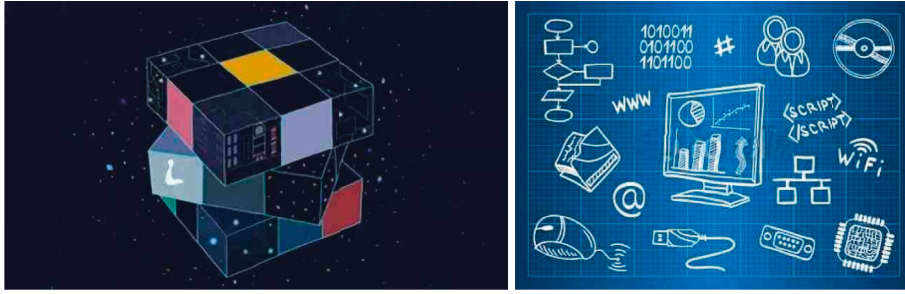


FIGURE 1: Digital media design.

own Weibo, space, homepage, and other things. This makes modern media art have the basis for rapid development and is also a cultural and artistic form. Modern media art is a very wide range of art forms. Therefore, to study modern media art, it must also be studied from the disciplines of art, sociology, technology, aesthetics, and popular culture. Today's modern media has formed a true art form—modern media art. Because digital technology is its main carrier, it can also be called digital media art [10, 11]. With the strong influence of digital media technology, many traditional artists have also begun to use the emerging technology of digital media. This technology allows them to find a new creative method, especially for young students and artists who are eager to raise the banner of media art. This is an excellent phenomenon because the creation of art requires innovation, and the use of new methods is itself an innovation. The use of digital media technology to create not only makes traditional hand-painted works as popular and loved by the audience but also makes hand-painted works of art have the possibility and trend of rising, which is undoubtedly one of the issues that should be paid attention to at the moment, as shown in Figure 2.

Digital art has broad market prospects. Taking the animation industry in the field of electronic art as an example, according to statistics from relevant departments, the market capacity of China is almost over 100 billion yuan. Moreover, the electronic art industry is characterized by the combination of consumption and creation, which is a brand-new industrial state. A scholar in the Netherlands found that the multilevel “long tail” theory of profits formed by the American digital industry represented by “Dream Works,” its core is “sharing”—the sharing between producers and consumers. This sharing has completely changed the previous operation mode, which also makes producers no longer just blindly “speak,” and consumers can no longer only “listen,” and the relationship between the two has undergone tremendous changes.

In digital media, design is a very important part, without design digital media will not be alive. Design is not only a method, but also a visible idea. It can solve the problems of strategy, planning, and design together. The design includes three aspects: First, the formation of plans and ideas. Second, people need to express ideas in a way that other can see. The third is to complete the content of the performance. In design, the core thing is thought, and thought comes from the mind, so in daily life, people



FIGURE 2: Digital logo design.

should see more, think more, and collect inspiration and materials [12].

The fusion of art and computer technology is a trend, and this trend may bring some problems. One of the most serious problems is that the boundaries between the two are becoming smaller and smaller. What art pursues is a personalized and original behavior, and its preciousness is its distinctiveness and its spirit of seeking differences. And computer technology pursues unity and standardization. The pursuits of the two are qualitatively different in direction, so when using the method of combining the two to create, we must distinguish what needs to be paid attention to. In terms of social production, people should pay more attention to the direction that needs to be pursued technically, and in terms of art, people should pay attention to expressing their own thoughts and spirits. Digital media art, like traditional art, comes from life. Without life, any form of art has no meaning. Now the generation of digital products is also because of people's needs in life. Since it is art, no matter what form it is, it is worth learning, because art is an expression of beauty, and art in the form of digital media should be carried forward. This is an unchangeable reality [13, 14].

Whether it is media or art, it exists to meet people's needs and is produced under certain social conditions. The impact of digital technology on art is obvious. Art works are often spread with the help of modern media technology, and modern media is supported by digital technology. Art work has an impact only when it is communicated, which makes art and digital technology closely linked. Digital media not

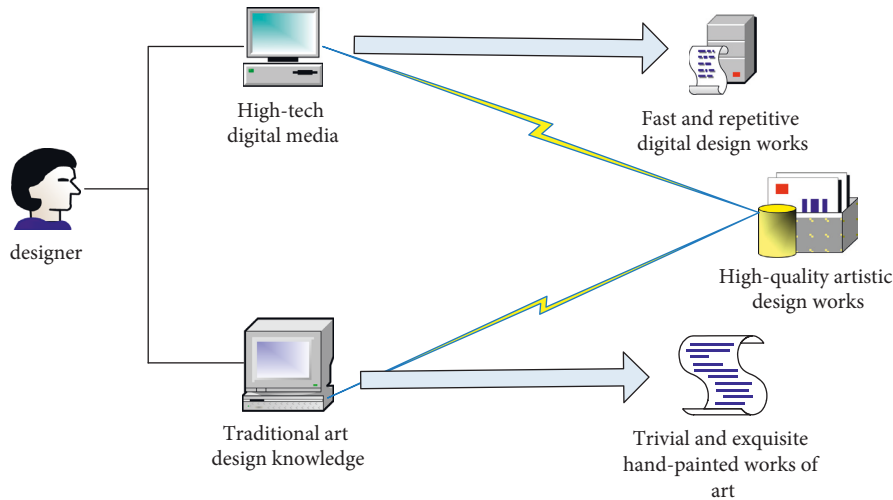


FIGURE 3: Combining digital technology with traditional art design.

only plays a role in the dissemination of art to a certain extent but it also determines the form of art works in the process of dissemination, as shown in Figure 3.

3.3. Big Data and Intellectual Property. The object of a patent right is a technical solution to a specific technical feature. According to the basic requirements of the patent system, this technical solution can be used to solve technical problems existing in reality, which have economic value as information. Moreover, with the improvement of the technical level, this kind of information has already been disclosed to the whole society through the Internet in digital form. Therefore, big data will contain more or less patent information. In the application process based on big data, the utilization of patent information is mainly reflected in two aspects. Provide digital information products containing patent information; methods of “mining” and “utilizing” data information may be patented methods. Returning to the status quo of the Chinese legislation, since the objects protected by the Chinese Patent Law are limited to patented products, patented methods, and designs, the products in the form of digital information are not included in the scope of patent protection and business methods are not regarded as objects that can be granted patent rights. Therefore, big data itself will not directly lead to the risk of patent infringement, or cause consequences that affect the normal exercise of patent rights. Compared with traditional patent infringement, patent infringement in the context of big data does not have obvious specificity [15].

As the right of the exclusive owner of a trademark to mark its own products and services, its object is essentially a kind of symbolic information used for identification. From the point of view of the function of trademark and the application of big data, the intersection of the two is very limited. However, after digitizing the identifying information in the trademark, it can be compared among a wide range of data information through the application of big data. To a certain extent, digital retrieval of trademark information can be realized, which is helpful to improve the

efficiency of trademark application review, or to discover inconspicuous trademark infringements. As for the trademark registration of big data and related technologies and applications themselves, it is still a traditional trademark registration examination standard issue in essence. Generic names of goods or services cannot be registered as trademarks. The particularity lies only in the fact that “big data,” as a representative of a series of information technologies, has strong technical attributes, which is easy to cause confusion between the censorship authorities and market players [16, 17].

4. Logo Recognition Method Based on Intellectual Property Big Data

4.1. Logo Recognition Algorithm

4.1.1. Shape Context Algorithm. In this paper, a shape context algorithm is proposed as an algorithm to measure the similarity between logos. The shape context algorithm proceeds in three steps:

Calculate the context information for each point on the two image point sets separately:

Generally, when the given image is not the contour image of the target object, some preprocessing should be done, including edge extraction, uniform sampling, etc. First, the inner and outer contours of the image must be extracted before they can be used for the calculation of the shape context algorithm. For example, when the number of contour points in the input image is insufficient, the image needs to be enlarged, and then sampling is performed when the number of contour points is sufficient. However, the image enlargement process may cause the original shape outline to become thicker, so it may be necessary to refine the image to keep the width of the outline as wide as possible by a single-pixel [18, 19]. As shown in Figure 4, we determine two different contour images of capital letter A. In this step, a point is the center to make concentric circles, and the circle is divided into 12 sectors. The concentric circles have five layers, so the entire contour map is divided into 60 grids.

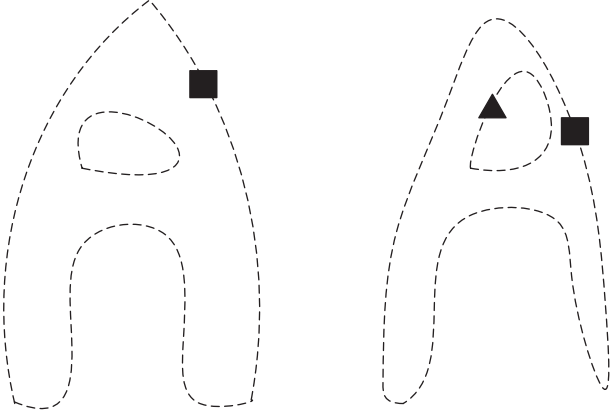


FIGURE 4: Sketch of handwritten letters.

The distribution of all other points on this contour in the grid should be counted. The shape information of each point is represented by the set of relative vectors that all other points form with it. To facilitate calculation of statistics and observations, a histogram is made to represent these vectors. Take the points marked by diamonds, triangles, and squares in Figure 4 as examples, make concentric circles, and calculate and draw histograms, respectively.

Calculate the difference between each two corresponding points in the two image point sets:

The shape context algorithm uses the χ^2 test statistic (the chi-square test statistic, the degree of deviation between the actual observed value of the statistical sample and the theoretically inferred value), as shown in the following formula:

$$C_s = \frac{1}{2} \sum_{k=1}^k \frac{[g(k) - h(k)]^2}{g(k) + h(k)}. \quad (1)$$

Among them, k refers to the k th grid, and g and h , respectively, represent a point in the two image point sets.

Use the Hungarian algorithm for matching search:

The shape penalty is shown in the following formula:

$$H(\pi) = \sum_i C(p_i, q_{\pi(i)}). \quad (2)$$

Finally, a transformation T is used to measure the transformation between shapes, that is, shape distance. Based on this shape distance, the similarity between the shapes of two objects can be basically measured. The shape distance calculation is shown in the formula:

$$D_{SC}(P, Q) = \frac{1}{n} \sum_{p \in P} \arg \min_{q \in Q} C(p, T(q)) + \frac{1}{m} \sum_{q \in Q} \arg \min_{p \in P} C(p, T(q)), \quad (3)$$

The shape context algorithm can capture the internal features of 2D images and obtain the point relationship between images at the same time, and maximize the use of point context information in the process of point set matching. The shape context algorithm has a very poor

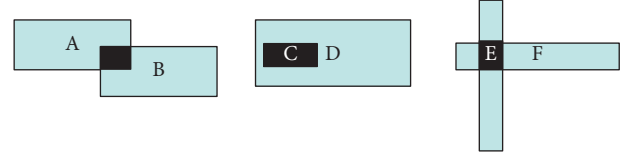


FIGURE 5: Schematic diagram of rectangle intersection.

matching effect when the image has a background and too many noise points. However, compared with other contour-based matching methods, the shape context algorithm is simple and does not need to consider the coordinate position of the point set, and has good robustness for nonrigid matching. This property makes it a better similarity measure algorithm [20].

4.1.2. Screening of Overlapping Regions of Identification Results. In target recognition, it is usually necessary to determine whether the output rectangle area overlaps. The calculation idea of judging whether two rectangles intersect or whether there is an overlapping area is mainly to calculate whether the coordinates of the four vertices of the first rectangle are included in the area where the second rectangle is located. However, there are logical flaws in this calculation idea. As shown in Figure 5, rectangles A and B, and rectangles C and D, all satisfy that the vertex coordinates are inside another rectangle, but although rectangles E and F have overlapping parts, they do not satisfy the judgment condition.

The specific calculation process is as follows:

Let the coordinate of the upper left corner of rectangle A be (x_{A1}, y_{A1}) and the coordinate of the lower right corner to be (x_{A2}, y_{A2}) . The coordinate of the upper left corner of rectangle B is (x_{B1}, y_{B1}) and the coordinate of the lower right corner is (x_{B2}, y_{B2}) . Then, the width of rectangle A is recorded as width_A and the height is recorded as height_A . Similarly, the width of rectangle B is recorded as width_B and the height is recorded as height_B . The center coordinates of rectangle A are marked as (x_{Ac}, y_{Ac}) and the center coordinates of rectangle B are marked as (x_{Bc}, y_{Bc}) . To judge whether two rectangles intersect, it only needs to satisfy formulas (5) and (6):

$$\begin{aligned} \text{width}_A &= |x_{A1} - x_{A2}|, \\ \text{width}_B &= |x_{B1} - x_{B2}|, \\ \text{height}_A &= |y_{A1} - y_{A2}|, \\ \text{height}_B &= |y_{B1} - y_{B2}|, \end{aligned} \quad (4)$$

$$(x_{Ac}, y_{Ac}) = \left(\frac{x_{A1} + x_{A2}}{2}, \frac{y_{A1} + y_{A2}}{2} \right),$$

$$(x_{Bc}, y_{Bc}) = \left(\frac{x_{B1} + x_{B2}}{2}, \frac{y_{B1} + y_{B2}}{2} \right),$$

$$|x_{Ac} - x_{Bc}| \leq \frac{\text{width}_A}{2} + \frac{\text{width}_B}{2}, \quad (5)$$

$$|y_{Ac} - y_{Bc}| \leq \frac{\text{width}_A}{2} + \frac{\text{width}_B}{2}. \quad (6)$$

Assuming that there is an intersection area between two rectangles, set the intersected rectangle to be C, the coordinates of the upper left corner of rectangle C to be (x_{C1}, y_{C1}) , and the coordinates of the lower right corner to be (x_{C2}, y_{C2}) , then:

$$(x_{C1}, y_{C1}) = (\max(x_{A1}, x_{B1}), \max(y_{A1}, y_{B1})), \quad (7)$$

$$(x_{C2}, y_{C2}) = (\max(x_{A2}, x_{B2}), \max(y_{A2}, y_{B2})). \quad (8)$$

Use formulas (7) and (8) to find the overlapping area of the two rectangular boxes, and calculate the overlapping area. Calculate the proportion of the overlapping area occupied by the two rectangles according to the overlapping area. If the overlap ratio threshold is exceeded, the two are determined to be the same logo area, and if the overlap ratio threshold is less than the overlap ratio threshold, the two are determined to be two independent logo areas.

4.1.3. Algorithm Evaluation Index. For the performance evaluation of the algorithm, the evaluation indicators such as the accuracy rate are used to evaluate whether the logo defect detection algorithm can accurately detect logo defects. This paper uses the confusion matrix to illustrate the evaluation indicators as shown in Table 1.

The description of each index in Table 1 is shown in Table 2.

Therefore, the definitions of Accuracy, Precision, Recall, and F1-Score are as follows:

$$\begin{aligned} \text{Accuracy} &= \frac{TP + TN}{TP + TN + FP + FN}, \\ \text{Precision} &= \frac{TP}{TP + FP}, \\ \text{Recall} &= \frac{TP}{TP + FN}, \\ F_1 \cdot \text{Score} &= \frac{2\text{Precision} \cdot \text{Recall}}{\text{Precision} + \text{Recall}}. \end{aligned} \quad (9)$$

Among them, the accuracy rate reflects the rate that all positive and negative samples are correctly classified, and the accuracy rate reflects the proportion of the normal logo samples in the discrimination result that are actually normal logo. The recall rate reflects the ratio of all normal logo inspection results judged to be normal logo, and the F_1 score is a comprehensive indicator of overall precision and recall. Only when both values are larger, the F_1 score is higher.

4.2. Logo Image Recognition Classification and Defect Search Based on Large Database. Data set 1 is used for the design and analysis of the logo defect detection algorithm in this paper. The source of the data set is divided into two parts: one part is the logo image obtained from the files used by SoftBank SBC&S Company daily; the other part is the logo

TABLE 1: Evaluation metrics.

Fact	Prediction result	
	Example (T)	Counterexample (F)
Example (T)	TP	FN
Counter example (F)	FP	TN

TABLE 2: Description of evaluation indicators.

Evaluation indicators	Indicator description
TP	OK logo detection result is OK
FP	NG's logo detection result is OK
TN	NG's logo detection result is NG
FN	OK logo detection result is NG

image artificially produced according to the relevant defect judgment criteria of SoftBank SBC&S Company. This part of the data is produced by Photoshop software. Some images of the dataset are shown in Figure 6.

The total number of logo images in this dataset is 2020. Among them, there are 1208 normal logo images (OK images) and 812 defective logo images (NG images). The ratio of OK Logo to NG Logo is about 1.5:1. Positive samples are slightly higher than negative samples. The defect logo may have one or more defects, but they are classified according to the defect detection priority introduced in the article. The detailed data distribution is shown in Table 3.

For normal logo, the maximum gray level greater than ratio can be extracted that is, the maximum gray level proportion is in 1 area. Adaptive foreground and background separation is performed for this type of logo, and foreground masks are extracted for subsequent foreground color detection. First, if the ratio of the maximum number of pixels is found to be greater than the ratio, then take the maximum gray level as the center, record the ratio as threshold, and expand to both sides to select the threshold for adaptive foreground and background separation. The algorithm flow figure for selecting the adaptive threshold is shown in Figure 7. After the expansion on both sides is completed, the pixels in the gray-level neighborhood are taken as the background, and the rest are classified as the foreground.

4.3. Logo Picture Defect Inspection

4.3.1. Color Defect. Part of the experimental results was randomly selected from the experimental data set as shown in Table 4. Referring to the logo color defect judgment criteria, the average foreground and background values of the logo can better reflect the real situation of the logo color. Referring to the logo color defect judgment criteria, the average foreground and background values of the logo can better reflect the real situation of the logo color. Color changes within this error range are invisible to the human eye. The foreground and background of the no. 2 logo are normal, but the contrast calculation result of gray is 12, which is too small to distinguish. It can be seen that the

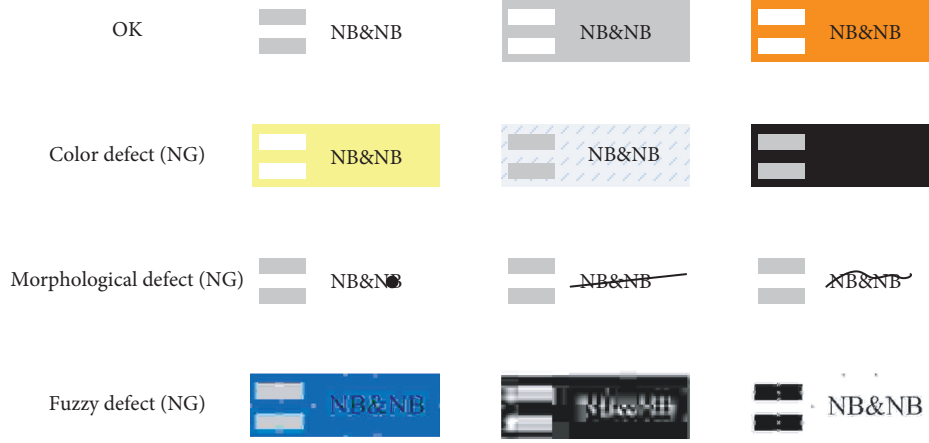


FIGURE 6: Data part display of dataset 1.

TABLE 3: Data distribution of dataset 1.

Logo defect category	Logo image quantity (piece)
Normal (OK)	1208
Color defect (NG)	269
Morphological defect (NG)	275
Fuzzy defect (NG)	268

algorithm in this paper can better detect the color of the logo foreground and background.

Then, all the logo images in the dataset are identified. The logo image color defect detection algorithm in this paper has a test accuracy of 97.0% in the 1208 normal logo images and 269 color defect logo images in dataset one.

From the above experimental results, the color detection algorithm in this paper quantitatively analyzes the foreground and background of each area. The subjective judgment of the human eye is combined with the actual numerical analysis to detect the problem of logo color defects. In general, the algorithm in this paper has played a good role in the detection of logo color defects. The reason why the algorithm does not reach 100% is mainly affected by the small size of the logo image. Because the logo image is too small in size, the boundary between the foreground and the background is often blurred, and many errors will be introduced in the process of foreground color detection and background color detection, causing misjudgment, which will affect the results of the algorithm.

4.3.2. Morphological Defects. Compared with the traditional image direct difference method and the image moving difference method based on the convolutional autoencoder-based logo morphological defect analysis algorithm proposed in this paper. If the number of white pixels (pixel value is 255) in the image difference result is less than 2% of the total number of pixels in the whole image, it is considered as a normal logo; otherwise, it is considered as a morphological defect logo. In order to ensure the uniformity of the experimental data, under the premise of the above data set division, 242 normal logo images and 275 morphological defect logo images in the test set are compared and tested, as

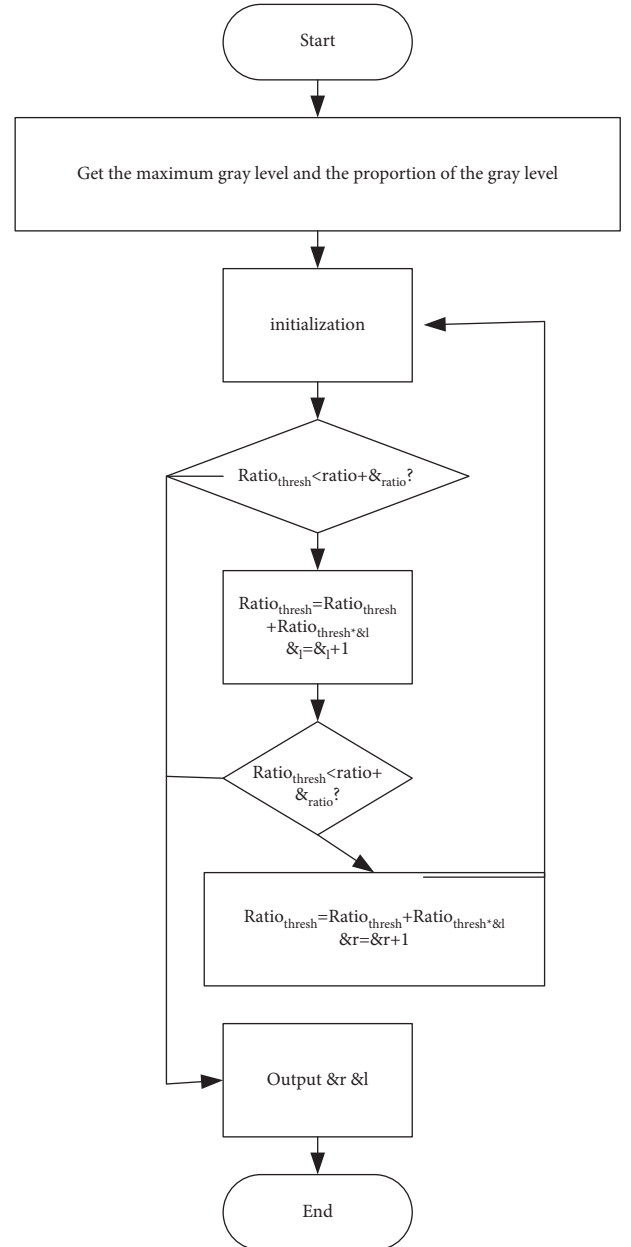


FIGURE 7: Adaptive threshold acquisition.

TABLE 4: Color defect analysis results table.

	Logo segmentation	Prospect mean	Prospect variance	Background mean	Background variance	Block determination	Overall determination
Normal logo image	1	28	1	251	363	OK	OK
	2	34	304	253	325	OK	
	3	32	313	250	325	OK	
	4	32	289	253	120	OK	
	5	31	266	252	192	OK	
	6	31	255	252	192	OK	
Color defect logo picture	1	254	0	242	0	NG	NG
	2	254	2	242	1	NG	
	3	254	2	242	1	NG	
	4	254	2	242	1	NG	
	5	254	2	242	1	NG	
	6	254	2	242	1	NG	

shown in Table 5. It can be seen from Table 5 that, compared with the traditional algorithm, the accuracy of the algorithm in this paper has been significantly improved. The reason why the accuracy rate is less than 100% is that the algorithm in this paper cannot distinguish small logo morphological defects in the final image difference and postprocessing, and these defects are mistakenly regarded as noise by the algorithm and removed. In general, the logo morphological defect detection algorithm in this paper still achieves good results.

4.3.3. Logo Image Blur Defect Detection. Aiming at the problem of logo image blur, this paper introduces the logo image blur detection algorithm from the mathematical calculation method based on structural similarity coefficient and the method based on image morphology and compares and analyzes it.

From the test results in Figure 8, the SSIM results all decrease as the blur radius of the logo image increases, indicating that the blur degree of the image is inversely correlated with the SSIM results. Through this anti-correlation change trend, it is found through experiments that the set threshold is around 0.9, and if the threshold is greater than this threshold, it can be considered as a normal logo; otherwise, it is a fuzzy logo.

The experimental results show that whether for out-of-focus blur or distortion blur, the results of SSIM will be affected by the reference template. Choosing different reference templates will result in different SSIM results, which adds a lot of uncertainty to logo fuzzy detection.

4.4. Logo Image Recognition Classification Test. For the logo fine-grained classification task, the Logo-2K+ classification dataset constructed in this paper is used for logo classification, and the data only contain the label information of the logo category. The Logo-2K+ dataset contains 167,140 images collected from different social networking sites. Figure 9 shows a picture example of the Logo-2K+ dataset, summarizing the statistics of the existing logo dataset.

The classification evaluation index of this experiment adopts the accuracy rate. The results of the multiclassification

TABLE 5: Comparison of the accuracy of the algorithm in this paper and the traditional image difference algorithm.

Algorithm	Accuracy (%)
Image direct difference method	81.4
Image moving difference method	85.5
Algorithm	97.4

of logo images are evaluated by calculating the accuracy with the first confidence and the accuracy with the top five confidences; that is, the Top-1 accuracy and the Top-5 accuracy are used as the classification evaluation indicators. The classification accuracy rate represents the proportion of correctly classified samples in all samples, and the calculation formula is:

$$\text{Accuracy} = \frac{\text{TP} + \text{FN}}{\text{TP} + \text{TN} + \text{FP} + \text{FN}} \quad (10)$$

The experimental results are shown in Table 6. It can be seen from the table that the classification network with the best performance is ResNet-152, the accuracy of Top-1 is 67.65%, and the accuracy of Top-5 is as high as 91.52%. After adding efficient and label smoothing regularization tricks, a Top-1 accuracy of 67.99% is achieved. The algorithm method in this paper exhibits the best Top-1 accuracy rate of 72.09% and Top-5 accuracy rate of 93.45%, surpassing the NTS-Net method by about 1%. The experimental results of this group show the effectiveness of the region-guided data augmentation strategy.

5. Logo Design Process Based on Property Rights Protection

The trademark search process of logo design includes three stages, namely the retrieval stage of the existing trademark big data, the design stage, and the protection stage of the design results, as shown in Figure 10.

5.1. Search Stage of Existing Trademark Big Data. First, determine the search scope. The search stage of existing trademark big data refers to the categories of goods and

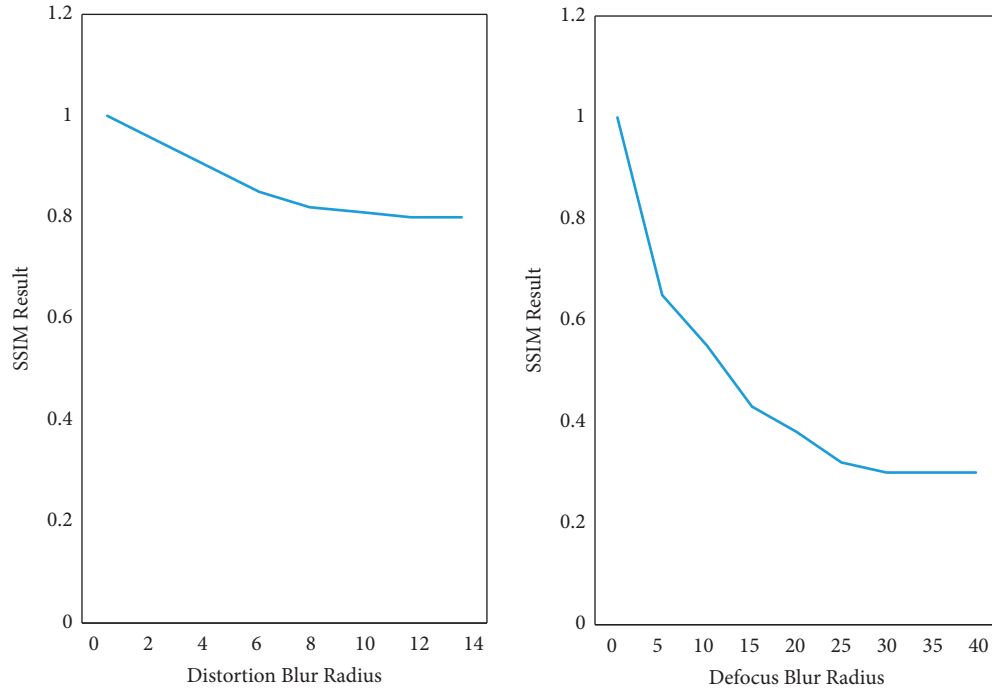


FIGURE 8: SSIM results for different blur radii.

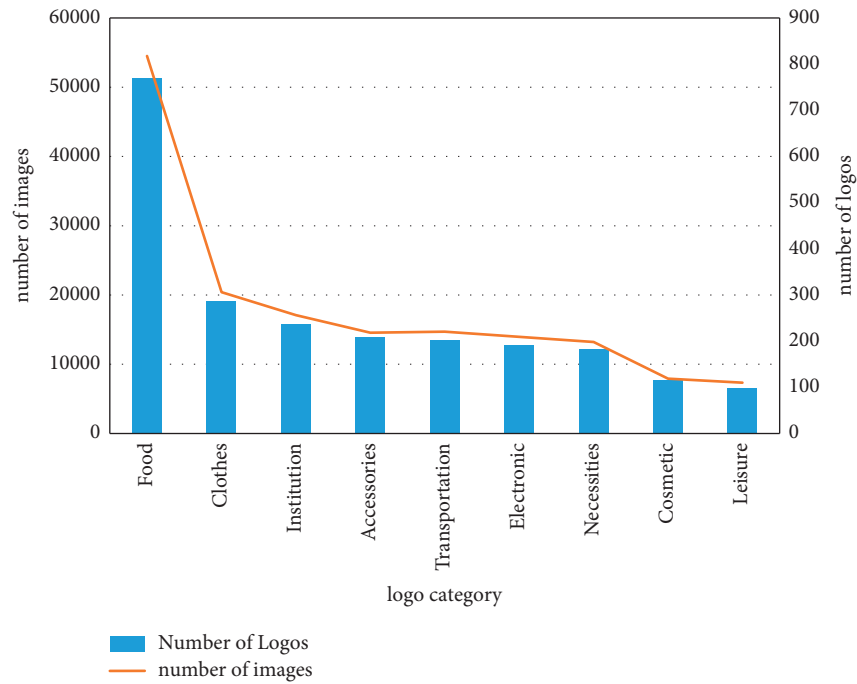


FIGURE 9: Dataset statistics.

TABLE 6: Experimental results of Logo-2K+ dataset (%).

Method	Top-1 accuracy	Top-5 accuracy
GoogLeNet	62.36	88.33
NTS-net (ResNet-50)	69.41	91.95
Algorithm	72.09	93.45

services for which the trademark is pre-applied. According to the business scope and service scope of the enterprise, find and lock the search scope by keywords in the classification table of similar goods and services. If the category of goods and services cannot be determined, people can search for the names of larger enterprises in the same industry in the applicant's "Comprehensive Query" column and refer to the

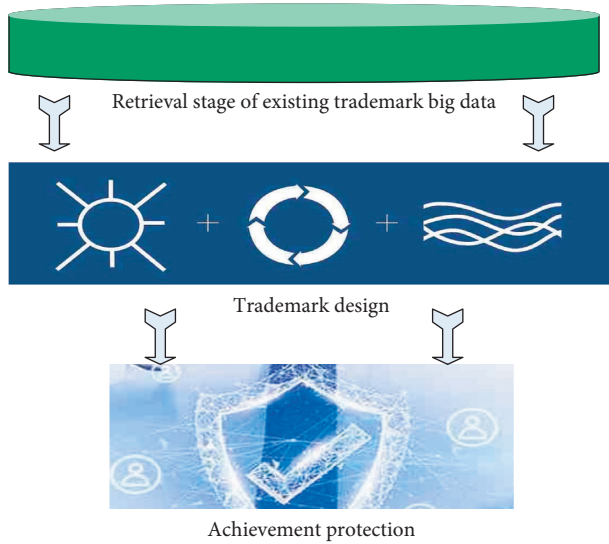


FIGURE 10: Logo design process.

categories of goods and services applied for by peer companies to determine the search scope.

Second, filter the elements of the design one by one within the specified search scope. According to the definition of a trademark, it consists of a combination of a single word symbol, a single graphic symbol, a single letter symbol, a single number symbol, a single sound symbol, a single three-dimensional symbol, and a single color, as well as a combination of the above single design elements. The design direction is finally determined according to the trademark search results.

5.1.1. Filter Chinese Characters. As the most direct information in corporate or product promotion, Chinese characters determine the recognition and acceptance of trademarks. Logos lacking Chinese information will be greatly hindered in publicity and promotion. At the beginning of trademark search, priority should be given to the availability of Chinese characters, and the original Chinese characters should be submitted for trademark protection as soon as possible. Especially at the beginning of the industrial and commercial registration of a newly established enterprise, the Chinese name of the enterprise should be comprehensively considered, combined with the trademark search. It is necessary to avoid the conflict between industrial and commercial registration and trademark registration and to prevent the name of the industrial and commercial registered enterprise from being preemptively registered as a trademark. In general, compared with two-character Chinese names, three-character or four-character Chinese names require fewer data to search and filter, and are more likely to make a difference.

The availability of Chinese characters can be filtered through the Chinese character query method in the trademark similarity query. When the search result shows that the original Chinese character has been approved to be

registered in the same or similar category, the application made in this Chinese character may be rejected. It is recommended to reselect the Chinese name to fundamentally solve similar problems. If the Chinese name cannot be replaced or changed, it can be added on the basis of the existing Chinese characters; that is, graphics processing is performed on the basis of the original Chinese characters. Or add elements such as Pinyin or English or graphics to adjust the text, and increase the combination with other elements on the appearance to improve the distinctiveness of the trademark and reduce the similarity with the existing trademark.

5.1.2. Filter Combinations of Letters, Pinyin, and Initials. Generally speaking, the alphabet involves phonetic trademarks, English, and letter combinations. The selection of Pinyin and English names is related to the Chinese name of the enterprise, and its availability can be filtered through the Pinyin query and English query in the trademark similarity query. The initial query can filter for a single letter or two letters. Based on the search results, by removing silent letters, or substituting other letters and words with similar pronunciation, and or replacing the meaning with Chinese characters, when the combination of the same or similar trademarks in Pinyin or English in the preapproved categories of goods and services the method of the associated English words, the name is adjusted from the transliteration and free translation to the trademark registration of the letters and their combinations.

5.1.3. Screening Graphics. Graphics can be filtered by the graphics query pattern in trademark similarity search. Cognitive differences in the same graph can result in very different search results. Graphical searches should be comprehensive and should retrieve and compare graphics as a whole as well as individual elements. But it is different from the internal screening system of the trademark office. Externally, there is a lack of graphic screening systems suitable for public use. For ordinary people, it is very difficult to filter the similarity of graphs. With the continuous development of information technology, it is hoped that artificial intelligence technology can help trademark screening in the future, improve the accuracy and depth of screening, and solve the asymmetric problem of trademark query information.

5.1.4. Screening Synthetic Graphics. For compound graphics, factors such as graphics, word pronunciation, and word meaning should be compared from the whole and main parts. Based on the search results, adjust the proportion and combination of certain elements or elements to increase the likelihood of registration.

5.2. Design Phase. Through the preliminary screening of logo elements, the accurate design direction is determined, and the design practice is carried out in combination with the traditional logo design method. In addition, in design

practice, trademark search tools should be used to monitor the stability of design proposals through various search methods. If a high degree of similarity is found in the search results, the design direction should be adjusted in time until the final design scheme is determined.

5.3. Protection Stage of Design Results. Once the design scheme is determined, it will enter the critical stage of achievement protection. For the protection of logo graphics, it is necessary to focus on the future development of the enterprise and achieve comprehensive and timely protection.

Comprehensive protection refers to a comprehensive trademark filing class and a comprehensive trademark filing strategy. The class of trademark application should cover all products and services that are related or similar to the future development of the business.

Timely protection means that applications for trademark registration should be submitted promptly and promptly. Company leaders should strengthen the awareness of trademark protection and avoid being sued for using others' trademarks or preemptively registering trademarks.

6. Discussion

Based on image recognition technology, the color detection algorithm in this paper quantifies the foreground and background of each area, combines the subjective judgment of human eyes with the actual numerical analysis, and then detects the color defect of logo. Generally speaking, the algorithm in this paper plays a good role in the color defect detection of logo. Moreover, the detection of image morphological defects and image blur can achieve good results. This shows that the logo identification technology in this paper can effectively check and verify the existing image trademarks and can effectively avoid the phenomenon of trademark intellectual property infringement.

Aiming at the design process of logo, this paper uses new media technology to increase data technology, which can effectively improve the efficiency of logo design, which is very meaningful in business. In particular, the use of big data technology to generate logo in batches to avoid infringement is revised by designers, which not only improves the efficiency but also improves the quality.

7. Conclusion

Taking big data as the object to study its role and influence in the current wave of social informatization is an inevitable requirement for the intellectual property system to adapt to social development. It is also the basic premise for the law to realize the sharing, full circulation, and rational utilization of social information through institutional design. With the rapid development of multimedia information and mobile Internet, data such as videos and pictures have grown on a large scale, and the information contained in these massive multimedia data are useful. Through the analysis of these visual information, the analysis of commodity brands, user preference analysis, and commodity personalized recommendation can be realized. Logo classification and detection

have attracted the attention of more researchers with the impetus of deep learning. Of course, this paper also has some defects, such as the analysis of the design process and identification of picture trademarks in the research, but the research on word mark is seldom mentioned, so the design scope of trademarks will be expanded in future research.

Data Availability

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

Conflicts of Interest

The authors declare that they have no conflicts of interest regarding the publication of this paper.

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