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Analyzing the Revolutionary Visual Symbol System in China's Hundred-Year Red Cartoon History Based on Computer Image Processing Technology

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ABSTRACT

Under the guidance of relevant theories and techniques, this project binarizes and segments red cartoon images, and then extracts their contour features. Neural network classifiers are used to identify and classify the outline features to realize the acquisition of visual symbols of the revolution in the history of Chinese red cartoons in the past 100 years. With the help of Pierce semiotics, the system of revolutionary visual symbols is constructed, and the system is explored in depth. Compared with other models, this paper has a high superiority on the recognition of revolutionary visual symbols in Chinese centuries-old red cartoons, and seven items of revolutionary visual symbols are extracted, specifically, flag, badge, gear, pentagram, wheat ear, hammer and sickle. In addition, the visual symbol system of the revolution has a high degree of recognition, for example, the CMYK value of the flag is 0, 100, 100, 0, and its color is red, which symbolizes the red of "passion and revolution", which well reflects the "red years" of China's development and the fruitful results of the revolution and construction. The fruit of construction.

Keywords: image segmentation, image recognition, neural networks, Peirce semiotics, revolutionary visual symbols

1. Introduction

With the beginning of the New Culture Movement in 1915, the ideological liberation of Chinese society broke out. Various cultural ideas were constantly colliding. At this time, cartoons with the advantages of easy to understand, sharp satire, fast creation and wide dissemination became the main force of propaganda of the New Culture Movement and anti-imperialist patriotic movement, and cartoons with strong patriotic spirit began to sprout rapidly. When China was troubled by wars at home and abroad and political turmoil, the people made use of easy-to-understand cartoons to express the anti-imperialist, anti-war and patriotic attitude of the Chinese people who were not

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willing to give in, and at the same time, the art of cartooning was colored with red temperament [1-4]. Red culture is an advanced culture with Chinese characteristics created by Chinese communists, advanced elements and people in the revolutionary war era, which contains rich revolutionary spirit and heavy historical and cultural connotations [5]. Red cartoon is one of the important carriers of Chinese civilization, which has important political value and practical significance [6]. With the centenary of the founding of the party in full swing, red cartoons once again returned to people's attention, and became an art expression actively organized by various local universities and widely popularized by the public.

As a form of artistic expression in the new era, red comics make the ancient art of comics revitalized with the help of digital technology, so as to promote the organic integration of comics and mass work, and to promote the benign development of culture and tourism propaganda in the new era [7-9]. The traditional paper version of the red caricature of this form of cultural communication, can only let people in a short period of time after reading the resonance, but if the digital art applied to the red caricature can lead the audience into the reality of the scene, enhance the sense of immersion, so that the audience will not be able to forget it for a long time [10-13]. Since the depth and breadth of cultural communication depends not only on the content of cultural communication, but also on the form of cultural communication, that is, how to communicate, what kind of communication methods and means [14-16]. Therefore, using the new era of computer image processing technology to fully explore the historical and cultural elements and heritage in the centuries-old red cartoons, to show the Chinese style, Chinese imagery, Chinese spirit, and to truly realize cultural confidence. At the same time, the established revolutionary visual symbol system is utilized to tell the red stories that are of interest to young people, create better cartoon works, and then achieve the purpose of passing on the red culture.

In this paper, we first systematically summarize the principle of acquiring revolutionary visual symbols, use GrabCut image segmentation algorithm to preprocess the images in the history of Chinese centuries-old red cartoons, and extract the image contour features. The features are put into a neural network classifier, and finally the revolutionary visual symbols in the history of Chinese centuries-old red cartoons are recognized and classified. Synthesize the theory of Peirce semiotics to construct the system of revolutionary visual symbols, which consists of flag, emblem, gear, five-pointed star, wheat ear, hammer and sickle. Image segmentation, symbol recognition, and system evaluation are explored separately, aiming to verify that the research in this paper has a promotional effect on the inheritance of China's red spirit and history and culture.

2. The theoretical basis of the revolutionary visual symbol system in red comics

2.1. Red cartoons

The so-called red comics refer to those comics whose narrative or picture presentations are mainly based on red themes. Red themes are often based on red classics, which are summarized as “people, objects, events and souls” in the revolutionary era. Along with the new era, the red theme has developed a broader meaning. In addition to the revolution and struggle before the founding of New China, the theme also includes the reform and construction after the founding. Nowadays, the definition of Chinese red comics should be based on patriotism education as the core, showing the CPC and the Chinese people, carrying out the great revolutionary struggle as well as socialist construction as the theme of creation. Red comics are the earliest type of paintings that participated in the revolutionary struggle in the history of Chinese art, and they were the most powerful fighting weapon against the empire and feudalism at the beginning of the 20th century, that is, before the founding of New China. Entering the new era, red-themed literary and artistic works have flourished, mining and writing red stories and red resources in different forms and from different perspectives,

and the “red” element in comics has also become increasingly prominent. Various creative competitions or comic exhibitions with the themes of telling China's story, spreading Chinese culture, glorifying the glorious history of the Party, and dedicating to the centennial of the Party's birth have emerged in an endless stream, aiming at arousing the creation of red themes and highlighting China's style with the red classics of the new era. No matter how the cartoons change, the creation of telling red stories and passing on the red spirit will not stop, and they will constitute the eternal charm of China's red culture.

2.2. Computer graphics image processing key technology

2.2.1. Image Recognition Technology. The application of image recognition technology is mainly realized with the help of CNN network and Opencv. CNN network, also known as convolutional neural network, is mainly used to recognize two-dimensional shapes that have been shifted or scaled [17-18]. In the process of using it, due to the special characteristics of its feature detection layer, thus it mainly learns the training data by implicit way. In addition, since the same features have the same neuron weights, the network supports parallel learning. Opencv, as a cross-platform computer vision and machine learning software library, can run on different operating systems and adopt common algorithms for computer vision and graphical image processing.

2.2.2. Image segmentation techniques. The image segmentation technique, which refers to the technique of intercepting the desired graphic image from the original file, is based on the discontinuity of brightness and is now widely used in the electronic manufacturing industry [19-20]. Since the components of electronic devices are very small and difficult to inspect manually, graphical image segmentation is used to find the missing parts. In addition, graphic image segmentation technology can also be divided into different regions of the original graphic image, and will be inconsistent with the rules of the division of the original screening out, greatly improving the production efficiency of the electronics manufacturing industry.

2.3. Revolutionary Visual Symbol System

The visual symbols of the revolution are non-verbal symbols, which, as “visual information”, achieve the purpose of effective transmission by virtue of their own characteristics, such as extensiveness and universality, directness and truthfulness, openness and multiple meanings, translatability and interculturality. The visual symbol system of the Chinese revolution should have the above characteristics and at the same time should have its own characteristics in order to be called the visual symbol system of the Chinese revolution, i.e., the characteristics that are beneficial to forging the sense of community of the Chinese nation, the construction of socialist culture with Chinese characteristics in the new era, as well as cross-cultural exchanges and the shaping of the national image, including: profound culture and history, unique artistry and innovation, profound plurality and inclusiveness, as well as the ability to communicate across cultures and the creation of a national image. The characteristics include: profound culture and history, unique artistry and innovation, profound plurality and inclusiveness, and scientific systematicity and regularity.

3. Revolutionary Visual Symbol System Supported by Image Processing Technology

3.1. Image Processing of 100 Years of Chinese Comic History

3.1.1. Revolutionary Visual Symbol Acquisition. Revolutionary visual symbols (flags, emblems, cogwheels, pentagrams, ears of wheat, hammers, and sickles) were acquired using image foreground extraction techniques in image processing, which divides the image into specific regions with

different characteristics and extracts the valuable parts. Program design in the selection of image segmentation algorithms taking into account the experimental purpose of abandoning the background and extracting only the foreground target, as well as the cartoons in the form of more free and rich, more intense visual effects, more personalized, single color and high saturation characteristics, in the threshold segmentation, region segmentation, edge segmentation, graph theory segmentation, and other image foreground target extraction techniques, the selection of the graph theory based on the GrabCut image foreground target extraction method [21]. This algorithm is very effective for color image segmentation and is fast, accurate and stable compared to other graph theory segmentation methods, and is suitable for all kinds of comic images as well as color images in other fields. The following steps are followed:

Step1: A rectangle containing the object is defined, and the pixels that are not within the rectangle are the portion of the image that is determined to be rejected during image segmentation, i.e., the image background. Within the defined rectangle, it is subdivided into foreground object and background. Distinguishing between foreground and background within the rectangular region is achieved by Gaussian mixture modeling.

Step2: Labeling target foreground and background for undefined pixels. Each pixel in the image is analogous to its neighboring pixels connected to each other, and the endpoints of its two ends are the nodes, either background nodes or foreground nodes.

Step3: After all the undefined pixel nodes are connected, the connected edges are cut based on the similarity of the color of this pixel with its neighboring pixels. This is a good way to separate the background nodes from the foreground nodes, and also completes the segmentation for the visual symbols of the revolution in the red cartoon image (flag, emblem, gear, pentagram, wheat ear, hammer, sickle).

3.1.2. Image binarization. After acquiring the revolution visual symbols (flags, badges, gears, pentagrams, ears of wheat, hammers, sickles) residual interference points and interference lines in the image, so the morphological erosion and expansion operations are used to remove the character edge white edges and other interference pixels. And image erosion and expansion mainly target the image after thresholding (0 or 255), so binarization of the image is performed to prepare for the subsequent operations. For color images, there are three channels, blue, green and red, all with a value range of 0-255. For grayscale images, there is only one channel 0-255, so there are a total of 256 colors. And for binary image, there are only two colors, black and white. Binary images have less data and image binarization highlights the outline of the target character. There are two steps in image binarization, the first one is to get the threshold value and the second one is to binarize the image according to the threshold value.

3.1.3. Morphological corrosion and expansion. There are multiple connected regions in the segmented image, and multiple connected regions play a serious role in interfering with the feature extraction of the revolutionary visual symbols (flags, badges, gears, pentagrams, ears of wheat, hammers, sickles). For example, when the polygon frames the target character, the small connected regions in the image, including interference points and interference lines, will be framed by the polygon as the target. Therefore, a morphological closure operation of erosion followed by expansion is performed on the segmented image after binarization to obtain a single connected region of the visual symbols of revolution (flag, badge, gear, pentagram, wheat ear, hammer, sickle) that are to be feature extracted.

3.1.4. Contour feature extraction. Feature Extraction of Revolutionary Visual Symbols (Flag, Badge, Gear, Pentagram, Wheat Ears, Hammer, Sickle) The part of feature extraction firstly introduces the feature extraction of revolutionary visual symbols (flag, badge, gear, pentagram, wheat ears, hammer, sickle). In the first step, the preprocessed image is input and the perimeter and area of the contours

are calculated. In the second step, frame the character using polygons. There are many external polygons, such as external circle, external ellipse, external horizontal rectangle, external minimal rectangle, fitted polygon, etc. The external polygon selected in the feature extraction part of the character outline is the external minimal rectangle. In the third step, the aspect ratio and tilt angle of the outer minimal rectangle are calculated. Finally, the extracted outline features of the visual symbols of the revolution (flag, badge, gear, pentagram, wheat ear, hammer, sickle) are built as feature vectors.

3.1.5. Neural Network Based Recognition Classifier. Neural network is a machine learning technology that simulates the nerves of the human brain to achieve intelligent training models. Deep learning based on neural networks has become very popular in recent years, and because of its intelligent learning ability, it can do “anything” and shine in many fields. Because it imitates the human brain, so it can be imagined that the human brain can do things it can do, and even stronger than the human brain, computing speed, computing power, etc. is generally incomparable to the human brain. Maybe the robots with human consciousness that we see in science fiction movies will become reality in the near future. Neural networks are also widely used in the field of image recognition, and have achieved very good results.

1) Neuron. Neuron model as shown in Figure 1, the neuron model is to simulate a human brain neuron, including input, output and calculation of three parts, equivalent to the dendrites of the human brain neurons, neuronal axons and nuclei.

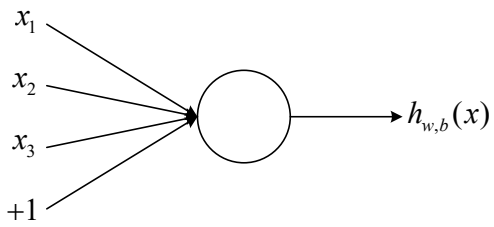


Fig. 1. Neuron model

The neuron model above has input x_1, x_2, x_3, intercept +1, and output:

$$h_{W,b}(x) = f(W^T x) = f(\sum_{i=1}^{3} W_i x_i + b) \tag{1}$$

where W_i denotes the weight of input x_i and b denotes the neuron threshold.

2) Neural network model. Neural network model as shown in Figure 2, the human brain nervous system is composed of countless neurons linked together, the computer's neural network model is also a lot of neurons linked together, the output of the previous neuron as the next neuron's input, which consists of a neural network.

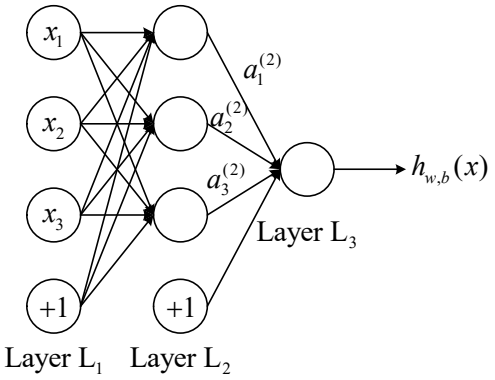


Fig. 2. Simple neural network model

In the above neural network model, the leftmost x_1, x_2, x_3 serves as the input layer, the neurons in the middle belong to the hidden layer and their values cannot be observed during training, and the rightmost one neuron node is the output layer.

Denote the number of network layers as $n_i = 3$, layer l as L_l, input layer L_1, and output layer L_{ni}. Parameters $(W,b) = (W^{(1)}, b^{(1)}, W^{(2)}, b^{(2)})$, $W_{ij}^{(l)}$ are the link parameters between unit j in layer l and unit i in layer $l+1$, and $b_i^{(l)}$ is the bias term of unit i in layer $l+1$. Denote by $a_i^{(l)}$ the output value of unit i of layer l. For a given set (W,b), the output is computed as follows according to function $h_{W,b}(x)$:

$$\begin{aligned} a_1^{(2)} &= f(W_{11}^{(1)}x_1 + W_{12}^{(1)}x_2 + W_{13}^{(1)}x_3 + b_1^{(1)}) \\ a_2^{(2)} &= f(W_{21}^{(1)}x_1 + W_{22}^{(1)}x_2 + W_{23}^{(1)}x_3 + b_2^{(1)}) \\ a_3^{(2)} &= f(W_{31}^{(1)}x_1 + W_{32}^{(1)}x_2 + W_{33}^{(1)}x_3 + b_3^{(1)}) \\ h_{W,b}(x) &= a_1^{(3)} = f(W_{11}^{(2)}a_1^{(2)} + W_{12}^{(2)}a_2^{(2)} + W_{13}^{(2)}a_3^{(2)} + b_1^{(2)}) \end{aligned} \tag{2}$$

3.2. Constructing a visual symbol system for the revolution

The above article obtains the features of revolutionary visual symbols (flag, badge, gear, five-pointed star, wheat ear, hammer and sickle) through image recognition technology and image segmentation technology, and analyzes the acquired features. On this basis, the revolution visual symbol system is constructed by utilizing Peirce semiotics theory.

3.2.1. Peirce's Semiotics. Semiotics is the science that studies the internal structure of symbols and the way of referring and meaning. Meaning is produced by the systematic construction of representation, and it is the product of the practice of meaning, i.e. a practice that produces meaning and makes things meaningful. Meaning is present in the relationship that exists between symbolic form and symbolic interpretation, using certain symbols to represent the process or result of the production of meaning. Some seemingly impossible to have a connection between the symbolic form and symbolic interpretation, can be linked together through the meaning of the meaning is already an integral part of the composition of the symbol, if not used properly, it will not be able to accurately convey the meaning of the symbol.

Peirce's theory of symbols is built on the basis of logic and structuralism, using symbols as objectively existing objects and carriers of subjective ideas to elaborate the formation, function, and role of symbols. In Peirce's triadic relation the sign form is the aspect in which one thing can represent another in a certain capacity. The symbolic object is the “something” mentioned in the symbolic form, and the symbolic interpretation can also be called the interpretive item, which is the message conveyed by the interpreter to the symbolic form about the symbolic object and the

meaning of the symbol, the triadic relationship is also known as the “symbolic triangle”, and there are two kinds of special relationships in the symbolic triangle. There are two kinds of special relations, one is the representation relation between the symbol form and the symbol object, and the other is the meaning relation between the symbol form and the symbol interpretation, and the meaning relation is equivalent to the energy and reference in Saussure's theory.

3.2.2. System construction. In China's century-long history of cartooning, visual symbols of revolution have been widely used, ranging from small guideline signs, posters and logos to large landmark buildings, sculptures and propaganda films, all of which belong to the category of visual symbols. Visual symbols through the color, shape, picture changes, abstracted to convey the information of the ceremony, the abstracted information in the audience's cognitive re-translation to produce a different ritual perception, thus forming a unified meaning of a variety of symbols under the interpretation. At the same time, the repetition of visual symbols can also deepen the memory and strengthen the role of identification, and realize the fixation of abstract images and symbols, the creation and presentation of visual symbols is a process full of subjective initiative. On the basis of the above, the revolutionary visual symbol system established by combining Pierce's semiotics is a concentrated manifestation of the visual cultural representations during the transition period of Chinese society, and is also a visual symbol expression of China's cultural self-confidence.

4. Exploration of Revolutionary Visual Symbols in Red Comics

4.1. Segmentation effect analysis of red cartoon image

Seven red manga datasets are selected as the research samples (A, B, C, D, E, F, G), and this paper is experimented in a PC environment with a 2.4GHz processor and 8GB RAM. This subsection verifies the effectiveness of this paper's manga image segmentation method (GrabCut image foreground target extraction method based on graph theory) in terms of both image segmentation time-consuming and interaction volume, where the control algorithms include Lazy Snapping (preprocessing the input image using the watershed algorithm), Rep Snapping (mean drifting algorithm), and FCM (clustered mean Image Segmentation Algorithm).

On the basis of the research samples, the segmentation effect performance of the image segmentation algorithms in this paper is verified and analyzed, and the interaction volume and segmentation time consumed statistics are shown in Table 1, where H, I, and J denote the interaction volume, the preprocessing time, and the segmentation time consumed, respectively. It can be seen that the pre-processing time consumed, the method in this paper takes the shortest time.Lazy Snapping method uses the watershed algorithm, which needs to calculate the gradient of all neighboring pixels in the image, and the FCM needs to calculate the image color mean.Rep Snapping method uses the mean drift algorithm, which needs to be iteratively solved for the optimal value. Therefore, both Lazy Snapping method and Rep Snapping method take longer time in preprocessing process, while FCM does not require preprocessing. Under the optimal segmentation results, the method in this paper requires the least amount of user interaction and the shortest total time consumption, which is good for the requirements of this study.

Table 1. Interaction volume and segmentation time statistics

Data set	Lazy Snapping			Rep Snapping			FCM			Ours		
	H	I	J	H	I	J	H	I	J	H	I	J
A	12	10.86	2.61	15	7.7	2.96	7	0	2.72	10	0.2	0.22
B	8	4.86	0.75	17	6.83	0.38	13	0	7.58	1	0.06	0.68
C	15	6.2	4.68	14	6.3	7.81	5	0	8.76	4	0.11	0.11
D	9	10.64	2.78	4	1.74	0.15	4	0	0.57	6	0.28	0.14
E	17	11.71	2.42	17	3.41	5.58	10	0	4.94	11	0.18	0.88
F	11	6.07	4.48	12	3.45	1.06	7	0	7.16	3	0.26	0.45
G	4	2.56	0.18	8	0.35	1.54	15	0	5.19	3	0.08	0.91

4.2. Revolutionary Visual Symbol Recognition Analysis

Confusion matrix is a visual schematic of classification effects. It can be used to depict the relationship between the real category attributes of the sample data and the recognition results, and is a method to evaluate the performance of classifiers, which is widely used in image recognition.In this paper, the confusion matrix is used to represent the recognition performance of different models on the revolution visual symbols.

In order to verify the priority of this paper's model in the recognition of revolutionary visual symbols, five reference models are set up, SVM, RF, LSTM, GA, BF, respectively, and the confusion matrix is used to represent the recognition performance of different models on revolutionary visual symbols, and the confusion matrix is shown in Tables 2~ [0-9], where Tables 2~7 represent SVM, RF, LSTM, GA, BF, and this paper's model, respectively, and the table has 7 kinds of revolutionary visual symbols, which are flag, badge, gear, pentagram, wheat ear, hammer and sickle in order. It can be clearly seen that the recognition rates of the six models are 0.676, 0.707, 0.733, 0.760, 0.809, 0.965, respectively. Compared with the other models, this paper's model is better at recognizing the revolutionary visual symbols in the Chinese centuries-old red cartoons, which is more conducive to the construction of this symbol system.

Table 2. Confusion matrix(SVM)

Revolutionary visual symbol	Banner	Badge	Gear wheel	Five-pointed star	Ear of wheat	Hammer	Sickle	Accuracy
Banner	332	22	38	17	11	55	25	0.664
Badge	19	341	22	34	18	49	17	0.682
Gear wheel	25	33	339	28	47	15	13	0.678
Five-pointed star	23	31	51	344	17	9	25	0.688
Ear of wheat	21	14	23	38	337	18	49	0.674
Hammer	45	27	16	14	26	335	37	0.670
Sickle	24	14	21	37	44	22	338	0.676
Total								0.676

Table 3. Confusion matrix(RF)

Revolutionary visual symbol	Banner	Badge	Gear wheel	Five-pointed star	Ear of wheat	Hammer	Sickle	Accuracy
Banner	332	22	38	17	11	55	25	0.704
Badge	19	341	22	34	18	49	17	0.716
Gear wheel	25	33	339	28	47	15	13	0.702
Five-pointed star	23	31	51	344	17	9	25	0.710
Ear of wheat	21	14	23	38	337	18	49	0.696
Hammer	45	27	16	14	26	335	37	0.714
Sickle	24	14	21	37	44	22	338	0.710
Total								0.707

Table 4. Confusion matrix(LSTM)

Revolutionary visual symbol	Banner	Badge	Gear wheel	Five-pointed star	Ear of wheat	Hammer	Sickle	Accuracy
Banner	360	22	20	14	23	31	30	0.720
Badge	31	372	20	16	22	26	13	0.744
Gear wheel	25	28	366	14	24	35	8	0.732
Five-pointed star	15	15	30	367	33	34	6	0.734
Ear of wheat	33	13	30	19	369	16	20	0.738
Hammer	15	29	26	12	27	368	23	0.736
Sickle	34	21	11	21	19	32	362	0.724
Total								0.733

Table 5. Confusion matrix(GA)

Revolutionary visual symbol	Banner	Badge	Gear wheel	Five-pointed star	Ear of wheat	Hammer	Sickle	Accuracy
Banner	378	18	22	22	29	16	15	0.756
Badge	12	388	29	13	21	12	25	0.776
Gear wheel	13	23	377	21	27	16	23	0.754
Five-pointed star	26	14	29	375	25	19	12	0.750
Ear of wheat	22	21	15	16	379	11	36	0.758
Hammer	28	26	23	18	16	376	13	0.752
Sickle	18	18	21	23	17	17	386	0.772
Total								0.760

Table 6. Confusion matrix(BF)

Revolutionary visual symbol	Banner	Badge	Gear wheel	Five-pointed star	Ear of wheat	Hammer	Sickle	Accuracy
Banner	398	25	12	12	19	11	23	0.796
Badge	14	404	14	22	17	19	10	0.808
Gear wheel	22	21	392	16	13	22	14	0.784
Five-pointed star	21	15	19	395	24	23	3	0.790
Ear of wheat	15	13	16	14	415	19	8	0.830
Hammer	16	16	12	17	12	417	10	0.834
Sickle	21	17	16	12	19	4	411	0.822
Total								0.809

Table 7. Confusion matrix(Ours)

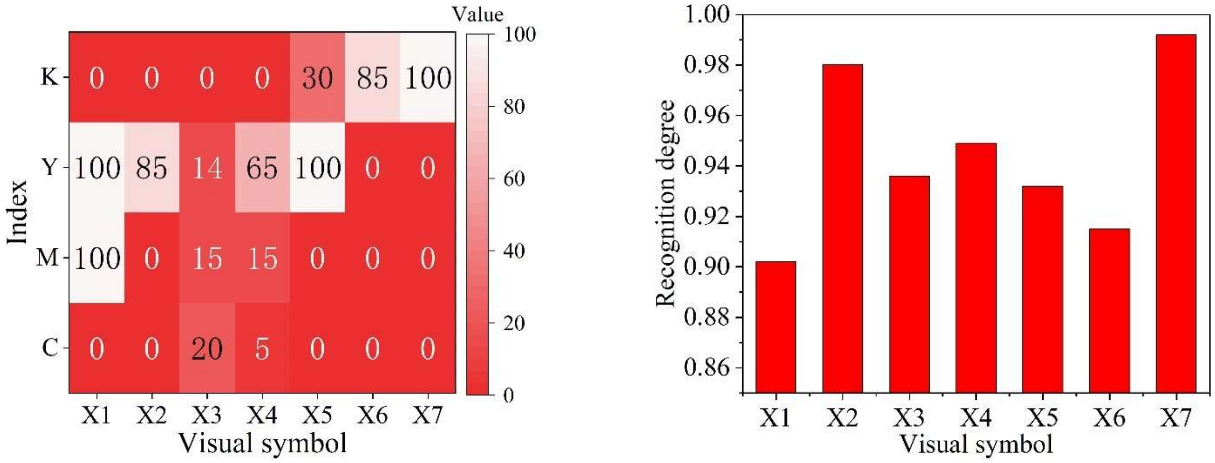
Revolutionary visual symbol	Banner	Badge	Gear wheel	Five-pointed star	Ear of wheat	Hammer	Sickle	Accuracy

Banner	461	11	4	8	8	2	6	0.922
Badge	2	472	1	9	6	5	5	0.944
Gear wheel	4	7	473	2	5	8	1	0.946
Five-pointed star	2	1	1	489	2	4	1	0.978
Ear of wheat	3	1	2	0	492	1	1	0.984
Hammer	1	1	1	0	1	495	1	0.990
Sickle	1	2	2	1	0	0	494	0.988
Total								0.965

4.3. Evaluation and Analysis of the Revolutionary Visual Symbol System

With the help of image processing technology, we successfully extracted the characteristics of revolutionary visual symbols in China's century-long history of red cartoons, and constructed a revolutionary visual symbol system under the guidance of Peirce's semiotics theory, which consists of a flag, a badge, a cogwheel, a five-pointed star, a sheaf of wheat, a hammer, and a sickle. In the following, the system will be evaluated and analyzed from two aspects: recognition and feasibility.

4.3.1. Recognition analysis. In this subsection, the color vision simulator software is used to verify whether the colors of the constructed revolutionary visual symbol system have the recognition degree, the revolutionary visual symbol system is placed into the color vision simulator software, and the results of the color CMYK value and recognition degree are obtained, and the color CMYK value and recognition degree are shown in Fig. 3, in which (a) ~ (b) indicate the color CMYK value and recognition degree, respectively, and X1 ~ X7 in the figure indicate the flag, respectively, badge, gear, five-pointed star, wheat ear, hammer and sickle, respectively. The CMYK value of the five-pointed star is 5, 15, 65, 0, corresponding to the color of gold, symbolizing the “dignity and glory” in the process of revolution, and the CMYK value of the flag is 0, 100, 100, 0, the color of which is red, symbolizing the red of “passion and revolution”, and the other visual symbols of revolution are the same. Other visual symbols of the revolution are the same, and also have good recognition, the system shows the “red years” of China's development and the fruit of revolutionary construction.



(a)The CMYK value (b)Recognition degree

Fig. 3. Color CMYK value and recognition

4.3.2. Feasibility analysis. The constructed visual symbol system of the revolution is evaluated to see if it meets the feasibility requirements, and the system is evaluated by experts in the field. A five-point Likert scale was used to assess the feasibility of the system at the historical and cultural level, the visual communication level, the social acceptance level, and the application practice level,

and the results of the feasibility analysis are shown in Figure 4. It can be clearly seen that the system has good performance in the historical and cultural level, visual communication level, social acceptance level, and application practice level, which are all above 3.5, indicating that the system not only makes the inheritance and development of the Chinese red spirit, but also highlights China's centuries-old history and culture.

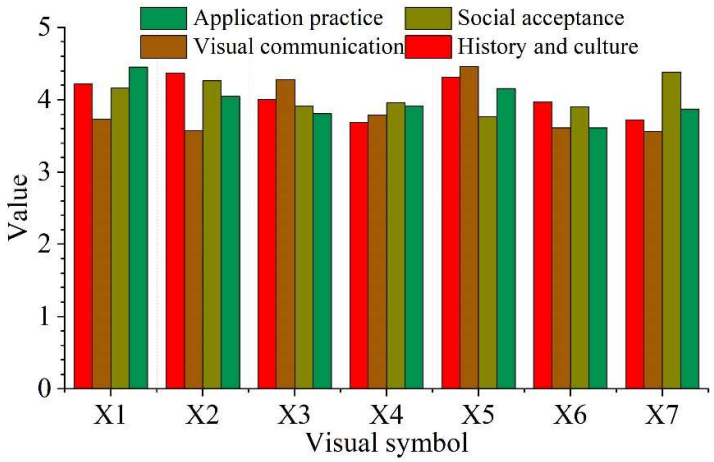


Fig. 4. Feasibility analysis result

5. Conclusion

In this paper, within the scope of image processing technology, image recognition technology and image segmentation technology are used to extract the visual symbols of revolution in China's centuries-old red color. With the theoretical support of Pierce semiotics, the extracted features are utilized to construct the revolutionary visual symbols. The above theoretical knowledge is synthesized to jointly explore the system of revolutionary visual symbols in red cartoons. The segmentation algorithm in this paper has excellent performance on the cartoon images, which is well capable of research and analysis. Confusion matrix form is used to test the recognition performance of this paper's model, and it is concluded that this paper's method (0.965) has a very good recognition effect, and successfully extracts the seven visual symbols of the revolution, namely, flag, badge, gear, five-pointed star, wheat ear, hammer and sickle. Finally, the revolutionary visual symbol system is evaluated, and it is found that the evaluation value of the system is more than 3.5 on the historical and cultural level, visual communication level, social acceptance level, and application practice level, which indicates that the system is of great significance to the inheritance of China's red spirit and history and culture.

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