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The function and significance of the history teaching of art design in the development of network of things of business design

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Abstract. With the rapid development of the internet of things, the teaching methods of art design history are increasingly enriched, and have certain positive effects and significance on commercial design. Based on the development of the Internet of things, it is necessary to research the role and significance of art design history teaching for commercial design. Focusing on the data acquisition and management of dynamic art in the teaching of art design history, a non-contact data acquisition method of motion capture is put forward by using unmarked motion capture technology. The function and significance of art history teaching for commercial design are analyzed. Experiments show that by adopting the dynamic art development technology of the internet of things, the teaching of art design history plays an important role in promoting the development of commercial design.

Keywords: Internet of things, art design history teaching, commercial design, function, significance

1. Introduction

In the long years, the Chinese nation has created colorful and precious intangible cultural heritage. Therefore, the teaching of art design history mainly includes three parts, which are digital data acquisition, data management, data display and application. Among them, digital acquisition and data management are the core of art design history teaching and the basis of perfecting commercial design. With the continuous development of the internet of things, the teaching of art design history can effectively promote the development of emerging cultural industries such as animation and other commercial designs, which is conducive to the protection and inheritance of art design [1].

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At present, in the context of the development of the internet of things, the teaching methods of art design history mainly include video, motion spectrum (dance spectrum) and motion capture technology data [24, 25]. Therefore, the focus is on motion capture data acquisition and motion capture data retrieval. With the progress of internet of things technology, the development of graphic images, video and computer vision technology, the combination of high-precision and high-fidelity digital protection technology and intangible cultural heritage protection has become a new method and new way to protect intangible cultural heritage [2]. Based on the development of Internet of Things, this paper studies the role and significance of art design history teaching in commercial design. This paper focuses on the data acquisition and management of dynamic art in the teaching of art design history. Through the use of unlabeled motion capture technology,

a non-contact motion capture data acquisition method is proposed, and the role and significance of art history teaching for commercial design are analyzed.

This paper is divided into five parts, the first part is the research background and significance, the second part introduces the latest research progress, the third part introduces the research methods, mainly including Biased Ncuts algorithm, joint foreground extraction (joint segmentation) method based on the apparent model, and the fourth part carries out the implementation of the algorithm. Experiments show that the teaching of art design history plays an important role in promoting the development of commercial design by adopting the dynamic art development technology of the Internet of Things.

2. Related work

At present, on the role and significance of the teaching of art design history for commercial design is still in its infancy. The purpose of art design history teaching in commercial design is not only digital records, but also the use of the Internet of things [22, 23] to develop digital data to promote the development of commercial art design in China, and to make more people contact and study commercial art design [3]. Therefore, the history of art design mainly includes three parts, which are digital data acquisition, data management, data display and application. Among them, digital acquisition and data management are the cores of commercial art design based on the digitalization of the development of the Internet of Things and are the basis for the display and application of the Internet of things. Effective data and efficient management can promote the development of animation, games and other emerging cultural industries, which is conducive to the protection and inheritance of commercial artistic design [4]. At present, modern artistic design has taken on a diversified development trend, with various styles and genres coexisting. But the inheritance and development of tradition is still a focus problem which needs to be solved urgently in modern design. Some scholars use motion capture technology to record human movements aiming at the digital dance movement problems, analyze the motion capture data, dividing it into basic motion primitives, and then use the motion primitives to create or reconstruct the motion data according to requirements [5]. Aiming at Japan's dynamic artistic digitalization, scholars have done a lot of work. In the study, the motion capture technology and Laban's motion spectrum are introduced, and the related technology of motion capture data retrieval is introduced [6]. There are many kinds of dynamic arts in our country, and the geographical distribution is wide, which brings great difficulties to data acquisition, and also puts forward new requirements for motion capture system: it is not only necessary to have portable equipment, easy to carry, but also to be able to deal with complex scenes [7]. At the same time, in order to effectively protect the history of art and design and to give full play to its role and significance in commercial design, efficient management, especially for motion capture data retrieval technology, is indispensable [8].

3. Ncuts algorithm and joint extraction method

3.1. Biased Ncuts algorithm

Normalized Cuts (Ncut) and Biased Ncuts are algorithms based on graph theory partition theory. Therefore, we first introduce the concept and symbolic representation of graph theory. For undirected graphs $G(V, E)$, $V = \{v_i | i = 1, \ldots, n\}$ is a vertex set and $|V| = n$ edge set the elements of $E = \{e_{ij}\}$ is connecting vertices v_i and v_j the edge of e_{ij}. The nonnegative weight matrix is $W = \{w_{ij} | w_{ij} \geq 0\}$, among w_{ij} describe the similarity of side sentences [9]. At the vertex degree, the sum of the weights of the edges of the vertex v_i and other vertices is the degree d_i of the vertex.

$$d_i = \sum_j w_{ij} \tag{1}$$

The degree diagonal matrix D is a diagonal matrix of $n \times n$, The element on the diagonal is the degree d_i of the corresponding vertex [10]. In the capacity of the graph, the capacity of graph G is the sum of the weights of all the edges in the graph, that is

$$vol(G) = \sum_{ij} w_{ij} \tag{2}$$

For subgraphs, for figs $G(V, E)$ and $G_1(V_1, E_1)$, if $V_1 \subseteq V$ and $E_1 \subseteq E$. Then fig. G_1 1 is a sub-graph of fig. G, and it is recorded $G_1 \subseteq G$. In that figure, if graph G is divide into two sub-graphs S and $\bar{S}$, and $S \cap \bar{S} = \emptyset$, $S \cup \bar{S} = V$. Then, the edge set connecting the two subgraphs S, $\bar{S}$ is called (Cutset), and the sum of the weights of the cut set is called (Cut). It is defined as:

$$cut\left(S, \bar{S}\right) = \sum_{i \in S, j \in \bar{S}} w_{ij} \tag{3}$$

For non-canonical Laplacian matrices of graphs, the non-canonical Laplacian matrix is defined as

$$L = D - W \tag{4}$$

The matrix L has the following properties: First, for any vector $f \in R^n$, there is

$$f^T L f = \frac{1}{2} \sum\nolimits_{i,j=1}^{n} w_{ij} \left(f_i - f_j\right)^2 \tag{5}$$

Where f^T is the transpose of vector f; L is a symmetric semi-positive definite matrix; L has the smallest eigenvalue 0, corresponding eigenvector is the constant vector 1 (each element in the vector is 1); L has n non-negative The real eigenvalue $0 \leq \lambda_1 \leq \ldots \leq \lambda_n$, Ncuts transforms the problem of partitioning an undirected graph $G(V, E)$ into a second small eigenvector problem for solving a Laplace matrix [11]. However, in many applications, interested in some local regions of an undirected graph, the second smallest feature vector provides a globally optimal division and cannot provide more local features [12, 13]. Some scholars have proposed a local bias subdivision framework based on the second smallest eigenvector. Some scholars have applied this framework to the foreground extraction, called BiasedNcuts, and use the vector $s \in R^n$ to indicate partial locality [14–16].

3.2. Foreground joint extraction (joint segmentation) method based on apparent model

Using superpixesl instead of pixel points as the vertex V of undirected weighted graph G, the following describes the definition of edge set e of the graph, that is, how to link superpixels in multiple images. For the top-level connection of a single image, neighboring superpixels are connected according to the topology adjacency relation, that is, for two superpixels $S_i.S_j$ belonging to the same image, If the Euclidean distance of the center point of the superpixel $S_i.S_j$ $S_i.S_j$ is smaller than the constant where $k_1 R$, k_1 is greater than 1, and R is the average distance between the center points of adjacent superpixels, then the edge e_{ij} exists between the superpixels $S_i.S_j$ For the connection relationship between the superpixels among the images. The feature point matching algorithm in the image can be used for feature point matching, such as SIFT, SURF, etc. The superpixel connection where the feature point matching description is located. In our previous work, we used SIFT algorithm for feature point matching. During the matching process, there will be an incorrect match point, and the Euclidean distance of the image pixel coordinates of the k matching points of the two images is calculated.

The average distance is $d_{avg} = \frac{1}{k} \sum d_i$, and the matching point pair of $d_{avg} > d_i$ is an error match and it is removed. The SIFT feature point is usually located at a corner point, and sometimes the corner point is located at the edge of the super pixel. It is difficult to determine in which super pixel the super pixel point is located [17, 18]. Therefore, for the matching points $P_i \in I_i$ and $P_i \in I_i$ of the two images, respectively, in the window R_i, R_j with P_i, P_j as the center size $2R \times 2R$ in the image I_i, I_j, there is also an edge e_{ij} j between the superpixels S_i, S_j $\left(\forall S_i = I, \forall S_j \in I_j\right)$ located in the window R_i, R_j, that is, the superpixels located in the two images are connected [19, 20].

Feature point matching algorithm is very effective for multi-view images or rigid object matching, but it can't match enough feature point pairs for any two images with similar foreground or human images at different times [21]. At the same time, the calculation of feature point matching is large and the calculation speed is slow. For the spectral features of the graph, the larger the edge set of graph $G(V, E)$, the more accurate the information of the graph contained in the spectral features. Therefore, we assume that any two superpixels between images have edges. In this way, the construction of graph $G(V, E)$ with superpixels as its vertices is completed, and then the definition of weights w of edges of graph $G(V, E)$ is introduced. For two connected superpixels $S_i.S_j$, the weight w_{ij} is defined as:

$$w_{ij} = \exp\left(-d\left(S_i, S_j\right)^2 \Big/ 2\delta^2\right) \tag{6}$$

The method of joint foreground extraction (joint segmentation) based on the apparent model is constructed here. Since some scholars first put forward the concept of joint segmentation in 2006, joint segmentation has attracted the attention of many researchers. Joint segmentation (extraction) assumes that two or more images have similar foreground (the same target or different targets with the same color) thus performing simultaneous foreground extraction of multiple images based on color consistency among multiple images. Assuming that the background of

the input images is irrelevant, some scholars use Markov field (MRF) to model the foreground extraction, and at the same time, a L_1 distance term is added to measure the similarity of the color histograms of the extracted foreground areas, so that the histograms of the obtained foreground areas are as similar as possible. Because Rother method color histogram metrics increase the complexity of optimization, some scholars replace L_1 distance with L_2 distance, and use pseudo-Boolean method to solve the optimization. Some scholars use the similarity of two foreground region histograms as gain terms rather than penalty terms, so the joint extraction uses the maximum flow method to solve it in polynomial time. In addition to MRF framework, some scholars have proposed a multi-class joint segmentation algorithm based on discriminant clustering framework. The cost function combines spectral clustering and discriminant clustering terms, thus transforming the optimization problem of cost function into a probability problem and solving it with expectation maximization algorithm. Meng et al. divided the image set to be segmented into many areas to be extracted, and then built a bipartite graph model based on the similarity and saliency mapping of local areas, thus taking the joint extraction problem as the shortest path problem. The above methods can automatically kick the foreground, which belongs to unsupervised methods, but need some additional constraints, such as: background is irrelevant, etc., which is difficult to meet in motion capture video.

Besides unsupervised methods, there are also many supervised segmentation methods. In the single foreground extraction, interactive segmentation method has achieved remarkable results, and the most commonly used method is GrabCutt. We can also look at the image set as a plurality of single images and use the foreground extraction method of single images to operate separately, but that takes time and effort. Based on MRF framework, some scholars proposed an interactive joint extraction method of marking foreground and background, known as iCoseg. When combining image feature information and seed information, and providing an automatic recommendation system, providing guidance for users to choose interactive images. Some scholars have proposed a joint extraction method based on Random Walks method. Supervised foreground extraction method has no requirements on the background of images, can meet the requirements of processing complex background images and improve the flexibility of motion capture system. However, the result of the interactive joint extraction method above depends on whether the appropriate image is selected for marking, and it is required that the color features of the marked foreground and background can fully represent the whole foreground and background. For complex background images, the amount of interaction is large. Therefore, in order to operate simply, it is necessary to further study the supervised joint extraction method with simple interaction.

4. Experimental design and analysis

4.1. Parameter settings

To evaluate our algorithm, the effectiveness of our algorithm is verified in the iCoseg dataset and our own recorded multi-view image set. For the choice of the number of eigenvectors K in Equation (8), and through experiments that the mean square error decreases sharply with the increase of A: value and tends to be stable (see Fig. 1). However, to ensure the robustness of the algorithm, K is usually set to 15. In addition to manual input, we can also use the distinctiveness of the image to automatically determine the area we are interested in.

4.2. Objective evaluation of segmentation results

For a clearer explanation, the result symbol is first introduced. The foreground is denoted by F, S is the background, and V is a pixel representing a in the segmentation result. The real value is 6, where #() represents the number of pixels, which represents the number of all pixels. Next, use the five criteria for sensitivity, specificity, accuracy, accuracy, and error rate defined in the literature. Based on the evaluation criteria defined above, a comparison was made between the method of Joulin and the method of Meng in the iCoseg image library. In these evaluation criteria, the

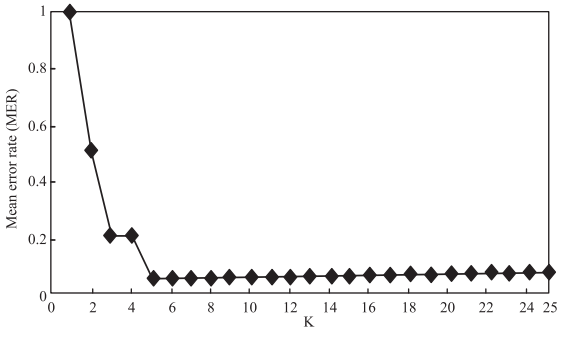

Fig. 1. The mean error rate for a different number of K.

sensitivity, specificity, accuracy, and accuracy rate are all lower, the better the result, and the lower the error rate, the better the result.

Sensitivity is about the recall of the foreground pixel, Fig. 2 is a comparison of the results of the sensitivity, and it is known from the graph that the algorithm is better than the other two algorithms in the Planes, Airshows, Kite, Skating-ISU and Kendo-EKC datasets in Skating and Kendo-Kendo approaches Meng's method on both datasets and is better than Joulin's method. The mean value was higher than Joulin's method and Meng's method was 1.6% and 14.1%, respectively. Specificity is mainly reflected in the recall rate of background pixels. The results are shown in Fig. 3. Except for the results on the Smata2 dataset being worse than the other two methods, the outliers and their variances are better or close to the best values on other datasets. The overall mean is higher than the other two methods.

The precision and accuracy rates are shown in Figs. 4 and 5. The methods of Meng in the Skating, Kendo-kendo, and Kendo-EKC datasets 'The results are worse than those of Joulin's state and our methods, mainly due to Meng's results. Part of the background is divided into prospects, and our results are consistent with Joulin's results. It is closer. Overall, the mean and accuracy of our method are better than Meng's method and Joulin's method.

Error rate is the error evaluation of the whole foreground extraction, and the ratio of the pixel number of the wrong points to all pixels. Since the Skating dataset contains discontinuous image regions, Meng's method only selects the ideal one from among them, resulting in the partial foreground region being divided into background regions, and part of the background regions being divided into foreground regions, resulting in higher error rates than other two methods. In the Smata2 dataset, the foreground and

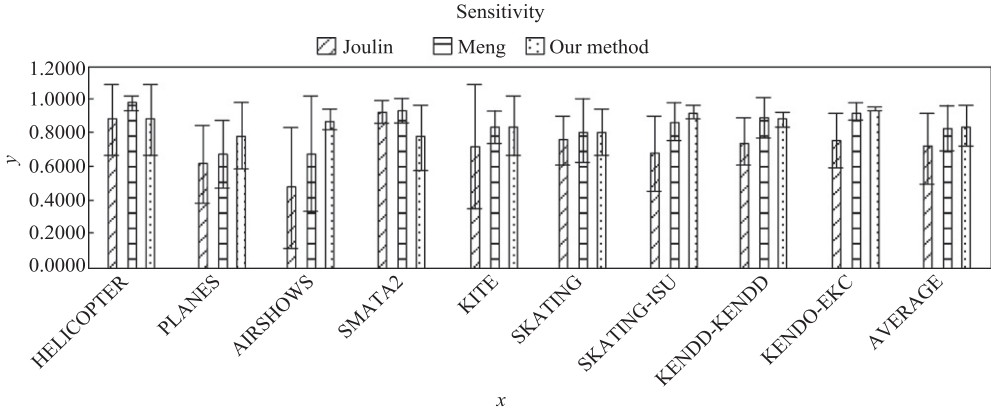

Fig. 2. Compared with sensitivity.

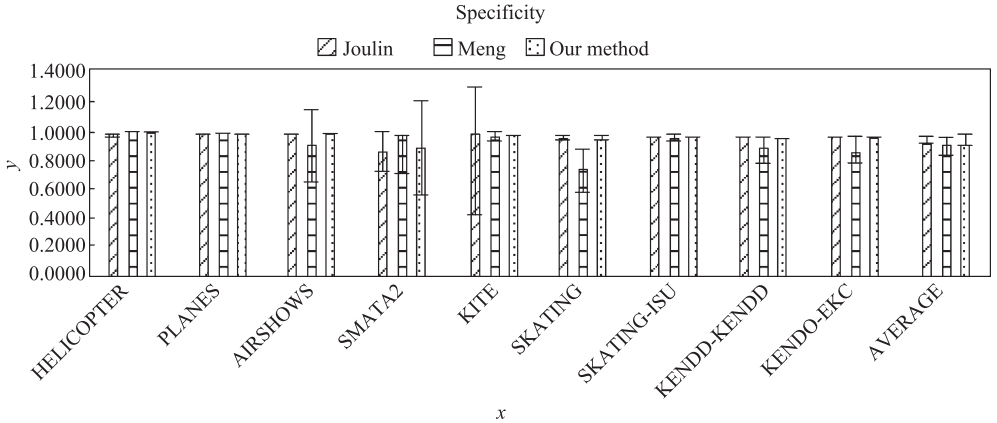

Fig. 3. Compared with specificity.

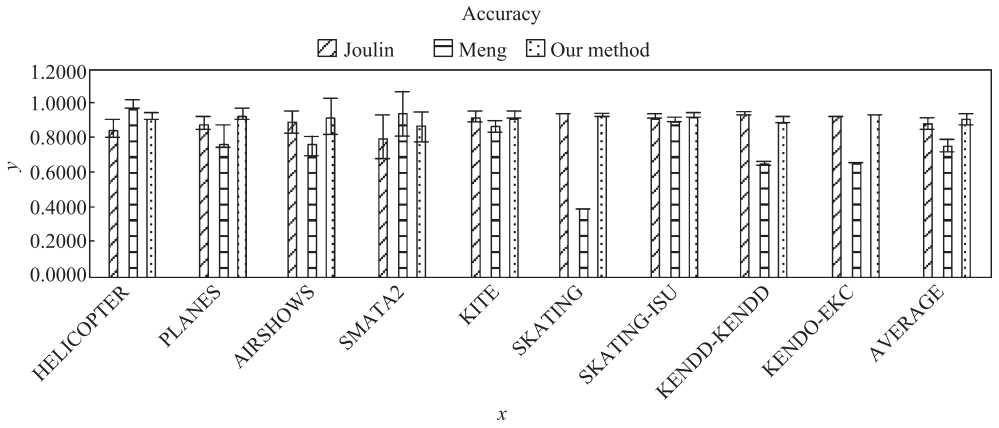

Fig. 4. Compared with precision.

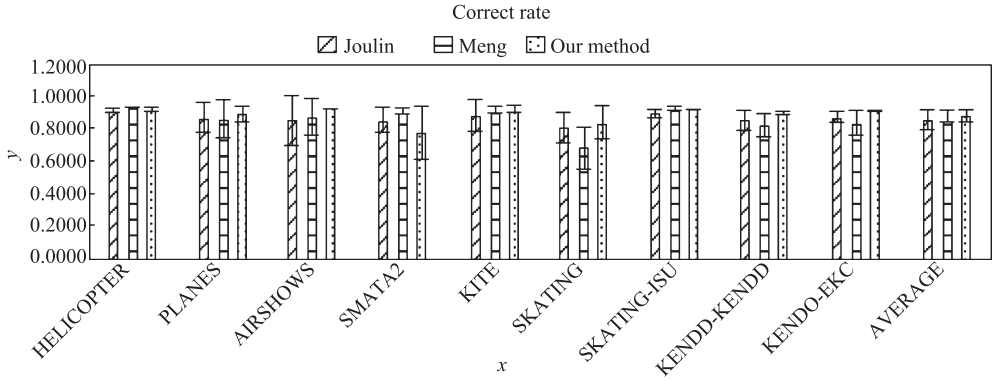

Fig. 5. Compared with accuracy.

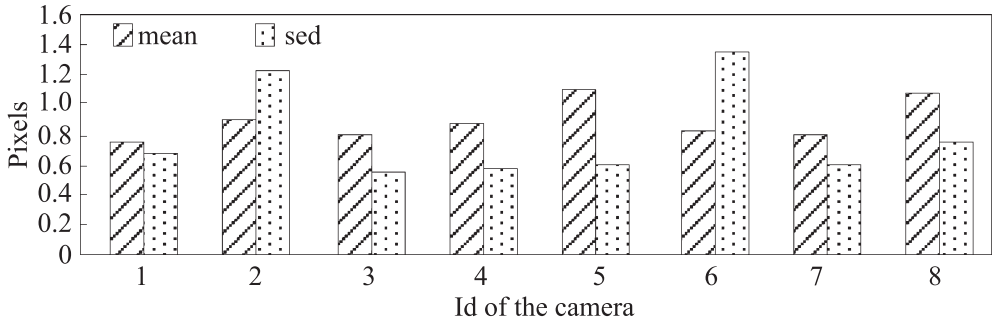

Fig. 6. The mean and variance of calibration ball for reprojection.

the background are similar, and in particular it is difficult to find a definite edge, resulting in a higher error rate for our method than for the other two methods. The mean of the overall error rate was better than the other two methods, and the results were smaller than the other two methods by 2.1% and 3.1%, respectively.

In the concrete application, 8 synchronous Gray-point CCD color camera is used to collect the hardware synchronously, and the camera focal length is 5 mm. The video resolution is 648*490 and the frame rate is 60fj/s. The system is divided into three parts: camera calibration, target extraction and attitude estimation.

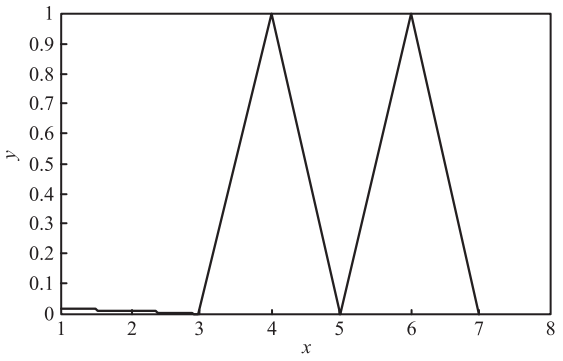

Fig. 7. The matching time and the number of false matching times.

Camera calibration after so many years of research nonporous has been more mature technology. The commonly used methods are Tsai method and Zhang Zheng you method. These two methods mainly use checkerboard as the calibration field. Dr. Sun Yun da draws materials locally, using the corners of a fixed-size square floor tile in the room, affixing the printed marking points at the corner points, detecting marking points from the image, and using the Tsai method to perform global optimization calibration of the plane calibration field algorithm. However, multi-camera calibration requires that in the same world coordinate system, it is usually necessary to manually mark the origin of coordinates. At the same time, in order to ensure the accuracy of calibration, the camera takes pictures of as many identification points as possible from the top view angle, which leads to the narrow range of human motion and does not use to capture large-scale motions. Svoboda matrix decomposition calibration method and its provided multi-camera calibration software are adopted to calibrate. The matrix decomposition method is characterized in that the corresponding points among multiple images are arranged in a matrix orderly, and then the matrix is decomposed into the product of photographic projection matrix and spatial point matrix by singular value decomposition. In our system, a homemade red ball is moved in the motion capture space, and videos are synchronously recorded by multiple cameras, so that the projection of the position of the ball in multiple cameras at the same time forms corresponding points, and the corresponding point matrix can be easily constructed by tracking the position of the red ball. The moving track of the ball covers the whole imaging plane as much as possible. Generally speaking, the expression of graphic symbols may return to the general graphic design we are familiar with. Graphic symbols design itself is an important part of graphic design, so the expression forms of graphic symbols mostly follow the various expression methods in graphic design. Among them, the expression method of plane composition is a little bit, such as line, surface, space and texture effect. We can draw lessons from illustration, photograph, collage and other means of expression, and use the comparative application of brightness, purity and color equality in color matching. A good visual communication designer is a designer who knows how to use graphic symbols to speak, just like a person who wants to clarify a thing, it is necessary to grasp the key words of this matter, and graphic symbols are the key words in visual communication design, we should actively find graphic symbols in the surrounding living environment, carefully. Accumulate outstanding figure symbols left by ancestors, and learn to create more vitality commercial design.

5. Conclusion

With the rapid development of the internet of things, although modern commercial design presents a diversified development trend, it does not conflict with the nationality and regionalism of design; on the contrary, the nationality and regionalism of design are just one of the major characteristics of design innovation and personalization. This is not to exclude the possibility of learning from foreign excellent designs, but the teaching of art design history plays an important role and significance in commercial design to some extent. The teaching of art design history based on the development of internet of things has studied the subject of commercial design, and proposed a method of motion capture data retrieval based on Laban symbol, which solved the problem of sample input in motion capture data retrieval. Through multi-view image technology, parallel recording method of motion capture data and motion spectrum record, and corresponding data management and display technology, a supporting platform of dynamic digital art collection, storage, management and display is built. Through the collaborative recording and display of digital images, motion capture data and Laban's action spectrum king heavy technology, advantages are complementary, and finally complete and comprehensive historical and cultural resources of cheese art design, giving full play to its teaching effect on the development of commercial design and positive significance.

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