Research Article

Design and Implementation of Print Advertisement Based on Computer Image Interactive Virtualization

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This study aimed to further enhance and enrich users’ visual experience, provide users with a more infectious image sense, and further promote the development of multidimensional, virtualized, and interactive graphic advertising design applications. This study presents a design idea of print advertisement based on computer image interactive virtual technology. Based on the in-depth analysis of the multidimensional expression of plane image interactive virtualization, this idea carries out interactive virtual design with the help of interactive virtual image segmentation algorithm and plane advertising image element optimization technology. Through the test of image interactive edge extraction function on MATLAB platform, the simulation results show that the edge width of single side extraction results with different gray levels of the same width and different widths of the same gray level are 9 pixels, the gray values are 50, 110, and 200, respectively, and the edge width corresponds to 3, 9, and 15 pixels, respectively. The results show that the system can effectively enhance the image definition and obtain better print advertising design effect.

1. Introduction

In today’s society, technological innovation has become an important means to promote the development of many industries, especially for the graphic design industry [1]. How to be accepted and recognized by more audiences and design more innovative products in the increasingly competitive industry is a problem that graphic designers need to focus on. In recent years, with the improvement of people’s consumption level, people’s aesthetic ideas and points of interest have changed to a certain extent. Modern people have put forward higher requirements for the content, theme, type, and color selection of graphic design. In the face of the rapid development of image, vision, and other fields, people also put forward higher requirements for the system operation performance of human-computer interaction [2]. How to improve the visual effect of print advertising design with the help of computer image interaction and virtual interaction technology is not only an important consideration in the design field but also the focus of this research [3].

2. Literature Review

The initial research structure of the “digital virtual human” research program was proposed in 1989. At that time, it was called the visible human project (VHP), that is, the “visible human program”, also known as the “virtual visible human” [4]. The main purpose is to establish a biomedical image retrieval system to provide biomedical literature and other materials to researchers in related fields. “Virtual visual human” is the first stage of the “digital virtual human” project. At present, it can only reconstruct the human body in three dimensions in the computer and describe and display the tissues and organs of the human body from a geometric point of view; in the second stage, the “virtual physical man” adds the physical characteristics of human organs to the “virtual visual man,” so that the “virtual physical man” can respond to the stimulation of the external environment; in the third stage, “virtual physiological human” adds the biochemical characteristics of human body, which makes it possible to simulate human physiological functions; and the “virtual intelligent person” in the last
stage not only has all the characteristics of the above stage but also has certain thinking ability [5].

So far, medical image segmentation is one of the important research fields in the field of image segmentation and has made many remarkable achievements in academics and application [4]. At the same time, many practical methods have been proposed: based on statistics, neural network, fuzzy set theory, mathematical morphology, pattern recognition, and a priori knowledge. However, the virtual human image is different from general medical image. It has the characteristics of complex human structure, rich details, unclear edge, and huge amount of data. Many traditional segmentation methods cannot obtain good segmentation results for virtual human image [6]. Therefore, at present, the segmentation of virtual human image is mainly manual segmentation, supplemented by interactive segmentation methods [7].

Due to the ambiguity of the content and the complexity of the structure of the virtual human image, the computer automatic segmentation is easy to lose the target content and extract the edge inaccurately, while the full manual segmentation is time-consuming and labor-consuming, and there are human errors, so the emergence of interactive segmentation method is inevitable. Interactive image segmentation refers to the process that users need to feed back the segmentation results or directly intervene in the process of image segmentation from completely manual segmentation to a small part of manual segmentation [8]. There are many ways of interaction. Marking the target foreground and background of the image and depicting the outline of the target are two common ways.

Generally speaking, interactive segmentation methods can be roughly divided into segmentation methods based on image edge, region feature, and other theoretical tools. The segmentation method based on image edge makes use of the edge information. Image edge is an important attribute in image segmentation. It contains information such as direction and shape, which can help to draw the outline of the target. These methods include active contour algorithm, live wire algorithm, live lane algorithm, and their derivative algorithms [9]. They all have a relatively similar principle: finding the optimal solution to minimize the predefined energy function, so as to obtain the image edge of the target part.

### 3. Virtual Image Segmentation Technology and Its Algorithm

**3.1. Characteristics of Virtual Image Segmentation.** The use of high-precision equipment and the suitable cutting process ensures that the virtual human image has high cutting accuracy. With the development of science and technology, the accuracy of virtual human image is gradually improved, which can provide more detailed information and thinner section slices, making the reconstructed human body structure more realistic. Table 1 shows some information about virtual human image cutting accuracy [10]. It can be seen from the table that the accuracy of virtual human image is gradually improving with the higher and higher requirements of researchers. In fact, the current machining and cutting technology can obtain the layer spacing accuracy of 0.02 mm, but the researchers did not cut with such layer spacing. Because the high demand for accuracy means that more sophisticated processing equipment needs to be introduced, the transmission and storage of image data and the corresponding postprocessing are becoming increasingly difficult. In addition, the sharp increase in the number of slices and the more complicated cutting process will also greatly increase the cutting error rate [11]. Therefore, researchers often choose a reasonable compromise scheme to balance the accuracy of slice image and the requirements of current research on image accuracy [12].

### 3.2. Graph Theory Based on GrabCut

The two tuples can be represented as follows:

\[
G = (V, E),
\]

where equation (2) is a finite non-empty set of fixed points of graph \(G\).

\[
V_G = \{v_1, v_2, \ldots, v_n\},
\]

\[
E(G) = \{e_1, e_2, \ldots, e_n\}.
\]

The above formula is a finite set of edges of graph \(G\). Intuitively, if each edge in a graph has a direction, the graph is called a directed graph; otherwise, it is called undirected graph. In the set of edges, if edge \(e_\preceq = \{v_i, v_j\}\), it means that \(e_\preceq\) is an undirected edge connecting the vertices of \(v_i\) and \(v_j\); if edge \(e_\mathrel{\leftarrow} = <v_i, v_j>\), it means that \(e_\mathrel{\leftarrow}\) is a directed edge with \(v_i\) as the starting point and \(v_j\) as the end point, and the arrow on the line points from \(v_i\) to \(v_j\). The adjacency matrix is often used to represent graph when computer is used to deal with the calculation problem of graph. The adjacency matrix is an \(n\)-order matrix with specific properties, which is used to represent the adjacency relationship between the vertices of a graph. If \(G\) is a network graph, the adjacency matrix of \(G\) can be expressed as follows:

| Serial number | Year of cutting | Nationality | Gender | Layer spacing (mm) | Number of slices | Data volume (GB) |
|---------------|----------------|-------------|--------|-------------------|-----------------|-----------------|
| 1             | 1994           | USA         | Male   | 1.00              | 1878            | 15.0            |
| 2             | 1995           | USA         | Female | 0.35              | 5179            | 56.0            |
| 3             | 2001           | Korea       | Male   | 0.20              | About 9000      | 158.2           |
| 4             | 2002           | China       | Male   | 0.21              | 9218            | 530.0           |
| 5             | 2003           | China       | Female | 0.20              | 8556            | 149.7           |
the following equations, respectively: 

\[ \theta \text{ are defined by} \]

\[ \text{is data term and } V \text{ term is smooth term.} \]

\[ \text{is equivalent to solving the bipartite problem of graph; that is, finding a partition so that one part of the vertices in the graph belongs to the background and the other part belongs to the foreground [15]. In the GrabCut method, a Gibbs energy function is introduced to describe the foreground and background attribution possibility of image pixels, as shown in equation (5). It can be proved that a good segmentation result can be obtained when the Gibbs energy function is minimized [16].} \]

\[ E(a, k, \theta, z) = U(a, k, \theta, z) + V(\theta, z). \]  \hspace{1cm} (5) \]

The Gibbs energy function consists of two parts, \( U \) term is data term and \( V \) term is smooth term. They are defined by the following equations, respectively:

\[ U(a, k, \theta, z) = \sum D(a_n, k_n, \theta_n, z_n), \]  \hspace{1cm} (6) \]

\[ V(a, z) = \gamma \sum [a_n \neq a_m] \cdot e^{-\beta(z_n - z_m)^2}, \]  \hspace{1cm} (7) \]

where

\[ D(a_n, k_n, \theta_n, z_n) = -\log p(z_n, a_n, k_n, \theta) - \log \pi(a_n, k_n), \]

\[ \theta = \{\pi(a, k), \mu(a, k), \sum (a, k), a = 0.1, k = 1, ..., K\}. \]  \hspace{1cm} (8) \]

In the above formula, \( \pi \) is the maximum weight, \( p \) is the Gaussian probability distribution, and \( \theta \) is the parameter model of the Gaussian mixture model. \( a \) in \( \theta \) is the opacity value, \( k \) is the parameter vector of the Gaussian mixture model, and \( \pi(a, k), \mu(a, k), \sum (a, k) \) are the percentage of Gaussian probability distribution, the mean, and covariance of Gaussian probability distribution, respectively [17, 18].

3.3. Image Segmentation Framework of GrabCut. GrabCut algorithm basically adopts the segmentation framework of graph cuts, but improves the judgment model of foreground and background attribution possibility, parameter estimation method, and interaction mode in the framework [13]. Figure 1 is a schematic diagram of the segmentation framework of GrabCut. Its core idea is to transform the image segmentation problem into a binary labeling problem that marks the image pixels as foreground and background and then use the solution of network flow to transform the minimization problem of energy function into the problem of network minimum cut maximum flow [14].

After establishing the corresponding relationship between image and graph, the problem of image segmentation is equivalent to solving the bipartite problem of graph; that is, finding a partition so that one part of the vertices in the graph belongs to the background and the other part belongs to the foreground [15]. In the GrabCut method, a Gibbs energy function is introduced to describe the foreground and background attribution possibility of image pixels, as shown in equation (5). It can be proved that a good segmentation result can be obtained when the Gibbs energy function is minimized [16].

\[ E(a, k, \theta, z) = U(a, k, \theta, z) + V(\theta, z). \]  \hspace{1cm} (5) \]

The input image

The output image

An image is mapped to a graph

Constructing energy function

Construct an S-T network

Seek the greatest flow on the web

Seek network minimum cut

Figure 1: Segmentation framework of GrabCut.

3.4. Grayscale Processing of Labeling Result Data. Image graying is a processing method to convert color image into grayscale image [19, 20]. Each pixel in the color image has three color components: \( R, G, \) and \( B \). When the values of the three color components are equal, the color represents a gray color, and its value is as follows:

\[ V_{\text{gray}} = V_R = V_G = V_B. \]  \hspace{1cm} (9) \]

There are three common methods for image graying:

3.4.1. Maximum Method. The maximum value of the three color components of each pixel is taken as the gray value of the gray image, which will form a gray image with high brightness. The calculation formula for the gray value is as follows:

\[ V_{\text{gray}} = \max(V_R, V_G, V_B). \]  \hspace{1cm} (10) \]

3.4.2. Average Method. The average value of the three color components of each pixel is calculated as the gray value of the gray image, and the gray image will be relatively soft. The calculation formula for the gray value is as follows:

\[ V_{\text{gray}} = \frac{(V_R + V_G + V_B)}{3}. \]  \hspace{1cm} (11) \]

3.4.3. Weighted Average Method. According to the importance of the color component or other measurement indicators, the three color components of the pixel are weighted and averaged with different weights, and the obtained value is used as the gray value of the gray image. Let the weights of three color components be \( W_R, W_G, \) and \( W_B \), respectively, and then the calculation formula of gray value is as follows:

\[ V_{\text{gray}} = W_R \cdot V_R + W_G \cdot V_G + W_B \cdot V_B. \]  \hspace{1cm} (12) \]
Scientific research shows that the sensitivity of human eyes to color is higher in green, followed by red and weaker in blue. Therefore, the values of $W_G, W_R,$ and $W_B$ meet the relationship of equation (13), and a more reasonable grayscale image will be obtained. The grayscale processing in this study adopts the weighted average method and the value combination of formula (14), so the final grayscale value calculation formula is as follows:

$$W_G > W_R > W_B,$$  \hspace{1cm} (13)

$$W_R = 0.34, \quad W_G = 0.50, \quad W_B = 0.16,$$  \hspace{1cm} (14)

$$V_{\text{gray}} = 0.34V_R + 0.50V_G + 0.16V_B.$$  \hspace{1cm} (15)

For the segmented human trunk and double lung images, the target foreground part uses the custom gray value to normalize them, and the remaining background part is filled and distinguished with the preset gray value, which is also an image gray processing.

4. Design of Interactive Virtual Image Segmentation System

4.1. System Requirements. Figure 2 is a schematic diagram of the data flow of the interactive virtual human image segmentation system, in which the dotted double space arrow line represents the data exchange between the system and the outside world; blue solid line and empty arrow line indicate the generation of data; black solid line and solid arrow line indicate the call of action process; and the blue solid line and open arrow line represent the input of data, and the blue solid line and double empty arrow line represent the output of data [21, 22].

Based on the above analysis, the detailed demand analysis diagram of each functional module can be obtained. The system is divided into five main functional modules.

4.1.1. Image Display Module. The system provides a Windows Explorer tree directory, which is convenient for users to select the target folder, displays all the image files under the folder in the form of thumbnails in the image preview area, and provides specific image viewing operations in another tab part. Figure 3 is the use case diagram of the image display module.

4.1.2. Image Segmentation Module. The image segmentation module is one of the key modules of the system. The module can realize the interactive segmentation of a single image; that is, the user can modify the segmentation result according to the current segmentation effect to make it meet the expected segmentation effect. In addition, it can also realize the continuous segmentation of sequence images. The module provides the function of segmentation result synthesis, so that the segmentation results of different tissues and organs can be presented on the same image, which facilitates the data reading of subsequent processing such as 3D visualization and reduces the storage space of the result file. Figure 4 shows the use case diagram of image segmentation module 4.

4.1.3. Image Annotation Module. Users can select multiple colors to label multiple tissues and organs, so as to realize the segmentation of complex target objects [23, 24]. The implementation principle of grayscale annotation is roughly the same as that of color annotation, except that color annotation has more steps of color selection and color mapping, while grayscale annotation only uses custom
grayscale values to label the target area. The use case diagram of image annotation module is shown in Figure 5.

4.1.4. Image Preprocessing Module. The image preprocessing module mainly solves various image problems in the process of image segmentation and image annotation, such as image noise, uneven edge, internal holes, and external bulges. For specific problems, the module puts forward specific solutions. A median filter and mathematical morphology filter are mainly used to eliminate noise; filling holes and erasing bulges use gray filling and mathematical morphology expansion operations; as for the smooth edge, the open operation and close operation in mathematical morphology are mainly used. Solving these problems is not just using one method, but combining multiple methods to form an operation sequence to obtain better results. Figure 6 is a use case diagram of the image preprocessing module.

4.1.5. Edge Extraction Module. The module can extract the edges of human trunk and lungs to meet the needs of subsequent image processing. Figure 7 is the use case diagram of the edge extraction module.

4.2. System Structure Design. The structure is shown in Figure 8.

The lowest layer of the system is the original data layer; the second layer of the system is the function operation layer, including four core modules: image segmentation, image annotation, image preprocessing, and image edge extraction; the third layer of the system is the intermediate data management layer, which is responsible for managing the data required by each functional module of the second layer of the system; the fourth layer of the system is the human-computer interaction interface layer; and the fifth layer of the system is the data display layer. Through this layer, the
**Figure 5:** Use case diagram of image annotation module.

**Figure 6:** Use case diagram of image preprocessing module.

**Figure 7:** Use case diagram of edge extraction module.
user can provide the human–computer interaction interface of the fourth layer with the parameters required for each image function operation and can observe the results of each image processing stage.

Figure 9 shows the image display function module, which is mainly realized by the sub-module of image display.

Figure 10 is an image segmentation function module diagram. After the module obtains the original image data, it calls the single segmentation or sequence segmentation sub-module to segment the image.

Figure 11 is an image annotation function module diagram. Image annotation can be regarded as the realization of another image segmentation method, which is mainly used to solve the segmentation of complex target objects with more regions to be segmented. The marking of each part of the target object is completed, and then, the gray processing of different color regions is equivalent to the segmentation of each part of the target object. This is because the marks of different parts are distinguished by different colors. In other words, different color areas represent different parts of the human body.

Figure 12 is a diagram of image preprocessing function module, which is responsible for dealing with problems such as noise, uneven edge, and internal holes in the process of image segmentation or image annotation.

Figure 13 is an edge extraction function module diagram. Extracting trunk edges, that is, single-edge extraction, first takes the segmented trunk image as the original image and then performs mathematical morphology corrosion operation on the original image. As for double-edge extraction, that is, extracting the edges of both lungs, similar to single-edge extraction, the only edge obtained after the difference operation between the original image and the corroded image is the desired edge.

4.3. System Test. The development of the system is based on Windows platform and Visual Studio integrated development environment and uses C++-based GUI application framework QT and open-source cross-platform computer vision library OpenCV. See Table 2 for detailed environmental parameters.

This study not only analyzes the segmentation results but also analyzes the performance of the segmentation process. Taking the segmentation of Chinese virtual human lung image CVH_1502 as an example, the image resolution, segmentation completion time, and interaction times are measured, and the results are shown in Table 3. It can still be seen from the table that the time required for segmentation is in direct proportion to the image resolution. The larger the image resolution, the longer the time required for segmentation. However, the number of human–computer interactions in image segmentation is not directly related to the image resolution, but related to the previous foreground and background markers.

The main functions of the edge extraction module are single-edge extraction and double-edge extraction. The so-called single-edge extraction refers to extracting the edges of human trunk and liver in this system; as for double-edge extraction, it refers to the edge extraction of both lungs. In addition, no matter what kind of edge extraction, users can customize the gray value and width of the contour. For the single-edge extraction results with different gray values of the same width and different widths of the same gray value, the edge width is 9 pixels, and the gray values are 50, 110, and 200, respectively.

5. Optimization Design of Visual Image Elements of Print Advertising

In the visual effect optimization design of graphic advertising image elements, through the design of graphic image virtual interaction based on visual communication effect, the maximum color connection area and edge roughness of the image are realized, the regional characteristics of image visual elements are successfully obtained, and the image similarity is defined as the overall approximation of graphic advertising vision, forming the local approximate weighted sum of block images, to continuously adjust the weighted value by visual feedback.

Assuming that the print advertisement image is represented by Q and an image in the image is represented by T, the quantization distance between the two forms a color histogram. The formula is as follows:

$$d_h = (Q, T) = \sum_{c=0}^{n-1} \frac{|H(Q_c) - H(T_c)|}{1 + H(Q_c) + H(T_c)}$$

According to the above formula, in order to ensure that the final result is consistent with the characteristics of human visual image, the visual RGB color space model of print advertising image is converted to the HSV color space model. According to the human eye resolution, the plane advertisement image can be divided into 8 hue H spaces, 3S saturation, and V spaces. Then, among the three visual elements H, S, and V, the vector formula that can
fuse the three to form one-dimensional image features is as follows:

\[ C = 9H + 3S + V. \]  \hspace{1cm} (17)

Based on the graphic advertisement image element division subblock under interactive virtual vision, it can be divided into \( n \times n \) subblocks to complete the extraction of different color-connected areas and image edge roughness in different subblocks divided by graphic advertisement, the block approximation value is calculated, and the obtained block approximation value is defined as the mean value of different block approximation. The formula is as follows:

\[ S_b = \frac{1}{n^2} \sum_{i=1}^{n^2} S_i. \]  \hspace{1cm} (18)

To sum up, the principle of virtual interactive visual optimization design based on graphic advertising image elements is adopted as the theoretical basis for the next optimization design of graphic advertising image element vision.
Figure 11: Image annotation function module diagram.

Figure 12: Image preprocessing function module diagram.

Figure 13: Edge extraction function module diagram.

Table 2: System development environment.

| Hardware environment          | Software environment                |
|-------------------------------|-------------------------------------|
| CPU: Core(TM) 2 Duo E4400 @ 2.00GHz | Operating system: Windows 7 Ultimate |
| RAM: 4.00 GB                  | Development language: C++           |
| Hard disk: 250 GB             | Development tools: Microsoft Visual Studio 2010 |
| Graphics card: ATI Radeon HD 2600 XT | Qt Libraries 4.8.2                 |
| Private video memory: 256 MB  | Qt-VS Addin 1.1.11                  |
|                               | Third-party library: OpenCV 2.3.1 and TBB |
5.1. Interactive Virtual Graphic Advertising Image Element Visual Optimization Design System

5.1.1. Structural Design. The optimization design system includes human-computer interaction virtual interface, plane image element acquisition module, and image color enhancement module, as shown in Figure 14.

As can be seen from Figure 14, the plane image element acquisition module completes the extraction of plane advertising image elements and successfully completes the information transmission to the image color enhancement module through the module. After the image color enhancement module successfully receives the image element information, it can use the image element virtualization technology based on the visual characteristics, to provide users with interactive virtual print advertising images on the human-computer interaction interface and form a good visual experience.

5.1.2. Image Element Acquisition Module. When designing the optimized print advertising image system, the image element acquisition module is mainly composed of image sensor, serial UART, FPGA controller, and SDRAM. Figure 15 is the structural design diagram of the whole module, and the FPGA controller component is an important hardware component. The sensor model used in this module is OV760, which can translate the collected image signal in real time. Based on the final translation result, the image element data are stored in SDRAM; that is, the image data acquisition and storage of this module are completed.

5.1.3. Design of Image Element Visual Enhancement Module. After the image information acquisition is completed, the collected image element information is transmitted to the image element visual enhancement module. After the full line of effective pixels is stored in the SDRAM image element memory, the memory can be successfully migrated and the DDR is saved in the image acquisition storage area. When obtaining the image element data of a larger storage area, the image color enhancement module and the visual optimization and enhancement algorithm of plane image elements can be used to effectively enhance the overall image visual effect and form an interactive virtual interactive experience. The relevant data obtained after the final processing are stored in the DDR return visit image memory, then the regional image data in the output image FIFO are migrated, DS90CF383 coding is used to successfully display the final standard image elements, and the color of print advertising image elements of human-computer interaction and virtual interaction is effectively processed and obtained, as shown in Figure 16.

5.2. Image Element Enhancement Based on Visual Interactive Virtualization

5.2.1. Feature Extraction of Visual Interactive Virtual Image Elements. When designing the virtual interactive expression effect of image, two methods can be used to extract the element features of print advertising image. The first is the horizontal method; the second vertical block method can form the entropy extraction of frontal image elements in two directions of the brand logo, and the visual area of interest of plane advertising image elements is selected according to the entropy feature difference in the finally obtained color image, and the formula for the mean value of color entropy in the bottom feature mapping area of visual space is obtained as follows:

| Image serial number | Image resolution size | Split time | Number of interactions |
|---------------------|-----------------------|------------|-----------------------|
| 1                   | 325 × 170             | About 4.7 s| 3                     |
| 2                   | 650 × 340             | About 14.5 s| 3                    |
| 3                   | 975 × 511             | About 20.8 s| 2                    |
| 4                   | 1300 × 682            | About 37.6 s| 1                    |
According to the area in the brand logo in the visual area of the selected graphic advertising image elements, the target area with $L/2$ based on the three image features of $R$, $G$, and $B$ is selected. $\zeta$ represents the average value of different image visual elements in the area. By calculating the color and entropy feature weights in the image element area of print advertising, the bottom features of the visual element system of print advertising can be formed.

5.2.2. Analysis of Experimental Results. To confirm the visual optimization design idea of print advertising elements based on image interactive virtualization, the above methods are used to create the effect of interactive virtual print advertising image elements. This experiment is carried out, and the constituent images in the Corel database are selected, covering a total of 5000 print advertising images. Based on Windows operating system, this experiment is completed using MATLAB 2016 platform programming.

Firstly, using the image element feature and entropy feature extraction method, the optimal design area of print advertising image elements is marked, and the results of the optimal design are recorded, to build a matrix and record the identification area. Then, the texture spectrum method is used to optimize the design to realize the virtual effect of image interaction. It has a strong sense of reality. It is a three-dimensional display of the real scene. Based on the production and generation effect of the real picture, it is more realistic and credible than other modeling and generation objects. Compared with plane pictures, it can express more image information, eliminate the uncertainty caused by remoteness, and provide the visual feeling of being in its environment. It is inclusive and can add text, pictures, videos, flash, and other functions. Good compatibility can be combined with the traditional two-dimensional website, and the effect is better. The system supports access to mobile terminal devices such as iPhone, iPad, and Android. You can
drag, zoom in and out the map through the mobile terminal, and click the point of interest to view the details.

The visual optimization effect of graphic advertising elements based on image interactive virtual can be found. The proposed visual optimization design idea of graphic advertising elements based on image interactive virtualization can obtain the effect of high similarity with the original graphic advertising image elements and obtain better interactive virtual design effects such as text, graphics, and joint charts. It is proved that the optimization design method can obtain effective image design through color and entropy features and improve the final visual image accuracy to a great extent.

After the optimized design of the original print advertising image, it is found that the brightness is insufficient and the definition is low, and the visual interactive virtual effect is also poor, which fails to form a better visual experience for users. However, by realizing the design idea of interactive virtual visual elements proposed by the plane elements, it is found that it can effectively enhance the color effect of human-computer interaction virtualization plane advertising image. To verify the application effectiveness of the system, according to the visual optimization effect, it can be found that a more concentrated RGB gray value can be obtained before optimization, there is a lack of visual contrast and interactive virtual effect in the details of image elements, the overall design details are fuzzy, and the significance of image edges is poor. The optimized graphic advertising visual optimization design system based on image interactive virtualization is found to effectively enhance the graphic visual virtual interaction effect and improve the image visual clarity of the overall graphic advertising.

6. Conclusion

This study designs a visual optimization system of print advertising elements based on image interactive virtualization, which can extract the relevant details of print advertising image elements through the acquisition module and transmit them to the print image visual effect enhancement module. Based on the visual characteristics, image interactive virtualization is used to effectively improve the visual design effect of print advertising image elements. After completing the system effectiveness verification, to further analyze the system performance, this study uses visual enhancement and mark enhancement to compare the performance of this interactive virtual optimization design. From the aspect of enhancement effect, according to the overall and local aspects as the evaluation indexes of this optimization design, the gray mean value and image contrast enhancement effect value of the three types of systems are completed, and the comparative analysis is completed. Through the comparative analysis of the system, it is found that the visual effect optimization design idea in this study is better than the other two visual image elements, and the visual contrast of image elements is also significantly better than the other two systems. Therefore, it is confirmed that the visual optimization design idea of print advertising elements based on image interactive virtualization can achieve the expected effect.

In a word, for the visual optimization problem of virtual interaction of graphic advertising image elements, this study proposes a graphic advertising design optimization system based on image virtual interaction. Firstly, through the image element information collection, the collected image element information is transmitted to the image element enhancement module. Using the image enhancement algorithm based on visual characteristics, the overall and local visual enhancement effects are realized, and the high-definition visual effect of virtual interaction is obtained. Through the experimental test, it is found that the visual display details of the system page are significantly improved. It also shows that the visual element optimization design system in this design can obtain the optimal interactive virtual visual effect when comparing the methods of visual enhancement and mark enhancement system.

Data Availability

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

Conflicts of Interest

The author declares that there are no conflicts of interest.

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References

[1] C. Wang, L. Zheng, B. Li, and Z. Li, “Design and implementation of ethercat master based on loongson,” *Procedia Computer Science*, vol. 183, no. 11, pp. 462–470, 2021.
[2] A. Sharma, G. Rathee, R. Kumar et al., “A secure, energy-and slae-efficient (seso) e-healthcare framework for quickest data transmission using cyber-physical system,” *Sensors*, vol. 19, no. 9, p. 2119, 2019.
[3] B. Zeng, Z. Feng, T. Xu, M. Xiao, and R. Han, *Research on Intelligent Experimental Equipment and Key Algorithms Based on Multimodal Fusion Perception*, IEEE Access, Manhattan, New York, USA, 2020.
[4] Hansraj, P. K. Tiwari, and A. Chaudhary, “Vm placement and cache based side channel attack at computational level in cloud computing: a survey,” *Journal of Discrete Mathematical Sciences and Cryptography*, vol. 24, no. 5, pp. 1467–1473, 2021.
[5] M. Bradha, N. Balakrishnan, S. Suvi et al., “Experimental, Computational Analysis of Butein and Lanceoolitin for Natural Dye-Sensitized Solar Cells and Stabilizing Efficiency by IoT. Environment, Development and Sustainability,” *Environment Development and Sustainability*, vol. 24, 2021.
[6] H. Gu, C. Jin, H. Yuan, and Y. Chen, “Design and implementation of attitude and heading reference system with extended kalman filter based on mems multi-sensor fusion,”
Z. Si, X. Xie, and D. Zhang, “Design and implementation of typical dynamic traffic scenes based on virtual reality technology,” *Journal of Intelligent and Fuzzy Systems*, vol. 2, pp. 1–7, 2021.

S. E. Prasetyo, “Design and implementation of lightweight virtualization using docker container in distributing web application with experimental methods,” *Journal Of Informatics And Telecommunication Engineering*, vol. 4, no. 2, pp. 270–276, 2021.

J. Gang and Y. Li, “Simulation design and implementation of voice landscape quantification in virtual reality based on cloud computing,” *Mobile Information Systems*, vol. 2021, no. 2, pp. 1–9, 2021.

X. Liu, C. Ma, and C. Yang, “Power station flue gas desulfurization system based on automatic online monitoring platform,” *Journal of Digital Information Management*, vol. 13, no. 06, pp. 480–488, 2015.

S. T. Arzo, D. Scotce, R. Bassoli et al., “Msn: a playground framework for design and evaluation of microservices-based sdn controller,” *Journal of Network and Systems Management*, vol. 30, no. 1, pp. 19–31, 2022.

T. Zhang, H. Qiu, L. Linguaglossa, W. Cerroni, and P. Giaccone, *Nfv Platforms: Taxonomy, Design Choices and Future Challenges*, IEEE Transactions on Network and Service Management, Piscataway, NJ, USA, 2020.

D. W. Goldberg, F. J. Bowlick, and P. E. Stine, “Virtualization in cybergis instruction: lessons learned constructing a private cloud to support development and delivery of a webgis course,” *Journal of Geography in Higher Education*, vol. 45, no. 1, pp. 128–154, 2020.

R. Huang, “Framework for a smart adult education environment,” *World Transactions on Engineering and Technology Education*, vol. 13, no. 4, pp. 637–641, 2015.

X. Ge, R. Zhou, and Q. Li, “5g nfv-based tactile internet for mission-critical iot services,” *IEEE Internet of Things Journal*, vol. 7, no. 7, pp. 6150–6163, 2020.

Z. Guo and Z. Xiao, “Research on online calibration of lidar and camera for intelligent connected vehicles based on depth-edge matching,” *Nonlinear Engineering*, vol. 10, no. 1, pp. 469–476, 2021.

C. Batara and C. I. Rapat, “Design and implementation of virtual university based on ict,” *International Journal of Regulation and Governance*, vol. 8, no. 4, pp. 144–152, 2020.

B. H. Yu, H. Wang, X. P. Dong, and X. Z. Zhang, “Design and implementation of a semantic gateway based on ssn ontology,” *Procedia Computer Science*, vol. 183, no. 6, pp. 432–439, 2021.

S. P. Hojun Yeom, “Design and implementation of real-time electrical stimulation artifact suppression based on stm32,” *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*, vol. 12, no. 5, pp. 424–427, 2021.

K. Ch En, Y. Zu, and Y. Cui, “Design and implementation of bilingual digital reader based on artificial intelligence and big data technology,” *Journal of Computational Methods in Science and Engineering*, vol. 20, no. 3, pp. 889–907, 2020.

W. Yong, “Design and implementation of intelligent English electronic dictionary system based on internet of things,” *Wireless Communications and Mobile Computing*, vol. 2021, no. 12, pp. 1–11, 2021.

A. F Abbas and M. Z Abdullah, “Design and implementation of a smart home gas detection system based on mobile network”*Journal of Engineering and Sustainable Development*, vol. 25, no. 2, pp. 9–16, 2022.

X. Chen, “Design and implementation of decentralized e-commerce model based on edge computing,” *Journal of Intelligent and Fuzzy Systems*, no. 3, pp. 1–11, 2021.

Q. Zhang, S. Qiao, Q. Zhang, and S. Liu, “Design and implementation of the detection software of a wireless microseismic acquisition station based on the android platform,” *Geoscientific Instrumentation Methods and Data Systems*, vol. 10, no. 1, pp. 91–100, 2021.