Analysis of Graphic Design Based on AI Interaction Technology

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The naive Bayes classification algorithm is used to determine the plane feature vector, and the color image enhancement algorithm based on the visual characteristics is used to improve the local contrast of the plane visual image. In addition, based on the visual perception intensity of each region of the interactive interface and the importance of visual perception elements in the edge contour, a hierarchical optimization model of graphical HMI is established, which is solved by the genetic algorithm. Finally, it has been proved that this system has high efficiency in image color processing, and the image enhancement effect is better, which meets the requirements of human visual perception. The contribution of this study lies in the design of the human-computer interface plane visual image color enhancement system, so as to improve the visual effect of plane visual image color.

1. Introduction

With the continuous development of modern science and technology, the technology people use in daily image design is also constantly innovating. Virtual reality technology has become the first choice of engineering design and image simulation for its convenient visual simulation and sensory experience [1, 2]. In graphic design, the interactive function can be realized through AI elements. Interactivity is a special performance in graphic design, and it is also an important part of virtual graphic design. In the virtual platform, through the adjustment of various product types and placement positions required in the process of graphic design, the interaction of graphic design can be realized by using VR technology and modeling language. VR is a new practical technology, which integrates computer, electronic information, and simulation technology, and reflects the plane image that the human body cannot feel through three-dimensional model [3]. In the multidimensional interactive system, the interactive effect of the original image is poor, which is unable to meet industry standards. In order to solve the problem that the original system cannot achieve, it is necessary to design a plane image interaction system based on virtual reality technology to improve the plane interaction effect. On the original plane interactive system, the system hardware equipment is upgraded and improved, and the image recognition resolution is improved by using new instruments. HMI (human-machine interaction) interface is the communication carrier of a human and computer system, which provides various symbols and actions for human and computer to transfer information. In addition, it can complete the human-centered HMI based on the visual channel of computers without visual function [4, 5]. In the process from image source to HMI page display, circuit noise, transmission loss, and so on will affect the quality of the plane vision image, which has become a key issue in the field of HMI. Some studies have used Photoshop color mode and advanced adjustment techniques to adjust images with color defects, but the two traditional methods have poor adaptive adjustment ability to image color, and there is a problem that the color difference of images is not obvious. On the basis of the traditional system and the integration of machine vision technology, a design method of the plane vision image color adaptive adjustment system based on machine vision is proposed, which is helpful to optimize the adaptive adjustment function of the system to the image color.

In this article, the color enhancement system of the plane vision image based on HMI is designed, where the image
acquisition module is used to extract the image details and transmit it to the image color enhancement module, and the enhancement module improves the color effect of the plane visual image through the color image enhancement algorithm based on the visual characteristics.

2. Application of AI Interaction Technology in Graphic Design

2.1. AI Algorithm. In the plane image design, the introduction of the AI algorithm can actively obtain the physical landscape and map its intelligence to the plane background. The application of the AI element is realized through the virtual platform. In the virtual platform, the specific position information of the landscape can be determined by acquiring the time when the signal arrives at the indoor landscape [6]. The application process is as follows.

Firstly, a signal transmitting device with a known transmission rate is established in the virtual platform, and the time from the transmitting device to the receiving device is recorded during the measurement. The calculation formula of the distance is as follows:

\[ S = (T - T_0) \cdot v, \]  

where \( S \) is the distance between the signal transmitting device and the signal receiving device when they are on the same horizontal line; \( T \) represents the time of signal emission by the signal emitting device; \( T_0 \) represents the time when the signal receiving device receives the signal; \( v \) is the propagation speed of the wireless signal in the medium. Through the calculation of the distance, we can infer the location of the main landscape. In this case, the transmitting device needs two kinds of signals, and the distance is determined by calculating the time difference between the two signals received by the signal receiving device. The calculation formula is as follows:

\[
\begin{align*}
S &= T_0 \cdot v = T_1 \cdot v', \\
T_1 - T_0 &= \frac{S}{v} - \frac{S}{v'} \\
S' &= \frac{v'}{v - v'} (T_1 - T_0),
\end{align*}
\]

where \( S' \) is the distance between signal transmitter and signal receiver; \( v \) represents the time of the first signal; \( T_1 \) represents the time of the second signal; and \( v \) and \( v' \) represent the propagation speed of two signals in the medium, and the specific position of the planar landscape can be determined accurately by calculation.

After the location is determined, the location data of the physical landscape is saved through the virtual platform, and a new plane is established on the virtual platform. The physical landscape data are introduced into the new plane, and the position of the object image in the plane is adjusted and arranged as the background map of the plane. In this way, the plane image design based on the AI algorithm is realized.

2.2. AI Interaction Technology. In the actual graphic design process, the introduction of sensor equipment can provide users with more real contact and perception, and realize a comprehensive understanding of the surrounding environment [7]. At the same time, users can switch the plane scene in the virtual platform according to their basic needs and even change the actual state of the modeling. In this way, users can interact with the graphic design content in a 3D environment. In addition, WAI can be used as the connection interface between the model building language and the external environment in graphic design, so as to construct the external environment, which can access the virtual scene in the current motion state, and through the corresponding modeling language, it can also be used as the interface between the model building language and the external environment, where the virtual graphic design space can be controlled and modified. By using the concept model of AI interaction technology, the communication and interaction between the platform and graphic designers can be realized, so as to ensure that graphic designers can obtain all kinds of parameter information in the plane landscape more accurately. Figure 1 shows the implementation process of AI interaction technology in graphic design.

Using the convenience and timeliness of the conceptual model, various information in graphic design can be more clearly and simply mapped, so as to ensure that graphic designers can understand and master it more easily [8]. Moreover, through the introduction of conceptual model, the specific information content that can accept or send things can be sent to the virtual graphic design scene, so as to realize the interaction between the model and the external environment, so as to expand the application scope of the virtual plane platform to the greatest extent, so as to provide more design resources for graphic design, and ensure the authenticity and effectiveness of the data information contained in the resources. In addition, the specific parts of the plane should contain interactive ability, according to the different location information in the plane landscape, to provide more intuitive information display for the plane design.

3. Color Enhancement System of Plane Image Based on AI Interaction

The system consists of human-computer interface, image acquisition module, and image color enhancement module. The system extracts image information through image acquisition module and transmits it to image color enhancement module. The image color enhancement module uses the color image enhancement algorithm based on visual characteristics to adjust the overall brightness of the image and enhance the local contrast [9], so as to complete the HMI plane visual image color enhancement output to the HMI display to the user.

3.1. Image Acquisition Module. In order to make the system hardware connectable, the setting with the same voltage is selected for series connection to complete the hardware.
design. In order to effectively control the computer image recognition, the computer vision controller is designed. The specific equipment image is shown in Figure 2.

Two high-pixel fast cameras and five infrared transmitting devices are installed in the controller. Through this design, the adverse effects caused by too dark or sufficient light at night can be reduced [10]. In the process of image recognition and control, the CPU and image processor are set. In the design process of CPU and image processor, a high-pixel and high-speed dual-core processor is selected to improve the processing efficiency and provide the basis for the next image processing, where the controller provides two kinds of application programming interfaces: one is used to obtain image information, and the other is local information interface, which is controlled by the C language.

The image acquisition module adopts the OV760 sensor. The FPGA chip is the control chip of the module, which is used to coordinate the whole image acquisition module. After the signal of the OV760 sensor is translated, the image data are saved into SDRAM memory according to the translation result, and then, the image data are collected and stored.

### 3.2. Image Color Enhancement Module

The image color enhancement module is shown in Figure 3. After the image acquisition module collects the image information, the information is transmitted to the image color enhancement module.

When the collected image is full of effective pixels in SDRAM memory, the line image data are migrated to the image acquisition storage area of external memory DDR. When the image data in this storage area are larger than one frame, the image color enhancement module uses the color image enhancement algorithm based on visual characteristics to adjust the overall brightness of the image and enhance the local contrast. The processed image data are copied to the DDR image return storage area, and then, the image data in this area are migrated to the FIFO of image output, and the standard image is displayed by DS90CF383 code to complete the color enhancement processing of the plane vision image of the HMI.

### 3.3. Algorithm Design

#### 3.3.1. Feature Extraction

In order to determine the feasibility of designing the plane image interactive system, the naive Bayes classification algorithm is used to determine the plane vector feature vector. Setting graphical space is $xyz$ coordinate system, $\theta_i$ is graphics vector $u$ and $y$ axis angle, and $y$ axis vector $Y$ can be represented as $\cos(\omega y/|u|)$). The plane vector of $xyz$ is set as $i$, the $x$-axis vector is set as $X$, and the projection of the image vector in the space coordinate system of the graph is $j$, and then, the calculation formula of the included angle between $j$ and $x$-axis is

$$\theta_{xj} = \sin\left(\cos\frac{ui}{|w|}\right).$$

The obtained image vector angle information is set as $\theta_w$, $\theta_{xj}$ and frame angle information is $\theta_{x1}, \theta_{x2}$. By calculating the motion value, the motion parameters of the plane image can be calculated as

$$r_m = \begin{cases} 0, & |\theta_{rw} - \theta_{rj}| < \frac{\pi}{6} \\ 1, & |\theta_{rw} - \theta_{rj}| \geq \frac{\pi}{6} \end{cases}.$$

where $\theta_{rw} = \sum_{w=1}^{4} (|\theta_{xw}| + |\theta_{jx}|)$; according to the features of graphic images to establish the corresponding training dataset, the formulas (1) and (2) are used to calculate each frame of data feature vector. To ensure the effectiveness of plane interaction, the test parameter is set as $n$, which can be expressed by the following formula:

$$n = \frac{m}{3}.$$

The feature vectors extracted from formulas (3) and (4) are recorded into a well-trained classification model, and command transformation is performed to control the plane image.

#### 3.3.2. Brightness Adjustment

The overall brightness adjustment of the plane vision image of the human-computer interaction interface is mainly based on histogram nonlinear adaptive pull-up to enhance the dark area in the interface [11]. The brightness component of the plane visual image MaxRGB($i, j$) was set as the maximum value of $RG$ and $B$ primary colors, as shown in the following equation:

$$\text{MaxRGB}(i, j) = \max(\text{OriR}(i, j), \text{OriG}(i, j), \text{OriB}(i, j)),$$

where $\text{OriR}(i, j), \text{OriG}(i, j)$, and $\text{OriB}(i, j)$ are used to represent the $R, G$, and $B$ components of point $(i, j)$ pixels of the original image in RGB space.

The number of gray values in MaxRGB($i, j$) was extracted where the number of pixels exceeds the threshold $\omega$. The number is described by $m$, and the threshold $\omega$ is

$$\omega = \text{uint8}(\text{Long} \times \text{Width} \times \frac{100}{256})$$
where uint8 represents the 8-bit binary number without sign; the length and width of the image are set as Long and Width in turn, 256 represents the number of gray value, and 100 is the amount of threshold value. Gray values of pixels less than the threshold need not be sorted out to reduce the interference of small gray values on mapping. The gray value after mapping is also an exponential mapping function, which is expressed as

$$\text{TraRGB}(i, j) = 255 \cdot \left( \frac{n - 1}{m - 2} \right) g_1,$$

where $n$ and $m$ are constants, and the value range is $[0, m - 1]$. $\text{TraRGB}(i, j)$ is the gray value after mapping, and the optimal pixel gray value $g_1$ is

$$g_1 = 0.0439 \times (\ln(\text{Value Mean}))^2 - 0.1163 \times \ln(\text{Value Mean}) + 0.573,$$

where the gray mean value of MaxRGB $(i, j)$ is described by an average value.

### 3.3.3. Local Contrast Enhancement

After the adjustment of the overall brightness, the details of the whole low illumination area of the image can be enhanced. Next, the correlation between the gray values of the local pixels is needed to enhance the local contrast of the brightness of the image, so that the image details are more significant. The calculated window size is $9 \times$. The median filter can store the edge details of the image completely. Therefore, the median...
filtering method is used to calculate the mean value of brightness in the range:

$$\text{MedRGB}(i, j) = \text{median} \left( \text{TraRGB}(i, j) \right).$$  \hspace{1cm} (10)

After obtaining the brightness mean value through equation (10), local contrast enhancement of color is completed by the following equation:

$$\text{ResRGB}(i, j) = g_2 \left( \text{TraRGB}(i, j) \right)$$

$$- \text{MedRGB}(i, j) + \text{TraRGB}(x, y).$$  \hspace{1cm} (11)

Type: $g_2 = 2$; $\text{TraRGB}(i, j)$ is the pixel gray value after overall brightness processing; $\text{MedRGB}(i, j)$ is the mean value of regional brightness; $\text{ResRGB}(i, j)$ is the gray value of the local contrast enhancement.

4. Hierarchical Optimization Model of HMI

4.1. Model Construction. The hierarchical optimization model of the graphical HMI based on the visual perception intensity takes the visual perception intensity of smooth area, nonsmooth area, curved surface area, and single frame distribution as the optimization objective. Firstly, the important parameters in each region of the HMI interface are defined as $D = \{d_1, d_2, \ldots, d_n\}$, where $d_i$ and $D$ are the level value of the $i$-th visual perception element and the importance level set of all visual perception elements in the graphical human-computer interaction interface, respectively, where the value of $i = 1, 2, \ldots, n$.

$X = \{x_1, x_2, \ldots, x_m\}$, where $x_j$ and $X$ are, respectively, the perception intensity level of the $j$-th visual perception region and the visual perception intensity set divided into each region of the graphical human-computer interaction interface, where $j = 1, 2, \ldots, m$. When the visual perception element $i$ is arranged, the area occupied by it in the $j$-th perception region is represented by $q_{ij}$.

$R = \{r_1, r_2, \ldots, r_m\}$, where $r_j$ and $R$ are the area occupied by the $i$-th visual perception area and the visual perception intensity index of each visual perception element, respectively; after they are placed in the graphical HMI,

$$r_i = \sum_{j=1}^{m} d_j x_j q_{ij},$$

where $d_i$ and $x_j$ represent the importance level and the perception intensity level of the area occupied by the position of any visual perception element, respectively, when it is placed on the graphical human-computer interaction interface, and the area occupied by the position is represented by $q_{ij}$.

If visual perception elements are to be arranged in the core area of graphical human-computer interaction interface, the value of $r_i$ should be larger. On the basis of this method, the hierarchical optimization model of the graphical HMI based on the visual communication perception intensity $Z$ is established, as shown below:

$$Z = m \left( \sum_{i=1}^{n} \sum_{j=1}^{m} d_i x_j q_{ij} \right).$$

where $\sum_{i=1}^{n} q_{ij} = q_{ij}, \sum_{j=1}^{m} q_{ij} = s_i, \sum_{j=1}^{m} q_j = \sum_{i=1}^{n} s_i$ are the constraint of the model.

If visual perception elements with high importance are to be placed in areas with high visual perception intensity in the graphical HMI, the value of $Z$ should be larger.

4.2. Model Solution

4.2.1. Model Coding. Genetic algorithm is used to solve chromosomes, and coding rules based on visual perception elements are used to ensure that visual perception elements can be properly arranged in different areas of the graphical HMI, and the arranged areas are connected, so as to realize the hierarchical optimization of the interface. If there are 8 visual perception elements, its serial number is regarded as a gene fragment to be solved for chromosomes. While if the serial number of perception elements is encoded by integers from 1 to 8, the feasible chromosome encoding is shown as follows:

$$p_1 = (2 \ 3 \ 5 \ 6 \ 7 \ 4 \ 8 \ 1),$$

$$p_2 = (5 \ 6 \ 2 \ 3 \ 7 \ 4 \ 8 \ 1).$$  \hspace{1cm} (14)

4.2.2. Chromosome Coding Solution. According to the above coding rules, the following steps are adopted to solve the layout of the graphical HMI.

(1) Obtain the information of visual perception elements such as $S_i$ and $d_i$, according to the gene code placed at the end of the extracted gene fragment.

(2) The information of each visual perception region of the unarranged visual perception elements can be obtained according to the grade of visual perception region from high to low, and the visual perception elements can be arranged into the visual perception region according to the area matching rules.

(3) Judge whether the visual perception element can be completely arranged in the current visual perception area. If yes, skip to Step (5); if not, skip to Step (4).

(4) According to the area matching rules, the visual perception elements are arranged for the next level visual perception area and the previously arranged visual perception area, and then skip to Step (3).

(5) The $r_j$ of the visual perception element was calculated after the layout was completed.

(6) Judge whether the decoding of all the currently encoded chromosomes is complete. If yes, skip to Step (7), if not, return to Step (1).

(7) The calculation of single chromosome can be realized through the current $Z$ value of dye coding and the distribution information of each visual perception element in each perception region obtained according to each calculation result.
5. Experiment and Analysis

In order to analyze the optimization effect of the graphical HMI of this model, a comparative experiment was designed. The improved FAHP-TOPSIS model in Ref. [12] and eye movements characteristics model (EMCM) in Ref. [13] were selected as the comparison models of this model. MATLAB simulation software and VC programming tools were used to design the system, and the sample size of image was 1000.

5.1. Image Enhancement Effect. In order to verify the effectiveness of the system in this article, the color enhancement effect of the plane vision image based on the HMI interface is compared with the original image. The experimental results are shown in Figure 4. The brightness of the original image is dark, and the image definition is not high. After the enhancement of the system in this article, the brightness and clarity of the plane vision of HMI are improved, and the significance of page details has been improved. The original image brightness enhancement effect is weak, while the proposed model has better brightness characteristics, which is consistent with human visual perception and can better realize the optimization of the graphical HMI and improve its visual comfort.

Information entropy is the standard to evaluate the average information content of an image. The larger the entropy value is, the better the image fusion effect is and the more abundant the information is. The information entropy of the three models is analyzed experimentally, and the results are described in Figure 5. Compared with the other models, the entropy of the two models in this article is always smaller than that of the other models. The information entropy fluctuation of the FAHP-TOPSIS model is relatively large, where the lowest value is 45, and the highest value is close to 60, while the information entropy of EMCM fluctuates sharply in [30, 40]. Comparing these data, we can see that the proposed model has a strong image fusion effect, which can greatly improve the performance of the graphical HMI.
In addition, two evaluation indexes of global brightness and local contrast are set up to calculate the average gray value and contrast enhancement index (R) of the three systems, respectively. The performance results of the three systems are shown in Figure 6.

By analyzing the data in Figure 6, it can be seen from the average gray value data of global brightness and local contrast that the average gray value of the system in this article is 174.23 and 110.23, which is greater than that of the other two systems. The R values of the system in this article are 4.32 and 4.65, which are also greater than those of the other two systems. It indicates that the system can effectively improve the overall brightness and contrast of the image, whose enhancement effect was better than FAHP-TOPSIS and EMCM.

5.2. Operation Efficiency. Five experiments of color enhancement were carried out on the plane visual images of the same HMI interface. The time consumption of the three systems is shown in Figure 7.

It can be seen from Figure 7 that the maximum time consumption for image color enhancement is 0.18 s, which is 0.2 s less than FAHP-TOPSIS and 0.18 s less than EMCM. In this system, only three experiments were used to reach the maximum time, while FAHP-TOPSIS and EMCM needed five and seven experiments, respectively. Therefore, this system has the shortest time and the highest efficiency of image color processing.

6. Conclusion

In order to optimize the effect of plane vision image of the HMI, this article designs the color enhancement system of plane vision image of the HMI. A color image enhancement algorithm based on visual characteristics is used to enhance the overall clarity of the image from both global brightness and local contrast. The test results show that, compared with FAHP-TOPSIS and EMCM, the proposed model has a strong image fusion effect and can greatly improve the performance of a graphical HMI. In addition, the model only takes three experiments to reach the maximum time, while FAHP-TOPSIS and EMCM need five and seven experiments, respectively.

Data Availability

The dataset can be accessed upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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