Computing and Informatics, Vol. 43, 2024, 900–925, doi: 10.31577/cai_2024_4_900

VISUAL COMMUNICATION DESIGN AND COLOR BALANCE ALGORITHM FOR MULTIMEDIA IMAGE ANALYSIS

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Abstract. As culture continues to evolve, the field of visual communication design faces new challenges in the era of new media. To address these challenges, a paper proposed innovative ideas for the industry's growth and development. Specifically, the paper suggested that incorporating visual communication design and color balance into multimedia image analysis can enhance the visual impact of images. Results showed that images analyzed under this approach received a visual effect score 10 % higher than those analyzed without it, validating the effectiveness of this proposal. The visual effect score of Image 2 (the visual design proposed in this article) was 10 % higher than that of Image 1 (general visual design). Based on the comparison of the spatial comparison Transfer Function of Modulation Transfer Function,

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the increase is about 12.5 % under this method. Overall, this paper offered new perspectives on improving visual communication design for the era of new media.

Keywords: Visual communication design, color balance algorithm, electronic imaging, multimedia images, image recognition, graphic design

1 INTRODUCTION

The rapid growth of digital technology has brought about significant changes in the way human beings obtain and process information. Where once paper was the primary medium for information transfer, we now have access to a wide range of multimedia formats that combine sound, light, and electricity. Visual communication design is a field of study focused on the art of arranging and combining various types of visual information in a manner that can be easily understood and accepted by a given audience. Visual perception is an essential component of this field, as it involves the complex psychological process of perceiving and recognizing the shapes, colors, and patterns present in our environment. As a vehicle for transmitting information, images possess a unique carrying capacity that far exceeds that of words and languages. Image is a vivid and similar description or photo of objective objects, and is the most commonly used information carrier in human social activities. An image is a representation of an objective object that contains relevant information about the object being described. It is the primary source of information for people. According to statistics, approximately 75 % of the information obtained by a person comes from vision. Due to the significant increase in computer speed, these technologies are rapidly being replaced by digital image processing methods. In general, digital image processing technology is more universal, reliable, and accurate. Compared to simulation methods, they are also easier to implement. Thanks to advancements in computer image processing technology, multimedia systems can now effectively process these images, making them more accessible than ever before. Today, multimedia images have become the data format of choice, aligning with the needs of modern society and its insatiable appetite for information. With the growth of this technology, we can look forward to an even greater convergence of various media formats and the continued expansion of visual communication design as we seek new ways to share and understand the world around us.

At present, many scholars have studied visual communication and color. Liu expanded upon the fundamental concept of visual communication, emphasizing the pivotal role played by color in modern visual elements. She not only delineated the various functions of color, but also provided compelling examples to elucidate its importance in effective visual communication. By thoroughly comprehending and skillfully applying these principles, one can effectively harness the persuasive power of visual communication to achieve success in a variety of contexts [1]. Drawing upon the color coordination theory, Yan and Luo conducted a comprehensive

analysis of the diverse impacts of color implementation. His insightful examination culminated in a rigorous teaching design that incorporates four essential elements, which serves as a valuable compass for researchers and educators alike who seek to enrich their understanding and application of this critical concept. With this strategy in hand, practitioners can confidently navigate the complexities of color coordination, creating compelling visual environments that captivate and engage their audiences [2]. Ancuti et al. introduced the basic concepts and features of visual communication design, and analyzed its main functions and applications in visual communication design. They discussed its color balance and fusion technology [3]. After understanding the concept and characteristics of visual communication design, the color of visual communication and its application in water, Zhou et al. proposed a fusion technology based on multiple features to achieve color distortion and low contrast of underwater images [4]. Yu discussed the climate and urban visual communication art in coastal areas, starting from environmental issues, and showed the direction for the future of visual communication design [5]. With the growth of the times, visual communication design and color play an increasingly important role in life. Although these scholars can enrich the content of this article to some extent by studying visual communication and color, their research is limited to theoretical borrowing. They have not proposed good methods for improving visual communication design and color balance algorithms, nor conducted empirical research, which has led to limitations in the research results and cannot be well applied.

There have been a number of studies on visual communication design for multimedia images. Ilma et al. pointed out that scientific and technological progress, the rise of new energy, and the growth and application of new products had all promoted the growth of visual communication in view of the current epidemic situation [6]. Yarkova et al. discussed the current application of multimedia design and visual communication, and pointed out the role of multimedia in teaching [7]. Li conducted an in-depth study and exploration of the use of digital multimedia technology in visual communication [8]. Srnic conducted in-depth discussion and analysis on the reflection and expression of multimedia art in all aspects of visual communication, as well as today's rapid development of the network [9]. Lee et al. put forward his own views on the innovation and development of visual communication in the multimedia era, and believed that information images played an essential role in the scientific communication of COVID-19 [10]. The development of multimedia image has a certain role in promoting visual communication design. Scholars' research has shown that the development of multimedia images has a certain promoting effect on visual communication design, but there is no specific analysis of the role of multimedia images in visual communication design and color balance algorithms, which leads to insufficient reference value for research [11]. As technology advances, visual communication design must adapt to new tools and methods, enhancing the interactivity and impact of the creations. Changes in consumer behavior require designers to focus on user experience, using visual design to capture attention and improve the efficiency of information transmission. Market competition pressure makes vi-

sual communication design key to strengthening brand recognition and attracting consumers. Designers need to master the latest trends and technologies to ensure their work communicates effectively and stands out in the market.

This paper mainly analyzed multimedia images from the perspective of computer vision, and designed a series of algorithms from many aspects. These algorithms not only consider the visual effect of images, but also consider that information can be better understood and transmitted after visualization. Visual communication design is to use image information and content to transmit and explain to users. It involves not only the visual elements and layout of pictures or video content, but also the layout of text content and graphic elements. Its purpose is to convey a complete message or explain its meaning to users, and at the same time, let users understand the meaning after reading. Color equalization is used to achieve the purpose of adjusting color distribution and image color contrast by changing the visual element of color contrast in an image.

Visual communication design and color balance algorithm of multimedia image analysis in this article is a method of filtering a small number of extreme pixel color values and proportionally increasing the remaining non extreme pixel color values. By processing multiple images, this algorithm achieves better results and performance compared to traditional color balance methods. The traditional visual communication design and color balance algorithm pay more attention to the application of human perception and design principles, while the visual communication design and color balance algorithm of multimedia image analysis in this article focuses more on specific image processing and analysis techniques. It focused on using image processing and analysis techniques to adjust the color balance of images, in order to achieve better visual perception and rendering effects [12]. Compared with traditional methods, the visual communication design and color balance algorithm proposed in this paper play an important role in optimizing image colors, improving image quality, enhancing visual impact, and conveying emotions and information. They also differ from traditional methods in terms of depth and application scope.

2 CONCEPT AND CHARACTERISTICS OF VISUAL COMMUNICATION DESIGN

2.1 Visual Communication Design Concept

In recent years, the remarkable advancement of technology has substantially enriched the diversity and intricacy of computer networks and the media formats they support. This evolution has significantly reshaped human visual experiences, altering the ways we engage with information and perceive the world. In our rapidly transforming information society, where media's influence is ever-expanding, design's role in mediating communication has become crucial. Yet, traditional design methodologies fall short of addressing the complexities of contemporary media landscapes, necessitating a refined and context-aware approach to visual communication.

The unique capacity of images as vehicles for information transmission lies in their ability to convey complex messages swiftly and intuitively, transcending linguistic barriers. This potency is notably enhanced by advancements in computer image processing technology, which enable more sophisticated manipulation and presentation of visual content. The emergence of visual communication design as a field responds directly to these developments, leveraging insights from psychology, semiotics, and aesthetics to forge innovative design methodologies suitable for modern media. This synergy of art and technology empowers designers to craft impactful and nuanced visual narratives, thereby deepening viewer engagement and comprehension across diverse media platforms.

However, despite its strengths, visual communication is not without its limitations. The depth of information it conveys is generally more superficial than text, focusing predominantly on immediate and apparent messages. Cultural disparities also influence how visual designs are received and interpreted across different regions, posing challenges in creating universally effective designs. Creativity and originality may wane, and adherence to prevailing design software and tools can constrain innovation unless designers continually adapt to emerging technologies. Nonetheless, as computer image processing technology progresses, the scope for enhancing the expressiveness and efficacy of visual communication broadens, offering a richer palette of tools for designers to articulate complex ideas visually and interactively, thus maintaining their competitive edge in a dynamic field [13, 14].

Visual communication refers to the process of transmitting information or ideas to audiences through visual media that are human-centered. This type of communication design is dominated by visual media, and it covers a wide range of design areas. Visual communication design is a proactive way of spreading information, mainly or partially depending on vision, and in a secondary space. It aims at communicating, educating and persuading audiences by using visual elements such as images, graphics, and video. Effective visual communication design can create a more powerful impact by combining words with visual elements. In practice, visual communication design differs from general graphic design due to its focus on conveying messages and ideas through visual media. As time progresses, traditional graphic design is gradually being replaced by visual communication design, which continues to develop in multiple directions. The importance of visual communication design has increased significantly in recent years due to advancements in technology, changes in consumer behaviors, and the need for businesses to stand out in a crowded market. Due to the development of artificial intelligence technology, we process visual content in different ways. Based on artificial intelligence and automation technology, marketers and companies leverage their advantages to quickly and effectively analyze large amounts of data, identify insightful information, and enhance decision-making. Visual communication is crucial as it enables nonverbal communication between individuals. In addition, it can easily provide a strong first impression, convey feelings, and retain reactions. Visual effects can become a useful tool for maintaining order and building harmonious relationships and trust. In conclusion, visual communication design is an essential component of

modern communication that requires creativity, innovation, and expertise in visual media.

The value and meaning of visual communication lies in its ability to promote both the product and the message in an effective and engaging manner. Through visual media, such as images, videos, and graphics, visual communication design can effectively communicate information, knowledge, and culture to audiences. In today's new media environment, visual communication design has become a crucial part of human culture development and is considered an indispensable tool for businesses and organizations to connect with their target audience. Visual communication design can be categorized into various types, including font design, packaging design, display design, logo design, and poster design (as Figure 1).

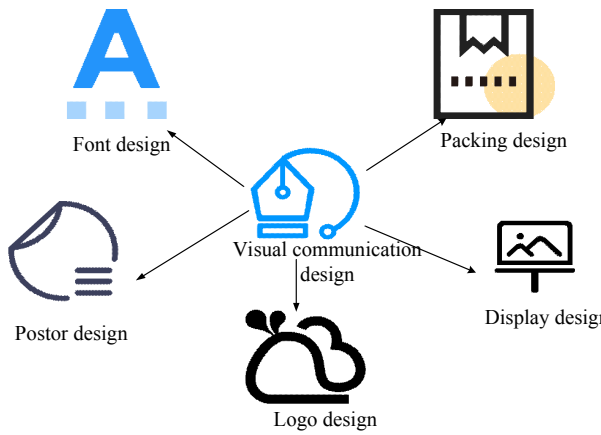


Figure 1. Classification of visual communication design

Among them, font design involves the creation of unique fonts and typography that help effectively communicating the message or brand identity. Packaging design focuses on creating visually appealing and functional packaging for products that can attract consumers. Display design involves the design of retail store displays, exhibition stands, and other marketing materials that showcase products and services in an engaging and compelling way. Logo design is a critical aspect of visual communication design as it is the face of a brand or organization. The logo must effectively convey the brand's identity, values, and message in a memorable and recognizable manner. Finally, poster design involves the creation of visually stunning and impactful posters that can effectively promote products, services, or events. Each type of visual communication design requires unique skills and expertise to create designs that effectively communicate the intended message and engage with the target audience.

2.2 Visual Communication Design Features

This article analyzes the characteristics of visual communication design from three aspects: components, expression forms, and functions. The constituent elements of visual communication design refer to a form of conveying information through symbols, graphics, or colors.

A. Components. The structure of images is the most fundamental unit of visual communication design, used to organize visual information in a way that is easy for the audience to perceive. The use of space is also essential in visual communication design. The positioning within an image is another important element of visual expression, and the center point is usually placed in the most eye-catching or prominent area of the composition. Form is another important component of visual communication design, showcasing various features and evoking emotional associations for certain images or concepts. The use of symbols further enhances the communication ability of visual imagery, making it easier for the audience to understand and remember the conveyed meaning. The law of formal beauty is an important principle that governs the creation of aesthetically pleasing visual designs [15]. In summary, each of these constituent elements plays an important role in creating powerful and effective visual communication designs.

B. Form of Expression. There are many forms of expression of visual communication design, such as text, graphics, colors, images, etc. Text is the main means of information transmission, which is created and formed by human thinking. Image: It is one of the most important expressive arts in visual form, and also the most important means of expression. Symbol: The symbol in the visual form represents the psychological process of people's understanding and understanding of things. Words: Language and writing are used as the main carrier to transmit information. Graphics: Visual information communication design is to use graphics to carry out publicity, education and other activities. Pattern: It refers to a visual symbol system formed by expressing information in different forms, with specific artistic effect and aesthetic feeling. Color: It is used to convey feelings, aesthetic concepts, social culture and other spiritual contents, including red, yellow and blue. Location concept (also known as space concept): In visual communication design, it refers to the perception ability and perception mode formed by people using different orientations and angles, as well as the results and psychological changes and processes generated when they understand and evaluate the surrounding environment and things [16].

C. Function. Visual communication design serves as an important way of exchanging information in modern society. Its main purpose is to transmit information to the public through specific forms of expression, while simultaneously expressing its own unique style and characteristics to guide public opinion. As such, visual communication design plays a significant role in shaping the beliefs, attitudes, and behaviors of audiences.

In addition to its role in shaping public opinion, visual communication design also serves a number of functional purposes. For example, it facilitates communication between businesses and consumers, guiding and influencing consumer behavior towards specific products. It also helps to meet social demand for product diversity and personalization, promoting corporate and product images through a unified form and function. By serving business objectives, visual communication design can help to achieve larger sales and greater profits for companies.

Overall, visual communication design plays a critical role in the modern economy as a driver of business success and a tool for shaping public perceptions. By leveraging the power of visual imagery and communication, businesses can create compelling marketing campaigns that resonate with audiences and drive sales growth.

3 OVERVIEW AND STATUS QUO OF COLOR BALANCE

3.1 Color Balance Overview

Color balance is an essential problem in the area of color research. From many aspects of color, the balance between various colors can be studied. All the colors that can be seen in life are composed of red, green and blue. Therefore, color is actually composed of these three colors. For human vision, red, orange and yellow correspond to the three color senses in the retina. Red corresponds to the red light from red eyes. Orange corresponds to the orange light from orange yellow eyes. Yellow corresponds to the yellow light from the yellow green eyes. When people observe objects, their eyes receive red, orange and yellow colors, and their brains match them with white or colorless colors. This is the "primary color principle" in the color composition theory. The principle of primary color is widely used in life, such as in advertising and packaging design, which can make people have a strong visual effect. At the same time, the application of primary color principle in industrial design can also play a role in highlighting the design focus and characteristics.

3.2 Current Status of Color Balance Algorithm

Color balance is a critical aspect of visual communication design in multimedia image processing, playing a vital role in ensuring that images convey the intended message and emotion effectively. Current color balance algorithms primarily focus on adjusting hues, luminance, and saturation to mimic human visual perception, enhancing the overall visual quality of images. These algorithms, including the Wallis filter, histogram matching, and covariance balance methods, aim to standardize color representation across various images, ensuring consistency and coherence in visual communication.

In the context of multimedia image visual communication design, color balance algorithms are essential for creating images that are both appealing and accurate in color representation. They adjust the color properties of an image to achieve a more natural and visually pleasing appearance, crucial for engaging the audience and conveying the desired message. However, these algorithms must account for the diversity in image content, color spaces, and intended use within various media formats to be truly effective.

Despite their capabilities, current color balance methods face limitations, particularly when dealing with images of varying content and color schemes. They may not always capture the subtleties of different color spaces or accommodate the unique requirements of specific image types, such as those with high contrast or vibrant colors. Moreover, many color balance techniques require manual intervention, necessitating a skilled operator to fine-tune the adjustments for optimal results.

To enhance the role of color balance algorithms in multimedia visual communication design, future developments should focus on creating more adaptive and intelligent systems. These advanced algorithms should be capable of automatically analyzing and adjusting images based on their content, context, and the communicative goals of the media project. By doing so, they will ensure that images in multimedia applications are not only aesthetically pleasing but also accurately reflect the intended message, thereby enhancing the effectiveness of visual communication in various digital and print media.

4 CURRENT SITUATION OF MULTIMEDIA IMAGES

Multimedia is a collection of various information formed in people's life and production. With the continuous growth and application of computer technology, the conversion and generation of multimedia information are completed by computer information processing technology. Multimedia data is realized by modularization, which is stored in the computer system in the form of coding. The formats of various multimedia information are also different. Therefore, they should be converted to the same format for combination and analysis. In addition, due to the different space occupied by various information, some multimedia formats occupy too much storage space. Therefore, in order to facilitate its storage and processing, digital compression technology is needed. Information processing is a digital process. With the advancement of information technology, the degree of multimedia digitization is also improving, and digital processing technology is more widely used. With the growth of digital technology, multimedia image processing technology has received more and more attention. The digital application of multimedia means such as text and audio is more and more extensive, and the image processing technology is also constantly developing and applying. At present, the digitization of multimedia image processing technology is mainly aimed at protecting images. It can solve the problem of label display and handle hidden labels.

In summary, multimedia refers to a medium of human-computer interactive information exchange and communication that combines two or more forms of media. It provides a dynamic and engaging means of presenting information and ideas to audiences through the use of text, graphics, audio, video, and animation. The applications of multimedia are diverse and include education, advertising, entertainment, and communication. Multimedia can be developed and created using a wide range of tools and software applications such as Photoshop, After Effects, Premiere, and Audition, which are excellent tools for multimedia design and creation. With these tools, designers and creators can manipulate various media elements, such as images, videos, and sounds, to create visually stunning and compelling multimedia presentations.

In the field of multimedia image analysis, the visual communication design and color balance algorithms employed exhibit significant differences and advancements compared to traditional visual communication design methods. Firstly, while traditional visual communication design focuses on artistic creation and intuitive expression, visual communication design applied in multimedia environments emphasizes the importance of data-driven processes and user interaction. This approach means that the design process is not just about creating visually appealing images but optimizing the effectiveness and attractiveness of information transmission through an in-depth analysis of user behaviors and preferences.

Secondly, the application of color balance algorithms in multimedia image analysis goes beyond simple color adjustments or corrections. Modern algorithms integrate advanced image processing technologies and artificial intelligence to automatically recognize and analyze image content, intelligently adjusting colors based on specific application contexts and target audiences. This method enhances the visual quality of images and ensures the accuracy and impact of information transmission, meeting the expectations and needs of a multimedia-era audience.

Furthermore, visual communication design in multimedia image analysis actively incorporates knowledge from interdisciplinary fields, such as cognitive psychology, information technology, and interaction design, to more comprehensively understand and meet user needs. This interdisciplinary integration not only expands the boundaries of design but also enhances the innovation and practicality of design solutions.

In summary, visual communication design and color balance algorithms applied in multimedia image analysis place greater emphasis on data analysis and user experience, utilizing advanced technologies to achieve more intelligent and dynamic visual communication, accommodating the complex demands of today's multimedia information society.

5 APPLICATION OF MULTIMEDIA IMAGES IN VISUAL COMMUNICATION DESIGN

In modern society, multimedia design has become increasingly important in the dissemination of information and the communication of ideas. This is achieved

primarily through the composition and layout of visual elements such as text, images, and videos, which are carefully designed to convey a message or idea to the audience. The primary goal of multimedia design is to create a maximum visual impact and to effectively communicate information to the intended audience [17].

In creating multimedia designs, it is essential to adhere to the general rules of public vision, as well as the characteristics and requirements of psychological, physiological, and other levels. For example, comparison and unity: Public vision needs to pay attention to both details and the whole to form a unified and contrasting visual effect. Repetition and Diversity: Public vision needs to seek diversity and change in repetition to form a unified visual style. Whole and part: Public vision needs to connect the parts with the whole to form a coordinated and aesthetically pleasing visual effect. Rhythm and balance: Public vision needs to grasp rhythm and balance in order to form a dynamic and stable visual effect. Adaptation and guidance: The public's visual needs need to adapt to different scenes and needs, while also guiding the audience's gaze and attention.This requires a comprehensive understanding of how visual elements can be coordinated to create a cohesive and meaningful message. By carefully considering these factors, designers can ensure that their multimedia designs meet the needs of information dissemination and visual communication.With the emergence of social media, visual communication design has undergone significant innovation and improvement. Social media platforms provide new opportunities for multimedia designers to connect with audiences and to distribute their work globally. Moreover, social media enables multimedia designs to be shared and viewed instantly, making it easier to reach a wider audience than ever before.

This article explores the visual communication design process of multimedia images from four aspects: visual communication design, efficient color balance algorithm, electronic imaging technology, and multimedia image processing platform. The structure is shown in Figure 2.

Multimedia enables computers to process the most direct and universal information in human life, thereby greatly expanding the application fields and functions of computers. With the acceleration of social informatization, especially the global trend of using "information highways" that has emerged in recent years, the development and application prospects of multimedia will be even broader. The development trend of multimedia image technology is as follows:

1. Distributed and networked collaborative multi coal systems: In the current form, cable television networks, communication networks, and the Internet are becoming increasingly unified. Various multi coal systems, especially network-based multimedia systems, such as video phone systems, on-demand systems, e-commerce, remote teaching, and healthcare, will develop rapidly. A multi-point distributed, network connected, and collaborative information resource environment is becoming increasingly perfect and mature.
2. The three electrical appliances (telecommunications, computers, and electrical appliances) will be integrated and integrated through multimedia digital tech-

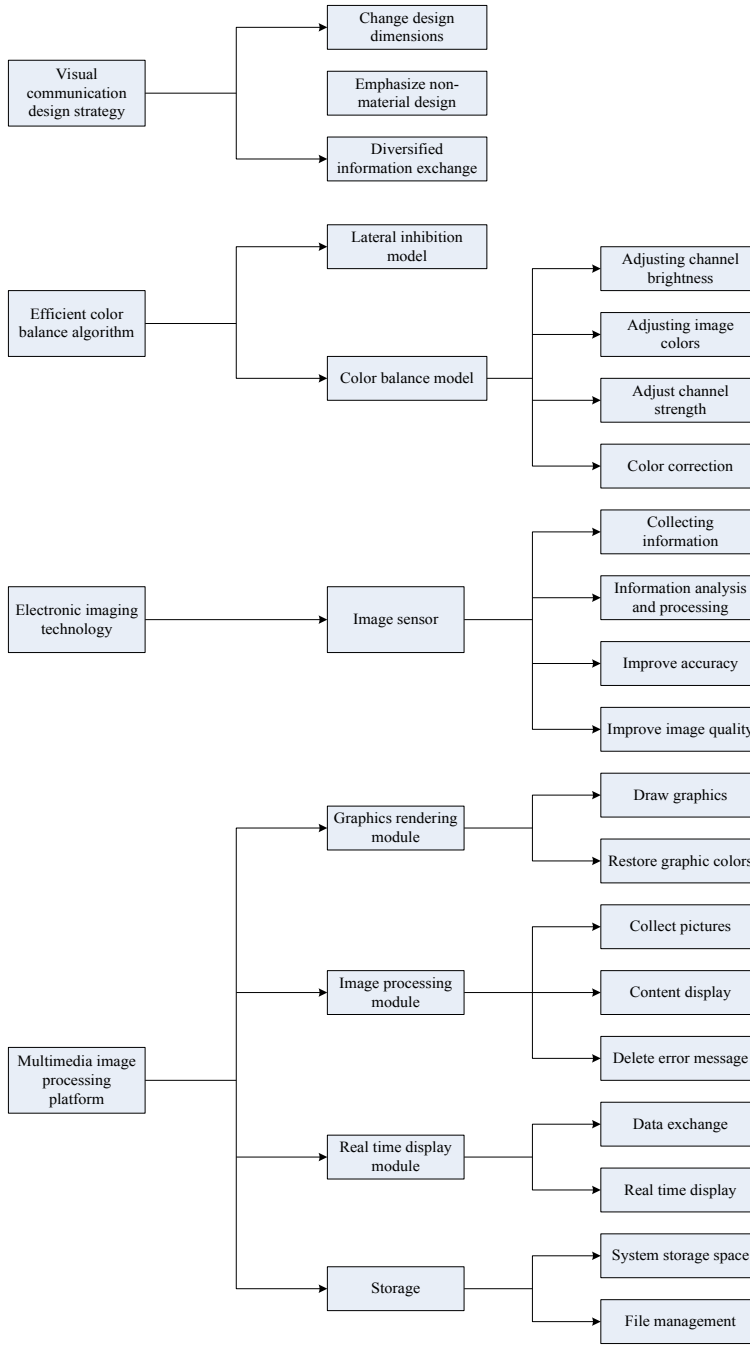


Figure 2. Visual communication design process of multimedia images

nology. The further development of multimedia technology will fully reflect the characteristics of multi field applications. Various multimedia technology means will not only be tools for scientific research work but also tools for production management and ways of life entertainment, such as various materials from Xinsheng Library, reading electronic magazines, consulting with comprehensive information centers, electronic shopping, etc.

5.1 Visual Communication Design Strategy

A. Changing the Design Dimension. From the industrial development perspective, visual communication design encompasses various fields such as posters, books, and corporate images, with graphic design being a subset. In the past, many designers relied on graphic design techniques such as arranging pictures, words, and colors to effectively convey information and attract audience attention.

Over time, however, there has been a need to explore more novel and advanced techniques to replace traditional graphic design methods. The use of three-dimensional and four-dimensional design elements has emerged as an effective alternative to graphic design. By incorporating these new design techniques, designers are able to create designs that are more visually engaging and memorable.

In the past, graphic design alone may not have been enough to capture public attention or effectively communicate ideas. However, the use of three-dimensional and four-dimensional design elements can create a strong sense of introduction, appealing to more people and achieving the desired effect of visual communication. This makes them extremely valuable tools in the visual communication design field.

In summary, while graphic design remains an important component of visual communication design, the emergence of new design techniques and technologies has expanded the tools available to designers. Three-dimensional and four-dimensional design methods offer the potential to create more impactful and memorable designs, making them an increasingly indispensable part of the visual communication design landscape.

B. Attaching Importance to Immaterial Design. In the current era, technology has become increasingly integrated into visual communication design processes. Many design activities now require debugging through computer programs or software in order to enhance efficiency and accelerate the design process. This not only saves time, but also expands the potential design space, providing designers with greater creative freedom.

In the past, visual communication design relied primarily on physical materials such as paper, ink, and other tangible media. However, the rise of immaterial design has revolutionized the field, opening up new possibilities for expression and

creativity. Immaterial design encompasses a wide range of digital and virtual design elements, including animations, interactive interfaces, and even augmented or virtual reality experiences.

By incorporating immaterial design elements into the broader visual communication design process, designers can create more expressive and impactful visual imagery. This can help to elevate the overall aesthetic quality of designs and promote enhanced engagement with audiences. Furthermore, by leveraging the power of immaterial design, designers can also drive material design innovation and inspire new approaches to product development and branding.

Overall, the integration of immaterial design into visual communication design is driving significant innovation within the field, leading to more dynamic and engaging designs that capture the imagination of audiences and drive business success. As such, it represents a major development trend that is poised to transform the way we think about design and its impact on society.

C. Diversification of Information Exchange. In the past, the information interaction platform industry was largely independent and fragmented, with limited regional scope and a small pool of participants. This resulted in a highly localized and monopolistic market, with little competition or innovation.

However, as technology has continued to evolve and improve, the interactive platform has become increasingly sophisticated. Visual communication design has also become more transparent, with designers leveraging a wide range of media technologies to seek out new ideas and inspiration. This has allowed for greater creativity and innovation in the field, while also breaking down barriers that previously limited access to design resources and knowledge.

One of the key benefits of this shift towards a more open and competitive design landscape is that it reduces reliance on copying and imitation. With a wider range of design tools and resources available, designers are better equipped to create original and distinctive visual imagery, which helps to drive differentiation and brand recognition.

Overall, the evolution of the interactive platform industry has facilitated significant improvements in visual communication design, enabling greater creativity and innovation across the field. As the industry continues to mature and expand, we can expect to see even more breakthroughs and advancements in the years ahead, further enhancing the role of visual communication as a powerful tool for driving business success and shaping public perceptions.

5.2 Efficient Color Balance Algorithm Application

A. Lateral Inhibition Model. Lateral inhibition is a crucial mechanism in neural signal processing that helps to enhance the quality and accuracy of sensory information. When a neuron is stimulated by a particular signal, such as a visual

cue, it sends inhibitory signals to surrounding photoreceptors in order to eliminate redundant information and enhance differential information. This process is known as lateral inhibition.

By selectively inhibiting the activity of surrounding neurons, lateral inhibition helps to sharpen the focus and clarity of sensory information, improving feature extraction ability and regional contrast. This is particularly important in visual processing, where the ability to identify and distinguish between objects is critical.

At the edge of an object, lateral inhibition can help to deepen the contour and improve recognition. This is achieved through the mutual inhibition between neurons, which enhances the contrast between the object and its surroundings.

Interestingly, the strength of lateral inhibition diminishes with increasing distance from the target point. This means that pixels located closer to the target point will have a greater impact on the target point, with their weight following a Gaussian distribution.

Overall, lateral inhibition is a fundamental component of neural signal processing, enabling more effective and efficient communication within the nervous system. By eliminating redundancy and enhancing differentiation, lateral inhibition helps to optimize sensory information and enhance the accuracy of our perceptions.

It is assumed that the two input grayscale values are m_1 and m_2, and:

$$m_2 = \gamma m_1, \quad 0 < \gamma < 1. \tag{1}$$

Grayscale values n_1 and n_2 are output as:

$$\begin{cases} n_1 = m_1 - \omega m_2, \\ n_2 = m_2 - \omega m_1, \end{cases} \quad 0 < \omega < 1. \tag{2}$$

Input contrast is represented by m_1/m_2, and output contrast is represented by n_1/n_2. According to Formulas (1) and (2), it can be obtained:

$$\frac{\frac{m_1}{m_2}}{\frac{n_1}{n_2}} = \frac{\frac{m_1}{\gamma m_1}}{\frac{m_1 - \omega m_2}{m_2 - \omega m_1}}. \tag{3}$$

From the statement provided, it is evident that the non-periodic side inhibition network is an effective means of enhancing visual contrast. This network likely operates alongside other image processing systems to achieve this result. The mathematical model used to implement the non-circulating side inhibition is presented in Formula (4), which might involve the use of complex algorithms and parameters to achieve the desired outcome.

$$g_a = \sum_{a=1}^{n} l_{ab} c_a. \tag{4}$$

Among them, g_a represents the output brightness value. c_a indicates input brightness value. l_{ab} represents an inhibitory factor. The processing of the side suppression network can be seen as the convolution operation of the template:

$$A'_u(a) = A_u(a) \otimes L(a,b). \tag{5}$$

In the formula, $A'_u(a)$ is the brightness value after its side suppression processing. $A_u(a)$ is the initial brightness value of the processed point a. $\otimes$ is a convolution operation. $L(a,b)$ is the matrix of lateral inhibition factors. It is extended to two-dimensional image processing:

$$A'_u(a) = A_u(a) - l_{fs}\left[\sum_{f=-2}^{2}\sum_{s=-2}^{2} A_u(m_f, n_s) - A_u(a)\right]. \tag{6}$$

In the formula, m_f and n_s are the surrounding coordinates. l_{fs} is the lateral inhibition factor matrix at point a and peripheral points.

B. Color Balance Model. In the process of capturing and processing digital images, various factors can contribute to color inconsistency. These factors include the imaging mode selected, specific parameter settings such as white balance and ISO, the duration of exposure time, and the camera angle relative to the subject and light source. Additionally, environmental lighting conditions and the inherent color profiles of different capturing devices can also affect color consistency. Variations in software processing algorithms and the color management systems used in editing software can further influence the consistency of colors in the final image output.

One approach to studying color inconsistency is through the use of a quadratic function to represent the image conversion function R. This function describes the change in gray level before and after color balance, taking into account the various factors that can impact color accuracy.

$$R(Q) = vQ^2 + eQ + b. \tag{7}$$

Specifically, the variable Q is defined as the gray level of the entire image. The other variables mentioned are second-order coefficients (v), first-order coefficients (e), and constant terms (b). When Q is defined as the gray level of overlapping areas, each overlapping relationship has a relationship expressed by Formula (8).

$$v_i Q_{ij}^2 + e_i Q_{ij} + b_i = v_j Q_{ji}^2 + e_j Q_{ji} + b_j. \tag{8}$$

Among them, subscripts i and j represent image sequences respectively. Q_{ij} is the gray overlapping area of image i and image j on image i. Q_{ji} is the gray overlapping area of image i and image j on image j.

Because of the existence of error, the error formula can be listed as Formula (9).

$$w_{ij} = \left(v_i Q_{ij}^2 + e_i Q_{ij} + b_i\right) - \left(v_j Q_{ji}^2 + e_j Q_{ji} + b_j\right). \tag{9}$$

The transform coefficients v, e and b are used to calibrate the image as a whole, so as to obtain the final color balanced image.

This article ultimately selects the color balance model as the main model for research. The color balance model is a method used to adjust or change the color balance in an image. Through the color balance model, the brightness of the red, green and blue channels can be adjusted in the image, thus affecting the color performance of the image. It plays an important role in photography and image processing. Firstly, color balance can be used to control the color distribution of an image, achieving the effect of color balance. In the process of adjusting color balance, it usually involves adjusting the RGB color space or CMYK color space. RGB color space is a commonly used color space that can change the color of an image by adjusting the intensity of each channel. The CMYK color space is composed of four channels: cyan, magenta, yellow, and black. By adjusting the intensity of each channel, the color of the image can be changed. In addition, the color balance model can also be used for color correction. It is a process of modifying and adjusting the color of an image, which can correct color deviation, enhance the contrast and saturation of the image, and change the overall color tone of the image. In summary, color balance models are very important tools in photography and image processing, as they can be used to control the color distribution of images, perform color correction, and so on.

5.3 Application of Electronic Imaging Technology

Electronic imaging is a process of creating images through the use of photoelectric methods that rely on changes in the electromagnetic characteristics of materials. This process can be predominantly physical, such as using sensors to capture light and convert it into electrical signals that can then be used to produce an image. However, it can also involve chemical processes, such as those used in traditional photography where light-sensitive chemicals react with light to produce an image [18].

The electronic imaging process involves capturing light or other radiation using an imaging sensor such as a camera or scanner. The sensor converts the light into electrical signals by utilizing a semiconductor material such as a CCD (Charge-Coupled Device) or CMOS (Complementary Metal-Oxide-Semiconductor) sensor. These signals are then processed and translated into a digital image by a computer or other electronic device.

Electronic imaging is widely used in various fields, including medicine, art, astronomy, and engineering. In medicine, electronic imaging is used for medical diagnosis, such as in X-rays, CT scans, and MRI scans. In art, electronic imaging plays a significant role in image editing and manipulation, as well as in printing techniques such as giclée printing. In astronomy, electronic imaging allows us to capture stunning images of distant galaxies and stars.

Electronic imaging systems are widely used in many fields. Electronic imaging technology is used to analyze multimedia images and design visual communication. When selecting electronic imaging technology, in addition to combining their own actual needs, attention must also be paid to select appropriate imaging systems. First of all, different types of images have different imaging characteristics and requirements, so the software selected for classification according to different types of images must be able to meet the requirements of electronic imaging systems. Secondly, the image is obtained through the sensor and transmitted to the display to form an image. Therefore, in order to obtain these information effectively, the collected information must be analyzed and processed, and then a more comprehensive and accurate understanding of these information can be obtained. In the design, the acquisition equipment, sensors and other aspects must be considered whether they can meet the requirements for accuracy and speed in the process of image acquisition and display. Thirdly, the electronic imaging system often has large noise and fuzzy image in the actual operation process. In order to avoid these situations, special filtering circuits must be added to the imaging system to eliminate noise, so as to better ensure the image quality [19].

During the application of multimedia image processing system software, the purpose of its application should be defined first, and then the entire computer system should be set according to this purpose. The application of electronic imaging technology can promote the development of visual communication design under multimedia image analysis. In conclusion, electronic imaging is a crucial technological innovation that has enabled us to create and manipulate images with incredible precision and clarity. Whether it is for medical diagnosis, artistic expression, or scientific discovery, electronic imaging has revolutionized the way we see and understand the world around us. Its applications are vast, and its potential for further development and innovation is virtually limitless.

5.4 Construction of Multimedia Image Processing Platform

The rapid growth of science and technology has led to the widespread use of digital technology in various aspects of social life. As a result, image processing technology has become an increasingly important area of focus. Digital image processing technology is currently utilized in various industries such as medical diagnosis, remote sensing, robotics, and more.

Despite its many applications, there are still numerous challenges and limitations that exist with digital image processing technology. One significant hurdle is the software and hardware requirements necessary to effectively use this technology. These include the need for specialized software programs, high-end computer systems, and advanced imaging equipment. As a result, many organizations and individuals may not have access to the necessary tools and resources to fully utilize digital image processing technology. There are also concerns related to the ethical use of digital image processing technology. Issues such as privacy, data security,

and algorithmic bias must be considered and addressed in order to ensure that this technology is used in a responsible and equitable manner.

In conclusion, while digital image processing technology has many potential benefits and applications, it is not without its challenges and limitations. Addressing these challenges will require continued investment and research in the field, as well as a concerted effort to ensure that this technology is used ethically and responsibly.

Based on this background, this paper designs a multimedia image processing platform, which is based on the innovation and enhancement of mobile application visual communication design of social network interaction interface design. The platform is mainly composed of four parts: graphics rendering module, image processing module, real-time display module and storage space. The graphics rendering module is the core part of multimedia image processing. There are mainly two aspects to the requirements of graphics rendering. The first is to simply and accurately represent the graph to be drawn. The second is to restore the color of the drawn graphics. The image processing module can be divided into three aspects. The first is to simply and accurately calculate the collected pictures. The second is to control the display of the content displayed in the picture. The third is to delete the error information in the picture. The real-time display module mainly includes two aspects. The first is to realize the data exchange with the image library software. The second is to achieve the real-time display function on the screen. Storage space is mainly composed of two parts: system storage space and file management. This paper proposes a multimedia image processing platform. Various resources and technologies provided by the system platform are used to develop a multimedia image processing platform with high operating efficiency and strong scalability, which provides convenient conditions for the use of visual communication design.

6 EXPERIMENTS RELATED TO MULTIMEDIA IMAGE PROCESSING

Color temperature balance is a crucial element in determining the overall quality of an image's color balance, referring to the equilibrium between warm and cool colors within an image. Inaccurate color temperature balance can render images unnatural or distorted, thus, ensuring precise color representation and optimal balance is vital for creating high-quality images. To address this, the article introduces an advanced color balance algorithm that proficiently assesses and corrects the color balance of images. This algorithm not only increases the luminance range for uniform distribution and reduces contrast but also amends specific flaws in the image, enhancing clarity and detail. It operates by integrating lower-frequency luminance levels with adjacent ones, thereby broadening the luminance interval and minimizing the number of levels to achieve a more consistent distribution and reduced contrast. The process involves statistical analysis of the image histogram, followed by applying the core principles of equalization to balance the distribution probability across various

luminance levels, resulting in a 256-level brightness mapping table. Finally, the image undergoes brightness mapping processing.

Expanding on this, the proposed color balance algorithm incorporates innovative techniques to dynamically adjust color temperature based on contextual analysis, ensuring that the adjustments are content-aware and maintain the natural aesthetics of the image. This method employs machine learning to analyze the image context, identify predominant color themes, and apply targeted adjustments to achieve a harmonious color balance. The algorithm also features an adaptive module that fine-tunes the color balance settings based on the specific genre of the image, whether it is a landscape, portrait, or urban scene, providing tailored optimization that respects the unique characteristics and intended mood of each image. Through these enhancements, the algorithm offers a nuanced approach to color correction, enabling more sophisticated and accurate control over image aesthetics, significantly contributing to the field of digital image processing and improving the visual impact of multimedia content.

To test the effectiveness of the proposed algorithm, three ordinary images with different color temperature attributes have been selected from the same angle. These images include a low color temperature image (C1), a normal color temperature image (C2), and a high color temperature image (C3). Figure 3 shows these experimental images, as well as the experimental image used to evaluate the effect of the algorithm. Through this experimental setup, the proposed algorithm has demonstrated its ability to accurately evaluate the color balance of images with varying color temperature attributes.

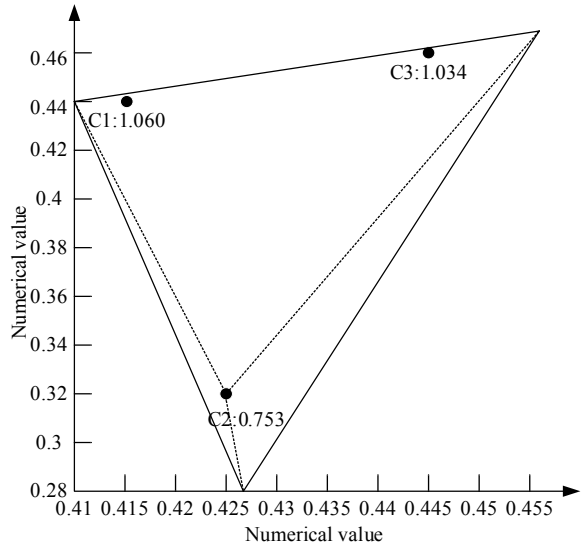


Figure 3. Color temperature experiment image and evaluation effect experiment image

It can be learned from Figure 3 that the evaluation value of C2 is the lowest, indicating that the normal color temperature has the highest color balance. The evaluation value of C1 and C3 is higher than the evaluation value of C2, indicating that low or high image color temperature reduces the color balance. This result accords with the human visual perception and achieves the effect of color balance evaluation.

Pictures and videos have become more and more important as information carriers. Therefore, the evaluation of image quality has become a broad and basic problem. To verify that the use method of multimedia images in visual communication design and color balance algorithm proposed in this paper can improve image quality, image clarity and noise frequency are selected to evaluate image quality from the objective evaluation. In Figure 3, we demonstrate the effectiveness of our proposed color balance algorithm through an experimental comparison of three distinct color temperature images, labeled as C1, C2, and C3, representing low, normal, and high color temperatures, respectively. These images serve as a testament to the critical role of color temperature balance in the realm of multimedia image processing and visual communication design. By applying our advanced color balance algorithm, we aim to showcase the nuanced improvements in image quality and color fidelity. The experimental results depicted in this figure are instrumental in validating our algorithm's capability to discern and adjust the color balance, thereby enhancing the overall visual aesthetics and communicative power of the images. This comparative analysis not only underscores the algorithm's effectiveness but also emphasizes its potential applications in enhancing the clarity, detail, and emotional impact of multimedia content, crucial for effective visual communication in various digital media platforms.

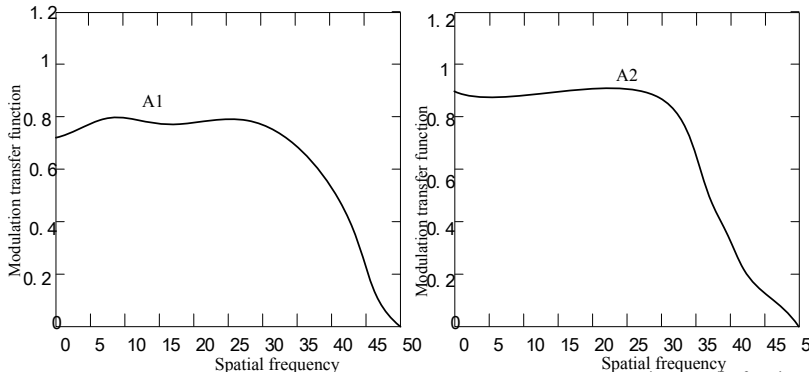
In the experiment of image definition, the clarity of general image A1 and image A2 under the method proposed in this article are selected for comparison. Figure 4 shows the MTF (Modulation Transfer Function) space comparison transfer function diagram. The larger the MTF, the better the imaging quality of the system.

It can be learned from Figure 4 that the spatial comparison transfer function value of image A2 in Figure 4 b) is about 0.9, while the spatial comparison transfer function value of image A1 in Figure 4 a) is about 0.8. Therefore, A2 has better image quality than A1.

In the experiment of image noise frequency, the noise frequency of general image B1 and image B2 under the method proposed in this paper are selected for comparison. Figure 5 is the noise frequency comparison chart. The higher the noise frequency, the better the picture quality.

It can be learned from Figure 5 that the noise frequency of image B2 in Figure 5 b) is higher than that of image B1 in Figure 5 a). Therefore, B2 has better image quality than B1.

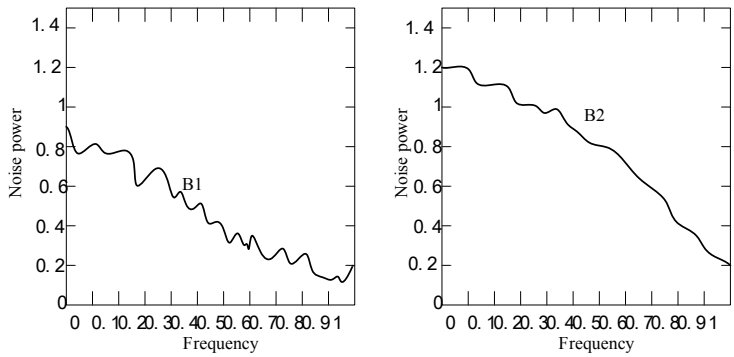
To finally verify the application of visual communication design and color balance under multimedia image analysis proposed in this paper, which can improve the visual effect of images, from a subjective perspective, the visual effect of general visual design image 1 and visual design image 2 under this method are selected



a) Image A1 space comparison transfer function diagram

b) Image AI space comparison transfer function diagram

Figure 4. Spatial comparison transfer function diagram



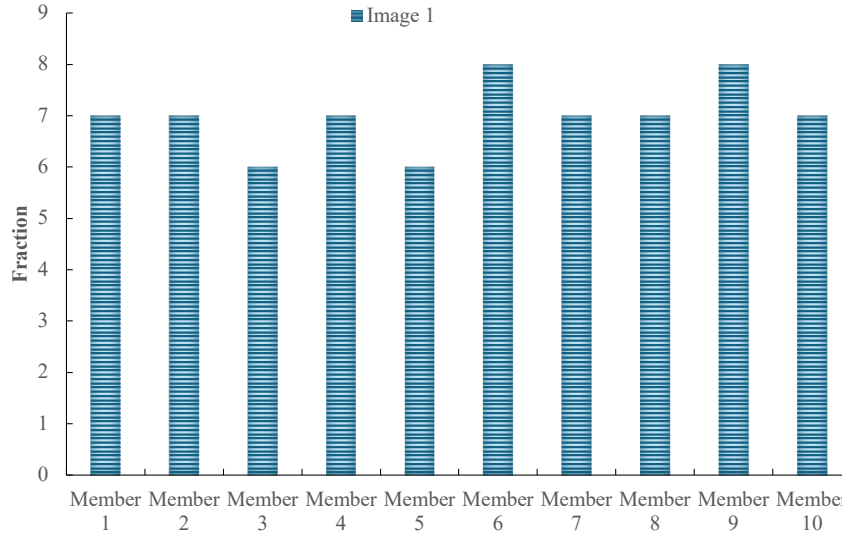
a) Comparison Diagram of Noise Frequency of Image B1

b) Comparison Diagram of Noise Frequency of Image B2

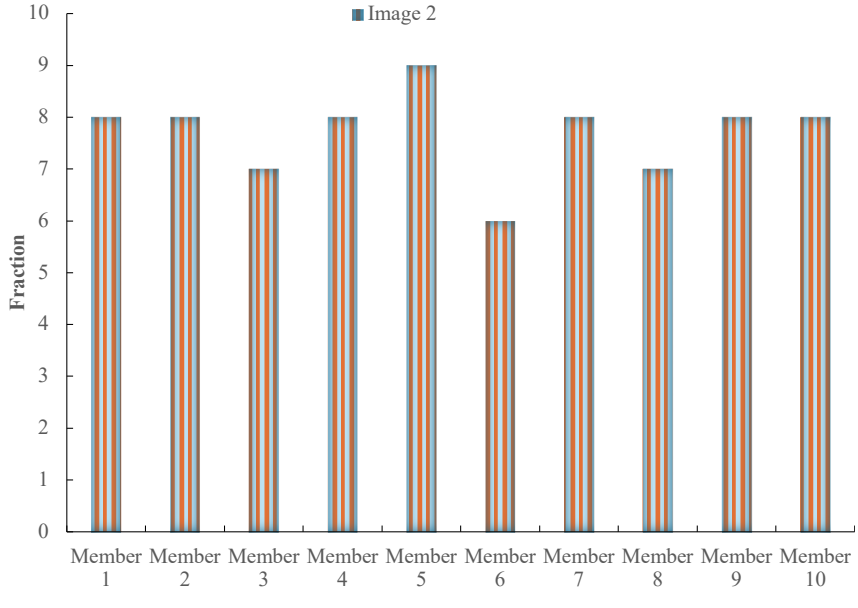
Figure 5. Noise frequency comparison

for comparison. Figure 6 shows the visual effects of the two images scored by the personnel of 10 visual communication design related disciplines.

It can be learned from Figure 6 that the average visual effect score of image 1 in Figure 6 a) is 6, and the average visual effect score of image 2 in Figure 6 b) is 7.7. Therefore, the visual effect score ratio of image 2 is 10 % higher than that of image 1. It can be learned that the application of visual communication design and color balance under multimedia image analysis proposed in this paper can improve the visual effect of images.



a) Image 1 rating chart



b) Image 2 rating chart

Figure 6. Comparison of visual effect scores

7 CONCLUSIONS

This article summarizes methods of visual communication design. It elaborates on several key concepts within visual communication design, particularly in the context of multimedia image analysis, and applies these to the current research work. The paper provides a detailed analysis of the concepts and features of visual communication design, the research overview and current state of color balance, and the concepts and status of multimedia images. Based on this analysis, it proposes application methods for visual communication design under multimedia image conditions and conducts relevant experimental research. It has been demonstrated that the application of visual communication design and color balance in multimedia image analysis proposed in this article can improve the visual effects of images. The solutions presented are effective in enhancing the outcomes of visual communication design, showing strong practicality and operability. Despite the positive results achieved with the proposed color balance algorithm and visual communication design methods in multimedia image analysis, there are some limitations in the experimental process: the algorithm primarily focuses on color temperature balance and does not fully address other key visual elements of images, such as saturation and luminance optimization. Future research directions should aim to expand the applicability of the algorithm to a broader range of image types and complex scenarios, thereby improving its universality and effectiveness; they should also consider integrating more dimensions of the image quality assessment criteria, such as texture, detail retention, and noise control to achieve more comprehensive improvements in the image quality.

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