RESEARCH ARTICLE

Sustainable visual communication art design from the perspective of big data and artificial intelligence

Bin Wang*

School of digital creativity and design, Henan Polytechnic, Zhengzhou, Henan, China.

Received: September 17, 2024; **accepted:** December 8, 2024.

People concentrate on their own feelings throughout the cognitive process and actualize their understanding of the environment by evaluating the data provided by their visual sense. Human lives are constantly surrounded by design, which transforms lives. By integrating visual communication design (VCD) and artificial intelligence (AI), this research primarily addressed the issue of visual discomfort. The features of visual illusion art were first examined, which explained that visual illusion was used in contemporary design, and the way it affected design worked using instances from prevalent works. Further, the study combined fundamental principles of visual impressions to identify the components and forms of visual impressions and the numerous visual illusions that occurred in daily lives. Three factors including a web page, a mobile device, and conventional media were used as the foundation of this study to examine the visual discomfort affecting contemporary designs for visual communication (VC). The results showed that visual design was efficiently created using artificial intelligence technologies and big data, creating a foundation for higher-quality design results. This research highlighted the connection between visual discomfort and graphical effects and offered suggestions to advance the logical concept of striking a balance between visual comfort and design.

Keywords: visual communication design (VCD); art design; high quality design; graphical effects; visual comfort.

***Corresponding author:** Bin Wang, School of digital creativity and design, Henan Polytechnic, Zhengzhou, Henan, 450046, China. Email: congcongw1982@126.com.

Introduction

People first perceive the world through their own eyes. Illusions are a unique visual experience. When people become the target of visual illusions, they unconsciously forget a certain psychological connection. For this reason, the senses are greatly stimulated. If you observe carefully, visual illusions can be seen everywhere in daily life, which is not difficult to explore [1]. To illustrate the application of illusion in visual communication design (VCD), scientists introduce the characteristics of illusion art that uses famous works as examples to show the application of visual illusion in modern design and their influence on design works [2, 3]. In addition, the core ideas of imagery are incorporated to pinpoint the elements, categories, and a range of real-world examples. The purpose of artificial intelligence (AI) is to make synthetic systems, such as computers, intelligent. The field of AI has gradually evolved around this goal and has developed various sub-technologies. It has been well known that there is a "dialogue" between humans and machines. In addition, computers will "recognize and respond" to humans [4]. AI advancements have improved machine learning algorithms and hardware processing capacity, leading to visual illusions in design. These illusions challenge viewers' psychological and visual prejudices, benefiting cognitive function, psychological health, and visual fatigue [5, 6]. Optical illusions are commonly used in virtual reality to enhance audience experience and improve visual communication [7], which can develop original visual arts thinking skills and reduce errors. Fosco *et al*. explored the use of optical illusions in VCD, providing a foundation for imaginative visual graphics design. By addressing uniformity issues and providing customized quality, these illusions enhanced expressive value and could be used in real life [8]. Huo *et al*. proposed a strategy for generating poster patterns based on state transition network (STN + LeNet + A-softmax). A trainee and a generator were both components of the outline composition process. The learner eventually realized the detection and localization of the pattern composition elements to construct the initial outline template after learning to categorize the pattern composition elements using STN [9]. Ji *et al*. employed VCD to keep customers feeling emotionally connected to their purchases for as long as possible with the hope of providing advice that would increase product longevity and decrease material use [10]. The research from Gou *et al*. focused on expanding the visual communication's infrastructure through increased familiarity with 3D-based picture technology [11]. The results analyzed how a computer-picture-based image-communication network might be laid out in the future. VCD's purpose is to increase brand awareness by attracting more customers and making things more appealing and imaginative [12]. Although the use of AI technology in the field of multimedia is still relatively new, they has already completed significant strides with products like intelligent voice speakers and multimedia players.

The study on the psychological impacts and interactions of visual materials on individuals has been studied along with fundamental techniques and general guidelines for applying interactive multimedia in visual communication artwork against a background of the Internet [13]. Pitt *et al*. found that visual scene displays (VSDs) could assist the success of alternative and augmented communication (AAC) for children and people with complicated communication needs [14]. Static VSDs include images that are contextual and depict significant people, places, and events. Previous study looked at how VCD, flexibility in layout, a variety of transmission methods, interactivity in integration, and resistance to the innovative thinking related to visual expression design and information technology [15]. Ackermann *et al*. concentrated on the viewpoint of weak road users, specifically pedestrians, in scenarios where automated cars were present to assess various human-machine interfaces (HMI), aiming to develop easy and comfortable communication. When automated vehicles served as the engagement partner, tried-and-true communication techniques like eye contact between drivers and pedestrians might no longer be effective [16]. Viswanathan *et al*. described a complete picture of the communication needs and technology that would exist in the 6G era [17]. The development of virtual twin worlds, which properly mirrored the experiences in every instant of space and time, would enable people to integrate human interactions in the practical, biological, and digital realms. Kumar *et al*. proposed a strong solution for protecting digital video [18]. By inserting the encoded watermark in the featured video frames, logarithmic bit shifts based reversible data concealing were accomplished. To achieve privacy for the watermark symbol, highly protected watermarks were hidden using histogram bit shifting. Further, a study investigated the uses of flexible VCD in a digital media context [19]. To serve as a study resource for different dynamic design domains, this work explored the fundamental design components application form of word in dynamic visual communication. This study examined the visual communication dynamics in digital media technology, analyzing key design components for unique design applications. Luo proposed a program focusing on the combination after exploring current teaching practices. The study focused on the coordinated development of the artistic and technical aptitude training principles and combined the material of "visual + tech,", altering the standard plane course [20]. Liu *et al*. discussed BC technology, the associated IV theory, and the BC-generated big data IV design approach. In addition, this study thoughtfully suggested the big data visual internet service provider (ISP), thoroughly addressed the issue of user experience, and evaluated the system's performance [21]. The results supported the idea that the proposed data-oriented visual ISP's overall color scheme and structure were more reasonable, obvious, and intuitive compared to the existing BC platform interface, which could help people learn it much faster and improve their overall user experience. In addition, the scientist suggested using a big amount of data to determine whether the plan was feasible [22]. More studies on how to include visual communication architecture into the teaching process were necessary to address the limitations of AI and big data for visual communication art design from the related works.

A visual standard is established by a designer following data collection and analysis on communicators, communications content, channel media, users, and anticipated impacts. It is necessary to decide on the design process. Designers are given a structure for their work and acquire these structures *via* prior education and professional experience. Designers know exactly what design methods to use for a certain design result when they are making it, such as making a digital poster or a packaging box. They each have a suitable design structure, and even posters have various design structures. Big data can be used for better understanding behavior, preferences, and cultural context, reducing time and cost. This study aimed to minimize the environment impact of visual communication by leveraging data and AI to reduce waste and encourage eco-friendly practice through the application of proposed Deep Art Adversarial Network (DAAN) method to test visual communication art design examples on the CIFAR-10 dataset. With the technical support of the art generative adversarial network for visual art design creation, the number of visual design samples was increased, sufficient samples were provided for visual relay design, and the construction of the visual image dataset was completed. The limitations of the current visual art design dataset were also examined. After analyzing a few AI generative design patterns, an effort was made to incorporate pertinent data-driven techniques into the design process, modifying and improving the initial design elements to investigate the potential for certain intelligent working patterns. This system suggested method and considered the subject's perspective to create optical illusion pictures, which evaluated ambiguity and inventiveness, improving parameter settings.

Materials and methods

Technical assistance for VCD

A neural network (NN) intelligent system that can store and reason on previously acquired knowledge, automatically update project examples, and make use of its associative power to make well-thought-out, integrated suggestions to designers was built to directly provide several visual elements needed for massive activities with big data analysis. A certain level of professional project area expertise was necessary to produce visual designs in addition to knowledge in the visual domain. With ongoing learning, it might achieve the fundamental element system knowledge structure and the “application element system” needed for the visual identification. Also, it suggested to designers for appropriate application project solutions based on the requirements of the project sector. Access to various data including structural diagrams and categorization kinds would be available to developers. The estimation of sigmoid was shown below.

$$f(x) = \frac{1}{(1+e^{-x})} \quad (1)$$

The sigmoid function's value was near 0 when x was tiny, while the sigmoid value was near to 1 when x was large. To make the input value of the subsequent layer fell within a predetermined range and increased the stability of the weight, the sigmoid function converted the continuous real number into a range of (0,1). The exponential operation e^{-x} was contained in the sigmoid function as follows.

$$f(x) = \frac{(e^x - e^{-x})}{(e^x + e^{-x})} \quad (2)$$

The exponential operation in e^{-x} ranged as [-1, 1], while x was 0 centered in equation 2. Rectified linear unit (ReLU) activation function was widely used in neural networks, particularly CNNs, and was typically a suitable first choice. When x grew large, the slope was linear if it was not plateau or "saturate". It was not affected by the vanishing gradient issue that other activation functions experienced. It was just partially activated and took less time to train the data in visual art design. Any given unit was likely to not activate at all if ReLU was zero for all negative inputs. The estimation of ReLU was shown below.

$$f_n(x) = \max(0, x) \quad (3)$$

Permeable ReLU (PReLU) was a sophisticated variant and had the highest accuracy compared to the classic ReLU and leaky ReLU activation functions, which could be used to further enhance neural network performance. The pReLU parameters were maintained constant because the system was not used to train ReLU DNNs to prevent them from influencing the other parameters in the first epoch. The estimation of PreLU was expressed as follows.

$$f(|x|) = \max(\chi|x|, |x|) \quad (4)$$

The averaged activation function level inside the hidden units could be determined by employing the equation 5.

$$\lambda \leftarrow \frac{1}{m} \sum x_i \quad (5)$$

The normalization formula for the minimum and maximum values to extract the feature representation was shown in equation 6.

$$x \leftarrow \frac{x - \mu}{\sqrt{\alpha + \pi}} \quad (6)$$

Visual development

The NN contained information that had been translated from the design stages into a form that might be understood by artificial neural network (ANN) layers. Generally, practitioners of basic AI technology were unable to digitally capture the behavior of design development. Therefore, the training of machine learning required the assistance of designers or technicians. For a machine to learn a certain design framework, it requires a matching agent for that structure as well as a library of supplementary design elements. The first iterations of the visual design scheme were completed with minimal human involvement beyond approving or rejecting previous iterations' results, which might also facilitate the rapid actualization of a wide range of visually simplistic design ideas, and not only increased design productivity but also provided opportunities to enhance the quality of designs. AI technology could be linked to the assistance provided to designers at the first phase of the production of the most fundamental visual design during the preceding basic design cycle. If the initial phase process was finished, the designer might go on to the second and make more alterations and revisions to the entire model. Given the assumption of the provided data and generator G to get two outputs from the discriminator D, the generator G in an adversarial network was shown in equations 7 and 8 below.

$$f(D) = alog(D) + blog(1 - D) \quad (7)$$

$$\frac{df(D)}{dD} = a \times \frac{1}{D} - b \times \frac{1}{1 - D} \quad (8)$$

The GAN's optimization behavior was constructed in equation 9.

$$V(G, D) = E_{x-p} logD(x) + E_{x-p} \log(1 - D(x)) \quad (9)$$

Then, it employed the technique of introducing penalty items rather than weight reduction for its optimization as follows.

$$W(P,G) = \max\{E[D(x)] = E_{x-p}[D(x) - \lambda \int \max\big(0, D(x)\big)\, dx]\} \quad (10)$$

Decision enhancement

Due to AI's relatively low degree of intelligence, it is currently unable to fully replace humans in the creation of key decision-making, and humans are still required to make significant judgments. Although AI can create some degree of decision-making, the designer will still be the one to make the ultimate choice. The designer must go through two sessions of design process following choosing and generating the finalized basic visual scheme to make creative changes and minute alterations to the complete basic scheme. Thus, intelligent technology can make simple decisions, while designer's decisions make things better. There are two major and auxiliary modes of cooperation. The designer's judgment, the primary one, is supported by technical judgment as below.

$$Gaussian\ pyramid\ G(I) = [I_0, I_1, I_2, \dots I_K] \quad (11)$$

The K level selected in the Laplacian pyramid represented the number of layers of the minimum spatial pixel that appeared in the last level as shown in equation 12.

$$h_k = I_k \quad (12)$$

By taking the difference between $g(I)$ neighbouring levels k in the Gaussian pyramid and upsampling the smaller one so that the sizes were consistent, the coefficients at h_k each level of the Laplacian pyramid were created in equation 13.

$$h_k = I_k(I) = g(I) - u\big(g(I)\big) \quad (13)$$

Each level intuitively depicted the visual structure that existed at a specific scale. The Laplacian pyramid's h_k last level was a low-frequency residual equivalent to the last Gaussian pyramid level rather than a difference image. The Laplacian pyramid was used to reconstruct the image as follows.

$$I_u = u(I_{u+1}) + h_k \quad (14)$$

$$f(x,z) = D(x) + m - f\big(x, D(x)\big) \quad (15)$$

Put otherwise, the study began at the coarsest level and proceeded to the full-resolution image by repeatedly upsampling and adding the difference image h at the next finer level. Reducing the reconstruction error of the actual picture and bringing the error measure of the recovered image near to a fixed value were both effects of auto-encoder fitting to the discriminator paradigm.

Proposed approach

AI-based art creation from unpredictability and autonomy of the attribute game based on the concept of AI art. As the operational core, it used a Deep Artistic Adversarial Network (DAAN). The system also took the subject's perspective into account in addition to these factors. The ambiguity and inventiveness of the created optical illusion pictures were evaluated and was supplied back to the AI to improve parameter settings and finally resulted in AI art pictures that created the optical illusions of the topic. The presentation format used by the AI art system was depicted in Figure 1. To get two outputs from the discriminator D, the generator G in a deep artistic adversarial network first sent out one signal that was a multi-tasking attempt at three goals including to create fresh works, not break any ground by departing too far from the expected distribution and broadening the scope of artistic ambiguity in contemporary works. The article's basic framework of the deep artistic adversarial network was shown in Figure 2. The discriminator D and the generator G were two networks inside the deep artistic adversarial network that counterbalanced one another. A dataset of human artwork was available to discriminator D. No current picture could be accessed by Generator G, which differed from

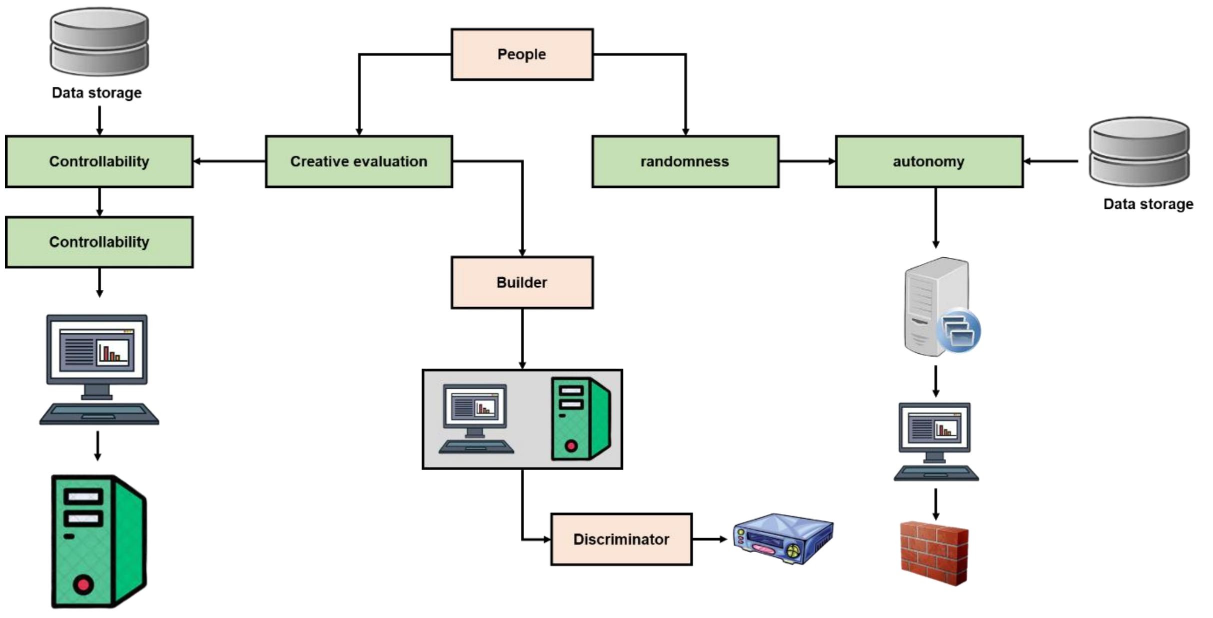


Figure 1. AI-based art format.

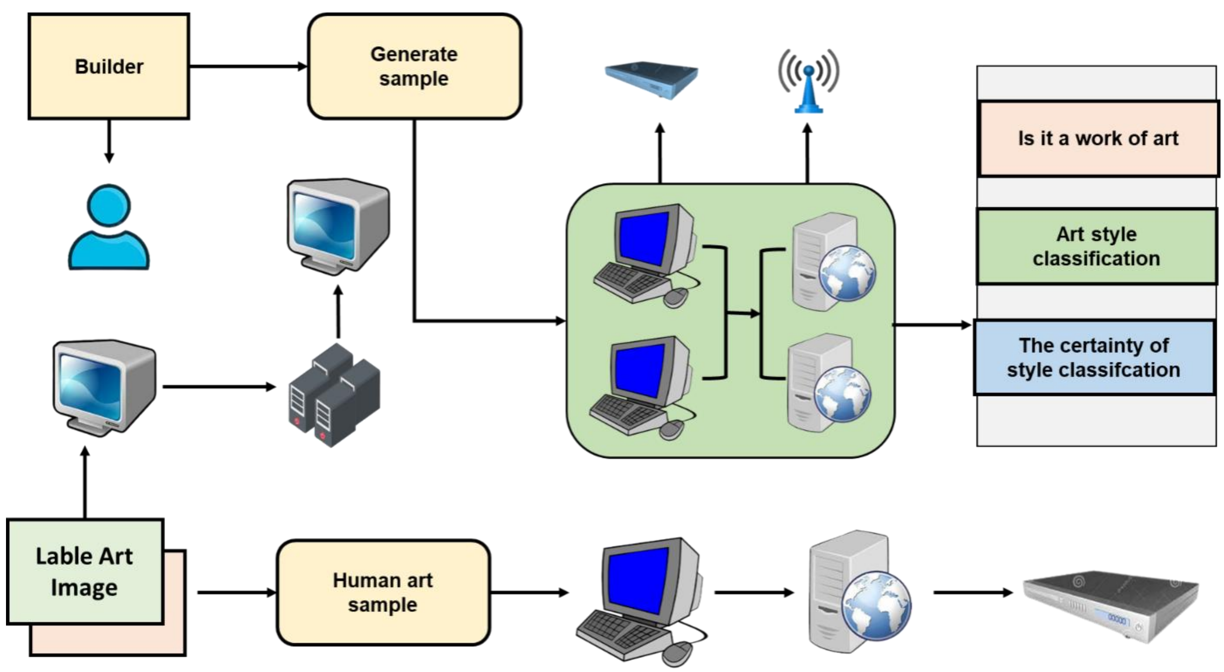


Figure 2. Proposed framework.

generative adversarial networks in that it created fresh pictures beginning with random inputs. Discriminator sent out two inputs including the decision of the classification question "is it a work of art" and the decision of the classification question "what sort of arts". Entropy was represented by the red curve, while the inversion of the uniformly distributed cross-entropy was shown by the blue curve. Each of the algorithms had the highest value whenever the classes were balanced. The inverting cross-entropy tended to be infinitesimal at the border as opposed to the entropy zeroing there. Hence, even when classification properly, there were too many penalties. It was necessary to build a “loss function” to produce style uncertainty, which made it possible for the generator G to produce pictures while increasing their entropy. The maximum operation in this phase was equivalently modified in this research to minimalize the mean distributions of the cross-entropy after the reductions to simplify the procedure. When the probability that the produced picture would be identified as belonging to a certain creative style exceeded a predetermined threshold, over penalization was carried out using cross-entropy to avoid fitting problem and outliers. In comparison, the loss function would grow quickly if the probability of beginning the categorization of the produced picture was too high, which produced a fitting span that was excessively wide, potentially beyond the ideal fit. As a result, it was required to recast the loss function with new competitive goals as below.

$$min_G max_G V(D,G) = E[logD(x) + logD_c] + E[logD_r(x) + D_c] \quad (16)$$

It captured the latent space's noisy data and separated it. Image A was produced by generator G utilizing noisy data. If the created picture A was determined to be "art" using the discriminator D, the program proceeded. For the created picture A, "artistic style identification" was carried out. When "Art Identification Uncertainty" exceeded the limit, it kept going. According to the identification outcome, the discriminator D was upgraded. The contour feature of picture A was extracted, and the intermediate layer A’ was generated, which made picture B of the intended item. In this study, a round-robin training method was used to retrain the generator G and discriminator D. When the classifier had been trained to a specific number of times, it trained the generation for a predetermined quantity of instances. The greatest discriminator would have been produced as follows.

$$D1(x) = \frac{p(x)}{p_1(x)+p_2(x)} \quad (17)$$

KL deviations were expressed below.

$$KL\left(\frac{p_1}{p_2}\right) = Elog\left(\frac{p_1}{p_2}\right) \quad (18)$$

KS deviations were expressed as follows.

$$JS(p_1p_2) = \frac{1}{2}KL\left(p_1\frac{p_1+p_2}{2}\right) \quad (19)$$

$$JP = 2JS(p_1p_2) - 2log3 \quad (20)$$

Whenever the discriminator was optimal, the generator's goal was equivalent to increase the JS difference between distributions of input data and output data.

When the vector of the generated image was gathered within every tier of the deep net method, the vector communicated by the core of the NN's field of view was generated at every specified phase and learning level, which narrowed the transreflective display spectrum down to [0, 255] after determining which color option most accurately represented the original image's contour details. To make the contour characteristics clearer and easier to understand, additional noise data were normalized. CIFAR-10 dataset, a collection of images that are commonly used to train machine learning and computer vision algorithms, from Canadian Institute for Advanced Research (Toronto, Canada) was employed for this study to analyze the performance of proposed method, which contained 60,000 32 x 32 color images in 10 different classes including airplanes, cars, birds, cats, deer, dogs, frogs, horses, ships, and trucks with 6,000 images of each class. A group of volunteers was recruited to review the images of this study. The proposed method was compared with the existing methods including genetic algorithm technology (GAT) [23], fuzzy cuckoo search optimization (FCSO) [24], and sine cosine algorithm with teaching learning-based optimization algorithm (SCA-TLBO) [25]. The performance of the proposed system, deep artistic adversarial network (DAAN), was evaluated in terms of accuracy, precision, recall, F1 score, and root mean squared error (RMSE).

Results and discussion

The outlined features of a leaf were depicted in Figure 3. Thirteen out of thirty-one participants of this study had the impression that the image was computer-generated, which indicated that these individuals had an innate ability to differentiate between the visual and pre-existing human works of art. Generative Adversarial Networks (GANs), an assumption in discussions about originality in art, are not supported by the images. Nevertheless, 18 participants believed the image was created by humans, indicating that the produced image used in this study was successful in fooling 60% of its viewers (Figure 4A). The deception rates for the DAAN and the standard GAN were 53% and 35%, respectively (Figure 4B). The results revealed that the illusion image producing method used in this research had a greater capability in promoting creativity in the created images than previous techniques prior optimization.

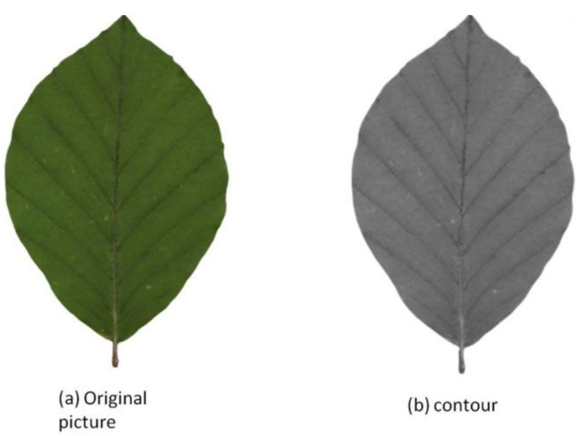
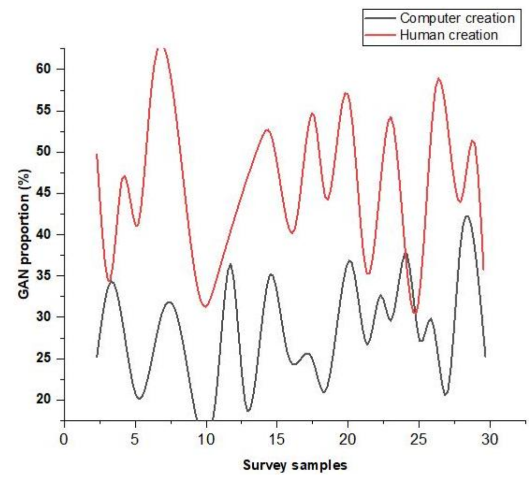


Figure 3. Output for leaf's outline features.

Accuracy is the frequency with which a classifier's predictions correspond to the actual value of a label. A percentage of correct assessments in relation to the entire number of tests may also be used to express it. The accuracy comparison between the proposed and existing approaches showed that the proposed method was more accurate than the existing methods (Figure 5) with the accuracies of 77%, 85%, 64% and 96% for GAT, FCSO, SCA-TYLBO, and DAAN, respectively.

A.



B.

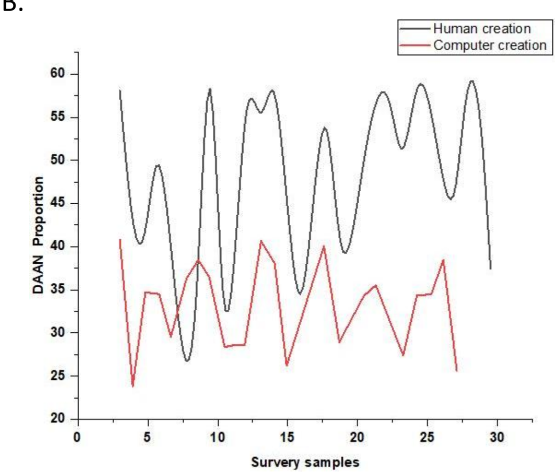


Figure 4. Outcomes of GAN proportion (A) and DAAN proportion.

Precision is defined as the ratio of classified instances cases to all instances of predicatively positive reports and is one of the most important measures for accuracy. An evaluation of precision between proposed and existing approaches showed that the precisions of GAT, FCSO, SCA-TYLBO were 89%, 87%, and 85%,

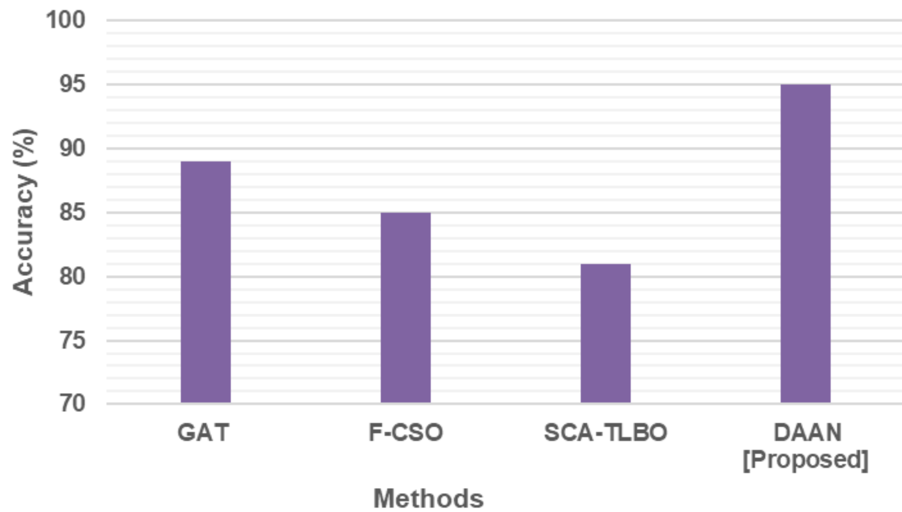


Figure 5. Comparison results of accuracies among the different methods.

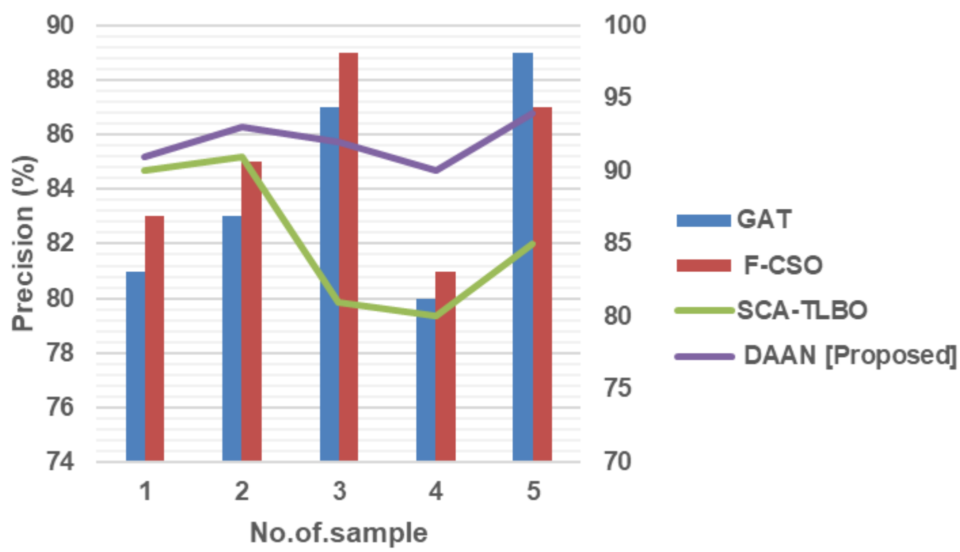


Figure 6. Comparison results of precisions among the different methods.

respectively, while the precision of DAAN was 94% (Figure 6). The results confirmed that the proposed method was greater than the existing methods.

Recall is a measure of how many occurrences the classifier correctly classified as positive to establish completeness. A comparison of the recalls for the proposed and existing approaches showed that the recalls of DAAN, GAT, FCSO, and SCA-TLBO were 94%, 80%, 87%, and 83%, respectively (Figure 7). The results demonstrated a higher recall of proposed method than that of other existing methods.

By averaging recall and precision, the F1 Score was determined. The proportion of incorrect results and false negatives was calculated. The F1 scores for GAT, FCSO, and SCA-TLBO were 90%, 87%, and 80%, respectively, while F1 score for DAAN was 95.5% (Figure 8), indicating the high performance of proposed method.

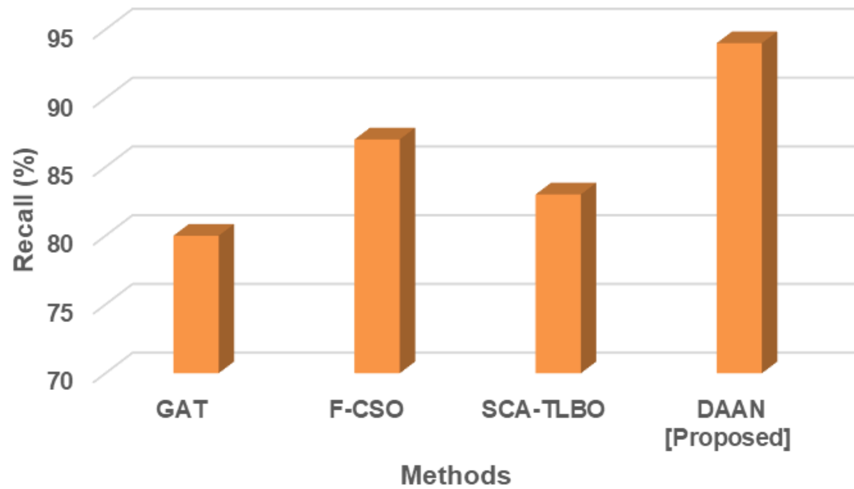


Figure 7. Comparison results of recalls among the different methods.

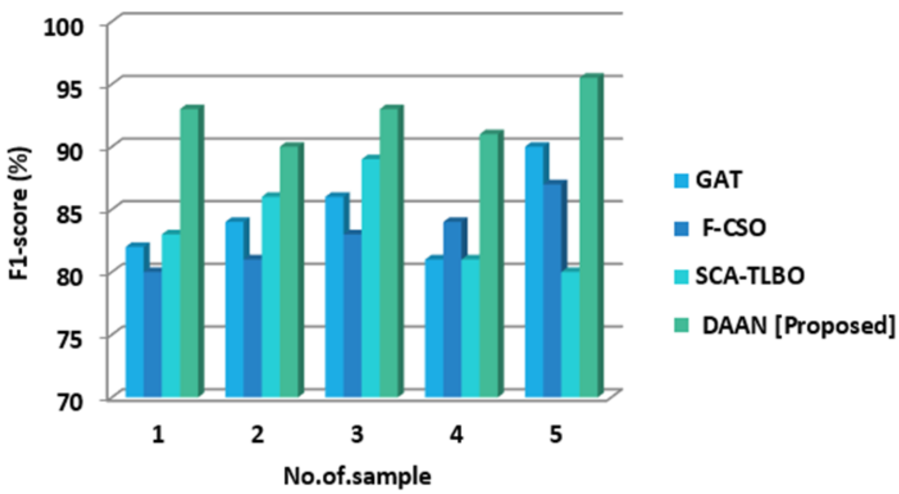


Figure 8. Comparison results of F1-scores among the different methods.

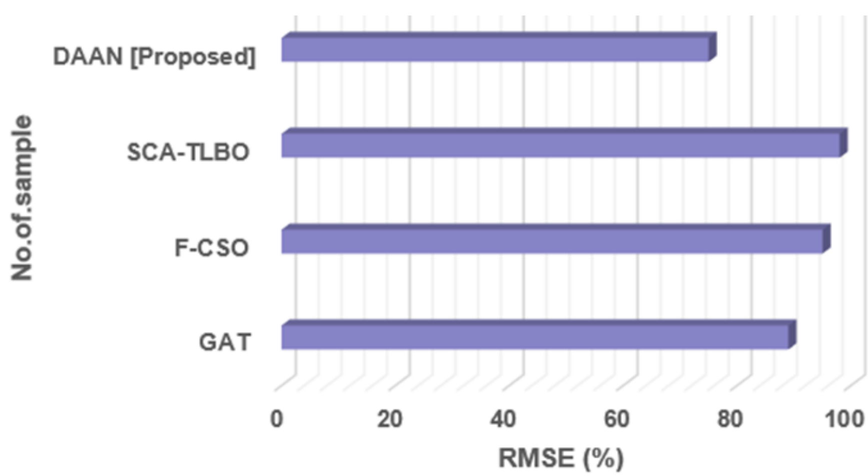


Figure 9. Comparison results of RMSEs among the different methods.

RMSE was obtained by comparing the results of the proposed and conventional methods and showed that RMSE of DAAN was inferior to that of GAT, FCSO, and SCA-TLBO (Figure 9).

Conclusion

In this study, big data and AI technologies were effectively used to develop visual design, laying the groundwork for higher-quality design outcomes. This research was built around three components including a web page, a mobile device, and traditional media to examine the visual discomfort affecting contemporary designs for visual communication (VC). This study showed that graphical effects and visual discomfort were related and offered guiding recommendations to lessen visual discomfort in VCD for the most relaxing visual experience. The results confirmed that AI was the sole method of stress alleviation. Future studies will be more focused on the investigation of more methods.

References

1. Xin T, Ye HY. 2018. The application of visual illusion in the visual communication design. In IOP Conference Series: Materials Science and Engineering. 317(1):012050.
2. Liu J, Zheng S. 2022. Research on design innovation systems in computer big data visual communication. International Conference on Electronics and Devices, Computational Science (ICEDCS). 2022:328-332.
3. Furini M, Gaggi O, Mirri S, Montangero M, Pelle E, Poggi F, *et al*. 2022. Digital twins and artificial intelligence: As pillars of personalized learning models. Commun ACM. 65(4):98-104.
4. Kehayov M, Holder L, Koch V. 2022. Application of artificial intelligence technology in the manufacturing process and purchasing and supply management. Procedia Computer Science. 200:1209-1217.
5. Han Z, Zhao J. 2022. Computer digital technology combined with dynamic visual communication sensors in target tracking with big data. Math Probl Eng. 2022(2):6713007.
6. Zhao J, Guo L, Li Y. 2022. Application of digital twin combined with artificial intelligence and 5G technology in the art design of digital museums. Wirel Commun Mob Comput. 2022:8214514.
7. Zheng J, Liu Q. 2021. Design of 3D scene visual communication modeling based on virtual reality graphics rendering framework. In Journal of Physics: Conference Series. 1982(1):012183.
8. Fosco C, Casser V, Bedi AK, O'Donovan P, Hertzmann A, Bylinskii Z. 2020. Predicting visual importance across graphic design types. In Proceedings of the 33rd Annual ACM Symposium on User Interface Software and Technology. 2020:249-260.
9. Huo H, Wang F. 2022. A study of artificial intelligence-based poster layout design in visual communication. Sci Program. 2022:1191073.
10. Ji S, Lin PS. 2022. Aesthetics of sustainability: research on the design strategies for emotionally durable visual communication design. Sustainability. 14(8):4649.
11. Gou S, Mei L. 2023. Design of 3D image visual communication system based on computer image technology. In Machine Learning, Image Processing, Network Security and Data Sciences (MIND 2022). 2023:170-177.
12. Liu C, Ren Z, Liu S. 2021. Using design and graphic design with color research in AI visual media to convey. J Sensors. 2021:8153783.
13. Liu W. 2021. Research on the application of multimedia elements in visual communication art under the Internet background. Mob Inf Syst. 2021:5525648.
14. Pitt KM, McCarthy JW. 2021. What's in a photograph? The perspectives of composition experts on factors impacting visual scene display complexity for augmentative and alternative communication and strategies for improving visual communication. Am J Speech Lang Pathol. 30(5):2080-2097.
15. Moore C. 2023. Celebrity Pastors' designer fashion representations on Instagram: A qualitative star studies analysis applying the sociology of impression management, visual communication, and semiotics. Regent University ProQuest Dissertations & Theses. 2023:29999628.
16. Ackermann C, Beggiato M, Schubert S, Krems JF. 2019. An experimental study to investigate design and assessment criteria: What is important for communication between pedestrians and automated vehicles? Appl Ergon. 75:272-282.
17. Viswanathan H, Mogensen PE. 2020. Communications in the 6G era. IEEE Access 8:57063-57074.
18. Kumar M, Aggarwal J, Rani A, Stephan T, Shankar A, Mirjalili S. 2022. Secure video communication using firefly optimization and visual cryptography. Artif Intell Rev. 55:2997–3017.
19. Hao YW. 2013. Expression methods of visual communication design in multimedia design. Adv Mat Res. 811:293-296.
20. Luo M. 2017. Exploring the practice of visual communication design in the new era based on the view of" Art+ Technology". Asian Journal of Social Science Studies. 2(3):8.
21. Liu GC, Ko CH. 2022. Visual communication design and wireless data transmission technology for blockchain big data information presentation. Wirel Commun Mob Comput. 2022:1380387.
22. Hao X. 2022. Innovation in teaching method using visual communication under the background of big data and artificial intelligence. Mob Inf Syst. 2022:731588.
23. Zhou L, Cho J. 2019. A new method of design based on genetic algorithm analysis of the application of traditional cultural symbols in visual communication design. J Intell Fuzzy Syst. 37(3):3401-3408.
24. Yang Y, Jiao S, Wang W. 2019. Cooperative media control parameter optimization of the integrated mixing and paving

machine based on the fuzzy cuckoo search algorithm. J Vis Commun Image Represent. 63:102591.

25. Nenavath H, Jatoth RK. 2019. Hybrid SCA–TLBO: A novel optimization algorithm for global optimization and visual tracking. Neural Comput Appl. 31:5497-5526.