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ORIGINAL

The Application and challenges of virtual reality technology on modern visual communication design

La aplicación y el desafío de la tecnología de realidad virtual en el diseño de la comunicación visual moderna

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ABSTRACT

Introduction: virtual reality (VR) technology is transforming visual communication design by providing immersive experiences that enhance the production and presentation of visual content. This study explores the application of VR in this field, emphasizing its transformative potential while addressing associated challenges.
Method: we utilized the Golden Eagle Optimized Flexible Bayesian Neural Network (GEO-FBNN) to predict feature distributions, such as element position and color, under specific VR conditions. A dataset comprising high-quality design elements, real-time user interaction patterns, and VR system data was pre-processed for consistency, through min-max normalization and data cleaning. Experiments were conducted using Python 3.8 on Windows 10, ensuring compatibility with VR hardware.
Results: the implementation of a deep learning approach significantly improved the real-time processing capabilities of VR systems. It established connections between visual frames, revealing insights that enhance design accuracy and responsiveness. The findings suggest that deep learning effectively mitigates challenges in VR integration, including motion sickness and navigation ease.
Conclusions: this research provides a comprehensive overview of how deep learning can address the obstacles to incorporating VR in visual communication design. The results indicate not only a reduction in technical challenges but also an increase in creative opportunities, paving the way for a more integrated future of design in virtual environments.

Keywords: Virtual Reality (VR); Visual Communication Design; Golden Eagle Optimized Flexible Bayesian Neural Network (GEO-FBNN); Graphic Design; Visual Frames.

RESUMEN

Introducción: la tecnología de realidad Virtual (VR) está transformando el diseño de comunicación visual al proporcionar experiencias inmersivas que mejoran la producción y presentación de contenido visual. Este estudio explora la aplicación de la RV en este campo, enfatizando su potencial transformador mientras se abordan los desafíos asociados.
Método: utilizamos la red neuronal Flexible bayesiana optimizada para el águila real (GEO-FBNN) para predecir distribuciones de características, tales como la posición del elemento y el color, bajo condiciones VR específicas. Un conjunto de datos que comprende elementos de diseño de alta calidad, patrones de interacción del usuario en tiempo real y datos del sistema VR fue pre-procesado para la consistencia, A través de la normalización min-max y la limpieza de datos. Los experimentos se llevaron a cabo usando Python 3.8 en Windows 10, asegurando la compatibilidad con el hardware VR.

Resultados: la implementación de un enfoque de aprendizaje profundo mejoró significativamente las capacidades de procesamiento en tiempo real de los sistemas VR. Estableció conexiones entre marcos visuales, revelando puntos de vista que mejoran la precisión del diseño y la respuesta. Los hallazgos sugieren que el aprendizaje profundo mitiga efectivamente los desafíos en la integración de la realidad virtual, incluyendo mareos por movimiento y facilidad de navegación.
Conclusiones: esta investigación proporciona una visión general comprensiva de cómo el aprendizaje profundo puede dirigir los obstáculos para incorporar VR en diseño visual de la comunicación. Los resultados indican no sólo una reducción de los retos técnicos, sino también un aumento de las oportunidades creativas, allanando el camino para un futuro más integrado del diseño en entornos virtuales.

Palabras clave: Realidad Virtual (Vr); Diseño de Comunicación Visual; Red Neuronal Bayes Flexible de Optimización Águila Dorada (Geo - Fbnn); Diseño Gráfico; Marco Visual.

INTRODUCTION

Virtual Reality (VR) technology has grown so rapidly, bringing forth an immersive experience that fuses the virtual with the real world. Initially utilized in gaming and entertainment, VR technology is under exploration in sectors such as design, healthcare, and education.[1] In the case of visual communication design, possibilities are quite interesting, where 3D dynamic environments are offered to designers, enabling real-time interaction with and manipulation of design elements.[2] However, despite the opportunities, significant obstacles remain to integrating VR in design work. One major challenge is the current limitations in the real-time processing of most VR systems, which can be limited to user experience.[3] Moreover, VR can cause motion sickness and has accessibility issues, which makes it more difficult for some users to fully engage.[4] These challenges have prevented the massive adoption of VR as a new standard tool in visual communication design.[5] Traditional design methods are mostly based on two-dimensional computer-aided designs, where a designer makes static images on a two-dimensional plane.[6] Although these work well, lacking the interaction and experience that VR delivers.[7] This basic tool also provides no instantaneous feedback on how users will interact with the design, and it becomes difficult for the designers to adapt and make changes promptly.[8]

In an attempt to solve these problems, it proposes a new method, the combination of VR with advanced machine learning methods, such as the GEO-FBNN. This algorithm assists in the prediction of optimal design element placement and improves real-time processing in the context of VR. The idea is to generate a more sensitive and accessible VR system for design systems that would replace the limited functionality of conventional designing methods, where designers work efficiently and with full access in such environments.

Aim of the research: To explore the application of VR technology in visual communication design for immersive environments, increasing real-time interactions by users while addressing challenges of motion sickness, accessibility, and navigation, using strong algorithms to ensure that the design is accurate and adaptive.

The function of creative new media applications in educational institutions' visual communication design was examined.[9] Innovative transformation was necessary since traditional media design does not effectively disseminate information. Research used data analysis and a cross-sectional design. The findings indicate that while creative uses of new media were essential to visual communication, their connection was adversely affected by reluctance to change. The research gives practitioners advice on how to encourage communication techniques in classrooms.

Through the use of deep learning (DL) algorithms, enhanced the design of a visual communication course. It presents Viscom technology, examines DL theory, and uses in the Viscom course.[10] The findings indicate a reduction in satisfaction with theoretical knowledge mastery but a rise in enthusiasm for learning and contentment with mastery of practical knowledge. It offers technical assistance for incorporating Decision Tree (DT) technology into contemporary education and serves as a guide for creating Viscom courses.

A visual communication system based on artificial intelligence (AI) was proposed by Gu et al. to enhance image clarity and magnification in contemporary visual design.[11] The technology performs 20 % better than typical samples, with a maximum deviation of 15 %. It may improve the image impact by resolving chromatic aberration in the optical system and provide notable benefits in graphics transformation. Its inventiveness in visual communication was demonstrated by the system's applicability to current art design.

The Visually Improved Digital Media Communication Framework (VIDMCF), which used DT and VR technologies, was presented by Zhang et al. to enhance information integration in businesses.[12] Real-time decision-making, real-time visualization, and repetitive process optimization were made possible by the framework. The methodology accomplishes connectedness and convergence between the digital environment and the reality atmosphere by implementing real-world components in the virtual design and incorporating virtual reality and digital mirrored twins into the output.

Traditional visual design, such as bookbinding, poster design, product packaging, and logo design, has been profoundly altered by the digital media revolution as examined by Guan[13]. Print media has a major effect on traditional visual design, although network media was aided by digital media technologies. In the era of digital information, China's visual design expertise was still in its infancy and lacked a common standard. In the information era, developing a home visual design expertise requires extensive research.

The potential of virtual reality training in the fields of nuclear, chemical, biological, and radioactive (CBRN) was examined by Regal.[14] Four themes the future of CBRN training, safety, and ethical standards, assessment and feedback, and physical items and tools were highlighted as described the difficulties of VR training in these settings. The research offers perspectives and suggestions for upcoming virtual training.

Nilsson et al. introduced user-centered design (UCD) to the engineering-dominated area of lunar exploration by examining the use of VR to replicate analog investigations in laboratory settings.[15] The initiative used VR to replicate a lunar operations situation and tested it with astronauts and space professionals using the European Large Logistics Lander as a model. The results demonstrate how well VR works to support UCD, make contextual queries more effective, and enhance project team collaboration. Future directions for VR in the construction of lunar systems are proposed.

Key contribution of the research

- Integration of VR and deep learning: The integration of VR technology with deep learning algorithms for enhancing the design of visual communication.
- Use of GEO-FBNN: Introduces the Golden Eagle Optimized Flexible Bayesian Neural Network (GEO-FBNN), which predicts the design features, such as the position and color of elements, in a VR environment.
- Improve design accuracy and responsiveness: Enhance high accuracy and response of designs in real-time systems of VR.
- Addressing VR challenges: Overcomes motion sickness, access, and user-friendliness in the designing of VR.
- Optimize real-time processing: Combining deep learning with the goal of enhancing the real-time processing ability of VR in interactive and immersive design experiences.

The organization is as follows: Section 2 reviews related work on VR in visual communication design, Section 3 outlines the methodology, section 4 presents the performance evaluation, Section 5 provides the discussion of the findings, and Section 6 concludes with key insights and future direction.

METHOD

The methodology uses a dataset of high-quality design elements encompassing elements for VR visual communication designs. The data was pre-processed, including cleaning to handle missing values and normalization using min-max optimization. The accuracy and responsiveness of the VR design are improved through the GEO-FBNN in the estimation of feature distributions. An overview of the investigation of VR design is shown in figure 1.

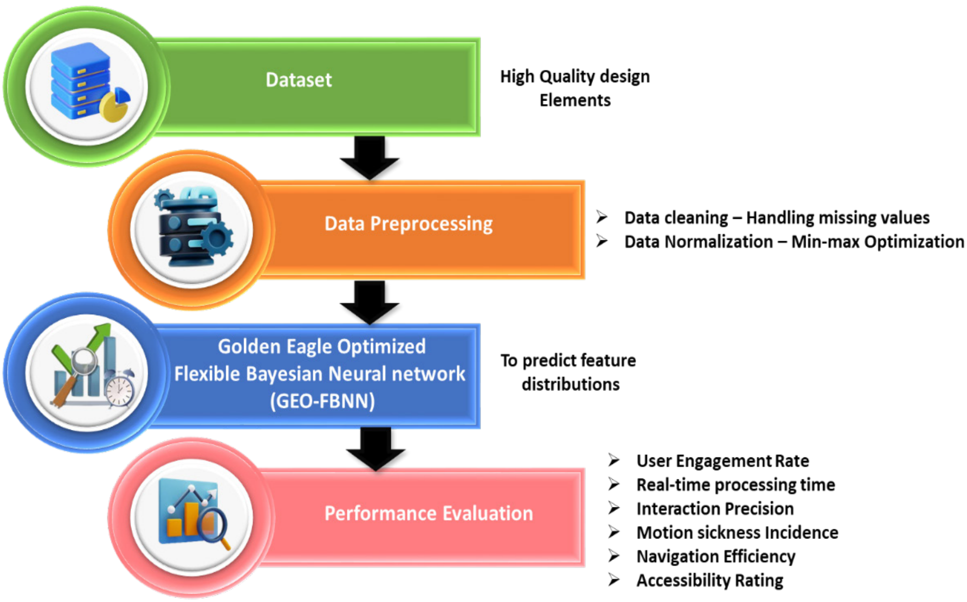

Figure 1. Outline of the VR in Visual Communication Design

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Graphic Design System for Virtual Reality (VR)

The process of using VR technology to create, interact with, and exhibit graphic designs in a 3D immersive environment is known as graphic design system design in VR. Using VR controllers or gestures, designers can directly manipulate design elements like shapes, colors, and layouts in the virtual space, which provides a more intuitive and interactive creative process. This system allows designers to collaborate in real time and enhances visualization and spatial awareness to develop a better comprehension of how their work will function in real space. VR, in graphic design, enhances the creativity of designs, improves the user experience, and offers new prospects for products as well as visual media design with challenges, such as motion sickness and a learning curve.

Data collection

Data [https://www.kaggle.com/datasets/ziya07/visual-communication-design-in-vr/data] was gathered from a VR-based visual communication design system on Kaggle, including observations of user interactions and system performance metrics. Key variables include the user engagement rate, real-time processing time, accuracy of interaction, incidence of motion sickness, navigation efficiency, and accessibility rating. Across different epochs, the dataset provides great insights into both the application as well as challenges of integrating VR technology in modern visual communication design, emphasizing aspects of improvements in user experience, responsiveness, and accessibility.

Data- preprocessing

Data cleaning through handling missing value

It handles missing data so that the designer achieves an immersive experience and accuracy during visual communication with VR. These are missing due to hardware as well as some software issues. The imputation of mean/median, forward fill, or even K-Nearest Neighbors (KNN) addresses the gaps within the data:

- Trivial (1 %): Easily handled using elementary imputation techniques.
- Manageable (1-5 %): It may be imputed with forward or backward fill.
- Complex (5-15 %): Needs advanced techniques, such as KNN or multivariate imputation.
- Extremely Heavy (>15 %): Requires advanced data recovery strategies.

All these require sophisticated missing data techniques to ensure the unbroken integrity of the data for smooth VR operation and high-grade visual design.

Scaling the data using Min-max normalization

Min-max normalization is an optimization of VR systems for visual communication design. It scales parameters latency in a range of [0-1], so that these factors receive uniform treatment, thereby enhancing performance.

$$v' = \frac{v - min_x}{min_x - max_x}(new\_max_x - new\_min_x) + new\_min_x \quad (1)$$

Where v' denotes the normalized value of the VR system parameter (such as latency), and v represents the actual value of the VR system, max_x, and min_A are the maximum and minimum transmission feature values of x. This step ensures optimized performance in terms of critical features such as latency, which may pose a problem in the design of the VR user experience for visual communication.

The Golden Eagle Optimized Flexible Bayesian Neural Network (GEO-FBNN)

The GEO-FBNN is a hybrid model that combines the power of Golden Eagle Optimization and Bayesian Neural Networks. It aids in predicting and optimizing design elements like color, layout, and user interaction patterns in VR environments. The real-time adaptation to VR conditions further improves the GEO-FBNN in terms of accuracy and efficiency for visual communication design, making it easier to handle challenges in user engagement, accessibility, and design precision.

Flexible Bayesian Neural Network (FBNN)

An FBNN model is used to anticipate the consequences of visual communication in VR. The model will include time-related inputs, such as interaction time and session type, environmental inputs including scene complexity and user engagement, and historical interaction data. To increase the accuracy of prediction, use highly correlated historical data vectors instead of continuous or fixed interval data. Measure Pearson and Spearman coefficients for the correlation between historical variables. Pearson correlation coefficients (O) are calculated as (2):

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$$O(N_1, N_2) = \frac{1}{M-1}\sum_{j=1}^{M}\left(\frac{N_{1j}-\mu_{N1}}{\sigma_{N1}}\right)\left(\frac{N_{2j}-\mu_{N2}}{\sigma_{N2}}\right) \quad (2)$$

Where μ_{N1} and σ_{N1} denote the average and standard deviation of N_1, and μ_{N2} and σ_{N2} denote the mean and standard deviation of N_2. This equation shows the correlation coefficient as a function of the covariance of N_1 and N_2, which are the data variables associated with the parameters of VR interaction and design. Spearman correlation coefficient (T) is calculated as (3):

$$T(N_1, N_2) = \frac{\sum_j (N_{1j}-\overline{N_1})(N_{21j}-\overline{N_2})}{\sqrt{\sum_j (N_{1j}-\overline{N_1})^2 (N_{21j}-\overline{N_2})^2}} \quad (3)$$

This model allows more efficient processing with a higher level of prediction accuracy when analyzing how VR applies in modern visual communication design while tackling challenges in the real-time adjustment of the VR environment and providing a smooth experience to users with predictive design trend analytics based on historical interaction data.

Golden Eagle Optimization (GEO)

The "golden eagle" in VR design optimization is the pursuit of the best design solution. Initially, the designers explored a high-level concept (exploration mode) and circled through lots of ideas. If no better solution is found, the current design will be considered the best and shared with others. If there exists a new design that is proven to be optimal, the present solution is rejected, and the search moves on with that new design by iteratively optimizing the solution towards the optimal design of VR.

Mathematical Framework

The golden eagle is a strategic hunter and can scout at high altitudes, make fast decisions, and use cooperative strategies to hunt. These principles can be applied to optimize design in visual communication in VR, hence the need to explore, exploit, and refine virtual environments and user interactions efficiently. Added challenges to a modified GEO framework include real-time interactivity, and the complexity of design in the presence of increasingly dynamic user feedback.

Attack (Exploitation)

In the VR design process, the attack mode may be related to an optimization regarding a previously determined optimal solution, perhaps the best layout for a user interface or the most involving interactive object. An attack vector for the golden eagle might be conceived as an effort to optimize the current VR design solution by fine-tuning texture, lighting, and interactive effects. The golden eagle attack vector for every design iteration may be expressed as follows in equation (4):

$$\vec{B_j} = \vec{W_e} - \vec{W_j} \quad (4)$$

If B_j is an attack vector, W_e is the best position of the VR design solution found so far (global best). W_j is the current position of the golden eagle j, which represents a particular VR design configuration.

Cruise (Exploration)

The cruise mode of VR design involves the explorative search for something innovative in new designs, varying between different structures in layout configuration and interactive designs or 3D models. That allows the designers golden eagles- to enter various alternative structures using different design visuals and the features of interacting models. Exploration is based on random factors that stimulate creativity and new insights. The cruise vector for golden eagle is defined as follows (5):

$$T(N_1, N_2) = \frac{\sum_j (N_{1j}-\overline{N_1})(N_{21j}-\overline{N_2})}{\sqrt{\sum_j (N_{1j}-\overline{N_1})^2 (N_{21j}-\overline{N_2})^2}} \quad (5)$$

Here, N1 and N2 are the design parameters that are related to the color scheme and element position, and the summation refers to the variance or spread of the possible design configurations over a set of design iterations.

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Transition from Exploration to Exploitation

During their early phases, golden eagles use spiral trajectory behaviours, looking for prey in low-attack and high-cruise modes. Later, switching between these modes to strike the best prey. It is essential to comprehend these modes' assault and cruise tendencies to validate them. The following equations (6) and (7) are consider as follows:

$$o_b = o_b^0 + \frac{s}{S}\left|o_b^S - o_b^0\right| \qquad (6)$$

$$o_d = o_d^0 + \frac{s}{S}\left|o_d^S - o_d^0\right| \qquad (7)$$

Here, o_b is to exploit, and o_d is exploration. S denotes the current iteration time. S means the number of maximum iterations possible. The parameters for attack propensity are denoted by o_b^S and o_b^0. The cruise propensity parameters are denoted by o_d^S and o_d^0.

Transferring to New Positions

The location update in the case of a golden eagle depends on an attack vector B_j and also a cruise vector D_j. To determine the new position, both vectors with weights are calculated (8) in terms of tendencies to either explore or exploit.

$$\Delta w_j = \vec{q}_1 o_b \frac{\vec{B}_j}{\|\vec{B}_j\|} + \vec{q}_2 o_b \frac{\vec{D}_j}{\|\vec{D}_j\|} \qquad (8)$$

Where, according to equation (9), $\|B_j\|$ and $\|D_j\|$ are the Euclidean norms of the attack and cruise vectors. The random vectors q_1 and q_2 have non-integer members that fall between 0 and 1.

$$\|\vec{B}_j\| = \sqrt{\sum_{i=1}^{m} b_i^2}, \|\vec{D}_j\| = \sqrt{\sum_{i=1}^{m} d_i^2} \qquad (9)$$

Hence, the position of the golden eagle in the next iteration, w_j^{s+1} can be calculated as (10):

$$w_j^{s+1} = w_j^s + \Delta w_j^s \qquad (10)$$

Where w_j^s means the position of the design solution (golden eagle) j in the current iteration. In case a golden eagle finds a better design, it updates the global best solution, and the algorithm restarts. If this design is an optimal solution then W_e stay the same, and the algorithm continues to refine a solution.

Proposed Stooping Behaviour

In the stooping mode, it descends in a fast, focused manner to the best solution, much like finalizing the design of VR after thorough exploration and refinement. Stooping can be expressed with the following equation (11):

$$w_j^{s+1} = \overrightarrow{W_e} \pm c \qquad (11)$$

Where c is an arbitrary number distributed in the range [0,α] with fine-tuning for the design solution. The stooping occurs when the eagle (designer) has recognized the best possible solution or at a critical point in the iteration process where further exploration is no longer necessary, and only fine-tuning of the design is required.

The adapted GEO VR design is an algorithm that considers the immense design space in finding the best configurations of visual communications. The act of strategic exploration, exploitation, and eventual refining, or stooping, is what the algorithm is designed to support in optimizing VR design elements such as layout, interactivity, and visual fidelity.

RESULTS

The GEO-FBNN is a noval algorithmic approach that improves the accuracy and responsiveness of the VR design by effectively estimating feature distributions. The system under test in this experiment will have 16 GB of RAM and 1 TB SSD storage. It utilizes Python 3.8 for the development of the algorithm and TensorFlow for the deep learning model implementation to create the environment in VR. The system runs on Windows 10 for compatibility with the VR hardware and software.

User Engagement Rate (%)

The number of active user interactions that occur in the VR application, meaning the extent to which the design manages to attract and hold the attention of the user during their experience.

Real-time processing time (sec)

This is the time taken by the system to process and act according to user activities in the VR environment, which reflects the responsiveness and smoothness of the application in delivering an immersive experience. The effects of real-time processing time and user engagement rate on VR design are displayed in figure 2 and table 1.

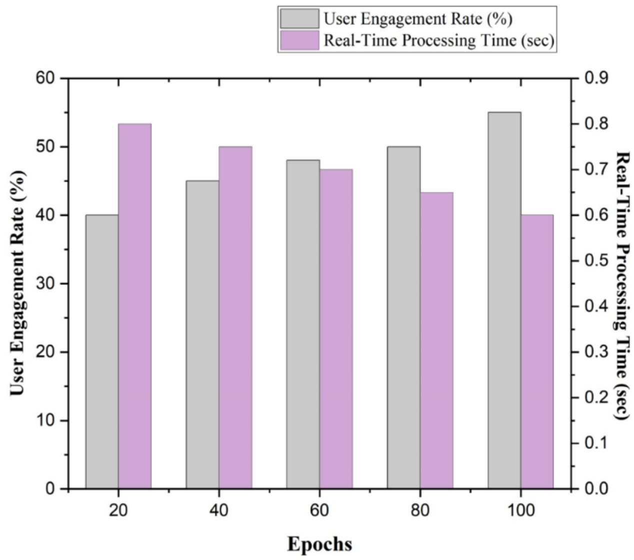

Figure 2. Impact of User Engagement Rate and Real-Time Processing Time in VR design

Table 1. Numerical Outcome of epochs on User Engagement Rate and Real-Time Processing Time in VR design

Epochs	User Engagement Rate (%)	Real-Time Processing Time (sec)
20	40	0,80s
40	45	0,75s
60	48	0,70s
80	50	0,65s
100	55	0,60s

Table 1 depicts how an increase in epochs has implications for user engagement and real-time processing time in VR for the design of modern visual communication. The table shows how increasing the number of epochs influences user engagement and real-time processing time in VR for modern visual communication design. In this regard, as the epochs increase the user engagement is enhanced from 40 % at 20 epochs to 55 % at 100 epochs while the real-time processing time is reduced from (0,80 to 0,60 seconds). At the 100th epoch, the GEO-FBNN significantly improves efficiency and engagement, increasing the efficacy of the system. This implies that the more training the VR system undergoes, the more efficient and responsive it will become in handling user interaction and, thereby improving the design experience in VR environments.

Interaction Accuracy (%)

It reflects the responsiveness and accuracy of the interaction of a user with a VR environment, meaning how well the input translation of the user into the expected outcomes occurs in terms of visual communication design.

Motion Sickness Rate (%)

The percentage of users, who felt uneasy or nauseated during the use of the percentage of users feeling discomfort or nausea during use of VR, indicating issues in achieving proper smooth immersion in the virtual world for an effective design of visual communication. Motion sickness incidence and interaction precision's effect on VR design are demonstrated in figure 3 and table 2.

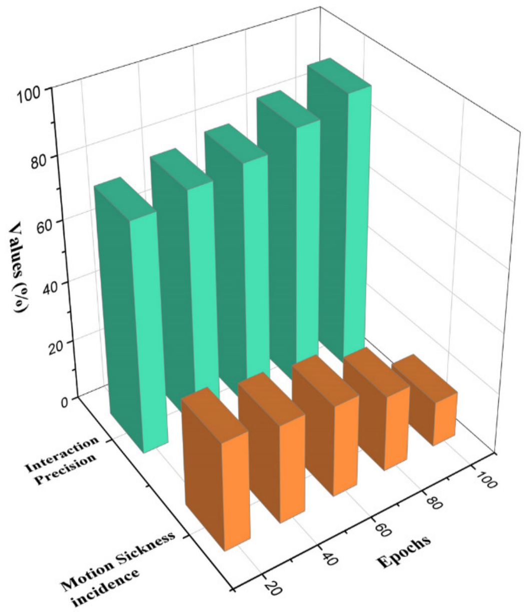

Figure 3. Effect of epochs on Interaction Precision and Motion Sickness Incidence in VR design

Table 2. Performance metrics of Interaction Precision and Motion Sickness Incidence in VR design

Epochs	Interaction Precision (%)	Motion Sickness Incidence (%)
20	75	35
40	78	32
60	80	30
80	85	25
100	90	15

Table 2 shows the relationship between epochs increase and interaction accuracy along with motion sickness in VR for visual communication design. While the number of epochs increases, interaction precision shows an improvement from 75 % at 20 epochs to 90 % at 100 epochs, while indicating higher precision in user interaction with the elements of the design. Meanwhile, the incidence of motion sickness decreases from 35 % at 20 epochs to 15 % at 100 epochs. The GEO-FBNN method significantly contributes at the 100th epoch to improving interaction accuracy while reducing motion sickness, thus proving that longer optimization not only improves design accuracy but also helps reduce discomfort in VR environments.

Navigation Efficiency (%)

It describes the ease of navigation through a virtual environment and indicates how easy it is for users to use the navigation system in VR design.

Accessibility Rating (%)

This measures the accessibility of the virtual environment to a wide range of users with diverse abilities, thereby reflecting the VR experience's inclusiveness in modern visual communication design. The influence of accessibility rating and navigation efficiency on VR design is shown in figure 4 and table 3.

Table 3 represents the efficiency in navigation and accessibility concerning the rise in epochs of VR-based visual communication design. The epochs in VR-based visual communication design are shown, where, at epochs of 20, navigation efficiency is 71 % and accessibility is 70 %. This increases to 88 % for navigation efficiency and 83 % for accessibility, at epochs of 100, respectively. At 100th epoch the GEO-FBNN method significantly improves both navigation efficiency and accessibility, hence enhancing the overall user experience. This shows the increased epochs make the VR system more efficient and accessible and, therefore makes the user experience more enhanced in designing applications.

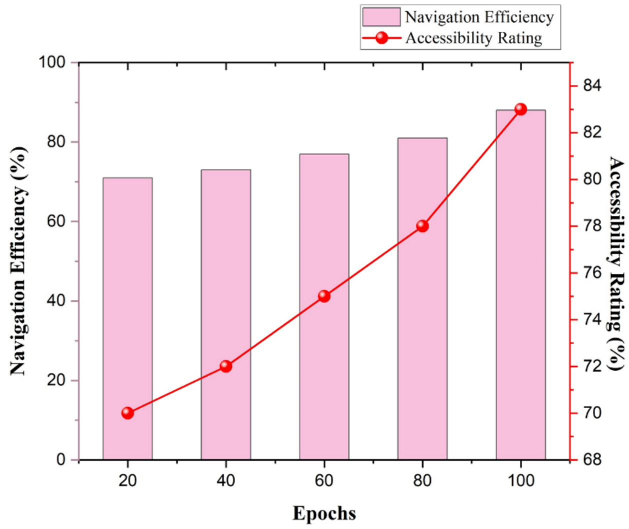

Figure 4. Influence of epochs on Navigation Efficiency and Accessibility Rating in VR design

Table 3. Evaluation of Navigation Efficiency and Accessibility Rating in VR design

Epochs	Navigation Efficiency (%)	Accessibility Rating (%)
20	71	70
40	73	72
60	77	75
80	81	78
100	88	83

DISCUSSION

Results show a significant positive correlation between the number of epochs and the performance metrics of VR in visual communication design. With an increase in epochs, user engagement increased from (40 % to 55 %), processing time decreased from (0,80s to 0,60s), interaction accuracy increased from (75 % to 90 %), and motion sickness decreased from (35 % to 15 %). These are in line with the results of previous studies, which have shown that longer training and optimization of VR systems improve user experience and reduce discomfort. For example, earlier work has shown that real-time processing time directly impacts immersion and engagement. The traditional methods in VR-based visual communication design usually suffer from higher processing latency and lower interaction accuracy, which can significantly reduce user engagement. Besides, they lack adaptability, especially for motion sickness, due to less adaptive optimization techniques. These findings illustrate that deeper optimization is key to improving the interaction in VR-based applications for design. The increase in accessibility and efficiency of navigation also makes a point towards the importance of inclusivity in design, responding to the growing necessity for VR systems to accommodate a variety of needs of users. In that regard, these results significantly affect the further development of design tools for immersive VR in visual communication.

The GEO-FBNN algorithm plays a crucial role in achieving improvements by effectively estimating the feature distributions that optimize key performance metrics. Enhanced user engagement, reduced processing time, improved accuracy of interaction, and minimized motion sickness are important contributions of this algorithm toward developing an efficient, immersive, and user-friendly design for VR.

CONCLUSIONS

VR technology has immensely changed modern visual communication design into an immersive dynamic environment that fosters the creation, interaction, and presentation of visual material. The incorporation of deep learning techniques, like GEO-FBNN, improves the accuracy and responsiveness of the elements used in the design, such as element positioning and color distribution. Despite the problems of motion sickness, accessibility, and ease of navigation, VR algorithms have evolved real-time processing capabilities to unprecedented heights, creating new possibilities for more efficient and creative design. The findings indicate a strong positive relationship between the number of epochs and the performance metrics of VR in visual communication design, including a decrease in processing time from (0,80s to 0,60s) seconds, an increase in user engagement from (40 % to 55 %), a decrease in motion sickness from (35 % to 15 %), and an increase in interaction accuracy from (75 % to 90 %). This development process is an indicator that the future of visual communication will unfold in ways with vast VR potential.

Limitation

Limitations include issues with motion sickness, accessibility, and navigation in VR environments. Future work may involve improving the comfort of the user, the responsiveness of the system, and further integrating VR into a wide range of design applications.

BIBLIOGRAPHIC REFERENCES

1. Durojaye A, Kolahdooz A, Nawaz A, Moshayedi AJ. Immersive horizons: exploring the transformative power of virtual reality across economic sectors. EAI Endorsed Transactions on AI and Robotics. 2023 Jun 9;2. https://doi.org/10.4108/airo.v2i1.3392

2. Li W, Zhu J, Dang P, Wu J, Zhang J, Fu L, Zhu Q. Immersive virtual reality as a tool to improve bridge teaching communication. Expert Systems with Applications. 2023 May 1; 217:119502. https://doi.org/10.1016/j.eswa.2023.119502

3. Hamad A, Jia B. How virtual reality technology has changed our lives: an overview of the current and potential applications and limitations. International journal of environmental research and public health. 2022 Sep 8;19(18):11278. https://doi.org/10.3390/ijerph191811278

4. Conner NO, Freeman HR, Jones JA, Luczak T, Carruth D, Knight AC, Chander H. Virtual reality induced symptoms and effects: concerns, causes, assessment & mitigation. InVirtual Worlds 2022 Nov 1 (Vol. 1, No. 2, pp. 130-146). MDPI. https://doi.org/10.3390/virtualworlds1020008

5. Fitrianto I, Saif A. The role of virtual reality in enhancing Experiential Learning: a comparative study of traditional and immersive learning environments. International Journal of Post Axial: Futuristic Teaching and Learning. 2024 Jun 27:97-110. https://doi.org/10.59944/postaxial.v2i2.300

6. Yin R, Wang D, Zhao S, Lou Z, Shen G. Wearable sensors-enabled human-machine interaction systems: from design to application. Advanced Functional Materials. 2021 Mar;31(11):2008936. https://doi.org/10.1002/adfm.202008936

7. Chang YS, Chou CH, Chuang MJ, Li WH, Tsai IF. Effects of virtual reality on creative design performance and creative experiential learning. Interactive Learning Environments. 2023 Feb 17; 31(2):1142-57. https://doi.org/10.1080/10494820.2020.1821717

8. Li X, Zheng H, Chen J, Zong Y, Yu L. User Interaction Interface Design and Innovation Based on Artificial Intelligence Technology. Journal of Theory and Practice of Engineering Science. 2024 Mar 19;4(03):1-8. https://doi.org/10.53469/jtpes.2024.04(03).01

9. Yu G, Akhter S, Kumar T, Ortiz GG, Saddhono K. Innovative application of new media in visual communication design and resistance to innovation. Frontiers in Psychology. 2022 Aug 3; 13:940899. https://doi.org/10.3389/fpsyg.2022.940899

10. Liu GC, Ko CH. Exploring multiple application scenarios of visual communication course using deep learning under the digital twins. Computational Intelligence and Neuroscience. 2022; 2022(1):5844290. https://doi.org/10.1155/2022/5844290

11. Gu Y, Wang Q, Gu W. The innovative application of visual communication design in modern art design. Electronics. 2023 Feb 27; 12(5):1150. https://doi.org/10.3390/electronics12051150

12. Zhang Q, Guo X, Sun M, Samuel RD, Kumar PM. Visually improved digital media communication using virtual reality technology and digital twin. Journal of Interconnection Networks. 2022 Jun; 22(Supp04):2146005. https://doi.org/10.1142/S0219265921460051

13. Guan X, Wang K. Visual communication design using machine vision and digital media communication technology. Wireless Communications and Mobile Computing. 2022; 2022(1):6235913. https://doi.org/10.1155/2022/6235913

14. Regal G, Pretolesi D, Schrom-Feiertag H, Puthenkalam J, Migliorini M, De Maio E, Scarrone F, Nadalin M, Guarneri M, Xerri GP, Di Giovanni D. Challenges in virtual reality training for CBRN events. Multimodal Technologies and Interaction. 2023 Sep 11; 7(9):88. https://doi.org/10.3390/mti7090088

15. Nilsson T, Rometsch F, Becker L, Dufresne F, Demedeiros P, Guerra E, Casini AE, Vock A, Gaeremynck F, Cowley A. Using Virtual Reality to Shape Humanity's Return to the Moon: Key Takeaways from a Design Study. InProceedings of the 2023 CHI Conference on Human Factors in Computing Systems 2023 Apr 19 (pp. 1-16). https://doi.org/10.1145/3544548.3580718

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