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PERCEPTION, AND RESONANCE: RESEARCH ON GENERATIVE AI IN DIGITAL PICTURE BOOK DESIGN

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Abstract. ***The purpose.*** *This research aims to the operation and role of generative AI in human-AI co-creation, with digital picture book design as the creative object. Using stimulation, perception, and resonance as the starting point, construct a human- AI collaboration model, and unleash the potential of emotional design in generative AI applications.*

Methodology. *By analyzing the current application of generative AI technology in story,image,sound and animation creation, summarizing the different work modes between human and generative AI, and using the three stages of emotional design influence the modeling construction.*

Results. *Based on analysing the current situation of humans working with generative AI, this paper constructs a four-step research framework from stimulation, perception to resonance and feedback based on the three levels of emotional design. Through an analysis of the creation process and feedback from the digital picture book 'Umbrella', this study evaluates the advantages and disadvantages of such collaboration. It identifies respective strengths in both humans and AIs during the collaborative process and highlights a gap in generative AI's understanding of human semantics, which impacts emotional resonance. The study suggests that visual and auditory stimuli can enhance mutual understanding between generative AI and humans through repeated exposure. Finally, it constructs an ideal model for human-AI collaboration to guide further research.*

Scientific novelty. *The research focuses on the human-AI collaboration model and how machine creations can understand humans and achieve emotional resonance.*

Practical significance. *This study provides some reference on the communication pathways between generative AI and human work, and how emerging technologies can understand human emotions in the creative field in the future.*

Keywords: graphic design, generative ai, digital picture book design, stimulation, perception, resonance, project object.

INTRODUCTION

With the improvement of human hardware, algorithm and Internet data in the field of computing science, artificial intelligence (AI) technology, as an important driving force leading a new round of global scientific and technological revolution and industrial change, is changing the way of survival and production in various fields [15]. Among them, the maturity of image generative artificial intelligence (AI) technology

is significantly influencing and reshaping the design industry. To date, designers can harness and interact with various text-to-image or image-to-image AI models (e.g., Midjourney, Stable Diffusion, Open-AI's DALL-E, and Deep Dream Generator), which could facilitate in augment-ing creativity and stimulating visual imagination and ideation [5].

Generative AI has become capable of creating stories and painting, from text to images, from images to sound, making people pay attention to its application in digital picture book design. Unlike simply generating a single image, picture book design has its unique creative rule: combining text and images. Text generative artificial intelligence provides convenience for illustrators skilled in drawing to create stories, while image generative AI provides the possibility for text writers who do not know how to illustrations to independently create complete story picture books. At the same time, the story in picture books has narrative and literary, the illustrations have a unified visual style, which poses certain challenges to the application of generative AI. Another important feature of picture books is emotional communication during reading: parent-child reading [11]. The potential of artificial intelligence (AI) to help create works that resonate with human emotions has not yet been fully explored. This article will study and analyze through actual creation process, and theoretically construct a design pattern that achieves emotional resonance with humans through human-AI co-creation under the guidance of emotional design.

ANALYSIS OF PREVIOUS RESEARCH

From AI to Generative AI. Artificial intelligence (AI) is a science that simulates human intelligence through machines, aiming to artificially endow machines with human cognitive, learning, and reasoning abilities, and transform problems solved by human intelligence into artificial machines to solve them [15]. Generative AI refers to a machine that learns the features of an object on its own and generates new data that is similar but different from the learned data based on the learned content. Image generation AI, as the name suggests, refers to a machine that can generate images on its own through learning. It is a way for users to input descriptive information such as words, sentences, or images to generate new images [4]. AI image generation was initially completed by Generative Adversarial Networks (GANs) developed by NVIDA in 2019, and later developed new image generation AI based on Diffusion Models or Autoregressive Models. At first, image generation AI was led by companies such as Open AI and Stability AI. Nowadays, global technology companies such as Microsoft, Google, and Meta, as well as some studios and personal computer programmers, are also interested in image generation AI technology and are investing in the development of related technologies.

From computer-aided design to human-AI collaboration. Computer-aided design (CAD) is the use of computer software to facilitate the creation, modification, analysis, or optimization of a design. But this still requires designers and artists to learn how to use software, which invisibly enhances the professional skills requirements of practitioners. However, with the development of AI technology, generative AI has changed the way creativity is created. The accessibility of these new AI tools has been signifcantly enhanced by their browser-based interfaces, rather than relying on proprietary software. This approach lowers the barrier to entry, making them more user-friendly and encouraging widespread adoption [1]. Its convenience and ease of use gradually conform to the early human imagination: "My dream is that in the near future, the human brain and computer can work closely together to think things that the human brain cannot imagine."(Man-computer Symbiosis, J.C.R.Licklider,1960) Human-AI collaboration has begun to receive more attention and research from experts, but the effective operation of the structure in what form is still under research.

Emotional Design. Donald Norman(2004) Proposed three levels of Emotional design, namely the Visceal layer, Behavioral layer, and Reflective layer [9]. The visceral layer refers to the origin of emotions, where users experience products through their senses and form initial emotional fluctuations; The behavioral layer refers to the period of emotional enhancement. Products with good functionality will create a sense of pleasure for users, thereby increasing emotional fluctuations, and vice versa, reducing emotional fluctuations; The reflective layer refers to the sublimation period after emotional fluctuations. The connotation of the works needs to meet the psychological needs of users, evoke emotional resonance, and achieve a sustained emotional fluctuation state [13].

Ahmed (2020) argues that the focus should be on how AI makes «immaterial humanistic characteristics» – such as emotions, experiences, senses, and memories—concrete and physical [1]. In this view, the interactions and emotions that humans experience whileengaging with art generated by Al can be seen as design elements themselves. Based on this, how

to make the design of generative AI with representations of human emotions remains a topic for further research.

STATEMENT OF THE PROBLEM

Based on literature review and research objectives, propose a research framework that integrates the hierarchy of emotional design into the generation process of digital picture book creation, and analyze and explore the specific situation of human-AI collaboration (fig. 1). A book does not have to be printed. It can be rendered in many ways, including electronic-visual and audio (talking books). (Bill Cope, 2001) According to Cope, books can be handcrafted, printed or digital artefacts [10]. Digital technology has endowed digital picture books with an important core feature that distinguishes them from traditional paper picture books: multimodality. Multimodality refers to the application of multiple information communication methods in a medium to comprehensively influence and assist the audience in understanding the work [2]. Images, text, layout, gestures, music, language, dynamic images, etc. are all modalities. They are the potential meanings formed by the long-term shaping of material media in society [3]. Digital picture books integrate multimodal expressions such as images, text, sound, animation, touch, and interaction, and can be completed using generative AI in the intermediate production stage.

The first step starts from the visceral layer of external stimulation, including visual, auditory, and tactile primitive sensory stimuli, which are mainly manifested in two parts in picture book creation: story and image. When humans create, creators can express initial concepts through storytelling and painting based on a certain inspiration. When using generative AI for creation, you can type keywords, generate story text, and simultaneously generate visuals that match the text description. With the multimodal development of generative AI, voice input can also be used to tell simple stories to AI, thereby generating more complete and rich narrative texts.

The second step is to enter the behavioral layer that guides internal perception, including enhancing and filtering specific expression elements such as style, language, color, sound, animation, and interaction. In the mid-term stage of creation, people usually guide the use of expressive forms that are more in line with the core purpose and expressive imagery through emotional perception. This stage generates a large number of drafts and process traces, while generative AI continuously and efficiently generates various expected images through machine learning, completing more complex and time-consuming tasks.

The third step is to reach a reflective level of emotional resonance, including the sublimation of ideas and expressions related to the connotation, experience, artistic conception, feedback of the work. People pay more attention to testing the deeper content reflected in their works in the later stages of creation, whether

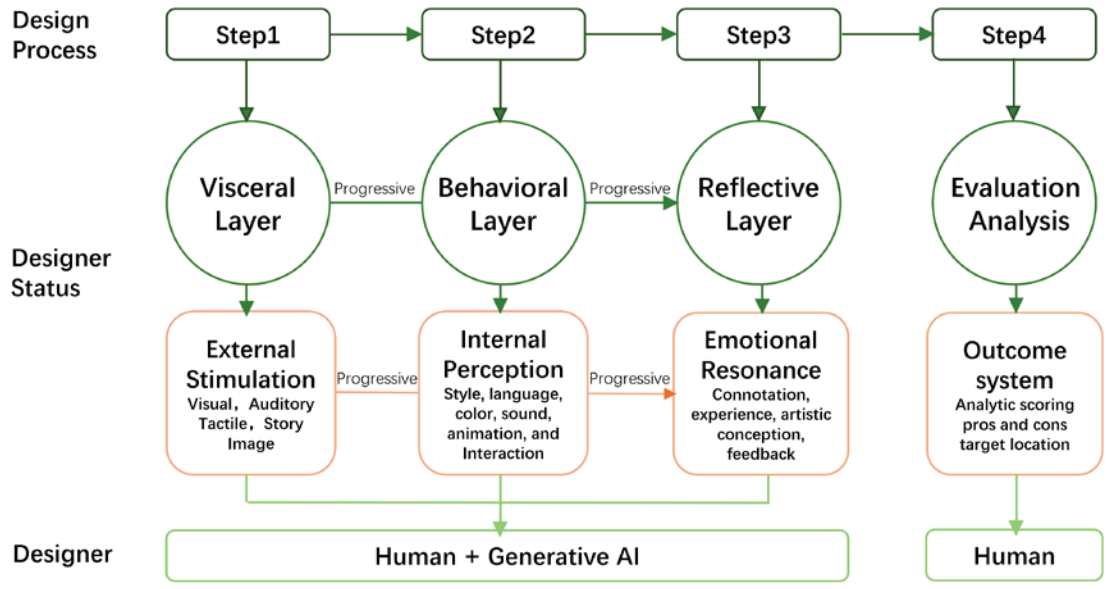

Fig. 1. Research Framework

they can move the audience or immerse them in a new world created by a certain creator. But generative AI does not reflect on this aspect, so human guidance is indispensable in the process of human-machine collaboration.

The fourth step is to test the results through feedback from creators and viewers, analyze the pros and cons, and propose suggestions for improvement.

RESULTS OF THE RESEARCH AND ITS DISCUSSION

Case : Design of Dynamic Picture Book for Umbrella. Use chatgpt to create text scripts. Firstly, provide a broad theme, such as creating a story with "Umbrella" as the theme. Then add specific descriptions of "girl" and "red umbrella" to narrow down the direction of the story. Based on the results, add emotional descriptions, such as "anger". After providing more precise descriptions step by step, generate a story script that better meets the creative needs (fig. 2).

Generate images using DallE-3, Stability AI-core,Ultra and Stable diffusion 3, compare and select the most suitable direction, and then proceed to image generation with consistent style. The prompt word is: an office in the rain, people are working, people are getting wet, and there is standing water on the ground., Children's picture book style (fig. 3). Due to the fact that the red umbrella is a very important prop in the story, the other scenes and characters in the picture are mainly black and white, accompanied by a small amount of blue, highlighting the visual center of the red umbrella in the overall visual effect. The color tends to use solid colors, and the style is mainly line with drawing light colors.

Using the selected style as a reference, complete the visual generation of the entire story. Then add text to form a storyboard (fig. 4). At present, there is no AI tool that can directly generate the layout of images and text on the same screen, and there are still technical barriers to accurately design the relationship

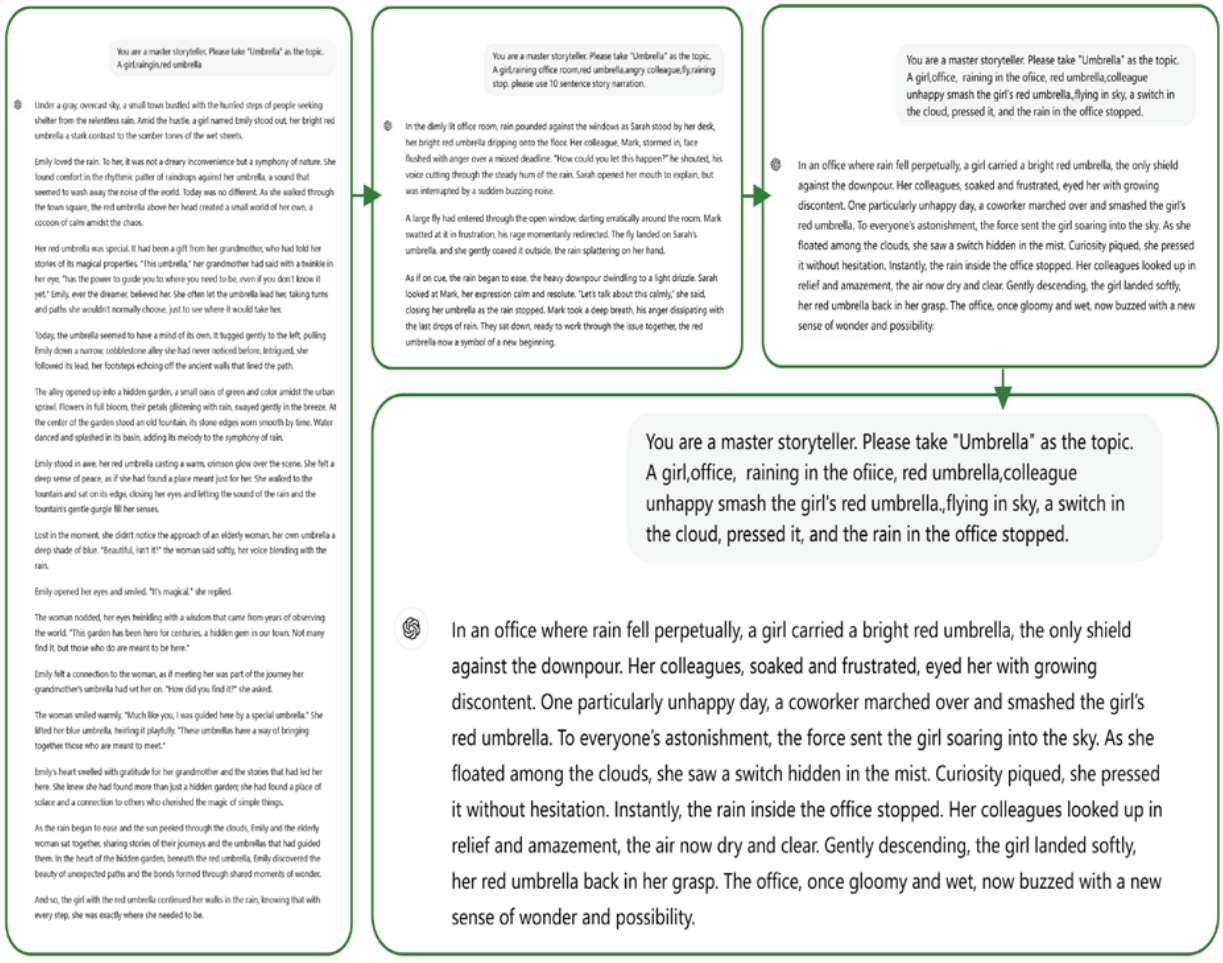

Fig. 2. The process of generating a story

between text and images. Due to the inability to generate accurate text in image format,this part still requires human intervention design to complete. Therefore, in the storyboard section, we chose to generate separate text and image pages to tell the story.

Input the materials into Mootion AI [7] to complete a simple shot motion design, include some 3D camera motion,add music, and use editing software to synthesize, completing approximately three minutes of dynamic picture book design (fig. 5).

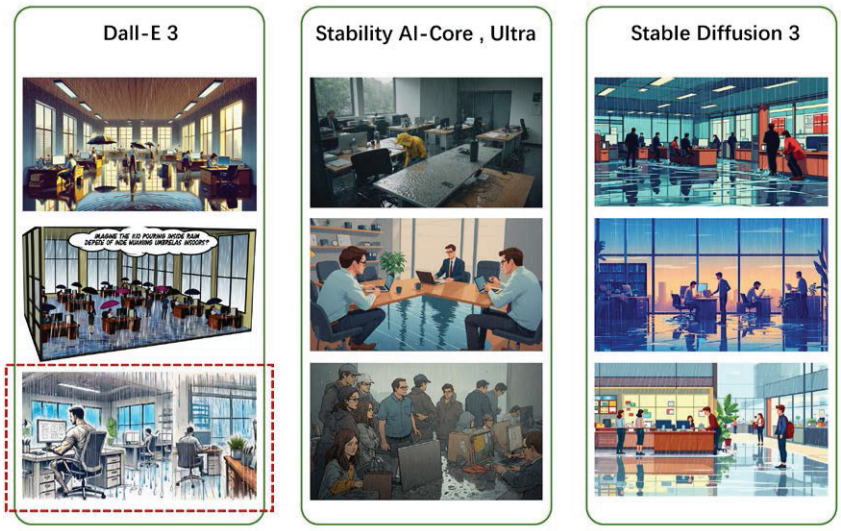

Fig. 3. Generate images and select styles

Fig. 4. Storyboard design with Dall-E and Human

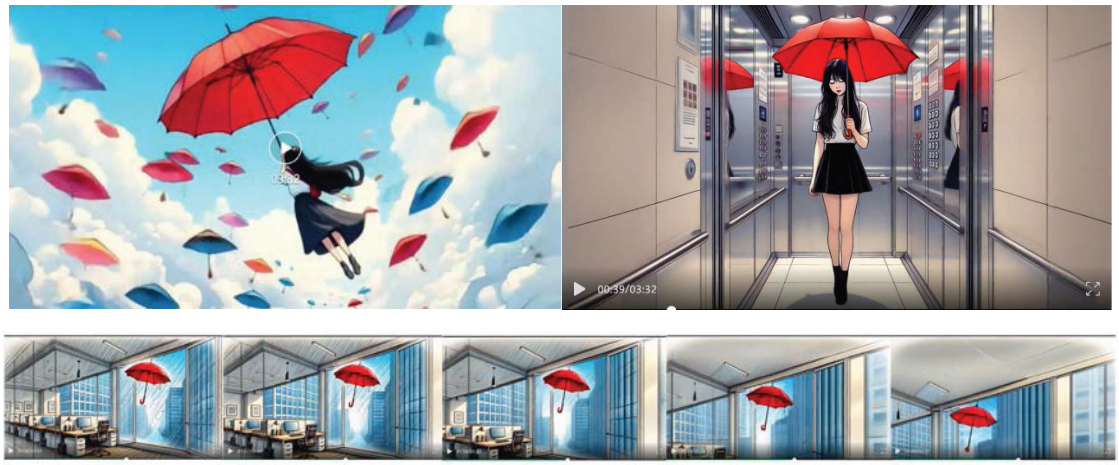

Fig. 5. Dynamic picture book and generative 3D camera motion

Analysis: Feedback and Rating for Umbrella. The feedback from both the authors and 40 readers was gathered via a questionnaire survey. The assessment system employs a straightforward percentage-based approach, and based on the findings, both authors and readers express dissatisfaction with the narrative quality of textual stories (table 1).

The generative AI is responsible for many production-type work in this project which was took the authors about 10 hours, whereas humans are only responsible for: coming up with ideas; discussing the story direction with the AI's big language model; picking the best story script; directing the AI tool to generate images and animations; telling the AI composing tool the tone of the soundtrack that is needed; and the final video compositing.

As can be observed from the outcomes presented in the table above, merely two sections, namely images and music, pass the test. Surprisingly, the most significant deficiency lies in article generation, which began its development much earlier. However, at present, it seems that AI is incapable of obtaining quality stories. Stories recounted by large language models are almost inevitably flawed, insubstantial or trite if they rely solely on AI. Over the past year, almost all of the works that have been submitted to AI short film competitions and have performed well, or have become popular online, have been human-written stories, with human-designed frames filled with AI-generated images and video footage.

Thus it can be seen, the primary impact of generative AI on work lies in significantly enhancing the efficiency of human labor by proficiently generating content based on concepts, occasionally leading to unexpected associations due to imperfect comprehension, thereby stimulating human imagination. Furthermore, AI can swiftly produce materials and fragments provided by humans while emulating the stylistic choices of human creators. Such stimuli originate from external visual and auditory sources, including images generated by the generative AI and music or lines produced in response to a cue. These stimuli prompt the human brain to process and interpret internal perceptions, thereby identifying and clarifying more specific needs. This then commands the generative AI, which, in turn, produces results that are closer to the desired outcome. This process is repeated several times. Nevertheless, the attainment of

Table 1

Assessment results from authors and readers

AI works	Quality scoring 100 points (The authors)	Quality scoring 100 points (An average of 40 readers)	Grade 60 pingts qualified	
AI Story writing	30	40	35	×
AI Storyboard	50	55	52.5	×
AI Painting (Text-Image)	70	80	75	√
AI Animation (Image-Video)	50	50	50	×
AI Music (Text-sound)	60	70	65	√

emotional resonance with humans through reflection and sublimation necessitates the implementation of feedback and evaluation of milestones. Humans must provide more precise instructions to the generative AI, based on the results of the aforementioned feedback and evaluation, in anticipation of the AI producing results that are more aligned with human emotional resonance. In this process, the human input assumes a primary role.

Today humans have attained a high degree of proficiency in the logical control of comprehensive creative endeavours. This encompasses the regulation of artistic expression and aesthetic direction, the formulation and implementation of top-down control strategies, the optimisation of the selection of modalities and algorithms, and the evaluation and selection of AI-generated material or clips [12].

AI's accurate understanding and mapping of semantics remains a gap in human-AI co-creation, whereas visual based iterations can still trigger emotio-nal arousal [5]. The continuous iterative process of AI, from its primitive to augmented forms, interacts with human perception and reflection. It is therefore to be expected that the results of multiple sublimations will be more likely to achieve emotional resonance.

CONCLUSIONS

This study focuses on the manner in which generative AI achieves emotional resonance with people during human-AI collaboration in digital picture book design. The experiment sought to integrate the three levels of emotional design, namely stimulation, perception and empathy, into the design process. The results demonstrated that the AI exhibited a progression from primitive to augmented and then to sublimated, particularly during the two stages of story stimulation and image generation. In the absence of human input, it is challenging for an AI-generated narrative to be perceived as such by humans, let alone to facilitate the subsequent presentation of elements that evoke a particular emotional response. In terms of evaluation scores, generative AI is currently adept at improving efficiency and ensuring a pass rate of results to a certain extent. Notably, generative AI can significantly improve the visual and auditory presentation of design and gain human emotional resonance in both areas. The challenge of human-AI co-creation in picture book design lies mainly in the communication gap, i.e., how to correctly understand human thinking and emotions and circumvent the generation of tasteless stories.

The human initiates the process by providing the initial entry points and prompts to the generative AI. Subsequently, the algorithm generates a multitude of text and image possibilities, which are then generated based on the AI's understanding of the human's purpose, achieved through the decoding of the provided information. Based on the findings of the case study, a hybrid imagery model for human-AI collaboration in the design of digital picture books is proposed (fig. 6). The model is based on the three

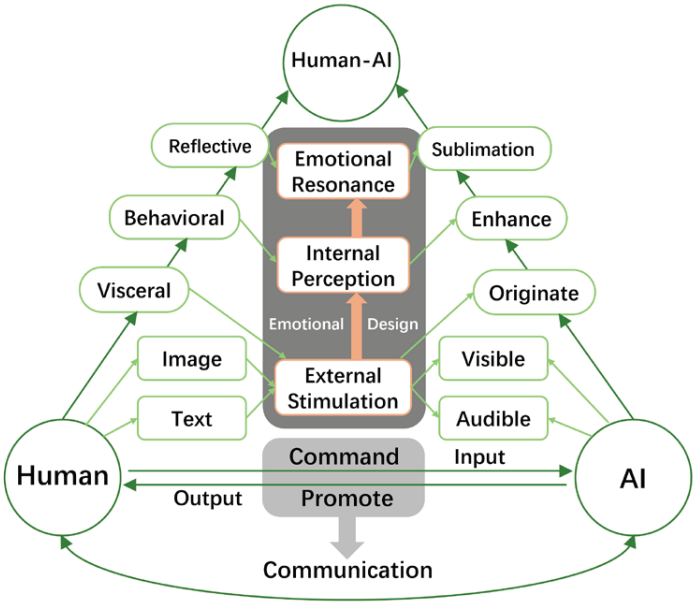

Fig. 6. Modeling constustion of Human-AI collabration for design with Emotional 3 stage

levels of emotional design and allows the creator and the audience to assess whether the generated work achieves emotional resonance with humans. The top priority is human-AI communication.This model can also provide a reference for effective models of human-AI collaboration for other topics.

One limitation of this study is that it only followed and analyzed a single creation as a case study, which may limit its generalizability due to the personal nature of the creative experience. For future research, it is recommended to involve more designers and users of generative AI in order to enhance sample diversity.

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АНОТАЦІЯ

Ян Лі, Чупріна Н. Сприйняття та резонанс дослідження генеративного штучного інтелекту в дизайні ілюстрованих цифрових книжок

Мета *статті спрямована на дослідження функціонування та ролі генеративного штучного інтелекту (ШІ) у спільному дизайні ілюстрованої цифрової книжки як творчого об'єкта. Використовуючи стимуляцію, сприйняття та резонанс як відправну точку, в роботі побудовано модель співпраці людини та ШІ та розкрито потенціал емоційного дизайну в генеративних програмах ШІ.*

Методологія. *В роботі здійснено аналіз поточного застосування технології генеративного штучного інтелекту у створенні історії, зображень, звуку та анімації, узагальнено різні режими роботи між людським і генеративним штучним інтелектом, а також проведено порівняння трьох етапів емоційного дизайну, що впливають на дизайн та моделювання цифрової ілюстрованої книги.*

Результати. *На основі аналізу поточної ситуації застосування генеративного штучного інтелекту в дизайні цифрової книги, ця стаття створює чотириетапну структуру дослідження від стимуляції, сприйняття до резонансу та зворотного зв'язку на основі трьох рівнів емоційного дизайну. Завдяки аналізу процесу створення та відгуків про цифрову книжку з малюнками «Парасолька», це дослідження оцінює переваги та недоліки такої співпраці. Воно визначає відповідні сильні сторони як дизайнерів, так і штучного інтелекту під час процесу співпраці та підкреслює прогалину в розумінні семантики людини генеративним ШІ, що впливає на емоційний резонанс. Дослідження показує, що візуальні та слухові подразники можуть покращити взаєморозуміння між генеративним ШІ та дизайнерами через повторне вплив. Обґрунтовано, що така взаємодія створює ідеальну модель для співпраці людини та штучного інтелекту в розробці ілюстрованої цифрової книги для подальших досліджень.*

Наукова новизна*. Дослідження зосереджено на моделі співпраці людини та ШІ та на тому, як машинні творіння можуть розуміти людей і досягати емоційного резонансу.*

Yan L., Chuprina N. V. (2024). Perception, and Resonance: Research on Generative AI in Digital Picture Book Design. *Theory and practice of design. Culture and art*. 4(34). P. 488–497, doi: https://doi.org/10.32782/2415-8151.2024.34.53

***Практична значущість**. У цьому дослідженні сформульовано рекомендації щодо впровадження зв'язку між генеративним штучним інтелектом і роботою дизайнера, а також про те, як нові технології можуть відобразити людські емоції в дизайні ілюстрованих цифрових книжок.*

Ключові слова: графічний дизайн, генеративний штучний інтелект, дизайн ілюстрованої цифрової книжки, стимуляція, сприйняття, резонанс, об'єкт проєктування.

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