ISSN: 2093-5374 / E-ISSN: 2093-5382

Using Artificial Intelligence to Strengthen the Interaction between Humans and Computers and Biosensor Cooperation

Wenyi Zhang[1], and Dongkwon Seong[2*]

[1]PHD Candidate, Department of X-Cultural Studies, Kookmin University, Seoul, Republic of Korea. 2691496943zwy@gmail.com, https://orcid.org/0009-0007-8475-2814

[2*]Assistant Professor, Department of X-Cultural Studies, Kookmin University, Seoul, Republic of Korea. dongkwonseong@kookmin.ac.kr, https://orcid.org/0000-0002-7607-1572

Received: July 12, 2024; Revised: August 28, 2024; Accepted: September 25, 2024; Published: December 30, 2024

Abstract

This article examines the application of artificial intelligence (AI) technologies to improve human-computer interaction (HCI) and foster cooperation in graphic design. Comprehensive study and practical use reveal that AI integration significantly enhances HCI's effectiveness and precision while introducing unique collaborative models in graphic design. The research employs natural language processing (NLP) and deep learning technologies in HCI to provide natural dialogue and intelligent responses between humans and machines by developing intelligent question-answering systems and automated task-processing capabilities. Data research indicates that with the implementation of AI, user-computer interface efficiency has increased by 21%, and the mistake rate has decreased by 12%. This accomplishment substantially enhances user experience and facilitates computers in comprehending and addressing user requirements more effectively. The biocompatibility and comfort of users of these substances are of concern. Investigating novel flexible biosensors is imperative to enhance these devices' adaptability, comfort, and interaction. In visual design, the research employs AI's picture recognition and analysis skills to facilitate intelligent recommendations and automatic modifications of design aspects. AI can autonomously produce visual components that align with the designer's goal and approach by analyzing several design scenarios using machine learning algorithms. Data analysis indicates that the design effectiveness of AI-assisted design projects has increased by 30%, and the caliber of the outputs has substantially enhanced.

Keywords: Artificial Intelligence, Human-computer Interaction, Visual Design Collaboration, Man-machine Cooperation, Biosensor.

1 Introduction

With the advent of the digital age, interactive design increasingly highlights its characteristics of the times; people have begun to pay more attention to interactive design development, and more and more people like to feel the various experiences of interactive design works (Sattar, 2019). To promote society's development and meet modern people's spiritual needs, interactive designers provide interactive opportunities for recipients from different angles and constantly promote the development of interactive art.

Journal of Wireless Mobile Networks, Ubiquitous Computing, and Dependable Applications (JoWUA), volume: 15, number: 4 (December), pp. 53-68. DOI: *10.58346/JOWUA.2024.I4.005*

*Corresponding author: Assistant Professor, Department of X-Cultural Studies, Kookmin University, Seoul, Republic of Korea.

From the receiver's point of view, the receiver of traditional design belongs to passive receiver, only passively accepting the creator's thoughts and emotions. Therefore, the design in the conventional sense belongs to stereotyped artistic creation, and the creator pays more attention to how to keep the stability of the work so as not to be influenced by the outside world (Alkatheiri, 2022). The receiver of interactive design under digital media belongs to the participant. The receiver actively integrates personal thoughts and emotions into the work and constantly enriches and perfects the work. The interactive design creator knows the recipient's feedback information through the computer and continuously improves the work to make it perfect (Kim & Song, 2023). Interactive design is more concerned with how to make visitors actively participate in creating his works, continue and even change their thoughts so that the works will finally have richer emotional expression and ideological embodiment and form a work of "gathering thousands of people's emotions into one."

The study subject involves developing an innovative human-computer interaction system utilizing flexible biosensors composed of polymer hydrogel substances to control the movement of fingertips and identify intricate motions (Haleem et al., 2021). Developing a robotic arm, adaptable biosensor controlling system characterized by substantial flexibility, affordability, outstanding recognition productivity, and the capability to facilitate human-computer interaction has significant research value. This project will utilize polymer hydrogel as the substance for the electrode and polydimethylsiloxane (PDMS) as the substrate for creating a resistance-flexible biosensor (Tony et al., 2023). Hydrogels made of polymers are used as electrode materials due to their outstanding sensitivity and ability to generate significant resistance changes in response to slight pressure.

From this, the research can see that the experience brought by traditional design works to the recipients is relatively simple and an emotional experience caused by visual experience. However, the experience brought by interaction design is diversified. From the sensory experience based on visual experience, visitors gradually feel the emotional experience, thinking experience, and behavior experience brought by interaction. Interaction design is different from traditional design, and with the participation of computer networks, interaction design has become the object of more and more attention and research (Ranjitha et al., 2020). Interaction design from the level of science and technology belongs to program design, which pays attention to the functionality of products and focuses on the operation process between people and machines. In this era of information explosion, computer science mainly analyzes and studies interactive design’s visual symbol combination coding, discusses the linguistic function and characteristics of symbolic visual coding design, and discusses the meaning conversion mechanism of combined visual structure. Visual elements in interactive design are the integration of visual symbol language coding, and the core communication information is effectively appealed through visual creative strategies. The combined visual expression of coding language characteristics is a new understanding and new thinking under broad linguistic semiotics (Nagamine et al., 2020).

From the beginning, the computer takes data as the processing object. At first, the data is limited to numbers. With the continuous development of computer technology, data extension is constantly expanding (Levshinskii et al., 2022). Nowadays, data is regarded as a collection of numbers, characters, graphics, and images describing objective things and all the symbols that computers can input and accept (Liu & Liu, 2018). Magnussen believes that "at the highest abstract level, the characteristics of computers are to collect, arrange, process, store, copy, transmit and display digital information, which can be translated into text, sound and image, video, three-dimensional world and other world forms representing the construction of large-scale symbols." From the relationship between data and art, data visualization is art data. Artistic content includes subject matter, theme, character events, and other

elements corresponding to art forms, such as language, structure, genre, and expression techniques (Shen & Sun, 2021). The digitization of artistic content inevitably requires art forms to adapt, so the digitization of artistic forms comes into being. With the continuous integration of art and computers, data artistry appears, including data visualization, data audibility, and data touchability, among which data visualization is the most common. People use intuitive charts and tables and strive to present abstract data structures in intuitive graphic forms. They constantly search for dynamic data, whether static graphics or dynamic curves, based on people's understanding of the logical relationship, development trend, and value orientation between data. Data visualization has become a hot topic (Mei, 2021). Visualization hardware consists mainly of graphics workstations and super visualization computers, while software comprises corresponding operating systems, development tools, and application programs. With the development of network technology, data visualization has been pushed to remote development, and new concepts, such as visual area networks, have emerged.

2 Related Works

2.1. Formation and Main Characteristics of Network

With the development of computer and communication technology, networks, as an effective means to obtain information, are increasingly popular, such as online shopping, e-books, online banking, and so on. The network has changed people's way of life and penetrated thousands of families more concisely and conveniently. Computer networks have experienced a long development process from simple to complex, from low-level to high-level. From the initial simple remote computing, information collection, and remote online systems to the development of computer networks for resource sharing, it marks the maturity of network technology.

Table 1: Comparison of Human-computer Interaction (HCI) Efficiency

Interactive mode	Average response time (seconds)	Steps required to complete the task	User satisfaction (out of 10)
Traditional interaction	15	10	6.8
AI assisted interaction	5	5	9.2

Table 1 shows a comparison of HCI efficiency. Different stages of network development have different characteristics. In the 1970s, from single-machine remote connection to multi-machine connection, the technology was simple, and the application scope was narrow, but stability was vital. In the 1980s, there was a move from network services to comprehensive information. After entering the 21st century, the Internet has provided users with an open and virtual reality space, which makes users immerse themselves in various interactive experiences. More and more people have loved it, and it has gradually penetrated multiple fields of human society, becoming a fashion lifestyle and information exchange mode for modern people.

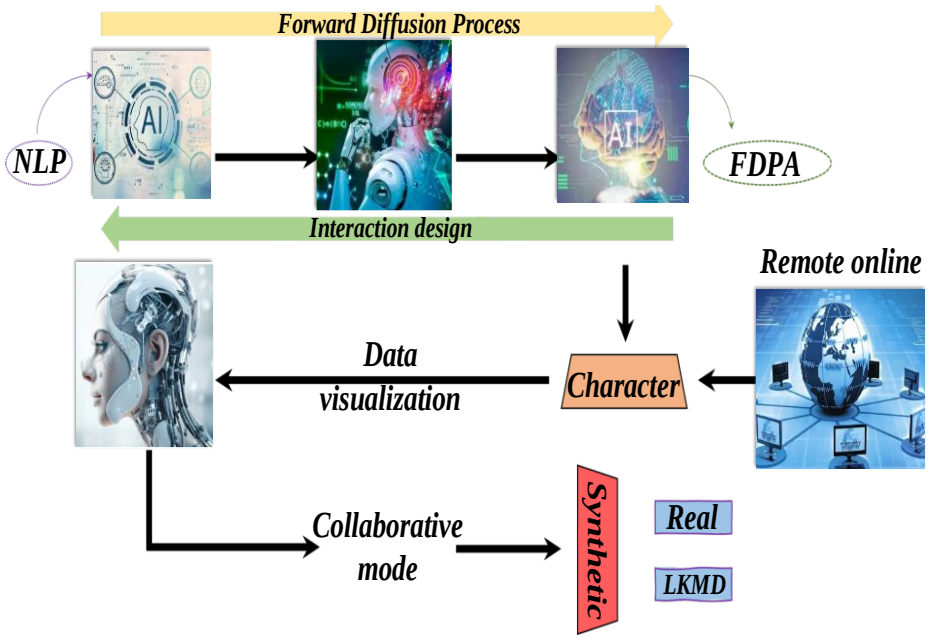

Figure 1: AI Optimization HCI Flowchart

Figure 1 shows an Artificial Intelligence (AI) optimization human-machine interaction flowchart. It is precisely because the Internet has the characteristics of large capacity, diversified forms, comprehensive coverage, open environment, and free interaction that it has rapidly developed into the most influential new media (Luo, 2018). The formation of the network dramatically enriches people's spiritual life and provides convenience for people's material life. People's spiritual and material lives can be satisfied on the network, mainly through HCI. The audience gradually changes from passive acceptance to active participation, free choice of information, and one-way output to two-way interaction, the most significant difference between new media based on network and traditional media. The network provides a platform for people to exchange information and experience interactions, which led to the birth of a new art form- interactive art design (Liu, 2022; Šumak et al., 2021).

2.2. Evolution and Conceptual Analysis of Interaction Design

Interaction has been a part of human culture since ancient times. The most primitive interaction is that people convey thoughts using their body language, and the scope, speed, and quantity of information transmitted are minimal. Later, interaction developed into expressing feelings using other things, giving interaction certain persistence, visibility, and effectiveness. Today's modern interaction, for designers, means navigation, and the primary consideration is “How to make the interactive interface easy for users to use (Han, et al., 2023).” For users, it means participation. Under navigation guidance, they participate in activities according to their design ideas and have various experiences while completing works with creators. From an aesthetic point of view, interaction is an exchange of ideas, giving while obtaining, influencing each other, and corresponding behaviors and reactions. The interactive process is a process of input and output. People input instructions to the computer through the interface, and the computer outputs the results to the user after processing (Gao & Li 2021). Therefore, the three interaction elements are machines or systems, people, and interfaces.

Table 2: Visual Design Efficiency Improvement Data

Design task	Completion time before AI assistance (hours)	Completion time after AI assistance (hours)	Percentage improvement in efficiency
Icon design	4	2	50%
Web page layout	8	4	50%
Poster making	6	3	50%

Table 2 shows data on visual design efficiency improvement. The interaction between people, between people and machines, and between machines can be regarded as an "interaction." In a narrow sense, interaction mainly refers to human-computer interface interaction. The term "interaction" in interactive artwork denotes the engagement between participants—readers, spectators, consumers, and guests—and the artworks, typically facilitated with the makers' consent, support, and backing. Because there are different understandings of "interaction," there are many interpretations of the interaction design concept (Jerbi, 2022). Some think interaction design refers to designing interactive products that support people's daily lives and work, which is about creating a new user experience. Others say, "Interaction design is the design of human communication and interaction space." According to a series of works by Bill Moggridge, the father of interactive art, the concept of interactive design has evolved from the earliest interface design to interactive design and then to people-centered experience design. Moggridge thinks that interactive design belongs to a kind of behavioral design (Pueyo et al., 2020). In 2007, Steven Heim, an associate professor at Long Island University in the United States, explained the harmony of HCI from the perspective of program and vision and expressed the importance of visual design from the interface perspective. Jesse James Garrett published "User Experience Elements" on the Internet for the first time. His book "User Experience Elements-User-centered Web Page Design" studies network interaction problems from the user use perspective. The "presentation layer" of five user experience levels expounds the visual design content.

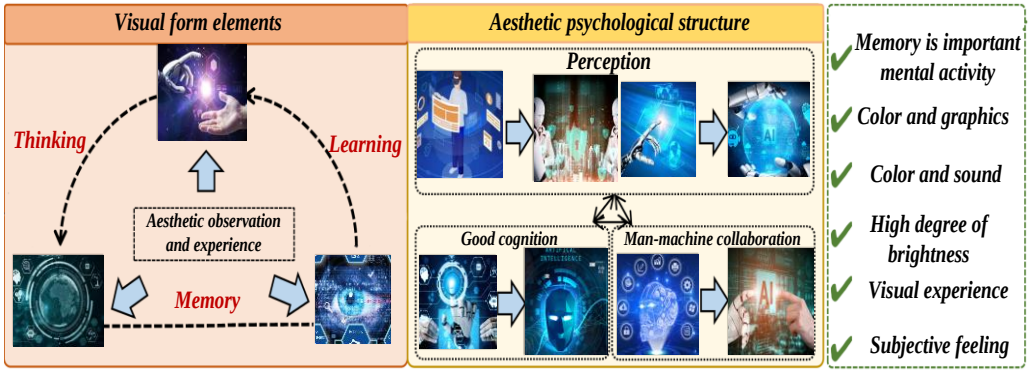

Figure 2: The Application Process of AI in Visual Design Collaboration

Figure 2 shows the application process of AI in visual design collaboration. Whether the interactive design is classified as product, behavior, or visual, it is an interactive mechanism based on user experience. After analyzing the user's background, use expertise, and operation feeling, the product that conforms to the user is designed, which makes the user feel happy in the process of using it and finally achieves efficient use of the product. Interaction design encompasses the behavior of objects, settings, and systems and the design and specification of visual aspects that communicate this behavior

(Hudon et al., 2021). Interaction design primarily focuses on planning and articulating behavioral dynamics, then delineating the most efficient means of communicating such behaviors. For example, when booking a train ticket online, you must first log in to the designated website, select the train ticket to be purchased, pay for it, and enter the ticket delivery address and other information, which is an interactive process.

Interaction design focuses on developing a novel user interface to improve and broaden how individuals work, communicate, and collaborate, thus facilitating more effective learning and productivity (Chen et al., 2019). Superlative interface design enhances product usability and enriches customer experiences throughout the usage process. Employing multimedia design in product interfaces and behaviors creates a natural link between goods and consumers, thereby ensuring user happiness and fostering product reliance.

Good interaction design can make a company succeed or lead to a company's failure. With the development of networks and new technology, many merchants use network interaction to promote and sell products, which enriches the form and content of interaction and simultaneously strengthens people's experience of interaction design (Zhao & Li, 2020). Among all kinds of interactive experiences, the visual experience is the first experience that users feel after entering the interaction, which mainly guides users to interact by conveying information through interactive visual elements. Because network media has its characteristics, the visual communication characteristics of network interaction design differ from those of other media (Oh et al., 2021).

In summary, conventional robots exhibit limited adaptability and substantial bulk. The study of flexible biosensors mainly focuses on integrated detectors, such as those used in healthcare and energy applications, with little use in human-computer interface recognition of movements. The conventional controller exhibits issues like inadequate control precision and sluggish reaction time. Implementing flexibility biosensors has several challenges, including insufficient scalability and flexibility and significant potential for enhancing sensor reliability. This project will utilize polymer hydrogel as an electrode component to design a flexible gesture detection detector. The suggested system enhances the controls, and a physical finger remote control is developed to augment the adaptability and practicality of the management system. The study seeks to overcome the deficiencies of current methods regarding flexibility, precision, security, and biocompatibility by creating innovative, flexible biosensors, enhancing gesture identification methods, and refining control mechanisms for distant robotic fingertips.

3 Methodology

The interactive visual experience is the most intuitive and easy experience for users and is the beginning of the interactive experience process. To attract users and guide users to complete the interactive process, designers need to consider its aesthetics and make it produce a visual impact. When designing visual interaction, the research should focus on clear expression, attract users' attention from copywriting, color matching and graphics, and make a desire and impulse to understand deeply. When visual interaction is used with other interactions, it should meet the requirements of other interactions as much as possible, especially the requirements of behavioral experience, and avoid the inconvenience of users' use and operation (Kim & Song, 2023). To reflect the harmony of functional and artistic beauty, the first step of interactive design is to consider users, understand how users perceive and grasp information, and how to understand beauty. The visual experience of interactive design is closely related to people's cognitive psychology, aesthetic psychology, and the

transformation of information symbols, which are the main factors affecting the visual experience of interactive design.

3.1. People's Cognitive Psychology and Aesthetic Psychology

Cognitive psychology is a discipline that studies how people perceive, learn, remember, and think. Cognitive psychology, referred to in interaction design, refers to the study of human cognitive psychological processes purely from the perspective of information processing, which is called cognitive psychology in a narrow sense. Aesthetic psychology is a subject that mainly studies the law of psychological movement in people's appreciation and creation of beauty. It is also known as aesthetic psychology. The study of interactive design is always inseparable from the study of people's cognitive psychology and aesthetic psychology.

Table 3: Quality Evaluation of Design Works

Types of works	Score before AI assistance (out of 10 points)	AI-assisted score (out of 10)	Quality improvement score
Brand logo	7.5	9.0	1.5
Advertising map	8.0	9.5	1.5
Product packaging	7.8	9.2	1.4

Table 3 shows the quality evaluation of design works. From the perspective of visual experience in interactive design, people's cognition of formal visual elements manifests in two aspects: functional expression and aesthetic experience of visual elements. Function, as a characteristic to meet people's needs, has become the core concept of art design. People's needs are multi-layered (Hult & Schmidt, 2018). As a spiritual need, aesthetic needs are embodied concretely in interactive art. The emergence of aesthetic needs is gradually formed in the development of human culture. From instinctive material to aesthetic needs, it is a social-historical and individual-emotional process.

From the cognitive psychology perspective, people are used to obtaining perceptual experience from familiar, tangible, and concrete things, then using perceptual expertise to recognize, think, experience, and understand those intangible and difficult-to-define abstract concepts. From the perspective of aesthetic psychology, people have a particular aesthetic and psychological structure and usually react positively to beautiful things, especially those with prominent formal aesthetic characteristics. The structure of people's aesthetic psychology determines the possibility and reality of people's aesthetic photos and experiences of aesthetic objects, as well as the selectivity and directivity of aesthetic objects. People's cognition and aesthetics of objects are mainly grasped by external visual form elements such as color, shape, and material. Usually, good cognitive design can give users clear hints, make users search in a specific time and space according to their characteristics, improve mental efficiency, and reduce wrong operations.

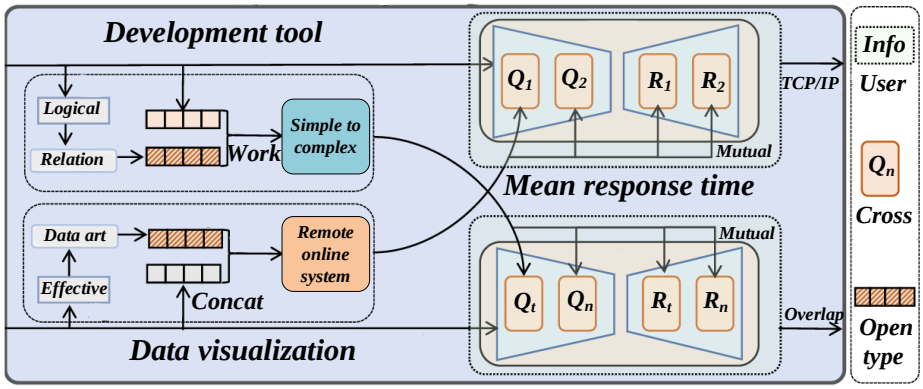

Figure 3: AI Enhanced Computer Vision Interaction Design Process

Figure 3 shows the AI-enhanced computer vision interaction design process. To explore the visual form elements of interactive design, the research must start with people's cognitive psychology and aesthetic psychology and analyze the relationship between people's visual experience and people's physiology, people's psychology, and people's emotions, which is helpful for people to recognize and understand the visual form elements of interactive design, and to grasp users from emotional aspects better and adopt effective design methods.

The interactive visual experience is mainly a sensory experience produced by the human eyes' perception and understanding of visual elements (Mahendran et al., 2021). The communication between eyes and objects is dynamic, and it is a grasp of the meaningful overall structure. Vision is the sensory function of human survival and the means of human thinking and communication. Studies have shown that 87% of the information obtained by human contact with the outside world comes from vision. However, from a physiological point of view, people's eyes produce visual phenomena that influence their understanding of things. From the physiological point of view, many factors affect users' visual experience.

The visual experience of interactive design mainly studies how to attract users' attention. Attention is a kind of psychological activity, which is the direction and concentration of certain things. The pointed and concentrated objects can be identified precisely because of the directivity and concentration of this psychological activity. These centralized and specified objects often become the center of attention, while the rest are at the "edge of attention."

Table 4: Man-machine Cooperation Task Completion Statistics

Collaborative task	AI Participation (Percentage)	Completion time (hours)	Success rate
Optimization of design scheme	80%	10	95%
Creative thinking stimulation	60%	8	85%
Suggestions on color matching	70%	6	90%

Table 4 shows man-machine cooperation task completion statistics. From the cognitive point of view, this is a kind of cognitive attention. This is a kind of aesthetic attention (Fan & Zhong, 2022). Cognitive attention is a kind of random attention, while aesthetic attention is involuntary attention. Cognitive attention is within the scope of human physiological vision from the position relationship,

while aesthetic attention is the information revealed in contrast, which can meet the aesthetic needs of the subject and conform to the aesthetic taste of the subject. The directivity and concentration of aesthetic attention are mainly manifested in the perception, experience, and understanding of the beauty of art form. The directivity and concentration of cognitive attention primarily manifest in the positional relationship of visual elements (Hao & Zeng, 2016). Aesthetic attention is a psychological activity, while cognitive attention is a physiological phenomenon. The visual experience of network interaction design includes cognitive and aesthetic attention.

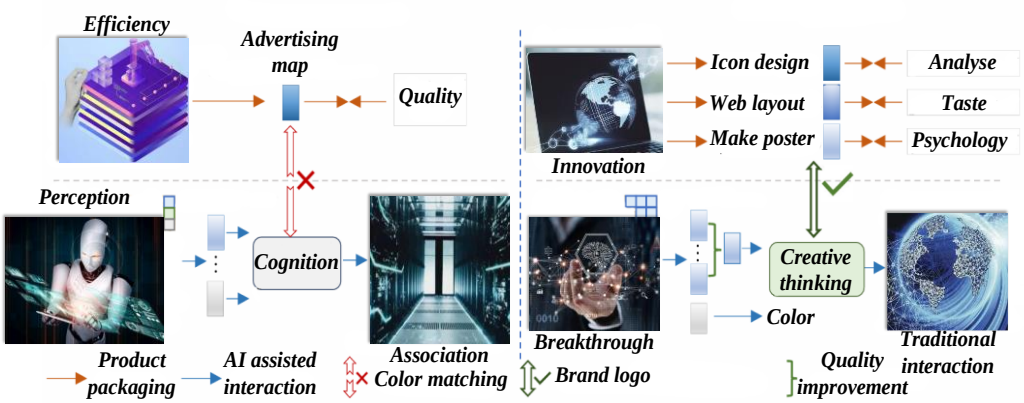

Figure 4: AI-Driven HCI and Visual Design Collaboration Optimization Flowchart

Figure 4 shows an AI-driven HCI and visual design collaboration optimization flowchart. Visual capacity is a problem that should be paid attention to in interactive visual design (Politikos et al., 2023). According to the physiological structure of the eyeball, the most effective perceptual part of vision occupies a small proportion of the retina, which determines that vision can only accommodate a small amount of visual information in a certain period, called visual capacity. The acceptance degree of visual capacity is affected by the personal qualities of visual objects and recipients (Wu et al., 2023). If the information received by vision exceeds the scope of visual capacity, it will produce a corresponding resistance reaction. According to people's visual capacity range, reasonable arrangement of various visual elements can create a good experience atmosphere.

3.2. Visual and Psychological Association

Vision can not only receive information but also arouse people's various psychological associations and produce emotional fluctuations. From the perspective of epistemology, visual psychology is a subjective reflection of the objective world. Visual elements of interactive design can not only convey information but also express people's emotions, promote people's emotions implicitly, and have a certain degree of influence on people's behavior. People's visual perception and psychological effects are carried out at the same time, which are interrelated and mutually restricted. Therefore, the designer should focus on visual perception and consider the relationship between visual and psychological activities (Mirra & Pugnale, 2022). According to network interactive visual design characteristics, this paper mainly analyzes the relationship between mental memory, psychological association, aesthetic needs, and visual experience.

Memory is a significant psychological activity in human visual psychological activities, and it is the basis of other thinking activities and behaviors. Among all cognitive psychological activities, memory and interaction are most closely related, and sensory and short-term memory are commonly used in the interaction process. Sensory memory refers to the instantaneous memory caused by

individuals feeling stimulated by sight, hearing, and smell, which only stays on the sensory level and has a short memory time. However, this visual stimulation has temporary afterimages, such as cartoon animation and sound.

Table 5: Effect Analysis of Key Technologies of HCI

Type of technology	Error rate before improvement	Error rate after improvement	Percentage decrease in error rate
NLP	10%	2%	80%
Speech recognition	15%	5%	67%
Affective analysis	20%	8%	60%

Table 5 shows the effect analysis of critical technologies of HCI. According to people's short-term memory storage law, attention should be paid to reducing people's memory burden in interaction design. The human brain has the function of reprocessing information, which makes it easier to remember commonly used memory contents and operation forms. It consciously inhibits similar but infrequent contents to reduce cognitive burden and prevent confusion (Wan & Ren, 2021). Keeping the correct correspondence is a way to reduce the memory burden. Because there is only one most important operation in a process, there is only one result in one operation. Therefore, the logical relationship should be clear, with the first, second, second, and second. The control of information is an effective way for designers to reduce users and burdens. The association is an essential psychological activity. The association is the relevant thinking from one thing to another, and it is a creative thinking activity carried out by the human brain, which integrates people's cognitive ability, memory ability, understanding ability, and imagination ability. The objective world has the truth of universal connection. Things with different connections are reflected in the brain, forming different associations, such as things that are close in time or space form close associations, things with similar characteristics form similar associations, things with opposite relations form comparative associations, and things with causal relations form causal associations.

People often use associative thinking to compare different things and find similar attributes between things. From blue to sky, sea, tranquility, and coolness; from purple to mystery, nobility, and charm; from orange to citrus, maple leaf, vitality, and enthusiasm; from swan to beauty, grace, and luxury; from swallow to lightness; from snail to slowness, from dog to loyalty, from the sun to light, enthusiasm, and hope, from mountain to mighty, from water to softness. These associations provide designers with multi-angle thinking for creating visual elements, thus creating many opportunities for recipients to think whimsically. People's impression of things is not a single existence and often has a particular connection with other feelings, such as color and graphics, color and sound, etc. In the interactive interface design, the research should make full use of the association of visual elements. For example, the design of music websites should consider the connection between music and color. Light music is mainly based on high brightness, while intense music wishes to consider using high-purity colors to express.

With the continuous progress of society, significant changes have occurred in the level of people's aesthetic needs, from sensory pleasure to implication comprehension, from value experience to spiritual realm sublimation. Aesthetic needs are usually divided into three stages: The primary stage is the pleasure beyond the physiological level caused by sensory stimulation, which gives people a pleasing psychological feeling and is attractive to the ear. The intermediate stage is to break through the limitation of perception through the perception of images inside information and experience the

infinite meaning of things. In the advanced stage, through the agitation of spirit, the research can achieve a life realm beyond morality, gain the experience of life value and the encouragement of ambition, and enjoy ambition and God (Wang & Gao, 2020). People's aesthetic needs first come from artistic visual elements with solid intuition and visualization. Visual elements meet people's aesthetic needs mainly through a series of processes from visual perception to feeling and then to perception, resulting in perceptual receptivity and emotional resonance. Among them, visual perception belongs to a physiological phenomenon, while sensory perception belongs to a psychological phenomenon.

4 Results and Discussion

In the information age, material needs are no longer the primary needs of people; subjective feelings are getting stronger and stronger, the direct interaction between people is reduced, the interaction between people and machines is increased, and people's emotional needs are more vital. The design tends to pay attention to people's emotional factors, hoping to find more accurate and precise semantics to strengthen the communication between users and products so that users can have trust and cordial emotional experience with products. At the same time, it is necessary to express the profound connotation of design using the symbolic meaning of graphic symbols to make up for the deficiency of modernist design connotation.

This work uses the template-matching approach for gesture extraction of features. This approach preprocessed the flexible sensing information and performed gesture identification by comparing the data with the gesture repository pattern. A standardized gesture collection was established for angles of 30°, 60°, 90°, and 120° according to the bending properties of finger connections, and template-based motion-matching studies were performed. Figure 5 illustrates the correlation between the corresponding impedance of flexibility biosensors and finger bending within the movement collection.

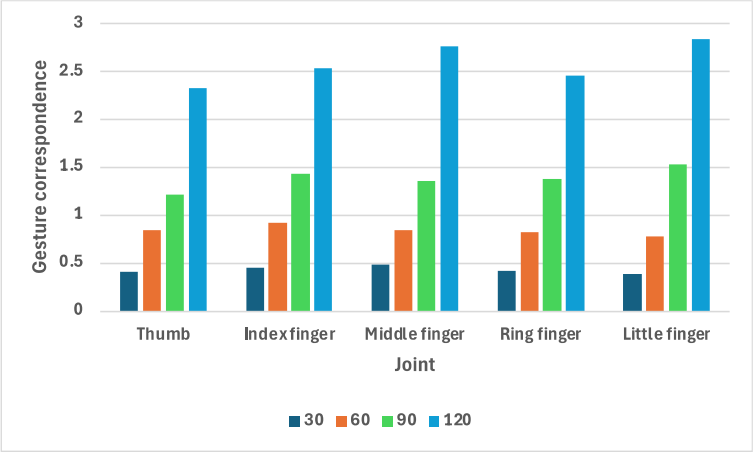

Figure 5: Gesture Analysis

In Figure 6, the degree of stretching positively correlated with the sensor's drawing force value, indicating that a boost in stretched corresponded with a rise in pulling force. The value of the pulling force exhibited a negative correlation with the temperature outside. At an ambient temperature of 0 °C, the necessary pulling force for the detector was at its peak.

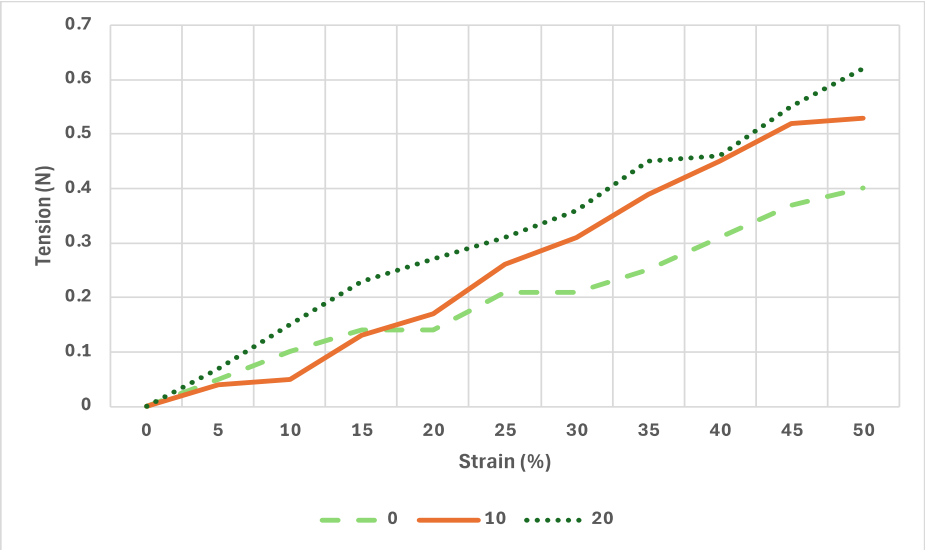

Figure 6. Tension vs Strain Analysis

Table 6: AI Innovation Application Effect on Visual Design Collaboration

Application type	**Design task completion time reduced (hours)**	**The number of innovation points has increased**	**User satisfaction improvement (out of 10 points)**
Intelligent color matching	2	5	1.2
Automated layout adjustment	1.5	4	1.0
Stylized Filter Recommendation	1	3	0.8

Table 6 shows the AI innovation application effect in visual design collaboration. According to the principle of psychology, emotion reflects the relationship between objective things and people's needs or an experience of whether objective things meet people's needs. Therefore, emotion belongs to a psychological expression of people, which is always accompanied by people's experiences and feelings about objective things. The emotion the research discusses from the angle of aesthetic psychology is called aesthetic emotion, which is different from general emotion. It belongs to an objective emotion and is detached. The generation of aesthetic emotion is always inseparable from aesthetic objects, and it is difficult for an unbeautiful thing to arouse aesthetic emotion. General emotion is often caused by the subject's perception of the content and form of the object, while the form can directly cause aesthetic emotion. Therefore, form plays a vital role in art.

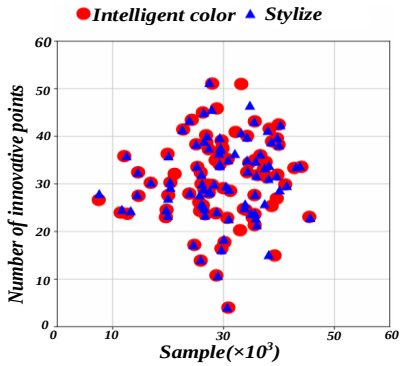

Figure 7: Data Analysis Chart of AI Improving HCI Efficiency

Figure 7 shows a data analysis chart of AI improving HCI efficiency. In the design of visual form elements of interactive design, aesthetic emotion should always run through the expression of visual form so that the original lifeless visual form elements can express deep inner feelings, enhance the visual impact of elements, and have profound connotations and ideas.

The starting point of network interaction design is to study people's psychological mode and behavior modes when people and things communicate, and on this basis, design interactive artifacts to meet people's three-level needs for using artifacts, namely usefulness, usability, and emotion. The aesthetic emotion of visual elements in interactive design plays a crucial role in interactive visual experience (Gavrilova & Kokoulina, 2019).

Network interactive interface is a visual form and a method of use. It has the accuracy of information transmission and richness of emotional expression, making people feel images and show interest. Interactive design often uses metaphor to express emotions. Metaphors are the most commonly used means of emotional expression in design, which can not only emphasize some appearance of the initial situation but make it full of interest in creating the situation. Metaphor connects the relationship between the whole picture elements through standard features so that each visual element can become a statement and convey information to varying degrees. When the visual elements in the picture are presented in front of the user, through the user's cognition, perception, and association of the visual elements, a kind of emotional fluctuation will naturally occur.

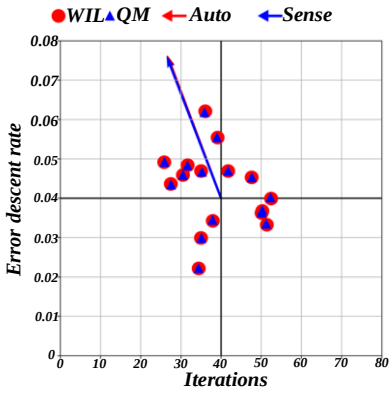

Figure 8: Efficiency and Accuracy Improvement of AI in Visual Design Collaboration Data Graph

Figure 8 shows the improvement in AI efficiency and accuracy in the visual design collaboration data graph. With the continuous development of immaterial products, function no longer follows form

but uses form to stimulate function. From an emotional perspective, turning boring data into interesting visual elements is not difficult. However, it is challenging to transform the visual form elements into art forms that meet the emotional needs of users. In Norman's Emotional Design, it is pointed out that the human brain has three different processing levels: instinctive, behavioral, and reflective. Three design levels correspond to the human brain's three processing levels: instinctive, behavioral, and reflective. The so-called automatic level design refers to the emotional design stimulated by visual, auditory, tactile, and taste experiences when people interact with things. For example, when people see red, they have a hot psychological feeling; when they see arc, they have a soft psychological feeling. These are easy to achieve in emotional design, and the designed works are more implicit, which makes people feel stimulated and rise to the emotional level.

5 Conclusion

The study effectively developed and evaluated an innovative resistive flexibility biosensor, mainly composed of polymer hydrogel substances, overcoming the constraints of conventional sensors regarding flexibility and size. The development of remote management systems for automated arms is significantly constrained. This research addresses pertinent issues by developing a flexible biosensor-based method of gesture identification in HCI, utilizing resistive extensible biosensors. By studying the application of AI in the field of HCI and visual design collaboration, the research can draw the following conclusions.

First, introducing AI has dramatically enhanced the interactive experience between people and computers. Through natural language processing, deep learning, and other technologies, computers can understand and respond to human language and make intelligent recommendations and automatic adjustments according to users' needs and habits. This improves the efficiency of interaction, makes the computer more intelligent and humanized, and further shortens the distance between man and machine.

Secondly, in visual design, AI shows excellent potential. By analyzing and learning a large amount of design data, AI can automatically generate visual elements that meet the requirements and provide intelligent suggestions and optimization schemes in the design process. This improves design efficiency and gives designers more creative inspiration and possibilities.

Finally, AI plays a vital role in man-machine cooperation. By building a shared working platform and intelligent decision-making system, AI can participate in design with designers and realize real man-machine collaboration. This cooperation mode helps improve design quality and efficiency and promotes innovation and development in the design field.

To sum up, AI is vital in strengthening the interaction between humans and computers and in the cooperation of visual design. In the future, with the continuous progress of technology and the continuous expansion of application scenarios, the research has reason to believe that AI will bring more innovations and breakthroughs to these two fields.

Future studies will concentrate on optimizing sensor content and designs, enhancing recognizing capabilities for complicated and shifting motions, broadening the management of multi-degree-of-freedom robotic systems, and integrating deep learning with multi-modal information integration to improve further the system's precision, solidity, and flexibility, thereby advancing the ongoing creation and utilization of adaptable electronics and intelligent control technology.

References

[1] Alkatheiri, M. S. (2022). Artificial intelligence assisted improved human-computer interactions for computer systems. *Computers and Electrical Engineering*, *101*, 107950. https://doi.org/10.1016/j.compeleceng.2022.107950.

[2] Chen, L., Wang, P., Dong, H., Shi, F., Han, J., Guo, Y., ... & Wu, C. (2019). An artificial intelligence based data-driven approach for design ideation. *Journal of Visual Communication and Image Representation*, *61*, 10-22.

[3] Fan, X., & Zhong, X. (2022). Artificial intelligence-based creative thinking skill analysis model using human–computer interaction in art design teaching. *Computers and Electrical Engineering*, *100*, 107957. https://doi.org/10.1016/j.compeleceng.2022.107957

[4] Gao, G., & Li, W. (2022). Architecture of visual design creation system based on 5G virtual reality. *International Journal of Communication Systems*, *35*(5), e4750. https://doi.org/10.1002/dac.4750

[5] Gavrilova, T. A., & Kokoulina, L. (2019). Using ontology engineering to design an artificial intelligence course. *In Smart Education and e-Learning 2019*, 201-207.

[6] Haleem, A., Javaid, M., Singh, R. P., Suman, R., & Rab, S. (2021). Biosensors applications in medical field: A brief review. *Sensors International*, *2*, 100100. https://doi.org/10.1016/j.sintl.2021.100100

[7] Han, X., Huang, D., Eun-Lee, S., & Hoon-Yang, J. (2023). Artificial intelligence-oriented user interface design and human behavior recognition based on human–computer nature interaction. *International Journal of Humanoid Robotics*, *20*(06), 2250020. https://doi.org/10.1142/S0219843622500207

[8] Hao, Y. W., & Zeng, C. (2016). On Reading Changes under the Fragmentized Reading Environment and Application of Visual Thinking in the Design of Mobile Multimedia Reading Interface. *In IEEE International Conference on Information System and Artificial Intelligence (ISAI)*, 168-171.

[9] Hudon, A., Demazure, T., Karran, A., Léger, P. M., & Sénécal, S. (2021). Explainable artificial intelligence (XAI): how the visualization of AI predictions affects user cognitive load and confidence. *In Information Systems and Neuroscience: NeuroIS Retreat 2021*, 237-246.

[10] Hult, C. H., & Schmidt, J. (2018). Human-Machine Interaction, Communication Initiation Probability Estimation-Communication initiation using Computer Vision, Machine Learning and Artificial Intelligence. https://hdl.handle.net/20.500.12380/256062

[11] Jerbić, B., Švaco, M., Šuligoj, F., Šekoranja, B., Vidaković, J., Turković, M., & Bušić, B. (2022). Interspecies Collaboration in the Design of Visual Identity: A Case Study. arXiv preprint arXiv:2201.10393.

[12] Kim, T., & Song, H. (2023). Communicating the limitations of AI: the effect of message framing and ownership on trust in artificial intelligence. *International Journal of Human–Computer Interaction*, *39*(4), 790-800.

[13] Levshinskii, V., Galazis, C., Losev, A., Zamechnik, T., Kharybina, T., Vesnin, S., & Goryanin, I. (2022). Using AI and passive medical radiometry for diagnostics (MWR) of venous diseases. *Computer Methods and Programs in Biomedicine*, *215*, 106611. https://doi.org/10.1016/j.cmpb.2021.106611.

[14] Liu, D. (2022). 3D face geometry optimization using artificial intelligence and computer graphics. *Scientific Programming*, *2022*(1), 9959153. https://doi.org/10.1155/2022/9959153.

[15] Liu, J. T., & Liu, Y. H. (2018). Application of computer molecular simulation technology and artificial intelligence in drug development. *App Innovation Technologies*, *2*, 46-47.

[16] Luo, J., Song, B., Blessing, L., & Wood, K. (2018). Design opportunity conception using the total technology space map. *Artificial Intelligence for Engineering Design Analysis and Manufacturing*, *32*(4), 449–461.

[17] Mahendran, J. K., Barry, D. T., Nivedha, A. K., & Bhandarkar, S. M. (2021). Computer vision-based assistance system for the visually impaired using mobile edge artificial intelligence. In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*, 2418-2427.

[18] Mei, Y. (2021). Module construction of new artificial intelligence system based on visual communication. *In International Conference on Forthcoming Networks and Sustainability in the IoT Era*, 336-342.

[19] Mirra, G., & Pugnale, A. (2022). Expertise, playfulness and analogical reasoning: three strategies to train Artificial Intelligence for design applications. *Architecture, Structures and Construction*, *2*(1), 111-127.

[20] Nagamine, M., Kohanteb, P., Yu, W., Chang, P., & Chow, D. (2020). Accuracy of Artificial Intelligence in Measuring Intracerebral Hemorrhage Volumes and Expansion Compared to Human Estimates (5018). *Neurology*, *94*(15_supplement), 5018. https://doi.org/10.1212/WNL.94.15_supplement.5018

[21] Oh, J. S., Kim, M. K., & Lee, D. H. (2021). A study on the selection of future AI+ X promising fields and the direction to strengthen competitiveness. *In IEEE International Conference on Artificial Intelligence in Information and Communication (ICAIIC)*, 371-374.

[22] Politikos, D. V., Adamopoulou, A., Petasis, G., & Galgani, F. (2023). Using artificial intelligence to support marine macrolitter research: a content analysis and an online database. *Ocean & Coastal Management*, *233*, 106466. https://doi.org/10.1016/j.ocecoaman.2022.106466.

[23] Pueyo, V., Pérez-Roche, T., Prieto, E., Castillo, O., Gonzalez, I., Alejandre, A., ... & Masia, B. (2020). Development of a system based on artificial intelligence to identify visual problems in children: study protocol of the TrackAI project. *BMJ open*, *10*(2), e033139. https://doi.org/10.1136/bmjopen-2019-033139

[24] Ranjitha, M., Nathan, K., & Joseph, L. (2020). Artificial intelligence algorithms and techniques in the computation of player-adaptive games. In *Journal of Physics: Conference Series*, *1427*, 1, 012006.

[25] Sattar, A., Khan, N., Moheeuddin, M., & Shaon, N. U. K. (2019). Bridging the Gap in HCI Between Industry and Academia: A Perspective in Bangladesh. *In IEEE 10th International Conference on Computing, Communication and Networking Technologies (ICCCNT)*, 1-6.

[26] Shen, A., & Sun, Y. (2021). Graphical AI: A user-centric approach to develop artificial intelligence and machine learning applications using a visual and graphical language. *In Proceedings of the 4th International Conference on Data Storage and Data Engineering*, 52-58.

[27] Šumak, B., Brdnik, S., & Pušnik, M. (2021). Sensors and artificial intelligence methods and algorithms for human–computer intelligent interaction: A systematic mapping study. *Sensors*, *22*(1), 20.

[28] Tony, A., Badea, I., Yang, C., Liu, Y., Wells, G., Wang, K., & Zhang, W. (2023). The additive manufacturing approach to polydimethylsiloxane (PDMS) microfluidic devices: review and future directions. *Polymers*, *15*(8), 1926. https://doi.org/10.3390/polym15081926.

[29] Wan, Y., & Ren, M. (2021). New visual expression of anime film based on artificial intelligence and machine learning technology. *Journal of Sensors*, *2021*(1), 9945187. https://doi.org/10.1155/2021/9945187

[30] Wang, Z., & Gao, Y. (2020). Application of artificial intelligence and Zen space in modern landscape design and topology optimization. *In IEEE International Conference on Electronics and Sustainable Communication Systems (ICESC)*, 173-176.

[31] Wu, Y., Ma, L., Yuan, X., & Li, Q. (2023). Human–machine hybrid intelligence for the generation of car frontal forms. *Advanced Engineering Informatics*, *55*, 101906. https://doi.org/10.1016/j.aei.2023.101906.

[32] Zhao, Z., & Li, X. (2020). The relationship model construction of dynamic color and visual attention based on mobile card layout. *In IEEE International Conference on Artificial Intelligence and Computer Engineering (ICAICE)*, 412-415.