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Reflections and Explorations on the Future Path of Human-Computer Interaction Design

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Abstract

With the rapid development of science and technology, human-computer interaction has penetrated into all aspects of our lives. From the popularity of smartphones to the rise of virtual reality, the ways and means of human-computer interaction are constantly evolving. The purpose of this paper is to explore the future of human-computer interaction design trends and thinking, and the interaction with the experience economy, digital survival and technology relationship. We will discuss from the three aspects of user experience, digital survival and technology relationship to provide some ideas and references for the development of human-computer interaction design in the future. Through in-depth research and continuous practical exploration, we can foresee that the diversity and richness of human-computer interaction design in the future will bring better experiences and more possibilities to people's lives.

Keywords

Design, Experience Economy, Digitization, Human-Computer Interaction (HCI), Interaction Design

1. Introduction

Human-computer interaction (HCI) is a technology that enables efficient communication between humans and computers through input and output devices. It encompasses the provision of extensive information and prompts to users by computers via output or display devices. HCI technology is a critical component of computer user interface design and is intimately linked with several academic fields including cognitive science, ergonomics, and psychology, positioning it as the future of computer science. Scholars have spent nearly half a century study-

ing computer production and programming; their next focus is on making computers more accessible to a broader audience, rather than obliging humans to adapt to computers. HCI encompasses a wide range of approaches: the first wave focused on the competence of specific machines for performing specific tasks, while the second wave emphasized contextualized use (Spence et al., 2013). Presently, HCI is evolving towards virtual reality and multi-channel directions from command-based, graphical, and multimedia phases (**Figure 1**).

The development of HCI technology is not only about improving the responsiveness and accuracy of computer systems, but also about optimising the user experience so that users can interact with computers in a more natural and intuitive way. By combining the theories of cognitive science, user interfaces can be designed to be more in line with human thinking patterns and operating habits, thus significantly improving user satisfaction and operating efficiency. At the same time, the study of ergonomics provides important theoretical support for HCI technology, and through the application of ergonomic principles, it can reduce the user's fatigue and discomfort when using computers and enhance the overall user experience.

In addition, the intervention of psychology has enabled HCI technology to have a deeper level of improvement in understanding and satisfying users' needs. Through psychological experiments and user behaviour analysis, designers are able to more accurately grasp the psychological expectations and usage habits of users, thus developing more humane interactive interfaces. For example, the introduction of affective computing allows computers to recognise and respond to the user's emotional state, thus providing more personalised and friendly services. The application of this technology is not only limited to the traditional computing field, but also shows a broad application prospect in various fields such as healthcare, education and entertainment.

The third wave of HCI trends is reflected in the rise of virtual reality (VR) and multi-channel interaction technologies. VR technology greatly expands the scope and depth of HCI applications by enabling users to interact in a virtual environment through immersive experience. Multi-channel interaction technology, on the other hand, provides a richer and more three-dimensional interaction experience by integrating multiple sensory information such as voice, touch, and vision. The development of these technologies foretells that HCI will continue to advance in the direction of greater intelligence and humanisation in the future, and become an important force in promoting the progress of computer science and technology.

HCI has ascended to the research dimensions of interdisciplinary integration and complex system optimization (Boy, 2022). Mishra et al. (2023) assert that the core of HCI lies in enhancing user experience to improve operational efficiency and satisfaction. Reddy (2024) contends that HCI should focus on the deep integration of artificial intelligence and human cognition to achieve higher levels of intelligent interaction. The transition from focusing on interface design to user experience and emotional interaction reflects the shift in research trends

from single technology optimization to multidimensional human-centric care (Pagar et al., 2024). HCI design is evolving towards greater intelligence and humanization. The knowledge barrier in related research is manifested in the disconnection between interdisciplinary research and technological application (Yang et al., 2023). Jiao (2022) emphasizes that HCI design needs to pay more attention to user experience and social impact. However, current work lacks in systematization and comprehensiveness. By clarifying the relationship between interaction design and the experience economy, this paper aims to outline the four major characteristics of HCI design in the digital context and to discuss its relationship with technological ethics, thus highlighting the opportunities and challenges in this field and exploring future HCI design pathways.

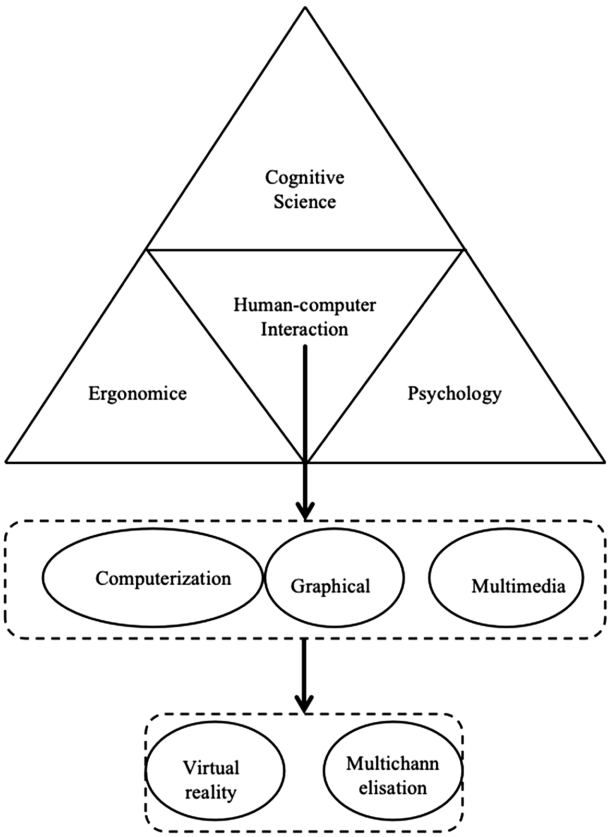

Figure 1. HCI related disciplines and trends.

2. HCI Design and the Experience Economy in the Future

2.1. Definition of the Experience Economy

Economic outputs exist in four categories—raw materials, products, services, and experiences, with each category ascending in value (**Table 1**). The experience economy represents the fourth category of economic output, differentiating experiences from services as distinctly as services differ from products (Scitovsky, 1992).

Shedroff, in "Experience Design", initially defined experience design as inte-

grating consumer participation into the design process. This approach involves using services as a "stage", products as "props", and settings as "backdrops" to create delightful experiences during commercial activities. The generation of experiences involves deliberately utilizing stories, stages, performers, and products as props to captivate consumers' attention. However, the experience has also been a long-unrecognized category of economic output. Indeed, the experience economy has always been around us, albeit often classified under services, confounding mundane industries like dry cleaning, repairs, wholesale, and telephone consulting. An experience involves personalized participation in events, providing unique memories. It offers a new source of value for consumers; successful product design creates agreeable consumption and usage experiences.

Table 1. Names and differences between the four economic outputs.

	Primary product	Offerings	Service	Experiences
Hidden meaning	Raw materials required for the production of the product	Physical manifestations required for service delivery	The intangible operations required to create the experience	Memorable events needed to induce change
Economic pattern	Agricultural economy	Industrial economy	Service economy	Experience economy
Economic function	Withdraw	Fabrication	Deliveries	Build
Key attributes	Naturalness	Standardisation	Customisation	Individuality
Elements of demand	Diagnostic property	Characterisation	Behalf	Feel

Purchasing a service results in a series of commercial activities. Simply put, the experience economy involves spending money on a service that delivers satisfaction—essentially a memorable experience akin to a theatrical performance that involves personal participation. Disneyland is a prime example of the experience economy. Creating experiences has always been central to the entertainment industry, offering complete products from stories to animations that provide unique, comprehensive sensory experiences. Customers may not remember when they bought a cup, but they will always cherish memories of visiting Disneyland with loved ones. The memorability of experiences, distinct from the exchangeability of raw materials, the tangibility of products, and the intangibility of services, is a defining feature of the experience economy.

Experience economy is also a form of embodied cognition, a school of cognitive psychology that has developed over the past half-century. Its core premise is that the physical state of the body plays a crucial role in shaping cognition (Shedroff, 2000). Unlike cognitive science, which views the human brain as a functional organ while overlooking the intrinsic relationship between the body and consciousness, the seminal work "The Embodied Mind" by Francisco Varela, which adopts and expands on Merleau-Ponty's phenomenological ideas, advocates an enactive approach. This perspective posits that cognition is shaped by sensory-motor interactions between the subject's body and the environment. Key viewpoints include: cognition depends on direct sensory and operational

experiences; an individual's sensory-motor capabilities are integrated within physiological and cultural environments; and cognition, body, and environment are inseparable, with cognition forming through the interplay between body and surroundings (Li et al., 2024).

2.2. The Purpose of Experience Creation in the Experience Economy

The substantive essence and the natural evolutionary trend of economic value, namely the progression from primary products to products, then to services, and ultimately to experiences, underscores a pivotal shift. This trajectory is propelled by the increasing affluence of society. As posited by the economist Scitovsky (1992), "The main manifestation of human affluence is the increased frequency of social gatherings and consumption; individuals are likely to augment the number of significant gatherings and festivals until they become routine practices such as weekend dinners." This parallels the indulgence procured through monetary expenditure, where individuals frequently patronize tasteful restaurants, choosing venues with a festive ambiance or picturesque settings even on non-holidays.

Although intangible and elusive, experiences are highly sought after primarily due to their memorability, which embeds their value deeply within the human psyche. Research by Kim and Yoon (2023) from Cornell University reveals, "Purchasing experiences brings greater happiness compared to purchasing products, yielding a higher satisfaction." Concurrently, The Economist has summarized recent economic studies on "pleasure", concluding that "the joy derived from experiences surpasses that of goods, the pleasure of leisure exceeds that of adornments, and the satisfaction from employment transcends that of possessing money itself (Scitovsky, 1992)." Evidently, the experiential economy harbors the potential to significantly enhance economic benefits (**Figure 2**).

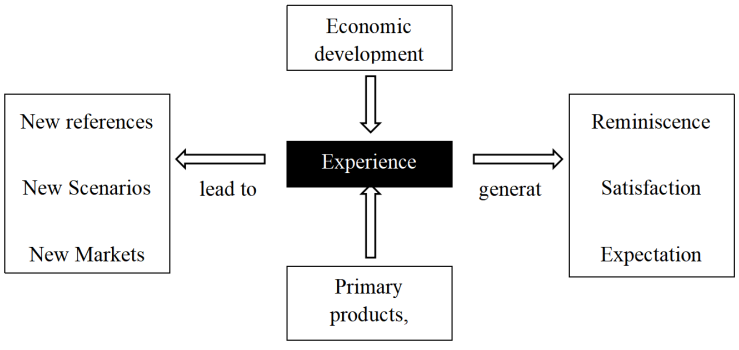

Figure 2. How the experience economy can lead to greater efficiency.

2.3. The Future of HCI Design and the Experience Economy Connection

"Experience" constitutes a critical research theme within the HCI discipline, where the design of engaging and friendly textual phrases, as opposed to stark

and rigid expressions, significantly appeals to users, resonating emotionally with them. With the continual advancement of technology, new materials, technologies, forms, and concepts (Zuraikat, 2020) are increasingly integrated into products, elevating the conceptual dimensions of products. In this process, adhering to the "user-centered" principle is crucial; users should be involved throughout the iteration of product design. Consumer demand has shifted from functional requirements to experiential demands; people are no longer satisfied merely with the functionality of products but place greater emphasis on the experiences these products facilitate. Currently, "experience" is poised to transcend the dichotomy of function (science and technology) and aesthetics (art and design), with future designs focusing more on comprehensive experiential aspects. As personalized design reaches the pinnacle of functionality, the relationship between users and products is becoming increasingly intimate, better satisfying users' spiritual needs.

For instance, Google's smart glasses represent a cutting-edge wearable digital device. Although smartphones are the most mature smart products currently available, Google Glasses offer similar functionalities, serving as a second "augmented reality display" (Lagerkvist, 2018). Their defining feature is the capability to project information directly onto the lenses, allowing users to interact hands-free at any time, facilitating information queries, file sending and receiving, selfies, or navigation and location tracking without the need for manual input, thus alleviating many inconveniences and enhancing the software application experience.

Experience design is a user-centric design approach that emphasizes addressing users' emotions, needs, and experiences in the design of products or services. The core of experience design lies in creating meaningful user experiences that emotionally connect users to products or services. Applied across various fields such as product design, interaction design, and service design, understanding users' needs and behaviors is imperative in experience design. By comprehending users' backgrounds, habits, preferences, and other aspects, designers can deliver personalized experiences. Moreover, experience design also focuses on considering factors such as usability, accessibility, and maintainability from the users' perspective.

As opposed to luxury goods that satisfy vanity, people prefer products with high new-value ratios, shifting consumption towards the experiential economy, as seen in the preferences of the youth for music festivals, comic conventions, and various markets. Businesses are striving to create experiential opportunities, adding elements that enhance the interactive feel between customers and products. For example, the new tea brand "Naixue's Tea" has collaborated with the Chinese animation "Heaven Official's Blessing" to set up co-branded theme stores. The stores are adorned with posters and displays related to "Heaven Official's Blessing", attracting many young patrons to visit and take photos. Future design will start with the younger demographic and gradually expand to include older audiences, designing experiences suitable for diverse groups. Hence, future

design should prioritize the experiential economy trend, as the experiential economy will form a significant sector in future economic consumption.

3. The Future of HCI Design from a Digital Perspective

3.1. Four Characteristics of Digital Survival

The four defining characteristics of digital existence are the decentralization of power, globalization, the pursuit of harmony, and empowerment (Ramoğlu, 2019). It is critical to distinguish between "power", a political construct signifying coercive authority over others, and "rights", a legal concept pertaining to one's entitlements to protect interests. Unlike rights, which are held by individuals and can be relinquished or transferred, power is typically wielded by state institutions and their functionaries, necessitating lawful and non-transferable execution.

In the context of digital existence, the characteristic of decentralized power does not align with state-level parliamentary or anti-autocratic systems; rather, it indicates that an individual's ability to exert personal influence is dispersed. Globalization needs little explanation. The pursuit of harmony may be understood as striving for peace and a balance between the spiritual and material realms. The empowerment in digital existence uniquely allows individuals to judge and surveil others, facilitating access to the fast-paced exchange of information that can precipitate change.

3.2. Designing Interfaces for the Human-Machine Future of Digital Survival

A principal tenet for future HCI design in digital existence is minimalism, encapsulated by the principle "less is more". Functionality that comprehensively understands user characteristics and the environmental context, capable of autonomously executing or condensing signals, and that respects individual preferences, is essential. An intelligent HCI interface acts as an informed intermediary that not only comprehends processes, fields of interest, and methods but also appreciates the user's tastes, tendencies, and social contexts, integrating expertise with user understanding as an "agent". Technologically driven product development often overlooks user needs; thus, it is the designer's duty to steer technology towards more human-centered goals (Konstantakis & Caridakis, 2020).

3.3. Future HCI Design for Digital Survival

In digital existence, the keywords for future HCI design are customization, personalization, controllability, and accessibility. Against the backdrop of digital existence, these elements represent the significant trajectories for the advancement of HCI design (**Figure 3**).

Customization in the Digital Era. In the digital age, user needs are diverse, and product requirements vary individually. Consequently, future Human-Computer

Interaction (HCI) design must cater to personalized user demands, providing tailored interactive experiences through data analysis and artificial intelligence technologies. For instance, smart home systems may automatically adjust environmental factors such as temperature, lighting, and humidity based on user habits and preferences, enhancing the comfort of living experiences.

Personalization in HCI Design. With the widespread adoption of mobile internet and the continuous evolution of intelligent terminals, user personal information and preferences are extensively recorded and analyzed. HCI designs of the future must leverage this data to integrate personal elements into product design, thereby improving product usability and user experience. For example, smartwatches could customize the watch face and straps based on user's wrist size and usage habits, enhancing comfort and convenience.

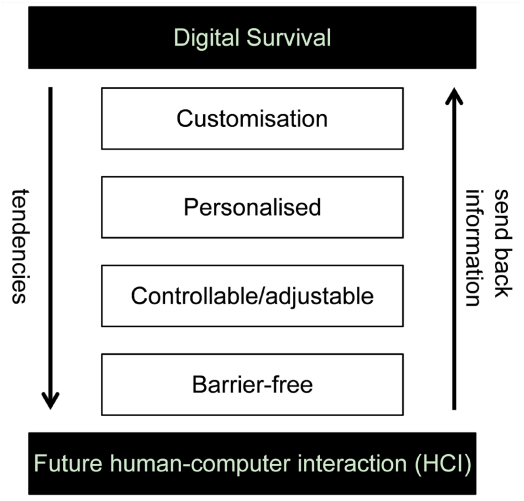

Figure 3. HCI design for digital production.

Control and Adjustability. In this digital era, users' control and autonomy over products are increasingly significant. Future HCI designs should thoroughly address user needs and psychology, facilitating product usage and functionality through intuitive interfaces and feedback mechanisms. Smart speakers, for instance, could employ voice recognition and natural language processing to allow users to effortlessly control music playback, inquire about the weather, and set reminders, thereby increasing trust and reliance on the product. The design philosophy enabling users to freely control product attributes and functions through customizable interface elements, like "knobs," enhances product flexibility and adaptability. Additionally, designers can employ intelligent technologies such as visual interface design, voice and gesture recognition to further ease of use and user experience.

Accessibility in HCI Design. Future HCI design will increasingly focus on accessibility, with designers emphasizing equal usage opportunities for all users, including those with disabilities or special needs. Accessible design aims to facilitate the convenient use of products or services by a broader audience, focusing

on the emotional elements of design to evoke emotional resonance and identification during use.

Designers must consider user needs and psychology, employing innovative design techniques and technology to continually improve product usability and user experience. At the same time, they should actively explore new interactive models and interface design methods to meet the demands of the digital age and the changing needs of users.

4. Dialectical Thinking about the Relationship between Future HCI Design and Technology

4.1. The Future of HCI Design versus Technology

Dialectical considerations between future HCI design and technology encompass several aspects: Interdependence: 1) Technological advancements afford new possibilities and tools for design, while the demands and challenges of design also drive technological innovation and progress. Design and technology foster a symbiotic relationship where one cannot exist without the other; 2) Collaborative Innovation and Balance: Design and technology require collaborative innovation, working in tandem to achieve optimal outcomes. Design relies on technological support to materialize its creativity, and technology seeks design guidance to fulfill user needs. Finding a balance depends on designers' understanding of technology and technologists' grasp of design principles. The evolution of technology also impacts the roles and responsibilities of designers, who must comprehend its potential and constraints to integrate it effectively into design. Moreover, designers are responsible for considering the human and environmental impact in their technological applications; 3) Human-centric Design and Technological Essence: The aim of design is to meet human needs and desires, with technology serving as the medium for realization. In combining design with technology, designers must prioritize human-centric principles, applying technology to enhance human welfare. Furthermore, design can guide the direction of technological development to serve human happiness and progress. This combination should also consider the principles of sustainable development, addressing challenges such as resource depletion and environmental pollution. Designers are tasked with contemplating efficient resource use and environmental protection to promote sustainable design and technological innovation; 4) The relationship between future design and technology is complex and multidimensional, necessitating close cooperation and understanding between designers and technologists to achieve innovative, sustainable, and human-centric development. A principal objective of future HCI is to contribute to the quality of life by designing for joy rather than merely the absence of discomfort (Bosch et al., 2022).

4.2. The Logic of Science, Technology and Design

The contemporary interplay of science and art is one of mutual influence, bor-

rowing, and integration. This intersection has unearthed an inherent progressive logic within art design. The evolution of science has given rise to pragmatism, prompting designers to integrate scientific theories for innovation to meet new market demands. This innovative process, where design and technical thinking converge, has propelled the exploration and extension of the integration of art and science.

Upon the advancement of science and technology, designers continually refresh their design thinking and methods, thereby fostering the ongoing development of design. In this synergy, designers and scientists align at a common starting point, unifying science and art. However, science and art remain as two distinct systems with significant differences in thought processes and practical methods. Scientific thinking, aimed at discovery and validation, emphasizes the principles of being scientific, objective, reproducible, and testable. Artistic thinking, on the other hand, is characterized by its sensibility and imagination, accentuating subjectivity, innovativeness, and creativity, highlighting the significant distinction between them.

4.3. The Relationship between the Four Literacies of Science and the Four Orders of Design

There are parallelisms between the four scientific proficiencies and the four orders of design (Table 2). The scientific knowledge within the four scientific proficiencies, which entails understanding and cognition, correlates with the first order of design where symbols intuitively convey cognition. Scientific methods, which involve using models and field experiments to solve practical problems, are akin to the second order of design, where physical models offer more intuitive pre-testing. Scientific interest, the continuous attention and exploration of the physical world, matches the third order of design, where experiential interactions are key to fostering ongoing engagement. Finally, the scientific spirit, a respectful and pursuit-oriented attitude towards the physical world, aligns with the fourth order of design, where systemic integration aids in better understanding of the physical world.

Table 2. Points of match between the four literacies of science and the four orders of design.

The Four Literacies of Science	Scientific knowledge	Scientific method	Scientific interest	Scientific spirit
Design Four Order	Conveyance/Symbol	Constructs/Objects	Interaction/Action	Integration/Ideas

The four orders of design expand the scope of design objectives and prompt a reevaluation of the essence of design. Their alignment with scientific thinking means that when designers contemplate these orders, they inherently integrate scientific reasoning. This is why the four orders of design can directly impact contemporary design thinking, thereby inspiring design innovation.

5. Discussions

This study echoes the following literature. Yang et al. (2012), through the introduction of 'affective computing' theory, discussed the role of emotions in interaction design, while this paper specifically relates to the relevance of intelligent interface design, revealing the forms of emotional factors in enhancing user experience. By incorporating affective computing into the design domain, Boehner et al. (2005) explored how affective computing plays a role in user interaction from a sociological perspective. In contrast, Konstantopoulos and Karkaletsis (2013) argue that technical intuition is crucial for user experience. They introduced the concept of "intuitive interaction" in interface design and discussed how to enhance users' intuitive operation experience from a psychological perspective. This paper applies affective computing specifically to intelligent interface design, providing a new perspective for intelligent interaction. From a sociological perspective, Stark and Hoey (2021) considers affective computing not only as a technical issue but also as a reflection of social phenomena, offering a bridge to evaluate and understand users' emotional responses. The application of affective computing in different historical periods shows significant differences, challenging traditional design theories and providing empirical support for the practical application of affective computing's critical framework. In the field of HCI, research typically focuses on "user experience" interactions, whereas in affective computing, research elevates to the user emotion level. In the design field, research often centers on how to meet user needs through design. Ghandi et al. (2021) extended affective computing to the discussion of intelligent interfaces, considering affective computing as a key factor in enhancing user experience. This paper traces affective computing back to intelligent interface discussions, expanding to emotional interaction design. Through interdisciplinary research methods, this paper provides a concrete implementation pathway.

Recent studies continuously update the concept of HCI design. Zhang et al. (2021) point out that the essence of HCI design is to achieve seamless communication and collaboration between humans and machines. Kulyk et al. (2014) believe that the purpose of HCI design is to find the best fit between technology and user needs. From a historical dimension, Sasse & Johnson (1999) state that studying the past is to extract valuable experiences to guide future design and innovation. This paper introduces related factors of multifactor interaction, exploring how different design concepts impact user experience, revealing the adaptability of HCI in various application scenarios, and how to extend user satisfaction through optimized design. From a sociological perspective, the social dynamics inherent in HCI drive the bidirectional development of technology and user needs. In the context of globalization, achieving innovation in HCI design within diverse cultures and complex demands becomes a crucial research topic. Practically, the value of HCI design lies in its multi-level adaptability mechanism and provides a new interdisciplinary perspective.

HCI design is embedded with and closely related to user behavior patterns,

originating from a complex social and technological environment. The new era of HCI concepts surpasses traditional interface design, merely achieving single-function realization. Instead, it aims to establish a more intelligent and humanized interactive system through multidimensional and multi-level design, innovatively expanding the boundaries of user experience. To address the comprehensive development of HCI design in the context of digital and intelligent eras, this paper proposes three levels of future HCI design implementation paths: 1) Fundamental level, aiming to enhance the intuitiveness and usability of the interactive interface by optimizing interface design and user feedback mechanisms to improve user experience; 2) Intermediate level, aiming to realize personalized and intelligent interactive functions by introducing artificial intelligence and machine learning technologies, enhancing system adaptability and response speed; 3) Advanced level, aiming to construct holistic optimization and collaborative design of complex systems through interdisciplinary integration, improving system performance and user satisfaction. Relevant literature over the past two decades has mainly focused on exploring the first two levels, while this paper provides theoretical frameworks and practical pathways for the realization of the third level.

6. Conclusion

This article explores the trends and considerations in future HCI (Human-Computer Interaction) design, analyzing the mutual influences between the experience economy, digital existence, and technological relationships. It discusses from the perspectives of user experience, digital life, and technological relationships, offering insights and references for the development of future HCI designs. By integrating various design keywords, the article suggests that innovation should be promoted through practical wisdom and research capabilities in design. The future direction of HCI aims to drive innovation, commercial success, and a higher quality of life, encouraging a shift in design from mechanization, electrification, and automation to intelligent systems.

Moreover, the paper delves into the future trends of HCI design and the interplay between the experience economy, digital existence, and technology. It provides strategies and references for the evolution of HCI design by elaborating on three facets: user experience, digital existence, and technological relationships. For future HCI endeavors, designers should focus on the trends and applications of emerging technologies while continuously innovating and developing user-oriented design solutions. Collaborative efforts with users, technical experts, and interdisciplinary fields are crucial for creating interactive products and services that are superior, innovative, and aligned with user expectations.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

Boehner, K., DePaula, R., Dourish, P., & Sengers, P. (2005). Affect: From Information to Interaction. In *Proceedings of the 4th Decennial Conference on Critical Computing: Between sense and Sensibility* (pp. 59-68). Association for Computing Machinery. https://doi.org/10.1145/1094562.1094570

Bosch, E., Bethge, D., Klosterkamp, M., & Kosch, T. (2022). Empathic Technologies Shaping Innovative Interaction: Future Directions of Affective Computing. In *Adjunct Proceedings of the 2022 Nordic Human-Computer Interaction Conference* (pp. 1-3). Association for Computing Machinery. https://doi.org/10.1145/3547522.3547703

Boy, G. A. (2022). *Aerospace Human System Integration Evolution over the Last 40 Years.* arXiv:2201.10275. https://doi.org/10.48550/arXiv.2201.10275

Ghandi, M., Blaisdell, M., & Ismail, M. (2021). Embodied Empathy: Using Affective Computing to Incarnate Human Emotion and Cognition in Architecture. *International Journal of Architectural Computing, 19,* 532-552. https://doi.org/10.1177/14780771211039507

Jiao, M. (2022). The Use of Cognitive Psychology-Based Human-Computer Interaction Tax System in Ceramic Industry Tax Collection and Management and Economic Development of Jingdezhen City. *Frontiers in Psychology, 13,* Article 944924. https://doi.org/10.3389/fpsyg.2022.944924

Kim, D., & Yoon, Y. (2023). The Influence of Consumer Purchases on Purchase-Related Happiness: A Serial Mediation of Commitment and Selective Information Processing. *Behavioral Sciences, 13,* Article 396. https://doi.org/10.3390/bs13050396

Konstantakis, M., & Caridakis, G. (2020). Adding Culture to UX: UX Research Methodologies and Applications in Cultural Heritage. *Journal on Computing and Cultural Heritage, 13,* 1-17. https://doi.org/10.1145/3354002

Konstantopoulos, S., & Karkaletsis, V. (2013). System Personality and Adaptivity in Affective Human-Computer Interaction. *International Journal on Artificial Intelligence Tools, 22,* Article ID: 1350014. https://doi.org/10.1142/s0218213013500140

Kulyk, O., op den Akker, R., Klaassen, R., & van Gemert-Pijnen, L. (2014). Personalized virtual Coaching for Lifestyle Support: Principles for Design and Evaluation. *International Journal on Advances in Life Sciences, 6,* 300-309. http://thinkmind.org/index.php?view=article&articleid=lifsci_v6_n34_2014_21

Lagerkvist, A. (2018). *Digital Existence: Ontology, Ethics and Transcendence in Digital Culture.* Routledge. https://doi.org/10.4324/9781315107479 https://www.amazon.com/s?k=9781351607179&i=stripbooks&linkCode=qs

Li, W., Liu, Y., Lv, H., Ma, Y., Shi, W., & Qian, Y. (2024). Using Graphic Psychology and Spatial Design to Intervene in Balance Coordination in Patients with Balance Disor-

ders. *Journal of Asian Architecture and Building Engineering*. https://doi.org/10.1080/13467581.2023.2300395

Mishra, R., Satpathy, R., & Pati, B. (2023). Human Computer Interaction Applications in Healthcare: An Integrative Review. *EAI Endorsed Transactions on Pervasive Health and Technology, 9,* 1-10. https://doi.org/10.4108/eetpht.9.4186

Pagar, M. C., Savale, T. K., Patil, P. U., Mutha, N., Wanjare, H. F., & Mogare, S. B. (2024). Human-computer Interaction in Smart Living Environments: Challenges and Opportunities. *Journal of Informatics Education and Research, 4,* 1083-1090. https://doi.org/10.52783/jier.v4i1.686

Ramoğlu, M. (2019). Cyborg-computer Interaction: Designing New Senses. *The Design Journal, 22,* 1215-1225. https://doi.org/10.1080/14606925.2019.1594986

Reddy, S. T. A. (2024). Human-Computer Interaction Techniques for Explainable Artificial Intelligence Systems. *Recent Trends in Artificial Intelligence & It's Applications, 3,* 1-7. https://matjournals.net/engineering/index.php/RTAIA/article/view/24

Sasse, M. A., & Johnson, C. W. (1999). *Human-Computer Interaction-INTERACT'99: IFIP TC.* IOS Press. https://www.amazon.com/s?k=9780967335506&i=stripbooks&linkCode=qs

Scitovsky, T. (1992). The Joyless Economy: The Psychology of Human Satisfaction. Oxford University Press. https://doi.org/10.1093/oso/9780195073461.001.0001 https://global.oup.com/academic/product/9780195073478?i=9780195073478

Shedroff, N. (2000). *Information Interaction Design: A Unified Field Theory of Design.* http://echo.iat.sfu.ca/library/shedroff_99_unified.pdf

Spence, J., Frohlich, D., & Andrews, S. (2013). Performative Experience Design: Where Autobiographical Performance and Human-Computer Interaction Meet. *Digital Creativity, 24,* 96-110. https://doi.org/10.1080/14626268.2013.808964

Stark, L., & Hoey, J. (2021). The Ethics of Emotion in Artificial Intelligence Systems. In *Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency* (pp. 782-793). Association for Computing Machinery. https://doi.org/10.1145/3442188.3445939

Yang, G. L., Zhang, J. H., & Sun, H. (2012). Design of Emotional Interaction System Based on Affective Computing Model. *Applied Mechanics and Materials, 198,* 367-373. https://doi.org/10.4028/www.scientific.net/amm.198-199.367

Yang, H., Tong, Z., Dai, L., Zhou, W., Dai, E., Wang, M. et al. (2023). Research on the Design of Ergonomic Simulation Platform for Complex System Equipment Based on Virtual and Real Fusion. In *2023 4th International Conference on Intelligent Computing and Human-Computer Interaction (ICHCI)* (pp. 163-170). IEEE. https://doi.org/10.1109/ichci58871.2023.10278023

Zhang, X., Sun, Y., & Zhang, Y. (2022). Evolutionary Game and Collaboration Mechanism of Human-Computer Interaction for Future Intelligent Aircraft Cockpit Based on System Dynamics. *IEEE Transactions on Human-Machine Systems, 52,* 87-98. https://doi.org/10.1109/thms.2021.3116115

Zuraikat, L. (2020). Google Glass: A Case Study. *Performance Improvement, 59,* 14-20. https://doi.org/10.1002/pfi.21919