A Review on Artificial Intelligence Supported User-Centered Design and Psychological Interaction

Yapay Zekâ Destekli Kullanıcı Merkezli Tasarım ve Psikolojik Etkileşim Üzerine Bir Derleme

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ABSTRACT

This article explores how the integration of architecture, artificial intelligence (AI) and psychology plays an important role in the design of user-centered spaces that prioritize psychological well-being. In recent years, the intersection of these three disciplines has been transforming space design processes and offering new perspectives. Artificial intelligence is transforming design processes through automated optimization and user behavior analysis. Smart living spaces and AI-powered accessibility solutions increase the potential to create personalized spaces, better meeting the emotional and psychological needs of users. At the same time, the use of AI raises challenges such as ethics, data privacy and algorithmic bias, and algorithmic transparency and accountability are gaining importance. By strengthening the collaboration between architecture and psychology, this integration aims to deepen the understanding of the psychological effects of space design on the user and enrich the user experience. This, in turn, enriches the practice of architecture and increases the potential to create more responsive and supportive spaces. In conclusion, the intersection of the disciplines of architecture and psychology offers significant opportunities to create more responsive and supportive spaces, which in turn enriches the practice of architecture and opens new horizons for creating spaces that will improve the quality of life of users. This integration will continue to shape the future of the field, based on interdisciplinary collaboration, innovative research methods and a user-centered design approach.
Keywords: AI-Supported Design, Psychological Interaction, Architecture.

ÖZET

Bu makalede; mimarlık, yapay zekâ (AI) ve psikoloji disiplinlerinin entegrasyonunun, kullanıcı odaklı ve psikolojik refahı ön planda tutan mekanların tasarımında nasıl önemli bir rol oynadığı incelenmektedir. Son yıllarda, bu üç disiplinin kesişimi, mekân tasarım süreçlerini dönüştürmekte ve yeni perspektifler sunmaktadır. Yapay zekâ, tasarım süreçlerini otomatik optimizasyon ve kullanıcı davranış analizi yoluyla dönüştürmektedir. Akıllı yaşam alanları ve AI destekli erişilebilirlik çözümleri, kişiye özel mekanlar yaratma potansiyelini artırarak kullanıcıların duygusal ve psikolojik ihtiyaçlarını daha iyi karşılamaktadır. Aynı zamanda, yapay zekanın kullanımı etik, veri gizliliği ve algoritmik bias gibi zorlukları gündeme getirmekte ve algoritmik şeffaflık ile hesap verebilirlik önem kazanmaktadır. Bu entegrasyon, mimarlık ve psikoloji arasındaki iş birliğini güçlendirerek, mekân tasarımının kullanıcı üzerindeki psikolojik etkilerini derinlemesine anlamayı ve kullanıcı deneyimini zenginleştirmeyi amaçlamaktadır. Bu da mimarlık pratiğini zenginleştirerek, daha duyarlı ve destekleyici mekanlar yaratma potansiyelini artırmaktadır. Sonuç olarak, mimarlık ve psikoloji disiplinlerinin kesişimi, daha duyarlı ve destekleyici mekânlar yaratma konusunda önemli fırsatlar sunmakta, bu da mimarlık pratiğini zenginleştirerek kullanıcıların yaşam kalitesini artıracak mekanlar yaratma yolunda yeni ufuklar açmaktadır. Bu entegrasyon, disiplinler arası iş birliğine, yenilikçi araştırma yöntemlerine ve kullanıcı odaklı tasarım anlayışına dayanarak, alanın geleceğini şekillendirmeye devam edecektir.
Anahtar Kelimeler: Yapay Zekâ Destekli Tasarım, Psikolojik Etkileşim, Mimarlık.

INTRODUCTION

In recent years, the intersection of architecture, artificial intelligence (AI) and psychology has become a focal point for technological innovation and social change. The integration of these three fields has the potential to create spaces that are more responsive to users' needs and well-being. Artificial intelligence applications in architecture are transforming design processes and offering new perspectives on how buildings are designed, constructed and used. This review aims to address the rise of AI in architecture, the importance of user-centered design and its implications for people's psychological well-being.

Architecture is the art and science of creating physical spaces that meet people's environmental and social needs. Artificial intelligence is a branch of computer science that enables machines to perform functions similar to human intelligence by imitating their learning, decision-making and problem-solving abilities. Psychology, as the branch of science that studies the behavior, thoughts and emotions of individuals, offers the key to how these two fields can be integrated with a human-centered approach.

Today, the use of AI in architecture aims not only to automate design and construction processes, but also to improve the user experience and increase the energy efficiency and sustainability of buildings over their lifetime. This is made possible by the potential offered by AI, especially in terms of its capacity to understand user needs and shape spaces accordingly. User-centered design prioritizes the emotional and psychological well-being of individuals, making spaces more functional, accessible and comfortable. In this context, AI-supported architectural solutions allow us to better understand and meet the physical and psychological needs of users.

This review article explores the current state of AI applications in architecture and the impact of these technologies on user-centered design, investigating the potential effects of this integration on human psychology. It also aims to discuss future research avenues and the ethical and sustainability aspects of AI-enabled architectural design. This comprehensive review aims to provide academics, architects, designers and AI researchers with valuable insights into the future of the field by approaching these issues from an interdisciplinary perspective.

The Role Of Artificial Intelligence in Architectural Design

Artificial intelligence (AI) is having a significant impact on architectural design. It offers new ways to increase creativity, optimized building performance and the efficiency of

workflows. AI stands out for providing designers with innovative design solutions by learning from large datasets. For example, AI-powered design tools are an efficient means of providing data-driven design decisions in areas such as environmental sustainability and building performance (Zhang et al., 2023). These technologies help reduce energy consumption and carbon emissions by analyzing variables such as building orientation and material selection.

AI also makes design and construction processes more efficient by speeding up architectural planning processes and reducing costs. AI-based tools can make volumetric estimates of buildings and plan interior space arrangements, saving time and resources in the early design stages (Muntañola et al., 2022). Furthermore, AI can assist in understanding and interpreting complex regulatory requirements such as compliance with building codes, allowing designers to resolve compliance issues faster (Web 1, 2024).

In conclusion, the role of AI in architectural design continues to transform the profession by enriching the design process and opening up new creative potentials. However, the effective use of these technologies requires architects to understand how to integrate AI tools into their creative process. Therefore, it is first necessary to understand the potentials in this field.

- **Artificial Intelligence Based Design Tools and Methodologies:** Artificial intelligence is being used to deeply understand and optimize the design process. AI-powered design tools allow architects to analyze complex datasets, quickly evaluate design alternatives, and make more informed design decisions. These tools are transforming design processes while increasing designers' creativity and efficiency (Johnson and Smith, 2019; Patel and Gupta, 2018).

- **Automated Design Optimization and Sustainability Analysis:** AI technologies provide sustainable architectural solutions by optimizing energy efficiency, material use, and environmental impact of designs. AI can simulate and analyze the sustainability performance of buildings so that designers can create greener and more effective buildings (Lee, et al., 2020; Zhang and Sun, 2021).

- **Analysis and Prediction of User Behavior Data:** By analyzing user behavior data, AI enables a better understanding of how buildings are used and how users react to spaces. This data can be used to more accurately predict user needs and develop user-centered design solutions. AI helps to personalize spaces in a way that improves users' comfort, safety and satisfaction (Rodriguez and Cho, 2022; Silva and Ramos, 2019).

The Impact of Artificial Intelligence in User-Centered Design

Artificial intelligence (AI) has the potential to transform the design process by being used in several key areas in the user-centered design process, such as understanding user requirements, supporting solution design and evaluating design. In this process, AI helps to produce more effective and accurate solutions and brings a new dimension to processes that rely on human creativity (Stige, et al., 2023). For example, major technology firms such as IBM, Google and Autodesk have successfully integrated AI to improve user experiences and deliver personalized solutions. These companies use AI to analyze user behavior and incorporate this information into product design and development (Interaction Design Foundation, 2024). This effective use of AI enables a deeper understanding of user needs and the development of innovative solutions to address these needs. In this context, AI-enabled design processes can provide users with more personalized and intuitive experiences, increasing user satisfaction and overall product effectiveness (Yang, et al., 2020). In addition to these effects, it is also crucial to adopt a human-centered approach in designing AI applications. In particular, striking a balance between automation and human control ensures that AI supports and does not replace human capabilities. This is a critical approach to ensure AI is developed in an ethical and balanced way (Guszcza, 2018).

In user-centered AI design, it is emphasized that AI systems should be developed in a way that is not only technologically, but also ethically and socially responsible. By supporting human creativity and input in the design process, AI enables the emergence of more user-centered and accessible technologies (Guszcza, 2018). In this context, to better understand the role of AI in user-centered design, a research and design approach centering on AI and human interactions becomes important. This helps to explore the potential of AI in human-centered design, both theoretically and practically (Stige, et al., 2023).

- **Customized Space Designs According to User Needs and Preferences:** Through big data analysis and machine learning algorithms, AI makes it possible to gain a deep understanding of users' behaviors, preferences and needs. This understanding allows architects and designers to create personalized spaces that are tailored to each user's unique needs and lifestyle. AI-based systems learn through user interactions and feedback and dynamically make adjustments during the design process, resulting in the comfort and functionality that users expect (Patel and Gupta, 2018; Silva and Ramos, 2019).

- **The Impact of Smart Living Spaces on User Experience and Satisfaction:** Smart living spaces are designed to improve users' quality of life by integrating AI and IoT (Internet of Things) technologies. These technologies provide automatic control of systems such as heating, lighting, security and entertainment, enriching the user experience and increasing their satisfaction. AI enables the creation of smarter and more responsive living spaces by learning user habits and adjusting home automation systems based on this information (Johnson and Smith, 2019; Zhang and Sun, 2021).

- **Artificial Intelligence Powered Accessibility and Usability Solutions:** AI is also being used to improve the accessibility and usability of spaces. For users with special needs, such as visual or mobility impairments, AI-enabled technologies enable spaces to become more accessible and usable through voice commands, gesture recognition, and other adaptive interfaces. These technologies facilitate users' interaction with space and aim to create more inclusive living spaces for everyone (Lee, at et al., 2020; Rodriguez and Cho, 2022).

Psychological Interaction and Well-being

The interaction between architecture and psychology has long been an important area of research for understanding and improving human well-being at both individual and societal levels. Artificial intelligence (AI)-assisted designs further deepen this interaction, offering new avenues that can significantly impact the psychological and emotional well-being of users. This chapter will explore the relationship between architecture and psychology, the psychological and emotional impacts of AI-assisted designs, and design strategies to enhance user well-being.

The Relationship between Architecture and Psychology: The relationship between architecture and psychology is becoming increasingly important, especially in the field of neuro-architecture, which studies people's emotional and cognitive interactions with buildings and environments (Oppenheim, et al., 2009; Vartanian, et al., 2013). Architecture can have a profound impact on people's mood and behavior. For example, architectural aesthetics has been shown to have a direct impact on individuals' mental states and emotional responses. People's attribution of aesthetic value to architectural works can be related to factors such as the social status of buildings. For example, socially important buildings, such as government buildings or religious buildings, may have a stronger impact on people than more modest private or economic buildings (Wang, et al., 2022).

Research in neuro-architecture uses various neurological measurement techniques to better understand the effects of architectural design on the human brain. These studies reveal how the aesthetic characteristics of buildings and spatial arrangements can shape people's cognitive and emotional responses. For example, rooms with high ceilings and open-plan designs have been found to have a positive effect on people's aesthetic judgments, and such architectural features activate regions of the brain associated with visual spatial exploration and attention (Oppenheim, et al., 2009).

In conclusion, the relationship between architecture and psychology offers a comprehensive approach to understanding how individuals perceive their physical environment and its effects on human emotional and cognitive functioning. This knowledge enables the development of more responsive and human-centered architectural designs, thus having the potential to improve the quality of life of individuals.

Psychological and Emotional Effects of Artificial Intelligence Assisted Designs: AI-assisted architectural designs have the potential to create spaces customized to better meet the emotional and psychological needs of users. By providing in-depth knowledge about user behavior and preferences, AI can guide designers to create spaces that are user-centered, emotionally supportive and psychologically comforting. This enables users' experiences in spaces to better adapt to their personal needs and emotional states (Silva and Ramos, 2019; Zhang and Sun, 2021).

Studies on the psychological and emotional effects of AI-enabled designs reveal how these technologies can profoundly affect the user experience. In particular, chatbots with emotional intelligence can sense users' emotional states and respond appropriately to them, thereby improving user satisfaction and interaction quality. For example, one study suggests that chatbots' emotional responses can positively affect users' moods and thus strengthen customer relationships (Ghazala, et al., 2022). Moreover, AI-assisted designs can also have significant impacts on users' psychological health. For example, AI-supported emotional support processes in online mental health communities have been observed to be effective in understanding users' emotional needs and providing appropriate support. Such systems can provide emotional support by extracting the emotional context from the texts that users write and generating appropriate responses to these emotions (Gui, et al., 2021).

These studies emphasize the need to develop not only the technological aspects of AI-supported designs, but also the social and emotional aspects. It is thought that the emotional

and psychological satisfaction that users receive from their interactions with AI could lead to wider acceptance of these technologies.

Design Strategies to Improve User Wellbeing: Design strategies centered on user well-being focus on improving the physical and psychological accessibility of spaces, enriching the user experience and creating environments that are sensitive to personal needs. AI can play a critical role in the development of these strategies, maximizing the positive impact of spaces on user well-being by analyzing user feedback and making real-time adjustments to the design process. AI can also enable spaces to respond adaptively to users' emotional and psychological states, creating healthier and happier living spaces (Lee et al., 2020; Rodriguez and Cho, 2022).

Literature reviews on design strategies to enhance user well-being reveal a range of effective approaches in different fields. In particular, interior design plays a critical role in creating healthy living spaces in workplaces. Research shows that the use of ergonomic furniture is important in reducing musculoskeletal disorders, appropriate lighting levels are important in enhancing mood and physical comfort, and noise control is important in reducing psychological discomfort (Colenberg and Jylha, 2022). Furthermore, biophilic design strategies have the potential to increase urban resilience by combining elements of nature and technology. These approaches integrate natural and digital solutions to create sustainable and healthy urban environments (Tarek and Ouf, 2021).

In the design of Internet of Things (IoT) products, positive experience design strategies are being developed to sustain user happiness. These strategies allow designers to develop creative ideas that prioritize user well-being, thereby providing users with sustainable happiness (Xu, et al., 2023). Consequently, user-centered design strategies applied to improve the impact of healthcare help healthcare practices to better adapt to user needs. These strategies maximize their impact by aligning healthcare practices with the user experience (Dopp, et al., 2020).

Consequently, user-centered design strategies applied to improve the impact of healthcare help healthcare practices to better adapt to user needs. These strategies maximize their impact by aligning healthcare practices with the user experience. These findings highlight the importance of design strategies to enhance user wellbeing, ranging from interior design to biophilic urban planning to IoT product development. These strategies meet both the physical and psychological needs of users, enabling the creation of healthier and more fulfilling living spaces.

Future Perspective and Research Directions

The interplay between artificial intelligence (AI) and architecture brings both great potentials and significant challenges. This chapter will address the ongoing challenges and criticisms in this field, potential research areas and technological developments, and the role of ethics and sustainability.

Ongoing Challenges and Criticisms: The use of AI in architecture faces challenges such as data privacy, security and algorithmic bias. Transparency and accountability of AI systems' decision-making processes are fundamental to building trust between users and designers. There are also criticisms that AI-supported design tools may limit creativity and encourage over-reliance on standardized solutions (Rodriguez and Cho, 2022; Zhang and Sun, 2021).

Potential Research Areas and Technological Developments: Research into the future of the interaction between AI and architecture could focus on the development of more advanced algorithms and machine learning models. These models can process users' behavioral and psychological data more effectively, enabling the creation of more personalized and responsive spaces. Furthermore, expanding the role of virtual and augmented reality technologies in design processes and examining their impact on user experience in more depth are potential research areas (Lee, Kim and Park, 2020; Patel and Gupta, 2018).

The Role of Ethics and Sustainability: Ethical dimensions of AI-assisted architectural design cover issues such as the collection and use of user data, algorithmic transparency and fair use. Sustainability, as an important component of AI and architecture integration, includes issues such as energy efficiency, environmental mitigation and long-term resilience. Research in this area should examine how ethical and sustainability principles can be integrated into design processes and the potential impacts of this integration on user well-being and environmental health (Johnson and Smith, 2019; Silva and Ramos, 2019).

CONCLUSION

In conclusion, the contributions of AI-supported architectural designs to user-centered design processes have a significant potential for the future of this field. By making design processes more efficient and innovative, AI technologies can significantly improve the emotional and psychological well-being of users. However, issues such as the ethical use of these technologies, data privacy, algorithmic transparency, and improving the user experience

are important problems that need to be solved for the effective use of AI-assisted design tools. The contributions of AI-supported architectural design to user-centered and psychological design processes offer revolutionary innovations in these fields. By learning from large datasets, AI enables designers to make more informed decisions and develop solutions that are better suited to user needs. However, this technology also brings challenges such as ethical use, data privacy and algorithmic fairness. Overcoming these challenges is critical for the effective use of AI in architecture.

The integration of the disciplines of architecture and psychology provides a deep understanding of the psychological and emotional effects of space design on people. This integration has the potential to create spaces that support users' mental health and encourage social interactions. For example, architectural elements such as high ceilings and large windows can enhance users' psychological well-being. In addition, AI-powered design tools provide detailed insights into user behaviors and preferences, enabling the creation of personalized living spaces.

In the future, further development of AI-assisted architectural designs is expected. These developments will help create more sustainable and energy efficient buildings, as well as spaces that better meet the emotional and psychological needs of users. Furthermore, AI can guide designers in areas such as complex building regulations and building codes, speeding up and streamlining the design process.

In this context, the ethical and sustainable progress of AI-enabled architectural designs is an issue that needs to be carefully addressed by professionals in the industry. Algorithmic transparency and accountability will increase users' and society's trust in these technologies and ensure their widespread acceptance. In conclusion, the intersection of AI and architecture paves the way for innovative design strategies that have the potential to improve users' quality of life. This integration will enrich the practice of architecture and enable the creation of more responsive and supportive spaces centered on user needs.

Research Statement

Ethical Aproval: The study does not require ethical approval.

Conflict of Interest: The authors declare that there is no conflict of interest for the study.

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