The Roles of LLM-based Artificial Intelligent Agents in the Design Process

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Abstract

The article proposes a conceptual model for integrating large language model (LLM)-based agents into the design, conceptualized as an iterative process of knowledge enrichment. Drawing on a review of contemporary AI capabilities and their limitations, the model identifies five key domains where LLM-based agents can contribute to design work: (1) interaction with digital and physical objects in the environment; (2) collaboration with human designers; (3) autonomous operation within complex design tasks; (4) support for creative ideation; and (5) ethical and safe use of AI technologies. The model highlights both the current potential and challenges of AI integration in design practice, emphasizing the importance of responsible human–AI collaboration.

Keywords

Design process; artificial intelligence; large language models; intelligent agents; human–AI collaboration

1. Introduction

Technologies of Artificial Intelligence (AI), and Generative AI in particular, have already found practical applications in multiple industries across different regions of the world. According to a survey from the international consulting agency McKinsey & Company, in 2024, 78% of organizations used AI in at least one business function [2]. The volume of private investment in Generative AI increased ninefold in 2023 compared to 2022, reaching 25 billion US dollars [1], and rose further to 34 billion US dollars in 2024 [2].

The development of Large Language Models (LLMs) has led to the emergence of entirely new capabilities within the family of AI technologies, such as the understanding and generation of natural and computer languages, multilingualism, possession of general and domain-specific knowledge, reasoning and planning abilities, and agency [3]. The technology demonstrates strong potential despite current limitations, such as a tendency to hallucinate, vulnerability to low-quality or harmful inputs, and unstable outputs, especially in tasks requiring complex reasoning.

The rapid evolution of Large Language Models has resulted in qualitative leaps in their capabilities over short periods of time. For example, in September 2024, the company OpenAI introduced the first model, o1, from a new family of models designed to solve problems requiring complex reasoning, and in December 2024, the next model from this family, o3, was announced. Based on the 2025 Artificial Intelligence Index report, published annually by a specialized department of Stanford University, o1 and o3 have shown impressive results across a variety of tasks requiring complex reasoning, including programming, quantum physics, and logic [2].

It is clear today that cutting-edge AI technologies can considerably assist in research, analytical, and creative activities [4]: processing high volumes of numerical, textual, and multi-modal data; analyzing semantic meaning; synthesizing conclusions and proposals; enriching existing and generating new design artifacts; conducting planning; and executing planned tasks. One of the most prominent directions for introducing new technology into business, management, and creative processes today is

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the development of artificial intelligent agents based on LLMs that can act autonomously in complex environments.

At the same time, there are ongoing disputes about the extent to which AI is able to generate completely new creative outputs. Considerable attention from researchers is also devoted to the conceptualization of the interaction between humans and artificial intelligence, including artificial agents.

This work proposes a model of the design process that sets the framework to define the place and roles of LLM-based agents in design, in interaction with the design team, external environment, and design artifacts.

2. Design as an iterative process of knowledge enrichment

Five traditional ways to conceptualise design are outlined in the literature today [5]: creation of artefacts (Simon, 1969); reflexive practice (Schön, 1983); problem-solving activity (Buchanan, 1992); a way of reasoning/making sense of things (Lawson, 2006; Cross, 2006, 2011); and creation of meaning (Krippendorff, 2006).

To define the place and roles of artificial intelligent agents in collaboration with humans in the design process, we propose to conceptualise design as an iterative process of knowledge enrichment. Designers, while conducting research, collect information from the external environment by making observations and conducting experiments (A). The data collected is processed, enriching the individual knowledge of design team members and contributing to the evolution of design artifacts (B). At stages when artifacts (ideas, concepts, prototypes) reach a certain level of maturity, they are returned to the external environment to test their influence on the system (C). The results of testing provide the team with additional information that enriches understanding of the context, user and stakeholder needs, and the nature of the problem, enabling the development of better solutions (A, new cycle).

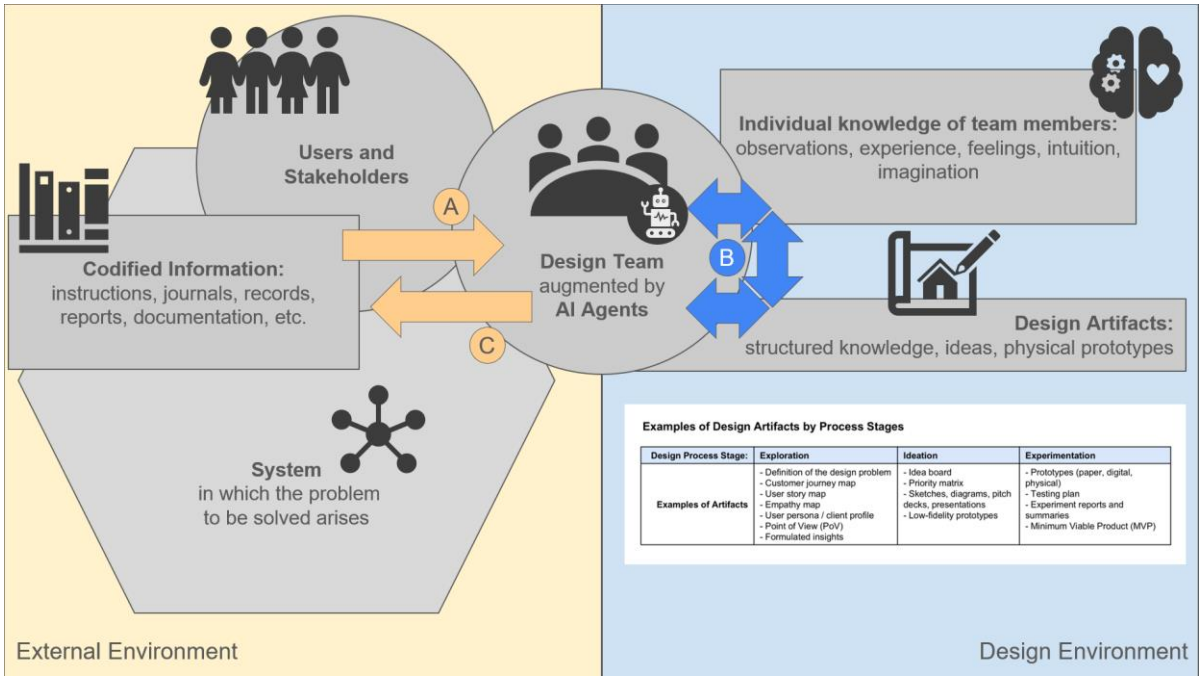

Figure 1: Conceptual model of design as an iterative process of knowledge enrichment

Such a conceptualization of design reveals, in this context, several relevant characteristics of LLM agents: the ability to operate on complex textual and multi-modal data from the external environment and the design space; a high level of fluency in natural language conversation; autonomy; and the ability to reason while considering complex context. It also defines five directions for further research into the place and roles of artificial intelligent agents in the design process.

1. Interaction with objects from external environments and artifacts from the design space. LLM-based agents can autonomously or semi-autonomously collect various data from different digital sources and assist in analyzing it. For example, a model can classify and categorize user feedback or identify bottlenecks in user experience on a website. AI can create new structured digital design artifacts or integrate new findings into existing ones (e.g., summarize user needs in the form of user stories, update online documentation, or prototype in Figma). The ability of AI-based systems to interact with physical objects is less established today but is actively evolving in domains such as robotics, autonomous driving, computer vision, and 3D printing. Human involvement is still necessary in many design processes that require interaction with the physical world – for example, building physical prototypes or conducting field testing.
2. AI–human collaboration. The chat interface – currently the most widely used method for interaction between humans and Large Language or Multimodal Models – enables complex and flexible collaborative scenarios. At the same time, this format can create challenges in providing the model with the full context of complex projects or with unspoken intuitions that are often key in design. An additional challenge is the limited ability of models to perceive and understand the inner world of humans (feelings, emotions, intuitions), interpersonal relationships, and the broader social context – all of which are significant in human communication and may be critical, for example, in UX design. These limitations of LLMs require design teams to responsibly combine AI-generated conclusions with their own empathy-based analysis. These challenges in human–AI interaction are relevant not only to collaboration between AI and the design team but also between AI and users or stakeholders. It is also worth noting that working with language or multimodal models requires specific skills – for example, in prompt engineering.
3. Autonomy. To act autonomously to a certain extent in a complex environment, agents should be able to navigate the overall structure and relationships between elements of the external environment and the design space and effectively operate at different levels of detail – switching between the general picture (zoom-out) and specific details (zoom-in). While this capability of LLM-based agents is not yet fully established, modern coding tools like Cursor.ai are able to: (1) generate and maintain complex textual structures such as code and knowledge bases for software development projects; (2) conduct reasoning and planning based on these structures; (3) execute necessary tasks using specific tools. It is worth noting that despite the impressive level of autonomy demonstrated by AI agents, control and responsibility should remain with humans. One of the most widely used patterns of human–AI collaboration in complex scenarios is requiring human confirmation before executing important actions by the AI agent (e.g., paying for goods or publishing an article on a website). This helps mitigate potential risks associated with AI errors.
4. Creativity. The question of AI's ability to generate new creative content is still under discussion. Some researchers have shown that models are capable of generating ideas that can serve as starting points for further elaboration by designers. The rapid generation of large numbers of alternatives or stylistic variations (for example, in user interface design) can significantly speed up the design process. At the same time, final solutions should be evaluated by designers based on criteria such as safety, ethics, alignment with user needs and social context, and overall quality.
5. Ethics and Safety. The integration of AI agents into design processes requires compliance with multiple principles, such as data privacy, avoidance of bias and discrimination, and AI explainability. For example, if incoming data is not representative (e.g., if young users are overrepresented), the model may apply and even amplify these biases across the entire audience. In highly sensitive contexts (such as healthcare, education, or services for people with disabilities), designers should pay extra attention to avoid AI-generated solutions that compromise ethical norms or the rights of specific groups. It is also important to keep in mind that the trust from users and stakeholders is a critical factor – designers should strive for robust and explainable AI solutions.

3. Conclusion

AI agents have significant potential in design, complementing and strengthening design teams, while the ‘final word’ should remain with humans – especially in areas such as empathy, consideration of complex social and cultural contexts, and responsibility for final decisions. AI can be very helpful in tasks that require the collection and processing of large volumes of multi-modal data or the generation of multiple options. However, the design team should critically evaluate and build upon the results generated by AI. Thus, the integration of AI into design is an iterative process that requires effective human–AI collaboration at different stages, with clearly defined roles and responsibilities.

4. References

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