

Rethinking Design Workflows with Artificial Intelligence

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Abstract

Artificial Intelligence (AI) has been an active research area for a long time, but its adoption as a mainstream technology in the creative/design space is a relatively new phenomenon. Much of the research has been directed into creating systems capable of performing tasks, and while many powerful systems and applications have emerged, the user experience has not kept pace. In applications of AI systems to the design process, there has been a general lack of focus on the designers' creativity. Most of the current approaches focus on the use of Artificial Intelligence to replace the repetitive work in the design process while ignoring the subversive changes in thinking and methodology that AI can bring to designers' as end users. This dissertation work explores the opportunities for AI to bring radical changes in human experiences during the design and creative processes, assist designers' creative ability, and provide new approaches to augment design cognition.

Keywords

HCI, AI, Creativity, Web-Design

1. Context and Motivation

Despite increasing levels of automation enabled by Artificial Intelligence — whether it is AI driving our vehicles, designing our drugs, determining what news and information we see, and even deciding how our money is invested — the common thread among these systems is the human element. AI's long-term success is contingent upon our acknowledgment that people are critical in its design, operation, and use [1, 2, 3].

Human-Centered AI (HCAI) [4] is an emerging discipline with the intent of creating AI systems that amplify and augment rather than displace human abilities [5]. HCAI seeks to preserve human control in a way that ensures artificial intelligence meets our needs while also operating transparently, delivering equitable outcomes, and respecting privacy [6].

Advocates of this new synthesis seek to amplify, augment, and enhance human abilities so as to empower people, build their self-efficacy, support creativity, recognize responsibility, and promote social connections. Researchers, developers, business leaders, policymakers, and others are expanding the technology-centered scope of AI to include HCAI ways of thinking. This expansion from an algorithm-focused view to embrace a human-centered perspective can shape the future of technology so as to better serve human needs. Educators, designers,

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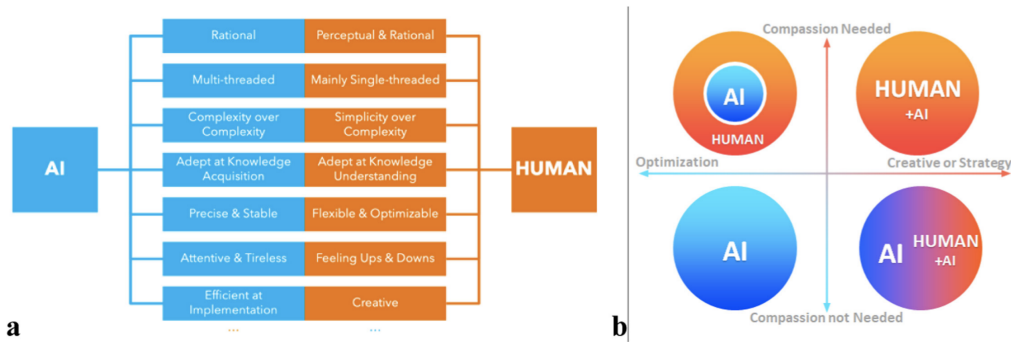


Figure 1: (a) Modalities by which Human-AI complement each other, (b) Blueprint of Human-AI collaboration. [7]

software engineers, product managers, evaluators, and government agency staffers can build on AI-driven technologies to design products and services that make life better for their users [8].

AI creativity refers to the ability of humans and AI to co-live and co-create by playing to each other’s strengths to achieve more. AI should complement to human intelligence, and it consolidates wisdom from human supervisions, making collaboration across time possible. AI empowers humans throughout the entire creative process and makes creativity more accessible and more inclusive than ever.

AI has been shown to be suitable to deal with repetitive and predictable problems, as well as complex and multi-tasking scenarios; while humans are more flexible and creative, and adept at knowledge understanding and strategic thinking, as is summarized in (Fig 1). Collaboration between humans and AI varies across domains [9, 7] . Human leads where tasks are more about creative or strategy and compassion is needed, while AI leads where tasks are more about routine or optimization and compassion is not needed (Fig. 1).

My dissertation work aims to exploit recently discovered AI methods to enhance human creativity in the design process, analyze existing approaches’ opportunities and limitations, and develop, test, and evaluate new techniques and tools to enhance designers’ creativity.

2. Background and Related Works

Increasing numbers of researchers are exploring AI-assisted creativity in industries such as the creative and arts sector [11, 12, 13, 3, 14, 15, 16], with a focus on data-driven design [17, 18, 19].

Zeng et al. [10] utilized AI to augment typeface design creativity, leveraging a generative network trained on standardized Chinese typefaces. Iterative application and retraining of the network, guided by designer feedback, yielded designs matching their needs, thus enhancing creative cognition.

Sun T. et al. [20] developed an AI system that assists with digital icon design. The system uses a generative model trained on a large icon database and allows user-guided generation of icons. A user study validated its performance.

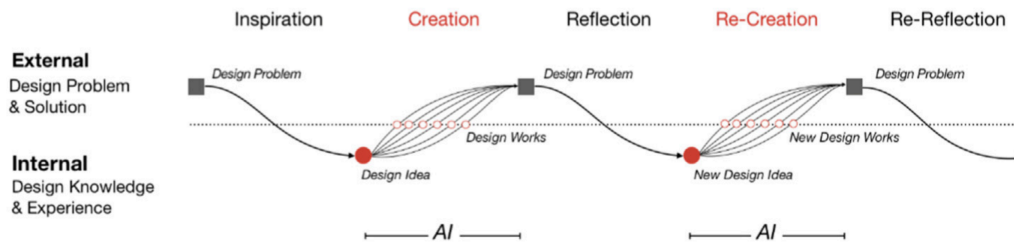


Figure 2: The AI-augmented creative design cycle as described by [10]. The authors describe how AI can be used to enhance the design process by generating diverse creations guided by the users' input. Allowing designers to explore a wider solution space. Figure demonstrate how the cycle of continuous interaction between creation and reflection remains unchanged.

Zhang et al. [21] presented a network that generates user-guided magazine layouts. Users sketch the rough positions and sizes of elements, and the network generates the layout.

Chen et al. [22] proposed a two-stage design system: a semantic ideation network and a visual concepts synthesis network. Users can explore semantic connections and then generate images synthesizing selected visual concepts using a generative network [23].

Building on these promising findings, my work will explore under-investigated aspects of the design process that could benefit from AI assistance, with the aim to enhance creativity and idea refinement.

3. Research Objective

The overall goal of the dissertation work is to explore how to use artificial intelligence to augment design creativity, expand new design methods and design forms, and improve the quality of design. Specifically, the following research questions will be addressed:

1. **RQ1:** How might we embrace AI and apply it to fostering personal human creativity in design?
2. **RQ2:** How does adjusting the AI control over the design decisions affect the human's creativity?
3. **RQ3:** What are the effects of AI over the designer's perception of limitations and frustration?
4. **RQ4:** What are the common characteristics and best practices that we can synthesize to design systems able to provide improvement in designers' creativity?

The presented research questions are synthesized from the needs highlighted in the available literature, and include hints from my personal skills and research interests, as well as long term goals of the research group.

4. Research approach

The objective of the research is to propose and evaluate approaches that can empower designer creativity. The current research plan envisions three main phases:

1. **Exploring opportunities and limitations of existing approaches to enhance designers creativity.** An analysis of the literature is carried out with the goal of identifying the potential need for alternatives or improved integration of the existing approaches (RQ1).
2. **Development of new techniques or tools to enhance designers creativity.** We aim to design, implement, and evaluate novel HCAI approaches that enhance the creative cognition of the designers, with a specific regards to the research of systems that potentially allow an high-user control and an high automation (RQ2). Evaluation of the effect of the tools being used on the quality and quantity of the outcomes, as well as the cognitive aspect of usability (RQ3).
3. **Guidelines elicitation.** Starting from the outcomes of the previous phases, explicitly identify guidelines for the design of HCAI tools that enhance designers creativity (RQ4). Extensive evaluation of the usefulness, usability, and pleasure of use of the tools that abide by such guidelines.

The methods include identifying relevant dimensions (in terms of quality of the outcome and support for the designers), converting such dimensions into measurable variables, and conducting user testing to establish an empirical basis for the approaches being offered and for making comparisons between them.

5. Results and contributions to date

Our research group is probing the integration of AI into design support tools, paying special attention to human-computer interaction [24]. The sketch-based UI design approach is prevalent, serving as "hints" for the AI network (Walker 2002, Suleri 2019).

Several projects, like Pix2code [25] and sketch2code [26], have aimed to automate sketch-to-code translation. Our unique approach [27, 28] translates a sketch into related code while letting the designer choose element styles from a reference image. We divide style selection into color and text style and have trialed our method using a navigation bar. Our results indicate effective style selection from the reference image.

6. Dissertation Status and long term goals

I am currently at the beginning of the second year of the National Ph.D. program in Artificial Intelligence at Politecnico di Torino under the supervision of professor Luigi De Russis.

In my first year, I explored the scientific literature focused on seeking opportunities for enhancing design creativity by using Artificial Intelligence as the main approach. Therefore, I tried to understand better the relationship between creative and design processes and explored opportunities for as well as obstacles against using AI methods in website design (Phase 1).

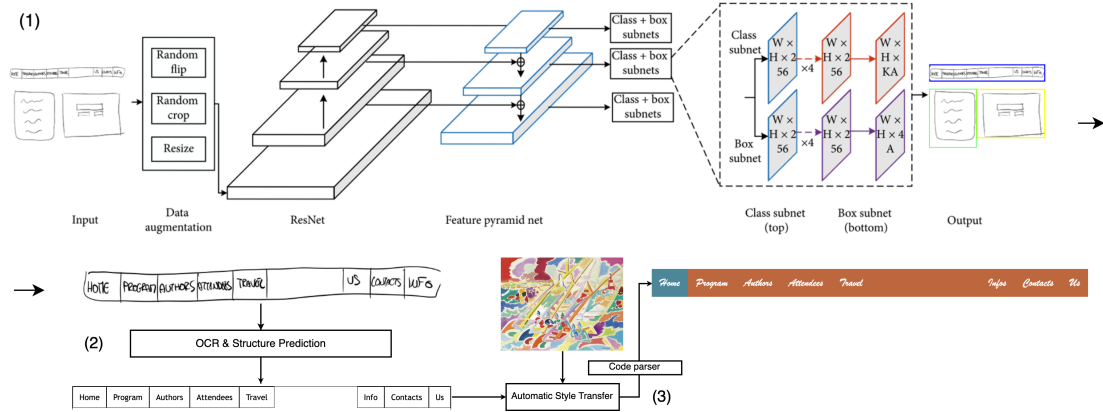


Figure 3: Method overview. (1) Starting from the sketch of a webpage, we perform a segmentation of its interface. (2) We infer the structure and the textual elements of the selected component. (3) Style properties of the reference image are extracted and injected into the structural properties of the sketch. Finally, a parser generates the final code along with the rendering of the component.

Method Overview.

In my second year, I am validating the obtained results with a pool of designers, and I will design, implement, and evaluate a tool that realize the proposed approaches (Phase 2). I plan to expand my research into a more broad set of AI applications to enhance creativity, such as image and text generation. Specifically, I will focus on overcoming AI limitations to fulfill the designers needs and analyze in depth the aspect of creative processes that can be enhanced by the more advanced AI methods.

The results will be used, during the third year, to elicit and refine guidelines to design systems that can empirically empower designers creativity (Phase 3).

I expect my contribution to influence and bring consistent improvement to the creative process of designers and to bring novelty and knowledge progresses in the intersection between HCI and AI.

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