The Model of Design Augmented with AI Agents

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Rapid Development of Generative AI: Overview

Generative AI models **surpassing human-level performance**, **saturating emerging benchmarks** within a year:

- Traditional benchmarks (ImageNet, SQuAD, MMLU) are now at their limits as top models match or exceed average human scores *(Stanford HAI, 2024)*.
- SWE-bench: top model performance jumped from 4.4% in 2023 to 71.7% in 2024 *(Stanford HAI, 2025)*.

Enterprise adoption of GenAI has moved **beyond experimentation to large-scale deployment**:

- 78% of organizations use AI in at least one business function *(McKinsey, 2025)*.
- Budgets for Gen AI are growing by over 75% year-over-year, and 37% of enterprises run 5+ models in production *(Andreessen Horowitz, 2025)*.

LLMs introduced new capabilities in AI:

The ability to understand and generate natural and computer languages; Multilingualism; Broad general and domain-specific knowledge; Reasoning and Agency.

Generative AI in Design Workflows: Overview

Multiple studies explore how Generative AI, especially LLMs, can be integrated into design, evaluate their capabilities, and develop theoretical models. Several examples are listed below.

- Designers **explored** GenAI models to generate ideas and sketches in **early design stages** *(Tholander & Jonsson, 2023)*
- Graduate students **explored** work with LLMs **across all design phases** *(Muehlhaus & Steimle, 2024)*
- Professionals **explored** LLM applications to **conceptual design tasks** *(Zhou et al., 2024)*
- ChatGPT was **evaluated** on a set of **industrial design and manufacturing** tasks *(Wang et al., 2023)*
- LLMs **evaluated** using **adapted Torrance Tests** *(Zhao et al., 2024; Chakrabarty et al., 2024)*
- Researchers **evaluated** performance of LLM-generated texts for ad campaign in **real-world field tests** *(Chen & Chan, 2024)*
- Researchers proposed **conceptual models** of AI integration into design *(Thoring et al., 2024)*
- The **structural model of Design Thinking** supports analysing and integrating generative AI into the design process *(Novakovskyi & Yaloveha, 2024)*

Researchers generally agree that **collaboration between humans and AI** can significantly **accelerate design**, driven by AI's ability to rapidly generate and refine numerous ideas and concepts. However, **theoretical models and quantitative benchmarks** for assessing AI's creative abilities are still **emerging and require further research**.

Approaches to Integrate LLMs into Design Workflows (1)

Three main approaches offer different levels of automation, flexibility, and human involvement.

1. Simple chat: Direct interaction between a designer and an LLM through a chat interface for **ad hoc tasks that don't require complex context**.

Example: using ChatGPT to brainstorm ideas, summarize interview notes, or generate quick alternatives.

2. Chain-of-prompts: A structured sequence of prompts, where the output of one step becomes the input for the next, enabling systematic decomposition of complex tasks. Ideal for **repeatable, multi-step processes requiring traceability and context management**. Supports iterative refinement and controlled complexity.

Example: User-data analyser that converts unstructured data into design insights.

- *Step 1: Collect raw user feedback (comments).*
- *Step 2: Classify comments into themes using one LLM prompt.*
- *Step 3: Summarize each theme with another prompt.*
- *Step 4: Generate recommendations for design decisions based on summarized insights.*

Approaches to Integrate LLMs into Design Workflows (2)

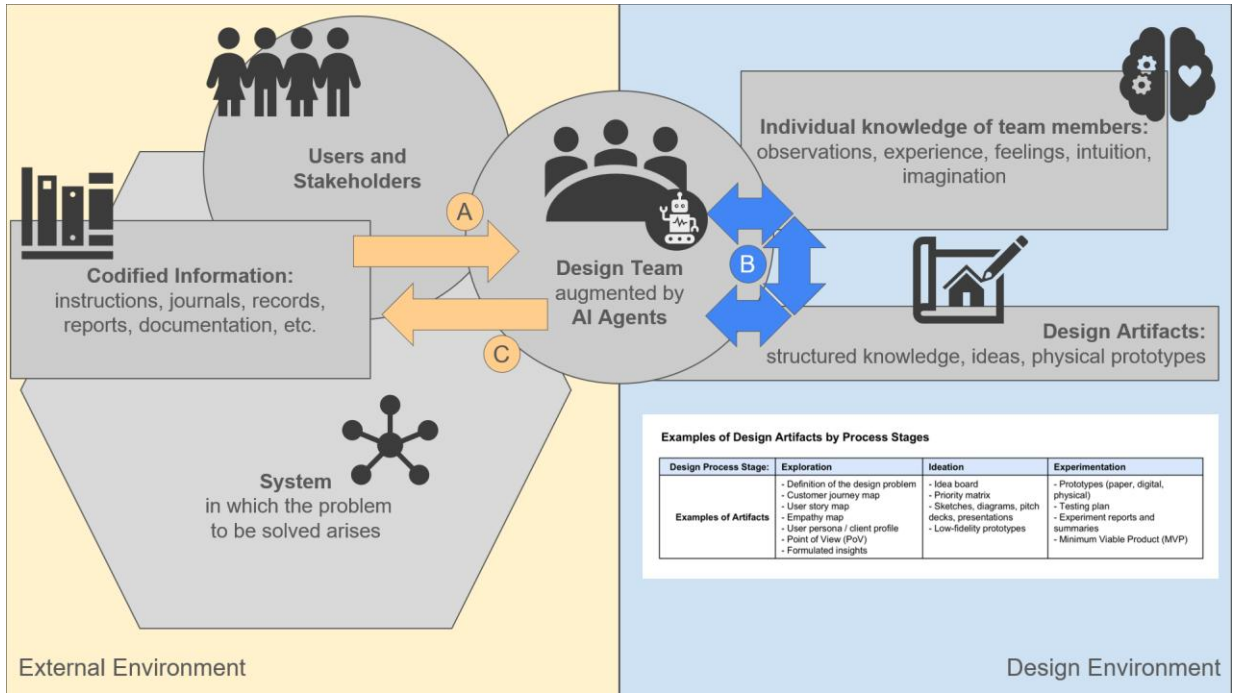
3. LLM Agents: Autonomous or semi-autonomous systems where LLMs perceive, reason, and act within design workflows. Best for **complex, continuous processes** requiring high automation, scalability, and the ability to manage **complex context**. Capable of interacting with external tools, APIs, and design environments.

> *Examples of agentic-based tools for design workflows (mentioned by professionals on Reddit; non-comprehensive list): Lovable, V0, Bolt, Repli, Windsurf, Subframe, Figma AI Agent, Cursor, ROO Code AI.*
>
> - *These tools enable rapid prototyping and iteration, allowing designers to quickly transform ideas into interactive prototypes or production-ready code.*
> - *They range from low-barrier, no-code solutions for fast concept exploration to advanced setups that provide fine-grained control over design systems and front-end code, bridging the gap between visual design and development.*

Agentic tools are increasingly used to augment design with AI, supporting the process **end-to-end – from early prototypes to real, shippable products**.

The Model of Design Augmented with AI Agents

To define the **place and roles of AI agents** in collaboration with humans in the design process, we propose to conceptualize **design as an iterative process of knowledge enrichment**.



(A) Information is collected from the external environment through codified sources, new observations, and experiments.

(B) The data is processed, enriching the individual knowledge of designers, supporting the evolution of digital artifacts and providing context for AI agents.

(C) Artifacts (ideas, concepts, prototypes, etc) are returned to the external environment to test their influence on the system.

Proposed approach does not contradict the five traditional ways of conceptualizing design that are outlined in the literature today: 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).

AI Agents in Design: 5 Research Directions

The model of design as an iterative process of knowledge enrichment defines five research directions for further exploration.

1. Agents' Interaction with the External Environment and Digital Artifacts: AI agents can collect and analyze diverse raw data, such as user feedback, from digital sources and generate or update design artifacts like user stories, documentation, or prototypes. Physical interaction (e.g., robotics, sensors, 3D printing) is emerging but still requires human involvement.
2. AI–Human Interface: Chat-based interfaces enable flexible teamwork, but challenges remain in providing full project context and capturing human emotions or social nuances. Modern tools are evolving toward design-native interfaces, improving usability for both designers and AI agents.
3. AI Autonomy: AI agents can plan, reason, and execute tasks, handling both broad overviews and fine details. However, human oversight is essential, especially for critical actions, to ensure safety and accountability.
4. Agents' Creativity: Guided by designers, AI agents can rapidly generate a wide range of ideas and stylistic variations, significantly accelerating the design process. However, final decisions must remain with humans, to ensure alignment with ethics, user needs, and quality standards.
5. Ethics and Safety: In collaborating with AI, designers must ensure data privacy, avoid bias, and maintain transparency. In sensitive contexts like healthcare or education, AI systems must be carefully managed to preserve user trust and protect vulnerable groups.

Thank you for your attention!

We are looking forward to your questions and discussion.