

A Taxonomy and Research Agenda for Generative User Interfaces

Katja Pott

katja.pott@bfh.ch

Bern University of Applied Sciences

Bern, Switzerland

Matthias Söllner

soellner@uni-kassel.de

University of Kassel

Kassel, Germany

Roman Rietsche

roman.rietsche@bfh.ch

Bern University of Applied Sciences

Bern, Switzerland

Thiemo Wambsganss

thiemo.wambsganss@bfh.ch

Bern University of Applied Sciences

Bern, Switzerland

01 Generation Process	Scope of Generation	Element Generation	Component Generation	Compositional Generation		
	Transparency of Generation	Opaque Generation	Static Transparency	Interactive Transparency		
	Generation History	No Generation History	Static Generation History	Interactive Generation History		
	Refinement Type	Full Regeneration only	Partial Regeneration	Iterative Refinement		
02 Interaction	Initialization	Prompting through Text/Voice	Prompting through Action	Context-driven Activation		
	System Initiative	Reactive	Assisted	Proactive		
	Human-AI Interaction Pattern	User-Initiated Turn-Taking	Predetermined Turn-Taking	Mixed Initiative Turn-Taking	Generator	Constant Co-Creation
03 Task Dynamics	Task Intent	Content Creation	Data Analysis & Forecasting	Research & Development	Task Automation	Personal Assistance
	Task Fluidity	No adjustments	Parameter Adjustments	Goal-Oriented Modifications		
04 Contextual Consideration	User Expertise	Casual / Lay Users	Domain Experts	Technical Experts		
	Target Environment	Desktop Environments	Immersive Environments	Ambient Environments	Mobile Environments	
	Adaptive Behavior	Static Generation	Reactive Adaptation	Context-Aware Adaptation		

Figure 1: Our taxonomy for generative user interfaces is divided into four parts, covering the *Generation Process*, *Interaction*, *Task Dynamics*, and *Contextual Consideration*. Each part contains dimensions that enable analysis of systems with generative user interfaces.

Abstract

With generative user interfaces, a new HCI paradigm is emerging that may change how users interact with systems and transform design and development practices. As interfaces are generated in real time based on generative artificial intelligence, new questions arise, such as how to ensure accessibility, consistency, and security. Although generative user interfaces have recently attracted research interest, there remains a lack of shared conceptual understanding

of their design characteristics and implications for HCI practice. Hence, guided by a socio-technical systems perspective, we have developed a taxonomy of generative user interfaces based on a structured literature review and expert interviews. Of the 29 publications we identified, 14 dimensions emerged, each with distinct characteristics for designing, developing, and comparing systems systematically. Based on our taxonomy, we provide a conceptual foundation to guide future HCI research in this emerging field.

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CCS Concepts

• **Human-centered computing** → **Graphical user interfaces; HCI design and evaluation methods.**

Keywords

Generative user interfaces, Generative AI, Taxonomy, User Experience Design

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1 A Taxonomy for Generative User Interfaces from a Social-Technical Systems Perspective

Personalization in Human-Computer Interaction (HCI) aims to enhance user experience [15, 18], reduce cognitive load [1, 8], and support diverse user needs [9, 17] by adapting content, structure, or functionality to individual users [5]. Generative AI enables the creation of generative user interfaces that dynamically generate or adapt components at runtime based on user intents [6], promising a new form of personalization and a transformation of the design and development process in user-centered design [13]. However, research on this topic remains scattered across disciplines due to the phenomenon's interdisciplinary nature (e.g., HCI, AI, Natural Language Processing) and often focuses on algorithms and models [6]. To address this gap, we aim to develop a taxonomy for generative user interfaces grounded in Socio-Technical Systems theory [2], considering the human, task, technology, and organizational structures involved in the design, evaluation, and instantiation of generative user interfaces. The taxonomy aims to support the systematic comparison of system design, the identification of underexplored dimensions in their implementation, and more informed design decisions for HCI researchers and practitioners in their user-centered development process. Following Nickerson et al.'s iterative method for taxonomy development [12], we conducted a structured literature review yielding 27 publications from ACM Digital Library, IEEE Xplore, Science Direct, and AISEL (e.g., [3, 4, 11, 14]). Based on this, we identified common characteristics of the systems to form design dimensions and evaluated our taxonomy with four semi-structured interviews [16].

Our resulting taxonomy (Figure 1) comprises four meta-dimensions, which we illustrate using systems from our literature corpus: For example, the system *Morae* [15] automatically executes a task based on user input and pauses when decisions must be made by the user. The system shows an *Element Generation* process with a *Static Transparency* during generation, a *Static Generation History*, and requires *Full Regeneration* to refine the interface. In the example of *Misty* [10], a conceptual blending UI prototyping tool, the initialization of the generation is based on *Prompting through Action*, shows an *Assisted* system initiative during interaction, and has the *User-Initiated Turn-Taking* Human-AI Interaction pattern [7]. *AmbigChat* [11], an interactive chat designed for open-ended questions about any topic, supports *Goal-Oriented Modifications* in the task fluidity and has the intent of *Personal Assistance*. Finally, *BISCUIT* [4], an ephemeral UI generation tool for Jupyter Notebooks, considers the code written by the user in the notebook during the generation process, providing *Context-Aware Adaptation*, is designed for *Technical Experts*, and for *Desktop Environments*. Our taxonomy provides a foundation for the systematic investigation of generative user interfaces, and each dimension presents distinct future research areas. For example, *generation processes* raise questions about transparency and consistency in generation, and how the role of designers evolves. The *interaction* dimension provides an

opportunity to analyze how users form mental models, calibrate their reliance, and determine effective interaction modalities. *Task dynamics* offers an analysis of application fields and visualization techniques to help users understand and influence interface adaptations. *Contextual considerations* include analyzing ethical risks and data privacy when data is collected for generation. Our literature review, taxonomy development, and analysis of current generative user interfaces also reveal several underexplored areas. First, while studies have developed novel systems with generative user interfaces, structured design methods are missing. This highlights the need to develop new approaches to apply design heuristics and adhere to guidelines when generating interfaces for each user. Second, generative user interfaces raise questions about quality assurance and user experience evaluation, prompting the question of whether current methods remain applicable to this emerging paradigm. As interfaces shift from predefined artifacts to dynamic outputs generated at run-time, many traditional approaches to ensuring usability, accessibility, and security may need to be rethought.

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