AI in User Interface Design and Evaluation

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The task of designing and testing user interfaces (UIs) has seen significant changes in the past years. Even when user-aware methods, like user-centered development,[1] have been around for decades, the switch to these methodologies is relatively recent. The current focus on user experience (UX) gave way to new challenges, new roles in development teams, and new processes—which had to be integrated with the already adopted agile methodologies. Such integration has not been trivial since the fast pace of these methodologies and their constant delivery policy collide with the longer times required by user-centric tasks.[3,4] Due to the unpredictability of user behavior, the design and evaluation of UIs require feedback from real users, which takes considerable time and resources. Besides, changes in the UI often impact the rest of the codebase, becoming yet another source of potential delays in the development process. In this context, academia and industry have come out with different strategies for automating the different tasks in designing and evaluating UIs. AI techniques, having received increasing attention in recent years, became a natural choice for automation, especially considering the human factors involved in the task of UI development and analysis.

From early prototyping stages to user testing, AI models can be trained to help the many processes that UI design and evaluation entail. Some of the first proposals to apply AI techniques for the design and evaluation of UIs go back many years, like using artificial neural networks to determine the best placement of icons on a screen.[2] Kong et al.[8] used neural networks to choose the best graphic interface style for a program. The UIs in applications have evolved very fast, including mobile interfaces, rich web interfaces, voice interfaces, virtual reality, and even brain–computer interfaces.[9] This fact poses the challenge of developing new and more effective design and evaluation techniques.

Prototyping and designing UIs, a task that seems unlikely to be automated at first glance, has been explored in different works, like Akin, which generates wireframes from patterns using deep learning,[6] or DLS Magician, which produces visual mockups from text requirements.[7] UX testing has also been supported by AI, to the point of analyzing user emotion from plain logs.[5]

The first article featured in this special issue takes advantage of AI techniques such as machine learning (ML) for UI evaluation in the field of human computer interaction (HCI). In "How Many Data Does ML in HCI Need? Re-estimating the Dataset Size for CNN-Based Models of Visual Perception"[A1], the title already poses an important and frequent question among researchers using AI in human–computer interaction. The amount of training data for more demanding AI approaches, such as deep learning, is a relevant topic that can benefit from reports like the one presented in this article. This is especially relevant for user-generated data that are difficult to gather and, at the same time, challenging to augment when there are subjective criteria involved.

Our second article in this issue, "Modeling Search Behavior Evolution on a Specialist Search Engine"[A2], proposes a model to understand user behavior evolution in specialized search engines. The study included data from more than 200 users performing unguided tasks, which holds good external validity. In the article, the authors characterize the users and how their behavior changes through periods of usage over time.

The third article in this special issue departs from the previous two to examine the tension between AI-driven performance quantification logic and professional medical logic in the hospital setting. "Examining the Dilemma Between Artificial Intelligence Techniques and Professional Medical Service: A Hybrid Balancing Perspective"[A3] offers a model that creates a

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ALSO IN THIS ISSUE

FEATURES

The nexus between computers and humans is quite common across all computer-based activities. Thus, the special issue topic, while explicitly related to AI, represents a part of a much broader phenomenon. The selections in this issue of *IT Professional* broadly highlight the intersection among systems, software, and humanity.

The first feature article deals with inevitable changes regarding software deployment. "Deeper Understanding of Software Change"[A4] by Essa et al. offers a robust literature scan, yielding valuable insights into the diversity of changes in evolving business environments. These changes lead to gaps requiring further software engineering.

The second feature article looks at who the influencers are on Twitter and how they drive the Bitcoin dialog on that platform. Using applied topic modeling, "Topic Modeling Based on Two-Step Flow Theory: Application to Tweets About Bitcoin"[A5] by Mulahuwaish et al. presents some interesting findings regarding the relationship between opinion leaders and the majority of Twitter users interested in Bitcoin.

The third feature article, "Bridging K–12 Mathematics and Computational Thinking in the Scratch Community: Implications Drawn From a Creative Learning Context"[A6] by Xie et al. considers the degree of educational interplay between computational thinking (CT) and K–12 mathematics within the Massachusetts Institute of Technology-sponsored Scratch community. The study correlates K–12 mathematical elements with K–12 Scratch components for CT applicability.

This issue's fourth feature article deals with what happens organizationally when agile teams are handled using traditional governance practices. "Organizational Type Mismatch in Agile SMEs"[A7] by Henriquez et al. addresses this common mismatch and offers concrete recommendations for easing the resulting organizational tensions.

COLUMNS AND DEPARTMENTS

This issue's departments and columns also deal primarily with the intersection been humans and computational assets.

Resident international economics expert Kshetri offers "ChatGPT in Developing Economies"[A8] for his popular IT Economics department. As always, Kshetri's department provides a tantalizing view of how computational assets are viewed worldwide. This issue's analysis is highly significant, as it deals substantively with ChatGPT, which has lately dominated many a feed.

"Approximate High-Performance Computing: A Fast and Energy-Efficient Computing Paradigm in the Post-Moore Era" by Menon et al.[A9] appears in Schordan's Software Tends department for this issue. This department delineates the value of approximation instead of precision for optimal high-performance computing. If carefully managed for a minimal loss of data integrity, approximation serves as a means to greatly enhance performance and reduce cost.

While the role of corporate accounting has long been questioned for C-suite viability, the arrival of ChatGPT; GPT-4; and, soon, GPT-5 add to the urgency of the question. "How Accountants Stay in the C-Suite (or Disappear Into the Digital Back Office)" by Andriole and Barsky[A10] uses ChatGPT to underscore the elements of this ongoing corporate debate. These accomplished authors then independently conclude that the traditional view of corporate accounting is liable to change if it is to survive as a C-suite function.

Strawn, a computer science mastermind in his own right, steps out of his Mastermind department and into the IT and Future Employment column. His provocative department, "IT, 21st Century Employment, and Demography"[A11], looks at existing demographic realities as a function of future employment in the IT realm.

Finally, Bojanova and Galhardo deliver a Cybersecurity column, "Heartbleed revisited: Is it just a buffer over-read?"[A12]. This column dissects the critical vulnerabilities in the highly destructive heartbleed OpenSSL bug discovered in 2014.

standards-based and secure dynamic, intelligent service development environment. This hybrid model accommodates both the AI-based and human expertise viewpoints.

APPENDIX: RELATED ARTICLES

A1. M. Bakaev, S. Heil, V. Khvorostov, and M. Gaedke, "How many data does machine learning in human–computer interaction need? Re-estimating

the dataset size for convolutional neural network-based models of visual perception," *IT Prof.*, vol. 25, no. 2, pp. 23–29, Mar./Apr. 2023, doi: 10.1109/MITP.2023.3262923.

A2. H. Yu, S. Harper, and M. Vigo, "Modeling search behavior evolution on a specialist search engine," *IT Prof.*, vol. 25, no. 2, pp. 30–35, Mar./Apr. 2023, doi: 10.1109/MITP.2023.3243413.

A3. C.-H. Huang and T.-C. Chou, "Examining the dilemma between artificial intelligence techniques and professional medical service: A hybrid balancing perspective," *IT Prof.*, vol. 25, no. 2, pp. 36–40, Mar./Apr. 2023, doi: 10.1109/MITP.2023.3246560.

A4. M. S. Essa, A. M. Elfatatry, and S. K. Guirguis, "Deeper understanding of software change," *IT Prof.*, vol. 25, no. 2, pp. 41–51, Mar./Apr. 2023, doi: 10.1109/MITP.2023.3239505.

A5. A. Mulahuwaish, M. Loucks, B. Qolomany, and A. Al-Fuqaha, "Topic modeling based on two-step flow theory: Application to tweets about Bitcoin," *IT Prof.*, vol. 25, no. 2, pp. 52–63, Mar./Apr. 2023, doi: 10.1109/MITP.2023.3253103.

A6. Z. Xie, G. K. W. Wong, D. K. W. Chiu, and J. Lei, "Bridging K–12 mathematics and computational thinking in the Scratch community: Implications drawn from a creative learning context," *IT Prof.*, vol. 25, no. 2, pp. 64–70, Mar./Apr. 2023, doi: 10.1109/MITP.2023.3243393.

A7. V. Henriquez, A. M. Moreno, J. A. Calvo-Manzano, T. San Feliu, and E. Scheihing, "Organizational type mismatch in agile SMEs," *IT Prof.*, vol. 25, no. 2, pp. 71–76, Mar./Apr. 2023, doi: 10.1109/MITP.2023.3244409.

A8. N. Kshetri, "ChatGPT in developing economies," *IT Prof.*, vol. 25, no. 2, pp. 16–19, Mar./Apr. 2023, doi: 10.1109/MITP.2023.3254639.

A9. H. Menon et al., "Approximate high-performance computing: A fast and energy-efficient computing paradigm in the post-Moore era," *IT Prof.*, vol. 25, no. 2, pp. 7–15, Mar./Apr. 2023, doi: 10.1109/MITP.2023.3254642.

A10. S. J. Andriole and N. P. Barsky, "How accountants stay in the C-suite (or disappear into the digital back office)," *IT Prof.*, vol. 25, no. 2, pp. 77–80, Mar./Apr. 2023, doi: 10.1109/MITP.2023.3254640.

A11. G. O. Strawn, "IT, 21st century employment, and demography," *IT Prof.*, vol. 25, no. 2, pp. 81–82, Mar./Apr. 2023, doi: 10.1109/MITP.2023.3254641.

A12. I. Bojanova and C. E. C. Galhardo, "Heartbleed revisited: Is it just a buffer over-read?" *IT Prof.*, vol. 25, no. 2, pp. 83–89, Mar./Apr. 2023, doi: 10.1109/MITP.2023.3259119.

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