Second Workshop on Engineering Interactive Systems Embedding AI Technologies

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ABSTRACT

This workshop is the second edition and aims to bring together researchers and practitioners interested in the engineering of interactive systems *that embed AI technologies* (as for instance, AI-based recommender systems) or that *use AI during the engineering lifecycle*. The overall objective is to identify (from experience reported by participants) methods, techniques, and tools to support the use and inclusion of AI technologies in the whole engineering lifecycle for interactive systems. A specific focus was on guaranteeing that user-relevant properties such as usability and user experience are accounted for. Another focus was on the identification and definition of software architectures supporting those integration. Contributions are expected to address system-related properties, including resilience, dependability, reliability, or performance.

KEYWORDS

Interactive Systems Engineering, Usability, Reliability, UX, AI technologies

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EICS Companion '24, June 24–28, 2024, Cagliari, Italy

ACM ISBN 979-8-4007-0651-6/24/06
https://doi.org/10.1145/3660515.3662837

ACM Reference Format:
Alan J. Dix, Kris Luyten, Sven Mayer, Philippe Palanque, Emanuele Panizzi, Lucio Davide Spano, and Jürgen Ziegler. 2024. Second Workshop on Engineering Interactive Systems Embedding AI Technologies. In *Companion of the16th ACM SIGCHI Symposium on Engineering Interactive Computing Systems (EICS Companion '24), June 24–28, 2024, Cagliari, Italy*. ACM, New York, NY, USA, Article 111, 5 pages. https://doi.org/10.1145/3660515.3662837

1 INTRODUCTION AND CONTEXT

Automation is pervasive in interactive systems [23]. While automation varies in nature and objectives, it is present in every layer of interactive systems architectures, from hardware input device driver level (e.g., mouse acceleration [4]), to interaction technique level (e.g., multimodal fusion such as finger clustering [20] or more sophisticated ones such as the bubble cursor [15] integrating in a single design automation at both input and output levels) as well as at the interactive application level (e.g., auto-completion [14], or the automatic generation of visual or textual components).

AI technologies (e.g., machine learning, rule-based systems) enable complex tasks to be performed, targeting the ultimate goal of autonomous systems, e.g., self-driving cars, autonomous cooking chefs [22]. On the other hand, having more automation might induce more potential for failures (known as the lumberjack analogy). Moreover, many AI technologies bring issues at the operation level due to their black-box nature, i.e., when users interact with an interactive application embedding them [2]. To address this issue, a recent contribution [26] has demonstrated the potential benefit of opening up that box and adding explanations.

Generative AI, for example, can generate various types of data (images, text, layout, persona's,...) driven by models that are trained with specific training data. Generative AI is best known for its capability to generate text and images. Still, it is also becoming more common as a supporting tool during the engineering life cycle for building interactive systems. Researchers have started exploring the use of Large Language Models for various aspects of

the Human-Centred Development Process [27]. So far Generative AI has been used to support data-driven designs and generating prototypes [8, 17, 28], human-robot interaction [30], integrating multi-modal interaction techniques [31], and even feedback on User Interface designs [12] and usage within a broader social context [25].

Integrating AI technologies can be performed at various levels, from micro to macro, requiring different (and maybe conflicting) engineering approaches. Thus, at the engineering level, different issues appear depending on the type of AI-related technologies used and the type of interactions provided to the users of such systems. Indeed, beyond explanations, issues related to display/visualization [18] and control/command [19] arise. At the dependability level, even though multiple iterations have been performed, reliability remains very low (at about 80% accuracy for simple datasets) but much lower in some domains, such as food allergies, which might be considered critical in case of severe pathology [26].

Despite the many challenges AI technologies bring in interactive systems, the potential for effortless and seamless interaction with systems far outweighs the cost of designing usable systems. With this workshop, we aim to offer a platform for scientists interested in the design, development, evaluation, and use of interactive systems involving AI technologies to address these engineering challenges. This platform offered idea exchange, discussions, and collaborations and, thus, drive the development of AI-powered interactive systems in an interdisciplinary manner.

2 WORKSHOP OBJECTIVES

The objectives of the workshop are broader than the ones of the first edition organized at ACM EICS 2023 in Swansea [11].

The **first objective** is to identify and gather information about knowledge and practice in the workshop's domain:

- Get an overview of current R&D practices (methods/ notations/ tools) to engineer usable interactive systems embedding AI technologies, as well as lessons learned and recommendations.
- Get an overview of current R&D practices (methods/ notations/ tools) to architect usable interactive systems embedding AI technologies, as well as lessons learned and recommendations.
- Identify a systematic approach for describing AI technologies and assessing their impact on properties such as users' UX and systems' usability.
- Understand how the multiple stakeholders involved in interactive systems design and development identify properties, how they describe them, and how they assess their relative importance when they embed AI technologies (going beyond the classical UX and usability but also addressing, e.g., performance, dependability, safety).
- Identify an engineering approach to find an equilibrium between (AI-based) automation and human interaction.

The **second objective** is to elicit the main gaps in AI technologies that hinder their exploitation in the design and development of interactive systems, especially if a user-centered design process is followed.

The **third objective** proposes to focus on the specific issue of engineering interaction-driven AI. User interaction with AI technologies can occur at very different levels, ranging from perception-based techniques for input recognition to application-level tasks such as recommending and decision support. Conversational techniques are also gaining ground as components of interactive systems such as e-commerce websites or data analytics applications [16]. Engineering interaction-driven AI includes, among others, the design of suitable user interfaces [19], the integration of AI components with other interactive parts of the system, or the engineering of prompts for the application of large foundation models. The workshop aims to identify engineering methods to make the interaction with AI components transparent, controllable, explainable, and predictable.

The **fourth objective** focuses on the design and use of AI technologies in methods, processes, and tools for building interactive systems in all stages of the engineering lifecycle. Generative AI such as LLMs are used to generate code, AI can be used for automatic training and validation of interactive systems, and design and prototyping of user interfaces and interaction techniques are driven by pre-trained models that generate "creative" solutions. In the near future, AI tools could gain the potential to create and integrate AI components in interactive systems too.

The activities carried out during the workshop aim to identify the current state of knowledge in the scope of the workshop but also to outline a research agenda by bringing together diverse and sometimes competing views from multiple stakeholders.

3 TARGET AUDIENCE

The target audience is scientists interested in, using of and working on heterogeneous models and methods for engineering interactive systems using AI technologies. The workshop is open to everyone who is interested in the topic and who wants to participate in the discussion or thinks about starting to work in the area.

4 FORMAT AND DURATION OF THE WORKSHOP

4.1 Duration

The workshop lasted one full day, including presentations from participants, interactive sessions, and the preparation of a joint summary to be presented during the conference.

4.2 Short Presentations

Participants with an accepted submission presented a summary of their contribution, highlighting the relationship with the main topics of the workshop. The presentation should highlight explicitly: the application domain and its specificities, the AI technologies deployed (and their objective), the user interface and the interactions, the users' goals and tasks, and the engineering issues related to the integration of these AI technologies in the interactive system. Other aspects relevant to the workshop may also be presented, such as lessons learned, both negative and positive, about the tools and methods used during the engineering process.

4.3 Interactive Session and Panel

The afternoon featured a panel discussion with the overall goal of discussing re-occurring problems and challenges, drawbacks, and benefits of integrating (or deciding not to) AI technologies. As basic material for the discussion, the workshop moderator took notes during the presentations and structured these into categories. Furthermore, in the call for participation, we asked all authors to indicate possible topics for the panel discussion specifically. Three to four persons (including some workshop organizers) have set up the panel. In the first round, each panelist had the chance to give a concise introduction followed by a short first statement on the points for discussion. Subsequently, a moderated discussion of the points identified happened, including questions and contributions by the audience. We planed to open the panel to other interested workshop participants who are thus not required to submit a position paper but would be interested in the workshop topics.

4.4 Break down into Smaller Groups

To foster interaction between workshop participants and to produce diverse outcomes, the second part of the afternoon was dedicated to working in groups with topics to be selected from the panel topics.

5 PRE-WORKSHOP AND POST-WORKSHOP PLANS

The workshop had three phases: first, submission of position papers of 2-10 pages before the workshop, which the workshop committee peer-reviewed, and second, the full-day workshop along EICS, including the presentation of the accepted papers and the previously presented panel discussion. The accepted authors (at least one) were required to attend the workshop to present their position papers. Participants who also attend the conference were offered the opportunity to co-create and co-present a summarizing poster presented during the EICS 2024 conference. The workshop has been advertised through the workshop web page (https://sites.google.com/view/engineering-interactive-system/home), while the submission and review process was handled by easychair (https://easychair.org/my/conference?conf=eiseait2024). The web page presents the timeline for submission, reviewing, and camera-ready deadline, such that all submissions are available to workshop attendees. Beyond this, workshop attendees were offered the opportunity to revise and extend their submission, which were, after another round of reviews, included in the post-workshop proceedings to be published by Springer in the LNCS series.

6 ORGANIZERS

Alan J. Dix is Director of the Computational Foundry at Swansea University, Professorial Fellow at Cardiff Metropolitan University, and general chair for EICS 2023. He has worked at the boundaries of HCI and AI over many years, including co-founding an intelligent internet interface start-up in the dot-com years and more than 30 years ago publishing on the dangers of social, gender, and racial bias in black-box machine learning algorithms [23] as well as speaking more recently on the topic [9]. Amongst other things, he is currently writing a book on AI for HCI and a second edition of an earlier AI textbook [10].

Kris Luyten is a full professor in Computer Science at Hasselt University, and deputy managing director of the research center Expertise Center for Digital Media – a Flanders Make core lab. He is a Principal Investigator for the Flanders AI Research Program. His research explores how to improve intelligibility for intelligent software systems, striving to simplify the interaction between humans and technology. Kris has contributed to the HCI field by investigating how intelligibility features can be integrated into, a.o., automation [7] and AI-driven applications [6, 29], aiming to enhance user awareness and control over system behaviors.

Sven Mayer is an assistant professor of computer science at LMU Munich, Germany. His research sits at the intersection between Human-Computer Interaction and Artificial Intelligence, where he focuses on the next generation of computing systems. He uses artificial intelligence to design, build, and evaluate future human-centered interfaces. In particular, he envisions enabling humans to outperform their performance in collaboration with the machine. He focuses on areas such as augmented and virtual reality, mobile scenarios, and robotics. He has served as a program committee member at numerous conferences, e.g., ACM CHI, and in various organizing committees, e.g., as General Chair for the International Conference on Hybrid Human-Artificial Intelligence (HHAI'23).
Philippe Palanque is a professor of computer science at the University Toulouse 3 "Paul Sabatier" in Toulouse, France. Since the late 80s, he has been working on the development and application of formal description techniques for interactive systems. For more than 20 years, he has been working on automation and its integration in interactive systems [13] for multiple domains [21]. For instance, he was involved in the research network HALA! (Higher Automation Levels in Aviation) funded by SESAR programme which targeted at building the future European air traffic management system. The main driver of Philippe's research over the last 20 years [3] has been to address in an even way Usability, Safety and Dependability [24] in order to build trustable safety critical interactive systems. As for conferences, he is a member of the program committee of conferences in these domains such as SAFECOMP 2024 (43rd Conference on Computer Safety, Reliability and Security) and EICS 2024 (16th annual conference on Engineering Interactive Computing Systems).
Emanuele Panizzi is an associate professor of computer science at Sapienza University of Rome, Italy. He directs a research team focusing on human-computer interaction, app design, gamification, and context-aware mobile interaction. In the two areas of smart parking and earthquake detection, his current study uses AI to recognize users' behavior and context. Designing mobile user interfaces with implicit interaction and crowdsensing applications is the experimental component of this study. He served as the conference's program chair for Advanced Visual Interfaces AVI2022. He is currently serving as Associate Chair for ACM AutomotiveUI '23. He teaches HCI and software architecture. He has served as a consultant for major national and international corporations.

Lucio Davide Spano is an Associate Professor at the Univerity of Cagliari since 2019. He is chair of the IFIP 2.7/13.4 WG on User Interface Engineering since June 2022 and Delegate for the Research of the Extended Committee of SIGCHI-Italy. He has been a member

of the Model-Based User Interface WG of the World Wide Web Consortium (W3C). He has been Programme Co-Chair for ACM Intelligent User Interfaces in 2020, and an associate editor for a special issue in ACM Transactions on Intelligent Interactive Systems. He is a member of the Senior Programme Committee of high-level international conferences in Human-Computer Interaction (e.g., IUI, INTERACT, EICS, NordiCHI). He is currently investigating the relationship between the logic reasoning style (inductive, abductive, deductive) in eXplainable AI (XAI) interfaces. He published results considering image, text [1] and temporal series [5] data types.

Jürgen Ziegler is a senior professor in the Department of Human-Centred Computing and Cognitive Science of the Faculty of Computer Science at the University of Duisburg-Essen, where he directs the research group on interactive intelligent systems. His main research interests lie in the areas of user-centered AI, interactive recommender systems, user modeling, and explainable AI. His recent work has focused on visualization in recommender systems, conversational explanations, human-AI interaction in decision-making support, and the mitigation of polarization in social networks.

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