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Human-Centered Software Engineering for Changing Contexts of Use

IFIP WG 13.2 Workshop at INTERACT 2021

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Abstract. The context of use plays an important role in Human-Centered Software Engineering (HCSE). Typically, user, environment, and platform are considered to make up the core aspects of the context of use. Changing the context of use has significant impact on how to design and develop with a user-centered perspective and how usage of these systems changed for example in the current pandemic situation with a focus on remote work. New kinds of work environments in industry providing different types of user assistance evolve, new settings for remote and distributed work styles are required to account for social distancing, or the trends towards autonomous and AI-based systems demand for new ways of thinking about socio-technical interaction and systems. This workshop promotes sharing of knowledge and experiences that address how to deal with evolving contexts of use in today's and future application domains and its influence on human-centered socio-technical system design and development practices. Beyond the traditional themes of IFIP Working Group 13.2 workshops, the main focus lies on theories, methods, and approaches for dealing with the context of use, its influence on HCSE, and factors for its change over time.

Keywords: Human-Centered Software Engineering, Context of Use, Change, Adaptive User Interfaces

1 Overview and Goals

The context of use plays an important role in Human-Centered Software Engineering (HCSE) and Human-Computer Interaction (HCI) research [1][2]. Typically, user, environment, and platform are considered to make up the core aspects of the context of use [3]. Changing the context of use, for example due to unplanned circumstances like the current pandemic situation, has significant impact on how we use systems, and how we adapt and adopt them even if the systems were not designed for such usages. In

HCSE research we have to account for this change, making interactive system development context-aware or design and develop in a way that systems can adapt for novel forms of usage. Recently, we observe developments that strongly change contexts of use. For example, in the area of industrial automation (Industry 4.0) work environments change, new kinds of user assistance evolve, and workers are going to be supported by innovative types of devices and digital assistance tools to accomplish their working tasks. Typical examples are augmented, virtual, and mixed reality (AR, VR, MR) applications in training or support situations. The COVID-19 pandemic has drastically changed where and the way how we work, particularly in collaboration with others to keep distance and increase personal safety. In contrast, the trend towards increasingly autonomous systems and systems that use and provide artificial intelligence gives rise to new kinds of interaction, particularly, human-machine interaction (HMI), in areas such as autonomous driving or human-robot collaboration in different domains such as industrial production, logistics, or health. These trends should be accounted for in the way we design and build such interactive systems, possibly coming to evolutionary or even revolutionary solutions. For example, expected or unforeseen changes of usage scenarios and their context of use may be accounted for by flexible and more resilient system solutions and be reflected in the development practices and technical frameworks. Specific kinds of interaction such as HMI, but also social and socio-technical interaction may demand for more prominent and explicit consideration. Quality aspects such as ubiquity, security, and safety may be seen in a different light. Changing contexts of use may even have an impact on the way we think about user motivation and user experience, away from short-term notions like emotions towards long-term traits like users' values. We want to specifically account for these developments in addition to the general concerns of HCSE. Discussions and interactive working sessions in the course of the HCSE@INTERACT 2021 workshop will particularly deal with these concerns.

In this workshop, we aim to broaden the traditional scope of the workshop series of IFIP Working Group 13.2 [4][5][6]. We focus on the study of context of use, its long-term evolutionary trends as well as its short-term design and management in a user-centered design process, from a social and user-centered methodological viewpoint as well as from a technical viewpoint. Our aim is to cover a large set of user interface perspectives, aspects, and properties and fuel new ideas and approaches for research and practice. The long-term perspective of this workshop is to foster the development of theories, methods, tools and approaches for dealing with the changing context of use and its impact on HCI and collaboration that should be taken into account when developing interactive and socio-technical systems.

This workshop is a follow-up of the successful workshops organized at INTERACT 2017 in Mumbai, India [5] and INTERACT 2019 in Paphos, Cyprus [6].

2 Target Audience and Expected Outcomes

This workshop is open to everyone who is interested in aspects of human-computer interaction from a user-centered perspective. Typical contributions to this workshop focus on user interface properties while designing and building interactive systems and

study associated methods, processes and approaches. We expect a high participation of IFIP Working Group 13.2 members. We invited participants to present position papers proposing novel solution ideas and describing real-life case studies that illustrate the role of the context of use in HCI and its impact on the system design and use. Any perspective and related aspects of user interface design were welcome. However, we were especially interested in work that deals with current trends that change the way humans use, interact and collaborate with technical components in socio-technical systems. We were also interested in methods, theories and tools for managing context of use at design and run-time. Submitted position papers were reviewed and selected for presentation in the workshop by an international program committee comprising the organizers and selected members of IFIP Working Group 13.2 who are experts in the field. Accepted papers were made available through the workshop website. Furthermore, an extended version of selected papers was considered for inclusion in a Springer LNCS post-proceedings volume published in conjunction with the other INTERACT workshops organized by the IFIP TC13 Working Groups.

3 Workshop Contributions

Nine contributions have been accepted for presentation at the workshop. They are briefly described in the following.

How to Identify Changing Contexts of Use With Creativity Workshops – An Experience Report, presented by Wasja Brunotte, Lukas Nagel, Kurt Schneider and Jil Klünder, reports their experiences with a multi-stakeholder requirements elicitation workshop method that combines the 6-3-5 Method with the Walt-Disney Method to ensure that a broad range of requirements can be elicited while ensuring equal contribution from different stakeholders and improving the number of perspectives on the future context of use of a software that is developed.

Describing Digital Work Environment Through Contextual Personas, presented by Ruochen Wang, Marta Larusdottir and Åsa Cajander, reports the results from a study involving student software developers using personas that were enriched to represent physical work context, organisational work environment, social work environment aspects as well as the cognitive load. Interesting insights regarding improvements are identified: the ability of representing diversity of user groups especially when it comes to aging populations or non-tech savvy user groups, and, more generally, personas that evolve with the project and over time.

Towards Flexible Interaction Design for Operator Assistance Systems, presented by Jan Van den Bergh and Florian Heller. The authors present an approach to assess the usability of Operator Assistance Systems, such as hoist, lifts, cranes, and robotic arms. Such systems help operators in handling components of various weights in order to reduce ergonomic stress and are currently evaluated based on ergonomic criteria. However, the acceptance of such systems by the operator does not only depend on the amount of support it generates, but also on basic usability factors. Based on the observations of a contextual inquiry, the authors designed a simple scoring sheet to evaluate and compare the usability aspects of such systems.

Creating a Post-Sedentary Work Context for Software Engineering, presented by Martin Hedlund, Cristian Bogdan and Gerrit Meixner, presents a research agenda on how to address the sedentary work style of software engineers by re-structuring tasks to be performed and supported by for example visual programming and providing associated technological solutions including virtual reality (VR), augmented reality, and haptic interaction within VR to perform these tasks. The research agenda addresses the possible study set-ups for such types of interventions and how to investigate aspects like program comprehension, code creation or novel types of interaction techniques.

Coping with Changing Contexts: A Healthcare Security Perspective, presented by Bilal Naqvi and Carmelo Ardito. The authors aim at stimulating a discussion on how to cope with changing contexts while considering the threats posed by phishing and ransomware attacks in the context of healthcare infrastructures. Indeed, phishing has been the most prevalent attack mechanism on the healthcare infrastructures during the ongoing COVID-19 pandemic, which increased the pace of digitization of the healthcare industry. The authors propose three ways to cope with these threats in the perspective of healthcare, i.e., i) training and supporting developers at work; ii) initiating cross-disciplinary education and training mechanisms; iii) application of existing HCI principles.

Privacy Knowledge Base for Supporting Decision-Making in Software Development, presented by Maria Teresa Baldassarre, Vita Santa Barletta, Danilo Caivano, Antonio Piccinno and Michele Scalerà. The authors propose an approach to support software developers in integrating security and privacy requirements at every stage of the software development cycle, which is critical to guarantee the confidentiality, integrity and availability of the system and consequently of the data. In particular, they define a Privacy Knowledge Base (PKB) that encompasses the key elements to support decision-making in privacy-oriented software development. An industrial case study shows preliminary results on how PKB provides the guidance needed for privacy-oriented software development.

bRIGHT – A Framework for Capturing and Adapting to Context for User-Centered Design, presented by Rukman Senanayake and Grit Denker, deals with user context modeling and adaptation. Particular challenges of creating and maintaining an accurate model of the user context are incomplete and uncertain information. The proposed HCI framework bRIGHT is capable of creating an accurate context model as the user engages with the computer system. In this paper, the authors discuss the new architectural design of bRIGHT for improving knowledge representation and base type system and its expected benefits.

Affordance-derived Declarative Interaction Models for Context Adaptation, presented by Cristian Bogdan, proposes an approach to achieving fully declarative interactive applications. A concrete user interface is sketched and the interaction function is derived from the UI's form through affordance mechanisms. As a result, a declarative model of the dynamic interaction aspects of the application is obtained. This model can be used to complement existing solutions for declaratively describing the static aspects of the user interface to make a fully declarative application. This is an important prerequisite for such an application to be automatically adapted to its context of use.

On the Consistency of UI Adaptations, presented by Kai Biermeier, Enes Yigitbas, Nils Weidmann and Gregor Engels, looks at employing Triple Graph Grammars (TGGs) as a sophisticated mechanism for controlling the consistency of user interface (UI) adaptations to the current context-of-use. To prevent the undesirable application of conflicting UI adaptations and ease the specification of UI adaptation rules, they introduce their notion of adaptation consistency based on TGGs augmented with a 0-1 priority system. TGGs are an established formalism for consistency maintenance in model-driven engineering. TGG semantics are extended with a priority system to control the rules' application order. The authors also outline the implementation of a prototypical TGG interpreter as a design and run-time solution for ensuring consistency of UI adaptations.

4 Workshop Format

This full-day workshop is designed to be held in hybrid format, i.e., allowing participants to either attend in person on-site or just remotely/virtually. It is organized around presentation of position papers and working activities in small groups. In the morning sessions, after welcoming the participants and setting the frame for the workshop, the selected position papers are presented. In addition, further position statements can be contributed by the workshop participants. Participants are also invited to comment on the propositions and case studies and to report similar experiences. Position papers and statements together are used to support the discussion that follows. The afternoon sessions are thus devoted to interactive sessions, where participants will be engaged to work in small groups, discuss and propose solutions to the identified challenges seen in the morning. Due to the hybrid workshop format, on-site and virtual group discussions are run in parallel. Solutions proposed by the participants are compiled and compared. Based on the lessons learned, participants are encouraged to draft an agenda of future work that can be accomplished.

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