AI4AUI: Workshop on AI Methods for Adaptive User Interfaces

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ABSTRACT

This workshop aims at exploring how adaptive user interfaces, i.e., user interface that can modify, change, or adapt themselves based on the user, or their context of use, can benefit from Artificial Intelligence (AI) in general, and Machine Learning (ML) techniques in particular, towards objectively improving some software quality properties, such as usability, aesthetics, reliability, or security. For this purpose, participants will present a case study, and classify their proposed technique in terms of several criteria, such as (but not limited to): input, technique, output, adaptation steps covered, adaptation time, level of automation, software quality properties addressed, measurement method, potential benefits, and drawbacks. These will be then clustered for group discussions according to the aforementioned criteria, such as by technique family or property addressed. From these discussions, an AI4AUI framework will emerge that will be used for positioning, comparing presented techniques, and for generating future avenues.

KEYWORDS

Adaptive interfaces, Intelligent user interfaces, Automation

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1 BACKGROUND AND INTRODUCTION

User Interfaces (UIs) of interactive applications can be subject to three primary forms of adaptation: *adaptability* when the end user controls its adaptation process, *adaptivity* when the application controls the adaptation, or *mixed-initiative* when the adaptation process is collaboratively managed by both the end user and the application [3]. Between these extremes exists a large spectrum for various forms of mixed-initiative adaptations [5] depending on the degree of intervention or control of the end user vs. the application. To express this variation more precisely, we revisit the Automation Level Description (ALD) [7], which defines ten levels of system automation where automation is defined as: *the execution by a machine agent (usually a computer) of a function that was previously carried out by a human. What is considered automation will therefore change with time. When the reallocation of a function from human to machine is complete and permanent, then the function will tend to be seen simply as a machine operation, not as automation.*

Based on this definition, we define the Adaptation Automation as any component of the interactive application, primarily its GUI, which achieves the GUI adaptation as a function that was previously ensured by the end user. Table 1 defines ten Adaptation Automation Levels (AAL), ranging from full adaptability (level=1) to full adaptivity (level=10). While this scale is useful for characterizing this aspect, it requires further investigation on how to specify, design, and implement the functions involved in these configurations as some of them are cumulative or exclusive. Such configurations could include techniques from Artificial Intelligence in general (AI: rule-based expert system, closed-loop system), or more specifically in Machine Learning (ML: decision-tree based technique, k-NN or 1-NN pattern matching, Support Vector Machines), Regression Learning (RL: autoshallow encoders), Deep Leaning (DL: multilayer perceptron, artificial networks, convolutional neural networks). Adaptability gives the full potential and control to the end user, which is often appreciated for its flexibility, but depreciated for being time consuming, which is perceived as even more constraining when repeated. The end user tends to enter into adaptability only if the win exceeds the cost. This is the main reason why adaptivity has been introduced: to delegate the execution of adaptation to the application as a function that was previously ensured by the end user. Adaptivity exhibits a series of potential benefits, such as the

AAL	Description
1	The UI offers no assistance: end-users make all decisions.
2	UI offers a complete set of decision/action alternatives, or
3	Narrows the selection down to a few, or
4	Suggests one alternative, and
5	Executes that suggestion if the end user approves, or
6	Allows the end user a restricted time to veto before automatic execution, or
7	Executes automatically, then necessarily informs end users, and
8	Informs the end user only if asked, or
9	Informs the end user only if the UI decides to.
10	The UI decides everything and acts autonomously.

Table 1: Adaptation Automation Level (AAL), based on [7].

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ability to improve the three usual usability aspects: effectiveness, efficiency, and subjective satisfaction.

By automatically changing the presentation and/or the behaviour of the GUI depending on each individual end user, it is expected that these benefits will become ultimately profitable for the end user. In practice, however, many obstacles exist before adaptivity provides its full benefits. Adaptivity also brings its own limitations such as its perpetual change over time which prevents the end user from learning it and increases the cognitive load [4], the loss of control, the rejection of adaptation, the impact on usability, the need for accuracy, the limited performance, the need for ensuring predictability, the need for explaining and understanding why a particular adaptation technique has been applied, the wish for providing the UI with feedback on the adaptivity quality, and the need for appropriate measures for evaluating the impact of adaptivity.

2 WORKSHOP OVERVIEW

The full-day workshop at IUI is aimed towards gathering participants who are working in the intersection of AI and HCI, and especially excited about the area of adaptive user interfaces (AUI).

The official webpage for the workshop is located at https://ai4aui.wordpress.com, which also includes the call for participation. Applicants are invited to submit an extended abstract describing a case study where an AI method has been applied towards adaptive interfaces. Each participant is asked to systematically characterise the AI/ML technique used for adaptivity according to a set of evolving criteria which will form the AI4AUI framework, such as: input (what data is required for running the technique), output (what is the scope of adaptivity), AI/ML technique and (sub-)family (to which family does the technique belong), adaptation steps covered (how does the technique covers the various steps based on Isatine framework [5], adaptation time (when is the adaptivity performed), AAL (Table 1), software quality properties addressed by adaptivity (which are the ISO 25010 factors and sub-factors addressed, such as usability, reliability), measurement method (how are the benefits of adaptivity measured), potential benefits and drawbacks. Participants will be invited to present a case study applying their method.

Up to 16 participants will be selected to enroll into the workshop. The workshop will begin with a keynote talk by a prominent figure in the field (details to be confirmed). Participants will then be allocated up to 10 minutes each to present one concept or application of AI methods for adaptive user interfaces. This could be either an example from the participant's prior work, or a new idea. After a short break, we will extract emerging themes, challenges, and opportunities, and discuss these with the entire group. In the post-lunch session, we will break out into smaller groups to brainstorm or prototype on the key aspects that have been discussed during the morning session. At the end of the day, we will come together as a group for a short discussion and summary at the end of the day, and chalk out a future research agenda.

3 ORGANISERS

Kashyap Todi is a postdoctoral researcher working at the User Interfaces Group, Aalto University. His research interests are concentrated towards developing different types of self-adapting user interfaces based on computational and statistical models of the user. In the past two years, he has published two papers at ACM IUI on this topic [2, 8].

Jean Vanderdonckt is a full professor in Information Systems at Louvain School of Management, Université catholique de Louvain, Belgium. His research interests are context-aware adaptation of user interfaces [6] and intelligent techniques for supporting user interface adaptation at design and/or run-time [1]. He was ACM IUI '04 Conference Chair and is ACM EICS '20 Full Papers Co-Chair.

Xiaojuan Ma is an assistant professor at the Department of Computer Science and Engineering (CSE), Hong Kong University of Science and Technology (HKUST).

Jeffrey Nichols is a senior researcher at Google LLC, in Mountain View. He is Co-Editor-in-Chief of Proceedings of the ACM on Human-Computer Interaction Journal.

Nikola Banovic is an Assistant Professor of Electrical Engineering and Computer Science at the University of Michigan. His research focuses on creating computational models of human behavior to study, describe, and understand complex human behaviors, and enable technology that automatically reasons about and acts in response to people's behavior to help them be productive, healthy, and safe. Nikola published award-winning research on methods to study and model human behavior in premier HCI conferences.

4 FUTURE DIRECTIONS

The key outcomes of the workshop will be shared online, as a blog post on the workshop webpage. In addition, we also plan to organise a follow-up workshop at ACM CHI 2020 with a similar theme. This is aimed towards not only ensuring continual exchange and collaboration among the participants at IUI, but also to attract other members of the wider HCI community who might not be present at IUI.

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