Multi-dimensional Context-Aware Adaptation for Web Applications

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Abstract. This tutorial presents the state-of-the-art of adaptation for web interfaces concerning multi-dimensionality and context-awareness. The specific goals include the presentation of: (i) fundamental concepts, as motivations, definitions and relevant context information; (ii) adaptation techniques for web applications, as methods, models, strategies and technologies; (iii) adaptable and adaptive web applications in scientific and commercial aspects.

Keywords: Web Interface Adaptation; Context-awareness; Multi-dimensions.

1 Context-aware Adaptation

A pre-defined context of use, of an able-bodied user, in a stable environment, with a conventional desktop PC, is often adopted for web applications currently developed. Though, actual web users are heterogeneous in their backgrounds, knowledge and goals; different devices, means and environments are used for interaction. Thus, considering a standard context of use may difficult or even prevent the interaction. Context concerns relevant information for the interaction, as: the user, the place, and available devices [1]. It can be mapped as a formal model by the triple (U,P,E) that characterizes the user, the platform and the environment [2]. The 'Future Internet' aims at providing users the right information, in the right time and in the right format, which requires high-level adaptation [3]. Since the early 90's, adaptation studies are being reported; in spite of the wide effort, the studies are widespread, and hard to be compiled to support the implementation of adaptation in web applications [4]. This tutorial presents an overview of the state of the art of Multi-Dimension Context-Aware Adaptation. It is organized in 3 parts:

Fundamental Concepts. Aiming to improve the users' interaction, adaptation transforms different levels and dimensions of systems. In this process context mainly involves user profiles, platforms and devices; and the dimensions are aspects, as modality or resources, subject to adaptation in different levels (e.g. at system level).

Methods. Many concepts support adaptation [5], [6] as: (i) The Context-Aware Design Space (CADS), a descriptive, exploratory and comparative, graphical representation for adaptation dimensions (means, UI component, deployment) [7];

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(ii) The Context-Aware Reference Framework (CARF) lists context information, concerning: what, who, where, when, how, to what and why. A technique to adapt images can be initiated by the system, performed in the client, at run time, considering users and improve the accessibility; animation can be used to smoothly present it for users [8]; (iii) Technologies support the adaptation, but to accommodate varied scenarios, the system architecture must be organized in layers (content, presentation and processing), User-Interface Description Languages are recommended; (iv) Distinct adaptation levels are modeled in 3-layers, first-order rules define commands, as: R1='if it is a mobile device, then replace radio boxes by edit fields', a second-order and a third-order rule define priority strategies in richer ways 'if the user is an expert, then prefer R1 than R2' and 'if user is an expert and device is a tablet, then reverse the preference order of R1 and R2'. Evolutive models capture user feedbacks, analyzes dynamic context, adapting efficiently [9].

Examples. Many web applications exemplify adaptation, as (i) Rekimoto's pre-distributed pick and drop exemplifies static UI deployment [10]. Pick and drop extends the drag-and-drop paradigm, users select a resource icon, drag it to another device, copying and sharing it. (ii) Sedan-Bouillon is a plastic website, users specify platform screens for its workspaces that are re-molded and re-distributed at the workspace level (title, content, navigation bar) [11]. (iii) A toolkit distributes interfaces in different levels partitioning the GUI over the display processes and distributing over devices and users a complex application. An interface and a workspace can be decomposed and migrated, and atomic elements, as buttons, can be detached and distributed [12].

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