A Model Driven Engineering Approach Toward User Interfaces Adaptation

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ABSTRACT

In ubiquitous computing, the context of use (user, platform, environment) is in a permanent change. This has brought about new challenges in the Human Computer Interface (HCI) engineering to obtain User Interfaces (UI) that are compliant to their context of use. This paper has benefitted from the interests of parameterized principle transformation in the framework of the Model Driven Engineering (MDE) to propose approaches based on the models for the generation of the adaptable UI. It provides meta-models for the various components of the context of use which plays the role of the transformation parameter of the abstract interface into a concrete interface. It is through a case study of an information system of industrial supervision that the approach is shown to be reliable.

Keywords: Adaptation, Adaptation Rules, Context of Use, Model Driven Engineering, User Interface

INTRODUCTION

Although the adaptation of the User Interface (UI) has become a necessity due to the variety of the contexts of use, it imposes new challenges in the Human Computer Interface engineering. Indeed, the multi-targeted oriented approaches consist in specifying the UI only once. Besides, the final interface can be generated, according to different sizes pertaining to the target platform, without necessarily changing the code or the style of display of the User interface (UI) constituents. That is why the need for the addition of the property plasticity of the UIs (Thevenin & Coutaz, 1999) emerges. Thevenin and Coutaz (1999) define the plasticity of interfaces (Thevenin, 2001) as the capacity of a user interface to adapt itself to the context of use which is denoted by the triplet <user, platform, environment>, while preserving usability.

With the aim of making User Interfaces (UI) adaptable to the context of use, several approaches were proposed. According to Samaan and Tarpin-Bernard (2006), these approaches are classified into four categories: 1) Translation Interface, 2) Reverse-engineering and migra-
tion Interfaces 3) Markup languages-based approaches and 4) model-based approach. The latter is adopted in this work because it has the advantage of applying the adaptation to the context of use of the models, leading to a strong abstraction.

Building on the concept of transformation parameterized by the context as defined within the framework of Model Driven Engineering (MDE) (Bézivin, Blay, Bouzeghoub, Estublier, & Favre, 2005; Favre, 2004), the proposed approach assures the adaptation of the UI to the context of use. It builds on MDE goes beyond the framework of Model Driven Architecture (MDA) (OMG, 2010), which can be summarised in the elaboration of the Platform Independent Models (PIM) and in their transformation into Platform Specific Models (PSM) (Bézivin, Blay, Bouzeghoub, Estublier, & Favre, 2005), to cover the methodological aspects. We apply the parameter setting at the level of the transformation of an Abstract User Interface (AUI) into a Concrete User Interface (CUI), whose generation is made on three phases. The first transformation parameterized by the model of adaptation describing the user, gives rise to a first CUI, which in turn is going to feed the second module of transformation. The latter will be parameterized by the characteristics of the platform to generate a Concrete User Interface in agreement with the preferences of the user and the properties of the interaction platform. In the last phase, the process of adaptation connected with the environmental context is launched to end up with a plastic Concrete User Interface to conform to the three dimensions of the context of use.

The remainder of this paper is structured as follows. First we present a state of the art on the model-based approaches for the adaptation of the UI. Next, we describe the proposed approach in terms of meta-models and adaptation rules. Then we provide a case study illustrating the approach. Finally, we draw the conclusion and provide perspectives to future research.

RELATED WORK

A great deal of research has been carried out in the Human Computer Interaction engineering, among which we can quote the TERESA method (Mori, Paternò, & Santoro, 2003) that supplies the tasks as a single model, and allows the generation of several interfaces for various platforms. We can also cite the Comets (COntext sensitive Multi-target widgETS) (Calvary, Coutaz, Dâassi, Balme, & Demeure, 2004), which essentially proposes a model for the plastic interactors that can be adapted to the variation of the screen size. Likewise, the UsiXML (User Interface eXtensible Markup Language) (Vanderdonckt, 2005; Limbourg & Vanderdonckt, 2004) approach represents a UI approach of engineering defined according to the Cameleon reference framework (Calvary, Coutaz, Thevenin, Limbourg, Bouillon, & Vanderdonck, 2003). Such an approach describes a context model consisted of three components: user, environment and platform. But, only the variant platform is considered during the UI generation.

Hariri, Lepreux, Tabary, and Kolski (2009) propose a method of UIs conception, by considering the biggest possible range of every element of the context <use, platform, environment>. This method is based on the use of patterns to facilitate the choice of business components related to the system tasks and the presentation components appropriate to the context of use.

The work of Sottet, Calvary, Favre, Coutaz, Demeure, and Balme (2005) is considered as one of the pioneers to join Model Driven Engineering with the domain of Human Computer Interaction. The reported approach has shown that the concepts of the MDE could be successfully applied to the UI engineering. Sottet (2005) proposes meta-models and models transformations to generate adaptable UI, and defines a general context meta-model. Based on the same approach (MDE), Hachani, Dupuy-Chessa, and Front (2009) suggest the introduction of the context of use at the tasks level rather than
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