An Abstract User Interface Framework for Mobile and Wearable Devices

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ABSTRACT

In the future, mobile and wearable devices will increasingly be used for interaction with surrounding technologies. When developing applications for those devices, one usually has to implement the same application for each individual device. Thus a unified framework could drastically reduce development efforts. This paper presents a framework that facilitates the development of context-aware user interfaces (UIs) with reusable components for those devices. It is based on an abstract description of an envisioned UI which is used to generate a context- and device-specific representation at run-time. Rendition in various modalities and adaptation of the generated representation are also supported.

Keywords: Abstract UI, Context-Aware User Interfaces, Mobile Devices, Unified Framework, Wearable Devices

INTRODUCTION

Desktop computers present no longer the only affordable technology with reasonable computing power. Over the last decades a new trend in computing has emerged: mobile computing. In recent years, mobile computing platforms have become available to the broad masses. Their price has decreased and today almost everybody can profit from devices, like smartphones or personal digital assistants (PDAs).

Nowadays many people use mobile phones, MP3 players or digital cameras in their daily lives. All of these devices provide functionality which can be accessed via a UI. They are typically graphically represented and must ensure an appropriate level of usability and information presentation in order to let users control the provided functionality. However, usability and information presentation are rather often neglected. E.g. using applications of mobile phones may be a burden as their UIs are still frequently based on desktop applications. Instead of creating an application that is specialized to solve a (single) problem, desktop applications are usually rather general purpose and feature-rich. While this may be a useful approach for desktop computers, it is not for...
mobile and wearable devices as they significantly differ from stationary systems (e.g., in terms of size, usage, computing power, etc.). Unnecessary features tend to hinder usability than being a useful extension when being in a mobile setting.

Not having expert knowledge on creating UIs for wearable and mobile scenarios makes it hard to develop applications for such devices. The heterogeneous nature of the hardware of these devices intensifies this problem as existing UIs are unlikely to be reused. A unified framework, that offers reusable components and facilitates UI development, could reduce development efforts and decrease programming errors.

UIs could be described in an abstract manner, so called abstract user interfaces (AUIs). AUIs can be used to transport information just like regular UIs. They are used to specify what is presented rather than how information is presented. Thus no concrete representation or visualization is defined instead a single AUI description can be represented in multiple ways. Furthermore an AUI can easily be adapted according to user preferences, device constraints or contextual information.

**RELATED WORK**

Several frameworks for automatic UI generation already exist. Three of them are listed and summarized as follows. Most frameworks can also be used to create wearable and mobile computing applications.

- **WUI Toolkit**: Witt et al. (2005) introduced “a toolkit for context-aware UI development for wearable computers” called wearable user interface (WUI) toolkit. It was designed and developed to meet requirements of wearable computers and aimed to ease development of WUIs. The toolkit first utilized reusable UI components and was based around a model-driven approach. It support self-adapting UIs without being limited to specific interaction devices or graphical UIs (Witt, 2005; Witt, Nicolai, & Kenn, 2007).

- **Huddle**: Huddle is a system that uses an abstract description language for automatic generation of task-based UIs for appliances in a multi-device environment (e.g. a home theater or presentation room). It makes use of an XML-based language for describing functionalities of appliances in those environments (e.g., televisions, DVD players, printers or microwave ovens). Huddle has been used to generate graphical and speech interfaces for over thirty appliances on mobile phones, handhelds and desktop computers (Nichols & Myers, 2007; Nichols, Myers, Litwack, Higgins, Hughes, & Harris, 2004; Nichols, Rothrock, Chau, & Myers, 2006).

- **SUPPLE**: SUPPLE is an alternative to creating UIs in a hand-crafted fashion. Instead UIs are automatically generated with respect to a person’s device, abilities and preferences. It is based around an abstract UI describing its functionality rather than its representation. The actual generation of UIs with SUPPLE is interpreted as an optimization problem (Gajos & Weld, 2004; Gajos, Weld, & Wobbrock, 2010).

**AbstractUI**

The AbstractUI framework eases development of applications using AUIs. It has been specifically designed to meet requirements of mobile and wearable devices. Furthermore development efforts are reduced as the same application can be used on multiple devices. A context-aware representation of an AUI can be generated at run-time.

Application developers describe what is to be displayed rather than how an envisioned UI is displayed. While doing so developers make use of several UI components and can interact with them just like they would with standard UI components of other toolkits and frameworks. Once an application is completed, it is passed to a renderer which in turn takes care of the concrete representation.
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