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Just a Smart Home or Your Smart Home – A Framework for personalized User Interfaces Based on Eclipse Smart Home and Universal Remote Console

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Abstract

In the last few years substantial progress has been made in smart home technologies, and promises to support and assist us in our daily life are higher than ever. This holds not only for regular users but also for people with special needs such as the elderly and people with disabilities. The appropriate design of smart homes can enable a more independent life for these users and can give them the chance to stay in their familiar environment for a longer period of time. Hence, the smart home concept can play an important role when addressing the demographic change that is present in most industrial countries. However, although technologies seem to be advanced and the expected benefits are high, a wide-spread adoption has not yet taken place. There are various reasons for this situation. Among them, the lack of appropriate user interfaces for the heterogeneous user group of future smart homes and the problem of low interoperability between different smart home systems can be mentioned. Two platforms addressing these problems are the Eclipse Smart Home (ESH) project and the Universal Remote Console (URC). ESH focuses on the integration of different device and back-end technologies; URC provides a personalized, pluggable user interface. This paper analyzes the similarities and differences between the two systems. As a result of the analysis, a concept for integrating the ideas of URC into the ESH project is proposed. This concept is a first step towards a platform for personalized user interfaces in the Smart Home and Ambient Assisted Living domain.

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Keywords: Smart Home, AAL; Personalisation; User Interface; Eclipse Smart Home; Universal Remote Console;

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1. Introduction

Nowadays, words like Internet of Things (IOT), Smart Home or Ubiquitous Computing are no longer of academic interest only. The emergence of these concepts was enabled by the continuous growth of interconnected, electronic devices in our everyday life. Possible use cases range from fancy and entertaining ones (e.g., video/audio distribution) to such that are helpful for everyone (e.g., energy management) but also ones that enable a more participatory life for the elderly or people with disabilities. Especially smart homes and the related field of Ambient Assisted Living with its wide spectrum of assistive functions can enable a longer independent life at home and will play an important role when coping with the demographic change that is taking place in most industrial countries.

However, although the technological base for these concepts seems to be established[1] and the promised benefits are high, reality is still lagging behind expectations and a wide-spread adoption has not yet taken place.

From the authors' perspective, the following reasons are of special importance. First of all, the focus of the research community has been rather on what is technologically possible[1,2,3] than on what the real user needs are. In addition, research has neglected the topic of appropriate user interfaces[4]). Since the user group of future smart homes will reflect the full range of our society, there is a need for personalized user interfaces that take the individual user requirements and preferences into account.

The second problem is the lack of interoperability of different smart home systems. The smart home market is just evolving and therefore it is very difficult for a user to decide which one to choose. Furthermore, it is likely that a user gains the highest value by integrating different systems. Along with the problem of low compatibility between different systems comes the fact that devices and backend technologies overarching user interaction concepts are missing.

Due to these reasons a framework is needed, addressing on the one hand the integration of different backend technologies, and on the other hand the provisioning of device overarching and personalized user interfaces. In order to realize such a system, the Eclipse Smart Home project[5] (ESH) and the Universal Remote Console[6] (URC) were chosen for investigation.

The URC framework was chosen because two of the authors are involved in the related development and standardization processes. ESH was selected, because just like the URC runtime implementation it follows the approach of a central gateway instead of relying on a distributed operating system, as some other IOT platforms do. Frameworks such as the AllJoyn framework locate their code directly on the target devices. A similar architecture with a central gateway makes the integration of the two frameworks easier. Another argument for our choice was the open source nature of URC and ESH; in addition, both projects are driven by communities instead of industry..

The remainder of this paper is structured as follows. In the following section the needs and requirements for personalized user interfaces are introduced on the basis of some illustrative use cases. Section 3 introduces the core concepts of ESH and URC. Section 4 contains our analysis on the two systems. In section 5, we propose a concept on how to transfer the ideas and major benefits from the URC framework to the ESH project.

2. Requirements for personalized user interfaces

This paper aims to evaluate the personalization features of URC and ESH with a special focus on graphical user interfaces. In the first part of the evaluation, a comparison of the systems' architectures is done with regard to the available components and general features. In the next step, the systems' abstraction models for describing connected devices and services are compared with regard to their structure and expressiveness.

. The need for abstract representations of physical devices can be illustrated by the following use cases:

- Frequently, elderly people are familiar with a specific device and have problems to adjust to a new one. Since any device will sooner or later get broken (e.g., washing machine, HVAC system), it is beneficiary for people to keep their familiar user interface. In order to do so, a separation between the physical device and its abstract representation in the smart home system is required *(U1)*.
- Such a separation enables many other use cases, among them supporting users who became paraplegic by