Assessing Smart-Home Platforms for Ambient Assisted Living (AAL)

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ABSTRACT

Smart-home platforms support applications, services, and devices for Ambient Assisted Living (AAL). The developers of those platforms commonly focus on technological requirements only, without having a clear understanding of end-users such as older adults living independently. Moreover, since there are no functional testing methods for AAL platforms, the authors introduce a testing methodology for smart-home platforms and use it to test two platforms for their suitability: the universAAL platform that is based on an ontology model, and the ‘Universal Plug and Play’ (UPnP) platform in combination with ‘Digital Home Compliant’ (DHC) framework (first version), both using fixed terminology and descriptions. The authors first developed a comprehensive overview the support older people may need from a smart home. The authors then developed scenarios that cover many of those needs and used the scenarios as test cases in functional tests in a simulation environment. The results show that 4/5 of the smart-home applications in the AAL scenarios will not work without a platform extension. This demonstrates the importance of these extensions. Therefore, the use of an ontology model for platforms is advisable because of its quick and easy adaption to new devices and services, needed for the worldwide rollout of smart-homes for AAL.

Keywords: Ambient Assisted Living (AAL), Assessment, Functional Testing, Platform, Smart-Home

INTRODUCTION

Ambient Assisted Living (AAL) is gaining importance; an increasing number of older people result in a growing demand for assistance at home and smart-care services. However, the available number of care staff is shrinking (Buerhaus, Staiger, & Auerbach, 2000). AAL may supply the required assistance by developing technologies to support older people to continue to live independently in their own environment (aging-in-place). AAL is a clear target of Ubiquitous Computing and Ambient Intelligence (AmI) (Bravo, Fuentes, & Ipiña, 2011). Ubiquitous Computing and AmI may improve health, safety, and well-being, with functionalities such as social gaming, improved

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communication, fall-detection, telecare, health monitoring, burglar alarm, to name but a few.

The required technologies face numerous challenges. The diversity in needs and aspirations is extensive and includes leisure as well as homework and medical care. Acceptance and adoption of new technologies may also be a problem (Chen & Chan, 2011). Moreover, the needs of older people may change fast depending on the rate of health decline. Satisfying needs and aspirations of older adults can be complex. Solutions may vary from simple monitoring services to advanced in-home interventions or instructions guiding the user carrying out a task (Das, Cook, Schmitter-Edgecombe, & Seelye, 2012). If you add this to the diversity of home-environments it is clear that AAL smart-home systems should be customizable, distributed, and heterogeneous (Lézoray et al., 2011).

The complexity of such smart-home systems calls for the integration of technologies from several domains by a dedicated middleware framework (Franchimon & Brink, 2009; Yu, Zhang, Indulska, & Becker, 2011). Such a framework provides a uniform platform to serve and to integrate heterogeneous devices and services. It has been shown that a uniform platform is required to arrive at a widespread introduction of AAL systems (Brink & Bronswijk, 2013; Franchimon F & Brink M, 2009). Functions of such a platform vary from dealing with complex heterogeneity problems, to providing the support for context awareness (Gámez & Fuentes, 2011). Despite the fact that platforms are considered from a pure technological angle, the requirements for platforms are mostly defined by the needs of the end-user.

Scenarios are useful tools to understand the needs and aspirations of end-users, and they are often employed in the development of AAL technology. Scenarios enable developers of AAL technology to focus more on the value for end-users than on the core technical workability (Tang, Yu, Zhou, Wang, & Becker, 2010). All user requirements should be understood during the development of a platform, since the range of functionalities that can be offered by the smart-home system will be dominated by the architecture of a smart-home platform (Denaro, Polini, & Emmerich, 2004). Unfortunately, developers of platforms commonly focus on technological requirements only, without having a clear view on end-users (Brink & Bronswijk, 2010). The scenarios that are incorporated in the development are rarely based on empirical data. A complete set of scenarios that cover all user requirements is needed. A theoretical background should be established for the creation of such a set of scenarios (Brink, Schalkwijk Ribeiro, González Alonso, & Bronswijk, 2013).

Functional testing can be used as a tool to assess the ability of smart-home platforms to support the needs and aspirations of end-users. It aims to validate the correct operation of a system with respect to its functional specification (Lai & Siewiorek, 1983). As with mathematical functions, one or more outputs are created on the basis of the function’s behavior and input(s). Services of smart-homes (that have a Service Oriented Architecture) can be seen as functions with an abstract input and output (e.g. an input can be a fall detection at home, the output could be a call for help) (Howden, 1980). The main aim of functional testing of a smart-home is to provide requests to the service and then to analyze the received responses (Ribarov, Manova, & Ilieva, 2007).

The aim of this paper is to introduce functional testing for smart-home platforms and to assess two platforms for their AAL suitability. We propose to use scenarios as test cases and simulations to run the tests. Test results will show whether the smart-home devices, applications, and services that people need to age-in-place (now and as new products become available in the future) fit with the platforms that are developed today. This will give insights into how the platform handles the information exchange for the devices, applications, and services.

The paper is organized as follows: related work is presented in the next section, followed by a section that introduces the two platforms we tested. We then introduce functional testing for smart-home platforms, followed by the test results, while discussion and conclusions form the last section.
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