Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 83 (2016) 537 – 544

Procedia Computer Science

The 7th International Conference on Ambient Systems, Networks and Technologies (ANT 2016)

Comparative Analysis of Prominent Middleware Platforms in the Domain of Ambient Assisted Living (AAL) for an Older Adults with Dementia (OAwD) Scenario

Rajjeet Phull[a], Ramiro Liscano[b,*], Alex Mihailidis[a]

[a]*Institute of Biomaterials and Biomedical Engineering, University of Toronto, 500 University Ave, Toronto, CANADA*
[b]*Dept. of Electrical, Computer, and Software Engineering, 2000 Simcoe Street North, Oshawa, CANADA*

Abstract

Diversification of application areas, technologies, and computational techniques in the Ambient Assisted Living (AAL) domain alongside the need for a balance between reproducibility and customizability for the heterogeneous end-user groups has led towards the development of domain-specific middleware platforms, which are software frameworks that facilitate integration and communication amongst heterogeneous hardware and software components, so they can operate synergistically within a shared environment. Recent efforts that study such platforms have emphasized the need for improved evaluation methods, particularly feature-focused scenario-based evaluations. Thus, the objective of this work was to perform a comparative analysis of two prominent AAL middleware platforms and their programmability for Older Adults with Dementia (OAwD) to ultimately derive guidelines for the development of AAL systems. Mapping of a platform-independence use-case scenario to both platforms, hinted towards the need for graphical-user interfaces over text-based interfaces and application area-specific modules.

Peer-review under responsibility of the Conference Program Chairs

Keywords: Ambient Assisted Living; Middleware; Unified Modeling Language; Older Adults with Dementia

* Corresponding author. Tel: +1-905-721-3086
E-mail address: rliscano@ieee.org

Peer-review under responsibility of the Conference Program Chairs
doi:10.1016/j.procs.2016.04.252

1. Introduction

According to the universal reference model for Ambient Assisted Living (AAL)[1], AAL systems can be defined as socio-technical systems that consist of networked artefacts (i.e. sensors & actuators) embedded in an AAL space to provide various types of AAL services for the wellbeing of the assisted persons (e.g. the elderly or disabled). AAL services (or applications) are specific functions that use the input sensor data to make actions which facilitate assistance or boost social integration for the assisted person[1]. AAL space is the smart environment equipped with the networked artifact that allow for the provision of AAL services.

Advancements in the AAL field are occurring in a broad range of applications areas such as cognitive orthotics, emergency detection, continuous health and activity monitoring, therapy, and emotional well-being[2]. Applications based on static smart environments incorporate ambient or environment sensors such as cameras, radio frequency identification, microphones, passive infrared sensors, and pressure sensors while mobile-based applications (i.e. e-textiles, vital sign detection) use wearable sensors like accelerometers, gyroscopes, ECG, and pulse oximeters[2]. Sensory information is processed using several types of computational techniques such as context modelling, activity recognition, anomaly detection, planning, and location identification[2].

The diversity and heterogeneity of assisted persons (end users of AAL services) is one of the main challenges when developing AAL systems. Persons supported by AAL systems can vary from one another in terms of age, cognitive abilities, preferences, physical capabilities, perceptions on technological aid, and environmental conditions. Therefore, the AAL solutions must be customizable and adaptive to the needs of its end users. Also, many of the developed AAL systems target only a subset of the entire user population and adopt methods and tools that are not easily transferable to other projects, resulting in fragmentation within the AAL field[3]. To ensure technical and financial feasibility of large, complex AAL systems, AAL middleware platforms are being developed. Middleware can be described as the systems of systems that resides between the operating system and the application layer. Requirements for AAL middleware are on the one hand mechanisms for personalized user interfaces and on the other hand integration of different backend technologies.

Many AAL middleware platforms have been developed[4,6,7,11,12] and the current contribution to the literature is primarily in the area of assessing the suitability of these AAL platforms on realistic AAL scenarios. With this in mind the objective of this work was to perform a comparative analysis of two prominent AAL middleware platforms and their programmability for Older Adults with Dementia (OAwD). The contribution of this paper is a set of guidelines and/or recommendations for future AAL systems to help improve adoption rates of the platforms by AAL application developers, and render the platforms more useful to a larger selection of AAL project types. Even though only two AAL platforms were compared one of these platforms, UniversALL[4] is a consolidation of the features from several AAL systems and a conscious decision was made to not include those AAL systems that were incorporated into UniversAAL.

This paper is organized as follows. Section 2, is an overview of work related to AAL systems. Section 3, leverages the scenario-based approached in Software Engineering to a particular assisted living scenario of an elderly person struggling with dementia trying to make a cup of tea. Section 4, discusses the platform specific models and methodologies and how they affect the programming of the tea making scenario. Finally, section 5 presents guidelines to help AAL developers based on the experience of developing the tea making scenario.

2. Related Work

Over the past decade, multiple AAL-related platforms have been developed, many of which have been consolidated into recent projects and/or have been discontinued. Many legacy projects have been consolidated as input projects for UniversAAL[4]. Other main frameworks and open solution platforms are highlighted in a recent literature survey of AAL by Memon et al.[5] which includes OpenCare[6] and AmiVital[11]. Additionally, Memon et al.[5] incorporated an email-based survey to create a detailed list of the contemporary AAL systems and platforms. From the presented list of AAL platforms, the ones that were based on a middleware were AALuis[12], HOMER[7], and OpenCare[6]. Of these platforms, HOMER[7] and UniversAAL[4] are the only prominent AAL-specific middleware platforms that are available under open source license and are still in development.