A Centralized Approach to an Ambient Assisted Living Application: An Intelligent Home

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Abstract. *Ambient Assisted Living* (AAL) includes assistance to carry out daily activities, health and activity monitoring, enhancing safety and security, getting access to, medical and emergency systems. But home environments are challengeable as they're different to represent. There are no only elderly people in a home In this paper we present the design of the contextual information for an intelligent home using a platform that exploits the modular and distributed architecture to develop context-aware applications.

Keywords: Ambient intelligence, ambient assisted living, context-aware services.

1 Introduction

The action of equipping environments with advanced technology to create ergonomic spaces for the users where they could interact with their digital environments the same way they interact with each other is the so called Ambient Intelligence paradigm [1]. It is also associated to a society based on unobtrusive, often invisible interactions amongst people and computer-based services taking place in a global computing environment. People will interact with these services through intelligent and intuitive interfaces embedded in these objects and devices, which in turn will be sensitive to what people need. Ambient Intelligence has also been recognized as a promising approach to tackle the problems in the domain of Assisted Living [2]. Ambient Assisted Living (AAL) born as an initiative from the European Union to emphasize the importance of addressing the needs of the ageing European population, which is growing every year as the United Nations World Population Prospects: 2004 Revision, http://esa.un.org/unpp (last access: 2007-01-30).

There have been several attempts to developed AAL systems; in the Gator Tech House [3], a work carried out by Florida University, a whole flat is instrumented with an assortment of coordinated, through an OSGi central server, assistive smart objects such as a smart mailbox which notifies letter arrival, a smart front door which enables to check who is outside the door and to remotely open it or a smart bathroom with a toilet paper sensor, a flush detector or a temperature regulating shower. The PAUL (Personal Assistant Unit for Living) system from University of Kaiserslautern [4] collects signals from motion detectors, wall switches or body

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signals, and interprets them to assist the user in his daily life but also to monitor his health condition and to safeguard him. The data is interpreted using fuzzy logic, automata, pattern recognition and neural networks. It is a good example of the application of artificial intelligence to create proactive assistive environments. There are also several approaches with a distributed architecture like AMADE [5] that integrates an alert management system as well as automated identification, location and movement control systems.

In this contribution, we focus on the design challenges of a context aware system for offering services to the members of a family that aim at alleviating everyday life of elderly and also of the rest of the family who have decided to continue living all together at home. The prototype has been developed on a commercial context-aware platform Appear (http://appearnetwork.com), which has been customized for this home environment to satisfy our system's needs. It is a centralized solution with a system core where all the received information is managed, allowing the correct interaction between system components.

2 AAL Domain: An Intelligent Home

In this section we will present an example of the definition of an intelligent home domain, especially for services offered to the different members of a family: kids, adults and elderly people, all of them living together in the same home.

Environment Context: A user is an entity which interacts with the environment and other people. It is almost impossible to sense every entity in the environment because it is enormous. So, it is useless try to describe everything surrounding a user. We will then define some concepts we thought as important. For instance, the user mobility is a key concept in an AAL domain, so we think location is an important concept in this part of the context specification requirements, we represent the absolute location as well as the relative one like: children_bedroom; elderly_bedroom; kitchen_room; TV_room; bathroom and garage. There is also the time&date concept to define the current conditions. And finally the environmental conditions like: temperature, humidity, light and noise; which will be a requirement for the provisioning of the services plus some other requirements explained below. User Context: As [5] context is only relevant if it influences the user and this is why the user takes an important place in AmI. This concept will have static facts like: gender, name and age and will also two important concepts to be taken into account: the role the user can have into the system and its preferences which contain the dynamic information of the user. Both concepts will determine which service should be available to which user as well as some other environment requirements. Role concept can be: elderly, children and adult and it will determine a set of common characteristic each role can have. And the user's preference will be subject to the current situation, that's why it is more or less dynamic. It is in this concept where users can specify personal activities they would like the house to automate (temperature control, light control, music control, etc.) or the services he would like to receive. Offering Context: It contains several categories of services with similar characteristics. These services might be adapted to the user's preferences and to the environmental conditions. Categories in the system can be

structured into comfort category where we can find light and music adjustments, social contacts service and a special service designed just for children where music, images, light and sound are used to transform the children bedroom in a special space. Another category is the autonomy enhancement including services like: medication, shopping and cooking mainly addressed to elderly people. And finally the emergency assistant category designed for the assistance, prediction and prevention of any emergency occurred related to any member of the family.

3 Intelligent Home Development Using Appear Platform

Appear is an application provisioning solution for a wireless network. Its solution enables the distribution of location-based applications to users with a certain proximity to predefined interest points. Appear just needs any IP based wireless network and any Java enabled wireless device. In order to locate devices and calculate its position, Appear uses an external positioning engine which is independent of the platform [6]. Appear platform consists of two parts: Appear Context Engine which is the core of the system and the Appear Client which is installed in the device. Applications distributed by the Context Engine are installed and executed locally in these wireless devices. The architecture of the Appear Context Engine is modular and separates the system responsibilities into: server, one or more proxies, and a client. Appear Context Server is part of the network management. It manages the applications distributed by the platform and the connections to one or more proxies or positioning engines. When a wireless device enters the network, it immediately establishes the connection with a local proxy which evaluates the position of the client device and initiates a remote connection with the server. Once the client is in contact with the server they negotiate the set of applications the user can access depending on his physical position. Appear's solution consists then of the Appear Context Engine and its modules: Device Management Module, Push Module and the Synchronization Module. The three modules collaborate to implement a dynamic management system that allows the administrator to control the capability of each device once they are connected to the wireless network. All of these modules are made context aware using the Appear Context Engine.

Medication_service is true
Roles_Medication_service is true
ELDERLY is true
AND *Zones_Medication_service* is true
TV is true
OR *kitchen* is true

Fig. 1. Rule evaluated to offer medication service to elderly users in the TV room

Taking into account our approach will be used in an intelligent home to assist the elderly and the member of a family while they're into the house; this is an example of Appear rules definition and its evaluation for providing the Medication service to an Elderly which is in the TV Room, see Fig 1. Once this rule is evaluated, services are pushed to the elderly device, Fig. 2:

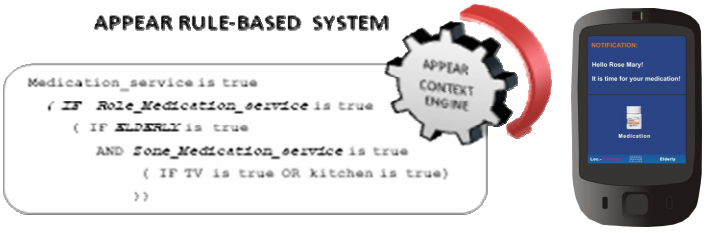

Fig. 2. Services offered to elderly users in the TV room

4 Conclusions and Future Work

We have used Appear as an off-the-shelf platform that exploits the modular and distributed architecture to develop context-aware applications, in order to design the contextual information for an intelligent home. Appear platform was designed to alleviate the work of application developers. At some point it succeeds to do so, but the applications inherit the weaknesses that the system possesses, for instance, the Context domain is limited to a set of concepts and it is impossible to represent the real environment. So, this is not a realistic approach if this system is to be deployed for a testbed with real users. Among the issues that could be additionally improved, the platform could be extended in a manner that enables the consumer application to get information about the quality of the context data acquired.

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