The European MobileSage Project –
Situated Adaptive Guidance for the Mobile Elderly

Overview, status, and preliminary results

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Abstract—MobileSage is an AAL project with the goal to provide particularly elderly people with relevant and useful multimodal guidance on demand, depending on the context, and in a personalized, adaptive, accessible, and usable manner. The project aims to increase the independence of elderly people in particular in the home environment and during travel. This work presents the project and its two main deliverables, discusses related research, summarizes preliminary results, and gives an outlook of anticipated results.

Keywords—AAL, mobile, application, assistance, help on demand, personalization, adaptive, accessible, usable, multimodal

I. INTRODUCTION

Today's society is flooded with a plethora of new technological devices. Although easy to use for newer generations, they are often unfamiliar to and can pose severe difficulties for the elderly. This is why many senior citizens meet these ICT based solutions (Information and Communication Technology), such as automated ticketing machines, with anxiety.

At the same time, modern elderly live longer, they are healthier, more active, mobile, independent, and more demanding customers than ever before [1]. They are increasingly looking for useful, user friendly and personalized ICT services that add value to their active and mobile life, and that can help them to stay active despite various impairments. Here, MobileSage provides a timely approach and solution. The project was started in July 2011 and ends by January 2014.

This article provides an update for a previous work-in-progress paper [2] and is organized as follows: After the European AAL Joint Programme has been introduced, related projects and research is discussed, before the MobileSage Project is presented together with its two main service deliverables. After that, preliminary results are discussed, an overview of the way ahead is given, and finally the conclusion is drawn.

II. THE EUROPEAN AAL PROGRAMME

The European Ambient Assisted Living Joint Programme (AAL JP) provides the settings for this ICT based innovation project targeting elderly individuals [3]. The main goal of AAL is to improve "*the quality of life, autonomy, participation in social life, skills, and employability of older people*",

while service delivery enhancement and care costs reduction are secondary targets. MobileSage targets the program's third call, named *ICT-based Solutions for Advancement of Older Persons' Independence and Participation in the "Self-Serve Society"* [4]. The Call considers both *primary* end-users (elderly individuals), *secondary* users (family members, care givers), and *tertiary* end-users (NGOs, public authorities, companies, vendors).

III. RELATED WORK

Before the development in MobileSage started, a literature study was carried out to get an update about state of the art in the field. The study revealed that there are few, if any, existing solutions witch the same scope as the project. Especially rare are related projects and solutions of this particular kind directed towards elderly and impaired users. However, the study showed that there are a number of recent and ongoing international projects related in various ways to the topics addressed by MobileSage; they are discussed subsequently.

A number of international projects fall within the same *scope*. The APSIS4ALL Project is dealing with personalizing public digital terminals such as ATMs and ticket machines [5], where an adaptive interface and personalized interaction is achieved by the human communicating with the terminal through a smartphone. In the ASK-IT Project, a framework has been developed that employs personalized intelligent agents for service provision and search for suitable semantics [6]. The MyUI Project is addressing specific user needs towards ICT products in general through adaptive personalized interfaces, and by recording user behavior and context information in real-time [7]. GUIDE is a project to design tools and aids for developers to efficiently integrate personalization, user friendly interaction, and accessibility features into applications [8]. In the DIADEM Project, electronic/online forms were made adaptable to the cognitive skills of the user by monitoring user actions and tailoring the user interface based on these data [9]. The GPII Project is building a framework that allows to store universal user profiles in the cloud [10]. Later, the profile can be accessed to adapt the user interface of any device to a user's needs and preferences.

The following research projects are related to MobileSage with regard to *user interface* matters. The aim of SNAPI was to develop a data format for the storage of user profiles, with a focus on smartcards and public digital terminals [11]. In the GoldUI Project, elderly are offered a num-

ber of cloud services which are deemed useful in the everyday life [12]. The goal then is that these services can be accessed through a variety of platforms, including telephone, smartphone, tablet PC, TV, and radio.

The following research projects consider *transportation.* WayFiS is addressing the topic of travel challenges [13], in terms of a web based pre-planning service and a mobile application, with route calculations, taking into account an individual's desired physical activity, nutrition needs, necessary facilities along the route, and disease restrictions, while trying to avoid inaccessible places. In Mediate, a number of criteria and tools have been developed to measure accessibility in public transport, including accessible ticketing and information systems, and accessibility information of public transport system in Europe [14]. In the Access2all Project, a number of guidelines, recommendations, roadmaps, and new research initiatives have been worked on [15]. The AmbienNet Project has developed an indoor location system based on intelligent infrastructure and a sensor network [16].

The following projects concern *multimodality.* In the HAPTIMAP Project, a cross-platform toolkit for the design of user interfaces incorporating haptics, audio, and video input and output is being developed for retrieval, storing, and manipulation of geographic data [17]. In the course of the MAPPED Project, a mobile application has been developed that provides accessibility information on buildings, traveling means like buses, trains, etc., combined with localization techniques [18]. Finally, the HearMeFeelMe Project [19] was aiming at replacing visual and textual information with audio, combined with touch-based interfaces for information access, all integrated in a mobile application employing near-field technology to gather information about items to buy, such as food and medication [20].

IV. OVERVIEW OF MOBILESAGE

The idea of MobileSage is to provide elderly with a personalized context-sensitive tool which provides relevant, accessible, usable, and multimodal assistance for carrying out and solving everyday tasks and problems in the self-serve society whenever and wherever they occur, just in time, or, on demand [21], [22]. As such, the system acts like a facilitator of knowledge. The project addresses all the areas of interest of the 3rd AAL Call, and it also accounts for the three aforementioned user groups. MobileSage consists basically of two services, which are the main two deliverables of the project. They are called Help-on-Demand (HoD) Service and Content Management (CM) Service. Figure 1 shows the overall architecture and the major building blocks.

The content itself is fetched from the CM Service. There are no limitations regarding what kind of content can be facilitated, including manuals, usage instructions, and travel descriptions. It is anticipated that mainly secondary users will upload content to the CM Service as they are likely to have a direct interest in helping the primary users. However, it is expected that also tertiary users provide content. For instance, a manufacture might regard it as advantageous to provide manuals for their ticket machines, or the railway operator that runs these machines might do so. Even a municipality might be interested in producing such help content as a special service for their citizens. Of course, there is nothing that prevents literate primary users from producing and making help content available themselves through the CM Service.

A. Help-on-Demand Service

The Help-on-Demand (HoD) Service is a thick-client application, a personal agent, running on a smartphone. Its main building blocks are built up in a service oriented manner, see Figure 1. The user interacts with the Dialog Manager through the User Interface. The Dialog Manager utilizes the functionality provided by the Profile Service, which takes care of the user profile. Besides the user's personal preferences also the use pattern is stored there. The behavior of the user and actions in the User Interface are logged and analyzed by the Personalization Service which is responsible for adjusting the user profile accordingly.

Besides utilizing services provided as cloud services, the Dialog Manager is further in contact with the Reasoning Service with the task to make an educated guess of the user's context. In order to do so, the Reasoning Service itself makes use of network services such as Media Service, Search Service, Content Service, etc. The most important factor for determining the user context is the current location. The Reasoning Service therefore gets help from the Localization Service which has the responsibility to determine the user's location with highest possible accuracy, based on technologies like A-GPS, WLAN, GSM/GPRS, and NFC, and triangulation methods.

B. Content Management Service

The Content Management (CM) Service is organized as a cloud service and runs on a web server. A user who wants to produce multimodal content uses a User Agent like a browser to gain access to the service. The user interacts with the service's Dialog Manager, which in turn controls the User Interface. The main logic for handling the multimodal content lies in the Content Manager, which has a modular design to be able to add additional modalities in a simple way. MobileSage includes the modules Video, Audio/Speech, and Text, including Subtitles. The fabricated content is finally stored by the Content Service. It is also possible, though, to refer to content which is located elsewhere.

V. CURRENT STATE AND PRELIMINARY RESULTS

Beta versions of the smartphone application and the web service have recently been released for evaluation purposes to complete the first development iteration. Currently, field trials with relevant user groups are being carried out in the three countries Spain, Romania, and Norway. The trials comprise mostly qualitative studies where the user has to solve a particular task, such as operating a coffee machine.

Another scenario involves a travel situation: A user has to find a ticket machine at a subway station, pay for a ticket, and find the right subway platform. Appropriate content is found by means of NFC tags or QR codes placed out in the field, or by a user issued search with a particular search phrase. Both methods will initiate a geographically limited database search for relevant content in the user's preferred languages and modalities. Available results are presented in the smartphone app for the user who can then in turn pick the one he/she thinks suits the context best, be it text, formatted text, audio, video, captioned video, images, etc.
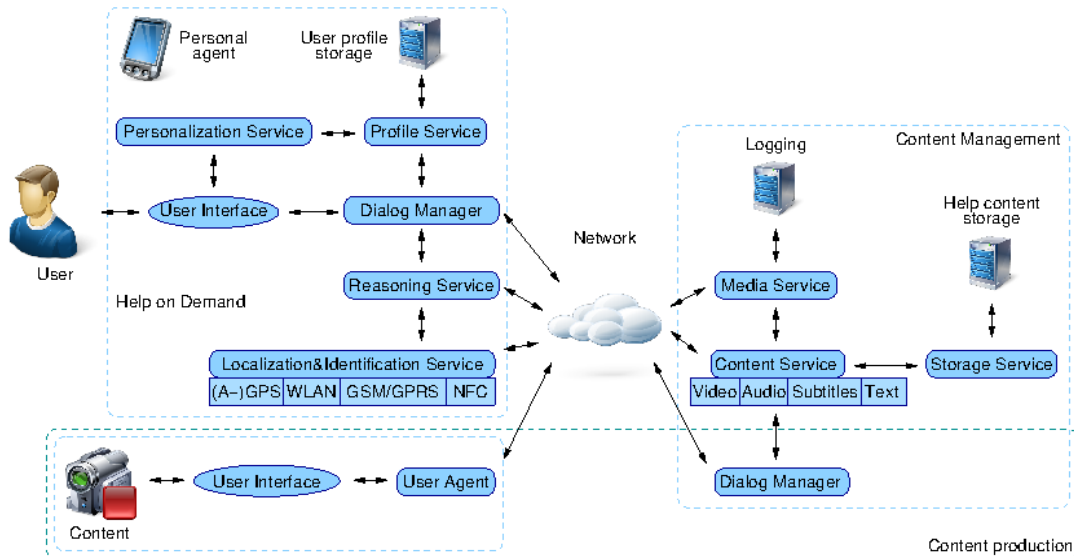
Figure 1: System architecture for Help on Demand Service (left) and Content Management Service (right) with the network in between

Results from these trials are going to be published in 2013. Concerning other publications, the following project results have been published so far:

A. Deliverable D2.1: User Needs Analysis

At the start of the project, user focus group work was conducted in the three countries Norway, Romania, and Spain to cover the needs of primary users [23]. The in total 39 participants of the focus groups were selected to represent a broad range of parameters, including age (48 to 96), gender (24 female vs. 15 male), dis-/abilities (sensory and cognitive impairments), nationality (4 foreigners), and ICT experience and usage. The participants were given the description of 2 scenarios. One scenario dealt with a travel situation, where a user was traveling in a foreign country, encountered language problem, and had to cope with reduced vision. The other scenario comprised a challenge occurring in the home environment, where an elderly user faced the problem of understanding the technical manual of an electric household appliance.

The results from the focus group work show that the target group "elderly persons" indeed is a very heterogeneous group with a wide range of – partly opposite – needs and wishes. This applies also to the users' familiarity with ICT in general and mobile technology in particular, which ranges from none to professional users.

An in-depth discussion of the results is available in the respective deliverable [23].

B. Deliverable D2.2: User Requirements Specification

The results from the user needs analysis were collected and formulated as user requirements [24]. The roughly 50 requirements address the expectations of primary users towards HoD and CM. An example of a user requirement is "*The HoD Service shall have measures for privacy protected audio output*". The user requirements served as input to the process of formulating the first draft of the system requirements for the two main deliverables of MobileSage.

C. Deliverable 2.3: System Requirements Specification for the Help-on-Demand System

This specification addresses the requirements towards the HoD application regarding the user interface, system functionality, and input/output matters. Its informal parts also include user interface mockups [25]. An example of a system requirement is "*An emergency button shall be shown on any screen of the application if the value for this feature has been set to 'on' in the user profile*". This deliverable serves as a set of instructions for the system development and integration.

D. Deliverable 2.4: System Requirements Specification for the Content Management System

This specification addresses the requirements towards the CM Service regarding the user interface to the database, system functionality, and input/output matters, including the data exchange with HoD and user interface mockups [26].

E. HoD and CM software prototypes

As already mentioned, beta versions of the smartphone application and the web service have been released.

F. Deliverable D 5.3: Market Analysis & Socio-Economic Impact and Potential

This document gives an in-depth analysis of the market segments that are relevant for the HoD application, stakeholders, and possible business models [27]. It also discusses similar products which already are on the market, and related projects.

VI. OUTLOOK

The development process in MobileSage foresees multiple iterations for the HoD and CM services, where one iteration consists of the steps specification work, risk analysis, development and integration, and evaluation. The development is user centric, meaning that users from the target

groups are involved in each evaluation step, and that the development starts with an analysis of the user needs. The idea is that the user requirements, which are a direct consequence of the user needs analysis, are "translated" to system requirements, and that the specification of those is refined in each development iteration based on the results from the previous user evaluation. Thus, deliverables D2.3 and D2.4 are expected to undergo several new revisions, as will the software prototypes. For an updated schedule and timeline, please refer to the project's web site [21].

VII. CONCLUSION

In this article, the AAL project MobileSage has been introduced by presenting its two main service deliverables, as well as status and preliminary results, and an outlook on the road ahead. The work also briefly mentioned the AAL Programme and discussed related projects and research.

The objective of MobileSage is to increase digital participation and involvement by providing particularly elderly people with relevant and useful multimodal guidance on demand, depending on the context, and in a personalized, adaptive, accessible, and usable manner. As such, it addresses all of AAL's areas of interest. The project's overall goal is to significantly increase the independence of elderly people in the home environment and during travel. It aims at stimulating people to help themselves and easing the production and availability of help content for just about anything. A first beta version of the services has already been released and is undergoing testing in Q4 2012, while the project itself is planned to last throughout 2013.

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