9-2016

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Human-Centred Design for Silver Assistants

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***Abstract*—To alleviate the rapidly increasing need of the healthcare workforce to serve the enormous ageing population, leveraging intelligent and autonomous caring agents is one promising way. Working towards the design and development of dedicated personal silver assistants for older adults, we follow the human-centred design approach. Specifically, we identify a number of human factors that affect the user experience of the older adults and develop an agent named Mobile Intelligent Silver Assistant (MISA) by applying these human factors. Integrating multiple reusable services onto one platform, MISA acts as a single point of contact while simultaneously providing easy and convenient access to a wide range of personalized services to support a more independent and active lifestyle of the older adults. Furthermore, the architecture of MISA would allow new services to be incorporated easily in the future.**

I. Introduction

The globally ageing population poses great challenges to both individual households and the society mainly due to the relatively shrinking healthcare workforce. To meet the ever growing need of the healthcare workforce, leveraging intelligent and autonomous caring agents is one promising way. Due to the high penetration rate of smartphones and the increasing level of adaptiveness and fondness exhibited by the older adults toward new media technologies, we believe silver assistants residing on the mobile platforms will become a prospective leading trend. Nonetheless, most existing personal assistants on mobile platforms are not dedicated to serve the special needs of the older adults.

Following the human-centred approach [1], we create MISA – an agent that provides all-round daily care as well as safety and independence supports to older adults. We identify a number of human factors and aim to improve the user experience of the older adults by applying these human factors. MISA adopts an open architecture which allows multiple reusable services to be integrated onto a single platform and maintains high extensibility for future open services. As such, MISA is able to provide personalized services to care for the fundamental aspects in older adults' lives, including health, exercise, calendar, and activities management.

II. Human Factors for Designing Silver Agents

The agent system targeting the older adults should be designed with special considerations for their use of the system, which makes it differ from other agent systems targeting the general or working population in a number of ways. We present our approaches to silver agent design by applying human factors that are specifically relevant to the older adults.

(1) Easy-to-use: Systems with increasing variety of functions may impose high cognitive load for the older adults [2]. Thus, the interactions between the older users and MISA is designed to be as simple and natural as possible to reduce cognitive load for them. MISA employs existing commercial-off-the-shelf technologies for speech recognition and natural language processing [3], which endows her with the ability to comprehend speech and utter responses in a human-like way.

On the other hand, directly exposing the older adults to various social platforms which may leave them in frustration and anxiety. MISA is designed as a point of contact to connect the older adults with their families, friends, doctors, and caregivers. Instead of introducing the older adults to new social platforms, MISA embeds social components in each of her services to offer easy ways for them to remain socially active.

(2) Memorability: The older adults tend to experience gradual deterioration in their cognitive capabilities as they age, especially in prospective memory [4]. Agent systems should play a much more supportive role when providing cognitive assistance to older adults for independent living. MISA employs a fuzzy reminding model to provide customized reminding services [5]. MISA can determine the appropriate number and schedule of reminders for each future task.

(3) Safety: The process of ageing is also a process of physical decline. The health and safety of the older adults is not only affected by their own physical condition, but also by various living and environmental factors (e.g., fall due to slippery floor). With the help of ubiquitous sensing technologies and ambient intelligence, MISA is designed with contextual awareness by processing the sensory information obtained in an unobtrusive manner. Specifically, MISA is able to recognize daily activities of the older user from the sensory data and use them for high level modelling and analysis [6].

(4) Persuasion: An agent system caring for the older adults should also be able to persuade them to adopt a healthy and active living style. MISA incorporates a computational persuasion model, named the Model of Adaptive Persuasion (MAP) [7], which enables MISA to choose appropriate persuasion strategies based on the individual users personal state.

III. Architecture of MISA

Adopting the approaches presented in Section II, MISA has been implemented as an mobile application. The overall

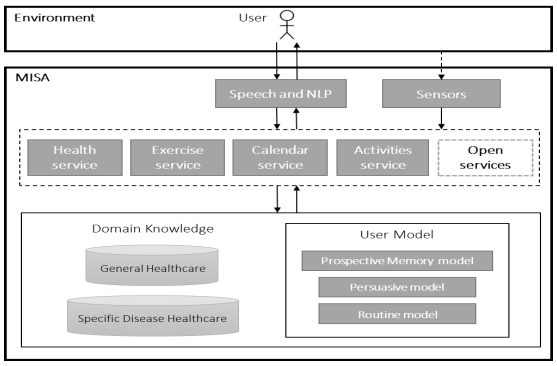

Fig. 1. The overall architecture of MISA.

TABLE I
MAPPING BETWEEN SERVICES AND DESIGN PRINCIPLES

Service	Design principles the service embodies
Health	Simple & natural interactions: chat interface, speech input and output
	Implicit user modelling: persuasive model (includes social proofing)
Exercise	Simple & natural interactions: chat interface, speech input and output
	Social connections: competition with friends
Calendar	Implicit user modelling: prospective memory model
	Social connections: calendar co-management with healthcare professionals and caregivers
Activities	Contextual awareness: unobtrusive sensing and ambient intelligence to perform activity recognition and anomaly detection
	Implicit user modelling: routine model
	Social connections: connecting with family members

architecture of MISA is shown in Fig. 1. The functionalities of MISA are encapsulated as individual services which are highly granular and reusable. Each of these services independently takes care of an important aspect of the older adults' daily life and cooperates with each other to offer thorough and more effective support and assistance. Currently, MISA provides four main services, namely health, exercise, calendar and activities. Table I summarizes the mapping between the proposed approaches and the services. The reasoning processes in these services are supported by a domain knowledge base, which consists of healthcare related knowledge, and user models for implicit user modelling. The **health service** of MISA is dedicated to provide health related supports by answering inquiries and offering recommendations. By incorporating the Model of Adaptive Persuasion (MAP) [7], MISA is able to persuade the older user to accept her recommendations (see Fig. 2). Acting as a unified interface, the **exercise service** helps the older users to centrally manage their exercises and make it for them to connect and compete with their friends. The **calendar service** of MISA provides assistance in schedule management and personalized reminding services (see Fig. 3). It also supports co-management of schedule by the older user and his doctors, caregivers or family members. The **activities service** monitors the older user's daily activities and recognizes the personalized abnormal behaviours of the older user using a routine model [6]. It also connects the older user with his family members or caregivers by sending them alerts and activity updates.

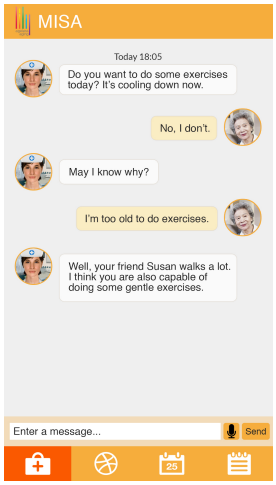

Fig. 2. Health service of MISA: persuading to do more exercises.

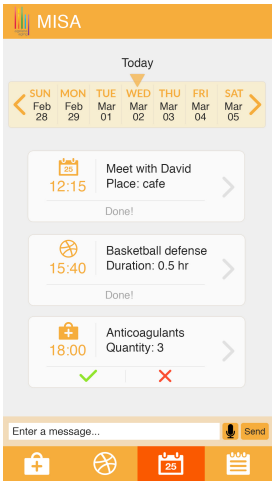

Fig. 3. Calendar service of MISA: list of upcoming tasks.

IV. Discussions and Future Work

MISA is easy-to-use, yet the pursuit of usability does not compromise MISA's rich service ability, contextual awareness, and adaptability to different older users. Although MISA provides only four services currently, other valuable services can be added easily. In the future, we consider including e-commerce service in MISA by modelling older adults' consumer behaviour, which will further enrich MISA's ability to provide care and support to the older adults.

Acknowledgement

This research is supported by the National Research Foundation, Prime Ministers Office, Singapore under its IDM Futures Funding Initiative. The authors would like to thank Peixiang Zhong, Dac Khue Nguyen, and Siyao Li for their contributions in application implementation and testing.

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