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Supporting Elderly Homecare with Smartwatches: Advantages and Drawbacks

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Abstract. The demographic transition in industrialized countries leads to a growth of elderly population. This population is more prone to chronic diseases and puts an increasing pressure on the healthcare system. One way to reduce the cost associated to the support of this population is to improve its autonomy to keep it independent as long as possible. Many assistive technologies and environmental interventions can be implemented to achieve this goal. In this paper, we are looking at the advantages and drawbacks of smartwatches as a platform to support elderly at home. By doing a literature search and by performing expert interview, we have identified the advantages of this technology to insure the success of promising applications as well as the obstacles that should be gone beyond. Among the advantages, the ubiquity of smartwatches makes possible a continuous medical surveillance, harder to achieve with other devices. Moreover, the versatility of smartwatches provides an appropriate ground to implement a centralized platform providing multiples services facilitating elderly homecare. However, the physical constraints of the watches such as the tiny screen size, the small connectors and the limited power autonomy can be significant barriers to the adoption of these tools. In conclusion, beside the actual homecare system, improving the autonomy and the independence of elderly at home can be leveraged by a combination of environmental and assistive technologies. Smartwatches have definitively the potential to become close assistants to help elderly in their daily life. However, this will not be achieved without dedicating a significant effort in designing appropriate user interfaces and certainly dedicated hardware to respond to the constraints associated with potential physical and cognitive impairments.

Keywords. Aged, Home Care Services, Health Services for the Elderly, Mobile Health, Medication Adherence, Personal Autonomy, Frail Elderly

Introduction

The increasing population lifespan generates a growing pressure on the health care system in industrialized countries. As people get older, they naturally get prone to chronic diseases, to physical and cognitive impairments and often need to be monitored more closely [1].

There are strong assumptions that the high costs associated with the hospitalization or care in specialized structures of this population can be diminished by prevention measures, encouraging home care and improving autonomy [2,3]. Moreover, many studies show that elderly prefer strongly homecare over hospitalization as it allows to

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maintain their independence and has usually a beneficial effect on their health [4]. Improving autonomy and independence of elderly population can be leveraged with assistive technologies (AT) and environmental interventions [5]. Among the first group, personal emergency response system, such as alarm watches, can be use as a way to reduce the fear associated with falling [6,7]. This fear is relevant as studies show both the incidence of falls and the severity of complications increase with age, increased disability and functional impairment [8]. Other technologies, such as medication reminders, are central to prevent the high costs and risk of death associated with medication low adherence [9]. Finally, a bunch of sensors such as blood pressure monitor [10] and glucose meter can be used to support people global heath evolution [11].

Whereas some specialized solutions are already available on the market, they still have limited applications. The association of mobile and personal monitoring associated with modern communication devices has the potential to create better integrated tools that may change radically the situations. We are particularly interested to look at the potential of smartwatches to see if they can be employed as an efficient assistant by elderly populations. By conducting a literature review and interviews with a gerontechnology specialist, we attempted to identify the key problems toward the adoption of this technology.

1. Method

This is an exploratory study that aims to identify the opportunities created by the use of smartwatches as a tool to favor home care of elderly. In order to identify the advantages and drawbacks of such scenario, we have looked at three sources of information. A search of the literature by querying Medline with keywords such as “fall detection”, “home care”, and “technology adoption” provided us with a more than dozens of articles that the authors have read in order to extract the key findings. A survey of specification pages of the existing smartwatches helped us to identify the capabilities and limitations of these tools such as the available sensors, the autonomy and so on. Finally, we have confronted our findings with a specialist by conducting some interview with local domain experts from the Geneva public home care organization.

2. Results

2.1. Key advantages:

Ubiquity: If ubiquitous computing is a broadly used expression to characterize the use of smartphones, tablets and other ultraportable devices, this is a malapropism. Indeed, there are still many situations where people do not carry their faithful digital companion [12]. Indeed, not everyone carries its smartphone at home; it is not exceptional that instead of keeping the device in their pocket, people let their smartphone at their home entrance. More importantly, at nighttime, the smartphone will be more likely found connected to a power plug as almost all devices currently on the market necessitate several hours power load daily. This is a real concern as a typical situation requiring alert is a fall of elderly during night. The alerting device has to be reachable and effective. If the smartphone is still on the bedside table, loading, it will

not detect any fall, nor will it be reachable to generate alerts manually. On the other hand, a smartwatch, beside the remaining constraint of charging, can be worn during night and use to generate alarms or detect incidents.

Integrated captors: Similarly to modern smartphones, smartwatches are a concentrate of technology. The most advanced one possess accelerometer, GPS as well as gyroscope. The accelerometer makes it possible to detect the fall of a person based on the unusual acceleration pattern recorded. This application has already shown promising results, even if the false positive rate is often cited as a barrier toward its adoption [13–15]. The GPS has also undeniable potential when people leave their home. Numerous conditions can produce cognitive impairments and weaken the sense of orientation [1]. In such situations, the GPS allow to be localized and propose help, such as generating alarms outside a given area or instructions to go back home. GPS can also be employed to monitor people activity. It can be use to evaluate the level of physical activity. More importantly, the activity sensors such as GPS, accelerometer, gyroscopes, and compass can be employed conjointly to identify unexpected modification in activity patterns and generate alerts accordingly to the detected change.

Safety: Personal emergency response system, such as portable alarm button, is not a novelty [16]. It has been demonstrated to be an efficient way to improve elderly independence [17]. Most of the commercial systems currently available are dedicated tools. Their advantage is a very long autonomy, but they often require a receiver box at home which limits the autonomy of the carrier to its immediate environment. Another disadvantage of the current system is that they are usually very recognizable, such as a big red button at the wrist, and are sometimes perceived as stigmatizing [18]. Using modern smartwatches could address some of the disadvantages of existing systems, while raising the question of power autonomy.

Development potential: There is an unlimited potential regarding the range of applications that can be installed on smartwatches. Whereas other devices are often limited to a specific use, smartwatches have the potential to act as a central platform to leverage numerous functionalities around elderly. We can imagine providing applications recalling people to take their medications [19], recalling medical appointments [20], or reminding to remain hydrated [21].

Personalization: Not all elderly have the same skills and needs. Some need to control their glucose level, other feel unsecure when they have to leave their home and other just need to be reminded to take their mediations. The modularity of smartwatches that works under the concept of apps (similarly to smartphones) allows to install only the required components and to offer a tailored tool responding to the specific user needs, including all the things that are not relevant to health but just desired.

2.2. Key problems

User adoption: The elderly feeling regarding the use of a watch to provide assistance goes in two opposite directions. On the one hand, watches are not intrusive in elderly life. Many of them are already accustomed to wear one. On the other hand, the large amount of money that can be invested to buy watches shows that they are not only worn as a utility tool, but also as a jewel. This is especially true among elderly. Even the most fashionable watch may meet resistance among elderly that are emotionally attached to the watch they have always carried. Another important reason playing against the adoption of such innovative tool is the stigmatization feeling that old people

can have when they wear such a device. The only fact of wearing such device is admitting that something goes wrong [22].

Usability: Most of the interfaces conceived today for the old people tend to display large interacting elements with large font to help people with reduced mobility and impaired eye to be able to effectuate the required task [23]. On a smartwatch the very limited size of the screen doesn't help the manipulation by impaired people [24].

Disruptive technology: The actual generation of people over 70 has not grown with the technologies that seem so natural for the newer generations. For many old people, managing digital interfaces with submenu and complicated gestures is not trivial. Moreover, the instructions provided by manufacturer are often not devoted to elderly and work on assumed implicit knowledge. However, some studies show that if elderly are convinced by the utility of the tool, they are likely to adopt it independently of their age. Therefore, the resistance toward such technology should diminish with the apparition of appropriate services [25,26].

Autonomy: Depending on the number of applications running on the device and on the number of sensors that are used, the battery of the watch can get empty pretty quickly. If users forget to charge their device or do not realize that the battery is empty, it might stop functioning at a critical moment. Another specific problem linked to the autonomy is the size of the connectors that must be plugged in order to charge the watches. Indeed, smartwatches have usually small connectors that are difficult to be manipulated by people with reduced dexterity.

Price: We can expect that smartwatches will cost less in the near future. However, many elderly living with limited resources are price sensitive and spend their money carefully. For them, buying a smartwatch is a significant investment that will have to bring significant added-value and substantial improvement on their life quality.

3. Conclusion

The increasing numbers of seniors from the current demographic transition creates a strong pressure on the healthcare system. There are strong assumptions that maintaining this population at home as long as possible is a way to reduce the associated cost and to improve their life quality. Maintaining elderly at home can be leveraged with a large palette of assistive technologies and environmental interventions. In this paper, we attempt to assess the interest of smartwatches to be use as assistant, to maintain elderly population at home as long as possible. A study of the advantages and drawbacks shows that the high technological nature of these tools opens many opportunities to maintain elders at home (fall detection, medication plan follow up, activity tracker…). However, we raise some concerns about the usability of the watches that should be addressed. The elderly cognitive and physical limitations can be a serious barrier toward the use of these tools. Consequently, the probable potential of smartwatches will not be expressed without serious effort to imagine dedicated interfaces and maybe dedicated watches more adapted for the target population.

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