

Magdalena Walczuch, Michael Stepping (2016):
Supporting Aging in Place by Sensor Technologies and Wearable Devices: A Work in Progress.
In Markus Garschall, Theo Hamm, Dominik Hornung, Claudia Müller, Katja Neureiter, Marén Schorch, Lex van Velsen (Eds.),
International Reports on Socio-Informatics (IRSI),
Proceedings of the COOP 2016 - Symposium on challenges and experiences in designing for an ageing society.
(Vol. 13, Iss. 3, pp. 29-34)

Supporting Aging in Place by Sensor Technologies and Wearable Devices: A Work in Progress

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Abstract. Information and Communication Technologies (ICT) have the potential to visualize patterns that might otherwise go unnoticed. Sensor technologies and wearable devices might even do so without the need of manually entering data into a computational system. Our intention lies in changing unhealthy behavioral patterns by visualizing unconscious connections and correlations between certain actions and its consequences. But also the reinforcement of healthy patterns might be achieved when a user becomes aware of the subtle progress he or she already is making. By showing connections between a behavior and the result in an unobtrusive manner we estimate to contribute to a healthier lifestyle and therefore the possibility to live longer independently in one's home up until old age. This paper presents a work in progress.

1 Introduction

Older adults wish to live independently in their homes as long as possible. There is a growing body of research that focuses on the issues of supporting elderly people living autonomously in their homes. Many of these studies and projects focus on medical issues (de Barros, Cevada, Bayés, Alcaine, & Mestre, 2013; Robben et al., 2014) and on detecting incidents like falling or on prevention of diseases (Aal, et al., 2014). Besides this it is more economic for the society to support older adults in living at home instead of stationary in hospitals or long-term care given in houses.

Authors, researchers and society are therefore interested in encouraging behaviors that lead to a healthier lifestyle (e.g. drinking a certain amount of water per day), and on preventing actions that lead to negative outcomes (e.g. smoking, overeating, undereating) – which might indirectly lead to a healthier life and therefore enable independent living up until old age.

Oftentimes the causal connection between a behavior and its consequence is not directly visible – although in many cases the connection is obvious, it is not really conscious, which often is the reason for breaking healthy patterns or ignoring negative actions. We try to make these connections visible in a non-intrusive manner in order to support lasting behavioral change. We think that the non-intrusiveness of such a system is important for gaining acceptance and when behavioral change is a goal. Since people need to feel autonomous in their actions in order to be intrinsically motivated (Deci & Flaste, 1995), we claim that it is important for the user not to gain the impression as if the system would try to dictate his behavior.

Further steps of the project at hand consist in exploring sensor technologies and wearable devices which on the one hand are able to document aspects of every-day life and on the other hand on devices that might visualize the results in a non-intrusive manner.

User centered design methods like workshops and interviews with elderly people who live independently will help us identify patterns in their every-day lives that have certain consequences but are not immediately obvious or not visible at all. Our aim is to find activities which directly or indirectly correlate with each other. E.g. going for a walk on a regular basis leads to a better mood and a subjective well-being.

Our vision is to create a toolset of applications which provide a real benefit for the users. On the one hand the involvement of future users will lead to a better understanding of their needs, doubts and expectations, which in turn results in a technological solution that is able to fulfill everyday life requirements. On the other hand results of a literature review focusing on the acceptance and non-acceptance of mobile and wearable devices and factors that foster or hinder the

motivation to use technological solutions will be one important factor that will accompany the design process.

Important questions that will be answered during the design and evaluation process are the following:

- How does the everyday life of elderly, independently living people look like? Which challenges do they have to face?
- What are important aspects to keep in mind when designing ubiquitous technologies for elderly? Which aspects foster acceptance for using assistive technologies and which factors result in a decrease in motivation for using new technologies?
- How can sensor data be visualized in order to be beneficial for elderly users and without giving the impression of wanting to control the user's behavior?

In the following chapter we will provide possible scenarios and a short description of the planned approach.

2 Scenarios and further steps

To illustrate the technological solution we intend to develop, we present in the following section two imaginary scenarios. The areas of interest are: medication adherence and physical activity.

The following scenarios will provide a tool for communicating with elderly users about our ideas. They will serve as a starting point for a discussion and will be refined, improved or maybe even discarded if they do not fit the everyday life circumstances.

Scenario 1: Medication adherence

Some elderly people stop taking their medicine because they do not think they need it when they subjectively feel good. They lose sight of the fact that the medication is the reason for them feeling better.

In this scenario, a daily questionnaire about the user's health provides a tool that helps the elderly person keep track of her current mood. A mood-analysis-system (introduced in the ongoing research project "Cognitive Village") might provide a better alternative for gaining information concerning the user's current emotional disposition, since the data would be collected in an automated manner without the need of an interaction from the participant's side.

A dialog on the user's mobile device "proposes" to take the planned medication in the near future. The user gets a message about the upcoming action. He can confirm having read the message. After having taken the medication the

user might confirm his action, too. This approach necessitates a manual feedback from the user about the consumption of the medication.

Another approach is the usage of a medication blister pack with IT support that would be an automated approach to monitoring the medication intake. The blister pack provides input data about the removed pills, but cannot verify that the pill is really taken by the user.

Nevertheless this approach helps to make a prediction between the user's state or mood and the taken medication. By visualizing a history of medication adherence on the one side and the user's mood or state on the other side the user gains a tool for making a connection between those two.

Scenario 2: Physical activity

When it comes to physical activities, the main goal might consist in increasing fitness. A secondary objective could be to keep or lower body weight. Both targets, staying fit or losing weight, are long term objectives. If the user does short term physical activities he will not recognize immediate results. Therefore some users might become impatient about the expected but still outstanding results and therefore give up trying.

Here the user's behaviour can be a source of input for IT supported device which leads the user to the long term goal. For example, a personal trainer sets-up a training schedule or the doctor advises to improve the fitness and sets up a certain schedule for training events. A smart watch, a mobile device or a stationary personal computer could give hints to the user. These hints will be designed applying user centred (UX) design methodologies.

Our idea for visualization consists in starting a screen saver with changing colours. Red usually signals very important messages or notifications. So the user gets pointed to the topic to do something for his fitness. When he touches the screen, further information could be displayed.

An activity tracking application on a smart-watch or a smartphone collects information about the user's sports activities without the need for an interaction with the system. Perhaps at the end of the day a positive message can motivate the user and encourage her to go on being active the next day. For example a light green colour might symbolize a job well done, e.g. when the user made a certain amount of footsteps during the day.

Further areas of interest will be explored in upcoming workshops and interview sessions. Based on those findings, additional use cases will be defined. These will serve as a foundation for a requirements definition and the development of the system which will finally be evaluated with future users.

3 References

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