



Short communication

Gardening in Ambient Assisted Living

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ABSTRACT

This paper suggests to extend the concepts of Ambient Assisted Living, active ageing and ageing in place to the outdoor areas of a home: the garden.

We examine the motivations and possible benefits of gardening in the generation 65+, especially in regard to managing health and well-being. From there, we explore technical assistance solutions, thinking them ahead into a dynamically adapting *Ambient Assisted Living Garden*. We derive a design guideline for the implementation of intelligent AAL Gardens, raising awareness that gardening is a leisure activity which should be supported through ICT, as it is popular in that age group and has been shown to be related to many positive effects. We aim to encourage more research and a practical realization of this empowering technological concept that enables people to live independently at home, doing what they like, without being confined to indoor spaces.

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Introduction

In recent decades, the issue of elderly people care and support has come to public attention as a consequence of an ongoing change in age demography in favour of the 65+ age group. This demographic change is a challenge for societies facing an increasing cost of professional care in nursing homes, but it also opens up chances to rethink established models. The concept of *ageing in place* summarizes possible solutions for both: the desire of elderly people to remain in their homes independently (Allen and Wiles, 2014) and to avoid costs and negative consequences of relocation to nursing homes (Oswald et al., 2011).

Under the label of Ambient Assisted Living (AAL) technologies are summarized that are more or less unobtrusively integrated into the environment to provide assistance with ageing in place. Through various forms of sensors and ubiquitous computing, the

ambience becomes intelligent and responsive to inhabitants, able to offer proactive assistance in daily living.

The vision for AAL systems is to enable people to keep performing all activities of their daily living, despite the wide range of physical and cognitive challenges especially older people might encounter. In an even more optimistic outlook, AAL systems will act preventively and encourage people to engage in activities to facilitate health and well-being and slow the deterioration of cognitive and physiological abilities. It is one of the major constraints of existing AAL systems that they are restricted to indoor living quarters (Memon et al., 2014; Rashidi and Mihailidis, 2013; Sun et al., 2009), since the action space of a person, his or her social life, the overall feeling of home and well-being is also affected by outdoors areas, such as the garden and the neighbourhood (Ghazali, 2013; Burton et al., 2015). These fulfil – among others – important social, representational and emotional functions in the biography of people (Rowles, 1983), which are worthwhile to be maintained in the older age and provide a sense of identity (Sime and Kimura, 1988). Gardening has been shown to be not only a popular leisure activity amongst older people in industrialized countries, e.g. carried out by almost 50% of older Europeans (Gagliardi et al., 2007), but also to

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have multiple health benefits (Wang and MacMillan, 2013). Several studies, summarized in (Cheng et al., 2010), report that the pursuit of leisure activities positively influences well-being and highlight the benefits of regular physical exercise (Crombie et al., 2004). Yet, gardening is to date only implicitly mentioned, for example in the AALIANCE roadmap subsection “Entertainment and leisure” (van den Broek et al., 2010).

Thus, we propose a practical concept to expand the scope of AAL and include gardening as an important factor to the concept of ageing in place.

Motivations to garden

The popularity of gardening can be explained by its eclectic impact and the diverse potential uses of a garden. Over the span of a lifetime, the garden is seen as a place to enjoy being outdoors and being able to observe nature (Clayton, 2007). This intuitive desire to be outdoors has been shown to have cognitive and physiological benefits, as summarized in a recent review by Keniger et al. (2013), and should be encouraged in all stages of life.

The most relevant motivation for older people to garden is physical fitness (Ashton-Shaeffer and Constant, 2005). As an activity, gardening is classified to have low to moderate intensity (Park et al., 2011). It is well known and acknowledged by older adults that physical activity is beneficial for health and well-being. Unfortunately, the amount of exercise required to reach desired positive effects is largely underestimated. This has been identified as the most influential factor for preventing older adults from participating in physical activity (Crombie et al., 2004).

The secondary motivations to engage in gardening are creativity, the intellectual stimulation and skill development (Ashton-Shaeffer and Constant, 2005). The work towards tangible goals is a possibility to experience competence, which is a contributor to raising self-esteem and self-efficacy (Cheng et al., 2010). When rating their quality of life, gardeners give significantly more positive answers than non-gardeners (Sommerfeld et al., 2010a).

The garden is a way of showing appreciation for and connection to the community, a display of personal values and expertise and a source of self-expression (Clayton, 2007). When part of the home, it also serves as a status symbol and an investment in real estate capital, as the value of a property is influenced by the state and size of a garden attached to it. By the same token, an untended or no longer tended to garden is seen as a symbol for the loss of control by older people (Bhatti, 2006), as a visual indicator of the inability to care for it, of physical decline and associated with a feeling of loss (Percival, 2002).

A garden can serve as a supplement of a self-subsistence strategy for fresh fruit and vegetables. Gardening has been shown to have a positive impact on dietary habits by increasing the intake for vegetables (Alaimo et al., 2008; Sommerfeld et al., 2010b), which in turn has a positive impact on the health and well-being. The motivation for self-subsistence can have logistic, economic, as well as a political motivation (Mueller, 2011). As the action space of older people declines with reduced mobility, living in areas where the demographic change leads to a decreasing population size concomitant with a loss of public services and shopping infrastructure can make the supply with fresh produce difficult.

Active ageing in place supported by AAL systems

In accordance with the concept of active ageing (World Health Organization, 2002), the design of a garden should reflect the current needs and preferences of its users throughout life, with them taking advantage of opportunities to enhance their environment to their benefit. The decision to install a comprehensive AAL system

does always entail some sort of structural redevelopment. This is no different in an AAL Garden, maybe unsurprisingly so as the garden is a dynamically changing and growing space. When fitting the garden with an AAL system, it is the time to evaluate current and prospected uses of the garden, incorporating the personal motivations to gardening as described in the previous section. Is it to be a potager with a focus on productive cultivation of edible plants, should there be lots of wildlife or should it mainly look presentable to onlookers? Which gardening activities do I enjoy most and where might I need assistance? It also includes the foresighted anticipation of challenges related to cognitive and physiological decline as well as (chronic) age-related diseases. In this process, gardening should not be seen as one singular activity that a person is able to do or not, but as an umbrella term for many individual activities. This counters the risk that people quit to garden all together in fear of not being able to handle one single task, which would result in losing the manifold of physical, psychological, and social benefits of gardening unnecessarily early. Instead, as is the idea behind active ageing, the AAL Garden will aid in empowering people to stay active, but obliging them to participatively adjust their range of activities appropriately to their physical and cognitive abilities.

In preparation of age-related changes or diseases likely to be encountered over the age of 65, there is a range of solutions that can be implemented to result in an aesthetically pleasing garden, individually tailored to the preferences of its user(s) and manageable well into old-old age (Cassidy and Winwood, 2011; Kleinod, 2010; Park and Shoemaker, 2009).

Examples for such measures are raised beds that diminish the need to bend over or kneel, well lit, smooth food paths with surfaces of good grip in all weather conditions without tripping hazards and with handrails, irrigation systems and an extensive selection of electrified tools, such as loppers which enhance the force applied at mechanical cutting or riding lawn mowers.

These measures are typically separate assistance solutions working side by side, yet their integration or expansion into intelligent AAL Garden systems can be realized with current technological standards. The prerequisite for this is giving them the means to sense and to communicate (Atzori et al., 2010), as it is not only a way to enhance the aforementioned systems, but also prerequisite for forming the individual measures into a comprehensive AAL system.

From electrified gardening appliances to comprehensive assistance

Since the garden is to be part of the AAL home and not a separate system, features known from existing AAL systems such as activity recognition, fall detection and health monitoring, (Alam et al., 2012) should be expanded into the outdoor areas of the garden.

AAL systems living up to their full potential, however, can be envisioned as systems that provide demand-actuated assistance, ultimately capable of doing every task at hand automatically, while at the same time acting preventively, encouraging people to embrace the concepts and challenges of active ageing. Of course, this is a long term research perspective, but with the restructuring of the garden as described above, a reasonable practical implementation is feasible.

While the deployment of sensor networks has been a leading trend in many application areas (Rawat et al., 2013), including farming, where wireless sensor networks (WSN) are increasingly popular in the context of precision agriculture (Ruiz-Garcia et al., 2009), they are not very common in gardening yet. WSN have been shown to allow for the monitoring of outdoor micro-environments (Cao et al., 2008) in farming and greenhouse contexts, making gardening an evident yet under-represented application area for WSN.

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