

## Chapter 24

# User-Centered Design of Wearable Assistive Devices for the Aging Population

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### ABSTRACT

*Due to modern medicine, the lifespan of the average person is increasing, with a concomitant increase in the need for care. According to the German Federal Statistical Office, DeStatis, there will be a deficit of 260,000 caregivers by 2025, which is not only an issue in Germany, but worldwide. New technologies, including wearable devices, will be crucial to manage this challenge, but there is a huge amount of research and investment required to incorporate wearable assistive devices into the lives of elderly users. It is crucially important that any new devices are fit for purpose, taking into account the specific needs of elderly people. This chapter, therefore, summarises and reviews the current state of wearable assistive devices, formalises the current design practice with respect to user needs, and presents design considerations such as wearability and usability, in order to assist in the future development of wearable assistive devices for the aging population.*

### INTRODUCTION

The urgency of developing wearable assistive devices for the elderly is driven by important socio-economic and technological factors. The ageing population presents challenges to social security systems, social services and health care delivery (Ashford, Osman, & Oldacres, 2007). Studies indicate that the quality of care afforded to older adults with medical conditions is substandard (Wenger et al., 2003). Due to the

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cost of hospital care, it is expected that health and social care will increasingly be delivered in the home rather than in a hospital or other institutionalised location (Ashford et al., 2007; Tommaso Faetti, 2012).

This opinion is supported by research showing that the elderly population is growing, and thus increasing the strain on national health budgets (Van de Ven, Bourke, Nelson, & O'Brien, 2010). The ageing population is generally due to falling birth-rates as well as increases in lifespan due to advances in medicine; however, this increase in longevity is accompanied by challenges. Apart from the general weakening of the body due to age, memory impairment affects some 15% of 65+ year olds (Newell, Liu, & Mayer-Kress, 2001), and other chronic diseases can diminish functionality and communication, for example arthritis or cerebrovascular impairments (Thimbleby, Cairns, & Jones, 2001).

It is also recognised that many of the age-related medical conditions that affect the elderly are of a longer term degenerative rather than acute nature, with the conditions increasing in severity with age (Ashford et al., 2007). Although there is a consistent preference amongst the elderly population to live independently and be mobile for as long as possible (Van de Ven et al., 2010), these medical conditions can reduce the ability of the older person to live independently, resulting in a greater need for personal care and for assistive technologies.

This need for personal care is one that cannot easily be met as the number of nurses and other providers of direct care have declined to critical levels in many health care facilities. There are also insufficient medical practitioners to meet the demand for health services. A shrinking workforce, an aging population, financial pressures, and increased consumer demand are expected to translate into a severe personnel deficit in the future (Fleming, Evans, & Chutka, 2003).

This presents a direct and urgent need for advances in assistive technology in order to bridge the gap between supply and demand for aged care. Assistive technologies include any services or tools that help the elderly to continue engaging in their normal activities, despite the progressive deterioration in physical or cognitive function associated with aging. Just as there is a range of different abilities amongst the elderly, there are many different categories of assistive devices and services available, such as:

- **Mobility Aids:** Equipment that assists the movement of the elderly, such as a wheelchair, stair elevator, or a simple walking cane.
- **Seating Aids:** A device or modification to regular chairs, wheelchairs, or motorised scooters that assists the user to maintain an upright posture, get up or down without strain, or helps to reduce the pressure on the skin.
- **Tools for Independent Living:** Any device that empowers the elderly to remain in a state of independence and autonomy by assisting with the normal activities of daily life.
- **Recreational Assistance:** Methods or tools to enable the user to enjoy a wide range of stimulating activities.
- **Communication Equipment:** Any device that increases the communication ability of the user, such as telephones or computers.
- **Sensory Enhancements:** Devices that enhance the sensory capacity of the user, such as hearing aids or visual aids.
- **Orthotic or Prosthetic Equipment:** A device that compensates for a missing or disabled body part, such as orthotic shoe inserts or an artificial limb.

As shown in Figure 1, the plethora of assistive technologies can typically be broken down into two categories, namely monitoring and functionality enhancing technologies. Monitoring systems can then

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