Chapter 9
Assistive Technologies in Smart Homes

Tatsuya Yamazaki
National Institute of Information and Communications Technology, Japan

ABSTRACT

This book chapter provides a review of the assistive technologies deployed in smart spaces with a variety of smart home or house examples. In the first place, home networking technologies and sensing technologies are surveyed as fundamental technologies to support smart environment. After reviewing representative smart home projects from across the world, concrete assistive services related with the fundamental technologies in smart environment are deployed not only for the elderly and handicapped but for people in ordinary families as well. Adaptability is one of the key essences in the assistive technologies in smart environment and, for this purpose, human-ware studies including man-machine interfaces, ergonomics and gerontology are needed to be linked with the hardware specific fundamental technologies.

INTRODUCTION

It is an old saying that 'a house becomes a home over time'. From the word 'house', one may imagine only a building. On the other hand, one is likely to feel comfortable and warm at the mention of the word 'home'—a place that residents make livable. A home is formalized by the harmonization of its residents, environments, household appliances, etc. and is then able to adapt to the lifestyles of its residents. How can we make our homes more adaptable to our lifestyles? Owing to the introduction of ICT (Information and Communication Technology), home functions such as networking, sensing and appliances have become smarter and home adaptability, as a result, has increased greatly. Today, a smart home can be defined as a dwelling that incorporates a communications network which connects the key electrical appliances, sensors and services, and allows them to be remotely

DOI: 10.4018/978-1-61692-857-5.ch009

controlled, monitored or accessed. Such smart homes adapt to their residents autonomously and assist readily in their ways of living, particularly in the case of the handicapped or elderly people. In addition, from the term 'smart', one may expect smart homes to possess the ability to think, predict and take decisions. Such behaviour must be supported by capabilities in the fields of adaptation, communication, pattern recognition and so on.

Speaking of assistive technologies in smart homes, both individual technologies (as outlined above) and total service provisioning technology consisting of individual technologies may be involved. As a result, the area covered by the field of assistive technologies for smart homes is indeed very wide. This chapter samples certain foundational technologies that are related to assistive technologies; further, we overview the smart home research and development area.

The remainder of this chapter is organized as follows. With regard to foundational technologies in smart homes, "Overview" describes home networking technologies while "Sensing Technologies" focuses on sensor technologies. In "Smart Homes in the World", I present representative smart home or house projects from across the world. I pick up several test beds from North America, Europe and Asia and test them in real situations. "Assistive Services in Smart Homes" describes a few examples of assistive technologies as integrated services. Finally, "Conclusion" concludes this chapter.

HOME NETWORKING TECHNOLOGIES

Overview

As mentioned in the previous section, the introduction of ICT into the residential environment has added a new layer of mediation between a house and its residents, and is likely to expedite the adaptation process outlined above. In this section, we describe networking technologies, as one of the technologies that are integral to smart homes.

Standardized technologies related to home networks are depicted in Figure 1. The technologies are classified into the two axes. The horizontal axis represents home appliance categorization and the three categories are depicted in Figure 1. The first category includes audio/visual appliances such as DVD recorders and digital TVs, which need high-speed connections. The second category is that of information appliances which need medium-speed connections. Lastly, the third category encompasses major appliances such as refrigerators and air-conditioners, which are capable of working on low-speed connections.

The vertical axis in Figure 1 represents the layer structure of the technologies. The upper-most layer corresponds to the applications layer; the lower-most layer lies just above the layer of physical communication. The communication layers in Figure 1 include the general networking technologies standardized in IEEE, ITU, etc. In the application layers in Figure 1, the technologies tend to depend on each application, especially for CODEC.

For the communication lower layer, there are various networking technologies for data link. Each networking technology has its own feature and its usage is differentiated according to purpose, situation and so on. Table 1 briefly summarizes a part of features for representative networking technologies for data link. Since there are several modes or options for each technology and its performance may change according to the environment in which it is used. Therefore the present best specification values are presented in Table 1.

Figure 2 presents a home network architecture, which was standardized as ITU-T J.190 in July, 2002 (ITU-T, 2002), and revised in October, 2007. In the revised version, the home network consists of IP-based and non-IP-based domains; ITU-T J.290, for example, is an application targeted at the home network.