Chapter 10
Beyond Communication and Control: Environmental Control and Mobility by Gaze

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ABSTRACT
This chapter reviews the challenges and requirements in taking gaze-based interaction beyond communication and control, such as environmental control and mobility by gaze. The chapter is divided into two sections: the first section is devoted to environment control and the second to mobility control. Each section starts by introducing its necessary underlying notions and definitions and proceeds by explaining the main arguments for the development of environmental and mobility control and examining the general problems with these areas and of those domain-specific problems related to gaze control. While special attention is devoted to standardization when environment control is at issue, user safety is the priority in mobility control. A brief review of existing commercial or advanced research solutions offered for domotic and mobility control is given for both sections, as is a review of current open research issues. Finally, some promising academic prototypes are described, along with the ways in which their developers are trying to solve some of the problems identified.

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INTRODUCTION

This chapter is divided into two sections, which share a similar structure – the first section is devoted to environment control and the second to mobility control. Each section starts by introducing its necessary underlying notions and definitions – namely, intelligent domotic environments, gaze-based mobility, and mobile gaze tracking – and proceeds by explaining the main arguments for the development of environmental and mobility control and examining the general problems with these areas and of those domain-specific problems related to gaze control. While special attention is devoted to standardisation when environment control is at issue, user safety is the priority in mobility control. A brief review of existing commercial or advanced research solutions offered for domotic and mobility control is given for both sections, as is a review of current open research issues. Finally, some promising academic prototypes are described, along with the ways in which their developers are trying to solve some of the problems identified.

The Need for Gaze-Based Environment Control

Domotic systems (‘domotic’ is a portmanteau from the Latin word for home, ‘domus’, and ‘informatics’), also known as home automation systems, smart home systems, or environmental control systems, have been available on the market for several years. However, only recently have they started to spread to residential buildings, thanks to the increasing availability of low-cost devices and the drive from newly emerging needs for house comfort, energy savings, security, communication, and multimedia services. The aim of smart home systems is:

- to reduce the day-to-day home operation work load of the occupants, and
- to enable the disabled occupants of a home to live as autonomously as possible.

Personal environmental control can be considered to be a comprehensive and effective aid, adaptable to the functional capabilities of the users and to their desired actions. When a user has a physical disability, that user might not be capable of physically manipulating all or some objects in the environment. Thus, an environmental control system moves from being a useful labour-saving device to a personal necessity for independent living, by enhancing and extending the abilities of a disabled user and allowing independence to be maintained. An environmental control system may be the sole and only way by which such persons can control their environment. Such personal autonomy over their environment has the benefit of reducing the reliance on the continuous help of a family member or other carer, and increasing the self-esteem of the users, as they can control the world around them.

The Need for Gaze-Based Mobility Control

In addition to environmental control, another significant requirement for assistive technology for many people with physical difficulties is that of powered mobility control. Without a self-controlled powered wheelchair, many people with disabilities are totally reliant on other people – not only to take them to a desired location but also in relation to their position once they get there. The freedom to come and go as we please, and its many benefits, is something that non-disabled people can take for granted. However, for people with mobility impairments, there are several specific benefits that are worth noting, including the following:

- Firstly, powered mobility, whether for adults (Evans, Frank, Neophytou, & de Souza, 2007) or for young children (Bottos, Bolcati, Sciuto, Ruggeri, & Feliciangeli, 2001), can considerably increase independence.
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