

## Chapter 3

# Scanning–Based Interaction Techniques for Motor Impaired Users

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### ABSTRACT

*Scanning is an interaction method addressing users with severe motor impairments, which provides sequential access to the elements of a graphical user interface and enables users to interact with the interface through at least a single binary switch by activating the switch when the desired interaction element receives the scanning focus. This chapter explains the scanning technique and reports on related approaches across three contexts of use: personal computers, mobile devices, and environmental control for smart homes and ambient intelligence environments. In the context of AmI environments, a recent research approach combining head tracking and scanning techniques is discussed as a case study.*

### INTRODUCTION

The fundamental human right for access to information has become even more important in the context of the Information Society. The risk of creating a two-tier society of have and have-nots in which only a part of the population has access to the technology, is comfortable using

it and can fully enjoy its benefits (Bangemann, 1994) has been recognized almost two decades ago, nevertheless it is now more timely than ever. The recent technological evolution has constituted the personal computer just a simple constituent in the pursuit of an Information Society for all, while new challenges arise due to the popularity of mobile devices and the emergence of ubiquitous computing and ambient intelligence environments.

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Users with severe motor impairments face the risk of being excluded from accessing information, services and technology in this technologically-dominated era. On the other hand, it is now possible to exploit technological advancements and consolidated experiences towards providing accessible services, in order to not only offer equal access to information and services, but also to facilitate everyday living. This chapter focuses on scanning, a specific solution addressing the needs of users with severe physical disabilities, and aims to provide a review of existing approaches and a discussion of recent advancements in the field.

The chapter is organized as follows: sections 2 and 3 present the scanning technique and how it provides access to graphical user interfaces. Section 4 discusses scanning systems and applications for personal computers, while sections 5 and 6 refer to more recent advancements, namely scanning-based accessibility of mobile devices and scanning applications for environmental control. Finally, section 7 summarizes the topics presented in this chapter and discusses current challenges.

## THE SCANNING TECHNIQUE

Scanning is an interaction method addressing the needs of users with severe hand motor impairments. The main concept behind this technique is to eliminate the need for interacting with a computer application through traditional input devices, such as a mouse or a keyboard. Instead, users are able to interact with computing devices with the use of switches. In order to make the interactive objects composing a graphical user interface accessible through switches, scanning software is required, which goes through the interactive interface elements and activates the element indicated by the user through pressing a switch. In most scanning software, interactive elements are sequentially focused and highlighted (e.g., by a coloured marker). Furthermore, to

eliminate the need for using a keyboard to type in text, an onscreen keyboard is usually provided.

There are several types of scanning techniques, mainly varying in their approach for accessing the individual interactive elements. The most popular scanning techniques include:

- **Block scanning:** (Applied Human Factors, 2012; Ntoa, Savidis, & Stephanidis, 2004; Stephanidis et al., 1998), in which items are grouped into blocks, aiming to minimize user input and enhance the interaction speed. A well-known block scanning technique is row / column scanning in which items are grouped into rows. Once a user selects a specific row, its columns are being scanned. Row/column scanning is widely used in on-screen keyboards. Other variances include row-group-column, group-row-column, column-row, column-group-item and quadrant scanning. In quadrant scanning, or three-dimensional scanning (Felzer & Rinderknecht, 2009), the two-dimensional grid of scanning elements is divided into smaller sub-groups (e.g., the four quadrants of an on-screen keyboard) and every scan cycle starts by cyclically highlighting the groups.
- **Two-directional scanning:** (RJ Cooper & Associates, 2012a), in which the user selects an element by specifying its coordinates on the screen that is being scanned at first vertically, through a line that moves from the top of the screen towards its bottom, and then horizontally, through a pointer that moves along the selected horizontal line.
- **Eight-directional scanning:** (Biswas & Langdon, 2011), which is used by several mouse emulation software. In this method, the mouse pointer can be moved towards one of eight directions, according to the user's preference. In order to achieve this, the pointer icon changes at specific time

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