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Perceptual User Interfaces

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Abstract

For some time, graphical user interfaces (GUIs) have been the dominant platform for human–computer interaction. The GUI-based style of interaction has made computers simpler and easier to use, especially for office productivity applications where computers are used as tools to accomplish specific tasks. However, as the way we use computers changes and computing becomes more pervasive and ubiquitous, GUIs will not easily support the range of interactions necessary to meet users' needs. In order to accommodate a wider range of scenarios, tasks, users and preferences, we need to move toward interfaces that are natural, intuitive, adaptive and unobtrusive. The aim of a new focus in HCI, called Perceptual User Interfaces (PUIs), is to make human–computer interaction more like how people interact with each other and with the world. This chapter describes the emerging PUI field and then reports on three PUI-motivated projects: computer vision-based techniques to visually perceive relevant information about the user.

3.1 Introduction

Recent research in the sociology and psychology of how people interact with technology indicates that interactions with computers and other communication technologies are fundamentally social and natural [1]. That is, people bring to their interactions with technology attitudes and behaviors similar to those which they exhibit in their interactions with one another. Current computer interfaces, however, are primarily functional rather than social, used mainly for office productivity applications such as word processing. Meanwhile, the world is becoming more and more "wired" – computers are on their way to being everywhere, mediating our everyday activities, our access to information and our social interactions [2,3]. Rather than being used as isolated tools for a small number of tasks, computers will soon become part of the fabric of everyday life.

Table 3.1 shows the progression of major paradigms in human–computer interaction (HCI). Historically, there was initially no significant abstraction between users (at that time only programmers) and machines – people "interacted" with computers by flipping switches or feeding a stack of punch cards for input, and

Table 3.1 The evolution of user interfaces

Era	Paradigm	Implementation
1950s	None	Switches, wires, punched cards
1970s	Typewriter	Command-line interface
1980s	Desktop	GUI/WIMP
2000s	Natural interaction	PUI (multimodal input and output)

reading LEDs or getting a hard copy printout for output. Later, interaction was focused on a typewriter metaphor – command line interfaces became commonplace as interactive systems became available. For the past 10 or 15 years, the desktop metaphor has dominated the landscape – almost all interaction with computers is done through WIMP-based graphical interfaces (using windows, icons, menus and pointing devices).

In recent years, people have been discussing post-WIMP [4] interfaces and interaction techniques, including such pursuits as desktop 3D graphics, multimodal interfaces, tangible interfaces, virtual reality and augmented reality. These arise from a need to support natural, flexible, efficient and powerfully expressive interaction techniques that are easy to learn and use [5]. In addition, as computing becomes more pervasive, we will need to support a plethora of form factors, from workstations to handheld devices to wearable computers to invisible ubiquitous systems. The GUI style of interaction, especially with its reliance on the keyboard and mouse, will not scale to fit future HCI needs.

The thesis of this chapter is that the next major paradigm of HCI, the overarching abstraction between people and technology, should be the model of human–human interaction. *Perceptual user interfaces*, which seek to take advantage of both human and machine perceptual capabilities, must be developed to integrate in a meaningful way such relevant technologies as speech, vision, natural language, haptics and reasoning, while seeking to understand more deeply the expectations, limitations and possibilities of human perception and the semantic nature of human interactions.

3.2 Social Interaction with Technology

In their book *The Media Equation*, Reeves and Nass [1] argue that people tend to equate media and real life. That is, in fact, the "media equation": *media = real life.* They performed a number of studies testing a broad range of social and natural experiences, with media taking the place of real people and places, and found that "individuals' interactions with computers, television, and new media are *fundamentally social and natural,* just like interactions in real life" [1, p. 5]. For example, people are polite to computers and display emotional reactions to technology.

These findings are not limited to a particular type of media nor to a particular type of person. Such interactions are not conscious – although people can bypass the media equation, it requires effort to do so and it is difficult to sustain. This makes sense, given the fact that, during millennia of human existence anything