Chapter 39
The Fundamentals of Human–Computer Interaction

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ABSTRACT

This chapter explains the overview of human-computer interaction (HCI); cognitive models, socio-organizational issues, and stakeholder requirements; HCI and hand gesture recognition; and the multifaceted applications of HCI. HCI is a sociotechnological discipline whose goal is to bring the power of computers and communication systems to people in ways and forms that are both accessible and useful in the effective manner. HCI plays an important role in identifying the environmental and social issues that can affect the use of systems, and provide techniques to ensure the design of the system will be usable, effective, and safe. HCI draws on computer science, computer and communications engineering, graphic design, management, psychology, and sociology as it tries to make computer and communications systems ever more usable in executing tasks. HCI is an important consideration for any business that uses computers in their everyday operation.

INTRODUCTION

As modern technologies continue to develop, the ability of users to interface with new computer systems becomes a paramount concern (Information Resources Management Association, 2016). Human-computer interaction (HCI) is a field of research that develops the advanced activities of user-computer interaction (Anishchenko, Osinov, & Shaposhnikov, 2011). HCI has been the focus of attention for researchers in the past decade, with considerable work being done in the various modalities for communicating with the computer (Reddy & Basir, 2010). HCI studies play an important role in the design, implementation, and evaluation of a new generation of graphical user interfaces designed to support consumer behaviors and information needs (Servidio, Davies, & Hapeshi, 2016).

Humans are limited in their capacity to execute the information. This perspective has the important implications for the interaction design. Information is received and responses given via a number of input and output channels, such as visual channel, auditory channel, haptic channel, and movement. A

primary goal of virtual environments is to support the efficient, powerful, and flexible HCI (Devyatkov & Alfimtsev, 2013). A computer system comprises various elements, each of which affects the user of the system. Input devices for interactive use, allowing text entry, drawing, and selection from the screen. Output display devices for interactive use: different types of screen mostly using some form of bitmap display; large displays and situated displays for shared and public use; and digital paper may be usable in the near future.

The interaction takes place within a social and organizational context that affects both user and system. Iterative design practices work to incorporate crucial customer feedback early in the design process to inform critical decisions which affect usability. Interaction models help practitioners and researchers understand what is going on in the interaction between user and system. Many interfaces, relying on body gestures (Liu & Jia, 2004), speech (Green & Eklundh, 2003), and brain computing (Mason & Birch, 2003), have been proposed or developed which assist humans to interact with robots in a more intelligent and natural activity. Various interaction techniques have been developed for interactive 3D environments (Jankowski & Hachet, 2015).

This article aims to bridge the gap in the literature on the thorough literature consolidation of HCI. The extensive literature of HCI provides a contribution to practitioners and researchers by explaining the fundamentals of HCI in order to maximize the impact of HCI in global operations.

BACKGROUND

HCI emerged as a distinct research discipline in the late 1970s and early 1980s when monitors and workstations became available and opened up the use of computers to non-engineers (Grudin, 1990). In the 1990s, network technology and mobile devices broadened the scope of research beyond the individual user and personal computers (Hollender, Hofmann, Deneke, & Schmitz, 2010). HCI should be designed to be effective, efficient, engaging, error tolerant, and easy to learn (Fallman, 2010). With the development of computer vision technology, researcher have studied a lot of HCI methods to replace the keyboard and mouse (Juan, 2012).

Major HCI research areas comprise theories and models of human behavior when interacting with information technology (IT), general or more specific guidelines or heuristics for the design and evaluation of IT, methods for the user-centered development of IT, and the development of new interaction paradigms (Preece, Sharp, & Rogers, 2002). Interaction models address the translations between what the user wants and what the system does. Ergonomics looks at the physical characteristics of the interaction and how these influence its effectiveness. The dialog between user and system is influenced by the style of the interface. Examples of effective strategies for building interactive systems provide paradigms for designing usable interactive systems. The evolution of these usability paradigms also provides a good perspective on the history of interactive computing.

Different HCI techniques and technologies with different design criteria have been developed for several decades (Rantanen, Niemenlehto, Verho, & Lekkala, 2010). Interaction design is about creating interventions in often complex situations using technology of many kinds including PC software, the web, and physical devices. Usability is key to the success of any interactive system-from commercial software to business-to-business (B2B) websites to the handheld devices (Rosson & Carroll, 2001). Promoting consistency in user interface and application design remains a prominent practical issue (Nielsen, 1989). Software engineering provides a means of understanding the structure of the design

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