

国外计算机科学教材系列

# 人机交互

## (第二版)

Human-Computer Interaction  
Second Edition

英文版

Alan Dix  
Gregory Abowd

Janet Finlay  
Russell Beale

著



电子工业出版社  
Publishing House of Electronics Industry  
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北京 · BEIJING

## 内 容 简 介

人机交互研究的是人和计算机二者之间相互影响的方式。本书集计算机科学、认知科学、心理学和社会学于一体,对人机交互进行了深入的讨论,重点介绍了交互系统的设计。全书分为三部分,内容由浅及深,涉及人机交互的基础知识及其前沿研究领域。第一部分是基础,讨论了人与计算机技术之间的交互;第二部分是设计实践,根据可用性和设计过程来考察人机交互的关键性问题,其中包括任务分析、对话设计、认知模型和软件工程符号,并讨论了有效的需求捕捉、实现、评估和文档编制;第三部分是高级主题,内容包括了组件、群体计算(计算机支持协同工作)、多传感器系统、多媒体和万维网等。

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# Foreword

Human-computer interaction is about devices that seem to exhibit a kind of magic. These devices respond with complex contingencies to actions visited upon them by people. They are used to build 'user illusions' (Alan Kay's term) of reactive paper or virtual worlds or artificial personae. They are used as computational mediators and media for individual and group work. This book is a text for how to engineer such devices.

Starting early in this century, there has been professional concern with how to match tools and machines to humans, their tasks and their social aspirations. 'Industrial engineering', 'human factors', 'ergonomics' and 'man-machine systems' are all names of professional specialities which took on this task. In recent years, the speciality called 'human-computer interaction' has emerged as another of these, reflecting the twin developments that many machines are being transformed into versions of interactive digital computers and that personal computers have propagated by the million. As a result, the techniques used to build interactive computer systems can be used to build many kinds of machines for many machine users.

Human-computer interaction can be defined as 'the discipline concerned with the design, evaluation, and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them' [6]. It is concerned with the joint performance of tasks by humans and machines; the structure of human-machine communication; the social and organizational interactions with machine design; human capabilities to use machines (including their learnability); algorithms and programming of the interface itself; engineering concerns that arise in designing and building interfaces; the process of specification, design and implementation of interfaces; and design trade-offs. It is vertically more extensive than human factors, being concerned not just with the human-machine interface of interaction, but also with the technical design of the interacting machine itself. But it is horizontally less extensive than human factors, being limited to a much narrower class of machines.

As a professional community, human-computer interaction dates from about 1982, the date of the Gaithersburg conference on Human Factors in Computing and about the date of the commercial emergence of the personal computer. During the ensuing decade, there was an increase in research and development activities surrounding computer interfaces and the use of computers. The development of the area has reached the point where first steps are being taken to codify the field. This textbook is one of these first steps and part of that process.

This text comes at an important historical juncture when there are enough scattered results to move the field to a new stage and when there is beginning to be a demand for courses and a process of academic institutionalization. Early texts in a field not only help the field be taught, but they also serve to crystallize the content of the field itself. They must work directly from the tangle and patchwork of literature, designed systems and informal practice to bring order

and shape and definition that did not exist before. That codification is then transmitted to students, who further propagate it.

An important part of the development of a field is the development of abstractions that give insight into its phenomena and allow predictions of the consequences of actions or designs. Dix, Finlay, Abowd and Beale give considerable attention in this text to emerging models and other abstractions that provide practical insight and lay the foundations for further progress and thus help the field and its students rise above a mere collection of miscellaneous techniques. At this stage in the development of the human-computer interaction field, their text is likely to change the very field it explicates.

*Stuart K. Card*  
Xerox Palo Alto Research Center

# Preface to the second edition

Many changes have occurred in interactive computing since 1993 when the first edition of this book was published. Technological developments have led to faster, more powerful machines being widely available, improving the capacity for and expectation of multimedia applications. The phenomenal growth of the Internet and in particular the World Wide Web has opened up communications and the ability to share information widely. It is estimated that more people in Britain now buy a personal computer in order to access the Internet than for any other single reason. Groupware has become more popular through applications such as Lotus Notes and the facility for video conferencing over the Web.

In this second edition we have addressed these changes through a complete revision, particularly of those sections which are technologically dependent. We have included detailed discussion of the Internet and of design for the World Wide Web, virtual reality, information visualization, and ubiquitous computing. In addition we have attempted to address some of the omissions that have become apparent from the first edition, including new sections on presentation and screen design and user requirements capture.

As well as improvements to content, the second edition has had a complete facelift and a new image. We hope that the new two-colour presentation will make it easier to use and more enjoyable to read. In particular, we have incorporated more examples and worked exercises, as well as a new feature, Design Focus, which aims to bridge the gap between theory and practical design.

The first edition had extensive worked answers to all exercises and OHP masters, made available to teachers using the book in paper and electronic form. Some of these worked answers have now been incorporated into the text. The book's accompanying web pages include the rest of the worked answers, all OHP masters and a bullet point outline of the entire book. The site will also include the full bibliography, indexing, demos and other useful links. HCI is a fast moving field. Watch the web site for updates as the new developments and issues arise.

As before we are indebted to numerous people for their help in producing this new edition. In addition to those mentioned previously we would like to thank colleagues and students at our current institutions (Staffordshire University, University of Huddersfield, Georgia Tech. and University of Birmingham) and elsewhere for their feedback on the first edition which has helped us to decide what revisions were required. Also thanks to Fiona Dix for taking on much of the thankless task of incorporating revisions.

*Alan Dix  
Janet Finlay  
Gregory Abowd  
Russell Beale  
May 1997*

web site <http://www.hiraeth.com/books/hci/>

# Preface to the first edition

Human-computer interaction (or HCI) is, put simply, the study of people, computer technology and the ways these influence each other. We study HCI to determine how we can make this computer technology more usable by people. This requires an understanding of at least three things: the computer technology, the people who interact with it and what is meant by 'more usable'. However, there is a fourth aspect which is implicit in the simple definition: understanding the work that people are trying to perform by using the technology. These four strands provide the focus for this book. We discuss human cognitive and physical capabilities and how to incorporate knowledge of these into the design of technology. We consider the technology itself, both in terms of what is available and how we can specify its functionality. We introduce principles and paradigms which embody usability and present methods for evaluating our designs against these. We consider the user's activity, both in terms of the tasks to be performed and the context in which they occur.

But, if this book has four primary areas of interest, it is unified by one central theme: the design of computer technology. Human-computer interaction is a multi-disciplinary subject and we aim to demonstrate the importance of contributions from many disciplines. However, it is only when these contributions affect the actual design of interactive systems that we will see improvements in usability. We therefore stress a principled approach to interactive system design which will fit into a software engineering environment. We describe techniques and models for interaction which can be used within the requirements, specification and analysis stages of a design life cycle. This design process must of course be centred on the user and will therefore incorporate cognitive models, which assess or predict the usability of designs, and analytical or empirical techniques for evaluating whether the system meets the user's requirements.

The book is influenced by several disciplines, drawing particularly on the contributions of psychology, cognitive science and sociology. But it is focused primarily on human-computer interaction from the perspective of computer science. We do not apologise for this. In many instances, computer scientists are trained in systems design or software engineering yet are given no exposure to HCI. Little wonder they then build systems which are unusable. If we can encourage computer scientists and system designers to adopt a user-centred design strategy then we will have succeeded in our aims. This is not to say that the book has nothing to offer students and practitioners from other backgrounds. We hope that psychologists, cognitive scientists, and others with an interest in HCI will find it helpful to consider the user within the wider context of a user-centred design process.

In the book we provide a broad coverage of the important topics within HCI with an emphasis on design methods. We also include a sufficient level of detail and worked examples from everyday activity to allow readers to apply the techniques in practice. The computer science and psychology perspectives are taken to be the major complementary components of a user-centred design

process. However, we do not assume that the reader has a deep knowledge of either discipline.

We aimed this book as an introductory text for HCI courses, but hope that its depth and breadth of coverage will also make it appropriate as a core text for more advanced courses and for those eager to begin a research career in HCI. Accordingly, the structure of the book is flexible for use in a variety of courses; the layout provides hints on how material can be selected to meet different needs (for example, a basic foundation course, or a course on models and methods of HCI design).

The book is structured in three parts. The first part covers the basic foundations of HCI in terms of human psychology, computer systems, and the implications of the interaction between them. In Chapter 1 we look at human perception, cognition and problem-solving as factors which influence the usability of a design. This gives us an understanding of what the user can and cannot do. Students with a background in psychology may wish to skip this chapter. We then take a parallel look at the computer in Chapter 2, discussing the technology that is available to the designer, and how it works. This material may be familiar to computer science majors. The final chapter in this part discusses the nature of the interaction between these two, how they communicate and how we can analyze the effectiveness of the interaction. The whole of this part can be used as an introduction to the second two parts, or on its own as the basis for a short introduction to HCI.

The second part concentrates on the design process and the integration of HCI into design practice. In Chapter 4 we look at the history of interactive system design and identify principles which support usability. We then, in Chapter 5, discuss the design process from a software engineering perspective and how this is influenced by insisting on user-centred design. Chapters 6 to 9 discuss modelling techniques which can be used to ensure usability principles are not violated. These include cognitive and user models, task analysis techniques, dialogue models, and mathematically-based software engineering models. In Chapter 10 we survey the support tools and environments that are available to programmers of interactive systems, and in Chapter 11 we look at analytic and empirical methods for evaluating the systems to see if they meet user requirements. Finally, in Chapter 12, we discuss the design of user support systems.

The third part of the book covers two more advanced topics which are currently central research issues in HCI, namely computer-supported cooperative work (CSCW) and multi-modal interfaces. They are considered advanced topics in so far as they are less commonly found in undergraduate curricula. However, they are pivotal areas of current research interest, so they are included. These chapters serve as a suitable springboard into understanding and pursuing further HCI research and interactive system design.

Any textbook on HCI is necessarily limited: we are using a static, non-interactive medium to convey information about dynamic, interactive systems. HCI is about interactive technology and cannot be adequately learned without exposure to such technology. Many of the exercises in this book therefore encourage readers to experiment with interactive systems, and course organizers

are urged to ensure that practical experience goes hand in hand with theoretical training. We hope that the combination of these two will lead to the design of interactive systems which put the user first.

## Stylistic conventions

As with all books, we have had to make some global decisions regarding style and terminology. Specifically, in a book in which the central characters are 'the user' and 'the designer', it is difficult to avoid the singular pronoun. We therefore use the pronoun 'he' when discussing the user and 'she' when referring to the designer. In other cases we use 'she' as a generic term. This should not be taken to imply anything about the composition of any actual population.

Similarly, we have adopted the convention of referring to the field of 'Human-Computer Interaction' and the notion of 'human-computer interaction'. In many cases we will also use the abbreviation HCI.

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## Acknowledgements

In a book of this size, written by four authors, there will always be a myriad of people behind the scenes who have aided, supported and abetted our efforts. We would like to thank all those who provided information, pictures and software which have enhanced the quality of the final product. In particular, we are indebted to Wendy Mackay for the photograph of EVA; Wendy Hall and her colleagues at the University of Southampton for the screen shot of Microcosm; Saul Greenberg for the reactive keyboard; Alistair Edwards for Soundtrack; Christina Engelbart for the photographs of the early chord keyset and mouse; and Simon Shum for information on design rationale. We are also grateful to the reviewers and survey respondents whose feedback helped us to select our subject matter and improve our coverage, and to our colleagues at York, Birmingham and

CMU who gave insight, encouragement and tolerance in what has been a long project.

Personal thanks must go to Fiona, Esther, Ruth, Meghan and Sue who all endured 'The Book' well beyond the call of duty, and Bruno who forewent long walks in the country and instead put up with long hours in the office without complaint.

The efforts of all of these have meant that the book is better than it would otherwise have been. Where it could still be better, we take full responsibility.

*Alan Dix  
Janet Finlay  
Gregory Abowd  
Russell Beale  
December 1992*

# 目录概览

引言 .....	1
Introduction	
<b>第一部分 基础 .....</b>	<b>9</b>
<b>Foundations</b>	
第 1 章 人的能力 .....	11
The human	
第 2 章 计算机的功用 .....	53
The computer	
第 3 章 人机交互 .....	103
The interaction	
<b>第二部分 设计实践 .....</b>	<b>141</b>
<b>Design practice</b>	
第 4 章 可用性范例与原理 .....	143
Usability paradigms and principles	
第 5 章 设计过程 .....	178
The design process	
第 6 章 设计中的用户模型 .....	222
Models of the user in design	
第 7 章 任务分析 .....	260
Task analysis	
第 8 章 对话符号与设计 .....	292
Dialog notations and design	
第 9 章 交互系统模型 .....	340
Models of the system	

第 10 章 实现支持 .....	377
Implementation support	
第 11 章 评估技术 .....	405
Evaluation techniques	
第 12 章 帮助和文档 .....	443
Help and documentation	
<b>第三部分 应用领域 .....</b>	<b>461</b>
<b>Application areas</b>	
第 13 章 组件 .....	463
Groupware	
第 14 章 群体计算 .....	509
CSCM and social issues	
第 15 章 超越传统计算机 .....	553
Out of the glass box	
第 16 章 超文本、多媒体和万维网 .....	592
Hypertext, multimedia and the World Wide Web	
参考文献 .....	611
References	
索引 .....	628
Index	

# Contents

<b>Introduction</b>	<b>1</b>
<b>Part I Foundations</b>	<b>9</b>
<b>1 The human</b>	
1.1 Introduction	12
1.2 Input-output channels	13
<i>Design Focus: Getting noticed</i>	16
1.3 Human memory	26
<i>Design Focus: Cashing in</i>	29
1.4 Thinking: reasoning and problem solving	36
<i>Design Focus: Whose error?</i>	47
1.5 Individual differences	48
1.6 Psychology and the design of interactive systems	48
1.7 Summary	51
Exercises	51
Recommended reading	51
<b>2 The computer</b>	
2.1 Introduction	54
2.2 Text entry devices	56
2.3 Positioning and pointing devices	63
2.4 Output devices	72
2.5 Paper: printing and scanning	79
<i>Design Focus: Readability of text</i>	83
2.6 Memory	89
2.7 Processing	96

	<i>Design Focus: The myth of the infinitely fast machine</i>	97
2.8	Summary	101
	Recommended reading	102
<b>3</b>	<b>The interaction</b>	
3.1	Introduction	103
3.2	Models of interaction	104
	<i>Design Focus: VCR</i>	109
3.3	Frameworks and HCI	109
3.4	Ergonomics	110
	<i>Design Focus: Industrial interfaces</i>	112
3.5	Interaction styles	115
3.6	Elements of the WIMP interface	123
	<i>Design Focus: Learning toolbars</i>	129
3.7	Screen design and layout	131
	<i>Design Focus: Checking screen colours</i>	132
3.8	Interactivity	136
3.9	The context of the interaction	137
3.10	Summary	138
	Exercises	139
	Recommended reading	139
	<b>Part II Design practice</b>	141
<b>4</b>	<b>Usability paradigms and principles</b>	
4.1	Introduction	143
4.2	Paradigms for interaction	144
4.3	Principles to support usability	162
4.4	Summary	177
	Exercises	177
	Recommended reading	177
<b>5</b>	<b>The design process</b>	
5.1	Introduction	179
5.2	The software life cycle	179
5.3	Using design rules	190
5.4	Usability engineering	199
5.5	Iterative design and prototyping	205

	<i>Design Focus: Prototyping in practice</i>	209
5.6	Design rationale	212
5.7	Summary	220
	Exercises	220
	Recommended reading	221
<b>6</b>	<b>Models of the user in design</b>	
6.1	Introduction	223
6.2	User requirements modelling	223
6.3	Socio-technical models	224
6.4	Soft systems methodology	227
6.5	Participatory design	229
6.6	Cognitive models	230
6.7	Goal and task hierarchies	231
	<i>Design Focus: GOMS saves money</i>	234
6.8	Linguistic models	241
6.9	The challenge of display-based systems	245
6.10	Physical and device models	246
6.11	Cognitive architectures	254
6.12	Summary	257
	Exercises	258
	Recommended reading	259
<b>7</b>	<b>Task analysis</b>	
7.1	Introduction	260
7.2	Differences between task analysis and other techniques	261
7.3	Task decomposition	262
7.4	Knowledge-based analysis	268
7.5	Entity-relationship-based techniques	274
7.6	Sources of information and data collection	280
7.7	Uses of task analysis	287
7.8	Summary	290
	Exercises	291
	Recommended reading	291
<b>8</b>	<b>Dialog notations and design</b>	
8.1	What is dialog?	292
8.2	Dialog design notations	294