GLOBAL EDITION

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Designing the User Interface

Strategies for Effective Human-Computer Interaction

Shneiderman • Plaisant • Cohen • Jacobs • Elmqvist

Pearson

DESIGNING THE USER INTERFACE

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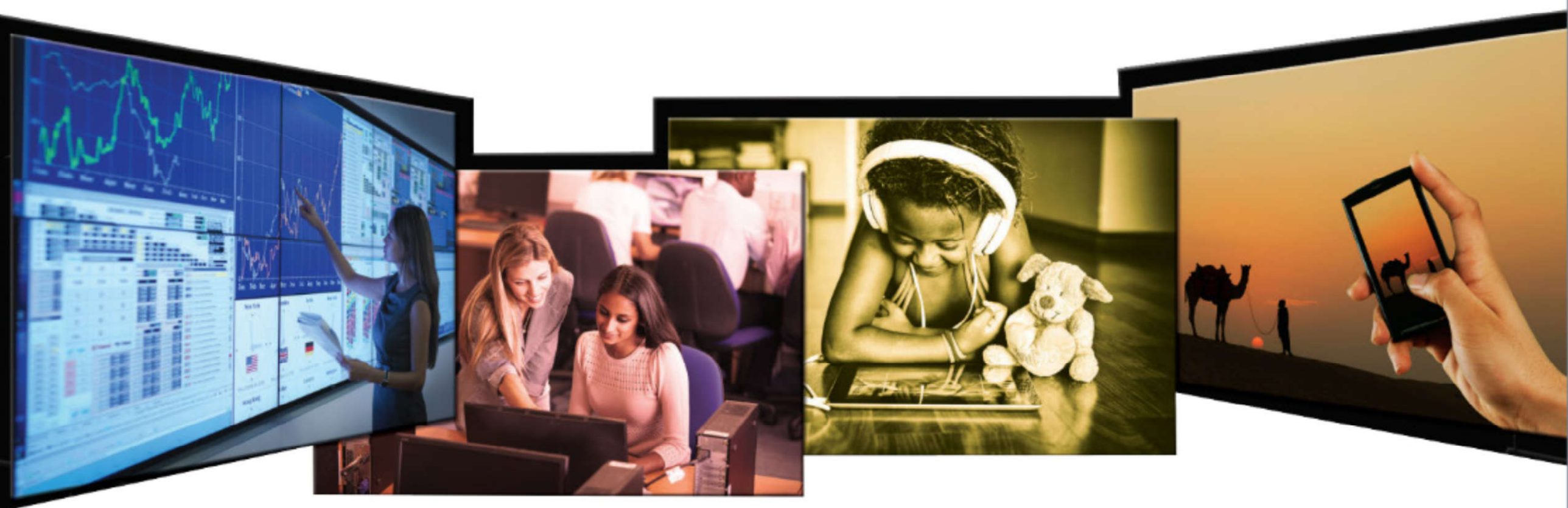

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STRATEGIES FOR EFFECTIVE HUMAN-COMPUTER INTERACTION

Pearson

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To Jenny, Anna, and Sara
Ben

To John, Thomas, Grace, and Peter
Catherine

To Arnold, Jason, Rochelle, Joe, and Sara
Maxine

To Sheila, Heather, Lindsey, and Andrew
Steve

To Helene, Keegan, and Corrie
Niklas

To Risa and Minny
Nick

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Preface

Designing the User Interface is written for students, researchers, designers, managers, and evaluators of interactive systems. It presents a broad survey of how to develop high-quality user interfaces for interactive systems. Readers with backgrounds in computer science, engineering, information science/studies/systems, business, psychology, sociology, education, and communications should all find fresh and valuable material. Our goals are to encourage greater attention to user experience design issues and to promote further scientific study of human-computer interaction, including the huge topic of social media participation.

Since the publication of the first five editions of this book in 1986, 1992, 1998, 2005, and 2010, HCI practitioners and researchers have grown more numerous and influential. The quality of interfaces has improved greatly, while the community of users and its diversity have grown dramatically. Researchers and designers deserve as much recognition as the Moore's Law community for bringing the benefits of information and communications technologies to more than 6 billion people. In addition to desktop computers, designers now must accommodate web-based services and a diverse set of mobile devices. User-interface and experience designers are moving in new directions. Some innovators provoke us with virtual and augmented realities, whereas others offer alluring scenarios for ubiquitous computing, embedded devices, and tangible user interfaces.

These innovations are important, but much work remains to be done to improve the experiences of novice and expert users who still struggle with too many frustrations. These problems must be resolved if we are to achieve the goal of universal usability, enabling all citizens in every country to enjoy the benefits of these new technologies. This book is meant to inspire students, guide designers, and provoke researchers to seek those solutions.

Keeping up with the innovations in human-computer interaction is a demanding task, and requests for an update begin arriving soon after the publication of each edition. The expansion of the field led the single author of the first three editions, Ben Shneiderman, to turn to Catherine Plaisant, a long-time valued research partner, for coauthoring help with the fourth and fifth editions. In addition, two contributing authors lent their able support to the fifth edition: Maxine S. Cohen and Steven M. Jacobs have long experience teaching with earlier editions of the book and provided fresh perspectives that improved the quality for all readers and instructors. In preparing for this sixth edition, the team expanded again to include Niklas Elmqvist and Nick Diakopoulos, who are both new colleagues at the University of Maryland. We harvested information

from books and journals, searched the World Wide Web, attended conferences, and consulted with colleagues. Then we returned to our keyboards to write, producing first drafts that served as a starting point to generate feedback from each other as well as external colleagues, HCI practitioners, and students. The work that went into the final product was intense but satisfying. We hope you, the readers, will put these ideas to good use and produce more innovations for us to report in future editions.

New in the Sixth Edition

Readers will see the dynamism of human-computer interaction reflected in the substantial changes to this sixth edition. The good news is that most universities now offer courses in this area, and some require it in computer science, information schools, or other disciplines. Courses and degree programs in human-computer interaction, human-centered computing, user experience design, and others are a growing worldwide phenomenon at every educational level. Although many usability practitioners must still fight to be heard, corporate and government commitments to usability engineering grow stronger daily. The business case for usability has been made repeatedly, and dedicated websites describe numerous projects demonstrating strong return on investment for usability efforts.

Comments from instructors who used the previous editions were influential in our revisions. The main changes were (1) to include more on design methods with case study examples and (2) to totally revise our coverage of social media participation and user-generated content, especially from mobile devices. We made major revisions to every chapter, changing almost every figure and substantially updating the references.

The first chapter more boldly recognizes the success story of HCI and user experience design. The growing issue of universal usability for increasingly diverse users of interactive systems became a separate chapter. The next chapters present design guidelines, principles, and theories that have been substantially updated to reflect new ways of thinking. Part 2 covers refinements to development methodologies and evaluation techniques. Part 3 explores progress in direct manipulation and its extensions such as virtual and augmented reality as well as changes to menus, form fill-in, and command languages brought about by the new platforms (especially mobile devices). Since collaboration and social media participation have become so central, that chapter has been heavily expanded and updated. Part 4 emphasizes high-quality and timely user experiences. The chapter on user manuals has been thoroughly revised to reflect the importance of well-designed documentation and user support in serving the goal of universal usability. Finally, information search and visualization

have their own chapters because each of these topics has grown dramatically in importance.

We strive to give balanced presentations on controversial topics such as 3-D, speech, and natural language interfaces. Philosophical controversies such as the degree of human control and the role of animated characters are treated carefully to present fairly the viewpoints that differ from our own. We gave colleagues a chance to comment on these sections and made a special effort to provide a balanced presentation while making our own opinions clear. Readers will have to judge for themselves whether we succeeded.

Instructors wanted guidelines and summary tables; these elements are shown in boxes throughout the book. The Practitioner Summaries and Researcher Agendas remain popular; they have been updated. The references have been expanded and freshened with many new sources and with classic papers still included. We worked hard to select references that were widely available and often web-accessible. Figures, especially those showing screen designs, age quickly, so many new user interfaces are shown. Printing in full color makes these figures valuable as a record of contemporary design styles.

Ways to Use This Book

We hope that students, practitioners, and researchers who read this book will want to keep it on their shelves or their electronic book readers to consult when they are working on new topics or seeking pointers to the literature.

Instructors may choose to assign the full text in the order that we present it or to make selections from it. The opening chapter is a good starting point for most students, the second chapter was written as a strong foundation for understanding the challenges of universal usability, and the third chapter covers basic guidelines, principles, and theories. We think all readers should start with these foundations. From there, instructors may take different paths depending on their disciplines. For example, instructors might emphasize the following chapters, listed by area:

- Computer science: 4, 5, 7, 8, 9, 10, 15, 16
- Psychology and sociology: 5, 9, 10, 11, 12
- Industrial engineering: 4, 5, 11, 13, 16
- Library and information studies: 5, 8, 9, 11, 12, 15, 16
- Business and information systems: 4, 5, 6, 9, 10, 12, 13, 14
- Education technology: 4, 5, 11, 12, 14
- Communication arts and media studies: 4, 5, 7, 11, 12, 13, 14
- Technical writing and graphic design: 4, 5, 6, 12, 14, 16

Companion Website www.pearsonglobaleditions.com/shneiderman

The presence of the World Wide Web has a profound effect on researchers, designers, educators, and students. We want to encourage intense use of the web by members of all these groups, but the volatility of the web is not in harmony with the permanence of printed books. Publishing numerous website addresses in the book would have been risky because changes are made daily, but we included key websites in a box at the end of each chapter. To provide more website addresses and keep them current, we have established a Companion Website for this book. We hope that interested readers will visit the site and send us ideas for improving it.

In addition to pointers to current web resources, a variety of supplemental materials for this text are available at the book's Companion Website. The following are accessible to all readers who register using the prepaid access card in the front of this book:

- Links to hundreds of human-computer interaction resources, examples, and research studies that enhance and expand on the material in each chapter
- Chapter/section summaries
- Self-test questions for each chapter
- Homework assignments and projects

PowerPoint lecture slides are also available from Instructor Resource Center (www.pearsonglobaleditions.com/shneiderman). For information about accessing these instructor's supplements, visit the Instructor Resource Center or get in touch with your Pearson representative.

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Writing is a lonely process; revising is a social one. We are grateful to the many colleagues and students who have made suggestions for improvements to prior editions. After one two-day kickoff meeting, we collaborated smoothly by using e-mail, Dropbox for sharing drafts, Google Docs for group-edited task lists, and hour-long phone conference calls every one to three weeks. Capable coauthors with cooperative personalities made the hard work for this massive project possible even with tight time constraints. We are grateful to Nick Diakopoulos for writing the chapter on communication and collaboration, which provided a fresh perspective on this vital topic, and for reviewing draft chapters.

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This book is written for the future students and professionals who will continue the remarkable work in human-computer interaction and user experience design that has helped bring the benefits of information and communications technologies to billions of users.

Ben Shneiderman
Catherine Plaisant
Maxine Cohen
Steven Jacobs
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Brief Contents

Preface 7
About the Authors 13

PART 1 INTRODUCTION 22

CHAPTER 1 Usability of Interactive Systems 24
CHAPTER 2 Universal Usability 56
CHAPTER 3 Guidelines, Principles, and Theories 80

PART 2 DESIGN PROCESSES 122

CHAPTER 4 Design 124
CHAPTER 5 Evaluation and the User Experience 166
CHAPTER 6 Design Case Studies 210

PART 3 INTERACTION STYLES 226

CHAPTER 7 Direct Manipulation and Immersive Environments 228
CHAPTER 8 Fluid Navigation 270
CHAPTER 9 Expressive Human and Command Languages 310
CHAPTER 10 Devices 336
CHAPTER 11 Communication and Collaboration 384

PART 4 DESIGN ISSUES 422

CHAPTER 12 Advancing the User Experience 424
CHAPTER 13 The Timely User Experience 464
CHAPTER 14 Documentation and User Support (a.k.a. Help) 484
CHAPTER 15 Information Search 516
CHAPTER 16 Data Visualization 550

AFTERWORD Societal and Individual Impact of User Interfaces 578
Name Index 591
Subject Index 597
Credits 615

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Contents

Preface 7
About the Authors 13

PART 1 INTRODUCTION 22

CHAPTER 1 Usability of Interactive Systems 24
1.1 Introduction 26
1.2 Usability Goals and Measures 33
1.3 Usability Motivations 35
1.4 Goals for Our Profession 40

CHAPTER 2 Universal Usability 56
2.1 Introduction 58
2.2 Variations in Physical Abilities and Physical Workplaces 59
2.3 Diverse Cognitive and Perceptual Abilities 61
2.4 Personality Differences 62
2.5 Cultural and International Diversity 63
2.6 Users with Disabilities 66
2.7 Older Adult Users 69
2.8 Children 71
2.9 Accommodating Hardware and Software Diversity 74

CHAPTER 3 Guidelines, Principles, and Theories 80
3.1 Introduction 82
3.2 Guidelines 82
3.3 Principles 88
3.4 Theories 104

PART 2 DESIGN PROCESSES 122

CHAPTER 4 Design 124
4.1 Introduction 126
4.2 Organizational Support for Design 128

4.3 The Design Process 131
4.4 Design Frameworks 137
4.5 Design Methods 141
4.6 Design Tools, Practices, and Patterns 149
4.7 Social Impact Analysis 155
4.8 Legal Issues 157

CHAPTER 5 Evaluation and the User Experience 166

5.1 Introduction 168
5.2 Expert Reviews and Heuristics 171
5.3 Usability Testing and Laboratories 175
5.4 Survey Instruments 187
5.5 Acceptance Tests 192
5.6 Evaluation during Active Use and Beyond 193
5.7 Controlled Psychologically Oriented Experiments 199

CHAPTER 6 Design Case Studies 210

6.1 Introduction 212
6.2 Case Study 1: Iterative Design Evaluation of Automated Teller Machines (ATMs) 213
6.3 Case Study 2: Design Consistency at Apple Computer 216
6.4 Case Study 3: Data-Driven Design at Volvo 218
6.5 General Observations and Summary 221

PART 3 INTERACTION STYLES 226

CHAPTER 7 Direct Manipulation and Immersive Environments 228

7.1 Introduction 230
7.2 What Is Direct Manipulation? 231
7.3 Some Examples of Direct Manipulation 238
7.4 2-D and 3-D Interfaces 248
7.5 Teleoperation and Presence 251
7.6 Augmented and Virtual Reality 256

CHAPTER 8 Fluid Navigation 270

8.1 Introduction 272
8.2 Navigation by Selection 274
8.3 Small Displays 287
8.4 Content Organization 290
8.5 Audio Menus 295
8.6 Form Fill-in and Dialog Boxes 296

CHAPTER 9 Expressive Human and Command Languages 310
9.1 Introduction 312
9.2 Speech Recognition 313
9.3 Speech Production 324
9.4 Human Language Technology 325
9.5 Traditional Command Languages 329

CHAPTER 10 Devices 336
10.1 Introduction 338
10.2 Keyboards and Keypads 340
10.3 Pointing Devices 346
10.4 Displays 364

CHAPTER 11 Communication and Collaboration 384
11.1 Introduction 386
11.2 Models of Collaboration 390
11.3 Specific Goals and Contexts 396
11.4 Design Considerations 404

PART 4 DESIGN ISSUES 422

CHAPTER 12 Advancing the User Experience 424
12.1 Introduction 426
12.2 Display Design 427
12.3 View (Window) Management 433
12.4 Animation 439
12.5 Webpage Design 441
12.6 Color 444
12.7 Nonanthropomorphic Design 450
12.8 Error Messages 454

CHAPTER 13 The Timely User Experience 464
13.1 Introduction 466
13.2 Models of System Response Time (SRT) Impacts 468
13.3 Expectations and Attitudes 472
13.4 User Productivity and Variability in SRT 474
13.5 Frustrating Experiences 476

CHAPTER 14 Documentation and User Support (a.k.a. Help) 484
14.1 Introduction 486
14.2 Shaping the Content of the Documentation 487
14.3 Accessing the Documentation 493

14.4 Reading from Displays versus Reading from Paper 498
14.5 Online Tutorials and Animated Demonstrations 503
14.6 Online Communities and Other Avenues for User Support 506
14.7 The Development Process 508

CHAPTER 15 Information Search 516

15.1 Introduction 518
15.2 Five-Stage Search Framework 522
15.3 Dynamic Queries and Faceted Search 532
15.4 Command Languages and "Natural" Language Queries 537
15.5 Multimedia Document Search and Other Specialized Search 538
15.6 The Social Aspects of Search 542

CHAPTER 16 Data Visualization 550

16.1 Introduction 552
16.2 Tasks in Data Visualization 553
16.3 Visualization by Data Type 561
16.4 Challenges for Data Visualization 569

AFTERWORD Societal and Individual Impact of User Interfaces 578

A.1 Future Interfaces and Grand Challenges 580
A.2 Ten Plagues of the Information Age 584
Name Index 591
Subject Index 597
Credits 615

DESIGNING THE USER INTERFACE

PART 1

Introduction

PART OUTLINE

Chapter 1: **Usability of Interactive Systems**

Chapter 2: **Universal Usability**

Chapter 3: **Guidelines, Principles, and Theories**

This first set of chapters provides a broad introduction to user interface design and interactive systems. Chapter 1 covers usability goals, measures, and motivations as well as general goals for the HCI profession. A rich set of resources is available at the end of the chapter, listing important books, guidelines, and relevant journals and professional organizations.

Chapter 2 discusses universal usability and exposure to the diversity of users. This includes the challenges posted by physical, cognitive, perceptual, personality, and cultural differences. Chapter 3 reviews the guidelines, principles, and theories of the field to help facilitate good design.

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CHAPTER 1

Usability of Interactive Systems

> Designing an object to be simple and clear takes at least twice as long as the usual way. It requires concentration at the outset on how a clear and simple system would work, followed by the steps required to make it come out that way—steps which are often much harder and more complex than the ordinary ones. It also requires relentless pursuit of that simplicity even when obstacles appear which would seem to stand in the way of that simplicity.

T. H. Nelson
The Home Computer Revolution, 1977

CHAPTER OUTLINE

1.1 Introduction
1.2 Usability Goals and Measures
1.3 Usability Motivations
1.4 Goals for Our Profession

1.1 Introduction

User-interface designers are the heroes of a profound transformation. Their work turned personal computers into today's wildly successful mobile devices, enabling users to communicate and collaborate in remarkable ways. The desktop applications that once served the needs of professionals have increasingly given way to powerful social tools that deliver compelling user experiences to global communities. These invigorated communities conduct business, communicate with family, get medical advice, and create user-generated content that can be shared with billions of connected users.

These life-changing shifts were made possible because researchers and user-interface designers harnessed technology to serve human needs. Researchers created the interdisciplinary design science of *human-computer interaction* by applying the methods of experimental psychology to the powerful tools of computer science. Then they integrated lessons from educational and industrial psychologists, instructional and graphic designers, technical writers, experts in human factors or ergonomics, and growing teams of anthropologists and sociologists. As the impact of these mobile social tools and services spreads, researchers and designers are gathering still fresher insights from sustainability activists, consumer advocates, citizen scientists, and humanitarian disaster response teams.

User experience designers produce business success stories, Hollywood heroes, and Wall Street sensations. They also produce intense competition, copyright-infringement suits, intellectual-property battles, mega-mergers, and international partnerships. Crusading Internet visionaries, like Google's Eric Schmidt, promote a world with free access to information and entertainment, while equally devoted protectors of creative artists, like singer Taylor Swift, argue for fair payments. User interfaces are also controversial because of their central role in personal identification, national defense, crime fighting, electronic health records, and so on.

At an individual level, effective user experiences change people's lives: Doctors can make more accurate diagnoses, and pilots can fly airplanes more safely; at the same time, children can learn more effectively, users with disabilities can lead more productive lives, and graphic artists can explore more creative possibilities. Some changes, however, are disruptive, reducing the need for telephone operators, typesetters, and travel agents. Too often, users must cope with frustration, fear, and failure when they encounter excessively complex menus, incomprehensible terminology, or chaotic navigation paths.

At a societal level, connected communities open up new forms of collective action and policy engagement. Having more informed citizens may lead to better decisions, more transparent governance, and greater equity when facing

legal, health, or civic challenges. But there may be increased dangers from extreme groups who promote terrorism, oppressive social policies, or racial hatred. The increased power of social media and collaboration technologies means that there must be a new balance of legal protections, police powers, and privacy.

The steadily growing interest in human-computer interaction stems from the designers' desire to improve the users' experience (Figs. 1.1 to 1.3 show some popular applications). In business settings, better decision-support and document-sharing tools support entrepreneurs, while in-home settings, digital photo libraries, and internet conferencing enhance family and personal relationships. Millions of people take advantage of the World Wide Web's extraordinary educational and cultural heritage resources, which provide access to everything from outstanding art objects from China to music from Indonesia, sports from Brazil, and entertainment from Hollywood or Bollywood

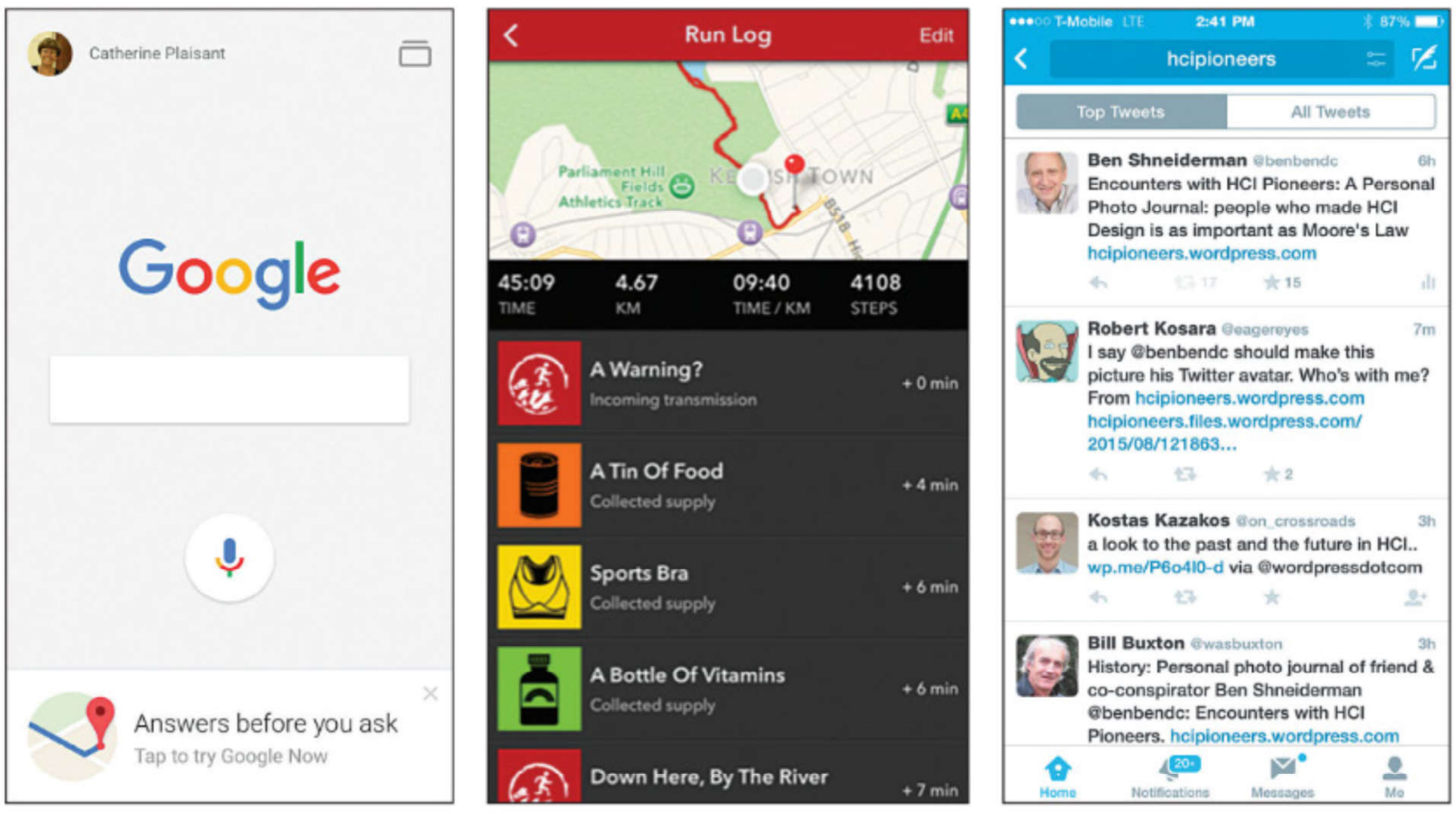

FIGURE 1.1

Smartphones have high-quality displays, provide fast Internet connections, include many sensors, and support a huge variety of applications.
Left: Google Now for searching, reviewing notification cards, and speaking commands.
Center: Zombies, Run! is an immersive running game and audio adventure which encourages runners to run as if pursued by zoombies, and to collect goods to help their community survive.
Right: A Twitter feed lists the top tweets after Ben Shneiderman announced the release of the HCI Pioneers website.

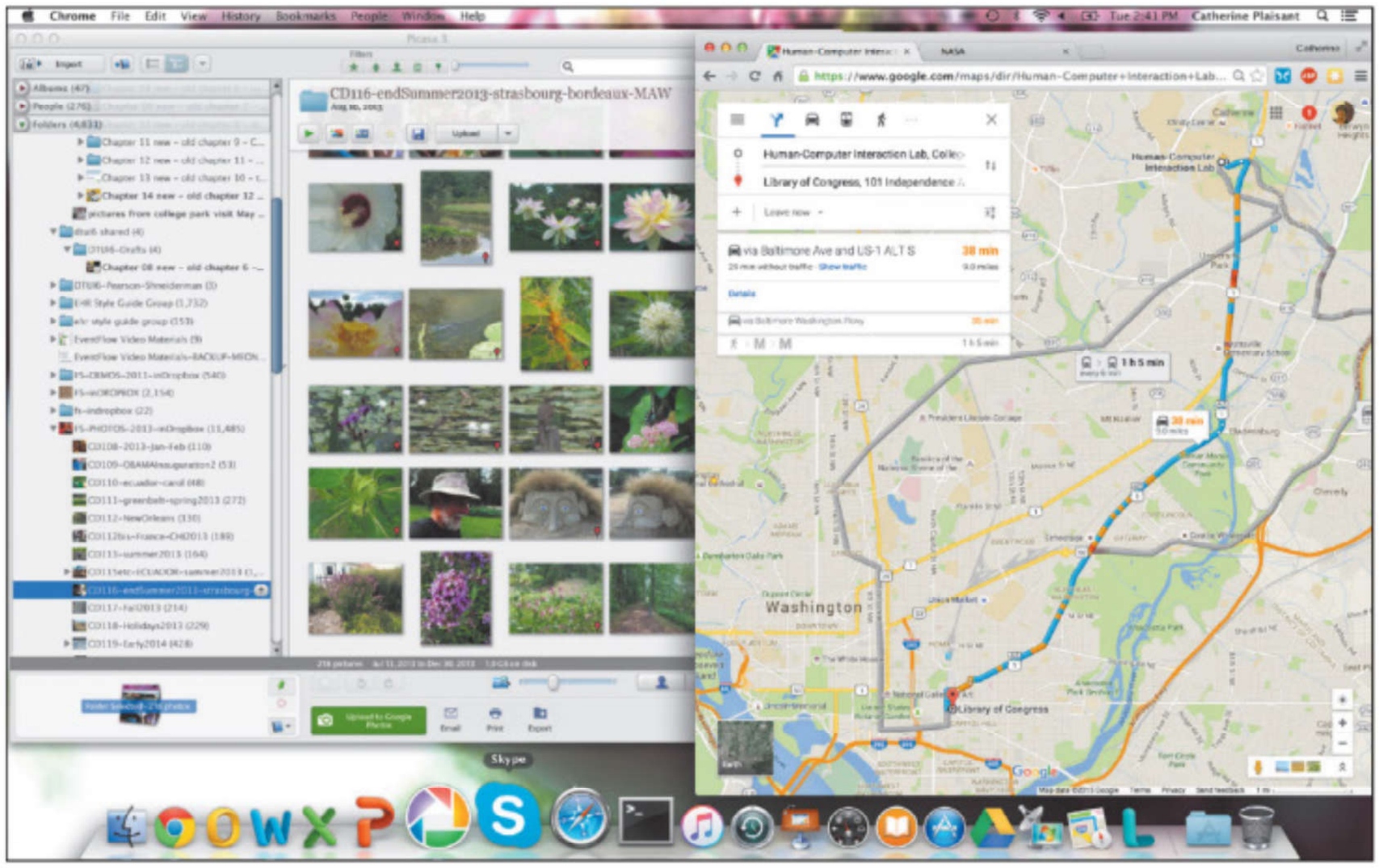

FIGURE 1.2

Apple® Mac OS X®. showing Picasa for photo browsing and Google Maps in a web browser. The bottom of the screen also shows the Dock, a menu of frequently accessed items whose icons grow larger on mouse-over.

(Figs. 1.4 to 1.5 show examples of popular websites). Mobile devices enrich daily life for many users, including those with disabilities, limited literacy, and low incomes. On a worldwide scale, promoters and opponents of globalization debate the role of technology in international development, while activists work to attain the United Nations Sustainable Development Goals.

The remarkably rapid and widespread adoption of mobile devices (including smartphones, tablets, game devices, fitness trackers, etc.) supports personal communication, collaboration, and content creation. The proliferation of such devices in developed as well as developing

FIGURE 1.3

Ben Shneiderman at a standing desk with two high-resolution screens. We can see a MS Word document (with six pages visible), two web browsers, and the Outlook e-mail application in a Windows environment.

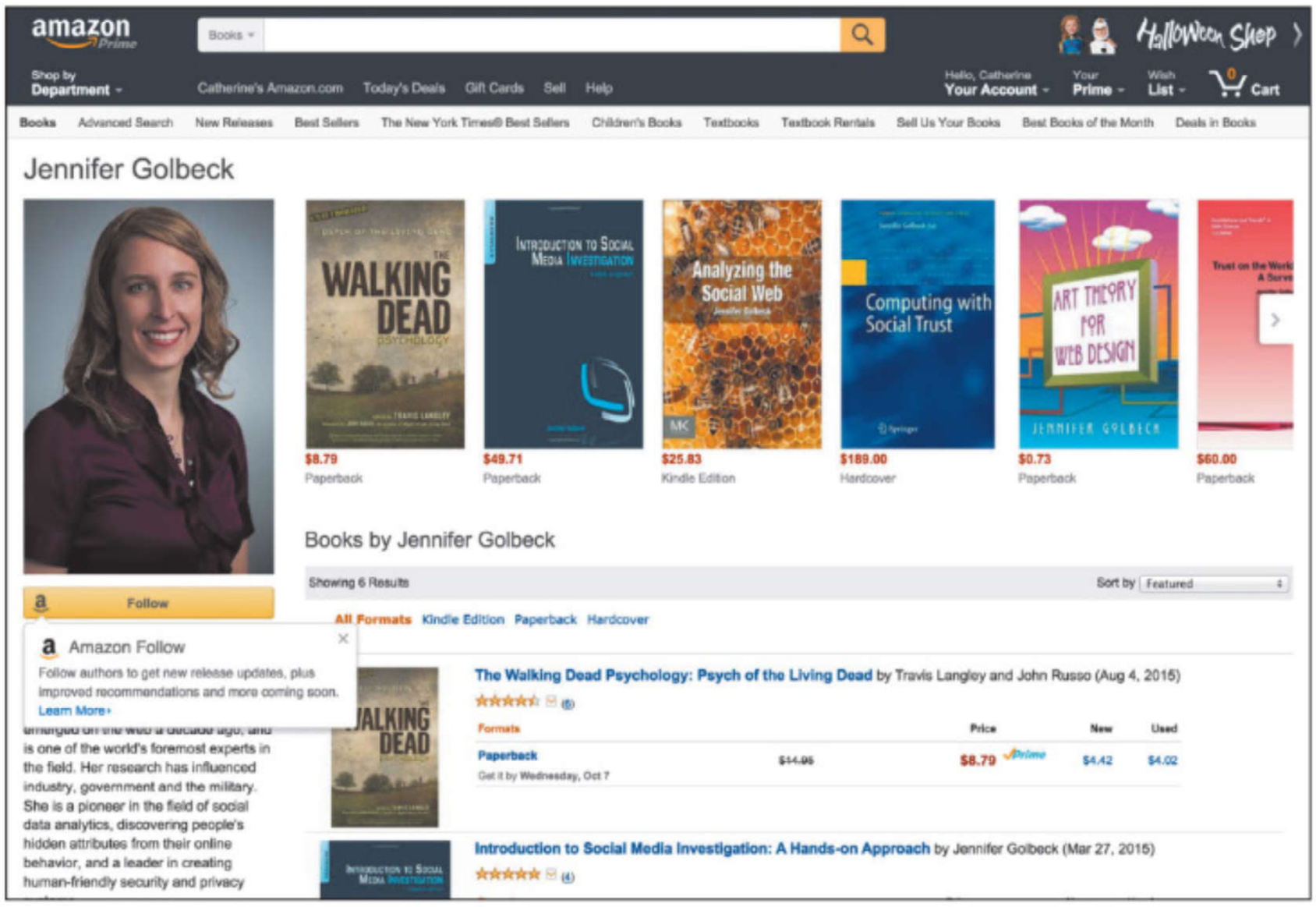

FIGURE 1.4

The Amazon.com website (http://www.amazon.com/) showing the books published by Jen Golbeck. Facebook will make book and product recommendations based on a user's personal history with the site.

nations has been astonishing. Economists see a direct linkage between cell-phone dissemination and economic growth since communications facilitate e-commerce and stimulate entrepreneurial ventures. Mobile devices also promote wellness, enable timely medical care, and provide life-saving disaster response services.

Similarly, explosive growth is the appropriate description for what's happening in the realms of social networking and user-generated content. Older media, such as newspapers and television, have lost audiences in favor of social media such as Facebook, Twitter, YouTube, and Wikipedia (all of which are among the top 10 most visited services). These leading websites are just a taste of what is to come, as entrepreneurs trigger ever more social media involvement accessible through web-based applications and small mobile devices.

Designers enable users to create, edit, and distribute 3-D printed objects, immersive virtual reality games, interactive animations, and increasingly high-definition music, voice, and videos. The result is ever-richer experiences and a creative outpouring of user-generated content available, even on mobile devices.