# Handheld Usability

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*Usable Products Company, New York*

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# Introduction

## Overview of this Book

This book is a practical, hands-on guide to designing applications for handheld electronic devices. Handheld devices, in the context of this book, are computing and communication devices that are usable and useful while held in one's hands. These devices include email pagers, personal digital assistants (PDAs) and mobile telephone handsets. Laptop, palmtop and tablet computers with large displays are not included since they look and work like desktop computers.

I start by discussing the differences between handhelds and the desktop. Following this is an in-depth analysis of the components and features of handheld devices, including an overview of all current wireless communication standards, such as the wireless application protocol (WAP), i-mode, 802.11 (Wireless Fidelity, or Wi-Fi) and Bluetooth™.

The second half of the book covers the disciplines of information architecture, rapid prototyping and usability testing as they relate to handheld devices. Though it might appear these three disciplines are universal to desktop and handheld products, design for handheld products is decidedly distinct from design for desktop computers.

Application design for handheld devices is different from the design of desktop Web and software user interfaces. Handheld devices are used by people who are 'on the go', and the devices – as compared with desktop computers – have smaller displays, trickier input mechanisms, less memory and storage, and less-powerful operating systems. Understanding these challenges is the first step toward designing great products for handheld devices.

There are several good books about designing for the desktop Web, and even

more about designing desktop software. There are, however, few books that cover handheld products at all and even fewer that focus on user interface design for this medium. This book will enable you to accomplish the following:

- understand the types of handheld devices and their differences
- design user interfaces for handheld devices
- design user interfaces for the wireless Web (WAP)
- prototype user interfaces for handheld devices
- conduct usability tests on prototypes and live handheld product applications

## Who Should Read this Book?

This book is for designers and developers of applications for handheld devices. It assumes a working knowledge of the Web, mobile telephone handsets, and PDAs. It does not assume a working knowledge of technical specifications for the wireless Web, nor does it expect readers to be experienced in designing for the desktop Web or other platforms.

## How Does One Design for a Handheld Product?

Understanding your audience is the first step. Knowing who they are and what they want to do helps you begin to understand their needs. People have instinctive ways of doing things. If someone is presented with a reasonable prototype and asked to do something with it, they will make an attempt. That attempt demonstrates their instinct and provides the designer with critical clues about how to design a product.

In this book, methods for 'usable design' are presented, including paper prototyping and usability testing. With product-specific user interface design guidelines and some practice, readers of this book will be able to design applications for any handheld device.

# Timeliness vs. Timelessness

This book represents a 'moment in time', especially with regard to the discussion of handheld devices. The pace of technological innovation is extremely rapid. Devices come and go so quickly that some are barely noticed. Perhaps part of the reason that device designs are so temporary is that no valuable guides to designing for them currently exist. This book is my attempt to address that problem.

Since the pace of design and development in the handheld arena has been so fast, many companies have reinvented the wheel, sometimes more than once. A glaring example of this problem is the lack of a standard layout for mobile telephone handset controls. The 'Back' button is the most popular control in desktop Web browsing, but only a small fraction of the dozens of Internet-enabled handsets has one. Using the Web without the 'Back' button is like using a word processor without being able to 'Undo'.

The result of these inconsistencies is a general lack of usability on most handheld devices. Learning about the different devices and their capabilities will enable you to design applications that are easy to use by themselves as well as with other applications found on the same platform.

Although technology and industrial design will march forward, this book's chapters on information architecture, prototyping, and usability testing will persevere. The principles and methods described here are timeless in scope. No book has been written about the design of handheld applications, a new discipline.

# Usability and its Value

Usability is most easily defined as 'ease of use'. Usability testing is the objective study of a product's ease of use by watching people while they attempt to complete tasks. Whenever the test participants encounter difficulty with a particular task, there is a usability problem. Users who encounter difficulty are not 'stupid' – bad design is.

Planning usability testing as part of the design and development process makes economic good sense. Product designs that are evolved through usability evaluation prevent customer support calls and increase customer satisfaction. Happy users become loyal customers, and with so many handheld devices to choose from, usability can be a powerful distinguishing factor.

# Chapter Breakdown

Each chapter in this book is intended to stand on its own. In other words, if you feel that you know enough about information architecture, then jump right to the chapter on usability testing without hesitation. If you find that you are in 'over your head', you can always step back to the chapters on information architecture.

The book is structured as follows:

- Chapter 1, Handheld vs. Desktop. This compares and contrasts handheld devices and the desktop computing platform.

- Chapter 2, Handheld Devices. This breaks handheld devices down into the three types – pagers, PDAs, and phones – and describes wireless networking standards, WAP, and i-mode.

- Chapter 3, Information Architecture: Process. This teaches the discipline of information architecture and all of its steps: audience definition, scenario development, flow charting, application mapping, and page mapping.

- Chapter 4, Information Architecture: Practice. This gives a full breakdown of software user interface constructs for handheld devices and when and how to include them in designs; common user interface types are described, and specific sections are included for WAP, Palm OS®, Windows CE/Pocket PC, RIM OS, and Motorola Wisdom™ platforms.

- Chapter 5, Prototyping. This presents the different types of prototyping and teaches paper prototyping and online prototyping methods.

- Chapter 6, Usability Testing. This describes usability testing and all of the issues unique to testing handheld devices; it provides detailed descriptions of the process and execution of formal (lab) testing and testing rapid prototypes.

In addition to the chapters, there is a rich set of appendices to help you in your handheld device design, prototyping, and usability testing efforts:

- Appendix A, Handheld History. This provides a timeline about technologies leading to handheld devices.

- Appendix B, Paper Prototyping Applications for the Palm OS®. This gives a step-by-step, illustrated example of how to create a paper prototype, using the built-in Address Book found on Palm OS® handhelds.

- Appendix C, Sprint PCS/NeoPoint 1000 Usability Study. These give the full usability study conducted by Usable Products Company in Winter 2000 of the Sprint PCS Wireless Web using the NeoPoint 1000 handset.

- Appendix D, Glossary. Here, hundreds of terms about handheld devices, wireless networking, and mobile telecommunications are defined.

# Conclusion

This book shares with you methods of design, prototyping, usability testing, and documentation that I have worked to develop for 12 years. I have looked for many of these methods in print and not found them, despite some books' promising titles. It is my sincere hope that *Handheld Usability* will help to bring about more enjoyable and easy to use applications for handheld devices.

# Author's Note

I have been fascinated by handheld computing devices since the introduction of the TRS-80 Pocket Computer Model 100 in 1983. I was amazed that a computer could be carried around, since most of the computers available at that time were bulky table-top models. The TRS-80 Model 100 had 24K of memory, a full QWERTY keyboard, a 240 × 64 pixel monochrome bitmapped display, and weighed about 3 pounds. Radio Shack was prescient enough to include a bar-code reader and a modem, perhaps anticipating the use of handheld computers as information appliances. Model 100s are in use even today. You can read a timeline tracing the development of handheld devices in the Appendix A, Handheld History.

The TRS-80 Model 100 of 1983 is a far cry from today's hottest Palm OS communicators, which are mobile telephone headsets with the Palm OS platform built in. The Handspring Treo, with 16 megabytes of memory, a QWERTY keypad, and 160 × 160 pixel gray-scale bitmapped display, weighs only 5.4 ounces (154 gs). It is also small enough to fit in a shirt pocket.

In exploring user interface design for these devices, I researched the available design guidelines for applications on all of the available handheld device platforms. Finding only limited product-specific guidelines and technical

programming information, the opportunity to research and write about designing for handhelds presented itself. I am pleased to offer you this book as the result.

**Scott Weiss**

# About the Author

Scott Weiss (sweiss@usableproducts.com) is the principal of Usable Products Company, the industry leader in the field of handheld device information architecture and usability testing. Usable Products has helped Sprint, Dun & Bradstreet, Intel, Chase, GlaxoSmithKline, and many others with their information architecture and usability needs since 1996.

Scott's design work on Apple's Macintosh System 7 and Microsoft's Windows 95 can be seen on more than 90 percent of computer desktops worldwide. In a career that has spanned desktop software and the Web, Scott has consulted, taught, and lectured extensively on usability and information architecture for handheld devices, desktop software, and the Web.

Scott received a Bachelor of Science degree in Engineering Human Interface Design from Stanford University. He lives in New York City with his bearded collie, Midge.

# Acknowledgements

This book was a project not just for me, but for my employees, consultants, friends and colleagues, all of whom contributed by providing feedback and moral support throughout the writing and editing process. I started this project soon after returning from the 2001 annual meeting of the Association of Computing Machinery's Special Interest Group on Computer–Human Interaction (ACM SIG-CHI).

First and foremost, I would like to thank Hira Murtaza for her excellent illustrations. Her work brings beauty and clarity to this material. Jerry Weinstein was an invaluable muse and editorial assistant. Robert Eisenhauer and Richard Martin, who work with me at Usable Products, were invaluable in their input and management of much of the editing process. Both Rich and Robert managed the extensive permissions necessary for including device and software photographs, and Rich conducted extensive research for *Handheld History*. I would also like to thank Karen Mosman and Jill Jeffries, my editors at Wiley, for their encouragement.

Kent Sullivan of Microsoft was kind to make referrals to members of the Pocket PC team. Alastair France of Openwave demonstrated the new Openwave browser at a meeting in London, far from his work and family. His technical prowess rescued a meeting of the Wireless Roundtable. Mark Taguchi of Openwave met with me to discuss the GSM's M-Services Guidelines. Erin Davis set up an interview with Calin Pacurariu, the Handspring Treo Product Manager. Calin Pacurariu was kind to take the time to meet with me about the Handspring Treo. Richard Weeks provided insight, information, and referrals. Eli Katz helped edit the Introduction.

I would like to thank Maria Sääksjärvi for sending content through the mail, and Clifford Nass and Ing-Marie Jonson for their contributions. Eddie Gomez provided his insights into usability of Windows CE-based tablet hardware and software. Kylie Trevitt prepared an excellent history of Openwave. Joshua

# 1

# Handheld vs. Desktop

This book is about designing applications for handheld electronic devices, specifically mobile telephone handsets, pagers and personal digital assistants (PDAs). To understand handhelds, one must first understand their place on the continuum of personal computing devices – and also their place within portable consumer electronics. Finally, one must understand the three key components of handheld electronic devices – and how they overlap. For a comprehensive history of technologies leading to handheld devices, see the Handheld History in Appendix A.

This chapter compares handheld devices with their closest cousins – desktop computers. Handheld devices are very similar to desktop computers in that they each involve computation, information management, and communication. The desktop computer, however, is far from portable, but that difference is only one of several, which this chapter quantifies.

## Definition of Desktop Computers

No comparison between 'handheld' and 'desktop' would be complete without a definition of what constitutes a desktop computer. Every modern desktop computer has the following components:

- CPU (central processing unit), the 'brain'
- display

- keyboard

- pointing device, typically a mouse

- cables to connect the components to each other, to power, and to a network

Some desktop computers combine components, such as the Apple iMac, which combines the CPU and display, but most desktop computers require five separate components to function effectively.

# Definition of Handheld Devices

Handheld devices are extremely portable, self-contained information management and communication devices. A candidate must pass three tests to be considered a handheld device:

- it must operate without cables, except temporarily (recharging, synchronizing with a desktop)

- it must be easily used while in one's hands, not resting on a table

- it must allow the addition of applications *or* support Internet connectivity [wireless application protocol (WAP), i-mode, or email]

I developed these tests as a way to frame this book. The tests eliminate laptop computers and noncomputer portable consumer electronics devices such as MP3 players. While this book specifically addresses only handheld devices, the principles presented are applicable to all devices that satisfy one or more of the tests above.

## The Personal Computing Continuum

Nomenclature is a particular challenge in any new area of technology. For this book, the term 'handheld' came to me after much thought and discussion. In earlier iterations, I considered 'wireless' and 'mobile'. However, each of those terms alone captures only part of the meaning of 'handheld'. The same consideration went into many other term selections, such as 'palmtop', 'pager', and 'communicator'. In this book, each term is defined when it is introduced, and there is a glossary for your convenience, at the end of the book.

In the illustration below, four different types of personal computing devices

overlap to show how the categories are not discrete. Some devices are difficult to quantify, such as ultra-small all-in-one desktop units, which look and act more like laptops. However, most devices comfortably fit into one of the categories shown in Illustration 1.1.

Size decreases to the right as portability increases. Desktop computers, at the far left, are stationary devices, tethered for both power and connectivity. Laptop computers enable mobility, but they are heavy and must be used on a table. They work best when connected to a power source, and most laptop users travel with telephone or Ethernet cables to connect to corporate networks and the Internet. Palmtops look like laptops, but they are significantly smaller, often fitting into a pocket or purse. They typically run off batteries, but need to be recharged frequently. At the far right are handhelds, which function best while held in the hand.

All of these devices can connect to the Internet, although some require modems or expansion cards to do so.
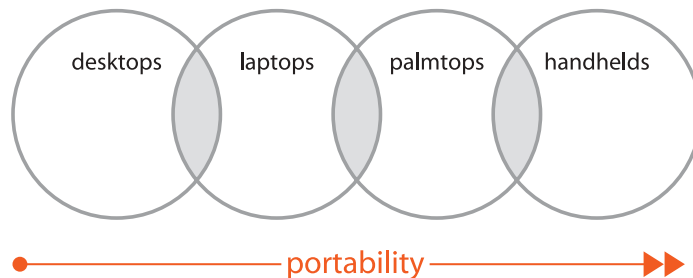
**Illustration 1.1**   The personal computing continuum

## Handheld Devices

Illustration 1.2 shows how the category of handheld devices is further segmented. At the edges are the three device types covered by this book. In the center, the overlap of all three types, is communicators, which offer all of the features of handheld devices: voice, computing, and Internet connectivity. In the next chapter, 'Handheld Devices', I describe, compare, and contrast each of these handheld device types in detail. For now, let's continue with the comparison of handheld and desktop devices.

## Portable Consumer Electronic Devices

Illustration 1.3 places different types of devices in the domain of portable
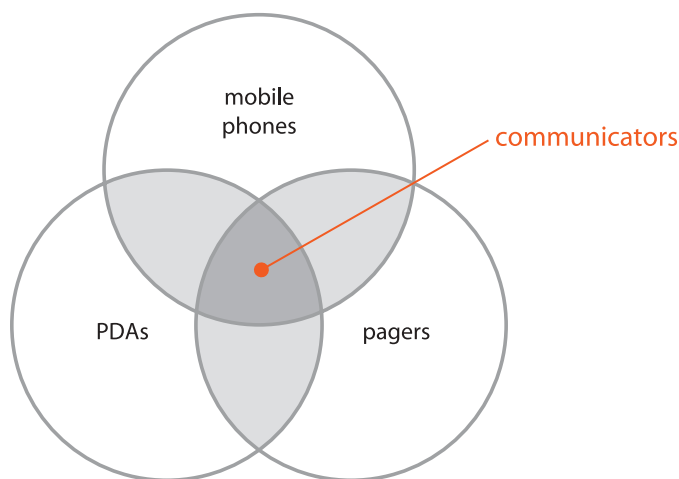
**Illustration 1.2**   Handheld devices

consumer electronics. While this book covers design for handheld devices, it excludes most portable consumer electronics devices, such as handheld electronic games, calculators, digital cameras, and MP3 players. Most of those devices lack the ability to add applications and lack wireless Internet connectivity, so they fall outside the purview of this book. In their capacity of allowing applications to be added, gaming machines are covered by this book, but not with respect to gaming user interfaces. Game design is very different from other user interfaces and is well covered by other books, such as *Game Design: The Art & Business of Creating Games* (2001) by Bob Bates and Andre Lomothe, and *Game Design: Theory and Practice* (2001), by Richard Rouse and Mark Louis Rybczyk.

# Handheld vs. Desktop

The desktop platform is stationary, while the handheld platform is extremely portable. In-between are portable devices that require a table to be operated effectively, such as laptop and palmtop computers. Table 1.1 sums up handheld vs. desktop devices.

As you can see from the table, handhelds are smaller, lighter, and less 'capable' than desktop computers. However, they offer portability and instant access to time-critical information as tradeoffs. Designs for handheld devices must capitalize on their advantages and accommodate their weaknesses.
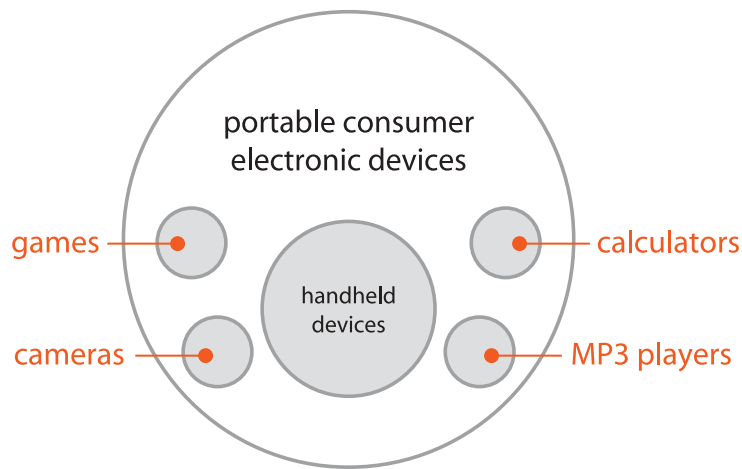
**Illustration 1.3**  Types of portable consumer electronic devices

**Table 1.1**  Summary of platform characteristics

|  | Handheld | Desktop |
| --- | --- | --- |
| Reasons for Use | On-the-go lookup and entry of information. Quick communication, such as instant messaging and/or voice. | Lengthy information processing tasks. Web browsing and email. |
| Form Factor | Less than 10" × 12". Can be used standing up without a table, typically fitting in a shirt pocket. | Requires a table; best used while seated. Sometimes portable. |
| Mobility | Can be easily used while on the go; has great battery life | Requires a power cord, or frequent recharges |
| Connectivity | Slow and unreliable, but improving. | Fast and reliable. |
| Input | Challenged. Stylus, keypad, mini-keyboard, roller wheel. | Full keyboard and mouse. |
| Display Size | 240 × 320 pixels or less. | 640 × 480 pixels or more. |
| Memory | Up to 16 megabytes. | Up to 1 gigabyte. |
| Storage | Sometimes none. Removable Memory Stick® media available on some models with up to 128 megabytes of storage. | Diskettes, CDRW, DVD RAM rewritable media, as well as hard disks with 80 gigabytes or more of storage. |

Understanding the differences between the two platforms will enable you to design excellent applications for each.

## Reasons for Use

Handheld devices and desktop computers are used for very different functions, although both have information management and communication features. Both devices often can synchronize their data as well. Applications designed for one type of device require rethinking in order to be useful on another device type.

Desktop computers are used for lengthy data processing applications, such as word processing, financial analysis, and computer-aided drawing. Handheld computers, since they are small and lightweight, tend to be used as personal information managers, portable compressed document viewers, and in-the-field data entry devices.

Desktop computer users remain in their seats in front of their displays for hours at a time. Handheld device users may glance at their schedule to learn where to go for their next meeting or to look up a telephone number just before placing a call – sometimes on the same device, sometimes not. Mobile telephone handsets and communicators are used for voice communication but offer messaging and/or Internet access as well.

The theme that is emerging from this discussion is *access to information*. Handhelds require fast access to information, while desktop computers require comprehensive access. For handhelds, the tradeoff for speed and portability is completeness.

## Form Factor

Form factor is a device's size–shape relationship. Handheld devices are easily held in one hand and operated with the other. Handheld devices with keyboards are typically held with both hands and operated with both thumbs. Desktop computers come in many form factors, such as the under-monitor, tower, compact, and all-in-one.

My true test for a handheld is whether it requires a table to be operated effectively. The Psion Revo Plus device, shown in Illustration 1.4, fails this test. Although it is very small and when closed would fit in a shirt pocket, it works best while resting on a table. These devices are classified as 'palmtops'. Palmtops more closely match desktop computers than they do handhelds, which is why they are not specifically addressed by this book. In order to design for

**Illustration 1.4**   Psion Revo Plus

palmtops most effectively, refer to books on desktop and Web application design as well as the sections in this book on PDA design, such as in Chapter 2, on Handheld Devices, and in Chapter 4, on Information Architecture.

The Fujitsu PenCentra 200, shown in Illustration 1.5 also is not a handheld simply because of its size.

This device sports a $640 \times 480$ pixel display, is $8.9" \times 6.5" \times 1.3"$, and weighs 2 pounds. Its large touch screen display makes it work much more like a desktop computer than a handheld device. As you can see in the photograph, the display is of a Windows desktop, so designs for this device should follow user interface guidelines for Windows desktop software.



**Illustration 1.5**   Fujitsu PenCentra 200. Reproduced by permission of Fujitsu PC Corporation

# Mobility

Desktop computers are obviously not 'mobile'. They are meant to be stationary. Handheld devices define *mobility*. They are small, lightweight, and very portable. Defining the traits that make a device 'mobile' requires a deeper look into quantifying the concept.

Mobility is determined by the following factors:

- combined weight of all necessary components, such as CPU, display, keyboard, and mouse
- number of required components and how they are configured
- cables needed for operation, such as power, networking, and component configuration
- size of fully configured system in height, width, and depth
- furniture necessary for system configuration

## Weight

Weight of desktop computers is measured in pounds, but usually just for shipping purposes. The weight of a handheld device is calculated in ounces or grams. Typically, handheld devices weigh less than 8 ounces.

## Components

Desktop computers are usually meant to rest on a table and require displays, input devices (keyboards and mice), and cabling to be usable at all. Handheld devices are often all-in-one units, but they frequently require a stylus input device, which is easily stowed within the unit. Handheld devices sometimes have attachments such as headsets, power connections, modem cables, etc., but they are usable as independent units most of the time. Some add-on components can be snapped directly onto a device, while others travel separately. The key is that all components for handheld devices must be portable or stowable. The exception is a cradle that is connected to a desktop computer for synchronization and sometimes recharging.