Preface

With the advent of the World Wide Web, electronic commerce has revolutionized traditional commerce, boosting sales and facilitating exchanges of merchandise and information. The recent emergence of wireless and mobile networks has made possible the introduction of electronic commerce to a new application and research area: mobile commerce. In just a few years, mobile commerce has emerged from nowhere to become the hottest new trend in business transactions. The success of mobile commerce relies on the widespread adoption by consumers of more advanced handheld devices such as smartphones, which include some data-processing capability and thus permit vital activities such as mobile Internet browsing. According to Canalys, a market research company, 118 million smartphones were sold worldwide in 2007 and they accounted for about 11% of the overall cellphone market, an increase from around 53% a year earlier. The market thus appears to be opening up for this new form of commerce, and a book covering mobile commerce programming and its related issues is therefore timely. This book discusses mobile commerce and handheld computing from a technical perspective and consists of three major sections:

1. *Mobile Commerce Systems and handheld Devices,* surveys the software and hardware systems necessary for performing mobile commerce transactions,

2. *Mobile Web Content Design and Implementation,* focuses on handheld computing and programming that require support from server-side programs such as database-driven mobile website construction, and

3. *Client-Side Handheld Computing and Programming,* looks at handheld computing and programming that does not require support from server-side programs, such as stand-alone address book construction.

MOBILE COMMERCE SYSTEMS AND HANDHELD DEVICES

Mobile commerce, which is defined as the exchange or buying and selling of commodities, services, or information on the Internet through the use of mobile handheld devices such as smartphones, is an effective and convenient way for consumers to engage in electronic commerce wherever they happen to be and at times that are convenient for them. Realizing the advantages to be gained from mobile commerce, major corporations have started to offer mobile commerce options to their customers in addition to the electronic commerce services they already provide.

Mobile Commerce Systems

It requires some effort to understand and construct a mobile commerce system because it involves such a wide range of disciplines and technologies. To facilitate this process, in this book mobile commerce systems will be broken down into six components: (i) mobile commerce applications, (ii) mobile handheld devices, (iii) mobile middleware, (iv) wireless networks, (v) wired networks, and (vi) host computers. Since each component is large and complicated enough to be a research area by itself, only elements in components that are specifically related to mobile commerce will be explained in detail. Lists of the technologies used for component construction are given and other important issues, such as mobile security, are also discussed.

Internet-Enabled Mobile Handheld Devices

Internet-enabled mobile handheld devices are a core component of every mobile commerce system, making it possible for mobile users to interact directly with mobile applications. Much of a mobile user's first impression of the application is formed by his or her interaction with the device, so the success of an application is greatly dependent on how friendly and convenient it is to use. This book will first explain the role of handheld devices in a mobile commerce system and then discuss the device components in detail. A mobile handheld device includes six major components: (i) a mobile operating system, (ii) a mobile central processor unit, (iii) a microbrowser, (iv) input and output devices and methods, (v) memory and storage, and (vi) a battery. Each component is described in turn and major products and technologies for the component are given. Several related technologies such as device-to-desktop synchronization are also discussed.

HANDHELD COMPUTING

Handheld computing refers to the use of handheld devices such as smart cellular phones and PDAs (Personal Digital Assistants) to perform wireless, mobile, handheld operations such as personal data management and mobile website construction. It consists of two kinds of computing and programming: client- and server- side handheld computing and programming.

Mobile Web Content Design and Implementation

Here, handheld devices are used to perform wireless, mobile, handheld operations that require the support of a server. Examples of these applications include: (i) instant messages, (ii) database-driven mobile web content searches, (iii) online video games, and (iv) wireless telephony. Server-side handheld computing requires the use of a range of programming and markup languages and tools. Two languages that are widely used will be introduced in this book:

- **WML (Wireless Markup Language):** This is a markup language that formats and styles web pages for display on mobile handheld devices such as smart phones and PDAs. WML is part of the wireless access protocol (WAP) and is based on XML (eXtensible Markup Language).
- **WMLScript:** This is a procedural scripting language and an extended subset of the JavaScript language. It is employed to complement WML, a markup language for mobile handheld devices.

A detailed, step-by-step construction of a database-driven mobile web site will be given.

CLIENT-SIDE HANDHELD COMPUTING AND PROGRAMMING

This refers to the use of handheld devices to perform mobile, handheld operations that require no support from a central server. Examples of these applications include: (i) address books, (ii) video games, (iii) note pads, and (iv) to-do-lists. Various environments/languages are used in handheld computing and programming and are available for client-side handheld application design and implementation. Unlike desktop operating systems, where the market is dominated by Microsoft Windows, it is not yet possible to determine who will be the ultimate winner and become the dominant player in the handheld device market. Android, BREW (Binary Runtime Environment for Wireless), Java ME (Java Platform, Micro Edition), Palm OS,

Symbian, and Microsoft Windows Mobile, which use either C/C++ or Java, will be introduced first, followed by Java ME, which uses Java, and Palm OS, which uses C/C++.

ORGANIZATION OF THE BOOK

Mobile commerce and handheld computing include such a wide variety of subjects and technologies that it is almost impossible for a single book to adequately cover all the subjects involved. This book therefore focuses on introducing the major topics concerning mobile commerce and computing and provides extensive references for readers interested in discovering more information. It is divided into three sections, with a total of fourteen chapters.

Section I. Mobile Commerce Systems and Handheld Devices

Mobile commerce, mobile commerce systems, and mobile handheld devices are fairly new subjects and are complicated. This section, consisting of four chapters, introduces fundamental material related to mobile commerce and handheld computing.

Chapter I. Fundamentals of Mobile Commerce Systems: An overview of electronic and mobile commerce system structures is given in this chapter. An electronic commerce system consists of four components: (i) electronic commerce applications, (ii) desktop or notebook computers, (iii) wired networks, and (iv) host computers. Due to its more complex structure, a mobile commerce system is best divided into six components: (i) mobile commerce applications, (ii) mobile handheld devices, (iii) mobile middleware, (iv) wireless networks, (v) wired networks, and (vi) host computers.

Chapter II. Mobile Commerce Applications: Mobile commerce includes a wide variety of activities, and this chapter surveys some of its major applications, including, among others: (i) mobile advertising, (ii) mobile entertainment, and (iii) travel and weather reports.

Chapter III. Mobile Handheld Devices: Mobile users perform mobile transactions by using their mobile handheld devices. A handheld device includes six major components: (i) a mobile operating system, (ii) mobile central processing units, (iii) a microbrowser, (iv) input and output devices and methods, (v) memory and storage, and (vi) batteries. Other handheld technology such as data synchronization will be discussed too.

Chapter IV. Essential Mobile-Commerce Technology: Mobile networking, security, and payment methods are three important facets of mobile commerce com-

munications. These three themes are fairly complicated and a whole book could be dedicated to any one of them. Therefore, rather than attempt to cover these issues comprehensively, this chapter will provide a brief introduction and discuss related technologies. A case study of handheld security using handheld usage identification will be given at the end of this chapter.

Section II. Mobile Web Content Design and Implementation

Server-side handheld computing uses handheld devices to perform wireless, mobile, handheld operations that require the support of a central server. Examples of these applications include: (i) instant messages, (ii) mobile web content, (iii) online video games, and (iv) wireless telephony. Server-side handheld programming includes the design and development of handheld software such as CGI programs that reside on the servers.

Chapter V. Mobile World Wide Web Content: The first half of this chapter provides the background and discusses system setup for server-side handheld computing and programming. To illustrate the concepts involved, the second half of this chapter examines a case study of adaptive viewing mobile web content using mobile web usage mining.

Chapter VI. WML (Wireless Markup Language): WML is an XML-based language that is used in conjunction with WAP (wireless application protocol) for the formatting of documents. WAP is a suite of network protocols that specify ways of sending data across the airwaves. As with all such protocol suites, they are organized hierarchically. At the bottom there are low-level protocols that are concerned with establishing connections, coding alphanumeric characters, etc., while at the top are the high-level protocols such as WML which perform activities such as passing page information. This chapter introduces fundamental WML elements such as images and tables.

Chapter VII. Advanced WML: Chapter VI covered the use of WML for static web pages, which have fixed content all the time. This chapter extends this to cover dynamic web pages through a discussion of advanced WML, which requires the support of external programs constructed using procedural languages. There are several methods for calling external programs from a WML page. This chapter will introduce one of the methods, CGI, chosen because of its relative simplicity. A case study of a mobile web search engine is given at the end of this chapter to illustrate its use.

Chapter VIII. WMLScript: WML is a markup language that is used for text formatting and display. The functions of a markup language are limited if there is no support from other programming languages. Two kinds of programming languages can be used to extend the functions of WML:

1.   Server-side scripts such as CGI Perl running on servers, and

2.   Client-side scripts such as WMLScript running on handheld devices.

   This chapter will introduce WMLScript; CGI was introduced in the previous chapter. WMLScript is a light JavaScript language that must be compiled into byte code on a server before it can run on a handheld device. It is based on ECMAScript but has been modified to better support low bandwidth communication and thin clients. WMLScript can be used together with WML to provide intelligence to the clients but it has also been designed so that it can be used as a standalone tool. This chapter includes a case study that applies WMLScript to permit handheld devices to access searches of web-based genome databases.

   Chapter IX. Database-Driven Mobile Web Content Construction: Among the various mobile applications, mobile web content is the most popular. This chapter will be devoted to a detailed consideration of the construction of database-driven mobile web content. Here, handheld programming refers to mobile-commerce programming for Internet-enabled mobile handheld devices and requires the use of various programming and markup languages and utilities. This chapter demonstrates handheld programming by giving a case study, construction of a B2C, mobile, online video-game store. A database-driven mobile web site is often implemented by using a *three-tiered client-server architecture* consisting of three layers: (i) the user interface, (ii) the function module, and (iii) the database management system (DBMS).

Section III. Client-Side Mobile Handheld Computing and Programming

The most popular applications of handheld server-side computing and programming involve database-driven mobile web content, which was described in the previous section. The remainder of this book will be devoted to client-side handheld computing and programming, whose applications do not need support from server-side programs. Client-side handheld applications are varied and numerous and they cover many everyday activities. Popular applications include address books, appointments, and to-do lists.

   Chapter X. Client-Side Handheld Computing and Programming: This chapter introduces six popular handheld programming environments/languages: (i) Android, (ii) BREW (Binary Runtime Environment for Wireless), (iii) Java ME (Java Platform, Micro Edition), (iv) Palm OS, (v) Symbian OS, and (vi) Microsoft Windows Mobile. Handheld programming using Java ME and Palm OS will be covered in more detail in the final four chapters.

Chapter XI. Java ME (Java Platform, Micro Edition) Programming: Most client-side handheld programming uses either Java or C/C++. This chapter gives an overview of the basic concepts involved in Java ME (previously known as J2ME), which is a version of Java. To illustrate the use of Java ME, a MIDlet is created that generates a simple greeting on a handheld device.

Chapter XII. Advanced Java ME Programming: This chapter gives an advanced study of Java ME programming based on the introduction to Java ME programming provided in the previous chapter. It focuses on two major topics of particular interest for handheld devices: (i) persistent storage, which is the storage embedded in handheld devices, and (ii) the network connection, which is necessary for many client-side applications such as weather reports and location-based applications that require a network connection.

Chapter XIII. Palm OS Programming: Rather than trying to squeeze all the features and capabilities of a personal computer into a tiny package, Palm OS devices are designed specifically for managing mobile information, communications, and entertainment. This gives Palm OS devices advantages in terms of their flexibility, ease of use, and compatibility. This chapter introduces readers to the basic concepts of Palm OS programming, and includes a detailed explanation of a "Hello, World!" program. Palm OS Resource Editor, which is a visual resource editor that allows users to create and edit XML resource description (XRD) files for Palm OS applications, is also described in outline in this chapter.

Chapter XIV. Advanced Palm OS Programming: Building on the introduction to Palm OS programming given in the previous chapter, this chapter examines one advanced topic of Palm OS programming in more detail, namely the use of forms. Step-by-step procedures are used to guide readers seeking to implement this Palm application. A section on Palm OS references is also provided for readers interested in pursuing this topic in more depth.

ACKNOWLEDGMENT

Handheld devices started to become more popular about ten years ago. Initially, the devices were used for simple personal data management such as calendars and schedules, but handheld technologies are advancing so fast that new applications, techniques, or devices are created almost every day. Mobile users now use their devices to perform complicated tasks such as browsing the mobile Internet, performing mobile-commerce transactions, and checking their emails. Attempts to keep up with the rapidly changing technologies involved have extended this project for several years past what we originally envisaged, and three co-authors had to withdraw from this project. The successful accomplishment of this book is a credit

to many people. The reviewers who provided such helpful feedback and detailed comments are particularly appreciated. Special thanks go to the staff at IGI Global, especially to Kristin Roth, Heather Probst, Mehdi Khosrow-Pour, and Jan Travers. Jan Szechi has spent many hours polishing my writing. Finally, the biggest thanks go to my family members for their love and support throughout this project.

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July 2008