Preface

This book, *Handheld Computing for Mobile Commerce: Applications, Concepts and Technologies* collects high-quality research papers and industrial and practice articles in the areas of handheld computing for mobile commerce from academics and industrialists. It includes research and development results of lasting significance in the theory, design, implementation, analysis, and application of handheld computing. Twenty-two excellent articles from 71 world-renowned scholars and IT professionals are included in this book, which covers four themes: (i) handheld computing for mobile commerce, (ii) handheld computing research and technologies, (iii) wireless networks and handheld/mobile security, and (iv) handheld images and videos.

INTRODUCTION

With the advent of the World Wide Web, electronic commerce has revolutionized traditional commerce, boosting sales and facilitating exchanges of merchandise and information. The 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 and location-based services. Table 1 gives the numbers of units of mobile phones, PCs and servers, and handheld devices shipped in the years from 2002 to 2008 based on reports from market researchers (BNET, 2004; Canalys, 2007; CNET, 2003, 2006a, & 2006b; Gartner, 2005a, 2005b, 2005c, 2006, 2007, 2008a, 2008b, & 2009; GsmServer, 2004; IDC, 2008). The table reveals that smartphones enjoyed the highest rate of increase compared to the sales of mobile phones and PCs and servers and that by 2008 the number of PDAs sold had dwindled to almost nothing. It is expected that smartphones will overtake the number of PCs shipped in the very near future. Handheld computing research is thus becoming a critical area as mobile users ask for more and more functions from their smartphones.

Mobile commerce prevails and mobile phones have become ubiquitous in today's society. However, mobile users are no longer satisfied with simple phones, but instead expect ever more powerful functions to be available from their mobile devices. Advanced phones, known as smartphones, allow mobile users to perform a wide variety of advanced handheld functions such as browsing the mobile Internet or finding a nearby theater showing a specific movie. The design and development of these new, improved handheld functions require the help of handheld computing research. A timely book covering handheld computing and mobile commerce is therefore needed.

Table 1. Mobile phones, PCs and servers, and handheld devices shipped from 2002 to 2008

	Mobile Phones	**PCs and Servers**	**Smartphones**	**PDAs** (without phone capabilities)
Number of Units Shipped in 2002 (Million)	432	148	—	12.1
Number of Units Shipped in 2003 (Million)	520	169	—	11.5
Number of Units Shipped in 2004 (Million)	713	189	—	12.5
Number of Units Shipped in 2005 (Million)	991	209	—	14.9
Number of Units Shipped in 2006 (Million)	991	239	64	17.7
Number of Units Shipped in 2007 (Million)	1153	271	122	—
Number of Units Shipped in 2008 (Million)	1220	302	139	—

AIM OF THE BOOK AND TARGET AUDIENCE

Mobile commerce is a trend of electronic commerce. Mobile handheld devices and computing are used to realize and assist mobile commerce. The handheld industry has applied handheld computing for many years. However, handheld devices and computing are diverse and there does not exist a formal approach to mobile commerce implementation. Our book is one of the first few books which systematically covers mobile handheld devices and computing and provides various approaches to mobile commerce implementation. It will help IT students, researchers, and professionals to better understand handheld devices and concepts and therefore produce more useful, effective handheld applications and products. Various handheld topics are covered in this book. Some of them are:

- Client-side mobile-commerce computing, applications, and programming
- Context/location-based services, computing, and applications
- Energy saving for handheld devices
- Handheld devices, architecture, and systems
- Handheld specifications, standards, guidelines, software, and tools
- Java ME systems, computing, applications, and programming
- Mobile advertising and sales
- Mobile and wireless networks
- Mobile commerce applications and systems
- Mobile Web 2.0 and plus
- Mobile Web and Internet
- Mobile/handheld algorithms and methodologies
- Mobile/handheld human computer interface and user interface design and implementation
- Mobile/handheld images and videos
- Mobile/handheld operating systems and platforms
- Mobile/handheld programming languages and environments
- Mobile/handheld security
- Web content adaptation for handheld devices

The target audience of this book will be composed of students, IT professionals, and researchers working in the fields of handheld computing and mobile commerce. It especially benefits the IT personnel of corporations because companies are gradually setting up the mobile versions of their electronic

commerce systems. This book will help IT workers smoothly build mobile commerce systems based on their traditional IT knowledge. It could be used for a textbook of an advanced computer science (or related disciplines) course and could be a reference book for IT professionals and students. Since this book covers the handheld computing for mobile commerce systematically, it is also for people desiring to learn the topics on their own. The benefits of this book include:

- Fill the gap of lack of handheld-computing books.
- Help IT students and professionals master the handheld technology.
- Provide a textbook for a course of handheld computing, mobile commerce, or mobile computing.
- Can be used as a reference book for IT workers and students.

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 handheld computing and provides extensive references for readers interested in discovering more information. It is divided into the following four sections, with a total of twenty-two chapters:

- *Handheld computing for mobile commerce*, which discusses how handheld computing supports mobile commerce,
- *Handheld computing research and technologies*, which covers major handheld technologies, methodologies, algorithms, and programming,
- *Wireless networks and handheld/mobile security*, which gives related issues of wireless networks and handheld security, and
- *Handheld images and videos*, which covers images and videos used by mobile commerce.

Section 1: Handheld Computing for Mobile Commerce

Handheld computing is the use of handheld devices like smart cellular phones to perform wireless, mobile, handheld operations such as browsing the mobile Web and finding the nearest gas stations. Mobile commerce is the most important application of handheld computing. This section discusses some handheld-computing methods for mobile commerce.

- *Chapter 1. A User Context-Aware Advertising Framework for the Mobile Web*, which elaborates over context-aware advertising on mobile web, discusses the benefits and challenges of adapting user contexts to the mobile advertising process, and classifies user contexts into three categories according to their characteristics and usage. The authors present a novel user context-aware advertising framework for mobile web that integrates the user contexts into the process of generating, selecting, matching, and presenting advertisements customized to mobile web pages.
- *Chapter 2. Plugging into the Online Database and Playing Secure mobile Commerce*, which discusses cloud computing, which is capable of appearing ubiquitously with mobile devices and intends to outstretch its various applications by the devices. The next generation of mobile devices will use wireless broadband access and human-computer interaction technologies which support cloud services and interface designs respectively advances to allow remote plug-and-play with web 2.0

applications that is suitable for mobile commerce in which this chapter emphasizes. Besides, for sustainable development of a mobile commerce solution, workable but not securable is absolutely not enough. Therefore, a secure information retrieval and reveal protocol for mobile commerce based on modified RSA digital signature is also proposed and demonstrated.

- *Chapter 3. Quality Evaluation of B2C M-Commerce Using the ISO9126 Quality Standard*, in which a new method has been introduced which measures the value of relevance for each m-commerce system attribute. The theoretical framework for this metric is also presented. The validity of the presented measures should further examine with different user groups in alternative evaluation cases and it is included in future work. It should be mentioned that the values presented are not strictly defined as numerical results but present the correlation among m-commerce systems attributes and external quality characteristics.
- *Chapter 4. A Picture and a Thousand Words: Visual Scaffolding for Mobile Communication in the Developing World*, which introduces Picture Talk, a software application that the authors designed for use in environments with low literacy, limited Internet connectivity, and little familiarity with information services. Because basic mobile phones are the most common devices used by BoP populations, the authors have implemented Picture Talk on mobile phones. The authors are now investigating ways of providing access to some Picture Talk features on less expensive mobile phones using voice and text messaging. The limitations of using these devices to access rich structured content by users with limited literacy skills exposes human-computer interaction challenges that are keys to enabling broad access to information by people in BoP populations.
- *Chapter 5. Web Applications on the Move: Opening Up New Opportunities for Mobile Developers*, which shows that there are a number of activities on the way to extend the Mobile Web platform towards a "hybrid" platform, which can compete with platforms for locally installed "fat" applications. The authors present a prototype of a hybrid platform, the FOKUS Mobile Widget Runtime and sample applications to demonstrate how these future hybrid applications may look like.
- *Chapter 6. A J2ME Mobile Application for Normal and Abnormal ECG Rhythm Analysis*, which presents a novel, but low cost and relatively equitable ECG signal analysis and alert system for telecardiology. This system fully harnesses the computational power of a plain mobile phone to perform real-time data mining tasks. The evaluation results not only prove it is a feasible approach but also show its potential for future practical applications.
- *Chapter 7. Factors Facing Mobile Commerce Deployment in United Kingdom*, which discusses the challenges facing mobile commerce deployment in United Kingdom. Although the number of mobile phone users is increasing and the technology is available for successful implementation of m-commerce, only a small number of users utilize m-commerce services. At the same time, mobile phones are becoming smarter, and the most of latest phones are capable of connecting to the Internet. The chapter looks at the background of m-commerce as well as the technological development of mobile phone to the current stage. Also, technical and non technical issues which hinder the adoption of m-commerce are discussed and solutions and recommendations given.

Section 2: Handheld Computing Research and Technologies

Handheld computing involves different disciplines such as wireless networks and mobile platforms and various technologies like Java and C/C++ handheld programmig. This section gives some of the major handheld technologies including energy saving, mobile platforms, handheld programming, and Web content adaptation.

- *Chapter 8. UbiWave: An Novel Energy-Efficient End-to-End Solution for Mobile 3D Graphics*, which presents UbiWave, an end-to-end framework using wavelets to transmit and render graphics content at various resolutions on mobile devices. Ubiwave improves the performance of mobile graphics applications by balancing energy consumption, rendering speed and image quality. Ubiwave includes four parts: (i) a perceptual error metric to guide the scaling of mobile graphics scenes to the lowest LoD at which users do not perceive distortion due to simplification (called the PoI); (ii) a novel Forward Error Correction (FEC) scheme based on the principles of Unequal Error Protection (UEP); (iii) an Energy-efficient Adaptive Real-time Rendering (EARR) heuristic to balance energy consumption, rendering speed and image quality and (iv) an energy-efficient 3D streaming technique. By combining PoI, UEP, EARR and our streaming technique, the rendering speed and image quality of mobile graphics applications in wireless networks can be maximized, while minimizing energy consumption.
- *Chapter 9. Peer-to-Peer Service Sharing on Mobile Platforms*, which introduces the *Networked Service-oriented Autonomic Machine (NSAM)*, which is a theoretical model of a hardware/software entity that is programmed to be altruistic in sharing its resources. The focus is on NSAMs whose hardware resources can be classified as mobile devices, offering and consuming services. In this context, the author present a framework for peer-to-peer service sharing, based on three key aspects: overlay scheme, dynamic service composition and self-configuration of peers. This framework is suitable to characterize many existing platforms and to define new ones.
- *Chapter 10. Scripting Mobile Devices with AmbientTalk*, which describes AmbientTalk, a distributed object-oriented scripting language specifically designed to deal with the hardware characteristics inherent to mobile ad hoc networks. What makes AmbienTalk a suitable scripting language for the implementation of mobile computing applications are its event-driven application model, its automatic buffering of messages to deal with intermittent connectivity and its built-in peer-to-peer service discovery abstractions to discover nearby applications.
- *Chapter 11. Interrupt Handling in Symbian and Linux Mobile Operating Systems*, which introduces a survey on differences among interrupts in the Linux and Symbian Mobile operating systems; we concluded that both interrupt mechanisms are similar in some ways and different in another, especially in organizational. In Symbian OS the pending interrupts are handled in a FIFO order but in the RT-Linux they are handled in a prioritized order.
- *Chapter 12. Web Page Adaptation and Presentation for Mobile Phones*, which presents two systems for mobile phone users in order to provide comfortable Web browsing experience. One system provide various presentation functions for Web browsing so that users can select appropriate one based on their browsing situations. The other system provides functions to navigate users within a Web page so that they can reach information of interest without getting lost in the page. This chapter introduces designs of these systems and introduces results of user experiments, through which the authors show that the browser can reduce users' burden on mobile Web by enabling to select appropriate presentation functions adapted to their situations and by navigating them on a large Web page with the entertaining interface.
- *Chapter 13. Technologies and Systems for Web Content Adaptation*, which investigates some of the Web content adaptation methods: (i) *page segmentation*, which is used to segment Web pages, (ii) c*omponent ranking*, which is used to rank page components after segmentation, and (iii) o*ther ad hoc methods*, such as text summarization, transcoding, and Web usage mining. Though each method employs a different strategy, their goals are the same: *conveying the meaning of Web pages by using minimum space.* The major problem of the current methods is that it is not easy to find the clear-cut components in a Web page. Other related issues such as mobile handheld devices and microbrowsers will also be discussed in this chapter.

Section 3: Wireless Networks and Handheld/Mobile Security

Wireless networks are an essential component of a mobile-commerce system and handheld security is mandatory for the success of mobile commerc. Related issues of LBS privacy, RFID system survivability, mobile Internet connectivity, handheld security, and wireless networks are discussed in this section.

- *Chapter 14. Positioning and Privacy in Location-Based Services*, in which the authors present how to achieve location privacy during LBS without a centralized and trusted middleware. First, they review the recent progress on location positioning technologies. Second, they investigate how to perform location cloaking without users exposing their accurate locations to a trusted third party. They decompose the problem into two sub-problems: proximity minimum k-clustering and secure bounding. Third, the authors study how to perform nearest neighbor query with guaranteed privacy. A framework called 2PASS is proposed that allows the client to control what objects to request in order to minimize their number while not compromising location privacy of the user. The core component of 2PASS is a lightweight WAG-tree index from which the client can compute out the objects to request from the server.
- *Chapter 15. Survivability in RFID Systems*, which discusses survivability enhancing techniques for RFID systems. Survivability is a relatively new research area. RFID survivability requires innovative techniques to address the limitations of low-cost RFID tags, highly mobile devices, and challenging environment in which an RFID system operates. This chapter summaries the potential survivability enhancing techniques in the literature and provides references for researchers and system developers to develop technologies towards resilient, secure, and survivable RFID systems.
- *Chapter 16. Mobile and Handheld Security*, which discusses the security issues and possible solutions of mobile security in three layers: mobile hardware, mobile operating system and mobile applications. In order to provide high level security and privacy good for business and daily life, it is essential to strengthen security in all three layers. Robust and reliable security is built on hardware that is initially designed and then implemented with security in mind. Mobile operating systems are expected to have better capability designed and management, while mobile applications need to be standardized and built with reliable quality. Mobile users need to gradually realize the importance of security and privacy on mobile systems and start to learn to utilize secure applications and secure features in the mobile OS to protect their mobile devices.
- *Chapter 17. Design and Performance Evaluation of a Proactive Micro Mobility Protocol for Mobile Networks*, which introduces the Proactive Micro Mobility (PMM) Protocol for the optimization of network load. A novel approach is proposed to design and analyze IP micro-mobility protocols. The cellular Micro Mobility Protocol provides passive connectivity in an intra domain. The PMM Protocol optimizes miss-routed packet loss in Cellular IP under handoff conditions and during time delay. A comparison is made between the PMM Protocol and the Cellular IP showing that they offer equivalent performance in terms of higher bit rates and optimum value. A mathematical analysis shows that the PMM Protocol performs better than the Cellular IP at 1 MHz clock speed and 128 kbps down link bit rate. The simulation shows that a short route updating time is required in order to guarantee accuracy in mobile unit tracking. The optimal rate of packet loss in the PMM Protocol in a Cellular IP are analyzes route update time. The results show that no miss-routed packets are found during handoff.
- *Chapter 18. A Comparative Review of Handheld Devices Internet Connectivity Revenue Models to Support Mobile Learning*, which provides a survey of mobile broadband revenue models deployed by mobile network operators in the UK, USA and Canada. The survey of exiting revenue models

highlights the technology adoption trends for handheld devices by consumers and identifies the future impact of these trends on the network operators and content providers with respect to educational content. The chapter focuses on innovations in consumer propositions that can support the Mobile Learning phenomenon. The study reveals that the various operators aim to differentiate their consumer propositions by branding, technology devices, and flexible pricing structures. From the results of the study it is clear that the current continuous convergence of multimedia applications, information services, digital networks, and devices will likely lead to an increase in adoption of mobile learning systems in the UK, Canada and the USA especially as the price per bandwidth drops and new innovative connectivity options are deployed such as built in mobile broadband processor in laptops and consumer devices.

Section 4: Handheld Images and Videos

Images and videos play an important role of mobile commerc. This section discusses critical issues of delivering images and videos to mobile handheld devics. It includes four chapters on vision movement (Spaanenburg and Malki), video coding (Lambert, et al.), fast mode decision techniques (Lambert, el al.), and video streaming (Lee and Smith).

- *Chapter 19. Mobile Vision on Movement*, which discusses mobile vision on movement. In the early days of photography, camera movement is a nuisance that can blur a picture. Once movement becomes measurable by micro-mechanical means, the effects can be compensated by optical, mechanical or digital technology to enhance picture quality. Alternatively movement can be quantified by processing image streams. This opens up for new functionality upon convergence of the camera and the mobile phone, for instance by "actively extending the hand" for remote control and interactive signage.
- *Chapter 20. Distributed Video Coding for Video Communication on Mobile Devices and Sensors*, which addresses the concept of distributed video coding which is currently emerging as a new video coding paradigm allowing the construction of ultra-low complex video encoder at the expense of a more complex decoder. The theoretical foundations of DVC were discussed briefly after which an overview was given of existing DVC solutions and architectures. One of these architectures was used as reference for a more in-depth discussion of the functional building blocks of a DVC system. As computational complexity plays an important role in the context of DVC, the latter DVC system was extended with a number of coding modes allowing to dynamically shift the complexity between encoder and decoder, facilitating the requirements of emerging video communication applications. Finally, they provided an outlook to some future research directions for which it is believed that advances in these domains will contribute to the overall coding performance of DVC systems.
- *Chapter 21. Fast Mode Decision in H.264/AVC*, which provides an up-to-date critical survey of fast mode decision techniques for the H.264/AVC standard. The motivation for this chapter is twofold: Firstly to provide an up-to-data review of the existing techniques and secondly to offer some insights into the studies of fast mode decision techniques.
- *Chapter 22. Mobile Video Streaming*, which introduces essential technical components for constructing mobile video streaming systems. They include the latest development on broadband wireless technology and video-capable mobile handheld devices. As many modern technologies are often

driven by consumer demand, user experience and expectation are discussed from the perspective of mobile video streaming. At the end, several cutting-edge research and development breakthroughs are presented as they may change the future of mobile video streaming systems.

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