Mobile social networking and computing: a multidisciplinary integrated perspective / Yufeng Wang and Jianhua Ma.

Summary: "This book introduces mobile social networking (MSN) and computing from a multi-disciplinary perspective. It covers fundamental theory and key problems in MSN, including characteristics, inner structural relationship, incentive mechanisms, resource allocating, information diffusion, search, ranking, privacy, trust and reputation in MSN. It reviews various applications and includes analysis on related platforms."-- Provided by publisher.

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Chapter 13

Mobile Social Networking Development Platforms and Examples

13.1 Introduction

The Internet has long been used for social interaction, with some of the more popular examples being social networking applications such as Facebook, Twitter, LinkedIn, and Instagram [1–4]. These types of applications help users share digital media and have proven to be successful tools for expanding the social network. There is also a trend toward extensive use of social networking application from mobile devices [5]. The landscape of mobile platforms has seen a major evolution in the recent past. In the era of smartphones and tablets, mobile applications are providing added value to several industries including transportation, ecommerce, net banking, travel, retail, and enterprise services. Developers are exploiting the state-of-the-art functionalities of the smart devices to offer a revolutionizing user experience. In turn, they are becoming the engine for innovation. Thus, it is of prime importance for a mobile platform provider to attract more and more developers in order to boast external investment and revenue. Not only the mobile platform owners and handset manufacturers but also network service providers and chipset makers are investing heavily to develop and release software kits to reach out to the developers [6].

Programming applications for mobile phones used to be a niche task. However, the recent extensive adoption of mobile devices and especially smartphones, together with the app store mobile application distribution model, has...
Mobile Social Networking and Computing

Elevated mobile application programming to a common activity. To support mobile application development, each producer of a major mobile application platform (iOS, Android, Windows Phone, etc.) provides a convenient software development kit (SDK). For example, Google’s Android SDK integrates nicely with the popular Java IDE Eclipse, which makes it easy to start programming mobile phone applications. That is, programmers install an SDK on their desktop computer and develop a mobile application there just as they would develop any other application. The SDK typically contains a powerful emulator or virtual device that allows programmers to simulate how their mobile applications will behave on an actual mobile device [7].

The development of these applications is much easier than earlier mobile application development platforms but still carries some of the same complexities and issues. Although these operating systems (OSs) are rich in libraries and built-in features, they still face the heat of the market to match customer’s high expectations. The basic architecture and support of OS programming language are very different from one another. Developed applications for a certain OS are not compatible for another OS [8]. The diversity of mobile platforms and the variety of SDKs and other tools pose unique challenges. These include choice of SDK, user experience, stability of framework, ease of updating, cost of development for multiple platforms, and time to market an app. Most of the developers would like to release apps for major mobile platforms (iOS, Android) and provide a consistent user experience (UX) across the platforms. Developing an app for separate mobile platforms require in-depth knowledge of them and their SDKs. This increases the cost of development and the time to market an app and decreases the ease of updating. This is where cross-platform development tools come into the picture [9].

Cross-platform tools (e.g., PhoneGap, Titanium, and RhoMobile) allow the implementation of an app and its user interface (UI) using Web technologies such as hypertext markup language (HTML) and cascading style sheet (CSS). Then the app can be built for several mobile platforms (e.g., iOS, Android, Windows Phone, and BlackBerry). This process is helpful only when a developer is willing to compromise user experience and places more importance on launching the app in several platforms to reach the maximum number of users. This approach allows an app to be developed for multiple mobile platforms at the same time. Thus, the cost of development and time to market the app is reduced [6].

This chapter focuses on the introduction of the mobile social networking (MSN) development platform. Specifically, Section 13.2 will give an overview of mobile device (hardware) and mobile operating system (software); MSN development architecture will also be discussed. Section 13.3 will take Android and iOS as representative examples to present some features of MSN applications, and then we will summarize the concerns and process when developing MSN applications. Because developing applications for separate platform requires quite a great deal of time and knowledge, cross-platform development tools will
be discussed in Section 13.4. Section 13.5 presents an educational example of MSN application development, based on the Wi-Fi Direct framework. Finally, we summarize this chapter in Section 13.6.

13.2 Overview of Mobile Platform

13.2.1 Mobile Devices

Mobility can be defined as the capability of being able to move or be moved easily. In the context of mobile computing, mobility pertains to people’s use of portable and functionally powerful mobile devices that offer the ability to perform a set of application functions untethered, while also being able to connect to, obtain data from, and provide data to other users, applications, and systems [10]. A mobile device has the following features—it is portable, personal, easy and fast to use, and has a network connection [11].

Clearly, cell phones, personal digital assistants (PDAs), and other manual electronic devices are converging into a single device, a smartphone, which incorporates some functions of mobile entertainment devices and other consumer electronic wireless devices. Mobile devices are not just a communication tool; they are also a computational tool, supported from mobile networks to global cellular networks. A mobile device can be used as a wireless control instrument that can unify monitoring and control over other kinds of electronic devices.

A mobile device consists of integrated and interconnected hardware components and software. These hardware components include a microprocessor, read-only memory (ROM), random access memory (RAM), expansion storage, network interfaces, battery, and a display. A mobile device is controlled by an embedded computer system, which performs a set of functions to control any electronic device or equipment ranging from an industrial system to home use devices.

When designing an application, it is important to consider the display attributes, such as size, resolution, color depth, backlight, and power consumption. The mobile device display represents a significant amount of power consumption; therefore, it must also be taken into account in the management of global energy. Specifically, the OSs and applications should employ techniques that allow screen use with low power. In brief, the power management is a priority in mobile devices due to the constraints of battery life; therefore, it is important that hardware components and application designs use energy efficiently [12,13]. Figure 13.1 shows the hardware architecture of a mobile device [14].

13.2.2 Mobile OSs

Modern mobile OSs combine the features of a personal computer operating system with other features, including touch screen, cellular, Bluetooth, Wi-Fi,
Global Positioning System mobile navigation, camera, video camera, speech recognition, voice recorder, music player, near-field communication, and infrared blaster.

Android, iOS, Windows Phone, and BlackBerry are the most popular mobile OSs. With a collection of choices, it can be difficult for developers to decide the platform on which they will work. Table 13.1 shows the main similarities and differences of these systems [15].

Devices that operated by Android and iOS occupy most of the mobile market, although these systems have their own advantages and disadvantages. For instance, iOS provides a polished and user-friendly experience and has the best app market. However, to ensure hardware and software work well together, iOS provides a controlled smartphone experience; Android is supremely customizable with an excellent notification system and many widgets, allowing multitasking; full Google is also Android’s feature. Table 13.2 shows many specific details about different systems.

### 13.2.3 MSN Development Platform Architecture

To support different data exchange, sharing, and delivery scenarios, different architectures are used in MSN development platforms, including centralized architecture and distributed architecture.

In centralized MSN application architecture, a centralized server is used to deliver data from server to terminal; this is a client/server (C/S) structure. Mobile users create their information and send it to the centralized server so that other users can access the online social network to receive these, as shown in Figure 13.2.
A centralized architecture forms the basis for Web-based MSNs where the mobile users depend on the updates of content providers (e.g., Facebook server). The advantages of a centralized architecture include the simplicity of service implementation and the high efficiency of centralized control. However, similar to a C/S structure, a centralized MSN architecture may have a single point of failure and may experience congestion at the server when a large number of mobile users access the services at the same time [21].

In a distributed MSN architecture (shown in Figure 13.3), instead of a centralized server, mobile users communicate directly using peer-to-peer (P2P) technology such as Wi-Fi or Bluetooth on the basis of encounter/reencounter. The data flow in distributed architecture can go through other mobile users as well as access points (e.g., as the relay node).

### Table 13.1 Overview of Popular OSs

<table>
<thead>
<tr>
<th>OS</th>
<th>iOS</th>
<th>Android</th>
<th>Windows Phone</th>
<th>BlackBerry OS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company</td>
<td>Apple, Inc.</td>
<td>Open Handset Alliance/Google</td>
<td>Microsoft</td>
<td>BlackBerry Ltd.</td>
</tr>
<tr>
<td>Market share [16]</td>
<td>13.4%</td>
<td>81.3%</td>
<td>4.1%</td>
<td>1.0%</td>
</tr>
<tr>
<td>Current version</td>
<td>7.0.4</td>
<td>4.4</td>
<td>8</td>
<td>10.2</td>
</tr>
<tr>
<td>OS family</td>
<td>Darwin</td>
<td>Linux</td>
<td>Windows CE 7/Windows NT 8+ [17]</td>
<td>QNX (Unix-like)</td>
</tr>
<tr>
<td>Supported CPU architecture</td>
<td>ARM</td>
<td>ARM, MIPS, x86, I.MX</td>
<td>ARM</td>
<td>ARM</td>
</tr>
<tr>
<td>Package manager</td>
<td>iTunes</td>
<td>APK</td>
<td>Zune Software</td>
<td>BlackBerry Link</td>
</tr>
<tr>
<td>Default Web browser/ engine</td>
<td>WebKit</td>
<td>WebKit</td>
<td>Trident</td>
<td>WebKit</td>
</tr>
<tr>
<td>Official application store</td>
<td>App Store</td>
<td>Google Play</td>
<td>Windows Phone Store</td>
<td>BlackBerry World</td>
</tr>
</tbody>
</table>

*Source: Comparison of mobile operating systems. Available online: http://en.wikipedia.org/wiki/Comparison_of_mobile_operating_systems*
Table 13.2  Main Differences among Mobile Operating Systems

<table>
<thead>
<tr>
<th>OS</th>
<th>iOS</th>
<th>Android</th>
<th>Windows Phone</th>
<th>BlackBerry OS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notification center</td>
<td>5+</td>
<td>Yes</td>
<td>No</td>
<td>6+</td>
</tr>
<tr>
<td>Push notifications</td>
<td>Yes (Apple Push Notification Service)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Multitasking</td>
<td>7+ [18] was limited from version 4 [19]</td>
<td>Yes</td>
<td>8+ [20]</td>
<td>Yes</td>
</tr>
<tr>
<td>Desktop interactive widgets</td>
<td>No</td>
<td>Yes</td>
<td>No; live tiles are not interactive</td>
<td>No</td>
</tr>
<tr>
<td>Lock screen widgets</td>
<td>Media player; 5+: notifications, voicemail, camera</td>
<td>4.2+</td>
<td>Media player; 8+: live apps and notifications</td>
<td>?</td>
</tr>
<tr>
<td>Notification view widgets</td>
<td>5+: Stocks and weather; 3rd party software with “jailbreak”</td>
<td>4.1+: Google Now and possible with 3rd party apps</td>
<td>No (there is no notification view)</td>
<td>?</td>
</tr>
<tr>
<td>Quick settings toggles</td>
<td>7+ or 3rd party software on jail-broken devices</td>
<td>2+</td>
<td>No</td>
<td>?</td>
</tr>
<tr>
<td>Screenshot</td>
<td>Yes</td>
<td>4+ also available on 3.7 or earlier with Cyanogen Mod and on certain devices (e.g., Samsung Galaxy S II)</td>
<td>8+</td>
<td>3rd party software</td>
</tr>
</tbody>
</table>

Source: Comparison of mobile operating systems. Available online: http://en.wikipedia.org/wiki/Comparison_of_mobile_operating_systems
On one hand, some applications (such as Apple’s AirDrop on iOS7 or other P2P software on Android or Windows) can be built on the distributed MSN architecture. On the other hand, distributed MSN architecture can work on its own on dedicated middlewares (e.g., AllJoyn, an open-source project led by Qualcomm). These dedicated middlewares are able to provide the necessary underlying functionalities for constructing MSN applications, including networking capability, storing the interests, identifying the other users, sharing data, and so on [21].

* iOS: Use AirDrop, available on http://support.apple.com/kb/hr5887
† A Common Language for the Internet of Everything—Alljoyn, Available on: https://www.alljoyn.org
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Preface

Over the past few years, online social networks (OSNs) have been steadily growing and have become ubiquitous on the Internet, greatly improving social connectivity and collaboration. Despite the wide spread of OSNs, the flexibility and sociability of these networks are questionable. First, access to OSN services is still not widely available upon user demand. Furthermore, human communication is still highly embedded in the physical contact and closeness provided by the physical environment. Unfortunately, there is no automated means to facilitate communication in the physical environment, which leads to the issue of sociability. Thus, people with shared interests and backgrounds fail to leverage interpersonal affinities for personal benefits.

On the contrary, we are living in a mobile device–focused society (most people today would find it very difficult to live without a mobile phone). Perhaps, this is because people love to socialize. With the great popularity of smartphones and the recent availability of open mobile platforms, we believe that there is a significant latent impact in the convergence of distributed content sharing, OSNs, sensor networks, and pervasive computing on the mobile phone platform.

Now, with numerous advancements in mobile phone technologies (especially smartphones and new location technologies), this is the right time to connect the virtual community with physical space and to tightly bind the rich social context with the local environmental context by providing personalized services to people who interact. This is the key idea behind mobile social networks (MSNs).

In a sense, MSNs could be regarded as part of an ecosystem of social devices. This book explicitly distinguishes MSNs from OSNs as follows:

- First, MSN applications are not just extensions of computer-based social computing because the usage patterns of mobile devices significantly differ from those in a wired environment. It is expected that user involvement in mobile social computing will foster undiscovered usages and interactions. In practical terms, because mobile devices have rich sensing capabilities, they allow users to augment the real-world commons with the Internet. In short, the mobile device will become the natural tool to bridge the gap between the physical world surrounding us and the wealth of information on the Internet.
Second, we argue that it is the user, through the mobile device, who will be placed at center stage, and the potential success of MSNs lies in active collaboration among participants. The importance of people’s participation, their feedback, and finding ways to satisfy their needs brings with it many interdisciplinary challenges. For example, a possible collaboration could be supported through peer-to-peer (P2P) networking that occurs when users are close to each other, and their mobile devices store and share location-based information. This would allow data to be shared easily among users who are working together.

In summary, user empowerment will have a determinant role in the mobile social networking ecosystem. Users are no longer passive consumers; they have the opportunity to create content or to contribute to social networks. Users’ real-life situations will be at the core of their mobile usage, and they will use their mobile devices as tools in both the real and the information/content/application domains.

This work differs from most existing books related to MSNs in the following aspects.

First, most other books look at MSNs only from a technical standpoint, but we believe that focusing only on the technical viewpoint is far from sufficient to thoroughly characterize MSNs. Our discussions on multidisciplinary perspectives and approaches will shed new light on various related issues in mobile networks and systems, will foster new applications, and will inspire novel economic and business models, forming the crux of our book *Mobile Social Networking and Computing: A Multidisciplinary Integrated Perspective*. This volume outlines incentive mechanisms inspired by classical economics, behavioral economics, and social psychology, and, perhaps for first time, summarizes economic and business models of MSNs.

Second, this book not only deals with the theoretical aspects of mobile social networking and computing but also throws light on the applications viewpoint. This book is an attempt to thoroughly introduce and categorize various existing applications related to mobile social networking and computing, aimed at inspiring potentially interesting social networking applications and suggesting important research opportunities. Both location-based service (LBS), one of the most popular MSN applications, and mobile social networks in proximity (MSNP), an emerging application, have been presented in a comprehensive manner.

Finally, we also address popular mobile social networking development platforms, such as Android and iOS, and some cross-platform development frameworks that would be of immense help for engineers and developers of MSN applications. The latest generation of mobile devices supports more application capabilities with fewer vendor-imposed restrictions. Openness and computational power combined with diverse capabilities of modern smartphones and
cross-platform development tools could significantly facilitate the emergence of new MSN applications that may ease communication and enhance intelligent social life.

In addition, this book includes the following features:

- An emphasis on the interaction between the macrolevel structure and the local rational behaviors (microlevel) in MSN: These two perspectives are interrelated—local interactions lead to the emergence of high-level properties, which, in turn, affect the local behaviors of rational participants.

- Two distinct (but related) viewpoints about MSN applications: Broadly speaking, we think that mobile social networking and computing include two different areas. The first is socially inspired networking technology, which adopts the concepts and methods in social fields to address the problems in networking areas, such as mobile search and ranking. The second is networking technology, which uses various recent advancements to facilitate our social life, thereby serving the society.

- Economic viewpoint of social networking and computing: Making the leap from fixed-line social networking to mobile networking is a lot trickier than it might appear. The distinguishing features of mobile terminals and their users, such as tiny screens, low bandwidth, different requirements, preferred experience, and so on, will render mobile terminal–oriented applications of social networks and computing very different from traditional computing. This book will discuss various issues from multidisciplinary viewpoints, including technology, economics, social sciences, psychology, and so on.

- Cross-platform development frameworks of MSN application development: Present day developments in MSN applications are much easier to operate than earlier mobile application development platforms but still have some of the same complexities and issues. Each platform is unique and exhibits different features, capabilities, and behaviors. Developing an app for separate mobile platforms requires in-depth knowledge of those platforms and their Software Development Kits (SDKs). This increases the cost of development and the time to market an app and decreases the ease of updating. This is where cross-platform development tools come into picture. Our book summarizes several existing multiplatform developer tools in the market today.

Briefly, we attempt to organize the book contents from two viewpoints: the structural viewpoint and the application viewpoint. From the structural viewpoint, multidisciplinary inspired research on open mobile networking and computing has two distinctive levels. First, from a high-level (macrolevel) perspective, we conduct some social and economic analysis of network and information infrastructure; then, from a relatively low-level (microlevel) perspective, we adopt some concepts and theories from other research fields to properly address or alleviate...
the detailed problems in the mobile networking and computing fields. Naturally, these two perspectives are interrelated; that is, local interactions lead to the emergence of high-level properties, which, in turn, affect the local behaviors of participants. From the application viewpoint, we argue that mobile social networking includes two different areas. The first area includes the socially inspired networking technologies, which adopt the concepts and methods in social fields to address the problems in networking areas. The second area includes the social networks serving society, which use various advanced technologies to facilitate our social life.

Certain fundamental issues run through all MSN research and applications, including incentive mechanisms, trust and reputation, energy efficiency, and so on. The new generation of mobile devices has more applications that run with few vendor-imposed restrictions. The combination of openness, computational power, and the diverse capabilities of modern smartphones and MSN cross-platform development frameworks could be used to construct applications that may ease communication and enhance intelligent social life.

This book exhaustively presents various aspects of MSN research and applications: fundamental theory, key problems, typical applications, development frameworks, and so on. It is organized into four parts comprising 13 chapters.

Section I introduces basic concepts, applications, and challenges related to MSNs (Chapter 1).

Section II presents the fundamental theory and key problems encountered in MSNs. Three chapters address the “fundamental theory”: Chapter 2 details the multidimensional (temporal–spatial–social) structural characteristics of MSNs; Chapter 3 focuses on the interaction between network structure and local autonomous interaction; and Chapter 4 discusses incentive mechanisms in mobile networking and computing. Five chapters address “key problems”: Chapter 5 highlights information diffusion; mobile search and ranking are covered in Chapter 6; Chapter 7 focuses on energy efficiency schemes in MSNs; Chapter 8 highlights issues of privacy, trust, and reputation in mobile networking and computing; the section ends with a discussion of the economic and business model in MSNs (Chapter 9).

Section III features a discussion on MSN applications, which is subdivided into two parts: socially inspired mobile networking (Chapter 10) and enhanced social life with mobile technologies (Chapters 11 and 12).

The book concludes with a final section (IV) on MSN development platforms and pertinent examples (Chapter 13).
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