Chapter 8

Location-Based Services and Navigation in Smart Phones

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ABSTRACT

The ubiquitous positioning ability and abundant computation capability of a smart phone allow the provision of a variety of location-based services (LBSs). This chapter focuses on the fundamental elements and principles of LBS in a smart phone. First, the basic concept of LBS is introduced. Second, the state-of-the-art smart phones and communication networks are described. Afterwards, the smart phone positioning technologies are presented as three groups: satellite-based technologies, network-based solutions, and sensor-based approaches. Then, the location relevant services, contents, data, and context in a smart phone are explained. Furthermore, in the perspective of the new generation of LBS, the emerging features and technical solutions are discussed. Finally, three examples show how the above elements are integrated into the LBS applications in a smart phone.

INTRODUCTION

From a historical view, LBSs are not anything new for consumers. In 1886, Reuben H. Donnelly produced the first Yellow Pages directory featuring business names and phone numbers, categorized by the types of products and services provided. In 1909, St. Louis combined the first Yellow Pages directory with coupons. In the 1970s, because of the increasing traffic jams in the large cities of the United States, the broadcast reports on the real-time traffic conditions became popular. However, the milestone of the modern LBS is E-911 announced in 1996, which obligated mobile operators to locate the callers of emergency services and deliver their geographic position to...
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the public safety answering point (US Federal Communications Commission, 1996). Nowadays, with the smart phones and communication technologies soaring, the use of LBS has taxied down the runway and taken off. The LBS applications can be easily found in each model of smart phones. For instance, Find My iPhone, Google Latitude, and Ovi Maps. Furthermore, the social network applications in smart phones, such as Facebook, Twitter, and Foursquare, also enable the location capabilities. To date locations and services are tightly coupled in a smart phone.

LBS Definition

In general, LBS is an application for a mobile device that requires knowledge about where the mobile device is located. LBSs can be query-based and provide the end user with useful information such as “Where is the nearest restaurant?” LBSs can also be push-based and deliver coupons or other marketing information to customers who are in a specific geographical area.

Virrantaus et al. (2001, p. 66) presented their definition: “The continuous availability of the device and the emerging capability of the terminals and/or the mobile network infrastructure to position the terminals on the earth allows new types of spatio-temporal real-time services that are called Location-Based Services (LBS)” A similar definition was given by the International Open Geospatial Consortium (OGC, 2008a, p. 4): “LBS is a wireless-IP service that uses geographic information to serve a mobile user. Any application service exploits the position of a mobile terminal.”

LBS Components

The above definitions indicate that LBS is an intersection of information technologies, communication technologies, and mobile devices, as shown in Figure 1. The information technologies include geographic information system (GIS), Internet technologies such as web services and mobile Internet. Communication technologies cover the mobile telecommunication, wide local area network (WLAN), wide personal area network (WPAN), and so on. The mobile devices, for instance smart phones with the positioning and communication capabilities, enable the end users to obtain various services from providers via communication networks.

Viewing from the overall picture of the LBS supply chain, there are five fundamental components, as shown in Figure 1, involved in a typical LBS.

Mobile Device

The mobile device is a platform on which the end user requests the desired information and services. As a result, the information is presented on the mobile device in various ways. Possible mobile devices can be a mobile phone, a laptop, a personal digital assistant (PDA), a tag, a personal navigation device (PND), and so forth. Due to the massive amount of users and powerful computational capabilities, a smart phone has taken a role as the most important LBS terminal among the booming mobile devices.

Communication Network

Despite the memory and computation capability of a mobile device are increasing, it is nonetheless impractical to contain all the data and carry out all the functionalities on a mobile device. Hence, services and contents are usually implemented on the remote providers. In order to couple the mobile devices and remote providers, a communication network with a full duplex channel is demanded. The service and content requests are transferred from a user terminal to service providers via the communication network. As a result, the requested information is sent back from the provider to end user through the same communication tunnel.
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