

Chapter II

Using Bluetooth for Indoor User Positioning and Informing

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ABSTRACT

The continuous evolution of wireless technologies has made them ideal for use in many different applications, including user positioning. Until now, user positioning applications were focused mainly on providing users with exact location information. This makes them computational heavy while often demanding specialized software and hardware from mobile devices. In this chapter, we present a new user positioning application. The application is intended for use with m-commerce by sending informative and advertising messages to the users after locating their position indoors. The application is based exclusively on Bluetooth. The positioning method we use, while efficient, is nevertheless simple. The m-commerce based messages can be received without additional software or hardware installed. After discussing the available technologies and methods for implementing indoor user positioning applications, we shall focus on implementation issues, as well as the evaluation of our application after testing it. Finally, conclusions are extracted and future work is proposed.

INTRODUCTION

Wireless technologies have become a very important part of today's life. Bluetooth, Wi-Fi and Infrared are three examples of such technologies, with a variety of usages for each one of them.

Wireless technologies can be used to form wireless networks among computers themselves and among computers and mobile devices. These wireless networks can be used for many applications including data exchange and accessing the internet from mobile devices. These potentials

gave ground for m-commerce to grow to a very profitable field of the business world (Xiaojun, Junichi, & Sho, 2004).

During the past few years, Bluetooth has become a very popular technology. Its low cost and low power consumption have made it ideal for use with small, low powered devices such as mobile phones and PDAs. Apart from forming wireless ad-hoc networks for sending and receiving data among Bluetooth enabled devices, wireless voice transferring, wireless printing, object exchange (such as business cards and messages) and many more applications, Bluetooth technology is also ideal for user location detection applications, mainly for two reasons: the first is that the technology itself provides ways for a variety of positioning methods to be efficiently implemented, like the triangulation and RX (Received X) power level methods (Kotanen, Hännikäinen, Leppäkoski & Hämäläinen, 2003). The second reason is that almost everyone possesses at least one Bluetooth device that can be used by a positioning application.

User positioning is the methodology used to detect the position of a user. This detection can be done according to some stationary points, which are usually called base stations. The position of a user arises when his distance from every base station becomes known. Two techniques can be followed: the first uses a central stationary point (server) that analyzes the data that come up from the base stations, resulting in the location of the user. The result is then sent to the user. The second technique, on the contrary, does not use any central stationary point. Instead, either the data that come up from the base stations are sent directly to the user's device to be processed there, or the user's device itself collects these data by detecting the base stations, and then processes them appropriately to find the desirable distances from the stations. This means that the user's device must be equipped with the necessary software to collect and process the data to find the users position, hence become software depended, something not desirable.

User positioning can be global or indoor. Global positioning is used to detect the geographic location of a user. GPS is a very well known and efficient global positioning system that uses satellite links to detect the location of a GPS device worldwide. Indoor positioning on the other hand is used to locate a user inside a building. Global positioning cannot be used for indoor positioning because the latter needs more accuracy than the former can achieve and because the building walls block the satellite signal.

In the bibliography, many positioning systems fall in an intermediate category, which may not be characterized neither as global, nor as indoor positioning. The target areas of these systems are larger than buildings and smaller than cities, for example large shopping malls, campus areas, even ancient castles. In such places, a technology that aims strictly to locate users worldwide, like GPS may not give as good results as a more general purpose technology, like Wi-Fi.

According to Xiaojun, Junichi, & Sho (2004), the development of wireless technologies and mobile network has created a challenging research and application area, mobile commerce. They note that, as an independent business area, it has its own advantages and features as opposed to traditional e-commerce and that many unique features of m-commerce like easier information access in real-time, communication that is independent of the users' location, easier data reception and having accessibility anywhere and anytime make a widespread acceptance and deployment of its applications and services. Such services can be disposed to the public using wireless technologies. In the next pages we study the use of wireless technologies in informing the users by sending them m-commerce related messages.

Xiaojun, Junichi, & Sho (2004), also state that according to the market research firm Strategy Analytics, the global market for m-commerce is expected to reach \$200 billion by 2004. Burger (2007) points out that while the U.S. and European Union markets are more crowded, closely regu-

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