Chapter 13
Mobile Geographic Information Systems

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ABSTRACT

This chapter introduces the concept of Mobile Geographical Information Systems (Mobile GIS) as an evolution of conventional GIS to being available on wireless mobile devices such as smart phones. The evolution of the technology and its applications are charted in this chapter. The main elements of Mobile GIS are then discussed. This focuses on: GIS servers; wireless mobile telecommunication networks; wireless mobile devices; location-awareness technology; and gateway services. This is followed by a discussion of the main features in terms of the services and usage of Mobile GIS: mobility; real-time connectivity; location-awareness; broadened usage. Mobile Geographical Information Systems are an important facilitating technology for Location-Based Services (LBS). A range of applications of Mobile GIS for smart phones are described. The chapter closes with a discussion of the prospects and challenges for Mobile GIS. Challenges derive from four broad areas: limitations that derive from the technologies being used; areas of GIScience that still need to be adequately researched; users; and business models for a sustainable presence.

INTRODUCTION

Mobile Geographic Information Systems (Mobile GIS) can be viewed as an outcome of the convergence of wireless mobile technologies and GIS to have real-time and mobility characteristics. With the fast development and increasingly wide usage of smart phones, Mobile GIS have become embedded in many Location–Based Services (LBS) applications, particularly in navigation functions, which are provided via smart phones. Mobile GIS can also be considered as a core part of LBS. Mobile GIS integrates GIS and wireless mobile communication technologies to offer a

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real-time capability of interacting with external software and remotely accessing and managing data and information.

In this Chapter, the development of Mobile GIS from conventional GIS is presented in the context of GIS functionalities and mobile technologies and smart phones. The principles and main features of Mobile GIS are addressed in a systematic way, covering topics regarding its real-time connectivity, mobility and location-awareness. Mobile GIS takes advantage of mobile technologies (e.g. wireless networks, mobile devices, smart phones) to offer the possibility of exchanging and analysing spatial information in a real geographic world in real-time. Mobile GIS also offers the potential for users to employ GIS in more mobile and diverse situations and for a range of applications through smart phones. Mobile GIS are further presented in the context of Location-Based Services (LBS). LBS have been made possible due to the maturation and convergence of a range of heterogeneous technologies, such as mobile phones, the Internet and the Web, global positioning system (GPS) and GIS. LBS are defined as the delivery of spatial data and information services where the content of those services is tailored to the current or some projected location and context of a mobile user (Brimicombe & Li, 2009). LBS have been considered by many to have evolved professional GIS applications to more public-centric services and thus promoting greater ubiquity for GIS. Later in this Chapter, a wide range of Mobile GIS applications via smart phones are covered, including areas such as on-site data collection and monitoring; navigation with real-time updates; wayfinding for individuals to orientate and discover routes; real-time tracking of contacts; mobile commerce (m-commerce) with location-awareness; user-solicited information for a range of business and social purposes; coordinating emergency and maintenance responses to accidents and essential services; location-based artistic expression in the community, mobile gaming where the players and actions are location–based. The chapter ends with a discussion of the challenges and research issues raised by Mobile GIS, such as the influence of fast development of mobile technologies.

FROM CONVENTIONAL GEOGRAPHIC INFORMATION SYSTEMS (GIS) TO MOBILE GIS

In mid-1960s, with the prospect of handling and analysing spatial data digitally, the beginning of geographic information systems (GIS) had been explored in both professional and academic areas, as shown in the time line in Figure 1. In Canada, a prototype of GIS was started for the Canada Land Inventory which aimed to map existing land uses and analyse land capability for forestry, agriculture, wildlife and recreation (Tomlinson, 1984). The output of this early stage of GIS was regarded the cost-effective way for mapping the whole land area of Canada at the time. This system became fully operational in 1971. In 1964, in the Laboratory for Computer Graphics and Spatial Analysis, Harvard Graduate School of Design, USA, the first digital mapping software, named SYMAP, was created in 1964. SYMAP used line printers to produce primitive maps to visualise landscape themes of human and physical phenomena for identifying spatial similarities and groupings (McHaffie, 2000). These maps were represented as coarse lines of equally spaced characters and symbols. Evolving from SYMAP, the GRID package with command-line user interface and ODYSSEY as a line-based (vector) prototype were developed as GIS software in the Laboratory in 1970s. Also in mid-1960s, the US Bureau of Census aimed to produce digital maps of street blocks and census tracts for supporting 1971 census. This introduced explicit topology into the data structure. These early developments set the foundation of GIS, such as raster (grid) and vector (line) data structures, the use of database management for spatial data, the use of data layers (treating each theme as a layer of data), and