Chapter 2.5
Integrating Mobile-Based Systems with Healthcare Databases

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ABSTRACT

In this chapter, we discuss issues related to e-health and focus on two major challenges in distributed healthcare database management: database heterogeneity and user mobility. We designed and prototyped a mobile-agent-based mobile data-access system framework that can address these challenges. It applies a thesaurus-based hierarchical database federation to cope with database heterogeneity and utilizes the mobile-agent technology to respond to the complications introduced by user mobility and wireless networks. The functions provided by this system are described in detail and a performance evaluation is also provided.

INTRODUCTION

The integration of healthcare management and advances in computer science, especially those in the areas of information-system research, has begotten a new branch of science: e-health. E-health is becoming more and more widely recognized as an essential part for the future of both healthcare management and the health of our children. The 2001 President's Information Technology Advisory Committee, in its report "Transforming Healthcare through Information Technology," noted that information technology "offers the potential to expand access to healthcare significantly, to improve its quality, to reduce its costs, and to transform the conduct of biomedical

research"(p. 1). Although much has been done, reality has proven to us that there are still a great number of problems remaining to be taken care of. Health and human-services secretary Mike Leavitt told the Associated Press (2005) in an interview after hurricane Katrina, "There may not have been an experience that demonstrates, for me or the country, more powerfully the need for electronic health records…than Katrina" (p. 1). The article also pointed out that the "federal government's goal is to give most Americans computerized medical records within 10 years"(p. 1).

E-health embraces a broad range of topics, such as telemedicine, medical-record databases, health information systems, genomics, biotechnology, drug-treatment technologies, decision-support systems, and diagnosis aids, just to name a few. In this chapter, we focus on the topic of technologies that deal with integrating mobile-based systems with healthcare databases.

One of the major challenges in healthcare database integration is the fact that the lack of guidance from central authorities has, in many instances, led to incompatible healthcare database systems. Such circumstances have caused problems to arise in the smooth processing of patients between health service units, even within the same health authority (Svensson, 2002). For instance, electronic health record (EHR) systems have been used in practice for many years. However, they are often designed and deployed by different vendors and, thus, patients' information is collected and stored in disparate databases. Due to the lack of uniformity, these systems have very poor interoperability. Even though the wide deployment of networks has enabled us to connect these databases, a large amount of work still needs to be handled manually in order to exchange information between the databases.F

There are two potential solutions to the problems of interoperability and automated information processing: redesigning and reimplementing the existing databases or using a database federation. Redesigning and reimplementing existing databases require large capital investments, and are difficult to achieve. An alternative solution is to build a database federation in which problems caused by database heterogeneity are remedied by the use of a mediator: metadata. This approach is often referred to as the multidatabase solution (Bright, Hurson, & Pakzad, 1994).

The Internet and the client-server-based computing paradigm have enabled us to access distributed information remotely, where the data servers act primarily as an information repository, the user's workstation bears the brunt of the processing responsibility, and the client and server communicate through a well-formulated network infrastructure. Recently, the surge of portable devices and the wide deployment of wireless networks have ushered a new era of mobile computing. Users access information via wireless media and from lightweight and less powerful portable devices. This paradigm shift permits the exchange of information in real time without barriers of physical locations. This is particularly helpful in situations where emergency medical teams need to access patients' information as soon as possible at a disaster site (Potok, Phillips, Pollock, & Loebl, 2003). However, mobile computing has also brought upon several technical challenges. First, unlike workstations, portable devices usually have limited CPU (central processing unit) processing capability and limited battery capacity. Second, low bandwidth and intermittent wireless network connections are often debilitating to client-server applications that depend on reliable network communications.

The mobile-agent-based distributed system design paradigm can address the aforementioned limitations. Unlike the client-server-based computational model, which moves data to computation, mobile agents move computation to data. This allows mobile users to take advantage of the more powerful servers on the wired networks. In addition, mobile agents are intelligent and independent entities that posses decision-making capabilities. Once dispatched, they are able to