Chapter 2.6
A Distributed E-Healthcare System

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ABSTRACT

In this chapter we describe a distributed e-healthcare system that uses service oriented architecture as a basis for designing, implementing, deploying, invoking and managing healthcare services. The e-healthcare system that we have developed provides support for patients, physicians, nurses, pharmacists and other healthcare professionals, as well as for medical monitoring devices, such as blood pressure monitors. The system transmits e-prescriptions from physicians to pharmacists over the Internet. It offers multimedia input and output, including text, images and speech, to provide a human-friendly interface, with the computers and networks hidden from the user.

INTRODUCTION

According to Carmen Catizone of the National Association of Boards of Pharmacy (Catizone, 2002), there are as many as 7,000 deaths from incorrect prescriptions in the United States each year. A Washington Post article (Weiss, 1999) indicates that as many as 5% of the 3 billion prescriptions filled each year are incorrect. In the United States Institute of Medicine report, To Err is Human: Building a Safer Health System, Kohn et al. (USIOM, 2000) discuss human errors in the workplace:

Human beings, in all lines of work, make errors. Errors can be prevented by designing systems that make it hard for people to do the wrong thing and easy for people to do the right thing.

The report sees the need to improve the quality of healthcare systems, ease the access to healthcare and healthcare information, and reduce the cost of delivery of healthcare. The Healthgrid review (Healthgrid Association & Cisco Systems, 2004) concludes that large healthcare systems have difficulties in managing personal data, standardizing the data, extracting content-based knowledge, and federating databases.

Computing and networking technology can contribute greatly to the quality of healthcare. The slow adoption of such technology in healthcare is caused in part by the highly decentralized nature of healthcare and in part because healthcare professionals are often uncomfortable with computers and networks, and feel that such technology is not central to their healthcare mission, even though they acknowledge that accurate record keeping and communication are essential to good healthcare.

In this chapter we present a distributed e-healthcare system that we have developed. The system is intended for use by patients, physicians, nurses, pharmacists and other healthcare professionals, as well as by medical monitoring devices. It aims to provide user interfaces that busy healthcare professionals and fearful patients find attractive and convenient to use, as well as more effective and efficient communication between them.

A patient can make an appointment with his/her primary care physician on the Web. The physician can refer the patient to a specialist electronically, if he/she is unable to treat the patient. When the physician prescribes medication, the system communicates an e-prescription over the Internet from the physician to the pharmacy, decreasing the probability of incorrect or lost information. The patient can check his/her prescription status on the Web and arrange for pickup or delivery of the medication.

BACKGROUND

Extensive work has been undertaken on the development of electronic healthcare information systems. Much of the work on such systems has focused on record keeping and databases based on the notion of the electronic medical record (Bourke, 1994; USIOM, 1997; Taylor et al., 2004; Tsiknakis et al., 1997). Work has also been done on access and security (Anderson, 1996; Andersen et al., 2001), as well as on social implications of recording and communicating healthcare information (Bloomfield, 1991). Less work has been done on human-computer interfaces and usability by healthcare professionals and patients, which our e-healthcare system aims to address.

Governmental and private organizations have promoted the use of electronic technology for healthcare, but these organizations typically incline towards centralized or centrally administered systems (Andersen et al., 2001; Detmer, 2003). Because of the fragmented nature of healthcare in the United States and the increasingly international nature of healthcare services and patients, more distributed and interoperable e-healthcare systems based on open international standards are needed (Grimson et al., 2000).

Beyer et al. (2004) discuss the limitations and challenges of developing an architecture for an integrated healthcare network. They identify flexibility, adaptability, robustness, integration of existing systems and standards, semantic compatibility, security and process orientation as key issues in developing a healthcare network. Song et al. (2006) present a survey of computer-aided healthcare workflow. They define workflow properties and provide a summary of requirements for common healthcare practices.

Omar and Taleb-Bendiab (2006) have utilized the service oriented architecture, in conjunction with grid computing technology, for a sensor and actuator framework that monitors the health status of a patient and provides feedback. Our e-healthcare system provides more extensive