Chapter 3.12
Choosing Technologies for Handheld and Ubiquitous Decision Support

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ABSTRACT

Wireless, handheld devices are becoming increasingly popular in health care settings, but the full potential of their role in patient-specific decision support remains to be achieved. This article presents a multicriteria framework for choosing technologies apropos to handheld and ubiquitous decision support architecture. This framework is illustrated through architectural middleware choices made in the context of a podiatry and diabetes care network. Performance issues are found to be very important in the handheld space, and minor aspects of connectivity and other constraints drive significant changes in choices of architectural approach. The resulting architecture employs layers, including serialized objects, XML payloads, event notification, Web services, and dynamic class loading, with the mix varying among the system interfaces. The overall recommendation is that organizations wishing to fully exploit mobile technology must use a flexible policy and pursue a process of technology choice that is scenario-based and iterative to take into account discoveries from prototyping and field-test experience.

INTRODUCTION

Handheld computers acting as personal digital assistants (PDAs) are growing in popularity in health care. They are increasingly trusted (particularly as sources for reference material), used, and considered to be efficient (Cimino & Bakken, 2005). A mid 2004 survey (Grasso, Yen, & Mintz, 2005) found 52% of medical students reporting handheld computer use, with drug reference and clinical calculators the major clinical applications of the technology. Characterizing the use and capability of PDAs is an exercise in measuring the position of a moving target, but the dominant trend sees students as a key user group and reference for education as a key application area. PalmCIS (Chen, Mendonca, McKnight, Stetson, Le, & Cimino, 2004) illustrates the less common use of mobile technology as a terminal for viewing patient data. In a nursing context, Chang, Lutes, Braswell, and Nielsen (2006) found that mobile technology integrated with a hospital's mainframe system improves the communications between shifts. Lu, Xiao, Sears, and Jacko (2005) and Fischer, Stewart, Mchta, Wax, and Lapinsky (2003) also have reviewed handheld applications in health care, and Wu and Straus (2006) and Lane, Heddle, Arnold, and Walker (2006) have conducted systematic reviews. Wu and Strauss found limited, but supportive, evidence that handhelds improved documentation taken by physicians. The more functionally ambitious handheld solutions in health care are generally "home-grown" (i.e., purpose-built for a specific application context).

Handheld computing and mobile communications move us closer to a ubiquitous computing environment, where the notions of "a computer" or "the information system" become less central to the attention of the end user and where many often loosely coupled subsystems collaborate to achieve an overall goal. At the University of South Australia (UniSA), we have been following a vision of ubiquitous decision support for

chronic disease management with an emphasis on diabetes and foot care that integrates the roles of clinical decision support, provider education, and patient education (Warren, Lundstrom, Osborne, Kempster, Jones, Ma, & Jasiunas, 2004). Two key elements of this vision have been a handheld data collection and decision support application for students at the UniSA Podiatry Clinic (Lundström, Warren, Jones, Chung, & Jasiunas, 2003); and an individualized Web-based consumer diabetes information service (Ma, Warren, Phillips, & Stanck, 2005).

In the context of ongoing iterative development of handheld and ubiquitous decision support, one is faced with a diversity of architectural options in an environment of rapidly changing technology. The remainder of this paper presents a framework for consideration of relevant technology choices, with particular focus on middleware architecture, which is illustrated in terms of a cycle of development in the UniSA podiatry/diabetes management environment. The outcomes highlight the sensitivity of technology appropriateness to existing constraints and the ongoing relevance of performance.

METHODS

Setting

A spiral development lifecycle has been pursued with the UniSA Podiatry Clinic from mid 2002. The objectives of a cycle for calendar year 2005 entailed: (a) achieving a production client-server system in the podiatry clinic, allowing students to undertake podiatry assessments using handheld computers with results logged to a central database; (b) active decision support for the podiatry students on the handheld terminal to critique assessment and plan in terms of recorded observations; and (c) interfacing of the podiatry clinic to a diabetes consumer education service such that the clinic acts as a recruitment point for the education

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