

Chapter 7

Supporting the Ubiquitous Doctor

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ABSTRACT

In health service environments, support to mobility is an important issue, given that the mobility of the medical professionals is inherent to the organizational structure of healthcare entities, such as hospitals and medical centers. The concept of the “Ubiquitous Doctor” refers to a doctor that works anytime, anywhere and uses any computer device. For doing this, the doctor needs support to migrate a work session started on a device to another one, either for convenience (more comfort) or forced (e.g. low battery). This so called ‘session migration’ presents some challenges like preventing from disruption and performing quickly, so the Ubiquitous Doctor’s productivity can be improved. This chapter presents the design and implementation of a context-aware system (middleware services and application) to support the Ubiquitous Doctor, as well as experiments that show that the average migration time represents a low impact on the transition time between medical activities, and an assessment carried out with a group of doctors confirmed the importance of supporting the migration process in order to make it fast and reliable. The doctors also agreed on the importance of using the most convenient device based on context variables like user status and location.

INTRODUCTION

Advances in wireless communication and mobile devices have increased the use of computer technologies in healthcare environments, making possible a wide range of efficient and powerful

solutions. Ubiquitous computing concepts meet healthcare principles, enabling physicians to connect to and use healthcare systems almost anytime, anywhere, and by using any device. For years, medical activities such as second opinion and telediagnosis took place via wired network infrastructures, performed by professionals connected to a network of medical centers or offices

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distant from the location where the patient was actually being examined. A survey involving almost 7,000 European General Practitioners in the third quarter of 2007 showed that 87% of doctors use a computer, 48% with broadband connection, and increasingly store and send patients' data (Martini, 2008). However, the report also indicates that doctors could make better use of those technologies to offer services such as telemonitoring and electronic prescriptions.

With the evolution of communication networks that brought higher bandwidth, wireless communication, and access through smaller devices such as smart phones, tablet PCs, and PDAs (Personal Digital Assistants), technology applied to health environment services became an even more interesting challenge. By using smaller devices and wireless high-speed communication nodes, telemedicine moves towards the concept of pervasive or ubiquitous computing as introduced by Mark Weiser (1991).

In health service environments, support to mobility is an important issue, having in mind that the mobility of the medical professionals is inherent to the organizational structure of healthcare entities, such as hospitals and medical centers. Medical staff has an extensive demand for information at a number of locations (Holzinger, Nischelwitzer, & Meisenberger, 2005). The concept of the "Ubiquitous Doctor" (Diniz, 2008) refers to a doctor that moves inside a hospital, as well as from a hospital to another one, or a clinic, or her private office, and is able to do some tasks like browsing an EPR (Electronic Patient Record, also called EHR – Electronic Health Record) or giving a second opinion on a specific medical case. Furthermore, the ubiquitous doctor not only moves throughout working sites, but she may use the device that is available or is the most appropriate. Additionally, Tentori and Favela (2008) showed that medical staff's work is highly fragmented. Doctors do not spend more than five minutes doing an activity, without being interrupted. They also measured the transition time between activities,

i.e. the time between two consecutive activities, and thus noted that this time was, on average, of 51 seconds – almost 15% of counter-productive time. Figure 1 shows a scenario of a Ubiquitous Doctor typical day of work.

In the above scenario, the UbiDoctor starts a working day at a hospital where he/she typically uses a tablet PC and does many tasks moving around the site, visiting patients, meeting with colleagues etc. At noon the UbiDoctor goes for lunch, but is able to keep working by using a notebook connected to a WiFi or 3G network to check some EPRs. After lunch the doctor goes to his/her private clinic (office) and is asked by a colleague to give a second opinion on a patient's case, and he/she does that by using a smart phone. At home the UbiDoctor uses his/her desktop computer to review and update patients' records.

In order to make those activities feasible, some challenges shown in the scenario should be met. The above scenario encompasses a great diversity of categories of mobile or fixed devices. Each one of those devices presents variations on screen sizes, operating systems, processing power and network connections, for example. Such technological diversity is even more remarkable when dealing with wide-area networks, since they go way beyond the limits of a hospital or an office. The physician can access the system from different locations in the city, such as a hospital, her home or even while commuting from one place to another. Therefore, she will be able to access the e-health environment through a local network, using the Internet or even the public cell phone network (Takeuchi et al., 2009). It is assumed that the handoff between different communication technologies is automatic, as proposed in (Cavalcanti, Cordeiro, Agrawal, Xie, & Kumar, 2005).

This variety of networks has an influence on bandwidth or even on the random interruption of working sessions due to problems of communication intermittence. An interruption can even occur during the migration of a working session between two devices – additionally in the scenario shown

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