The Study in the Use of Hand Held Devices in an Emergency Department

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ABSTRACT

This paper outlines the results of wireless development for a private healthcare provider in Western Australia. The case study is presented in terms of software methodology used, problems encountered in developing the software application and then delivering it, issues associated with integration of new software with existing modules, human factors that impeded some aspects of development and issues associated with rigorous testing to ensure user requirements are accommodated properly.

Keywords: wireless technology, healthcare, Information Systems, Software Development

INTRODUCTION

Wireless technology provides increased flexibility and mobility to the use of information technology in today's competitive environment. Due to increasing costs and due to the complexities in managing the patient data [1], levels of services provided to the healthcare stakeholders are compromised in the current climate. It appears that wireless technology will be able to provide better access to data from anywhere at any time and hence will be able to provide better services [2]. Prior studies have argued the need for wireless technology in healthcare in terms of solutions to the financial crisis encountered in many healthcare systems [1], in addressing the increasingly complex information challenges [3], in complying with the rigorous regulatory framework [4], in reducing the medication errors [5] and in generating affordable healthcare applications that allow for greater mobility and ease of use in entering, sending and retrieving data [6]. While the use of wireless technology can be justified, it should be remembered that wireless technology can not solve all problems encountered in healthcare [4]. Even though the technology is rapidly improving and cost declining, there are still some practical problems, including slower speed compared with the desktop computers [7], lack of real time connectivity due to the mobility of the device [8], the limited size of the screen and hence the problems that may be encountered in displaying data, little or no provision for high quality graphic display [9]. Therefore, any solution provided should consider these prior to implementation.

DESIGN METHODOLOGY

The PALM series PDAs were used for the wireless development as the healthcare provider expressed a preference for this operating system compared to the HP series PDAs. Further, at the time of development, various software development environments, especially for data base connectivity, were available for PALM platforms. The development issues discussed below, therefore, are specific to this platform. This study, in order to realise efficiency gains in the healthcare setting, addressed three major issues of wireless development, namely, (1) development methodology in order to properly integrate the new solution with the existing solution, (2) communication issues between the mobile device and existing databases and (3) user interfaces in order to capture data that is accurate and timely.

The software engineering issues encountered in this project related to these two methodologies used. This study deliberately chose two development methodologies for

the software development. They were rapid prototyping and Waterfall Method. Rapid prototyping method helped to develop and test the code on a device that was emerging at the time of development, as well as obtain essential and timely feedback from the client. For the prototyping method, an abbreviated representation of the requirements was essential [10]. Only after completion of this abbreviated model, an abbreviated design specification could be created. The design strategy included top-level architectural issues rather than detailed procedural issues. The prototyping also ensured that the functionality of the system was kept separate from the implementation and the specification was encompassed with the operating environment [11]. Due to the relative newness of the environment, the specifications were kept localised and loosely coupled. This facilitated changes to the coding and module development. On the other hand, for the waterfall model, procedural issues were given importance, followed by data flow consideration in order to realise a detailed design. The waterfall model allowed the sequential development procedure as this was essential to mentally map various activities required to complete the project successfully. These approaches were followed to ensure that the wireless application was developed properly and quickly. Software engineering principles recommend combining approaches in order to deliver better solutions.

The communication issues involved data access, validation, verification, data capture and transmission. Due to the sensitivity of the nature of the application, it was decided not to write or over-write any data that are available on the main healthcare database. So, an intermediate tier was developed as a holding platform for the data for various purposes. The data for this development consisted of patient details such as names, specific admission details, details of the doctors and other billing information. These data were written onto the main database only when all the validation was performed. Data was verified by healthcare staff for accuracy and relevance prior to certifying for accuracy. As the data was written onto an intermediate tier, the data was not stored on the device. This eliminated security issues associated with the theft of the wireless device. The communication of data between the mobile device and the main database warranted additional discussion with the IT team in the healthcare setting as there are two main operating platforms available for the handheld devices. The PALM series of PDAs used a different operating system compared with some other devices. While some IT staff in the healthcare setting preferred the PALM devices, others were neutral. After discussions with the healthcare management, it was decided that a device independent code would be developed for the application. Java 2 Micro Edition (J2ME) for handheld devices was chosen as the development tool.

The software was trialled by about 20 healthcare staff including nurses, doctors, administration staff, IT staff and front desk receptionists. While the main data capture

was performed by the medical staff, receptionists and IT people were involved in accessing the data that emerged from the PALM PDA. The trial went for about 3 months prior to signing off the project for testing by the private healthcare according to their standards.

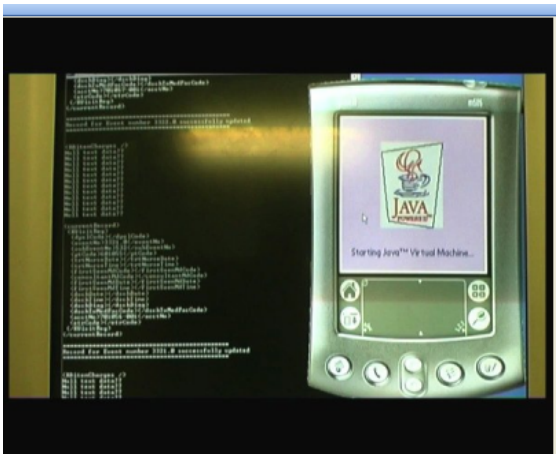
The third issue, user interfaces, was crucial as many people were involved in entering the data. So, it was decided that most of the data capture would be developed in the form of optional buttons and context sensitive predefined codes so as to enable users just to place a tick or choose an option. Further, the healthcare staff were restricted in many 'writing' type procedures and provided with data from the main database to minimise any errors.

Further issue that emerged during the development was the security of data. Due to the environment, the healthcare industry was concerned with the security of patient data. To avoid any issues pertaining to the privacy issues, it was decided that the handheld devices would not be used to store any data. The device will access the main database to retrieve any data that are needed for the context and once the context is over, the data will be flushed from the device. Further, the system sent alerts to security people when the handheld devices left certain physical boundaries of the healthcare provider. Access to any application was secured with two levels of passwords and this also restricted the usage. Only certain healthcare personnel were allowed to access certain data fields and hence the device was mainly used for the purpose of data entry at the point of care.

LIMITATIONS OF THE CASE

While the prototype was successful, there were a number of limitations. These include the code, integration with existing applications, user interfaces and data transmission. The code was written as generic as possible and parameters were kept as variables to allow flexibility. During real time testing, some of these parameters caused run time errors, as the compiled code was not able to resolve certain data types prior to the run. This created the necessity to re-visit the code and examine every instances of the run in order to remedy the problem. Integration with existing applications caused concern, as the healthcare industry did not have uniformity across all branches, data redundancy still existed causing adverse performance influences and the applications developed by the national office followed national standards while local branches followed their own ad-hoc standards. The development environment (Java libraries) used for the development was superior to the existing environment and caused problems while the product was tested in the healthcare setting, as some libraries were not available in the existing environment. These caused minor difficulties while integrating the wireless application with existing applications.

User interface created confusion as a number of staff were used to paper and pencil method. During the testing, the issue of 'light' emerged as some staff found the screen of the handheld device was not bright enough and encountered difficulties in reading the fields or forms displayed. The size of the screen of the PDA also prohibited the display of forms in their entirety and this introduced operational difficulties. Memory restrictions on the device also restricted certain operations.



Data transmission issues introduced certain limitations. While the prototype was tested using the infrared technology in a closed environment, the 'line of sight' required by the infrared created some limitations as it was not be possible to guarantee the line of sight always due to the sensitive nature of the emergency department. On the other hand, Bluetooth technology (another wireless technology) did not provide acceptable levels of coverage. It was not be possible to transmit data using wireless technology alone, as some branches of the healthcare were about 400 KM from the national office. These issues are being investigated currently.

CONCLUSION

The wireless development provided valuable experience to everyone involved. The product is currently undergoing rigorous testing to meet the standards of the healthcare industry. Operational difficulties encountered are being addressed in order to prepare the product for implementation. The future development plan includes training staff in the emergency department to use the product and then to study the adoption issues of the product in the specified environment.

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