Development of a mobile patient data management system using ASP .Net

N.A. Kadri[1], M.H. Mat Som[1], M.G. Raha[1], and N.F. Mohd. Nasir[2]

[1] Department of Biomedical Engineering, University of Malaya, Kuala Lumpur, Malaysia
[2] School of Mechatronics, Northern College University of Engineering, Perlis, Malaysia

Abstract— The primary aim of this study is to look into the feasibility of developing a mobile patient data management system using ASP .Net technology. It was envisioned that medical personnel, by using any WAP-enabled devices, will not be restricted to a specified location in order to retrieve, add, or edit patient data. The current system has achieved its main objectives of adding and editing patient demographical data, medical prescription, medical images and graphs. The system has been designed to be backward and forward compatible; ensuring unlimited module expansion in the future.

Keywords— **Patient data management, telemedicine, ASP .Net, WAP, Internet**

I. INTRODUCTION

The primary aim of this study is to look into the feasibility of developing an open source, wireless patient data management system using currently available wireless developer tools and widely accepted protocols, in managing and maintaining patient data in the healthcare environment.

It was envisioned that medical personnel, including doctors, nurses, and administrators will not be restricted to a specified location anymore in order to retrieve, add, or edit patient data. By using any WAP-enabled devices, including PDAs, smart phones, and normal web browsers; any personnel with the required level of authority may have access to a given patient data.

II. MATERIALS AND METHODS

A. System features

In order to start developing the system, a consensus must be made with regards to the features to be made available. For the initial phase of the development of this system, it has been agreed that there are three main features to be included: a) to retrieve and display currently available patient data, b) to add new patient data, and c) to edit the previously added patient data. The latter consists of a number of actions, including the addition of medical prescription, images, and graphs for a selected patient. This decision was made primarily by observing the features of the medical administrative software currently utilized at the University
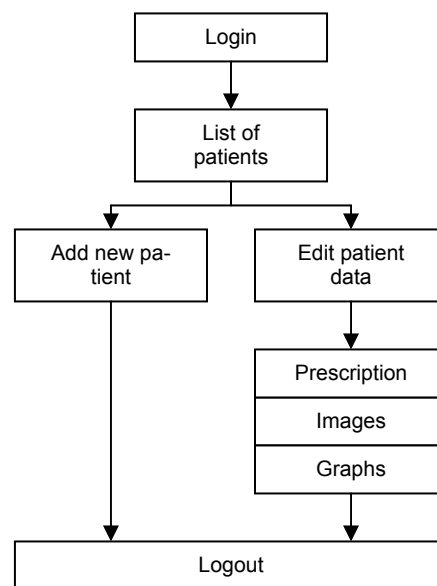

Fig. 1 Proposed usage flow pattern of the patient data management system

of Malaya Medical Centre, Kuala Lumpur, Malaysia, and the HIS component of Care2x (Elpidio Latorilla, GNU General Public License), an open source web-based software intended for use in the healthcare environment [1]. Fig. 1 shows the proposed usage flow pattern of the system.

B. Programming

The source code for the system was primarily written using the ASP .Net technology, chosen based on its scalability and ease of deployment for web-based applications. A set of WAP-enabled web pages will be developed, which are dynamically generated from a sample set of patient information retrieved from the database using a connection string written in industrial standard SQL commands [2].

C. Database

MySQL (MySQL AB, Sweden) was chosen as the database of choice, primarily due to its highly reliable multiple sessions of data retrieval. It also has effectively reduced the overall operational cost of developing and maintaining a

database for the system. Another important reason is that the system was meant to be open source, and MySQL is the most obvious choice, being the open source database with the most number of active installations in the world [3].

The sample data used for the system were arranged in a tabular format that should be compliant with the HL7 standard. Compliance to the protocol is important since it is envisioned that third party developers may want to develop additional modules, and the issue of compatibility may arise. HL7 enables dissimilar healthcare applications to exchange textual clinical and administrative data [4].

D. WAP development kit

Developing an application intended to be used in handheld devices requires a suitable development kit, and for this purpose the popular Openwave® Phone Simulator Version 7.0 (Openwave Systems Inc., Redwood City) was chosen. It contains Openwave Mobile Browser, which allows developers of mobile applications to observe the outcome of their programs at a local machine [5].

E. Other tools

Other development tools that were used in the development of this system include:

- .NET Framework 1.1
- Internet Explorer 6.0
- MySQL Server version 4.1.13
- ODBC Driver version 3.51
- MyODBC Driver
- Microsoft Data Access (MDAC) 2.6
- Microsoft Visual Studio.NET 2003
- Core Lab MySQL Developer Studio/MySQL Admistrator

Note that the system was developed on a PC running Windows XP Professional Service Pack 2 (SP2) and installed with Microsoft Internet Information Services (IIS) version 5.1.

Fig. 2 Openwave Phone Simulator display of a) the patient list, and b) personal information of a selected patient from the list

Fig. 3 Openwave Phone Simulator display of a) the login page, and b) the form to add new patient data

Fig. 4 Openwave Phone Simulator display of a) the form to add prescription data, b) the updated patient details

III. RESULTS

Three main features of the system have been developed, namely the display of currently available patient data, addition of new patient data, and editing of patient data.

A. Displaying current patient data

The list of patients currently residing in the database will be displayed once a user visited the site (Fig. 2a). A user can now view the selected personal details of a patient by clicking on the patient's name (Fig. 2b). Details of prescribed medication for the patient are also displayed, if available. Adding a new patient data requires the user to click on the 'Add' link located on top of the page. The list may be accessed later by clicking the 'List' link.

B. Adding new patient data

By clicking on the 'Add' link the user will be redirected to a login page (Fig. 3a) prior to being presented with the form to add new patient data (Fig. 3b). The system will post an error message if an unauthorized individual tried to access the system. Clicking the 'Submit' button completes the process of adding a new patient data.

C. Adding medical prescription data

Adding medical prescription data: There is an additional 'Prescribe' link on top of the page containing personal information of a selected patient. By clicking on this link the user will be redirected to a login page (Fig. 4a) prior to being presented with the form to add medical prescription data (Fig. 4b). Only doctors responsible for the patient will have the authority to access this form. Clicking the 'Prescribe' button completes the process of adding the prescription data. The newly added prescription data will be made available as part of the patient personal data.

DISCUSSION

The main purpose of determining the feasibility of developing a mobile patient data application has been achieved. Nevertheless, before the current system can even be considered for use in the healthcare environment, three main aspects must be satisfactorily addressed. Firstly, additional features and capabilities of the system must be in place, at the very least at par with those found in Care2x. DICOM-compliant medical image storing and viewing capabilities, similar to those found in all PACS applications, have to be a standard feature. Secondly, real usage simulations, employing real-world hospital working load, must be conducted in order to test the robustness and flexibility of the system. Finally, being a web-based application, the issue of data security must be dealt with effectively. This is especially so, since one is dealing with highly sensitive medical data. To fully cater for the above recommendations, the structure of the current system must be transformed, especially the incorporation of additional features.

CONCLUSIONS

The developed system showed that it is highly possible that a wireless patient data management system be completed using commonly available developer tools. The current system has achieved its main objectives of retrieving patient data, adding new demographical patient data, and adding basic medical prescription for a selected patient record. The programming was written using ASP .Net technology, and MySQL was chosen as the database. Compliance to HL7 will ensure that additional modules, if applicable, from other developers and vendors may be used in extending the capabilities of the system in the future. However, improvements must be made to the current system structure before it could be finally used in a real-life healthcare environment.

ABBREVIATIONS

ASP – Active Server Pages
DICOM – Digital Imaging and Communications in Medicine
HIS – Hospital Information Systems
HL7 – Health Level 7
PACS – Picture Archiving and Communication Systems
SQL – Structured Query Language
WAP – Wireless Applications Protocol

REFERENCES

1. Care2x – Integrated Healthcare Environment at http://www.care2x.org
2. W3Schools SQL Tutorial at http://www.w3schools.com/sql/
3. MySQL – The world's most popular open source database at http://www.mysql.com/
4. What is HL7? at http://www.hl7.org/about/
5. Openwave Phone Simulator at http://developer.openwave.com/dvl/tools_and_sdk/openwave_mobile_sdk/phone_simulator/

Address of the corresponding author:

Nahrizul Adib Kadri
Department of Biomedical Engineering
Faculty of Engineering
University of Malaya
50603 Kuala Lumpur
Malaysia
nahrizuladib@um.edu.my