

The Internet in Connecting Electronic Health Record Mobile Clients

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Abstract: *The European Center for Medical Informatics, Statistics and Epidemiology - Cardio (the EuroMISE Center - Cardio) was focused on new approaches of designing of electronic health record (EHR). In the first EHR pilot application - MULTImedia Distributed Record (MUDR) we include the possibility of mobile patient data accessing by physicians outside of their consulting rooms. By virtue of the defined communication interfaces based predominantly on HTTP, HTTPS, XML and WAP protocols, it is possible to use clients for various purposes like medical data entering and their visualization, statistical data processing or mobile data accessing. These clients may be connected over the Internet from anywhere in the World which enables easy sharing of patient data. In the MUDR we are using an extensible set of services at the application layer, which transforms the command-response based XML to documents conforming the HTML or WML language. In the full text we present a solution, where these utilities are mostly implemented as preprocessors in form of programs conforming to the "Common Gateway Interface" (CGI) or as HTTP Server modules. Using this facility, more application complexity can be moved to the second layer of the MUDR, which simplifies the user interfaces and enables to communicate with clients in form of web browsers, Pocket, Handheld or Tablet PCs, PDAs or mobile phones. Our solution, we are testing by using the Nokia 3330, Nokia Communicator, PSION and T-Mobile MDA devices as the MUDR Clients.*

Keywords: distributed electronic health record, mobile health data access

1. Introduction

The European Center for Medical Informatics, Statistics and Epidemiology – Cardio (the EuroMISE Center - Cardio) was focused on new approaches of designing of electronic health record (EHR). In the first EHR pilot application - MULTImedia Distributed Record (MUDR) [1] we include the possibility of mobile patient data access by physicians outside of their consulting rooms.

By virtue of the defined communication interfaces based predominantly on HTTP, HTTPS and XML protocols, it is possible to use clients for various purposes like medical data entering and their visualization, statistical data processing or mobile data accessing. These clients may be connected over the Internet from anywhere in the World which enables easy sharing of patient data.

2. Main Architecture of the MUDR EHR

Main inspiration for our work was the product of European project I4C/Triplec – the multimedia EHR ORCA [2]. Next inspiration was the document ENV13606 "Electronic healthcare record communication" of the CEN/TC251. The prime purpose of this multipart pre-standard is Electronic Healthcare Record communication, communication being defined as the act of imparting information. The first part describes a conceptual model of structure and content suitable for communicating the EHCR. It is a high level template, which provides a set of design decisions, which can be used by system vendors to develop specific implementations for their customers [3].

Based on previous experience, the modular structure of the MUDR system was defined. The two-layer architecture used in the "Open Record for Care" (ORCA) developed within

the I4C-TripleC project was extended to a three-layer architecture in the MUDR. The main architecture consists of data layer, application layer and user interface layer.

3. Using Thin Clients

The main MUDR system uses XML defined by MUDR XML Schema [4] for the communication between clients and the application layer. Because of the command-based character of the defined communication protocol, standard clients must have quite much business logic included.

To enable the usage of thin client we are using an extensible set of services at the application layer, which transforms the command-response based XML to documents conforming to the HTML or WML language. These utilities are mostly implemented as preprocessors in form of programs conforming to the "Common Gateway Interface" (CGI) or as HTTP Server modules.

Using this facility, more application complexity can be moved to the second layer of the MUDR, which simplifies the user interfaces and enables to communicate with clients in form of web browsers, Pocket, Handheld or Tablet PCs, PDAs or mobile phones.

Application layer services are mostly implemented using object-oriented technologies and programming languages. These services interact with the application layer using shared memory to transmit XML commands and responses. Physicians need often fast access to the health record, so speed is the crucial requirement on these services. Hence the C++ programming language is mostly chosen.

4. Mobile Devices

It is important to conform to special conditions of small mobile devices. Compared to personal computers we have to adapt to smaller and often just monochrome display, aggravated controlling possibilities, lower memory and computing power, slower data transfer etc. Taking note of these constraints we are preparing a solution, where the patient data will be pre-selected at the application layer using physician's specifications together with the semantic knowledge about the stored patient data. Using this technique just the selected relevant data will be transformed according to the needs of the mobile clients. The other attributes will be enabled on a special demand. Therefore the required amount of transferred data will be lowered which will lower the needed communication speed as well.

5. Limitations and Future Work

One of the first MUDR mobile modules we were developing was a special utility at the application layer, which transforms the MUDR application interface (MUDR API) to a special form of HTML. This HTML must conform to the limited possibilities of small web browsers used internal in mobile devices. Using the Nokia Communicator as the MUDR Client, whose browser supports neither tables nor frames, tested this portable and universal solution. As follows we found out, that information organized by this device is not well arranged enough to fit the physician's needs. Nowadays, there are new devices with extended capabilities. Our future development is focused on these advanced devices.

Our development of MUDR Mobile Data Access was divided into three different parts. MUDR-WM is a special module using WML developed for lowest possible requirements and security constraints. It will allow physicians to get general information about drugs, medical

guidelines, recommended values etc. in a brief form advisable to basic mobile clients such as mobile phones using WAP.

MUDR-JM module development focuses on new Java2ME technologies and uses Java for mobile devices as system environment.

Our newest research task is the .NET Compact module. We are starting to use the .NET Compact Framework to implement MUDR mobile clients on the Pocket PC and Smart Phone 2002 platform. Using the Windows XP Embedded and Windows CE .NET operating system we are trying to enable similar functions on mobile devices as on MUDR thick clients on PCs. We plan to use the Microsoft Visual Studio .NET extended with Smart Device Extensions. To increase the efficiency of our mobile access we are developing a special MUDR application layer extension, which will enable accessing MUDR using web services. Now, we are also testing the Microsoft Mobile Internet Toolkit, which extends the power of the Microsoft .NET Framework to a wide variety of mobile devices. The toolkit enables to build a mobile Web application generating HTML, compact HTML (cHTML), or Wireless Markup Language (WML), depending on the capabilities of the target device.

6. Conclusion

Usage and capabilities of EHR mobile data access depends mainly on the development in mobile communications but also on research and fast development of relevant support tools for physicians. We attempt to respect this fact by developing mobile modules, by research in field of telemedicine and mobile data access and by using new technologies and most supported and popular tools. The developed software is tested by physicians in cardiology ambulance in our institute, so the mobile EHR access becomes usual reality.

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References

- [1] Hanzlicek P., Development of Universal Electronic Health Record in Cardiology. *Proceedings of MIE 2002*. Amsterdam IOS Press, 2002. ISBN 1-58603-279-8, ISSN 0926-9630, pp. 356-360
- [2] Zvarova J., Hanzlicek P., Pribik V., Application of ORCA multimedia EPR in Czech hospitals. *Proceedings of 3rd European Conference on Electronic Healthcare Records*, Sevilla 1999, pp. 160-165
- [3] CEN/TC251, ENV 13606, parts 1-4
- [4] Spidlen J., MUDR XML Schema: <http://www.euromise.cz/MUDRAPI.xsd>

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