

Mobile Access to Patient Clinical Records and Related Medical Documentation

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Abstract. On-line access to patient clinical records from pocket and hand-held or tablet computers, will be an useful tool for health care professionals and a valuable complement to other medical applications if information delivery and access information systems are designed with handheld computers in mind. In this paper we present and discuss some partial results of two different research projects: SINAMED¹ and ISIS², both of them has as main goals the design of new text categorization and summarization algorithms applied to patient clinical records and associated medical information, and advanced, efficient user interfaces to mobile and on-line access to this results. Continued and new research is expected to improve additional handheld-based user interface design principles as well as guidelines for results organization and system performance and acceptance in a concrete public health institution.

1 Introduction

Although information overload is a common element for the whole society, perhaps it is in the biomedical domain, one where it is impacting with more relevance. In this domain, researchers and professionals in general, need tools oriented to provide facilities for accessing and visualizing the adequate information to their needs. Intelligent

¹ The research described in this pape, SINAMED, "Designing and Integrating Automatic Text Summarization and Categorization Techniques to Improve Information Access to Bilingual Information in the Biomedical Domain", is partially supported by the Spanish Ministry of Education and Science, as part of Programa de Tecnologías de la Información (Plan Nacional de I+D+I) – (FIT-350200-2005-16)

² The research described in this paper ISIS "Sistema Inteligente de Acceso Integrado a Información de Historial Clínico del Paciente y Documentación Médica Relacionada", has been partially supported by the Spanish Ministry of Industry as part of Programa PROFIT – Area de Tecnologías de la Sociedad de la Información – (TIN2005-08988-C02-01)

information access systems integrate, in an increasing way, text content analysis capabilities and mobility as relevant elements.

For the mobile information access to the clinical records and associated medical information [1], it is very important to have in account the limits in the processing power and physical constraints of the pocket or hand-held device, this characteristics limits the design possibilities of the system, requiring special consideration two aspects, user interface design and information contents, it is not enough to merely scale the desktop computer interface, normally a web explorer, to a smaller screen.

2 The Medical Domain

The medical information is voluminous, heterogeneous and of extreme complexity. One of the factors with a major repercussion in the heterogeneity of the medical contents is the source diversity. Each source (scientific papers, databases of summaries, structured or semi-structured databases, Web services or clinical records of patients) has several features. For example, the existence or not existence of an external structure for the document, the existence of free text together with structured data (tables with clinical results) or the length of the documents[9]. These differences in domain, structure and scale hinder the development of robust and independent systems that facilitate the access to this kind of content.

Considering, for instance, the scientific medical articles, there are about thousands of scientific journals in English language, and the problem grows if we consider other languages and other sources. Medline³, the most important and consulted bibliographical database in the biomedical domain, constitutes a main example. Medline contains more than 13 million references, with an increment between 1.500 and 3.500 references per day. This huge volume of articles makes the experts difficult to take advantage of the whole published and interested information.

The patient clinical record is defined as the set of documents (data, assessments and other type of information) that are generated throughout the assistance process of a patient. The system of clinical record sheets presents many drawbacks (unreadable information, chaos, absence of consistency, questionable availability, uncertain confidentiality guarantee, damage in the documents,) that could largely be corrected with the usage of electronic clinical records.

Some of the advantages of the electronic clinical record are: a better accessibility to the information, and an improvement in the confidentiality; data homogenization; prescription filled in an automatic way; overall view of the patient; coordination of medical treatments; gathering of the whole information of a patient. The combination of a scientific information system with the electronic clinical record would help the doctors to the medical decision making, to decrease the mistakes and the clinical variability and to increase the patient's safety.

³ <http://www.ncbi.nlm.nih.gov/entrez/query.fcgi>

In this context, the ISIS and SINAMED research projects have as an important task to develop tools for improvement the intelligent access to the medical information, having in mind the medical and the patient as end users. It is focused to provide advanced and more effective tools than the current ones for the search, localization, use, and understanding of different sources of medical information. Some interesting aspects are the integrated access to patient's clinical record and related health information. We intend that, both medical and patient, exploit the methods and techniques of text mining and intelligent analysis of document's content. Figure 1 shows a schema of the whole system components that are part of ISIS research project.

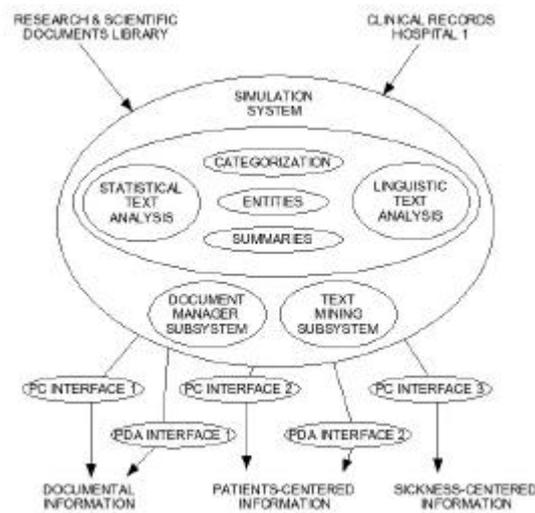


Fig. 1. Main Components of the ISIS research project

3 Mobile Client Design

In our projects, the medical information sources as for example clinical patient records and patient evolution notes are in electronic format, then it is possible to access it through a web browser [5], although the designed pages that are well view in a desktop PC are not easy viewed in a pocket PC or hand-held computer due to small size screen, this fact guide us to consider other alternatives and not only merely resize the pages to fit in the hand-held computer. At the other hand, the amount of memory and limited processing power of mobile devices involve other restrictions in the system

design, for example how to do an efficient transmission of information, performance monitoring, utilization of aggregate usage statistical information and the ability to facilitate precision through support of user-specific preferences (user profile).

3.1 System Architecture

From the system architecture point of view, three alternatives have been considered for search and retrieval the results. Briefly, they are: (a) develop client software for the PDA to access the data repository directly; (b) develop a proxy server as an intermediate website for PDAs, using templates to format html pages for small screens; (c) develop client software for the PDA to communicate with a proxy server that, in turn, communicates with repository via a servlet.

Each of them has advantages and disadvantages, in the first case the advantages may be the total control of the user interface but the main drawback of this approach is the PDA has to do whole processing, in the second case it is clear that the use of a web browser does not permit the total control on user interface and the size of html pages is too big for processing on PDA. The last alternative, that we choose, permits the total control of the user interface and the whole processing of queries is done for the server, the client on PDA only transmits to the server the data necessary for the query and wait for the results in order to be displayed on the PDA screen, only local data are stored on the mobile device. A schematic of the system is shown in Figure 2.

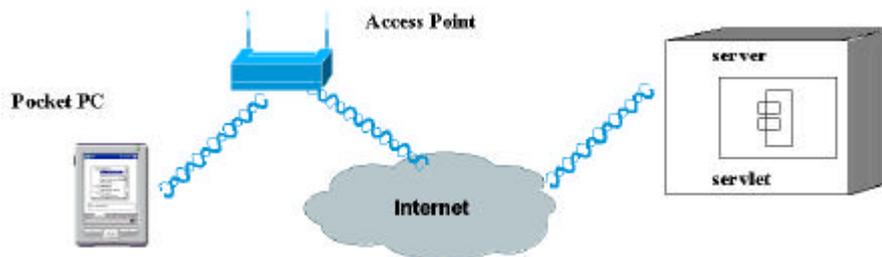


Fig. 2. Simplified System Architecture

The client in this design is not platform independent; it was designed for PDAs running the Windows Mobile operating system, and the client program is written in C# using the Microsoft Visual Studio development environment. It uses the PDA's wireless communication interface and the http protocol to communicate via the Internet with a servlet on the proxy server. The initial servlet implementation has been written in Java, running in a Tomcat servlet container on an Apache http server in a Linux environment.

3.2 Graphical User Interface

The graphical user interface running on the PDA is based on ideas presented in ePocrates [7], the popular drug database application for PDAs among healthcare professionals, and PubMed on Tap [8], an pocket PC application running on a PalmOS operating system for accessing MedLine, integrated with specific elements taken from intelligent information access systems exploiting text contents analysis, including text categorization and summarization [9,10].

Following these models, tabs organize functions and drop down lists are used where possible to save space. Although space is at a premium the small screen, readability trumps space utilization, so white space is used to separate distinct items on the screen. In the future we will consider the use of icons used in place of larger, text-identified buttons. Search limits are easily selected from the Profiles tab. Figure 3 show some screen of the pocket graphical user interface.



Fig. 3. Some screen showing different aspects of the application

The search screen permits the input of the search terms, the number of results that we want and the source of information, in a first stage it only contains patient clinical records and patient evolution notes, this information joining with the user profile information (third screen) is transmitted over wireless to the server for processing.

The second screen in Figure 3 shows results send back for the server, only a few data of the found documents are presented, the most important the number of clinical patient record and the date of them, matching this criteria with the user profile information, if the user wants more information this screen supports navigational paths for obtaining the whole document (pdf or word format).

The third screen of Figure 3 is showing the user profile information, in this case, the user can choose what kind of information wants, patient clinical records or patient

evolution notes, or in a futures some others sources of information, and to limit the search by date of publication.

4 Conclusions and Future Work

Initial implementation of the mobile access to patient clinical information must be validate with health care professionals feedback about the usability ands value of the application, some initial inputs received for a public healthcare institution shows a good acceptance, obviously next versions of our system will incorporate changes after these observations, although our immediate interest was focused on the graphical User interface design, future efforts will be directed to better ways to results organization as for example categorization of received information, including modification on the user interface design in order to display categories.

Other important aspect to be considered in the future is improvement of the software communication aspects of the system and then ensures the speed and reliability of retrieval of data. Areas of research include choice of parsers, efficient use of a database to store recent queries and citations, and load testing, also the problem of platform independence will be considered and the possibility of access to related medical information sources.

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