m-doc: mobile solution for hospitals

Darabi K
darabi@m-creations.com
Germany

Abstract: Access to patient information is critical in modern health care. Desktop computers are no longer the only mean for accessing digitally stored information. Personal Digital Assistants (PDAs) offer clinicians the ability to enter and manage critical information at the point of care. However, this information is only of value, if it can be merged with other clinical and administrative information in the hospital. We have developed a client/server architecture for clinical documentation which uses PDAs and a server to communicate bidirectionally with hospital information systems. Secure data transmission over a wireless network (Bluetooth or wireless LAN) provides immediate delivery of new or modi£ed information. Centralised update of shared information improves the clinical work¤ow while reducing the administration overhead of such a distributed system.

Keywords: Handheld, personal digital assistant (PDA), medical record, HIS, wireless LAN, Bluetooth

1 Introduction

To provide the best patient care, a physician in a hospital has to gather and evaluate a great amount of data from different sources. Laboratory £ndings, results of examinations, reports of previous treatments are some of these sources of information. Only by use of information technology, this vast amount of information can be handled ef£ciently.

With desktop computers however, the information is not present at the place, where it is needed: at the point of care. Moreover, the desktop approach limits the mobility of the physician whose work is highly mobile and is performed at different places in a hospital (operating room, outpatient department, ¤oor etc.). To maintain mobility, computers could be installed in several places, but in times of cost reduction in health care, this approach does not seem to be feasible.

With mobile computing devices being more widely used everywhere, their use by medical workers is increasing in parallel. Handhelds are being used in such different areas as:

- patient information [BKB01]
- clinical trials [KGM00, TJC00]
- charge capture [Gar01, Nel99, Pin98]

- signal processing [SYS01, KM00]

However, only few systems aim at integrating handheld computers into the IT infrastructure of a hospital. Our solution m-doc uses personal digital assistants (PDAs) and middleware technology to retrieve patient related information from the Hospital Information System, deliver it to PDAs of the medical workers and vice versa. Data transmission is performed preferably over a wireless network, either Bluetooth or wireless LAN. For the case of network failures, of¤ine storage and intermitted synchronization of data is also possible.

2 m-doc client software for handheld computers

The greatest challenge in putting PDAs to work is to make the most ef£cient use of the limited resources of the device:

- limited screen size
- small amount of memory
- low computing power

m-doc allows for easy documentation of medical procedures and diagnoses according to standards, such as ICD 10 (International Classi£cation of Diseases) or ICPM (International Classi£cation of Procedures in Medicine) by performing textual searches and picking the appropriate entries from the result list. Patient history, allergies, medication, lab results and many other categories of documents are easily accessed through a uni£ed, easy-to-use interface. The software has been implemented for PalmOS (¿ 3.5) and WindowsCE (2.11, 3.0, 2002) to give the end user the choice of which system to use.

But, besides the user interface, other requirements have to be met by the handheld software:

- user authentication and authorisation
- hybrid storage mode: of¤ine storage of data to allow work without an online network connection
- encryption of locally-stored patient personal data for security
- encrypted transmission of sensitive data to m-doc server
- on-the-air update of software for centralised administration

Most of these requirements are implemented on top of functionality offered by m-doc server, which is essentially a middleware with modules for communication with different target systems, including the handheld devices.

3 m-doc Server: hub for patient information

By introducing mobile computing into the hospital, we do not intend to create yet another clinical data storage which works in isolation from the hospital's main information systems. We believe that a central hospital information system (HIS) is crucial to the IT needs of modern health care. Therefore, m-doc enterprise is meant to be a system to bridge the gap between the HIS and the patient's bedside.

m-doc server is a middleware available for many hardware platforms which ful£ls the following tasks:

- synchronising new or updated data items between the handhelds, while minimising the network load
- central administration and customisation of m-doc clients' software and contents
- interfacing to the HIS for synchronising new or updated data items
- Reformatting/remapping data from the HIS to document formats suitable for presentation through m-doc client with its limited resources
- routing of messages to appropriate recipients, including change of electronic media: fax-/email-gateway

To be able to interconnect to different HIS, we use a pluggable connector/translator framework, which makes it possible to adapt to the peculiarities of certain HIS such as SAP R/3. However, we try to use standards such as HL7 for this purpose, wherever possible.

With graphical customisation tools, some power users among the physicians are able to adapt the contents and presentation of the system to the needs of their department. With this concept, the system can be highly specialised while maintaining a common documentation base line for different departments. Central administration and update of the client software reduces the time and effort spent on PDA administration to a minimum.

The email and fax connectors built into the server are a key feature to improve work¤ow in the hospital. The physician can tag data items to be sent as email or fax messages to speci£ed recipients.

4 Conclusion

With m-doc, we have shown that mobile medical documentation is possible with today's technical means. The positive user response and the higher documentation quality justify the use of handhelds. However, we believe that a tight integration into the IT infrastructure of the hospital is mandatory for successful use of such a system.

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