Mobile Voice EPA

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Abstract: Comparat is developing the so-called Mobile Voice EPA (MVEPA), a mobile voice-controlled electronic patient record. The product has certain special features which will be described in detail in the following.

1 Mobile Voice EPA

By enabling the dictation of services, diagnoses, results, and treatments on the spot into a small handheld device and carrying out its further processing, the Mobile Voice EPA offers a large savings potential in hospitals. The files thus created are immediately saved to the server and automatically transcribed.

This article presents the product Mobile Voice EPA, a mobile voice controlled electronic patient record, which is currently still in development.

Speech recording is the fastest and most effective way of documenting patient data. For years, doctors have been using dictating machines for that purpose. However, up to now, there was no way of integrating the audio data into everyday hospital procedures and into the electronic patient records. The access to patient data is restricted to PC applications. The audio tapes have to be typed in by doctors or secretaries and there is no connection between these tapes and the patient record. Speech recognition is often restricted to certain departments and a functioning connection to the Hospital Information System is rare.

The MVEPA's main concern is clinical documentation. It is to be developed in several well-defined stages. The initial version focuses on the possibility of an overall service documentation, which enables doctors to charge for their services according to DRG (Diagnosis Related Groups) guidelines. Usually, the introduction of DRG leads to a change in the accounting method in favour of a service-orientated system. To achieve this, doctors and qualified employees must document their services as thoroughly as possible, in order to enable the hospital to operate cost effectively. With the help of mobile voice-controlled recording, it will be possible to increase the number of actually recorded services significantly.

Our goal is to support universal mobile communication in hospitals and thereby to facilitate workflow. The use of mobile devices should not be restricted to doctors alone, but rather extended to all qualified employees who, according to recent studies, would save

Figure 1: Schema of the Mobile Voice EPA

much of their precious time by using such a device. In the beginning, mostly Compaq's iPAQs will be used. Later, devices integrated in watches (e.g. the IBM Watch Pad) or products specially produced for the medical sector could be added.

Embedded Linux is used as an operating system with all mobile devices. The basic version stems from `www.handhelds.org`. Linux is also used for the server, the client PCs support Linux as well as MS-Windows.

2 Communication

Communication with a mobile device based on Linux takes place directly via the network. Using wireless LAN, the mobile device is simply an extra client. As other communication standards like GPRS, GSM, HSCSD, UMTS and Bluetooth are also supported and because there are different rules for each method of communication, the mobile client is regarded as "exotic" within the network. Therefore a session identification (based on SIP/RFC 2543) is used which enables the interruption of the communication session on the basis of TCP/IP

3 Security

Communication via TCP/IP based on Linux is simple and extremely versatile. The Wireless LAN connection is made absolutely bug-proof by IPSEC/VPN (Internet Protocol Security/Virtual Private Network). However, the potential danger of a hacker logging into the network via Wireless LAN is quite negligible, when compared to the probability of somebody stealing or simply using a notebook or PDA left lying around somewhere. Often unauthorized users literally stumble onto confidential data.

That's why no confidential data is stored on the MVEPA. It is an online device, which requires the user to authenticate himself, before being able to access the server. In the testing stage, this is accomplished by a spoken pass phrase (e.g. "My name is Manfred Rebentisch") which is analysed by the server. There are other methods that could be used if the identification by speech should prove impractical. Every PDA is assigned to a certain user. However, if a different user identifies himself, a new user assignement is created. Thus, each device can be used by different people, without revealing personal data and can be quickly and easily replaced.

Nonetheless, the last user, who authenticated himself, is held responsible for the whereabouts of the device.

4 Voice online - speech recording

The mobile devices are designed for online use. That means, ideally, there would be a permanent connection to the network. This way, the PDAs wouldn't have to be put into docking stations in order to synchronize data with the server. Voice online signifies that, while speech data is being recorded, it is simultaneously compressed and sent to the server. Users can move forward and backward in the recording to replay certain passages, make corrections or even delete passages. The recording is clear and high-quality, despite compression.

Speech transcription starts either when a recording session is explicitly ended or after a fixed period of time, e.g. 10 minutes. The exact time of translation is determined by a separate service on the server within the workflow. This acts as a precaution against overload.

At this point, the sound document has already been added to the patient record and can be retrieved from a PC client as well. At the same time, all audio documents are also assigned to the respective user. This enables him/her to administrate the files properly according to their purpose.

Offline use of the MVEPA is restricted to certain defined tasks - for example, if areas with no reception have to be bridged or online time has to be optimised during the use of GMS. The PDA-Application can also be operated by speech in the offline mode, because a separate system is used to enable speech operation. Speech recording can also take place offline, as long as no direct reaction from the server is required.

5 Voice Online - Speech control

Speech control of the device is completely separate from speech processing. There is a configurable amount of keywords that are recognized directly by the device, regardless of the speaker. The mobile client's software is controlled by means of these keywords. For example, by speaking the word "menu", the menu opens. Thus, the software can largely be operated without a pen. Nevertheless, the user interface is configured in a way that also allows general operation by pen, if requested.

Users in a hospital make great demands on the user interface: screen layouts must be graphic oriented instead of text oriented, they must be in colour, clearly structured and adjustable to special demands.

The PDAs that are used have a screen dimension of 320×240 pixels and can depict at least 4096 colours. The screen layouts can be changed by means of a GUI-XML description.

6 Standards: XML, HL-7, CDA and more

Communication in the MVEPA system is performed transparently in XML, HL-7 and CDA formats. The respective services are addressed via defined port addresses. A communication service on the server receives the connections from all clients and identifies and assigns them to the appropriate services.

By working with generally recognized standards, we give our partners and competitors the possibility to integrate their own applications into our system, and at the same time our customers achieve long term investment security.

XML and HL-7 lead directly to CDA, the so-called Clinic Document Architecture, which is based on XML. This standard was presented to the ANSI Committee by the HL-7 organisation and was declared an ANSI standard in November 2000.

MVEPA consistently relies on internationally recognized standards. Open interfaces are desirable, because they provide hospitals with independence and freedom of decision-making, where software architecture is concerned.

7 Services

The services of our system are able to validate and transform XML and HL-7 messages, as well as receive and create CDA documents. The communication protocol allows for several servers to share the processing load. If one server is overloaded, processing is taken over by another machine. Load sharing can be administrated transparently and flexibly. This sort of architecture is necessary, because large sound and image documents are sent across the network and, in addition, the sound documents have to be translated on a language server, which is time costly. Due to this automatic load sharing, the MVEPA has

excellent prospects to be in the lead concerning actual performance, in comparison with other solutions.

The complete business and organisational logic is implemented on the server. Several services work hand in hand. Besides Business Objects, we use Medical Objects which can easily communicate via TCP/IP by XML and HL-7. A workflow server controls the data traffic, and a status server is responsible for the restart of an application at the point of the last interruption. The SQL machine is responsible for traffic to and from the SQL database, and an archive service communicates with the archive system. Speech recognition, user authentication and OPS encryption are provided by separate services.

8 Software Techniques

In developing a completely new system, a team has the freedom to create an optimal application with the best tools available, without having to take into consideration inherited problems. C++ is used as the programming language, the creation of the user interfaces on PC and PDA is achieved by the Qt library and Trolltech.

9 Prospects

A first version of the product will be presented at Medica 2002. Practice reports from the pilot project are expected by the end of 2002

10 Abbreviations

CDA Clinical Document Architecture (`http://www.hl7.org`, `http://www.sciphox.de`)

DRG Diagnose Related Groups

GPRS General Packet Radio Service

GSM Global System for Mobile Communications

HL-7 Health-Level-7 (`http://www.hl7.org`, `http://www.hl7.de`)

HSCSD High Speed Circuit Switched Data

ICD International classification of diseases (`http://www.dimdi.de`)

IPSEC Internet Protocol Security

OPS Operationenschlüssel nach Paragraph 301 Sozialgesetzbuch (`http://www.dimdi.de`). Specific German health care expression

PDA	Personal Digital Assistent
Qt	Trolltech's C++ Library (`http://www.trolltech.com`)
SQL	Structured Query Language (`http://www.sql.org`)
TCP/IP	Transmission Control Protocol over Internet Protocol (`http://www.ietf.org/rfc/rfc1180.txt`)
UMTS	Universal Mobile Telecommunications Systems
VPN	Virtual Private Network
XML	Extensible Markup Language (`http://www.xml.org`)