

Country-wide, Network Based Data Acquisition System for Newborn Hearing Screening

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wielka orkiestra
świątecznej
pomocy

The presented data acquisition system has been prepared for the Universal Newborn Hearing Screening Program (medical supervisor The Children's Memorial Health Institute) organized and financed by the **Great Orchestra of Christmas Charity Foundation** in Poland

The concept of the system

The first level terminals allow to enter the personal and medical data of the newborn into the database. The data include results of the hearing test performed with the Eroscan diagnostic device. The data are stored in the database, however in emergency cases it is possible to store small amount of the data on the terminal's FLASH disk. The data can be downloaded back to the terminal to be modified or supplemented.

The second and third level terminals allow to download the patient's data from the database and to supplement them with the records describing the present visit or hospitalization. The central database allows to keep track of diagnosis and therapy of each child, and to generate statistical reports.

The terminals

- To assure low costs and high reliability, FLASH disk equipped terminals (SCCOVERY manufactured by Fujitsu Siemens) have been chosen
- The Linux operating system (eLux distribution) is used in terminals for both high stability and low cost
- To establish connection with database server, GPRS modems (manufactured by Wavecom) have been used
- The 1st level terminals additionally equipped with Eroscan diagnostic device (manufactured by Maico, distributed by Oticon)

The server

- The server Fujitsu Siemens GP7000F model 400 with 2 CPUs
- Operating system: SunOS 5.8 (Solaris 8.0)
- The database system based on the PostgreSQL database engine

The application software

The application software for terminals has been written in Java, with some supplements written in pure C language. Such solution assures:

- costs minimization - Java (both compiler and runtime libraries) is free
- easy application development due to advanced features of Java language
- operating system independence (it is even possible to run the application software on the MS Windows platform).

Open standards, open source tools

To facilitate further upgrades and minimize costs system widely uses open standards and free and open source software:

- Free Java language and Swing library with open source extensions:
 - Cryptix32 - cryptographic package
 - PureTLS - SSL implementation
- Free open source Linux operating system
- Free open source PostgreSQL database engine
- Zlib library for data compression

GPRS network

Because of the country-wide nature of the system it was essential to assure the low cost permanent links between the server and the terminals. The GPRS network offers following advantages:

- low cost of installation
- permanent connections availability - generally users are charged for the amount of transferred data

Maintenance of the system

To facilitate maintenance of the system a special mechanism for remote upgrade of the terminal's application software is provided.

- Version numbers allow for fast and cheap checking whether the upgrade is necessary
- The upgraded software is transferred in a secure way - it is both signed and encrypted
- The cryptographic signature protects the software package against damage or malicious manipulation
- The encryption protects software against stealing by unauthorized persons

Data transfer protocol

To minimize costs it was essential to keep the amount of data transferred between the terminals and the server as small as possible.

- The client-server architecture with "intelligent client" allows to send only the data, without the formatting information
- Only the modified data are sent by the terminal
- The transferred data are compressed using the Zlib library

Data security

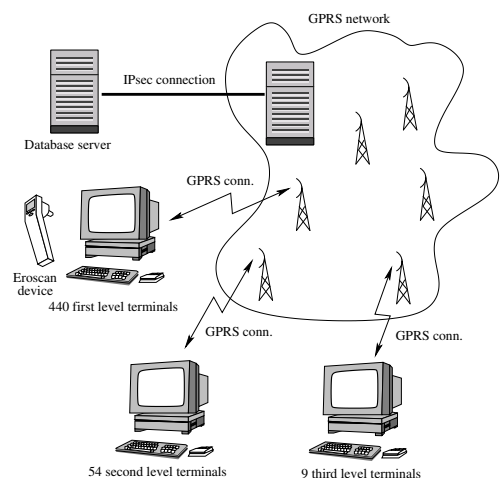
In the medical systems like this one it is essential to provide security mechanisms to protect medical and personal data against stealing or manipulation. In this system data are double protected:

- The connection between terminals and server are linked through the secure networks (GPRS-APN and IPsec protected link).
- The data transmitted between terminals and server are additionally protected with the SSL algorithm.

Resume

The presented system is currently working and has proven to be an efficient tool for acquisition and processing of the biomedical data. The solutions used in the system may be used to build other similar IT systems for health care.

Structure of the system



The terminal



The server



Terminal application

Edycja danych dziecka	
Kod urodzenia	aaa
Imię matki	Anna
Nazwisko matki	Kowalska
Płeć dziecka	K
Imię dziecka	Karla
Nazwisko dziecka	Kowalska
Data ur. dziecka	2002-11-03
Nr ks. gł. matki	
Nr ks. gł. dziecka	1265

Badanie przesłowe	
Dane adresowe	Lekarz POZ
Oddz. noworodkowy	Inny oddział
Wykonano badanie	2002-10-02
Data badania	En
Imię badającego	Gracz
Nazwisko badającego	
Pomiar lewy	
Wynik lewy	K
Pomiar prawy	
Wynik prawy	K

Postępowanie terapeutyczne	
Dane adresowe	Lekarz POZ
Oddz. noworodkowy	Inny oddział
Wykonano badanie	2002-10-02
Data badania	En
Imię badającego	Gracz
Nazwisko badającego	
Pomiar lewy	
Wynik lewy	K
Pomiar prawy	
Wynik prawy	K