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Ambulance Acquisition and Teletransmission System

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Abstract. Telemedicine has been defined as "...the use of electronic information and communications technologies to provide and support health care when distance separates the participants..." This paper presents an idea of a project based on telemedicine concept that can improve in a considerable way the ambulance intervention process. The main idea is to transmit data about the patient situation (from the moment when the patient is taken into ambulance till one arrives to the medical clinic) to a central level, to a dispatcher. The purpose of the data transmission to the dispatcher level is to make possible conducting ambulances to the closest and the most qualified medical clinic and also, to offer the possibility of implementing teleassistance.

Key words: telemedicine, monitoring, teleassistance, teletransmission

1. INTRODUCTION

Telemedicine applications are ensembles of services that permit images and medical data transmissions between medical centres in order to confirm or verify a certain diagnosis. The advantages of using telemedicine are remarkable: improved quality and quantity of medical information, medical assistance given to the patients situated far away from medical structures, unified data collected from clinical medium and pre-clinical medium, limited medical assistance costs.

The acquisition and teletransmission system as regards pre-clinical assistance permits the analysis (in real time) of patients state and gives fast decisions that are so important in an emergency. Consequently, the time interval between the illness symptoms appearance and the medical assistance tuning is considerably reduced.

Monitoring of medical emergencies is a very important domain of telemedicine. As often as not, in these cases, an immediate intervention is necessary. Because of that, fast complex data transmission (electrocardiogram transmission for example) is essential.

The process could be described as follow: the patient calls ambulance service; the dispatcher obtains information as accident location and a short description of what has happened and sends the convenient ambulance to the accident location. The ambulance team has access to the data introduced by dispatcher. After arriving at the respective location, the most important data are transmitted to the central level in order to the most suitable medical clinic could be announced about the patient state. During the patient transport, the local level (ambulance) and the central level (dispatcher)

communicate in real time. The central level is connected with more centres permitting the access of specialists in real time to the data. Therefore, specialists can guide the ambulance team in the treatment process.

2. OVERVIEW

The project makes possible realization of the following objectives:

- Creating of telemedicine centre that will represent the dispatcher of the ambulances network; the dispatcher centre (central level) centralizes all data received/sent from/to ambulance (local level)
- Data, images and sounds teletransmission in order to make possible the teleassistance
- Ambulances to be directed to the closest and the most qualified medical clinic
- Improving quality and quantity of medical information
- Limiting medical assistance costs
- Creating the possibility for the ambulance team to consult specialists during the patient transport

One has to be considered the following aspects in order to obtain a viable solution for the project:

- Data acquisition, transmission and interpretation
- Data security
- Network logical structure
- Performant systems and equipment
- Communication speed
- Data compression
- International standards
- The possibility of using ambulances equipment and central level (dispatcher) resources

3. PRESENTATION

Architecture of the monitoring and teletransmission system is structured on two levels, representing an open system. The local level, placed on ambulance, contains data processing functions and transmission functions to the central level. The central level (dispatcher), located to a medical clinic, is connected with other medical centres and contains data analysing functions. At this level, decisions are taken and sent to the local level that has solicited assistance. The connections to the other medical centres permit responses from the specialists to the problems posed by the intervention team.

At the local level, the system contains acquisition equipment, acquisition interface, a control process unit and communication inteface. At the central level, there are a control process unit that receives the patient data from the local level, stores and manipulates the data and assures communication with the other medical centers (using Internet or Intranet) and comunication interface to the local center. All patients data stored at the central level are confidential.

Considerring the real time system's requirements, data volum transffered between the two levels, the communication serial chanel will be endowed with two high speed modems with radio or GSM transmission.

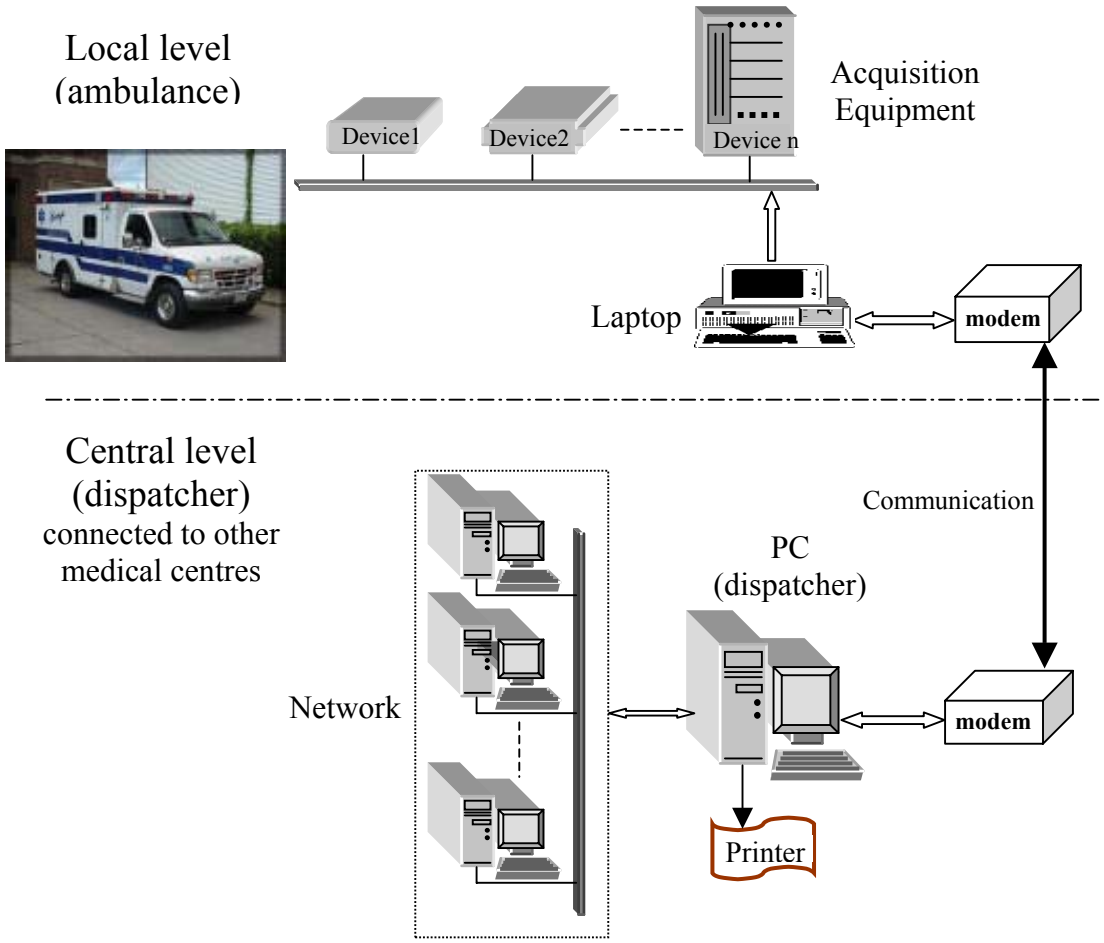


Fig. 1 Telematic system configuration

The application at the local level is an acquisition and teletransmission program. The modules that will be included in the application are:

- The main module
- Data acquisition modules:
  - The analogue – digital converssion and electric signals processing module for ECG, EEG
  - The analogue – digital converssion and sound processing module for cardiac and pulmonary listener
  - The analogue – digital converssion and image processing module for portable ecograph
- Interface module for communication with databases located to the central level (server)
- Data criptography module for data protection
- Data configuration module
- Module for teleassistance requests

At the central level, the global relational database is stored. The modules that will be included in the application are:

- The main module

- Module for database manipulation:
  - Module for database administration
  - Module for inserting, modifying and deleting in/from database
  - Interogation module
- Module for communication with the other medical centres in order to make possible the communication between ambulance team and the specialists who could offer teleassistance
- Module for communication with the local level
- Module for data vizualisation (reports, statistical results)
- Module for answering to the local level requests

4. SPECIFICATION

Data (database) at the local level is not defined in a standard format. It includes data received from acquisition equipment located to the local level distributed in codified messages such as they could fit easily in the global database on the central level. One has to be verified if transmitted data are corect, if the data transmitted from the local level are identical with the data received by the central level. Considerring this problem, the transmitted messages include data about the patient but also, they include a control amount computed by the control processing unit from the local level. This amount is recomputed at the central level and compared with the initial one. The application at a local level could be implemented in LabWindows CVI.

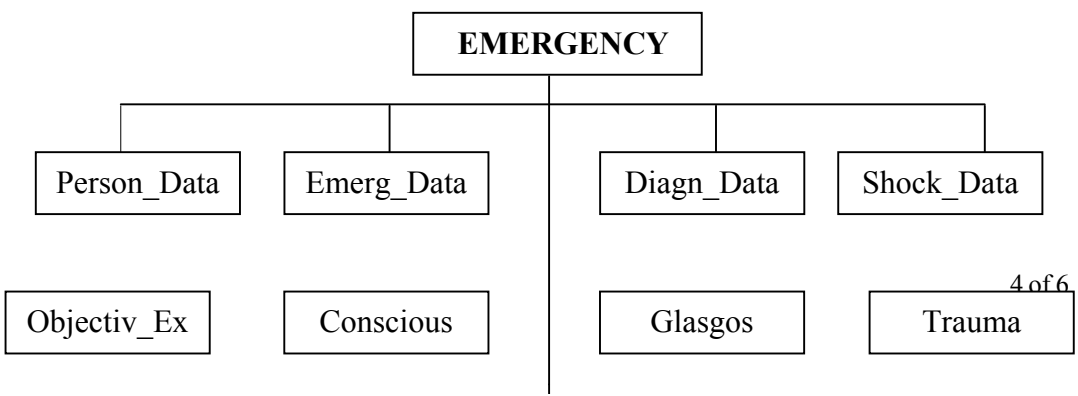
The global database at the central level will be implemented and manipulated in SQL Server. The advantages of chosing SQL Server are: its facility and scalability, easy to use, high data control, low costs (multiserver features), event oriented jobs execution, alertness, integrated security.

SQL is the standard language used for data manipulation and interrogation within relational databases. Using SQL one could easily make the following:

- modifying database structure
- changing the configuration values for the system security
- interrogating the database in order to obtain cerain information
- adding user rights within the database (or certain tables)
- updating the database information.

One has to be considered the following technical issues:

- the fidelity of the image captions and their transmission in real time to the central level
- the adaptation of the digital information from acquisition equipment to a standard compatible format for communication; one has to develop software solution or hardware/software solutions for data conversion
- the high speed of data transmission in order to preserve data integrity between the two levels



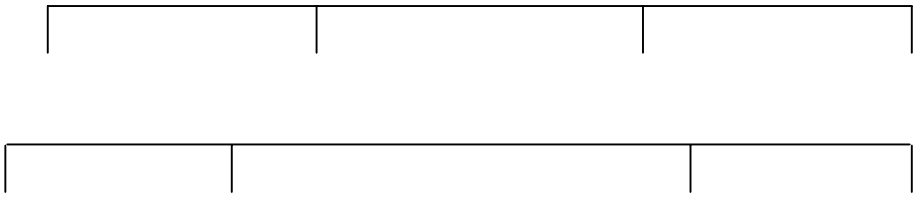


Fig. 2 The Main Normalized Tables within the Global Database Diagram

As one has specified, some of data, as images and sounds, have to be transmitted in real time. A possible solution for sounds and images transmission could be Microsoft® Windows Media™ Technologies that provides a set of components and features for delivering audio and video (digital media) over a computer network, like the Internet or a corporate intranet. These technologies are primarily focused on the delivery of digital media using a technique called streaming.

The clients (the other medical centres) that are connected to the server located at the central level (dispatcher) need to have access to sounds and images transmited in real time from the ambulance. In order to provide this service, the computer located at a central level (dispatcher), running Microsoft Internet Information Services (IIS) on Microsoft Windows 2000 Server could be configured as a Web server for distributing Web pages, images, and other files. The server can also run Windows Media Services for delivering streaming media (streaming - a method of digital media delivery in which audio and video content is delivered to users, but files are not copied).

The Windows Media file format is optimized for streaming, but the files can be downloaded as well. The best way to stream Windows Media files is by hosting them on a server running Windows Media Services. After encoding the digital media to a Windows Media file, the file is hosted by copying or publishing the file to a location on the server. This location is called a publishing point. When a request is received from a client, Windows Media Services accesses the digital media from this publishing point. Then, assuming the server computer has a high-speed connection to an ISP and is properly registered on the Internet, users can play the digital media.

A client can play Windows Media files by streaming them from a Windows Media server. This is done by entering the URL (Uniform Resource Locator) of the digital media in the player, but typically, the digital media is accessed from a link on a Web page. When the user clicks the link, Windows Media Player opens and initiates a connection to the file on the server. After the connection is established, the digital media starts to play.

For streaming to work, the bit rate of the media must be lower than the bandwidth of the network. It‘s possible that one to stream a very large file, even one that has an undetermined size (such as a live stream), as long as the bit rate is within a client's bandwidth.

The bit rate of high-resolution, full-frame, broadcast video is about 128 megabits per second (Mbps). To download one second of broadcast video over a 28.8 kilobit per second (Kbps) connection using a modem would take one hour and 14 minutes. Streaming this type of video would be impossible over a network. Windows Media

Technologies handles this problem by using *compression*. Compression lowers the bit rate while maintaining the best possible quality.

It would be practical for the clients (specialists form the other medical centres) to start viewing an image or hearing sounds as they open the Web page. This issue can be solved by adding an embedded Windows Media Player control and plug-in to a Web page, and configuring the Player to initiate a stream as soon as the page is opened. When the user opens the Web page, the embedded Player opens and plays the stream.

Windows Media Services and the Windows Media SDK provide also the features and tools for creating sites that require an authorization check before a user can view content. Therefore, the security problem can be solved.

5. CONCLUSIONS

The project is situated within telemedicine, scientific domain that integrates the medical concept in general concept of IT using the latest technologies from telecommunication and computing science. Using technologies that permit communication in real time and relational database servers that offer an easy way to manipulate data, there will be remarkable improvements in the medical domain and especially in the medical emergency services. The advantages of teleconsulting, teleassistance, real time data transmission and databases manipulation make possible the following:

- Reducing dead times
- “Just in time” intervention
- Medical emergency services improvement
- The high quality of medical services

6. REFERENCES

[1] Diethorn M.L., Diethrich T.R., Harrison Gillman P., Headley J.M., Leeper B., Lameier D., et al., (1993), Monitoring critical functions. Advanced Skills. Springhouse, Pennsylvania.

[2] Drugan T., Tigan S., Achimas A., (1999), Serviciile de transmisie video in retele Microsoft Windows NT si telemedicina. Editura SRIMA Colectia <INFOMED>. Cluj-Napoca.

[3] Rusca N., Iordanescu Gh., Duta L., Rusca C., Cosma C., Chitu D., et al., (1999), Hiperspital – Telemedicine internet. Informational Network. In extenso: MEDINFO ’98 National Conference on Medical Informatics, Arad.