Telecenters Network for Medical Services – TELMES

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Cuvinte cheie. *Telemedicina, Telecentru medical, telemonitorizare, bază de date medicală.*

Rezumat. *Materialul prezintă un model pentru o rețea pilot de telecentre medicale, realizată pe baza unei platforme multimedia, în vederea implementării unui set de teleserevcii medicale complexe. Scopul principal este acela de a oferi unei largi categorii de medici, şi în mod special medicilor generalişti din zonele rurale, un instrument auxiliar în activitatea acestora. Acest sistem de telemedicină include şi capabilitatea de a achiziționa, distant, o serie de înregistrări medicale ce sunt arhivate într-o bază de date medicale realizată în cadrul rețelei.*

Key words. *Telemedicine, Medical telecenter, telemonitoring, medical database.*

Abstract. *This paper presents a pilot model for a regional medical telecenters network, based on scalable multimedia platform, which should allow to implement some complex medical teleservices, in order to enhance the opportunities for medical care targeted to a large category of patients, especially for those that are in the responsibility of General Practitioners and for those in remote or rural areas. This telemedicine system includes, also, a capability for transmission and acquisition of medical records and remotely updating of the medical regional database developed within the network.*

1. Introduction

In Romania, the diversification of telecommunication networks and advances in communications technologies, including the Internet, has considerable potential as a medium for telemedicine applications that is the use of telecommunications technology for medical diagnostic, monitoring, and therapeutic purposes where distance and/or time separates the patient and health care provider. In this context, National Communication Research Institute – INSCC, together with four romanian partners, develops a Romanian telemedicine project, *Multimedia platform for Complex medical teleservices implementation* – TELMES. The main propose of this project is to implement a scalable medical telecenters network, based on new ITC technologies that are available in Romania.

This paper presents a pilot model for a regional medical telecenters network, based on scalable multimedia platform, which should allow to implement some complex medical teleservices, in order to enhance the opportunities for medical care targeted to a large category of patients, especially for those that are in the responsibility of General Practitioners and for those in remote or rural areas.

This telemedicine system includes, also, a capability for transmission and acquisition of medical records and remotely updating of the medical regional database developed within the network.

Therefore, the regional telecenters will be a support for the developing of a regional medical data base, that should serve for a complex range of

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teleservices such as teleconsulting, telediagnosis, telemonitoring and it also should be a center for continuous training tasks, by tele-learning for medical personal or for the patients' informing/educating.

2. Regional Medical Telecenter - Model

The regional medical telecenter – RMTc, *fig. 1,* is a structure having all needed logistics, furniture, IT systems, telecommunications devices, made up at a region level, and designed for medical teleservices implementing and exploiting.

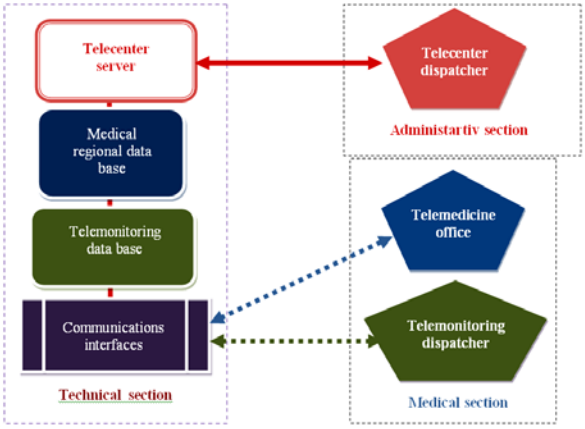

Fig. 1. Medical Telecenter structure.

The **RMTc** should enable for transmission of data, text, fixed images, real time images, sounds separately or simultaneously with the images, depending on the concrete medical applications.

The **RMTc** have three mainly sections:

⇒ Technical section;

⇒ Medical section;

⇒ Administrative section.

a) Technical section

The role of ***Technical sections*** is to:

- Hosting a local server to assure the users access to the network;
- Hosting the medical regional database;
- Hosting software applications used for telemedical services;
- Hosting software applications used for information/training services;
- Supporting the conditions to run the medical continuous remote training tasks, at national level;
- Enabling the integrity and the safety for the data that are processed in the network, in order to maintain the patients privacy;
- Ensures the connectivity with other regional telecenters, within the TELMES network.

The technical section includes two type of medical data bases: **Regional data base – RDB,** and **Telemonitoring data base – TmDB.**

1) **Regional data base – RDB,** contain all patients and doctors that resides inside that region. **RDB** use standard SQL for managing data. Because one of the main system architecture is to define a database independent layer we are able to interact with different database systems that support standard SQL language. Current implementation supports MySQL, Posgress, MS SQL database systems.

RDB contains the following main information categories:

✓ **Doctors related data.**

Regional Medical Telecenter gathers family doctors and specialists that belong to the local medical institutions, and the database will define and manage the following main informations:

- Medical institutes dates that contains general information and services provided;
- Assurance institutes dates that manages assurances types and sources that interacts with hospitals;

- Family doctors information like contact dates, medical identification dates, relationships with assurance and medical institutes;
- Specialists that belongs to a medical institution or to the regional Telecenter.

✓ **Patients related data**.

Each patient will be registered in the regional database according to their home address. The main structures Handled contain:

- **Identification date of the patient**
  - o Name and surname;
  - o CNP;
  - o Address;
  - o Phone , mobile phone;
  - o Profession and job;
  - o If is a insured person.
- **Medical historical of the patient**
  - o Medical historical of the family
  - o Habits
  - o Immunizing Historical
  - o Allergies
  - o Surgery Historical
  - o Obstetrics historical
  - o Medical treatment
- **Medical Consultations**
  - o Symptoms
  - o Physic examination (body temperature , pulse, blood pressure, respiration) as well as the investigation of various intern organs especially those which requires medical attention
  - o Diagnosis – this section includes the list of diagnosis (principals, secondary)
  - o establish by the physician after the investigation performed
  - o Treatment – include the list of recommended medicaments (name, quantity, duration etc) in pursuance of diagnosis establishment
- **Laboratory Analyses**
  - o This section includes the list of all analyses which were effected (blood, urine, secretions) with the emphasizing of the resulting values in the normal limits
- **Other medical information**
  - o Many other information may be register in patient medical record as :digital image, monitoring EKG , EEG , outlets of medical equipment, chemotherapy protocols etc
- **Recommendations**
  - o Include instructions given by the physician who pursues the patient and the other members of the team who examine the patient health.

b) Medical section

The role of ***Medical sections*** is to:

- Enabling the conditions to proceed the teleconsulting activities by telemedicine office;
- Enabling the conditions to run the telediagnostic tasks by telemedicine office;
- Enabling the conditions to run the telemonitoring applications by telemedicine dispatcher.

c) Administrative section

The role of ***Administrative sections*** is to assure all administrative and technical conditions to run the telemedical applications.

3. Pilot Model For Regional Telecenters Network

The TELMES project proposes to develop a pilot multimedia network, with integrated teleservices for the medical area, using the most recent IT&C technologies. These teleservices should help optimize the medical decisions to increasing of quality, with the decreasing of costs for the medical act, and also the expanding of the services range in the healthcare, by introducing medical teleservices.

This goal could be reached in the most efficient way only by a systematic approach within a national telemedicine system.

Therefore it's proposed a hierarchical network structure that should include three hierarchical layers, fig. 2:

Layer 1 is the *local layer – users zone*. This contains the possible interfaces that are offered to the users, depending on the concrete technical opportunities from their area and also on the requested applications complexity, in order to ensure the availability, accuracy and safety conditions with the optimizing of the needed costs for the application implementing and exploiting.

Layer 2 is the *regional medical telecenters layer*. This includes the telemedicine regional nodes by which the certain region local areas' users are connected.

Layer 3 is the *national management center - **NMC** layer*. This is a central node, at national level, that is responsible with the management of the communications and the running of the telemedicine services between different regions, and, also, with the management of its links with other international networks.

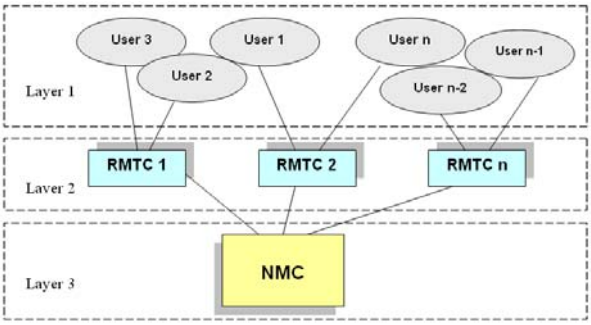

Fig. 2. Hierarchical TELMES network structure.

Thereby, the TELMES network consists of a lot of regional medical telecenters connected within a multimedia platform, enabling to implement some applications from the medical teleservices category.

Based on this model, at this moment we're developing a pilot network with two regional telecenters, located in two Cities in Romania - Pitesti and Iasi, fig. 3.

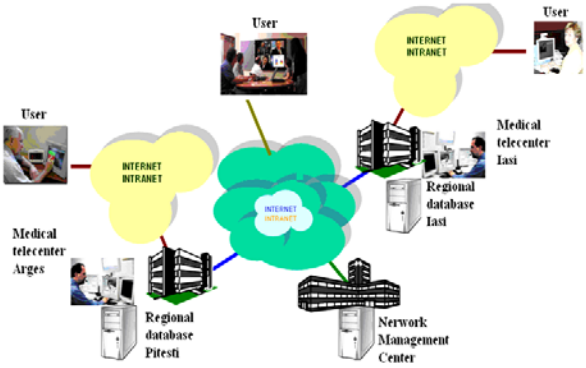

Fig. 3. TELMES telecenters networks.

The **NMC** represents an entity with the following functions:

- Hosting a central server to ensure the telecenters access to the network;
- Hosting the central database;
- Hosting software applications used for network management services;
- Ensures the connectivity between regional telecenters, within the TELMES network.

4. Medical Teleservices

From **user** point of view, medical telecenters network is *addressing especially to the segment of generalist medicines* in order to allow:

- Access to the qualified information, by direct cooperation with specialized medicines;
- Efficient management of the chronic ills;
- Covering the rural and remote areas.

We are considering that making of such tool available for the GP or for a doctor placed in a rural environment covering a large area, allowing him to call for a group of experts by means of a telecenter, and without need to move the patients, sometimes

on hundreds of kilometers away, is a real gain for the medical practice in this field.

In present, we start to experiment, based on TELMES network, the following applications :

a) Teleconsultation/telediagnostic medical teleservice

Teleconsultation – remote discussion of the concrete clinical case for the answer to precisely formulated questions for the help in acceptance of the clinical decision with two types of applications:

1) Store-and-forward – off-line – applications

In *store-and-forward* telemedicine, clinical data are collected, stored, and then forwarded to be interpreted later. A store-and-forward system eliminates the need for the patient and the clinician to be available at either the same time or place.

2) Office based – on-line – applications

Office-based telemedicine services are real-time clinician-patient interactions that substitute for face-to-face encounters between a patient and a physician or other health care provider. The use of office/hospital-based telemedicine was evaluated relative to face-to-face encounters on the basis of the following questions.

In routine medical practice these techniques can be combined: an off-line teleconsultation may be expanded through real time dialogue between the consulting and inquiring physicians through the chat or video conferencing; a real time video conference may be preceded by exchange of medical information through email and so on.

Teleconsultation services are used for:

- determination (confirmation) of diagnosis;
- determination (confirmation) of treatment;
- determination of diagnosis and treatment of rare, severe diseases or diseases with a non-typical course;
- determination of complication prevention methods;
- lack of immediate specialists in the necessary or adjacent medical field or lack of sufficient experience for diagnosis or treatment of the disease;
- the patient doubting diagnosis, treatment and its results, complaint analysis;
- decrease of diagnostics and treatment cost without impairment of quality and efficiency;
- search and selection of medical establishment most suitable for urgent and planned treatment of the patient, coordination of terms and conditions of hospitalization;
- medical care for patients located at considerable distance from medical centers, when geographical distance between the patient and health-care provider cannot be overcome.
- search for alternative solutions for clinical tasks;
- obtaining of additional knowledge and skills concerning a given medical problem.

b) Telemonitoring medical teleservice

Telemonitoring service represents *a set of activities necessary for planning and deployment of medical telemonitoring applications*. Medical telemonitoring application represents the transposition of distance medical monitoring activities, through a dedicated communication network.

Telemonitoring services – ***home-based applications,*** enable physicians and other health care providers to monitor physiologic measurements, test results, images, and sounds, usually collected in a patient's residence or a care facility.

Telemonitoring system must comply with the **interoperability principle**: ***"anytime, anywhere, by anyone which is authorized and in any manner."***

Within the project it was made an experimental model for a home telemonitoring application of a patients' health status, by considering the blood pressure and the pulse.

The main focus was on the designing of a *simple telemonitoring unit for "home using"* and a telemonitoring network for a realistic application implementing, that could be used with or without a specific informatic support.

It was necessary to consider the market mobile communications solutions available in Romania currently, and also the offering for the medical devices for measure the blood pressure and pulse, in order to find a solution that should be easy to be implemented and especially easy to be used.

The system uses an **Mobile Telemonitoring Unit – MTmU,** that enables:

- the interface with the measuring medical device for measuring the blood pressure and the pulse;
- data gathering from the medical device for the blood pressure and pulse measuring;
- local processing of the data to establish the framing of the measured parameters within the stated limits;
- interface with mobile communications network;
- packing data acquired from the patient, personalization data attachment in order to transmit them using a TCP/IP protocol;
- the immediate transmisision of data to the MTmU unit server;
- the alarms sending, if the measured values overcome the stated alarm thresholds

Fig. 4. Mobile Telemonitoring Unit.

In order to design a unit in low-costs conditions, for connecting to the mobile phone network CDMA it is used a standard mobile phone ensuring the basic functions.

The functions for processing of the gathered data, the system control and the alarms transmission are supported by a control and processing block, having the following features:

- CPU ARM RISC 32 bit 180 MHz;
- Memory DRAM 8 MB;
- Flash memory 512 KB;
- USB port version 1.1, type A;
- Application protocols HTML, http, Telnet ;
- WAN port : wireless connection CDMA, 230 Kbit/s
- Embedded firewall protection;
- Software features: IP Routing, RIP, PPPTP, web-based setting, IP sec

The selected medical device allows for:

- the patient to make by him or herself the parameters measurement, in a way as simple as possible, but also in safety, accuracy and flexible way;
- acquisition for the data representing the measured parameters by the patient sending of the gathered data to MTmU by using of an USB interface.

The results of medical measurements are collected to regional telecenter, from MTmU of the patient, within a Telemonitoring data base. Therefore, based on web software applications, developed, also within project, the GP have the possibility to see these results from his office, fig. 5.

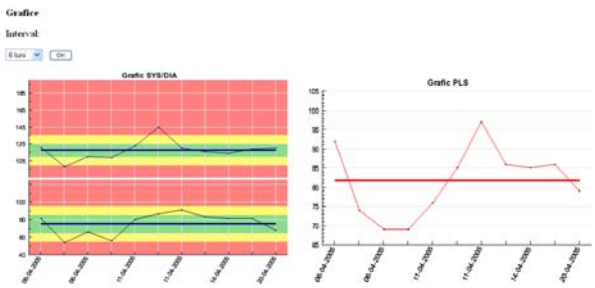

Fig. 5. Results for Telemonitoring application.

5. Conclusions

In this paper was presented the medical telecenters network, based on multimedia system, designed for medical teleservices. The main goal is to build a complete pilot system that will connect several local telecenters into a regional telemedicine network. This network will enable the implementation of complex medical teleservices (teleconsultation, telemonitoring, homecare, urgency medicine, etc.) for a broader range of patients and medical professionals, mainly for family doctors and those people living in rural or isolated regions. Thus, a multimedia, scalable network, based on modern IT&C paradigms, will result. It will gather two inter-connected regional telecenters, in Iaşi and Piteşti, each of them also allowing local connection of hospitals, diagnostic and treatment centers, as well as a local network of family doctors, patients, and even educational entities. As communications infrastructure, we aim to develop a combined fix-mobile-internet (broadband) links. As a first step we implemented and tested teleconsult and telemonitoring applications.

Acknowledgements

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