Integrated platform for home teleassistance - TELEASIS
Platformă integrată pentru teleasistentă la domiciliu - TELEASIS

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Rezumat: *Dezvoltarea retelelor de telecomunicatii a făcut posibilă dezvoltarea aplicatiilor de telemedicină. În cadrul programului eRomania o atentie specială se acordă dezvoltării aplicatiilor electronice publice si la domiciliu. Extinderea, în România, a Internetului a permis accesul la servicii electronice a unui număr sporit de utilizatori. În acest context, Institutul National de Studii si Cercetări pentru Comunicatii - INSCC, a coordonat proiectul "*Sistem complex, pe suport NGN, pentru teleasistenta, la domiciliu, a persoanelor în vârstă - TELEASIS"*. In acest material este prezentat rezultatul acestui proiect ce constă intr-o platformă integrată de tele-asistentă, pentru dezvoltarea de servicii integrate la domiciliu care să permită asistenta – la domiciliu – a persoanelor în vârstă, din punct de vedere medical dar si social.*

Abstract: *The diversification of telecommunication networks and advances in communication technologies, including the Internet, has considerable potential as an environment supporting telemedicine applications. Within eRomania government programme a special focus is on public and private electronic services development. During the last decade, communications systems development and expansion of Internet enabled more and more users to access public electronic services. In this context, National Communication Research Institute – INSCC is coordinating a Romanian telemedicine project called Complex System on NGN support offering Home Telecare Services for Elders – TELEASIS. This paper presents the integrated tele-assistance platform - TELEASIS, as a support for implementation and development of homecare electronic integrated services, allowing tele-assistance of elder people, at their residence, with a medical and as well, a social target.*

Cuvinte cheie : telematica, telecontrol, tele-asistentă, telecomunicatii, senzori
Key words: telematics, telecontrol, teleassistance, telecommunication, sensors

1.INTRODUCTION

As well as in European countries, in Romania the number of elderly people is increasing. Older people are more likely to suffer multiple health conditions, chronic physical diseases and mobility limitation, often with concurrent mental and cognitive disorders, all of which requiring constant attention and care. [1] For elderly people who decide in favour of home care, the distance between home and the point of care can become an issue.

The assistance provided to elderly people is ensured by the immediate family and/or assistants at high costs and time-consumption. A more serious focus on home care and the ageing society in Europe started around two decades ago with an EC project (Age Care Research Europe) that assessed the status and issued three related research strategies for the domain. [2]

Since then the domain was exploited and lots of research done and results obtained. On the Europa CORDIS site there are reported 100 relevant projects listed since 1999 on home care subjects starting from problems, statistics and ending with biosensors, agents, smart homes, etc. 98 Exploitable results can be associated with these projects, 19 documents available, and 1528 web pages.

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At national level several projects were developed and shown results. The solutions were either simple, but cost and life saving like the ones based on telephone alarms connected to a dispatcher usually used by municipalities [3] or more sophisticated ones creating multimedia regional networks [4][5] or answering to clinical problems [6] [7].

This paper presents the integrated tele-assistance platform – TELEASIS, developed into the Romanian telemedicine project called Complex System on NGN support offering Home Telecare Services for Elders, as a support for implementation and development of homecare electronic integrated services. [8]. The project started at 2007 and will be finished at the end of 2010.

The presentation includes the context, issues regarding project management, hardware and software platforms, devices, and patients/clients benefits.

2. CONCEPT

The last decade shows a major progress towards home-oriented healthcare electronic services that have been developed to help elderly people to increase their life quality. Home integrated services and tele-assistance systems allow medical and social services being delivered to elders [9][10]. A tele-assistance system offers medical and social citizen-centred responsive services at economic costs.

The TELEASIS project is developing a pilot tele-assistance network with homecare electronic integrated services, allowing tele-assistance of the elderly, at their residence, based on the most recent IT&C technologies, with a medical and as well, a social target.

Designing a tele-assistance system, as part of an assisting service, offers personalized services based on environment conditions and users' requirements. The service-integrating tele-assistance system grants elders the opportunity to benefit from healthcare at home, to enjoy an improved personal lifestyle.

The general objective of a home tele-assisting system is to supply a bunch of integrated services for the users (Fig.1): medical care, premises security through telemonitoring environment conditions, video-conversation with family and friends, electronic payment, electronic shopping.

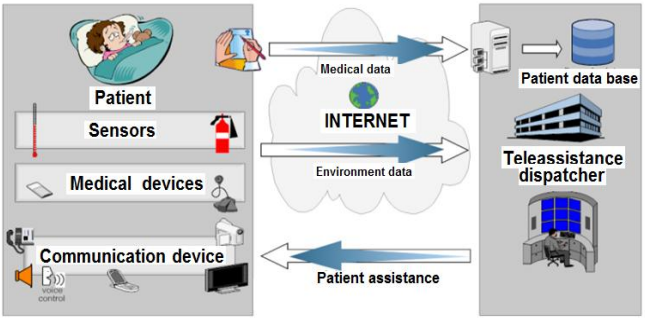


Fig.1 Tele-assistance home integrated services concept

The system optimizes the performance for home assistance services and offers customized services depending on certain conditions and concrete requirements of users, with the related costs optimized through focused involvement of the medical personnel or social assistance, as well as increasing the nursing at home. Secondly, it may meet the demands of elder persons to live in their own home and not in care homes, the continuation of the active period by involving this in daily activities, as well as improvement of the customized management of the assisted person lifestyle. Third, the project explores how older people accept the use of electronic technology, at home, in everyday life, also.

3. TELEASIS PLATFORM ARCHITECTURE

3.1 User and system requirements

The TELEASIS's architecture has specifically been designed to meet social, technical and economic users' stringent requirements. Therefore, the system is aiming to provide the elderly people with medical and social decent home assistance while living the everyday live undisturbed. Last but not least, the system is allowing users to fully benefit from friendly/familiar electronic technologies, for example TV-based teleassitance.
Basically the following criteria were been taken into account in order to have the platform accepted at large by the targeted elder population:

✓ Small size and light weight for portability;
✓ Medical-oriented appearance for a better recognition;
✓ Open functionality for future development;
✓ Easy-push minimized keyboard;
✓ Friendly operating menu;
✓ Intuitive commands.

The appearance must be familiar, but medical oriented, so that they recognise it quickly and the display must have large characters and also a good contrast. The IT menu must be friendly and intuitive, so that the training necessary for the utilisation to be reduced to a minimum.
TELEASIS ensure a support for to medical and social personnel to provide the teleassistance with installation and use reasonable cost.

3.2 Hardware platform

In this context, we developing particular system architecture from fig.2, based on a services architecture that links a large number of components:

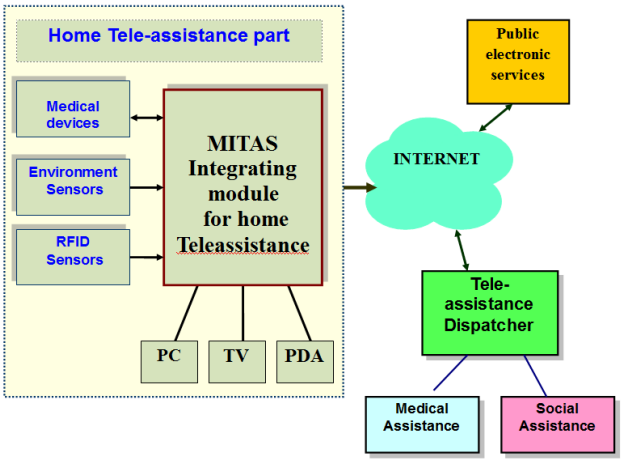


Fig.2 TELEASIS platform architecture

✓ **Hardware components, and devices**, a customized telecare module to interface medical devices - MITAS module (Home Tele-Assistance Integrating Module), sensors, display devices: PCs, PDAs or TV sets;
✓ **Software components** support: (1) system logic applications to coordinate activities of the assisting staff and (2) client-customized applications for agenda activities.

3.2.1 MITAS module

MITAS module is a complex electronic module carrying the following main functions:
✓ provides interfaces to medical devices for remote healthcare services;
✓ provides interfaces to field sensors for home security services;
✓ provides interfaces to PC, PDA or TV set to link users and dispatchers or public services;
✓ provides interfaces to Internet;
✓ processes the data collected from medical sensors to determine their classification in the predetermined limit, the exceeding of which generated an alarm.
✓ insures automatic transmission of data collected at certain programmed time intervals to the Tele-assistance Centre, in normal operation conditions.
✓ allows the transmission of alarms, collected from medical devices or sensors to the Tele-assistance Centre, in emergency conditions.
✓ allows transmission of information from the Tele-assistance Centre and display on a display device connected to the module MITAS: TV, PDAs or PCs.

3.2.2 Medical devices and sensors

Medical data acquisition is done from medical devices for the related areas:
✓ Cardiology – blood pressure, pulse
✓ Diabetes - blood sugar/ glycaemia
✓ Pulmonary – peak expiratory flow

Environmental sensors are used:
✓ Water leak sensor will be used to control water sources in homes when the production of damage,
✓ records and stores events (application, analysis, decision sharing, expertise, action performed, results, costs);
✓ provides optional services (monitoring, security, interventions in home environment breakdowns, on-line shopping, legal advice, etc.)
✓ Smoke sensor who sends an alarm signal to the receiver where it passes the default activation,
✓ Gas sensor that is activated when the concentration exceeds the minimum detectable.
Alarm signals from medical devices or sensors are handled by module MITAS.

3.2.3 Display devices

MITAS Module is designed to connect one of the devices: TV, PDAs and PCs, and to display information provided by the Tele-assistance dispatcher. The TV set being a device which is easy to use by the majority of seniors is the preferred device used by the TELEASIS platform.

3.2.4 Tele-assistance Centre

The Tele-assistance Centre is a complex structure with the following functions:

✓ retrieves requests from the user and/or from the nurse/assistant who comes to the user's home;

✓ analysis the requirements;

✓ records and stores events (application, analysis, decision sharing, expertise, action performed, results, costs);

✓ provides optional services (monitoring, security, interventions in home environment breakdowns, on-line shopping, legal advice, etc.)

3.3 Software platform

Software platform consist in a set of applications, serving system activity. Dedicated applications interact with support staff as well as the tele-assisted person with medical guides and general information. The platform provides the tele-assistance centre with a complete set of information resulted from monitoring activity and also displays data from the centre to the patient, as a feedback. The architecture of this software is depicted in the Figure 3.

The Server hosts WEB Services that ensure the support for communication between MITAS, databases and the local clients (Administrator, Specialist, Monitoring user), described in paragraph 4, and an http server that allows remote clients (medics, nurses and patients) to access appropriate data, accordingly to their roles, by a simple browser. A broker component is used to intermediate the dialog between the patients and/or staff, and allows video streaming from the WEB cams located at the patient's home. In order to respect the intimacy of the people involved, the cameras will be remotely activated only in emergency situations.

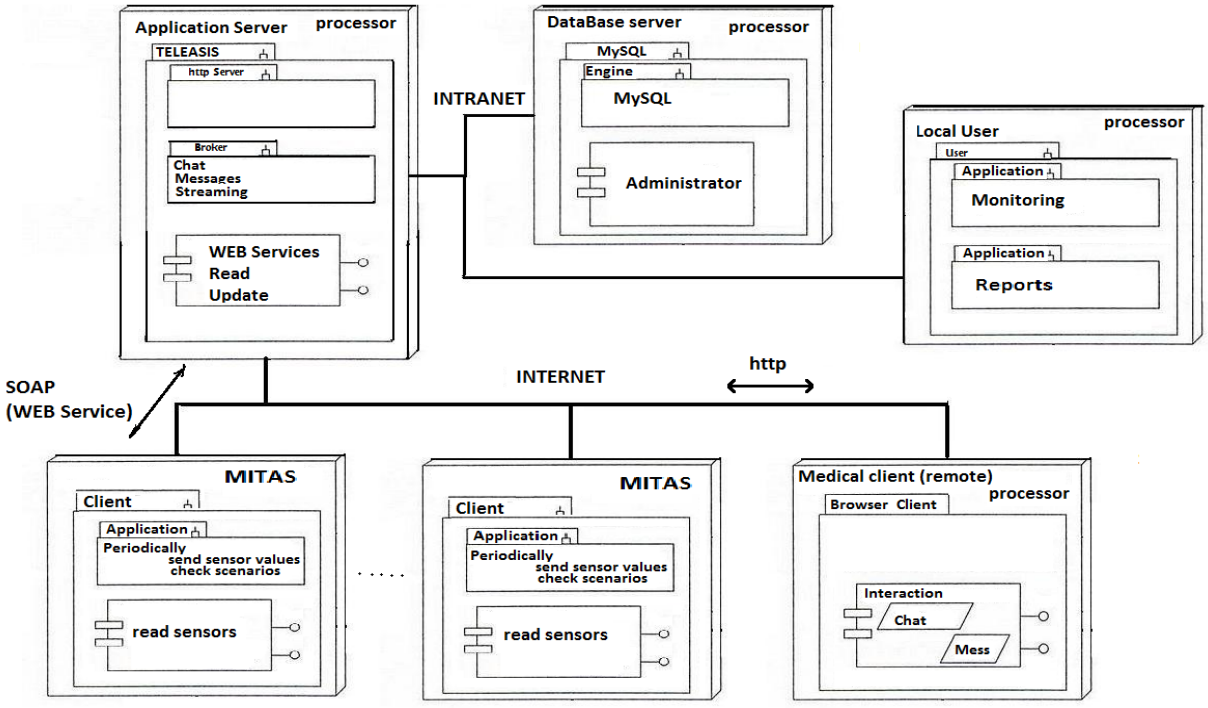


Figure 3 The TELEASIS Software Architecture

At the level of the Dispatcher, a periodically activated software component ensures the visualisation / monitoring of the signals read from the sensors and the alarms/warnings. The software reads the data from the database and displays the graphs of the signals configured for visualisation,

for the patients selected by the monitoring staff (Fig. 8).
Another software component allows the set-up of the data of the patients, the alarms and other settings which personalise the monitoring to the specific needs of each elderly person.
Future interoperability modules will ensure the connectivity of our system with the emergency services and with an automated SMS Sender. The software solutions are developed under Microsoft Visual Studio.NET (Visual Basic and Visual C#).

4. APPLICATIONS

The TELEASIS experimental platform consists of two modules MITAS and one Tele-assistance Centre.
The roles associated with the TELEASIS platform are diverse, from the monitored patient to the administrator:

Administrator:
✓ performs system management functions (server level);
✓ adds new system users, edits/deletes users;
✓ views data contained in databases.

Specialist:
✓ acts as a medical dispatcher - patients may be consulted for clarification of medical problems;
✓ establishes general scenarios (valid for any class of patients), standard scenarios (for categories of patients: cardiac, diabetic, etc..) or custom scenarios for certain patients;
✓ matches scenarios and patients (general, standard or custom scenarios) based on active sensors set by the technical dispatcher.

Technical dispatcher:
✓ configures the MITAS modules and allocates the sensors for each patient;
✓ it is consulted by patients for technical problems and may intervene in the case when there is a technical failure at home of assisted person.

Current state monitoring user:
User with medical training, but not a medic (e.g. nurse), who observes continuously critical issues arising in the state of a patient under certain circumstances or unforeseen scenarios, acting based on predefined protocols guiding its work.

Patient:
✓ monitors his/hers healthcare status;
✓ it is monitored in terms of health;
✓ it is required to confirm that certain actions were performed (e.g. specific drug administration);
✓ may consult the specialist or the technical supervisory control on medical or technical problems.

MITAS module, placed in the patient's home and serves as intermediary between data collection devices - medical, environmental, present, devices to display the patient data and connect to the external tele-assistance network, was designed based on a IBX-530-atomic device, fig.4, which satisfy the conditions for implementing the necessary functions of system operation.



Fig.4 IBX-530-ATOM device used for MITAS

MITAS ensure connecting for the following medical devices:
- ✓ Blood pressure – model 705CP-II
- ✓ glucometer + Blood pressure – model Clever Check TD-3213
- ✓ peak flow meter – model PIKO-1

The relevant information for user, such as medical data, indications of the doctor, provided by the Tele-assistance Centre are displayed on a television screen was in his house, fig.5.



Fig. 5 Using TV to display the information from Tele-assistance Centre

Communication with the TV set is initiated when the desire is to get relevant information unconditionally TV screen located in patient room. This function is initiated by MITAS and controls the following events:

- ✓ start TV (if off);
- ✓ switch to AV (if turned on any one program).
- ✓ present MITAS user interface to patient
- ✓ transmit information;
- ✓ interact with patient and present the necessary information
- ✓ power off the TV or (optionally) return to the original channel after application.

The software architecture made for MITAS module contains the following components:

- ✓ Core Framework - basic software that has overall management functions;
- ✓ Update Application - application that will take care of updating all modules loaded;
- ✓ Content Update Application - Using this application is done updating the information database used by all applications;
- ✓ Access Database Application - An application for access database insert values in tables, queries the table, save results of query and update tables;
- ✓ Application Alarms - Alarms are designed to record and transmit real-time information on the key parameters set for the entire module assistance;
- ✓ Scheduler Application - It is the list of actions to be taken at predetermined intervals;
- ✓ Data Acquisition Application - Data acquisition involves the acquisition and processing signals or wireless signals to get information;
- ✓ Data Processing Application - The term 'data processing' is applicable to any process that converts data from one format to another, the process of converting information (raw data) in data (and vice versa);
- ✓ Medical Content Delivery Application - patient-specific content displayed on the screen;
- ✓ Medicine Schedule Application - is an application designed for tracking medication and patient notification.

TELEASIS Platform will be managed by the Tele-assistance Centre organized on OrthoVitaMed Hospital in Pitesti, which includes a telemedicine section. This is the best solution to ensure the needs of health care, and allow, at the same time, the organisation of social assistance services, in conformity with TELEASIS platform architecture presented in fig.2.

The dispatcher software is installed on the server unit of the Centre and consists of a role user oriented interface that facilitates the dialogue between all types of users. When starting the application, after displaying a form of greeting, it requires a user and password. Depending on the current user's assigned role, the access is granted to a specific application. The following solutions are implemented:

✓ *Users from group 'Administrator'* can add new users to the system, amend and delete users (fig.6).

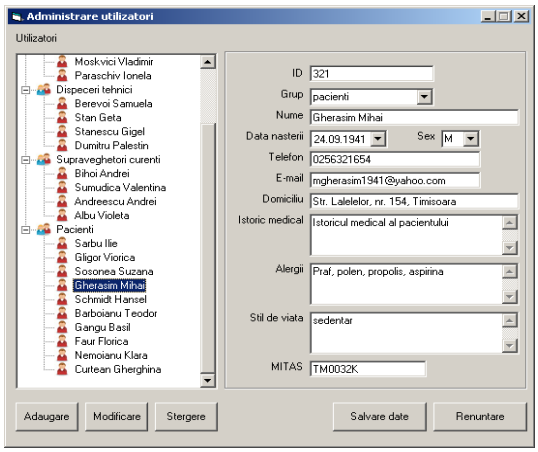


Fig. 6 Administration of users

✓ *Users in Group 'Specialist'* set scenarios (fig.7) and draw scenarios for each patient based on active sensors by technical dispatcher.

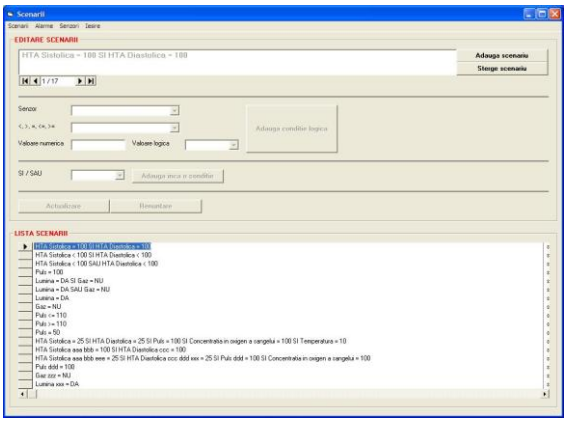


Fig. 7 Set scenarios

Examples of scenarios:

- Gas (gas sensor detects increasing gas concentration in the eventuality that the assisted person forgot cooker opened and a flame went out for some reason);
- Increasing temperature (oven temperature has grown beyond a certain limit);
- Overriding the limits of physiological parameters (simple, logical combinations, trends) - increased blood pressure over a significant period of time; aberrant cardiac parameters (arrhythmia); oxygen saturation of blood in a certain limit; low blood pressure with danger of loss of consciousness; low glucose level: blood glucose decreased below the limit permitted, with risk of entry into a coma;
- System failure: the essential function is lost, the monitoring system is not used for supervised person to address the connection was lost, the protocol should provide for making regular link by telephone to remedy.

✓ *Users from group 'Current monitoring'* supervision the critical aspects of a patient, can report emergency situations (Fig. 8).

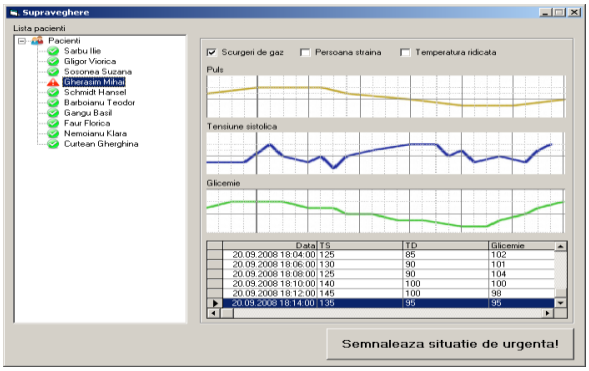


Fig. 8 Patient's monitoring

5 CONCLUSIONS

Telemonitoring service includes activities to plan and deploy remote monitoring medical applications via dedicated communication network.

TELEASIS project delivers a home care tele-assistance system to the elderly targeting medical as well as social results. Its goal is to encourage development and implementation of such systems in Romania, supporting medical and social services for the elderly and home care.

Romanian elder people are health consumers and aid receivers from different medical, social and family sources. The common healthcare that hospitals and medical centers are supplying the elder people with causes the elder population to migrate from home to medical premises at huge expenses and time-costs.

Telemonitoring system must comply with the interoperability principle: "anytime, anywhere, by anyone which is authorized and in any manner." Development of a "tele"-component for an assistance service, leads to optimization, reducing costs, performing more actions at low price, shifting the cost burden from hospital care to homecare, reducing it.

The system enables medical home services with no need for elders to travel or hospitalize. The system is mainly targeting 60+ years old people who suffer from chronic diseases.

The system is confronting real barriers while implementing it such as:

✓ A lot of elders lack digital skills ;
✓ Specific elders needs are still off the mainstream products;
✓ Legal shortage.

MITAS unit and Tele-assistance Centre complete the project together with a manual for developing/implementing the system.

The TELEASIS system is offering elderly users with:

- Healthcare private management;
- Conformity which improves the responsibility for the personal healthcare;
- New lifestyle quality;
- Proficiency of the medical and social assistance.

ACKNOWLEDGEMENTS.

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