

# A HOME TELECARE MANAGEMENT SYSTEM

M.J. Rodríguez, M.T. Arredondo, F. del Pozo, E.J. Gómez, A. Martínez, A. Dopico  
Grupo de Bioingeniería y Telemedicina - GBT, ETSI Telecomunicación, U.P.M., 28040 Madrid, Spain

**Abstract:** The actual tendency to discharge chronic patients from hospitals, as well as the increasing request for improving quality of life of elderly and disabled people at home, was the original motivation of the development of the Home Telecare Management System (HTCMS), here described. The HTCMS allows, at the Home Telecare Service Center, the remote monitoring of biological signals and data and the management of different types of alarm calls generated at home.

## INTRODUCTION

Telecare is a provision of health care to a patient at distance from the care provider (human or machine). This telemedicine service is supported in other services as telemonitoring, that implies supervision at distance of biomedical data of patients.

Home Telecare (HTC) [1] may help elderly and disabled people to stay as long as possible in their own environment allowing an increased independence and a reduction of social costs through the management of different alarm calls and the remote follow-up of some of their biological variables.

As a prototype of telecare, a Home Telecare Management System (HTCMS) was developed to test its feasibility in a real environment, and to validate it in an European context as part of the EU funded EPIC project (AIM A.2007). So far, the implemented functionalities of HTCMS are: 1) tele-alarm management; 2) long-term monitoring of biological signals and data (blood pressure (BP) and ECG). This paper describes briefly the whole system, in both sides: the patient's home and the HTC Service Center.

## SYSTEM DESCRIPTION

The HTCMS comprises two main subsystems (Figure 1): the Patient Unit (PU), and the Home Telecare Service Center (HTSC), described as follows.

The **Patient Unit** can be composed by one or several of the elements categorized as: 1) alarm devices; and 2) biological variable and data (within prototype: BP and/or ECG) self-measurement equipments.

The alarm device is integrated in the phone set. Alarms can be triggered by: a) phone set buttons; b) portable units; c) emergency detectors (fire, intruders, patient falls, absence). An automatic dialling to the HTSC is always established as a result of any alarm event.

To measure BP and ECG any commercially available device, able to transmit data via modem, can be used; in this prototype, a system provided by one of the partners of EPIC (Bertin & Cie, Aix-en-Provence, Cedex 3, France) is used.

The BP system developed for EPIC stores heart rate (HR) and BP data and download them via PSTN to the HTSC. Other data can be collected by the PU, not included in this prototype: drug intake, daily activity, subjective measurements (i.e. level of stress) and other relevant events associated to possible complications (fever, headache, ...). All data are stored with time and date of occurrence.

The system used to record the ECG is a twelve lead device, provided by another partner of EPIC (STS, Hörsalsvägen 11, Göteborg, Sweden); raw ECG data are transmitted by phone according to a preestablished protocol.

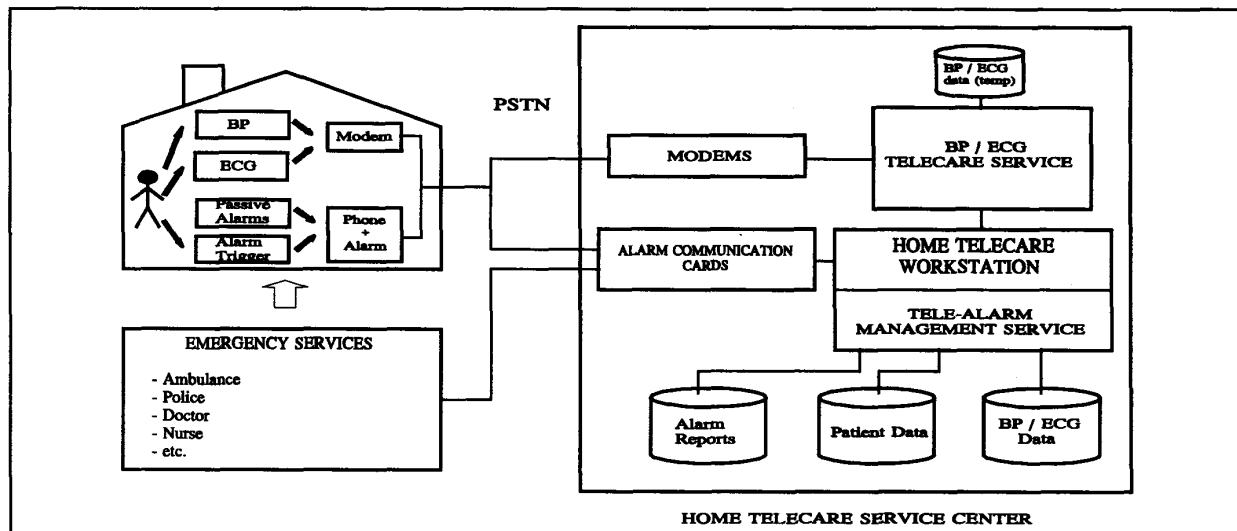


Figure 1: Architecture of the Home Telecare Management System

The **Home Telecare Service Center** provides two services: 1) tele-alarm management (TAM); and 2) patient signal monitoring, that includes for this prototype the BP and ECG signals. At the moment, the two applications are installed in two different PC computers connected through the serial port.

The TAM application allows the management of any alarm call. The communication with the alarm home device of the PU is made using a rack with as many communication cards (tone receiver/decoder) as phone lines are simultaneously attended, each card is connected with the computer through the serial port. A specific communication protocol to guarantee privacy and data security has been developed.

The TAM application is a PC-based software package developed in Visual Basic under Microsoft Windows and designed to be used by personal without training in computer systems. The user interface follows some general design guidelines [2]: 1) important information is explicit on the screen; 2) action sequences for different tasks are unique; 3) information handled by the user was minimized; 4) dialogue is accomplished by direct manipulation of push buttons; 5) help screens and error information are provided.

In absence of alarm calls, the operator is able to perform other tasks: phone the patient, complete previously written alarm reports, elaborate different kind of statistics, etc.

When an alarm call reaches the computer, all tasks being made by the operator are automatically disabled and the alarm type, the patient name and the current time are displayed in the screen. When the operator responds, a voice handsfree link is established between the patient and the operator, and the screen shows the following information (Figure 2): 1) possible appearance of new alarm calls; 2) icons allowing the operator to dial automatically the emergency phones (fireman, doctor, ...); 3) patient's data, retrieved either from a local database as in Figure 1 or from a health care database the system could be connected to, comprising: personal data, medical data, location data, patient impairments, current services.

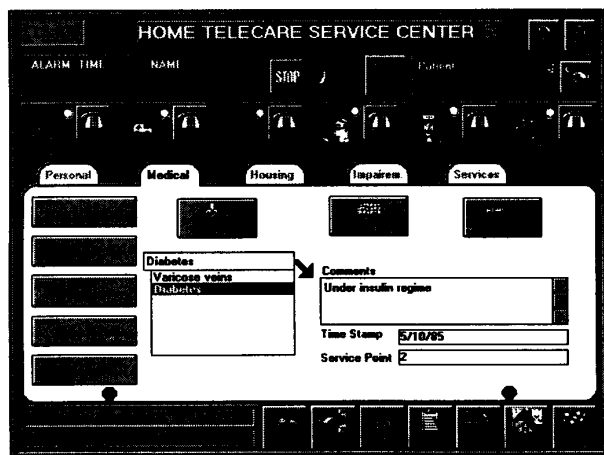


Figure 2: Screen for alarm management

Different actions can be taken by the operator, to solve the patient's problems, ie. call the doctor, call an ambulance, etc. Finally, a report is made (in two steps) and stored in the alarm report database: 1) an automatic report not modifiable by the operator: patient and operator identifiers, alarm code, date, starting and ending time of the alarm, act plan (list of actions made by the operator with their starting and ending times); 2) an operator report: free text where the operator writes the reason for alarm, actions taken, response time, and comments.

BP/ ECG applications are divided in: 1) communication module, common to ECG and BP applications; 2) software to display and analyze BP/ECG data, that can be or not installed in the same place where the data transmission is made.

The communication with the BP/ECG devices is made using modems, connected through the serial port to a PC computer, where, during the communication, data are temporally stored. When the communication finishes, data are sent to the HTSC workstation to be stored in the BP / ECG database.

The patient's physician retrieves the data from the HTSC workstation and examines them using the software developed for analyzing BP and ECG data.

As an example, the BP service is briefly described here. The software facilitates and automatizes BP profile analysis, allowing BP data analysis till a maximum of 7 days, being 24 hours the basic period. It comprises the following procedures [3]: 1) BP data analysis using graphical and statistical tools; 2) doctor/ patient remote interaction; 3) production of printed document for patient and doctor; 4) automatic classification tools, that, using an unsupervised learning artificial neural network classifier, did the discrimination between normal and different types of hypertension profiles.

## DISCUSSION

The system has been tested with voluntary users that have found it very easy to use. In real emergency situations, the operator was able to take fast and efficient decisions, handling real information about the patient. In many cases, the alarm calls are loneliness calls, and the information shown in the screen facilitates the operator a better support of the patient.

The use of ambulatory monitors to control chronic patients has increased in the last years. This system allows the storage of ambulatory data in a centralized way, providing the doctor with a more automatic tool to analyze this kind of data.

## REFERENCES

- [1] F. del Pozo, M.T. Arredondo et al: "Medical Informatics: Improvements in Telemedicine", *MEDICON* 1989: 262-265.
- [2] P. Booth: *An introduction to human-computer interaction*. United Kingdom: LEA Publishers, 1989.
- [3] M.T. Arredondo, F. del Pozo et al: "A Telemedicine Approach for Hypertension Care", *Computers in Cardiology* 1990: 595-598.

## ACKNOWLEDGMENT

This work has been supported by the European Program AIM: EPIC, project number A.2007 and TELEPRIM, project number A.2054; and by the Spanish TELEMEDICINA, project TIC-93-1279-E.