S-3-3

SCP-ECG Transmission by a Tele-medicine Home Care Device: an Implementation Approach

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1. Overview

The aim of the project is to create a generic medical device that can create SCP files independently of the hardware used to capture the vital sign and is able to transmit this ECG data remotely to a data center using the SCP standard.

The prototype resulted from the project fetches the ECG waveform from an ECG board (that can be from any manufacturer), saves the ECG data into a file according to the European standard EN1064 and sends it through the Internet to a remote server, which can analyze the incoming data, generate different results, store them in a database (together with the original received SCP file) and return this results to the user.

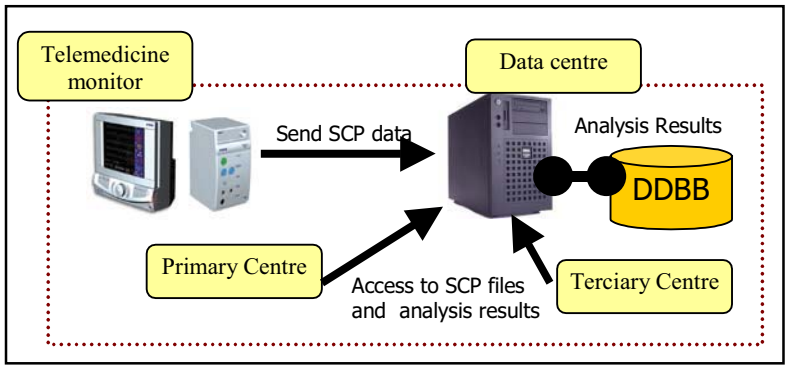

Figure 1. Communication schema

This schema allows the user to perform measurements and then retrieve a complete remote automated arrhythmia analysis in an specialized center, append the SCP to the patient history or perform any kind of evaluation of the received ECG data.

This model is oriented to the communication between primary and tertiary care centers, because the physicians working the primary care are not specialist in cardiology, but can have a complete report of every taken ECG in just some seconds.

2. Implementing a generic SCP writer

To test the results of the project, we have modified an existing medical device, the Telemedicine Monitor AlteaTM, which most remarkable feature is the use of ISO11073 standard to represent the measured medical data and transmit this data in real-time to a data center for trends storage purposes.

Any medical device can be connected the AlteaTM as a client (if the medical device is not ISO11073 compliant, the connection must be done through one software adapter or protocol converter called *Agent*). The AlteaTM, playing a role of *Manager* in the communication, can transmit the data of the connected medical device to a remote data center. This can be done for every medical device because the way of representing the medical data using the ISO11073 is universal

The SCP writer is a software module entirely written in ANSI C that communicates with the *Manager*. This module scans the Medical Device Information Base (*MDIB*) of the *Manager*, searching for the ECG data and when it encounters the objects that stores the raw data, creates a SCP file with the contents of this Object.

The reason of using ANSI C instead of other programming language like C++ or Java is that this source code can be re-used in small devices, equipped with 16 bits microcontrollers, less powerful than a 32 bits microprocessor.

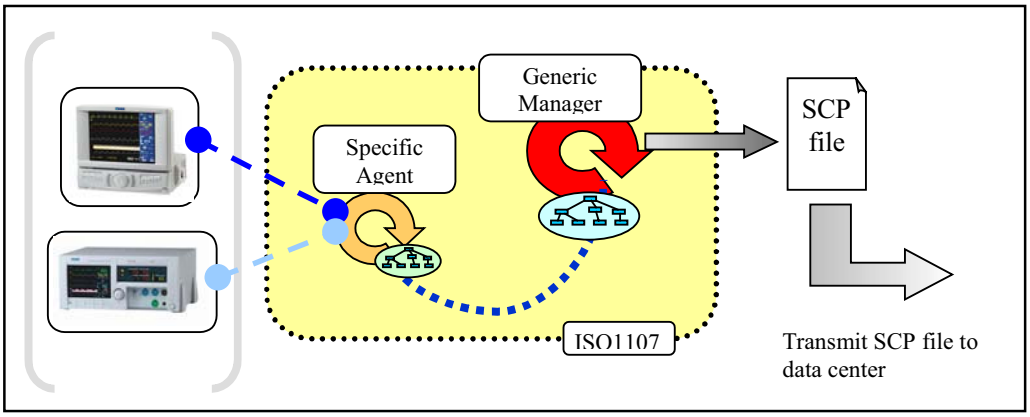

Figure 2. SCP writer implementation schema

3. The Server Side

The method to transmit the SCP file from the medical device to the server is SOAP (Simple Object Access Protocol), a lightweight protocol for exchange of information in a decentralized and distributed environment.

We have selected SOAP because it is a web service that can operate over http, so is usable with a simple Internet connection and has no problems with firewalls or proxies.

SOAP is a XML based protocol that consists of three parts:

- An envelope that defines a framework for describing what is in a message and how to process it
- A set of encoding rules for expressing instances of application-defined data types
- A convention for representing remote procedure calls and responses.

Since the client side (AlteaTM) is written in C and the server side is written in Java, SOAP has several available libraries for different platforms and languages.

The server is entirely written in Java, and implements three different profiles with different access level:

- *Administrator*: Add, remove and modify patients or doctors. Associate doctor and view sessions
- *Physician*: View his patients sessions and add result files to existing patient session
- *Patient*: View his own sessions

The server behavior is the following: The server receives one authentication request to send an SCP file. Then user and password are verified and if correct, the SCP file is stored in the database with all the information regarding the connection and associating the file to the user in the database. The server can launch an external program, so has the ability of using external programs like arrhythmia analyzers to check the SCP file, or SCP viewers to generate an image of the received SCP. All the outputs from the external programs can be stored in the database as well to be browsed by the physician

4. Conclusions

The physicians can perform ECG measurements and then can obtain online a complete arrhythmia analysis in a remote specialized center and append the SCP file to the patient history at the data center

This implementation is actually working in the Chorleywood Pilot, carried out by Brunel University of London (UK) using three AlteaTM in different houses and using the Data center from Trends in Technology in Madrid (Spain). Arrhythmia analysis is not actually being performed and data is just stored to be shown as part of the patient's medical data.