A "global" Telemedicine approach for tele-care integrated in the Health System

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ABSTRACT

Telemedicine, exploiting the new communication technologies and capability in processing and management of data, furnishes a powerful mean for the integration of complex sanitary structures, geographically distributed. In this work, we present the first results of a pilot study, aimed to the development of a multi-functional tele-monitoring network for the elderly.

Keywords: Telemedicine, Internet, Telemonitoring.

INTRODUCTION

Telemedicine is a synonym for "Medicine intervention at distance"; the definition is a neologism that represents the practice of Medicine that takes advantage of Telecommunications. Historically, the employment fields are mainly Second Opinion and Telemonitoring applications. The modern means, available for communications, data processing and management, concur today to possibly set up complex and powerful Telemedicine approaches, where the sanitary structures involved appear not only as the physical place for care delivery to be acqutred "at distance", but as a telematic process to which the patient, and any potential user may be connected for an effective remote care service.

In fact, the main objective of the present work is the development of a reference model for a global approach to the integrated Telemedicine services in the Public Health Organization; as an example, a multifunctional telemonitoring system for biological signals is presented.

Analysing the performed experiences in the field of the Information Technologies and in some specific applications about health systems in the world, it appears that an extended standardization of the procedures and the protocols is not easily applicable to complex structures, such as the health system. The method that borrows the requirement to maintain already existing procedures and protocols, well set up for specific care activities, with the possibility of an effective exchange of information among the several operating realities, is generally the use of Middleware technologies; a normalisation process should be limited to detect the minimal information units to be standardised, for an effective and practically usable care information exchange, for every field of application, to make them available through data exchange on geographic scale. In this sense, the network availability of communication and the related diffused knowledge of the potential users, today occur to conceive the common base of data as a logical instead as a physical entity, with the related logistic and management advantages.

Another important aspect of the reference model we suggest is the integration, in an extended Telemedicine system, of well tested and experienced Telemedicine applications, by using Medical Provider Servers and the Internet as the means to spread the service on the territory.

MATERIALS AND METHODS

The aspects of the necessary Middleware and the selection of the minimal necessary amount of care information units to be remotely accessed, together with the set up of Medical Providers, capable of managing the sparse data base, constitute the reference architecture and model of the Telemedicine approach we are realising.

The several already tested experiences of Telemedicine, the produced instruments and the available communication networks (i.e. internet), are the fundamental instruments on which the integration approach is based. As physical support, we refer to the public telephone network (ISDN and ADSL digital link enclosed), the fire optic and wireless technologies, such as GSM, including the simple short messaging system (SMS) and the modern GPRS techniques, for the data communications without dial-up The emerging wide band technologies (UMTS) have also been considered. Fig. 1 briefly summarizes the communication characteristics of the available physical links on the network, related to the typical size of some selected medical information to be transmitted.

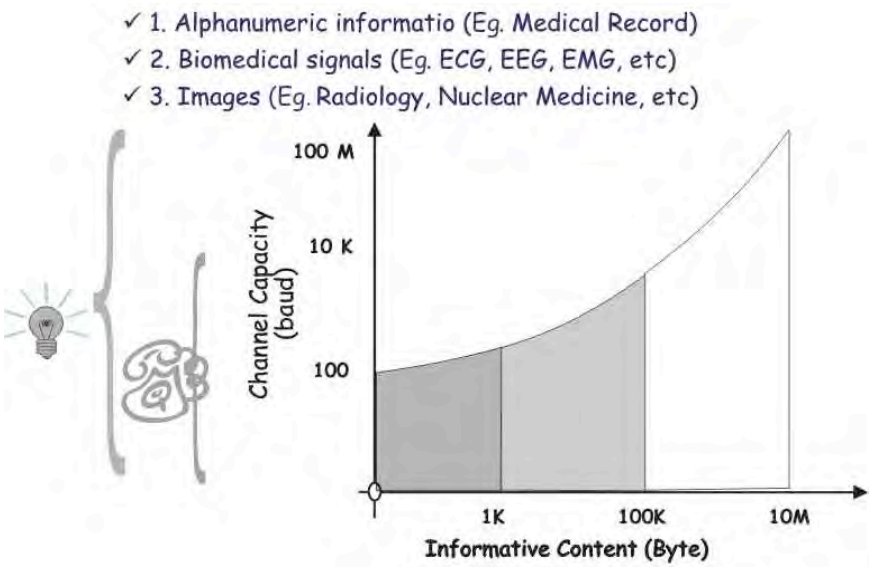

Fig. 1 Information Characteristics and channels

For large amount of data, such as high resolution images in radiology, the use of fibre optics (light) backbones must be considered, while alphanumeric information, signal and low resolution images (or compressed ones) may be transferred by wire/wireless based links, with time transmission compatible with practical use.

The presented work reports on a pilot study in the field of multi-functional tele-monitoring of the elderly. The work was partially financed by the Istituto Superiore di Sanità, Roma , Italia and represents a practical example of the described approach. The used methodology follows the "Medical Provider" architecture and access to the monitored data (also online) is possible by any kind of network, including web based access.

The stored and monitored parameters are:

- Electrocardiogram (one lead)
- Oxygen saturation
- Body acceleration on two axes
- Length of the walking step

The system (fig. 2) is capable of connection to the telephone network in three ways:

- Modem communication by the public phone net;
- Transmission by GSM;
- Wireless link to a dock station connected by modem to the public telephone network

The server is constituted by a PC with every proprietary interface (physical and application level) to/from connecting network usable by the remote devices (i.e. modem for public telephone net, GSM for wireless)

Fig. 2 The Prototype Assembly for communication

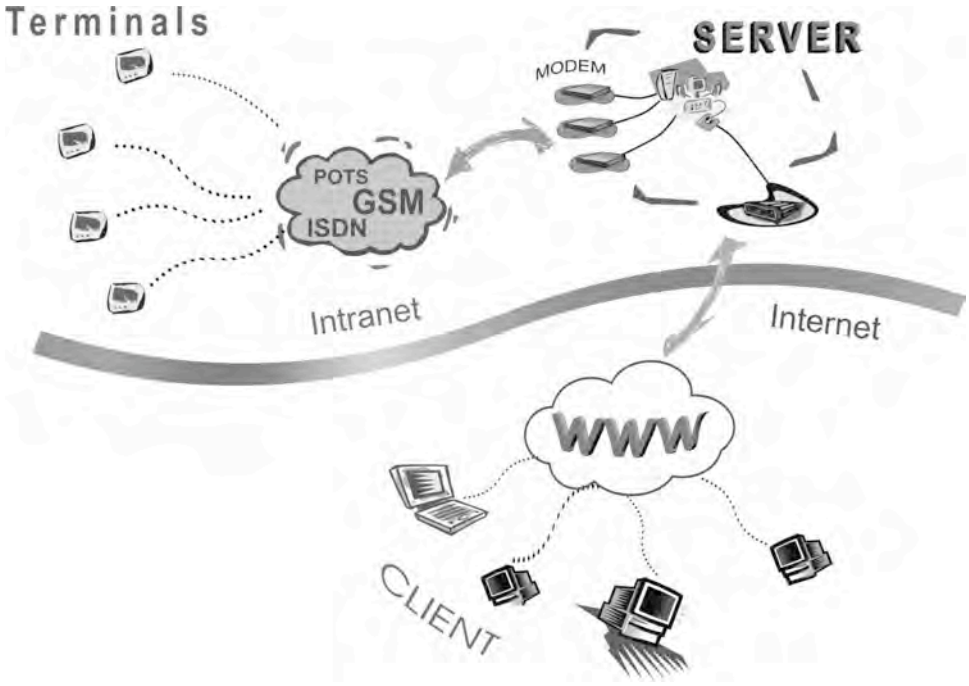

Fig. 3 represents a schematisation of the network approach for the "Medical Provider" architecture.

RESULTS AND DISCUSSION

The system has been tested at prototype level and assures, from a technical point of view, reliable operation also when used for on line control and data acquisition through a web connection. As an example the fig. 4 shows an on line recorded ECG.

Fig. 4: example of on line recorded ECG (by web)

The typical remote Client access (e.g. the remote physician or hospital) to the service involves the use of any kind of PC, simply equipped by a standard Internet Browser, disregarding the Operating System and the Hardware platform, and a network connection (modem or any other link).

When connected to the website of the Medical Server, the proper control interface is loaded by the Java engine of the browser and made available for remote control of connected devices to the Medical Provider. At this level, this linkage is realised by a specific net to the remote monitoring device, providing all the proprietary control protocols. Then this connection appears fully transparent for the Client, who is able to remotely collect data and properly control the device operations.

The Medical Provider Utility Software assures the necessary specific data organisation (depending on the data nature), some processing software and any other needed data handling (e.g. statistics). Also security and safety tools are foreseen operating on the Server.

The proposed example, even if limited to a pilot experience, constitutes an operating system following the general features above described.

To move the developed approach to more complex care environments on a geographical basis, the crucial aspect to be faced is represented by the extension of the architecture. At present we are involved in a National Project (eRMETE); starting from the described experience, some available Telemedicine applications will be tested and integrated in such a developed architecture. Both Second Opinion services and telemonitoring will be fused in the system and organised at a multiregional level, connecting several Italian Regions.

In fact, we believe that only "globalizing" answers will be effective to move the specific Telemedicine applications towards a fully integrated service of the public health organization.

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