MULTIMEDIA PERSPECTIVES FOR NEXT GENERATION PAC SYSTEMS

Santina Franchi, Mario Imperato, Franco Prampolini
IBM SEMEA Rome Scientific Center,
V. Oceano Pacifico 71/73, 00144 Rome, Italy.

Abstract

The design of a multimedia medical information system implies an extension of the issues previously described for PAC systems. Database structures must be defined to describe the physical features and the clinical contents of each kind of multimedia clinical data. Mass storage requirements dramatically increase to archive audio and/or video sequences. As for PACS, high speed networking is necessary. Moreover, the transfer of multimedia information implies further requirements for the network subsystem, e.g., the capability to support synchronous traffic. In order to achieve a richer interaction of the radiologist with the system, the user workstation must be properly equipped to allow access and presentation of multimedia data. At a higher level, the hypertext model can be exploited for effective consultation of clinical data.

All the previous issues have been considered in the design of a multimedia system under development at IBM Rome Scientific Center. The system addresses multimedia information management and can provide the basis of an advanced PAC system.

Introduction

Current PAC systems have been designed as particular case of image database system characterized by strict constraints imposed by the specific needs of medical applications.

One of the most important requirements is short response time, which can be achieved by a fast access to stored images, and by a high speed image transfer via suitable networking. Another critical issue concerns medical image visualization:
proper resolution and contrast are required for diagnosis (the values of these characteristics depend on the specific category of medical image), while image manipulation and enhancement functions must be provided for examination. A further key point for system usability is a full featured friendly user interface.

These issues have not been completely achieved by current PAC systems. On the other hand, new technologies allow the integrated and synchronized management of different media, such as video, audio, still image, text, and graphics.

Since the information to be managed in the hospital is extremely heterogeneous, the multimedia approach can address new solutions for the design of PAC systems. A first perspective is the integrated management of all the different kinds of output provided by modalities. Moreover, the concept of "multimedia document" can be applied to provide the user with a more natural view of clinical information (like the radiologist’s report usually managed as mere text), whose native form is a mix of images, text and audio.

A global architecture of the hospital information structure can be based on the integration among HIS (Hospital Information System), RIS (Radiology Information System), and a multimedia medical information system.

At Rome Scientific Center, activities have been carried out first on image database system, and later on multimedia systems. On the basis of this background, a multimedia distributed system has been designed and partially realized. The next paragraphs will describe the architecture and the modules of the system, which can be applied, in perspectives, in the medical context, both to realize a multimedia PACS and to provide tools for cooperative diagnosis and consultation.

**Architecture of a multimedia medical information system**

The clinical information managed in a hospital is intrinsically heterogeneous. In some cases, the modality output is converted to a different data type, in order to be managed by the information system, as for the report, which is often recorded on tape by radiologists, and then written as text by a secretary. Furthermore, there are kinds of information that are not managed by traditional information systems, which are unable to deal with their original data type (for instance, this can happen when the modality output is a full-motion video). Solving these problems allows to provide the physicians with richer clinical information.

The previous considerations lead to extend the PACS concept towards the coordinated management of different types of information, according to the concept of multimedia.
The multimedia system under development at IBM Rome Scientific Center addresses multimedia information management; it can provide the basis of an advanced PAC system. Figure 1 shows the software architecture of the system, structured in layers that will be described according to a bottom up view.

The application works on the formatted and unformatted data of the lowest level: the files (FF) of the multimedia objects (texts, images, etc.), and the relational tables, which can be logically divided in three databases:

- EM tables report the characteristics of the multimedia entities and the description (a text and a free number of attributes) of the contents of the multimedia entities.
- MM tables provide the description of mass storage resources used in the system.
- HRM tables describe and manage hypermedia structures, like nodes and links.

![System software architecture diagram](image)

Figure 1. System software architecture
The following layer is composed by the operating system (OS), which is extended by local (DD) and network (ND) device drivers, by the relational DBMS and by the resource manager (RM). RM manages the communication and the access to local and remote resources.

At a higher level, there are the following libraries of elementary functions:

- MAIM, access method to description of the contents of multimedia data;
- MARM, access method to description of mass storage resources;
- GESI, entity manager of the hypermedia structures.

The libraries are used to realize the complex functions of the upper layers, which are:

- APP_IND: a set of application independent functions, like conversion routines and network facilities.
- APP_DEP: an application dependent module, that realizes the application dependent functions clustering library functions and/or calling APP_IND functions.

The interaction with the user is carried on by a Native User Interface (NIU), by which the user files and retrieves multimedia data, manages single or composite multimedia entities and structures, and consults hypermedia networks.

An Extended User Interface (EUI) can be realized by the User Interface Authoring (UIA) module.

Future extensions will involve the integration of a knowledge base (BAC); the inferential engine MOBAC access by the elementary functions of the library ABACO, which are bricks of high level functions that provide intelligent retrieval capabilities and integrity constraints control.

The structure of the system is based on a Local Area Network (LAN). The user workstations (OS/2 PS/2 or AIX RS/6000) are connected to the LAN, as other stations that play the role of mass storage servers (PS/2, RS/6000 and disk libraries), relational DBMS servers (RS/6000), and input servers (PS/2 or RS/6000).

The DBMS is running on one or more dedicated servers; database access programs will be run on the servers by the workstations. Also the APP_DEP functions run on a server to preserve system generality.