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Standardisation of Medical Images and Mimosa Model

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Abstract---This paper mainly deals with the standardisation of medical images and picture archiving and communication system (PACS). PACS manages the image related documents and reports. Though PACS made a huge revolution in the medical field it failed to satisfy the need of the medical community requirements. This was because PACS mainly focused on the technical solutions and little on the management of the image itself. To solve these problems, the only solution was modelling. This paved the way for the medical image management in an open system architecture (MIMOSA) model. Its contribution is explained in detail along with importance of PACS and need for standardisation in medical images. Emphasis is put on architectural issues and methodology of MIMOSA. This paper also deals with the relevance of the Digital Imaging and Communications in Medicine (DICOM) standard with respect to image management issues to be assessed, highlighting some current limitations of this standard and proposing extensions. Thus a survey on MIMOSA finally reveals that it can bring solutions to the standardisation of medical imaging.

Index terms- MIMOSA, PACS, and standardisation

I. INTRODUCTION

PACS was introduced in the mid 1980s and became mature in late 1990s. It man- ages radiological examinations, collects digital images from computed tomography (CT), magnetic resonance imaging (MRI),etc; and archiving them for future references. It eliminates the need to manually file, retrieve, or transport of film jackets. Generally PACS images are stored and transferred in a format called DICOM (Digital Imaging and Communications in Medicine). PACS is an integration of many classes of imaging computer system such as radiological imaging devices, device interfaces, PACS controllers with database and archiving servers. Though PACS revolutionised the imaging process, it wasn't even to provide the required standards. There are two aspects for this standards. One concerns the protocols used in image exchanging and other concerns the format used to represent the image during exchange. Thus to bring about standardisation, the ACR-NEMA chose a purpose-built standard to solve the problem of formatting, access and communication. The reason behind this choice shows the influence of general technological context on the development standards.

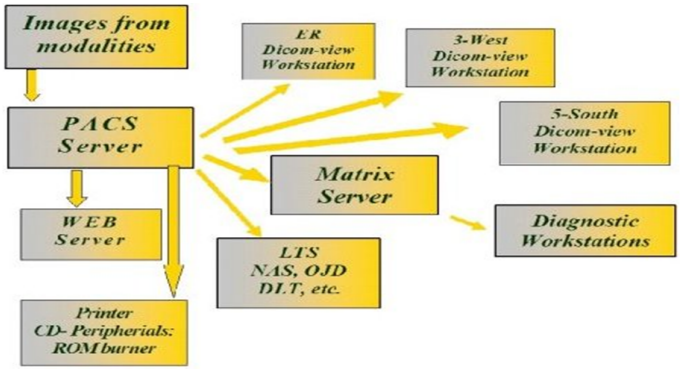


Fig: General block diagram of PACS

Then emerged the conceptual model called MIMOSA. The aim of the MIMOSA model, developed within the framework of the AIM EurIPACS (1992–1994) project, was "to provide a generic framework for an information system dealing with the exchange and the management of medical images and their related information within a medical information processing organization" [1], [2].

II. CREATING STANDARDS IN THE FIELD OF PACS SYSTEM

A. Need for standardisation in imaging

During the late 1980's, HIS, was mainly focusing on the administrative and financial management of hospitals. But later due to growing support of patient care and in management of medical data, there a raised a need for both autonomy and flexibility. This

has increased the need for communication and sharing of information between the patient care department and technical department to make better use of the collected information.

Thus, development of such solutions required the existence of standards that define how the systems of HIS will interact. These standards, therefore, required the agreement exists regarding the following.

1) The external description of various components.
2) Model for how the organising components will actually function.
3) Definition of interfaces between the component

The first two points of agreements are commonly refered as “reference architecture”.

III. PROBLEMS ON THE DEFINITION OF STANDARDISATION

Creating standards in these areas causes problems on two levels.

A. The first problem is linked to diversity and complexity of organisations that differ in their size and their role in the health care and their interaction.

B. The second difficulty is linked to the ambivalence of the standardization aims, i.e., whether 1) to create uniformity in modes of work organization or 2) to define a framework allowing the accommodation of different work organization modes.

IV. STRATEGIES FOR DEFINING STANDARDS IN THE MEDICAL IMAGING

The definition of standards in these fields depends on two strategies, one sectoral and the other global. Table I gives an overview of the advantages and drawbacks of each of them.

Global strategy: This strategy takes the full range of requirements into account and abstract them to extract the reference model , needed for managing the interaction between the components of the information system.

Sectoral strategy: This strategy is a restricted one that can be applied only to limited sectors, in response to short term or medium term demand.

V. MIMOSA-FUTURE OF MEDICAL IMAGING

The aim of the MIMOSA project, carried out in the frame- work of the EurIPACS (AIM no 2009) contract, was to create a conceptual model for image management, based on user requirements, that was generic (i.e., independent of particular medical specialities and of local organizations) and implementation-independent.

During the early 1980’s, importance of PACS in medical imaging was realised. This image management concept necessitates not limiting oneself to the exchange or storage of the images themselves, but implies instead the taking into account of a set of information as- sociated with images which describes the why and how of image acquisition and processing, and also taking into account the framework in which health professionals will use the images and associated information. This kind of approach to PACS design, although proposed by some pioneers in the 1980’s [3], did not materialize until the 1990’s.

This has lead us to define a model for the management of images. This model does not aim to take account of all possible situations. It works rather by identifying the major basic concepts of medical image management, and considers these basic concepts as being independent of the modes of local organization.

The MIMOSA model, thus, concentrates on the functions of a medical image management system (MIMS) assisting in the carrying out of medical Acts leading to the production or use of images, and in communication between users.

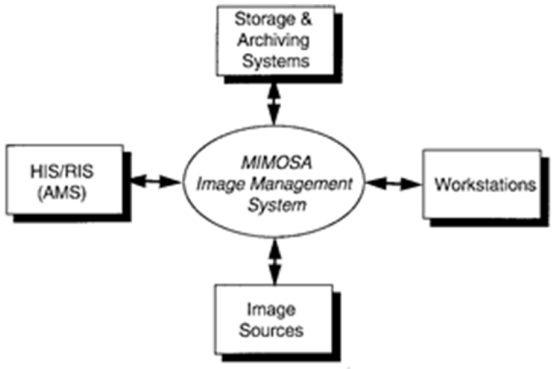


Fig. 1 shows the position of a MIMS in relation to its surroundings.

VI. METHODOLOGICAL APPROACH

This model essentially concerns on the interaction between between image-producing sources, the worksta- tions which use images, storage systems which archive them, and administrative information systems. . The functional frontier between MIMS and administrative information systems is more difficult to define. Many authors emphasize the difficulties of assigning precise functions to a PACS or radiological information system (RIS) [4], [5]. We have, thus, opted in the MIMS to retain only functions genuinely specific to image management.

The creation of a model which can contribute to the defi- nition of a reference model necessitates that the methodology employed takes into account the three fundamental aspects of an information system, under the form of: 1) a data model, 2) a functional model, and 3) a dynamic model.

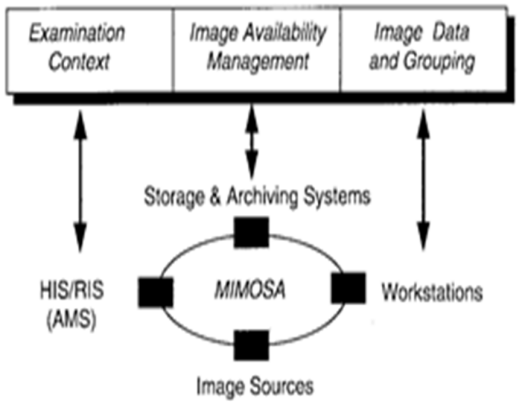


fig: the domain of interest of MIMOSA model

A. Summary

A detailed and complete summary is given on MIMOSA in its final submission to the European Union [1] [2]. This paper mainly focuses on the description of the data model and of the functional model, which are the most relevant with respect to the definition of an architecture of reference in the field of PACS's.

VII. ROLE OF MIMOSA MODEL IN STANDARDISATION

This part mainly deals with how this MIMOSA model act as framework in the development of future standards and its effect on DICOM standards with regards to the image management. Then we also deal with MIMOSA demonstrator and this analysis gives the limitation of DICOM.

VIII. CONTRIBUTION TO THE REFERENCE ARCHITECTURE FOR IMAGE MANANGEMENT

The MIMOSA model, since it specifies the functional elements inherent to image management, independently of imaging techniques and of image producing and user medical specialities, contributes to the definition of a reference model in the image management field.

The MIMOSA model sets out the interactions between the image management functions and the HIS components, and notably, the relations with the Act manager in charge of organizing the activity. This setting out is vital for the development of standards. One of the principal advantages of the MIMOSA model consists precisely in defining the appropriate level of abstraction++n.

Besides this, the generic nature of the MIMOSA model gives manufacturers the means to construct products which facilitate the reuse of components in other application areas. The model can easily be extended and specialized to meet the requirements for image management in, for example, a radiotherapy unit. The benefits of this generic aspect are: 1) economies in terms of the design, development and maintenance of products, due to reusability and 2) easier interoperability between applications, due to the fact that the different applications or application modules are developed using the same model

IX. MIMOSA DEMONSTRATOR

The ultimate aim of this demonstrator depends on three things: 1) to show that the MIMOSA approach is realistic; 2) to show that it responds well to the user requirements; 3) to show the compatibility of the model with DICOM standards.

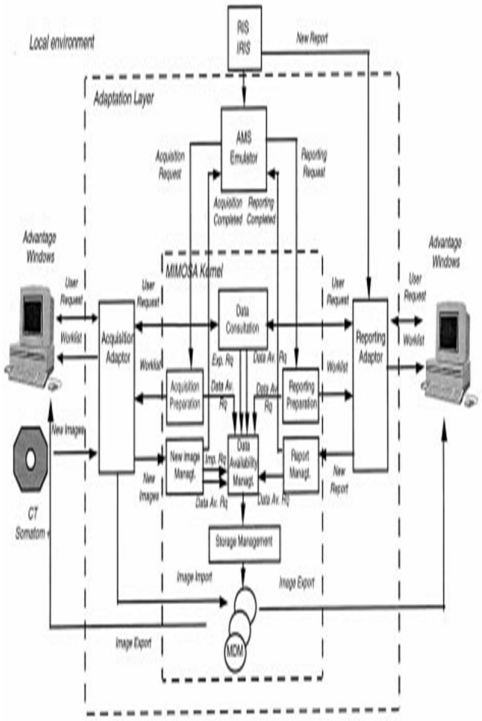
A detailed presentation of the contents of this demonstrator has been given elsewhere [6]. We present here a concise description of the architecture used. The choice of architecture took account of two major constraints. The first is that the MIMOSA kernel, implementing the MIMOSA services, be developed as an autonomous, generic set of software, that is, totally independent of the components of the site, and that the kernel be portable. The second constraint relates to the openness of the system, implying that the MIMOSA services be implemented by making maximum use of the DICOM communication standard. These constraints led us to design an architecture with three layers: local environment, adaptation layer and MIMOSA kernel [see Fig. 3].

Besides the improvement and clarification of the model, the demonstrator permitted correctly situating the MIMOSA model in relation to the DICOM standard, in investigating the suitability of the DICOM standard, and in studying in detail, in conformity with the functional specificities noted above, the three following services:

1.worklist management;

2. image importing, that is the bringing of images into the image management system;

3. image availability management, in order to take distributed storage into account.



IRIS: Integrated Radiology Information System. AMS Emulator: Act Management System Emulator. MDM: MIMOSA Directory Managers.

Data Av. Rq: Data Availability Request.

Exp. Rq: Export Request. Imp. Rq: Import Request.

Fig. 3. General architecture of the MIMOSA demonstrator. The first layer (the local environment) contains the existing components on the site, that is the RIS (IRIS software developed locally), an X-ray scanner (Somatom Siemens), a workstation linked to the scanner, and an interpretation workstation (Advantage Windows by General Electric). The second layer (the adaptation layer) takes into account the specific characteristics of the components on the site and interacts with the MIMOSA server; it includes notably the AMS emulator. The third layer (the MIMOSA kernel) implements the MIMS services, in conformity with the MIMOSA model. It is implemented in the form of generic and portable software.

X. CONCLUSION

With this, we can draw the conclusion that the success and failure of a product depends on its efficiency in the market and the attraction it gains. Not only that but also depends on its quality or standards. Especially in medical field, quality is more important than quantity because it deals with a human life. But one can ask what is the use of standardisation of medical images?,

well with growing technology, everything in health care sector is computerised and all the treatments are given based on medical images. Hence standardisation of PACS will help the users interpret the problem more easily.

But why MIMOSA?, in 1991, when the concept of MIMOSA was put forward, it was not welcomed by everyone. Some doubted the feasibility of the model and did not understand why the initiators did not start with ACR-NEMA work as a starting point. And also, in 1991, DICOM did not exist and the only source of medical image was ACR-NEMA 2.0 and it did not meet the users requirement in terms of image management[6] [7]. Though it dealt with the problem of image communication, it failed to make any impact on image management.

Thus, MIMOSA contributes this purpose in an efficient way. The experience from the development of the MIMOSA demonstrator has allowed us to clarify where DICOM proves suitable to the implementation of image management systems, and equally what are its limitations. The MIMOSA demonstrator has also shown that DICOM cannot respond to all the needs expressed by users, for instance in the management of image availability, which the MIMOSA model for its part does take into account. This should, thus, lead to desirable extensions of the current DICOM standard.

The approach used in MIMOSA offers industry the support of a reference model for creating a generic image management product, easily extendible and customisable in order to meet the specific requirements of different specialities

XI. ACKNOWLEGEMENT

We could like to thank all the resources who contributed to the MIMOSA model and the implementation of demonstrator.

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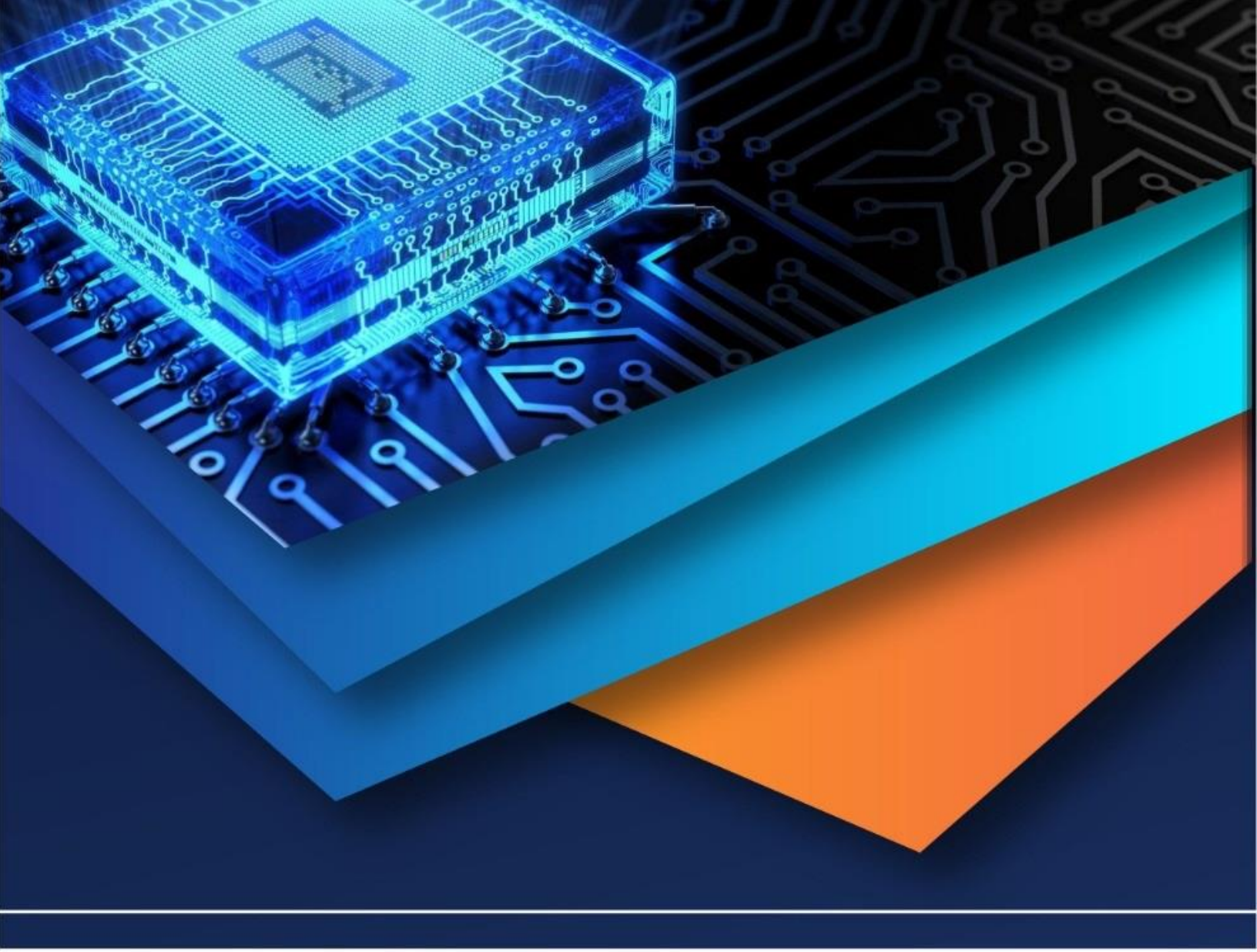

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