

A Storage and a Research Model of Medical Imaging in a Hospital Information System

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Abstract: *The objective of our study is to focus on the domain of handling digital image [1] by a medical information system. The real evolution of the image is not recent but dates to the year 1963 with the project sketchpad of Ivan Sutherland [2] which shows the feasibility of creating, storing and manipulating computer images [3]. The construction process of digital image (IRM, CT, ...) [4], [5] pass by specific materials allowing to convert the medical image information into a set of digital information stored in the computer machine [6]. Thus, we need to transfer the medical image information into a computer which retains this information as a set of files by respecting the protocol of image conversion and the medium which manages the computer tool i.e. operating system. Afterwards, we must realize a system which permits the communication of medical image with a medical information system. The Database Management Systems (DBMS) are designed to manage textual information but makes difficult the management of medical image. In our case, we are interested in the information system « CheBHosp » [7], [8] which uses a browser that allows the user to manipulate the medical image.*

Keywords: Medical Image, Medical Information System, Patient, DBMS, DICOM, PACS

1. Introduction

Medical images are not limited to the process of scanning or digitalization, and they remain a complex task that is currently the subject of numerous studies. The nature of medical images requires taking new considerations in terms of capacity structuring, organization and storage. The management of medical images has been firstly highlighted by [9]. While medical images indexing is a difficult step to achieve on operating system level, since most operating systems store medical images as a set of files defined by certain number of restricted information (name, extension, creation date, modification date, ...). On the other hand, database management systems are indexing systems [10] which manage textual and numerical information but are not designed for the management of medical images. For this reason, we are interested in realizing a model that combines between the database management system and the operating system in order to facilitate the management and indexing of medical images.

2. Medical image and information system

The creation of the medical image [11] takes place in a hospital center by a technician which sends the result of the medical image to a radiologist who manipulates and analyzes the image in order to write a descriptive report with conclusions which are necessary for the concerned doctor who must make a decision about them in order to be carried out by the nurse(s) of the department (figure 1)

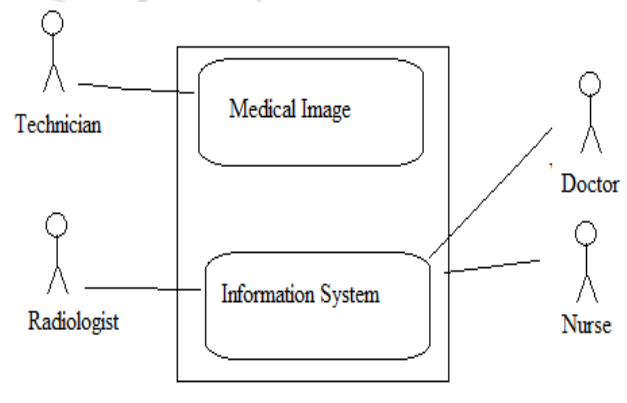


Figure 1: Use case diagram

The integration of medical images in a hospital information system has several advantages:

- *Reducing the cost of image production.* To avoid generating some non-useful images, there is a need for a tool for sharing medical images between physicians of different specialties and services.
- *Quick access to images.* The implementation of a solution for medical image management improves the analysis time and the study of images and therefore optimizes the diagnosis and the therapeutic strategy.

3. DBMS and Medical Image

The traditional Database Management Systems (DBMS) [12] are designed to manage textual or numerical information which suffer from some problems that make difficult the integration of images. Quoting:

The storage of images requires on one hand, a larger disk space and, on the other hand, a more advanced storage techniques [13] that are used for textual data.

Image searching remains an open reflection domain for the scientific community [14]. The general problem of image searching [15] circulates around four main axes:

1. What information we can extract from the image and how?
2. How to interpret the image?
3. What the user searches for?
4. How to formulate and interpret the user's needs?

4. Link between information system and medical imaging

A patient in an information system is generally identified by two identifiers:

One that describes the patient personal information, and the other describes the patient entry within the hospital whether an external patient (just to make some examination without having to stay in the hospital) or an internal patient (staying within the hospital)(figure 2)

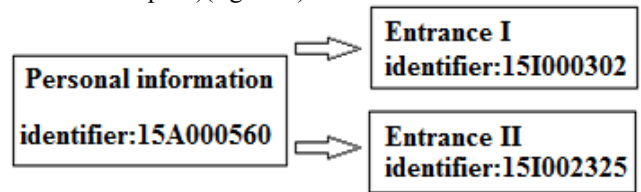


Figure 2: Patient identifiers

The patient entry identifier links the directory name which contains all the files representing the medical image of the patient (figure 3)

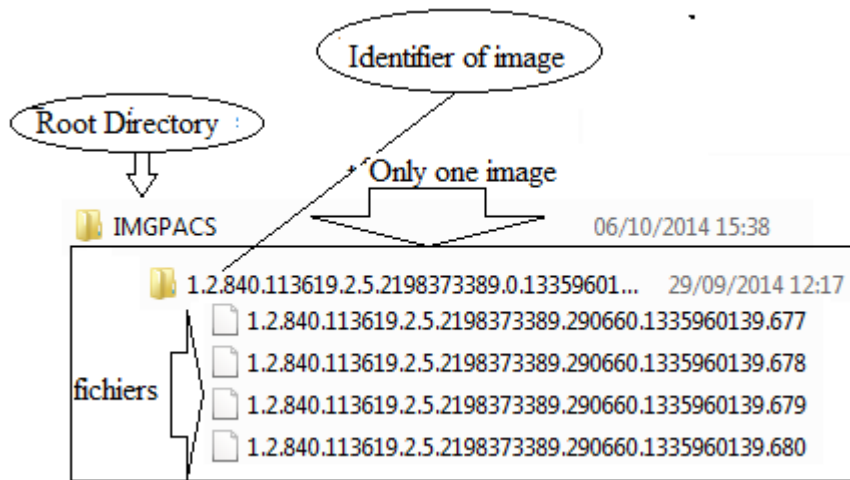


Figure 3: Medical image in an operating system using DICOM format

The link between all medical images and the hospital information system is described by the following entity nt:

RXRAY(ADMI ,CARACT , SERIAL, CODE_TECH, COE_RADIOLOGUE, FDICOM, REPORT)

ADMI: is the identifier of the patient's case
 CARACT: indicates image type (ECHO, SCANNER, IRM,...)

SERIAL :is an integer number so that ADM I, CARACT, SERIAL is an identifier of the entity RXARY and this identifier makes the link with other financial or medical image information.

CODE_TECH:is a codethat links technician information that are described in the HR (Human Resources) system.

CODE_RADIOLOGUE:is a code that links radiologist information that are described in the HR (Human Resources) system.

REPORT: contains information of the written report by the radiologist.

FDICOM: contains information of the files identifiers of the medical image. So it makes the connection between the operating system and the hospital information system of the image information.

To realize the link between the operating system and the hospital information system the technician must enter the patient entry identifier of the file contents(ADMI) (figure 4)

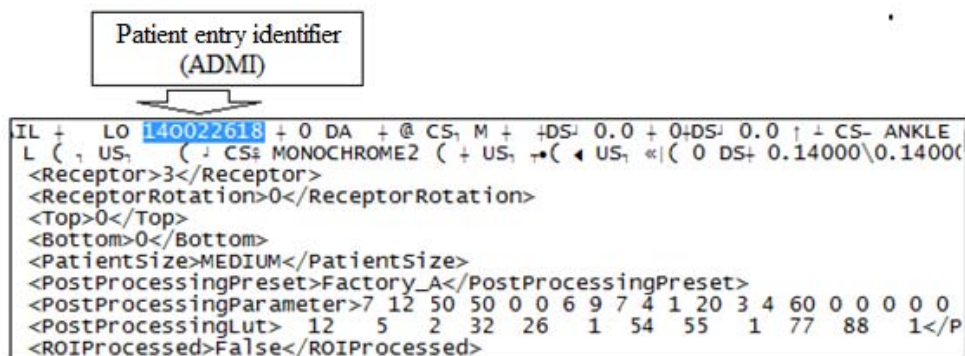


Figure 4: Notepad information describing medical image of identifier140022618

The medical image can be displayed by the software “UniViewer” and we can view the information entered by the technician (figure 5)



Figure 5: Entered information by technician (ADMI)

5. The Search Interface

The user must enter the necessary information in order the system to retrieve the patient medical image with the minimum time. For this, the user submits the reference and the date estimate limits (from date –to date) for the creation of the image (figure 6). The date estimate method allows to select all the files having their creation date between the two entered dates based on the following operating system command (ADIR(TP1, '*.*', 'D'))

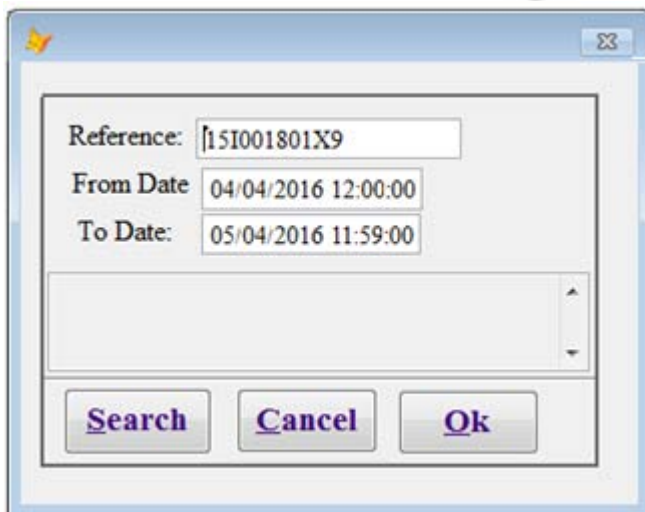


Figure 6: Required information to retrieve the patient's medical image

6. The proposed algorithm to retrieve patient information

```

FUNCTION CherchDcmFile
Test=False
MaAdmi=""

File=FOPEN("IMAGE.DCM",10)
DO WHILE((Not Test) AND (!EOF(File)))
    C1=FREAD(File,1)
    IF(C1='L' AND Not Test)
        C1=FREAD(File,1)
        C2=FREAD(File,1)
        C3=FREAD(File,1)
    IF(C1='O' AND (ASC(C2)=10 OR ASC(C2)=4 OR
ASC(C2)=2 OR
ASC(C2)=6 OR ASC(C2)=12) AND ASC(C3)=0)
        Test1=True
        Test=True
    DO WHILE(Test1 AND (!EOF(File)))
        C1=FREAD(File,1)
        IF(ASC(C1)!=16)
            MaAdmi=MaAdmi+C1
        ELSE
            Test1=False
        ENDIF
    ENDDO
    ELSE
        FSEEK(File,-3,1)
    ENDIF
ENDIF
    
```



```
ENDIF  
ENDDO  
=FCLOSE(File)  
ENDIF  
RETURN MaAdmi
```

7. Conclusion

With the advance of technology, the integration of medical images in the database management systems has become a necessity in several domains. In fact, thousands of images are daily produced by medical equipment's, so the usage of medical images requires new methods of storing, organizing, searching and browsing images. Since 70s, image search has experienced an important research and study activity. Most of the proposed solutions are based on highly correlated parameters of a chosen application domain and the expressed user's needs. In this domain, existing solutions, are often called PACS (Picture Archiving and Communication Systems), are only based on limited parameters such as patient name, and the date of image acquisition. In response to this problem, we have introduced a model that permits to store the image on the hard disk. Moreover, we have made a link through a special search that permits sharing the time by doing its link with the medical information system by conserving the directory name containing all the files of the medical image. These files play an important role in describing the concerned patient medical image and by a simple launch of the browser (UniViewer) we can access this image in order to write a text report of all the information detected by the radiologist.

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