

Methodology for the Registration of Images and their Inclusion in Medica Image Management Systems, Based on the DICOM Protocol

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Abstract

Nowadays, information is being generated that can be considered as necessary for a medical evaluation, in this sense, it is necessary that this information can be registered in the different information systems that are used in the medical environment; In this work, we describe a method to convert images in conventional format such as PNG, BMP, JPG, among others, to the DICOM format, which is the standard format for the use and manipulation of medical images for use in medical imaging, to demonstrate the method we use the Matlab programming language as a programming tool, the results show that the images generated can be stored in PACS systems, which can be integrated into computer systems for clinical use. We conclude that the method can be scalable to different types of images that can be exploited in the medical field.

Keywords

Medical image, protocol, DICOM, Protocol and processing.

1. Introduction

Currently, technological progress is causing the generation of information, the health area is no exception, where applications are developed that record signals and images, in a review of the state of the art, we find works where applications are developed related to the registration of vaccines for different types of diseases as is the case of those dedicated to the pandemic by Covid-19 [1]. Also in the care of children there are vaccination programs, in most countries, in order to control these processes there are applications where they are responsible for controlling the children who access vaccination programs [2].

When developing devices for recording medical signals, one of the main functions is that which is responsible for sending the signals, its proper use and application ensures the integrity of the signal

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[3]. If it is desired that the devices can be integrated with the various computer systems that are running in health centers, the use of interfaces related to interoperability for communication between devices and computer systems is resorted to [4]. These new solutions are also dedicated to the use in hospital centers, with the intention of being able to monitor hospitalized patients, who are under the care of nurses, these solutions are based on IoT-based technologies [5]. In the use and exploitation of medical images, they are dedicated to the design of algorithms for the search of disease gap patterns in images [6].

In the exploitation of images, we find uses dedicated to explore land cover, as is the case of satellite images, which also have their own formats where they join scene information with location information, measured by longitude and latitude measurements [7]. This registration is done through satellite images of different modalities such as panchromatic and multi-spectral, all of them worked from hardware platforms such as GPUs [10].

In the analysis of solutions for the health sector, we must be very careful in the regulations governing the development and implementation of medical devices, in order to reach commercial uses and clinical application, one of the mechanisms that ensures the integrity of the equipment and to ensure the protection of the patient in situations of unforeseen electrical discharges, are contemplated in the electrical compatibility tests through the IEC-60601 standard [8]. In this way, if we wish to dedicate ourselves exclusively to the analysis of the signals apart from the hardware design, we find the wearable devices where they present safe designs and leave open the possibilities of the development of software-based applications to analyze and characterize the recorded signals [9].

In the present work, we developed a methodology to be able to record images of different types and to be able to take them to a situation of a possible medical image, by converting commercial formats to the DICOM format, which is the most used in computer systems dedicated to the management of medical images, with the conversion of these formats, we can store the images in medical image servers known as PACS.

2. Materials and Methods

The materials and methods are described in the form of a block diagram, which describes the procedures necessary to convert images that are in commercial formats such as PNG, BMP, JPG among the main ones, can be transformed into images in medical format such as DICOM, then presents the procedures for conversion and can be stored in medical image management systems, such as PACS systems.

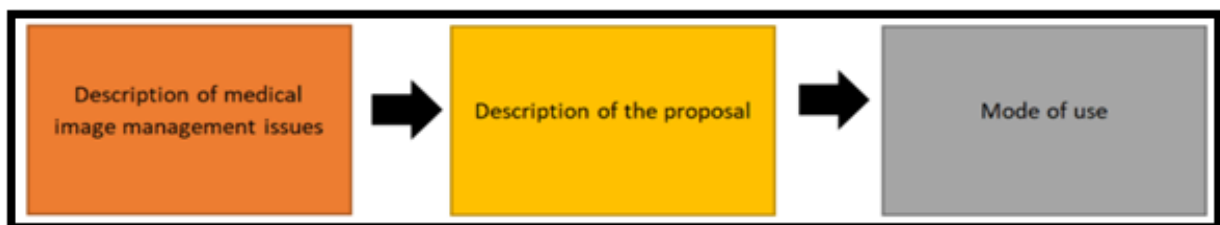


Figure 1: Block diagram of the proposal

Figure 1 shows the block diagram of the methodological proposal, where the procedures for the conversion of images to the DICOM standard are developed, starting with a description of the problematic situation, describing the description of the proposal and ending with the modes of use.

3. Description of Medical Image Management Issues

The problem that we can describe is related to the information that is originating today, related to the exploitation and use of digital devices that record images and videos, such as those that can record

images that correspond to the eyes, such as equipment that evaluate the fundus of the eye, thermal cameras, optical cameras that can record any part of the human body, among others. These generated images need to be registered in the systems that manage medical images, but this registration cannot be performed, because the new images are not in the DICOM format, which is used as standard in the management of medical images, which provide the functionality to be stored in PACS systems, so that they can be shared and displayed in hospital management systems. Since these new images cannot be stored, most of them are lost. The presented method can be used to transform the images that are in commercial format into DICOM format, so that they can be stored in PACS systems.

3.1. Description of the Proposal

The proposed method starts with the identification of the image to be stored. In our case, the image is a fundus image, which is required to be stored in PACS systems.

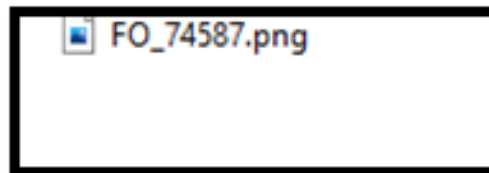


Figure 2: Original image in PNG format

Figure 2 shows the original image in PNG format, this image is generated in the ophthalmological equipment, which records the ocular fundus; the image corresponds to the location of the files within the Matlab development environment.

```
>> fondo_ojo=imread('FO_74587.png');  
>> dicomwrite(fondo_ojo,"FO_74587.dcm",metadata);  
>>
```

Figure 3: Image reading in PNG format and writing in DICOM format

Image 3, shows the programming lines in Matlab, where the image is read in PNG format, we store it in the variable "eye_background", after having created the matrix corresponding to the eye fundus image, the next procedure is to create the DICOM image, for which we resort to the function "dicomwrite", which converts the vector where the medical image is stored, in a format with extension. dcm, which identifies the medical images, to complement this conversion, the creation function needs a file with the Metadata of the image, the structure of the metadata is described in image 4.

Field	Value
Filename	'C:\Program Files\Pol...
FileModDate	'18-dic.-2000 12:06:43'
FileSize	525436
Format	'DICOM'
FormatVersion	3
Width	1152
Height	1500
BitDepth	8
ColorType	'color'
FileMetalInformati...	192
FileMetalInformati...	[0;1]
MediaStorageSOP...	'1.2.840.10008.5.1.4.1....
MediaStorageSOP...	'1.2.840.113619.2.1.24...
TransferSyntaxUID	'1.2.840.10008.1.2'
ImplementationCl...	'1.2.840.113619.6.5'
ImplementationVe...	'1_2_5'
SourceApplication...	'Devide_eyes'
IdentifyingGroupL...	414
ImageType	'DERIVED\SECONDA...
SOPClassUID	'1.2.840.10008.5.1.4.1....
SOPInstanceUID	'1.2.840.113619.2.1.24...
StudyDate	'1993.04.30'
SeriesDate	'1993.04.30'

Figure 4: Metadata editing

In Figure 4, we present the format of the metadata structure, this information is necessary to complete the requirements of the DICOM format, the information contained in the metadata, are part of the characteristics of the generated image, processes and equipment data among others, these data help the search processes that are installed in PACS systems, the creation of the data structure for metadata, can be done manually or automatically, depending on the management of a programming language that can be programmed and complete these necessary data.

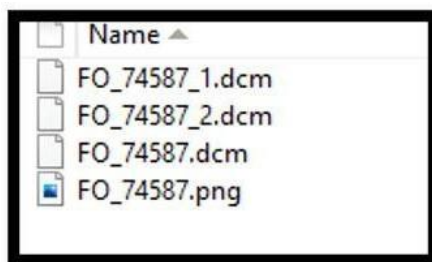


Figure 5: Final result of DICOM image generation

Figure 5 shows the final files after having carried out the medical image creation processes in DICOM format, we present in the image 3 files with the DCM extension, which can be used with PACS systems.

3.2. Mode of Use

The mode of use of the DICOM images generated with the method can be used in different ways, we can indicate that they can be entered to the PACS systems, so that they can be accessed from the workstations dedicated to the visualization and diagnosis of the medical images, we can also visualize them by means of the programs that have the properties of reading DICOM type files. We can also exploit the new images in tele-diagnosis, by means of which the image can be shared and the personnel in charge of image analysis can perform the aforementioned operations, causing other image modalities to be entered into the PACS systems.

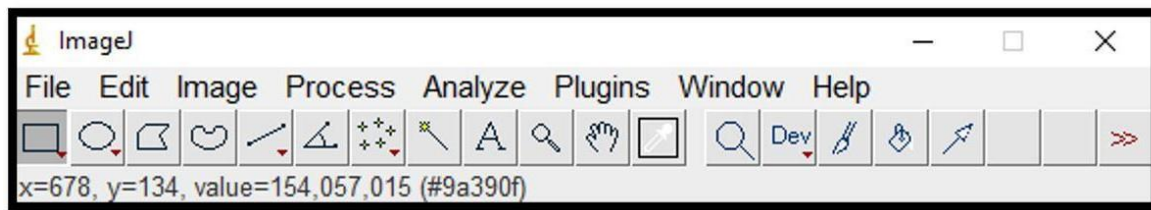


Figure 6: Program for verifying the reading of a DICOM image.

In image 6, we can visualize the interface of the "ImageJ" program, which is one of the most used applications for the visualization of images in DICOM format.

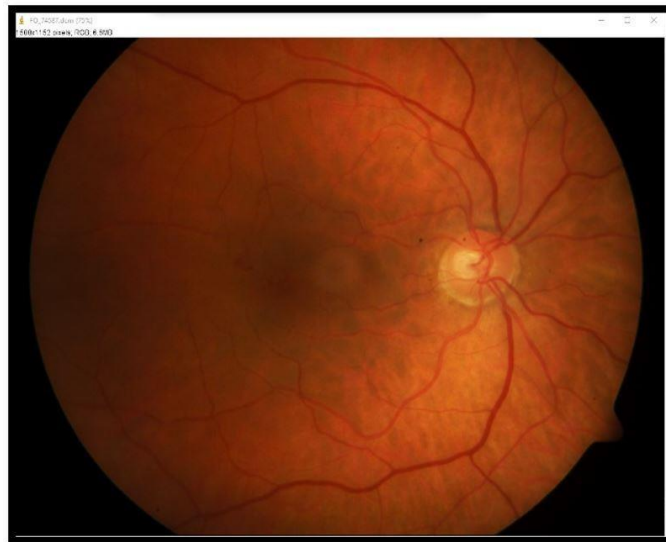


Figure 7: Visualization of a DICOM image.

Image 7 shows the image in DICOM format generated and visualized by means of the "ImageJ" application.

4. Results

The results that we present are related to the description of the method, to be able to transform an image in commercial format into a format characteristic of the medical area, which is the DICOM format, the conversion was demonstrated using a function that is installed by default in the Matlab development environment. The function used is "dicomwrite", so that it can be used without problems and be compatible with other applications, we must create a file containing the metadata that has information of the registry, the equipment, the image capture, among others. The results showed that the images generated are compatible with those generated by the medical equipment itself. We can use other development environments, with the only recommendation being that they may have some verification mechanism, which in our case was performed with the "ImageJ" application.

5. Conclusion

The conclusions we reached at the end of this work, is related to the use of technology, which can be used in real environments, as is the case of medical, we resort to the use of image format conversion mechanism, so that we can have new modalities of images in DICOM format; we recommend working with different programming languages, with the difference that it must have a library for working with medical images, mainly the function of saving images in DICOM format.

These new images can be entered into the databases for storage and use by the different offices of the health center, and can also be used in local mode with the various programs related to the visualization of medical images in DICOM format, as well as being able to be sent to other professionals for analysis and diagnosis.

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