ISSN No:-2456-2165

Analysis of Various Medical Image File Formats

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Abstract:- A medical image is a portrayal of the inward design or capacity of an anatomic locale. It has a variety of picture components called pixels (2 dimensional) or voxels (3 dimensional). The quantity of pixels used to portray the field-of-perspective on a specific securing methodology is an outflow of the detail with which the life structures or capacity can be portrayed. The communication of the pixel data relies upon the imaging methodology, the obtaining convention, the remaking, and at last, the post-processing. This paper presents a demystifying outline of major file formats right now utilized in clinical imaging: Neuroimaging Informatics Technology Initiative (Nifti) and Digital Imaging and Communications in Medicine (Dicom). Concepts which is common to all document designs, like pixel profundity, photograph metric understanding, metadata, and pixel information, are first considered. Then, at this point, the attributes and qualities of the different formats are examined.

Keywords:- *Medical Imaging. Image Processing, File Formats, DICOM, Nifti.*

I. INTRODUCTION

A medical image data set comprises ordinarily of at least one pictures addressing the projection of an anatomical volume onto a picture plane (projection or planar imaging), a progression of pictures addressing slim cuts through a volume (tomographic or multi slice two-dimensional imaging), a bunch of information from a (volume or three-dimensional imaging), or numerous securing of the equivalent tomographic or volume picture over the long haul to create a unique series of acquisitions (four-dimensional imaging). Medical images has different file formats which explains the arrangement of the data within the image and also depicts the ways of pixels interpretation. All image file formats should be analyzed which includes information of pixels, analysis of medical data and metadata. Then the various file formats are given. At the end, limitations and advantages of the file formats are deliberated, with few contemplations about the upcoming instructions in the area of medical image file formats.

Fundamental Ideas

A medical image is a portrayal of the inward design or capacity of an anatomic locale. It has a variety of picture components called pixels (2 dimensional) or voxels (3 dimensional). The quantity of pixels used to portray the field of-perspective on a specific securing methodology is an outflow of the detail with which the life structures or capacity can be portrayed. What the mathematical worth of the pixel communicates relies upon the imaging methodology, the obtaining convention, the remaking, and at last, the postprocessing. The first category is about the depth of pixel. The pixel depth also called as depth of bit. It allows to store the file in specific range. It works on the equation 2 raise to the power n where n represents the depth of pixel. For example, an raster which is having 8 bit can include 256 values which is considered as unique and its starts from zero and extends till 255. Bit depth has different type which usually depicts the limit of values for storage. The following limits are for unsigned data type. If it is a single bit, it starts from 0 and end at 1. If it is a two bit, it starts from 0 and end at 4. If it is a four bit, it starts from 0 and end at 1. If it is a eight bit, it starts from 0 and end at 255. If it is a sixteen bit, it starts from 0 and end at 65535. If it is a thirty-two bit, it starts from 0 and end at 4294967295.The following limits are for signed data type. If it is eight bits, it starts from -128 and end at 127. If it is sixteen bits, it starts from -32768 and end at 32767. If it is thirty-two bits, it starts from -2147483648 and end at 2147483647. Real and imaginary part of complex data consider as pairs of real numbers. Therefore, pixel depth of complex data is double the single real number. Second is about the Data Information. Information that explains the image is called as metadata. For any image, information about the image presents at the backside of pixel data. This information presents at the initial part of the file as a header which consists of sizes, resolution, photometric interpretation. Metadata plays an important role in the medical image file format. Various modalities produce information about the creation of images. For example, attributes of MRI are related to sequence of pulse which is used. For example, e.g., information about the time, angle how u flipped, acquisitions count etc. positron emission tomography uses a radioactive drug and MRI uses magnetic fields which is so strong, gradients of the magnetic field, and radio waves to produce picture of the various organs in the human body. Metadata portion presents in post operation file format explain the depth of pixel data. Modality produced images are different from the post operational images which comprises different contents. Metadata are a powerful tool to comment and make full use of information which is related for medical and investigation purposes and to arrange and fetch into archives images and relevant data. Third is about the Pixel Information. Pixel Information is the numerical values which can be stored in the medical images. It can be either integers or floating point numbers. It is used to represent by the bytes which is the form of numerical values. CT, PET images are having 16 bits to represent each pixel information and it is in the form of integer. The characteristics of each file formats are different. Each can be represented in the form of either

ISSN No:-2456-2165

signed or unsigned integer. Integer data type is suitable for front end but it is not sufficient for the post-processing. Floating point is the best way of representing naturally and also it is suitable for post-processing. As floating point consists of real and imaginary parts, by passing is easy even for the complex data type. Two bytes storage is not sufficient when the pixel information is stored. Problem arises in the LSB and MSB of the pixel information when representing in 2 bytes. This problem arises with respect to the processor. Pixel information starts at the standard location and sometimes in the variable location which depends upon the header length. In either way, the information can be stored in uncompressed format. Compression can be categorized into two techniques. First is lossy and another one is lossless. Lossless compression is the greatest advantage with respect to the storage. Benefit of lossy technique is the information loss cost. It's anything but clear under which conditions the perusing of the pictures or potentially the quantitative post-handling systems are not affected by information loss. Then again, the appropriation of lossy techniques with a low or moderate loss of information instead of lossless ones can be considered. Recovering exact data which is original and recovering complete data from the compressed data is a tedious task which can be allowed by very few compression forms. Referring this technique as "lossless" or "reversible" compression schemes. Take a consumer application as an example. While decompressing text documents, character changes is not acceptable irrespective of frequency of occurrence. Applications of medical images may expect the exact restoration of the input and hence lossless compression is widely used. Lossy or irreversible compression occurs when the output which is compressed are not similar to the original, but still the loss amount and loss type is adequate for some application. Lossy compression is widely used in pages of web browser and also continuously applied the colorful images which is extracted from digital cameras.

II. FILE FORMATS

Medical image file formats can be categorized into two formats. Standardization of the images is in the format of DICOM where the images can be generated by modalities. To improve the post- processing, the Nifti can be used. Medical images are always stored in two ways. First way is using meta data and image data which can be stored in one single file. Second way is storing the two in different files.

A. DICOM

DICOM stands for Digital Imaging and Communications in Medicine which is used to share the medical images, which is used to view the medical images, store the medical images and finally used to retrieve the medical images. It is widely accepted format. It follows certain rules to manage the correct information conforms to set protocols to maintain accuracy of information transmitted through medical images. Each and every DICOM medical image has two components. First one is header and the second is the original image itself. First component has the data which explains the image contains important information about patient. It contains all the patients basic and necessary information such as their name, sex, birth date and age. It also provides the data about the properties of image such as image size, rows and column size, attributes and pixel resolution. The header provides the patient's medical information and also basic information when DICOM images opens in the folder. Patient information can be identified easily by verifying the images which is coded. But still the header information be lost sometimes if the file format is converted to any other formats like PNG, GIFF etc. Sometimes the header data will be lost usually for the purpose of anonymization. Some few software's can achieve this anonymization. PACS stands for Picture Archiving and Communications System. It is a database where all the medical images can be saved. The server of Picture Archiving and Communications System should have enough space to store high quality DICOM files as it tends to consume more space. PACS server is owned by each and every hospital. Hospital has the setup to store each and every medical image automatically in its PACS server. Before storing the images, file converts to various formats such as Joint Photographic Experts Group, Portable Graphics Format, Tagged Image File Format, Graphics Interchange Format. Both lossless and lossy compression techniques can be supported by Joint Photographic Experts Group. Compression specification can be applied and thereby the amount of lost data can be controlled. Basic Joint Photographic Experts Group supports lossy compression. Lossless compression can be supported by next version of Joint Photographic Experts Group. Images can be partitioned as ROI with respect to specific areas. Lossless compression takes only that particular area as an input whereas the lossy compression takes remaining parts as an input. Image sharing between the system is easy in case of JPEG. If the DICOM is in the form of JPEG, it is easy to upload in the websites and also helps in the PowerPoint presentations. On the other hand, publications of paper is not be supported with this type of images. Both lossless and lossy compression techniques can be supported by Tagged Image File Format. Various journals support Tagged Image File Format as it produces the images of higher quality. But it is not apt for the PowerPoint presentations and also for the websites as the size of the file is very large. Lossless compression type is used by Portable Graphics Format. Clarity and Brightness which is very important features in an image can be controlled by Portable Graphics Format. As the header components of DICOM file, metadata concept used in images in PNG which provides greater benefits. Various journals support PNG as it produces the images of higher quality and also it suits for the PowerPoint presentations and also for the various websites. Mostly this format is not in use today as it is the oldest imaging formats. It leads to improper compression and also it has very minimal features. This format is mostly used in websites and it also supports lossless type of compression.

B. Nifti

Nifti (Neuroimaging Informatics Technology Initiative) is a data format for the storage of Functional Magnetic Resonance Imaging (fMRI) and other medical images. The Nifti format is adapted from Analyze, developed by Biomedical Imaging Resource (BIR) at Mayo Clinic. Nifti and Analyze are still compatible – Nifti simply adds additional fields. There are two variants of the Nifti format:

ISSN No:-2456-2165

NIfTI-1 and NIfTI-2. NIfTI-2 improves the data types supported by NIfTI-1, as well as precision and voxel size; however, the two formats are not binary compatible. Currently only NIfTI-1 is supported by the Nifti reader. Nifti Files can be extended to include additional information, such as attribution. Nifti formats can be read/write using reader and writer. Nifti Reader – Reads one or more raster slices from one or more volumes in a single Nifti file. Nifti Writer - Writes a series of raster slices into one or more volumes into a single Nifti file.

C. Other file formats

Various other file formats with inhibit compression techniques also available which is following particular standard. Various applications and Graphical system are using the other file formats. Those formats are available in Group Portable Graphics Format, Tagged Image File Format, Graphics Interchange Format. Due to insufficient support of compression techniques and restrictions in bit depth, it is not used much for medical imaging. Text file and data files such as ZIP can be used in the images with the compression techniques. Other file formats are not efficient since the techniques which used not provides the benefits of structure of image.

III. ELABORATION

CT scanners and MRI scanners which falls under digital imaging modalities stores various medical images. Fetching those medical images is a tough task. File need to be encrypted and decrypted when it is available. Each and every file contains information of four types. First is unmodified image data which is also compressed. Second is the basic personal information about the patient. Third is related to the examination of patient's health. Direct method is retrieving the information of the patient's medical data. In PACS area, data usage is distributed which deals with elaborative information and also can retrieve the abstract details in order to merge the images into three-dimensional data. This process is more tedious, and it needs in-depth understanding of the way the files are built. The three different formats which are very popular are fixed, block and tag based. The layout of each file is same which is referred as fixed format. Header present in the file points to the information is referred as block format. File item individually contains the own information of its length. Out of all three, very popular format is the second one which is block format. The beginning part of the header has very few pointers for each block having larger size. Almost all the blocks are in present in the same location and at fixed length.

IV. CONCLUSION

There is a tremendous growth in the field of image file formats. DICOM is the recommended standard in the image encoding which can created by diagnostic modalities. It provided the greater advantages in the medical field and also leads to the development of technology in the advancement of medical imaging. In the future, there can be evolvement of new file formats which is useful in post-processing. The importance of image specific information is increasing globally especially in the field of image processing and the binding of information and results within a medical image related to the clinical context is a big concern.

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