2D and 3D Medical Imaging GUI TOOL

The medical image is categorized by its complexity. In order to assist the analysis, it is very important to have graphical user interface as a data exploration and visualization systems that can behave like an interface among the specialist and algorithms that propose various functionalities. In this project, visualization (Graphical User Interface) system is proposed. It comprised of two portions. In which 1st portion covers the 2 dimensions medical image and 2nd portion covers the 3 dimensions medical image. Overall, this assignment is to develop the Graphical user interface which includes different characteristics functionalities to visualize the medical image such as 1) Zoom, 2) Contrast adjustment, 3) Cut selection and exploring the information in the image.

Visualization format: Visualization of the medical images can be possible using DICOM format.

DICOM:

DICOM stands for digital imaging and communication in Medicine. This is standard for handling, printing, storing and transmitting in medical imaging. It includes a network communication protocol and a file format. DICOM files can exchanged among two entities that has ability of receiving image information and patient data. The National Electrical Manufacturers Association (NEMA) have copyrights. In addition, two types of information such as 1) Tag information and 2) image pixel information.

1. **DICOM Tag**: A DICOM attributes or data elements composed of following parts. It has three kind of information such Tag, VR (Value Representation) and human understandable information. Format of the DICOM Tag is presented below in Table 1.

TAG: Tag is machine understandable information which has following format (XXXX, XXXX) with hexadecimal numbers. It is further divided as (Group Number, Element Number).

VR (Value Representation): Data type and format of the attribute value.

Image pixel: DICOM file information also include pixel information. Which combined together to develop the image. Table. 1 DICOM TAG

Tag	VR	Name
(0002,0000)	UL	File Meta Information Group Length
(0002,0001)	OB	File Meta Information Version
(0002,0002)	UI	Media Storage SOP Class UID
(0002,0003)	UI	Media Storage SOP Instance UID

Environment Selection: There are various programming environments are available to develop the graphical user interface such as python, dot net, Java, HTML, MATLAB etc. Due to prior programming experience in the Matlab and availability of special took kit for designing the graphical user interface, decision was taken to go with MATLAB.

Project: Part A

In this next portion of report, different functionalities for medical images analysis will be discussed.

1) **LOAD DICOM**: It is the first step to import the DICOM image into the graphical user interface. To do this, Matlab Programming was done (Available in the m.file attached).

2) **Visualization**

   a) **Display:** Default image in the DICOM is 3 dimensions. As the image has three portions/dimensions which includes Sagittal, Transverse and Coronal axis as show in the figure 1(Represented as. As in project, we have to make 2D image. We can see 2 dimensions of the image at a time.

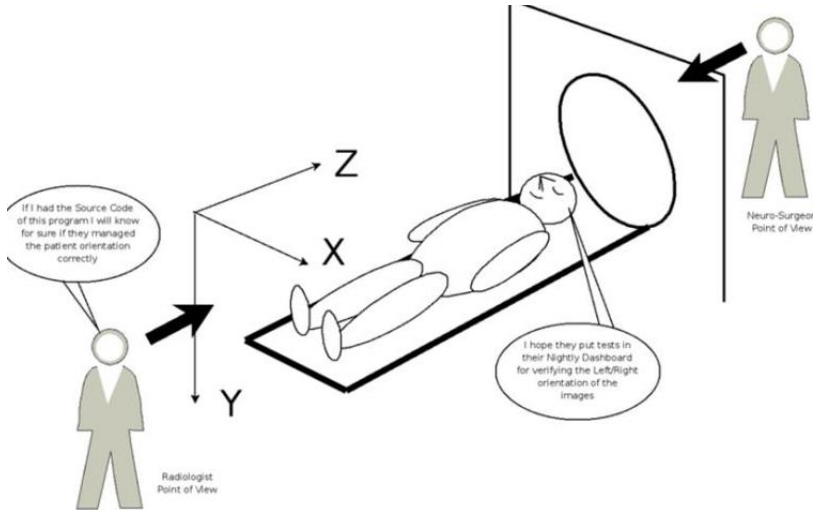

Fig. 1 Three dimension view of imaging

Issue: While loading the medical image, it was hard to display the image, the reason behind was understanding.

Remedy: I got to know that; image has to display by frame. I displayed via frame and it works.

   b) **Zoom:** Displayed image is zoomed in or out. It works fine this help to visualize the medical image clearly.

Issue: This is zooming only the right up corner of the image, but it is not zooming in specific selected area. However, it will be sorted out by working with cursor.

c) **Contrast Adjustment:** In the contrast adjustment, Gray mapping is used. In Matlab simulation, Slider is used to adjust the contrast mapping. Sometimes, it's hard to visualize the specific information directly from image. This helps to see the medical image deeply.

Issue: I was not aware of the contrast function.

Remedy: I found the specific function which is used in Matlab to deal with contract functionality.

d) **Cut Selection:** (Fig.1): 3 main representations were used and mentioned below (visualize from different axe perspective)

The sagittal or lateral plane dives the body into left and right halves and is an x-z plane. Technically, the sagittal or median plane goes right through the middle between the body's left and right halves. Planes parallel the sagittal planes are called parasagittal planes. It is called the sagittal plane because it goes through or is parallel to the sagittal suture, the line running along the top of the skull that marks where the left and right halves of the skull grew together.

The coronal or frontal planes divide the body into front and back (also called dorsal and ventral or posterior and anterior) sections and are x-y planes.

The transvers planes, also known as **the axial** or horizontal planes, are parallel to the ground and divide the body into top and bottom parts. The top and bottom sections also called the superior and inferior section s or the cranial (head) and caudal (tial) sections). They are x-z planes.

3) Select pixels and obtain their numerical value: In this portion, Selection of the pixel is done with rectangular coordinate system X and Y. In addition numerical value has been taken.

Issue: numerical value of the pixel, I am not able to retrieve back at specific selection.

4) Explore the DICOM headers of the image: Information from the DICOM headers is found. Different information such as patient's biodata is approached by tag (XXXX, XXXX) or Human Understandable way. This is a kind of patient identifier information. It helps the medical specialist to manage patient profile in compact form.

Record all the actions (posteriori): In this, we have to develop the log for the user that he/she does to extract information a posteriori.

Project: Part B

1. Explore two of the images provided (one mandatory, according to the assignment available in Digital Classroom, another one of your choice). Provide the information that can be extracted: the modality imaging, demographic data of the patient, the date of the study, the acquisition machine, etc.

As per instructions, Information from two DICOM images has been extracted and presented (demonstration in video).

Implement a visualizer for 3D images by cuts: In this part 3D DICOM image has to be presented in the GUI by cuts which includes Sagittal, Transverse and Coronal axis as shown in (you can see this in the recorded video time: 07:55). This representation improves the visual ability for the medical expert to see infected/effected part of patients in 3 Dimensions minutely.

Issue: Understanding is clear, facing problem in coding implementation of 3D DICOM image.

NB: A Necessary modification will be updated soon + new functionalities will be added in the Interface. Apart another graphical interface using python will be added.

All of this will be published in Git Hub. LINK: