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Medical Image Processing using 3D Slicer

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Abstract–The evolution of imaging has been the topmost priority in recent medical progression. There are several techniques available for brain image processing. 3D slicer is a open source software used for medical image processing. It is available free on the internet. It can visualize and reconstruct several clinical image data in 3-Dimensions. Three-dimensional reconstruction of hematomas, nerve fiber and blood vessels will help doctors to identify the problem and to plan operation accordingly. In our paper we have focused on showing the CT images in 3D view. Instead of Slicer app we have used jupyter notebook for displaying CT or MRI images in 3D view. For that we have added Slicer extension to jupyter notebook, and preprocessed the dataset in jupyter platform itself.

Keywords: Three-dimensional, 3D Slicer, CT, MRI.

I. INTRODUCTION

Medical Image Processing envelops the utilization and investigation of 3D picture datasets of the human body, gotten most generally from a CT (Computed Tomography) or MRI (Magnetic Resonance Imaging) scanner to analyze pathologies or guide clinical medications like careful arranging, or for research purposes. Medical Image Processing is performed by clinicians, specialists and radiologists to more willingly understand the life formation of many people or single patient.

3D slicer is an open source software used for medical image processing. It is available free on the internet. As a clinical examination setup, 3D Slicer is like a radiology department that backings flexible perceptions yet in addition gives progressed usefulness like mechanized division and enrollment for an assortment of utilization spaces. In contrast to an average radiology department, 3D Slicer is free and isn't attached to explicit equipment. As a development stage, 3D Slicer works with interpretation and assessment of the new measurable techniques by permitting the biomedical scientist to zero in on the execution of the calculation, and giving deliberations to the regular errands of information correspondence, perception and UI development. Comparing withcontrasting devices that give the usefulness, 3D Slicer is open source and can be swiftly broadened and reallocated. Furthermore, 3D Slicer is intended to work with the advancement of new usefulness as 3D Slicer augmentations.

3D Slicer is used forvisualization and analysis of medical image computing data sets. 3D Slicer gives Improved Interactive utilize like sliders, buttons and so forth to control Slicer or change preparing and perception boundaries. The intelligent perception capacities of 3D Slicer incorporate the capacity to show discretionarily situated picture cuts, assemble surface models from picture names, and equipment sped up volume delivering. Slicer exploits rich information perception capacities and it likewise Slicer arose as a climax of a few autonomous undertakings that zeroed in independently on picture representation, careful route and graphical UI (GUI). 3D Slicer has a particular association that permits the expansion of new usefulness and gives various conventional highlights not accessible in contending devices.

Here we present how 3D Slicer is used for visualization and analysis of medical image computing data sets. To provide a clean, well-defined, flexible and functional application structure for medical image computing developers and users. To understand the 3D Slicer support for multi-modality imaging including, MRI, CT. To reduce and removing unwanted noise or artifacts with image filters. And to Crop and resample input data to make it easier and faster to process images.

II. LITERATURE SURVEY

Authors Zhang, Kexin, Pan and Chang [1] had discussed in this paper about Three-dimensional reconstruction of hematomas, nerve fiber and blood vessels will help doctors to identify the problem and to plan operation accordingly and how this can impact the future medical areas. Along with this 3-dimensional reformation of cerebral nerve bundle and reformation oof CT data of brain has also been discussed.

Authors Jegou, Franck, Lee, Bajger, Acosta, Julie and Crevoisier [3] has debated about the introductory study which assess the partition of 7 OARs on CT's of head in 3D slicer environment. They have considered 313 CT images and an expert oncologist has manually described the truth or OAR's. The reciprocal function grow from seeds which is present in 3D slicer The interactive "Grow from Seeds" function in 3D Slicer was was used to analyze the semiautomatic OAR's journey. This experimental study examines the powerfulness while using 3D slicers for OAR's journey for head CT in RT planning for glioblastoma patients. Authors have said that the results are comparable with state of art process but more data sets are required to support the obtained results. With addition to the given 3D assessment measures each slice execution assessment which helps to find errors. These measures are important in assessing the outcomes using various aspects.

Authors Massirisa, Dennehya, Claudio and Thomsena [6] have done a python implementation using 3D slicer Extension, for implementation anaconda environment has been made use along with pycharm compiler as pycharm is used widely for neurology field like NAMIC. The DTI study organized by the the primary processing pipeline from which the local inter voxel components were developed again. Matlab was used to

implement the initial code later was implemented in python. Every developed operators were calculated for a certain patients with the local operators the error was between 0-45%. The obtained results have been compared with normalized root mean square error.

Authors Luping, Zhengjie, Wenye and Ping Cao [8] has conducted a research on internationalizing the 3D slicer. In this paper the main discussion has been about the internationalizing the GUI platform which was assessed and completed the cross platform model which was extensively used for building software with GUI (Qt). There were two methods of internationalization. First is to choose the source code straight which requires re compile the program according the various types of codes. However this method is not proper to provide effective results. In Second method transactional operations is used to all user-visible strings and then those strings are loaded dynamically. 3D slicer consists of 3 major components as per its analytical structure: command line modules, core and python scripts. GUI development can be done as per logical framework. The core module consists of data probe, main window, 3D viewer, core modules and several modules. #D slicer software initially creates main window which consists of partial toolbar and application menu. All the modules are made by a structure outlined by some of widgets and Qt. The internationalization is accomplished by using translation function in various situations.

Authors Fedorov, Reinhard, JayashreeKalpathy and Julien [2] have described about the 3D slicer environment which is used as a platform for developing, evaluating and prototyping of image analyzing tools for medical related applications and has embellished about the subsequent ways which can additionally ease the validation and building of the biomarkers using three dimensional slicer. The partition is performed for solid and cystic components of the ventricles and tumors. This kind of partition is used to develop 3D rebuilding for geography testimonial in neuro-navigation. The partition process is repeated 5 times and the time consumed for whole process is 2 and half minutes on laptop. The Standard deviations of the average volumes were between 1.2-3.2%. The outcome of the repeated partitions were also similar.

III. METHODOLOGY

In this paper, we present how 3D Slicer is used for visualization and analysis of medical image computing data sets. To provide a clean, well-defined, flexible and functional application structure for medical image computing developers and users. To understand the 3D Slicer support for multi-modality imaging including, MRI, CT. To reduce and removing unwanted noise or artifacts with image filters. And to Crop and resample input data to make it easier and faster to process images.

To begin with we have downloaded slicer app from the official website. In slicer app install slicer jupyter extension

once the extension is added wait for the restart button to become active, click on it and copy the link of installed extension. You can see the slicer extension in jupyter notebook. Now slicer application can be used in notebook platform.

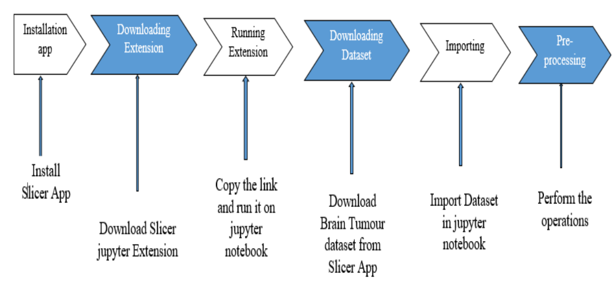

Figure.1 Installation

The datasets for this project has been obtained from the slicer app and we have downloaded Brain Tumor sample data in slicer software and have imported the same. The images present in the datasets are CT and MRI images of brain. In the current kernel slice and 3D views can be displayed in notebook as simple static images. Interactive viewers are accessible at four different Dynamic view levels each with various advantages and disadvantages.

In Dynamic view-Level 1 displayed content are saved in the notebook and views can be adjusted using Standard iPython widgets. In level 2 view widgets can be placed in layout and views can also be placed in layouts. In level 3 only selected views can be controlled, displayed and some view controlling keyboard and mouse events are captured. Also some views can be controlled remotely using mouse and keyboard [browse slices, place points and rotate view]. In the final level, High update rate and it is suitable for working on remote computers. All mouse and keyboard events are captured. Full application window can be displayed and controlled and full application window interaction is available in notebook cells via VNC protocol.

VNC (Virtual Network Computing) protocol is a simple protocol used to remotely access the GUI. It uses RFB (Remote Frame Buffer) protocol to control another computer remotely.

Next step is Markup Displays where MRML data nodes [markups and tables etc.] can be displayed directly in notebook cells. MRML (Medical Reality Modeling Language) is a data framework which is built to illustrate all datasets that are used in clinical software programs.

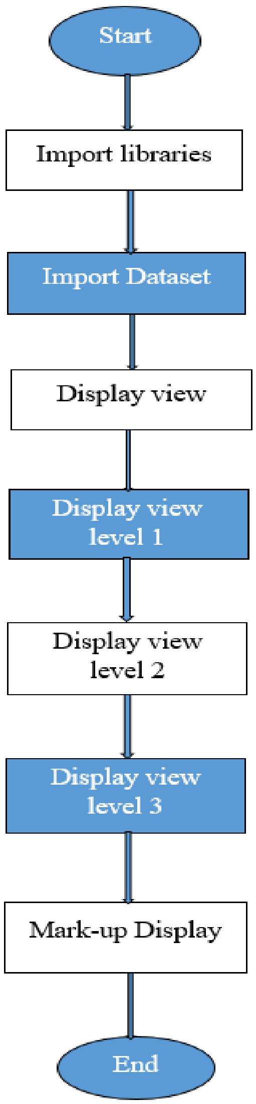

Figure.2 Flow Diagram

All standard jupyter notebook plotting options are still available, such as matplotlib. All Slicer data processing capabilities are accessible from notebooks. Processing parameters can be adjusted using standard IPython widgets. Processing modules can report their progess. Processing results can also be downloaded.

IV. RESULTS

Improved interactive use: User will be able to utilize iPython gadgets (catches, sliders and so in) to control Slicer or change preparing and perception boundaries. For instance, CLI module boundaries can be changed utilizing slider gadgets and results are figured and shown automatically in the scratch pad. 3D Slicer sees are in journals are presently intelligent. User can zoom/pivot 3D perspectives, peruse cuts, place focuses, or alter divisions - directly in the scratch pad.

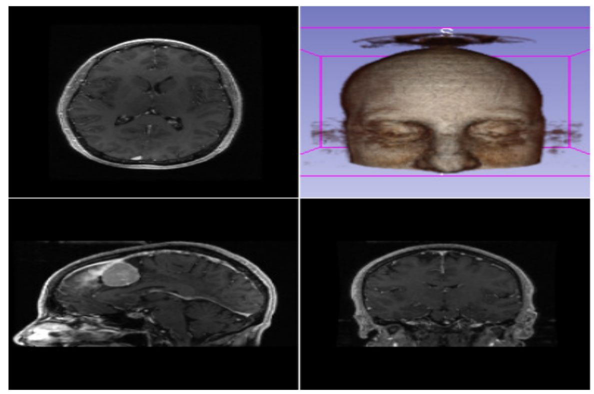

Figure.3 Slice and 3D View

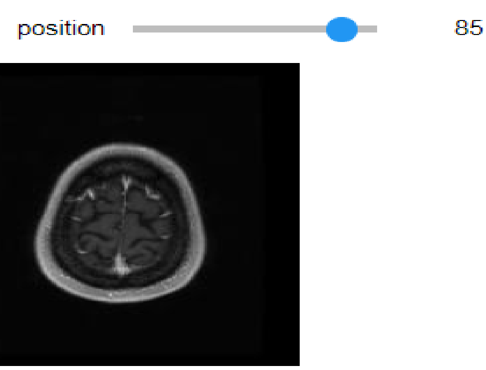

Figure.4Position

User can display and control selected viewers, all viewers, or the entire application in notebook cells. This allows users to implement complete data processing workflows in a notebook, even if certain steps require manual user inputs (3D regions, seed points, etc.)

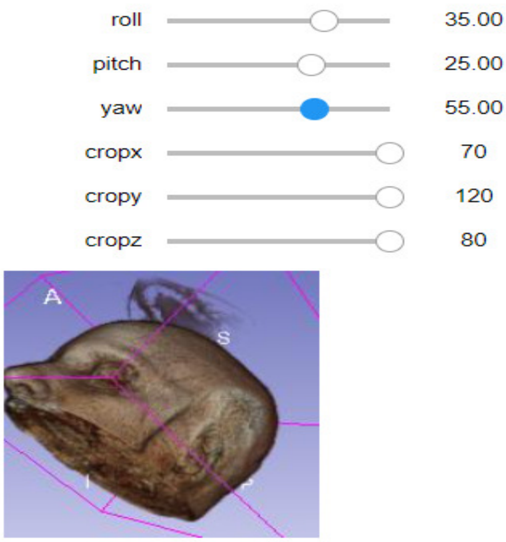

Figure.5 Volume cropping

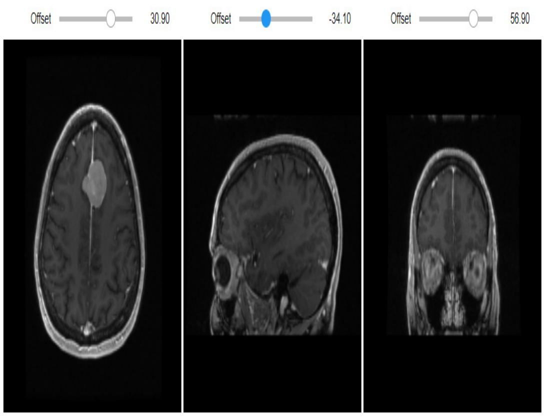

Figure.6 Slice View Widgets

Data node visualization directly in the notebook: Slicer exploits rich information perception abilities of Jupyter scratch pad. For instance, markup fiducially rundown hub is shown as a pleasantly arranged table, model hub is delivered as a 3D article, and so on New visualizers can be added for all MRML hub types, if this ends up being helpful.

The outcomes and results of this project is:

1. User can zoom in and zoom out the image.
2. User can rotate the Images.
3. User can view in 3D format

	label	position.R	position.A	position.S	selected	visible	description
0	MarkupsClosedCurve-1	69.124842	-8.732266	-2.175	True	True	
1	MarkupsClosedCurve-2	56.325896	32.618174	-2.175	True	True	
2	MarkupsClosedCurve-3	46.152375	57.887888	-2.175	True	True	
3	MarkupsClosedCurve-4	34.027398	74.358438	-2.175	True	True	
4	MarkupsClosedCurve-5	3.931934	85.644236	-2.175	True	True	
5	MarkupsClosedCurve-6	-45.510614	62.535220	-2.175	True	True	
6	MarkupsClosedCurve-7	-61.633184	-10.016345	-2.175	True	True	
7	MarkupsClosedCurve-8	-51.972877	-54.020844	-2.175	True	True	
8	MarkupsClosedCurve-9	-18.102245	-87.942100	-2.175	True	True	
9	MarkupsClosedCurve-10	32.952560	-83.642748	-2.175	True	True	
10	MarkupsClosedCurve-11	58.623143	-59.599872	-2.175	True	True	
11	MarkupsClosedCurve-12	67.884795	-35.275038	-2.175	True	True	

Figure.7 Markup Display

V. CONCLUSION AND FUTURE ENHANCEMENTS

In this paper, we present 3D Slicer that exhibit how this research application is presently applied to study various organs using a diversity of imaging/diagnostic modalities. Our objective has been to introduce the capacities of 3D Slicer as a stage for innovative work of new diagnostic based biomarkers. As we contend in this composition, Slicer provides a broad range of highlights for flexible representation, investigation and measurable examination diagnostic information. Universal progression and acceptance of image inquiry components have functioned with Slicer across its application of reported and open structure for transmission of various details of the instruments, like images, organization of outline changes implemented by assignment, partition covers and surface prototype. The stage gives a protractile design to personalize and advancement of modules that are interoperable across different stages.

Over the time span, 3D Slicer has acquired expansive acknowledgment in the clinical diagnostic research area. It is a powerful program that develops along with the ventures that utilizes it in latest examination software, frequently rewarding the local area as new commitments to the Slicer. The present capacities of Slicer have come about because of various tasks directed in the course of the most recent years of history of slicer. The Slicer stage guaranteed congruity, development, reproducibility.

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