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A Study of Open Source Toolkits of Image Processing for Healthcare Industry

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Abstract

Image processing is used in every sector of life. The development of medical field is entirely contingent on image processing algorithms. Radiologists utilize these algorithms for detection of diseases such as tumors. These algorithms are designed using proprietary tools which enhance the cost of disease detection. In this paper, various open source toolkits for medical image processing such as ITK, VTK, VV, 3D Slicer, Bioi mage XD are explored. We have also performed various image processing operations such as inversion, enhancement and segmentation using these toolkits. These toolkits provide a cost effective solution to healthcare industry.

Index terms— ITK, VTK, OPENCV, 3d slicer, BIOIMAGEXD, proprietary tools

1 Introduction

edical imaging plays a pivotal role in detecting disease. Proprietary tools are utilized in order to design image processing algorithms [35]. But these tools are very expensive. Hence open sources are a good option for detecting disease as it provides cost effective solution. Open source softwares are those whose source code can be modified or enhanced by anyone. These are free of cost while proprietary software's are very costly and also it consist some restrictions regarding license availability. Open source softwares provide accurate and cost effective access to the scientist in order to provide the wealth of information. Open source toolkits are used to meet following constraints such as faster feature implementation, free of cost, fast fixes for security and multiple options for a given task and fast upgrades to new releases. Open source tools for image processing can be divided into two categories -general purpose [23] and application specific open source tools. General purpose open sources are Scilab [10] and Open CV (Open computer vision) [2]. Application specific tools are designed for some specific applications. For example the special designed toolkit for medical is not applicable in the field of agriculture and remote sensing etc. For medical image processing, there are some specially designed toolkits which performed operations on medical images. Although general purpose tools are very efficient but still they fails to perform operations such as image labeling and 4d visualization etc. These are some specially

2 b) ITK

Insight segmentation and registration (ITK) toolkit is open source software which is written in C, C++, FORTRAN and python languages. It is also crossplatform software. It requires CMAKE for its installation which is an open source software used for managing the build process of a software. It is used for segmentation and registration of medical images. In the medical environment, segmentation is used for extraction of data or some kind of disease while registration is used for combining information contained in CT scans and MRI. ITK is also used for visualization, analysis, image-guided surgery applications.

3 c) FSL

FSL stands for FMRIB Software Library is also open source software which consist a library for analysis of MRI, FMRI (functional MRI). Its size is 1.7 GB and is written in Python language and runs on PCs and apple. It can be run either from command line or from GUI (Graphic User Interface). It has application in analysis of brain imaging data.

4 k) VV

VV is free open source software which is implemented in C++ along with QT, ITK and VTK. It is distributed under BSD and Ce CILL-B license. It runs on Linux, windows, Mac OS (32 and 64 bits). For researchers, it is compatible with Linux while for clinicians used it on windows. It visualizes 2D, 3D, 4D images and is very fast and simple to use. It has application in visualization, fusion and placement of landmark. It also performs operations on images like cropping an image, pixel manipulation, image arithmetic and re sampling [33].

5 l) Fiji

Fiji is an open source whose main purpose is to distribute image processing packages based on ImageJ. ImageJ is an image processing program invented by National institute of health. It is written in java and performs operations like image reading, the creation of histogram and line profile, smoothing, geometric transformation etc. Fiji is compatible with Linux, Intel (32 and 64 bit) and windows but it has the least support for MacOSX/PPC. Fiji has applications in life science as it performs operations like segmentation, registration, visualization and other advanced level operations.

6 m) Bioimage XD

Bioimage XD is free and open source software which is written in C++ and python and distributed under General Public License. It is compatible with Mac operating system, Windows and Linux. It supports 2D, 3D, 4D and XD data. It performs operations like segmentation, filtering, visualization and qualitative analysis. It also supports on ITK and VTK for image processing and segmentation. It has various advantages like easy access, increasing scientific output.

7 n) Elastix

Elastix is open source software which is compatible with Linux and windows and Mac Operating system. It is highly configurable, easy to extend, reliable and suitable for a large amount of data. In this scripts are written. It is totally based on ITK and is multicompiler. It supports various image formats such as hdr (Analyze), mhd (MetalO), nii (NIFTI), gipl, dcm (DICOM). But elastix not support DICOM directories directly. It is highly applicable for registration of medical images.

8 o) MITK-DI

Medical Imaging Interaction Toolkit -Diffusion Imaging is open source software is a part of MITK which is written in C++ and runs on windows, Linux and Mac operating system. It is an object-oriented toolkit and in the form of GUI. It is basically used for brain imaging. It also performs operations like pre-processing of diffused image, visualization and reconstruction. It is used for implementation of DTI [31].

9 III.

10 Analysis of Image Processing Algorithms Using open Source Medical Toolkits

There are some open sorce toolkits specially designed for medical image processing [34] such as VV, 3D Slicer, Bioimage XD etc in which various image processing operations can be performed in addition to some additional operations which are required for analyzing medical images.

11 a) Image analysis using VV

There are various image processing operations can be performed in VV which is a 4D slicer. Image inversion is used to obtain information hidden behind white pixels. Image inversion using VV is depicted in figure 2. Image enhancement operation is performed in order to improve contrast of images. Image enhancement is very important for medical sector as it improve the visualization of images. Hence radiologists can easily detect abnormalities. There are various types of enhancement operations [27] such as mask processing, point processing, histogram based and frequency based operations etc. Image enhancement using VV is depicted in figure 3. VV performs various image processing operations. VV can perform operations on 2D, 3D and 4D images. Image segmentation plays very pivotal role in detecting location of tumors and artifacts [30]. Edge detection operation is a type of image segmentation operation can be performed using VV is depicted in figure 4. Image thresholding operation which is a method of image segmentation can also be performed using 3D slicer as depicted in the figure 6. Image segmentation is done in order to segment the tumors and other parts affected due to diseases [29]. Edge detection is a part of image segmentation. Edge detection using 3D Slicer is depicted in figure 7. 3D Slicer can perform various image processing operations by using 2D as well as 3D images. There are varieties of operations which can be performed using 3D Slicer for detecting diseases.

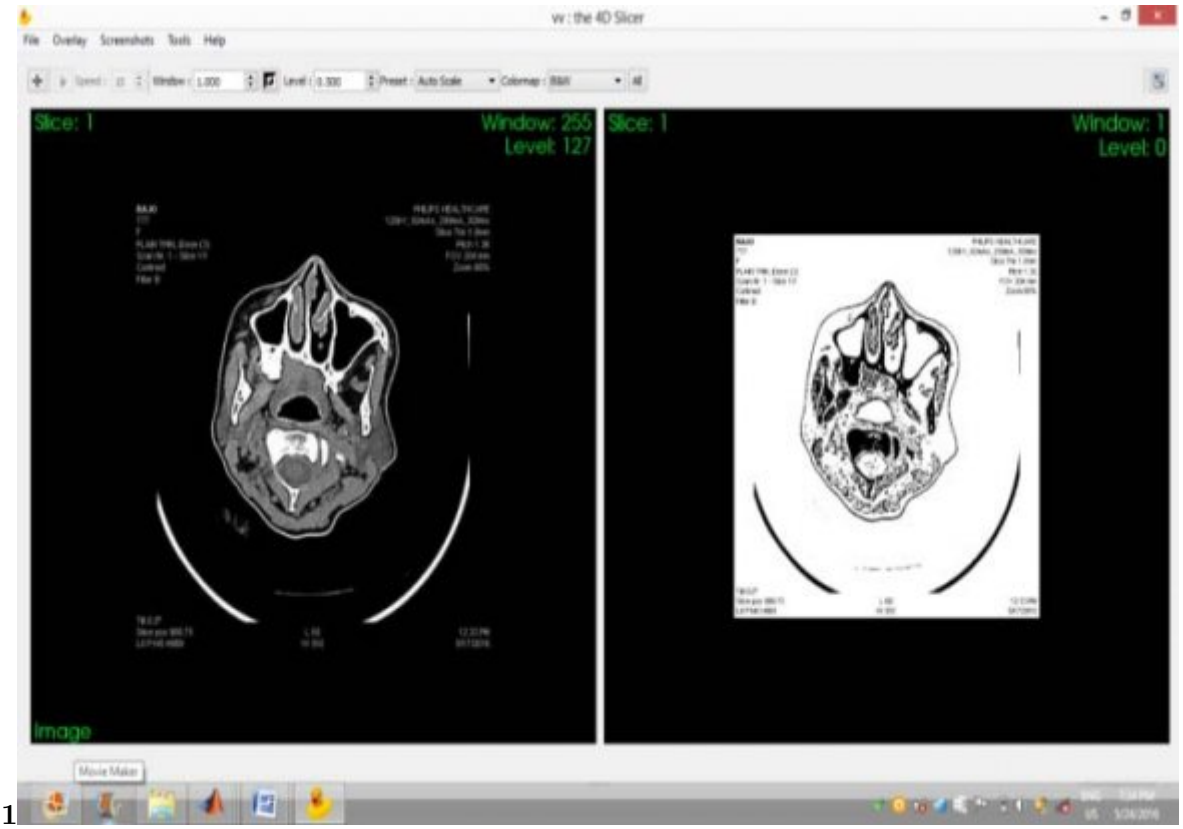
12 c) Analysis of images using Bioimage XD

Bioimage XD performs operation on signal image and as well as on multiple images. Thresholding is also used in order to segment images. Image thres holding using Bioimage XD is shown in figure 8. The open source soft wares can also perform the same operations which can be performed using proprietary tools. Biologists directly utilize open sources toolkits for medical applications in order to detect abnormalities and disease. In this thesis, we have designed algorithms for image inversion, enhancement and segmentation using proprietary as well as open source soft wares.

IV.

13 Conclusion

In summary, we have concluded that there are some specially designed open source toolkits for medical image processing such as ITK, VTK, GIMIAS, VV, 3D Slicer, Bioimage XD and elastix etc. We have performed image inversion, segmentation and enhancement operations using these toolkits and concluded that these toolkits can perform these operations with high speed and accuracy. These toolkits not only perform basic image processing operations such as 3D and 4D visualization. These toolkits are very beneficial for radiologist as they can detect tumors and artifacts easily. Hence we have designed a cost effective framework for health monitoring. [1] [2] [3]



1

Figure 1: Figure 1 :

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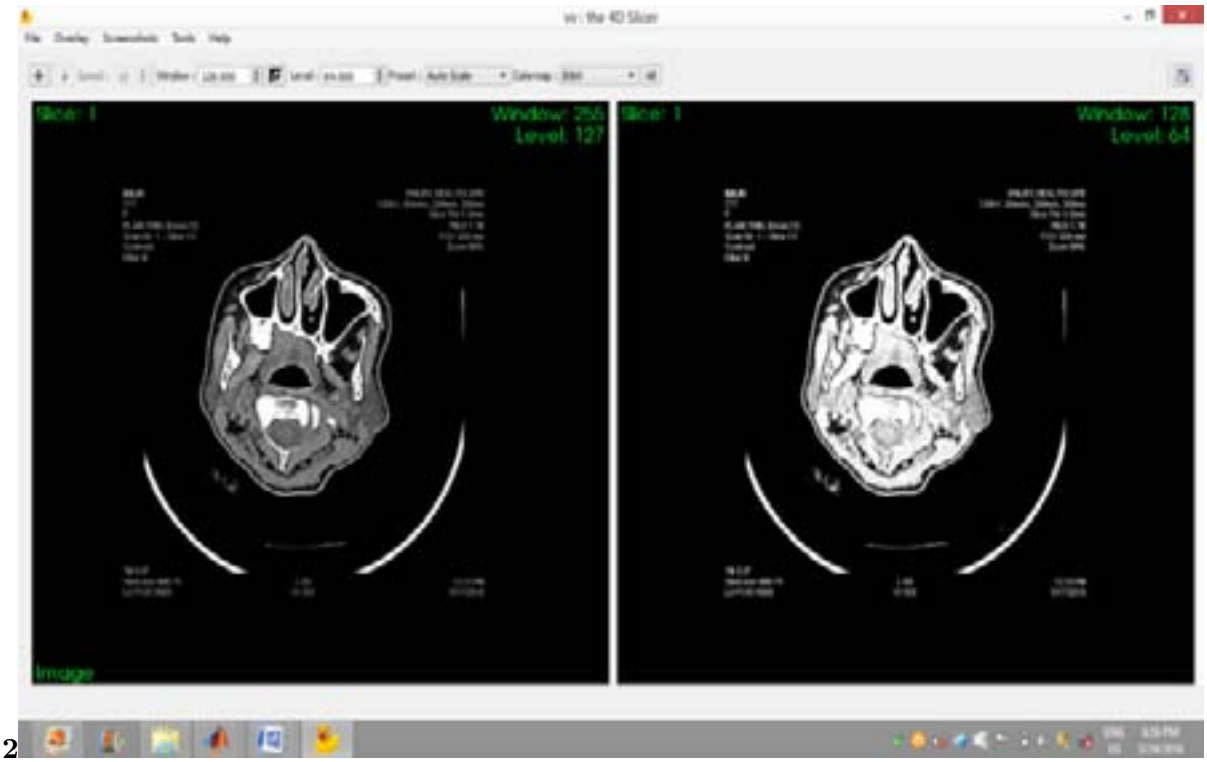
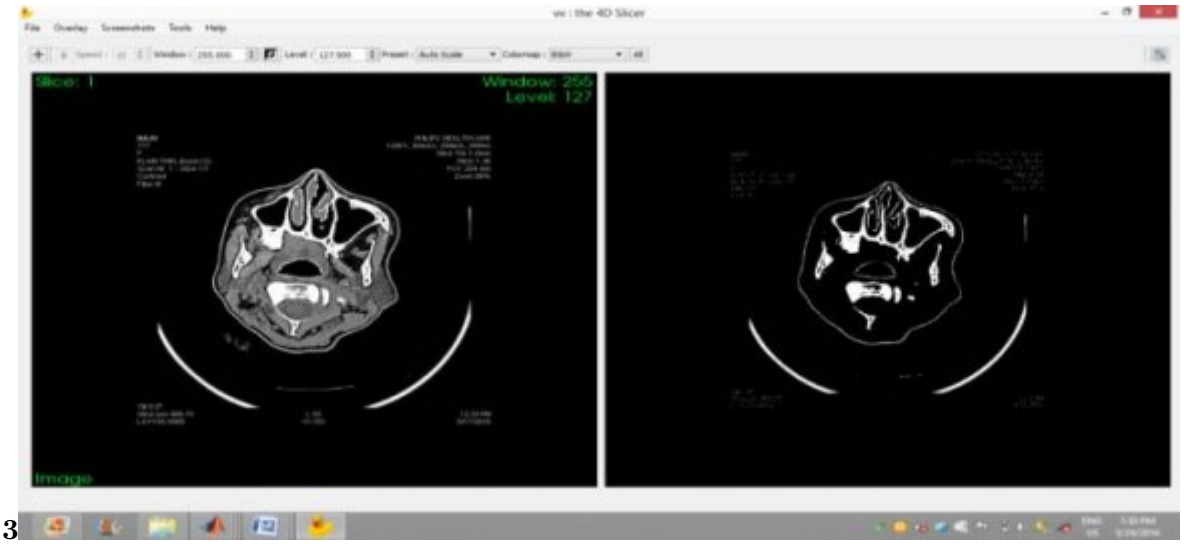
[2] © 2017 Global Journals Inc. (US)

[3] F © 2017 Global Journals Inc. (US)



2

Figure 2: Figure 2 :



3

Figure 3: Figure 3 :

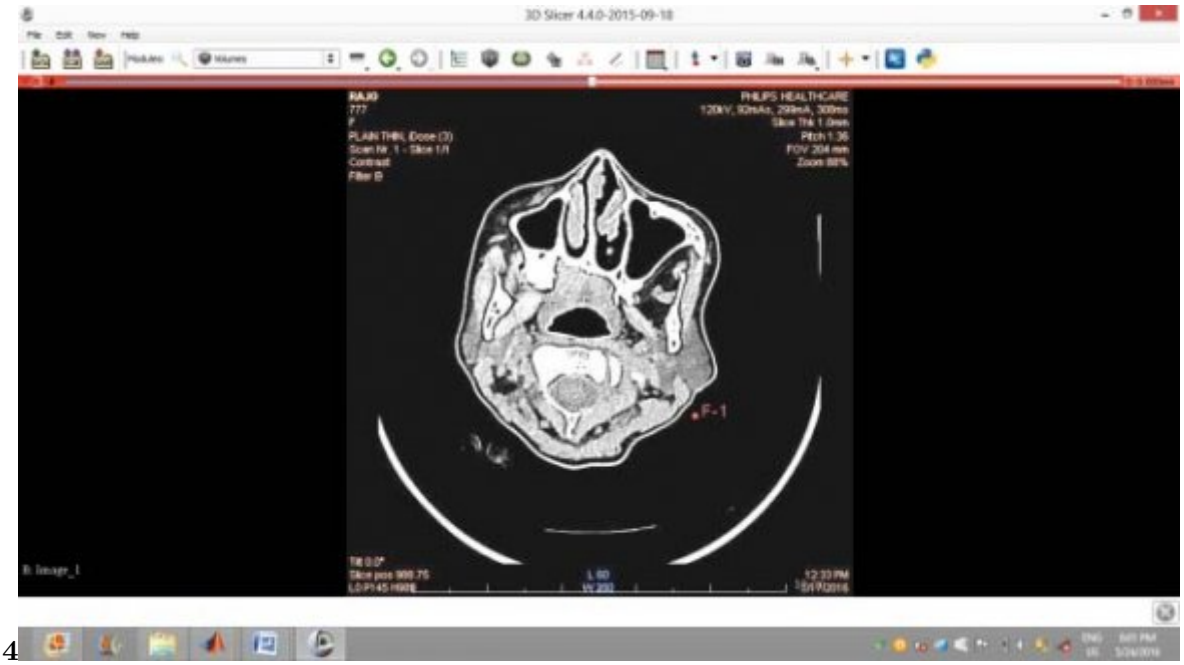


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Figure 4: Figure 4 :

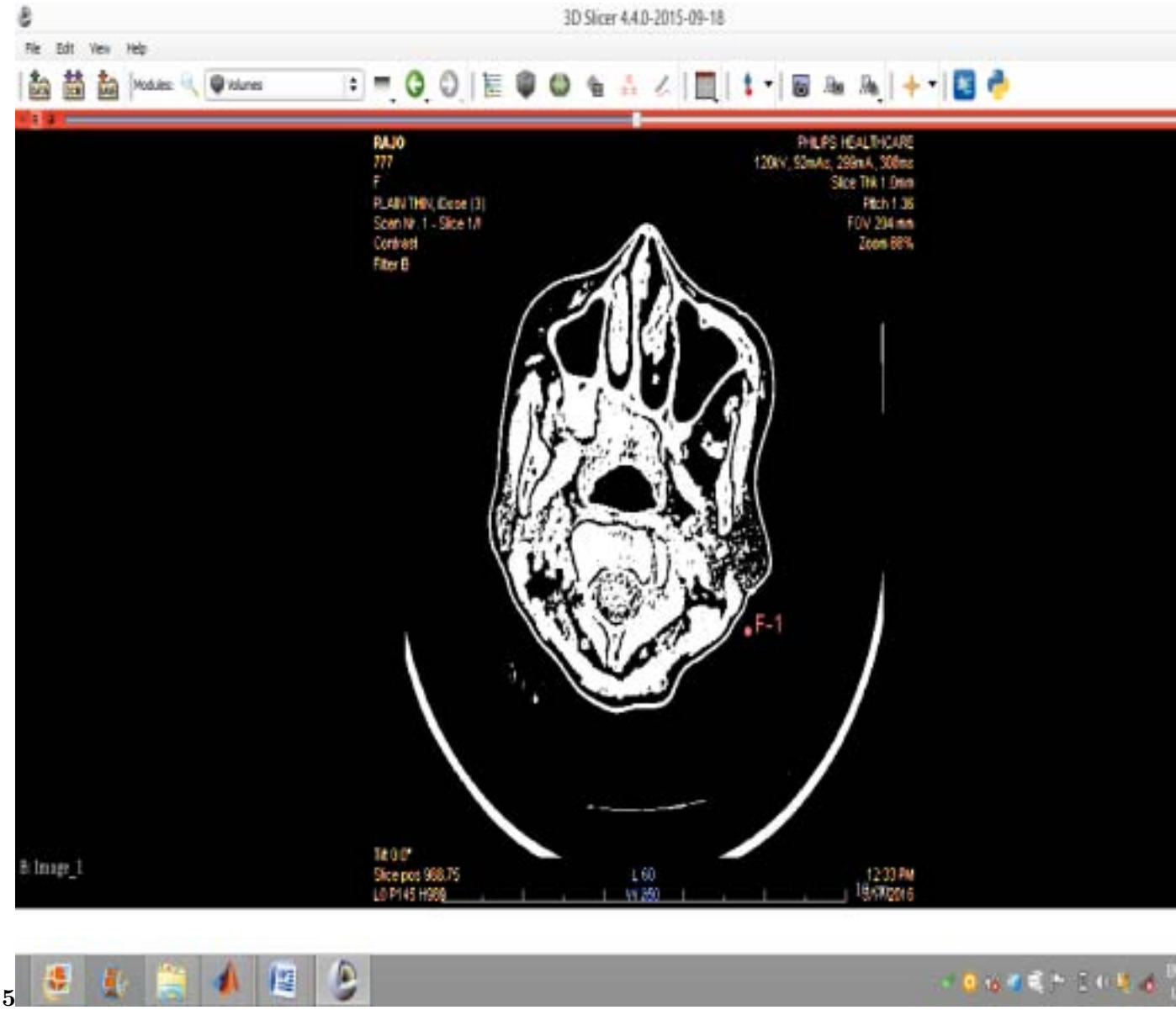

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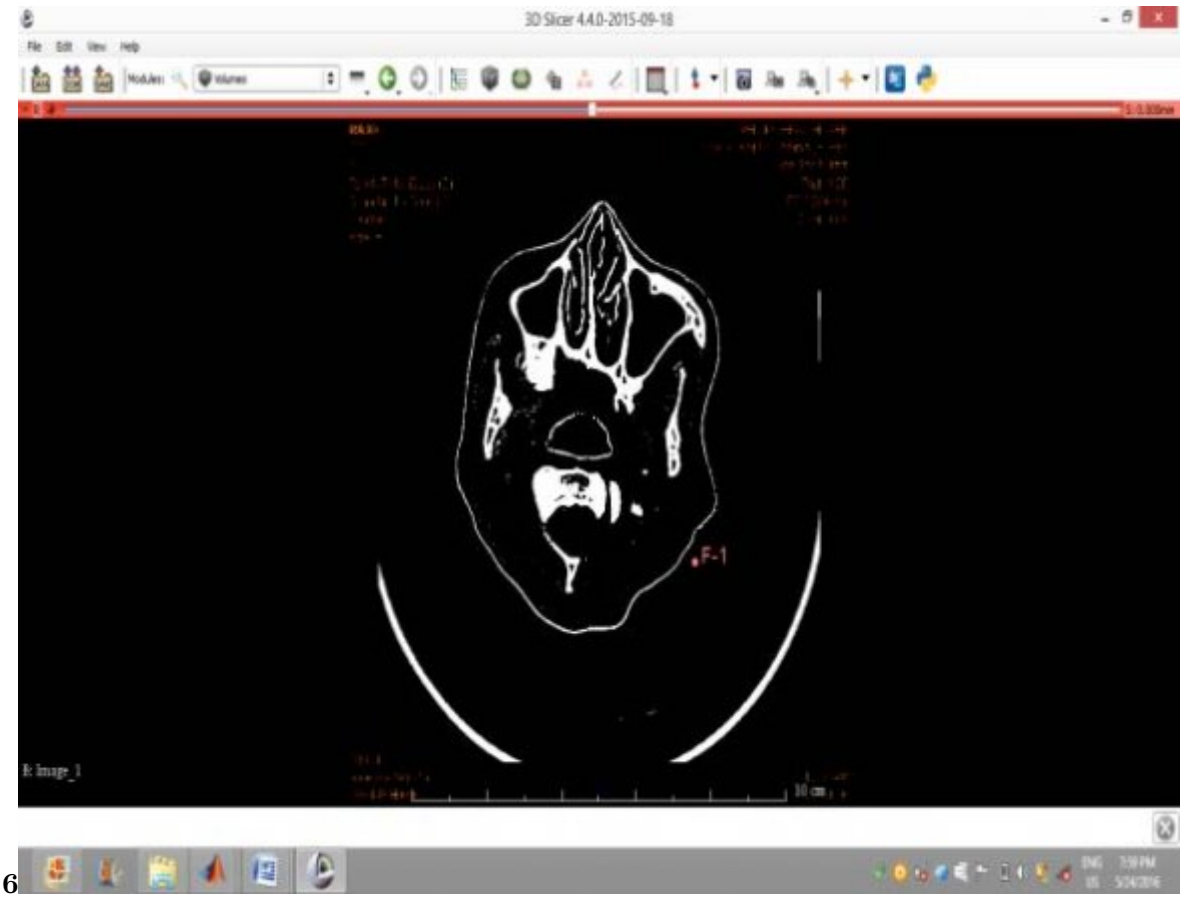
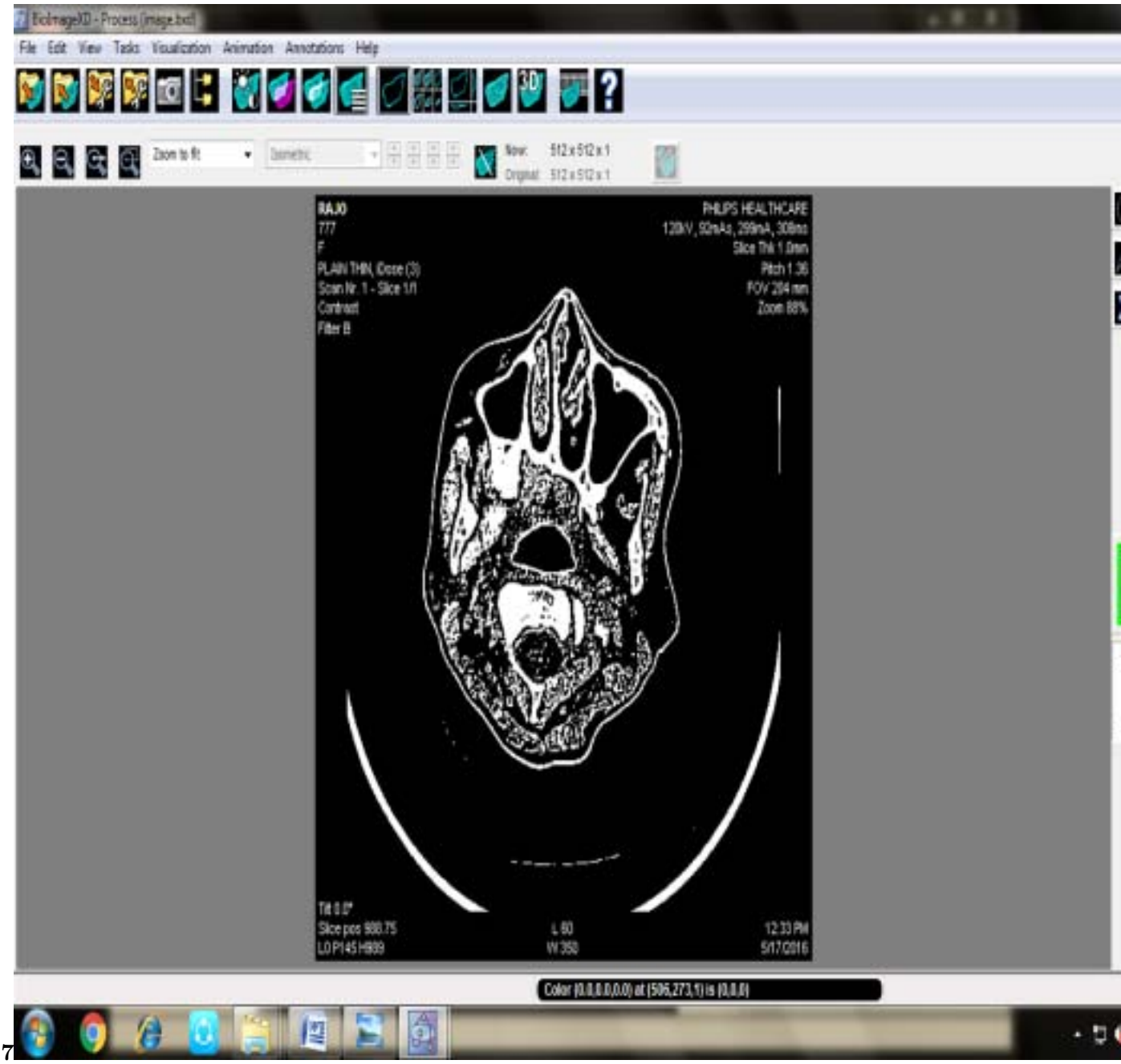
Figure 5: Figure 5 :



6

Figure 6: Figure 6 :



7

Figure 7: Figure 7 :

3D Slicer basically used for grayscale image processing. It has BioimageXD applications in many research sc

(portable network graphics), TIFF (tagged image file
d) SPM SPM (statistical parametric mapping) is an open source for medical image processing which is writt
ITK-snap is open source software leverages
from ITK which supports medical image formats like
DICOM etc. DICOM (digital imaging and communication
in medicine) is a standard for handling and transmitting
medical imaging information. j) Paraview
Paraview is free and open source software. It is
written in C, C++, FORTRAN, Python and compatible
with Unix/Linux, Mac OS, Microsoft windows. It is
distributed under BSD license. It is a multi-platform
visualization application server

architecture. It supports a variety of file formats including
VTK.VTK is a set of libraries which provides data
visualization and pipeline architecture. It was developed
to analyze large data sets by using distributed memory
resources.

[Note: f) MIAIt is free and open source software which is an image processing toolkit. It is written in C++and distributed under GPLv3+ license. It is compatible with Linux and POSIX (portable operating system interface) which is based on UNIX operating system .MIA is]

Figure 8:

[Kumar et al. (2014)] 'A Conventional Study of Edge Detection Technique in Digital Image Processing'. Indrajeet Kumar , Jyoti Rawat , H S Dr , Bhadauria . *International Journal of Computer Science and Mobile Computing* April 2014. 3 (4) p. .

[Sharma et al. (2012)] 'Colour image segmentation techniques and issues: An approach'. Nikita Sharma , Mahendra Mishra , Manish Shrivastava . *International Journal of Scientific & Technology Research(IJSTR)* May 2012. 1 (4) p. .

[Maheshwari and Kumar (2015)] 'Comparative analysis of lung cancer using different medical modality'. Shikha Maheshwari , Krishan Kumar . *International Journal of Advanced Research in Computer and Communication Engineering* September 2015. 4 (9) p. .

[Smruti Ranjan Nayak and Aman (2016)] 'Design and implementation of real time video image edge detection system using My RIO'. Shanaz Smruti Ranjan Nayak , Aman . *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering* March 2016. 5 (3) p. . (Harish Chandra Mohanta, Dr Satyasish Miishra)

[Fritzsche et al. ()] 'Diffusion Imaging in the Medical Imaging Interaction Toolkit (MITK)'. K H Fritzsche , M Nolden , H-P Meinzer , B Stieltjes . *Proc. Intl. Soc. Mag. Reson. Med* 2011. 19 p. 4028.

[Borbely et al. ()] 'Digits Recognition with Beagle Board Platform'. Richard Borbely , Michal Blaho , Leo Mrafk , Tatiana Mudrakova . *Technical Computing Prague*, 2015.

[Gururaj and Naveen (2016)] 'Identification of counterfeit currency and denomination using Raspberry pi'. Swami Gururaj , M Naveen , J . *International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering* April 2016. 4 (2) p. .

[Hema Ramachandaran (2012)] 'Image and voice processing toolbox in Scilab'. Hema Ramachandaran . *CSI Communication* July 2012. 36 (4) p. .

[Snehal et al. (2012)] 'Image Enhancement and Its Various Techniques'. O Snehal , Prof V K Mundhada , Shandilya . *International Journal of Advanced Research in Computer Science and Software Engineering (IJARCSSE)* April 2012. 2 (4) p. .

[Kalyani et al. (2015)] 'Image Enhancement using Hardware co-simulation for Biomedical Applications'. A Kalyani , Prof P N Dakre , Pusdekar . *International Journal on Recent and Innovation Trends in Computing and Communication (IJRITCC)* February 2015. 3 (2) p. .

[Sharmila et al. (2015)] 'Image Processing on DSP Environment Using Open CV'. B Sharmila , N Karalan , D Nedumaran . *International Journal of Advanced Research in Computer Science and Software Engineering (IJARCSSE)* February 2015. 5 (2) p. .

[Horak and Zalud (2015)] 'Image Processing on Raspberry Pi in Matlab'. K Horak , L Zalud . *Advances in intelligent systems and computing*, 4 November 2015.

[Gupta et al. (2015)] 'Image Processing using Xilinx System Generator (XSG) in FPGA'. Ankita Gupta , Himanshu Vaishnav , Himanshu Garg . *International Journal of Research and Scientific Innovation (IJRSI)* September 2015. 2 (9) p. .

[Nirmal and Joy (2015)] 'Implementation and optimization of connected component labeling in Raspberry Pi'. T M Nirmal , K R Joy , RajeevK . *ARPN Journal of Engineering and Applied Sciences* September 2015. 10 (17) p. .

[Sundari and Manikandan (2015)] 'Implementation of Multi Target Tracking Algorithm on Beagle Board-Xm'. V Sundari , M Manikandan . *Paripex-Indian Journal of Research* July 2015. 4 (7) p. .

[Ying Shin and Zhu (2013)] 'Medical Image Processing A Machine Vision Based Approach'. Weihua Ying Shin , Zhu . *International Journal of Signal Processing* June 2013. 6 (3) p. . (Image Processing and Pattern Recognition)

[Zaidi ()] *Medical image: Current status & future perspectives*, Habib Zaidi . 2009. Geneva University Hospital (Division of Nuclear Medicine)

[Rit et al. ()] 'Medical Imaging Implementation Using FPGAs'. Simon Rit , Romulo Pinho , Vivien Delmon , Maxime Pech , Gauthier Bouilhol , Jo¨el Schaerer , Bharath Navalpakkam , Jef Vandemeulebroucke , Pierre Seroul , David Sarrut . *Fourth International Workshop on Pulmonary Image Analysis*, 2011. July 2010. Altera Corporation. 34 p. . (VV, a 4D slicer)

[Wollny et al. (2013)] 'MIA -free and open source software for grayscale medical image analysis'. Gert Wollny , Peter Kellman , María-Jesus Ledesma-Carbayo , M Matthew , Jean-Jaques Skinner , Thomas Hublin , Hierl . *Source Code for Biology and Medicine* 11 October 2013. 8 (1) p. .

[Dr et al. (2014)] 'Motion Detection Alert System using Beagle Bone Black'. S A K Dr , P Mohammad Jilani , Gouse . *International Journal of Engineering Research & Technology (IJERT)* September-2014. 3 (9) p. .

[Samar et al. (2015)] 'Object Tracking Using Embedded Platform for Video Surveillance'. D Samar , Gajbhiye , P Pooja , Gundewar . *International Journal of Innovative Research in Computer and Communication Engineering* July 2015. 3 (7) p. .

[Bosansky et al. ()] *Pattern Recognition with Raspberry Pi Platform*, Michal Bosansky , Leo Blaho , Tatiana Mrafko , Mudrakova . 2015. University of chemistry and technology (Technical Computing Prague)

[Prof et al. (2016)] 'Pedestrian Counting System Using Raspberry-Pi and OpenCV'. Prof , T Mangesh , Mr Nikam , A Jitendra , Patil , Mr , S Vishal , Patil . *International Journal of Innovative Research In Electrical, Electronics, Instrumentation and Control Engineering (IJIREEICE)* March 2016. 4 (3) p. .

[Dr et al. (2014)] 'Raspberry Pi Based Color Speaker'. S A K Dr , G S A Jilani , Manasa . *SSRG International Journal of Electronics and Communication Engineering (SSRG-IJECE)* September 2014. 1 (7) p. .

[Yadav et al. (2016)] 'Raspberry pi based gesture photography'. Jyoti Yadav , Mohammed Firash Khanna , Muhammed Shahan , K K Sreedevi P , K Sumayya , V Manju . *International Journal of Advanced Research in Computer and Communication Engineering* March 2016. 5 (3) p. .

[Manasa et al. (2015)] 'Real Time Object Counting using Raspberry pi'. J Manasa , J T Pramod , Dr S A K Jilani , . S Mr , Hussain . *International Journal of Advanced Research in Computer and Communication Engineering (IJARCCE)* July 2015. 4 (7) p. .

[Altuncu et al. (2015)] 'Real-time system implementation for image processing with hardware/software co-design on the Xilinx Zynq platform'. M , Ali Altuncu , Taner Guven , Yasar Becerikli , Suhap Sahin . *International Journal of Information and Electronics Engineering* November 2015. 5 (6) p. .

[Dixit and Deshmukh (2015)] 'Realization of canny edge detection algorithm using FPGA'. S R Dixit , Dr A Y Deshmukh . *International Journal of Engineering Sciences & Research Technology (IJESRT)* September 2015. 4 (9) p. .

[Nirmala et al. (2012)] 'Review of Image Enhancement Techniques: FPGA Implementation Perspective'. S O Nirmala , T D Dongale , R K Kamat . *International Journal of Electronics and Computer Technology (IJECCT)* November 2012. 2 (6) p. .

[Narkhede (2013)] 'Review of image segmentation technique'. H P Narkhede . *International Journal of Science and Modern Engineering (IJISME)* July 2013. 1 (8) p. .

[Kamboj and Gupta (2012)] 'Simulink Model Based Image Segmentation'. Amandeep Kamboj , Anju Gupta . *International Journal of Advanced Research in Computer Science and Software Engineering* June 2012. 2 (6) p. .

[Savant (2015)] *SIVP: SCILAB image and Video processing toolbox*, Shubhashree Savant . September 2015. 39 p. . (CSI communication)

[Swati et al. (2015)] 'Sobel Edge Detection Implementation using Spartan 3 FPGA and Xilinx System Generator'. R Swati , Dr A Y Dixit , Deshmukh . *International Journal of Engineering Research and General Science* July-August 2015. 3 (4) p. .

[Bedi and Khandelwal (2013)] 'Various Image Enhancement Techniques-A Critical Review'. S S Bedi , Rati Khandelwal . *International Journal of Advanced Research in Computer and Communication Engineering (IJARCCE)* March 2013. 2 (3) p. .