Anonymizing Functional Magnetic Resonance Imaging Files

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Introduction

Digital Imaging and Communications in Medicine (DICOM) files are the standard file format, which is widely used to handle images produced by cutting-edge medical imaging techniques like Magnetic Resonance Imaging (MRI) scan, Computerized Tomography (CT) scan, X-ray radiography, medical ultrasonography, etc. [1,2]. The DICOM file format is described by American College of Radiology and National Electrical Manufactures Association. The basic file format of this file format comprises of "File Header", "Data Set", and "Data Elements". The header consists of 128 byte file preamble, followed by a 4 byte DICOM prefix. Each file shall contain one or more Data Set (2-Dimensional image) representing a single SOP instance. A data set represents an instance of real world information object, which is constructed of data elements. The data elements contain encoded values of attributes of that object. A data element is uniquely identified by a Data Element Tag [1]

Functional magnetic resonance imaging (fMRI) measures brain activity by capturing changes associated with blood flow; which relies on the fact that cerebral blood flow and neuronal activation are inter-related. When an area of brain is in use, the blood flow to that specific area also increases [3]. Physicians use fMRI technique to access how risky can a brain surgery be, or similar invasive treatments; and to learn how a normal, diseased or injured brain is functioning. They map the brain with fMRI to anatomically identify regions of critical functions, which can be useful in planning a surgery or radiation therapy for brain [4].

Python is a widely used high-level programming language for general purpose programming, which was created by Guido van Rossum. Python has a dynamic type system and automatic memory management and supports multiple programming paradigms, including object-oriented, imperative, functional programing and procedural styles; supported by large and comprehensive standard library [5]. Python is way ahead compared to other languages in connection with bioinformatics related use. We have used Pythons' file handling capabilities and parsing capacities; along with navigation functionality for accomplishing this task.

Application

Maintaining patient, and or, volunteer details is becoming highly important and needs to be handled with prime importance. As the fMRI produced DICOM files are rich in participant's information; handling these files as such raises confidentiality issue. On the other hand, a DICOM file with encrypted/ concealed

patient information would be more than handy to address this issue to a great level.

Method

We used Python programming language to solve the problem. The files were searched for across multiple directory structure, to find and to be copied to a temporary location. This is to avoid any unintended manipulation of originals. Later these files are read using Python's 'dicom' function to access relevant felids to be edited/ conceived. After this step, the resulting files are saved as another file, to negate overwriting the files.

Python script used for this task can be accessed from GitHub repository at https://github.com/Sukithar/Medbioinfo_assignments. The script is named "fmri_anonymize_suki.py"

Reference

1."Dicom Specification Overview." LeadTools. Accessed online on October 19, 2017 at: https://www.leadtools.com/sdk/medical/dicom-spec

2."Medical Imaging." Wikipedia. Accessed online on October 20, 2017 at: https://en.wikipedia.org/wiki/Medical_imaging

3."Functional Magnetic Resonance Imaging." Wikipeida. Accessed online on October 20, 2017 at: https://en.wikipedia.org/wiki/Functional_magnetic_resonance_imaging

4.Glover G.H. 2012. *Overview of Functional Magnetic Resonance Imaging*. Neurosurg Clin N.Am. Accessed online on October 20, 2017 at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3073717/

5."Python". Wikipedia. Accessed online on October 20, 2017 at: https://en.wikipedia.org/wiki/Python_(programming_language)