

A Web-Based Data Management and Processing System to Support the Prevention of Vascular Dementia

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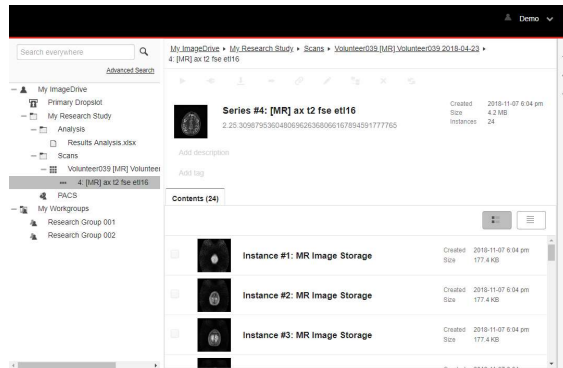
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Introduction

We present a dedicated, web-based, image management system built for imaging research applications such as the South American MRI Challenge. We propose that this system could be used to automate the management and processing of both DICOM and non-DICOM data, thereby enabling the development and systematic application of image processing and machine learning algorithms that will be necessary to achieve the goals of the Challenge.

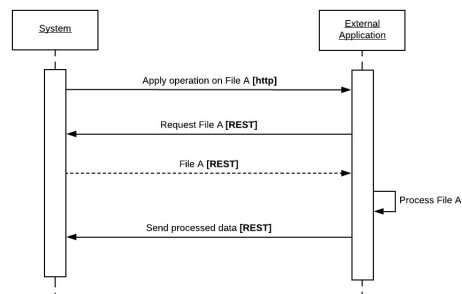
Data Organization

The System accepts files in a taggable and searchable Virtual Folder System (VFS). A diversity of file types can be stored, including DICOM MR images, documents, spreadsheets, videos and binary data. DICOM data is richly supported through a) the native representation in the VFS of the study-series-image hierarchy b) DICOM networking for communication with modalities and PACS c) web-based image viewing, and d) export to NIfTI and NRRD. Research collaboration is made possible using special VFS folders known as Workgroups, which facilitate permissions based data sharing with other users.



Machine Learning and Automated Processing

A key feature of the System is its ability to work with other software applications that are external to the System itself. These "External Applications" could be, for example, image processing and machine learning algorithms. Users can invoke these applications on a selected dataset, which sends a configurable request to an http based listener that in turn downloads the data and runs the algorithm on it. To complete the communication loop, the System also offers a RESTful API that the External Application can use to perform operations such as writing back data, adding tags, etc. This External Application functionality can be further leveraged to create an automated processing pipeline by making use of the System's rules engine. Rules can be defined on VFS folders to automate the processing of DICOM images. By daisy chaining folder rules together, a multistage processing pipeline can be created, with each folder representing a different stage in the pipeline.



Application to the Challenge

A VFS folder would be created and configured as a DICOM endpoint, allowing for DICOM MR studies to be sent to it from another DICOM device, or manually uploaded to it. Related patient data, such as blood pressure, cholesterol or other relevant biomarkers could be associated with those DICOM studies through a structured attachment (e.g. JSON or XML). A separately developed External Application, would automatically download studies and quantify the T2 hyperintensities and ischemic and haemorrhagic lesions. The application would write back key metrics to the study, again through a structured attachment. When this data curation and preparation step is complete, another separately developed External Application would run the data to the relevant machine learning algorithms. That output of those algorithms would be written back to the System and systematically made available to researchers through a Workgroup. This data could then be analysed and used to build a model to flag patients at risk of vascular dementia based on their risk factors.