DICOM Lake

A Big Data Approach to Monitor PACS Protocols

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Introduction

To perform an MR study, many parameters must be provided, such as repetition time, echo time, matrix size, slice thickness, number of averages (NEX), etc. These parameters can be adjusted to increase the image quality or reduce the scan time.

Finding a perfect balance can be a tough trade-off, even harder when a company has more than one scanner.

Every time a study is performed, all these technical parameters come along attached to each DICOM image in pieces of information called data elements (DICOM Tags). When a study is sent to a PACS, these data are stored with all images.

But giving the nature of a PACS and its purpose to serve mainly as an image repository, analyzing these metadata can be a challenge.

DICOMweb™ is a relatively new technology that enables one to connect to the PACS using REST API requests. Through it, it is possible to query and retrieve images or only metadata, which is not possible with the standard DIMSE protocol in most PACS.

Using Business Intelligence (BI) techniques, one can easily analyze all this data, identifying incorrect parameters and optimizing protocols in large scale.

Objectives

1. To develop an automatic pipeline to extract DICOM tags from PACS using DICOMweb™;
2. To store these DICOM metadata in a data warehouse;
3. To use BI techniques to identify protocols with potential to improvements.

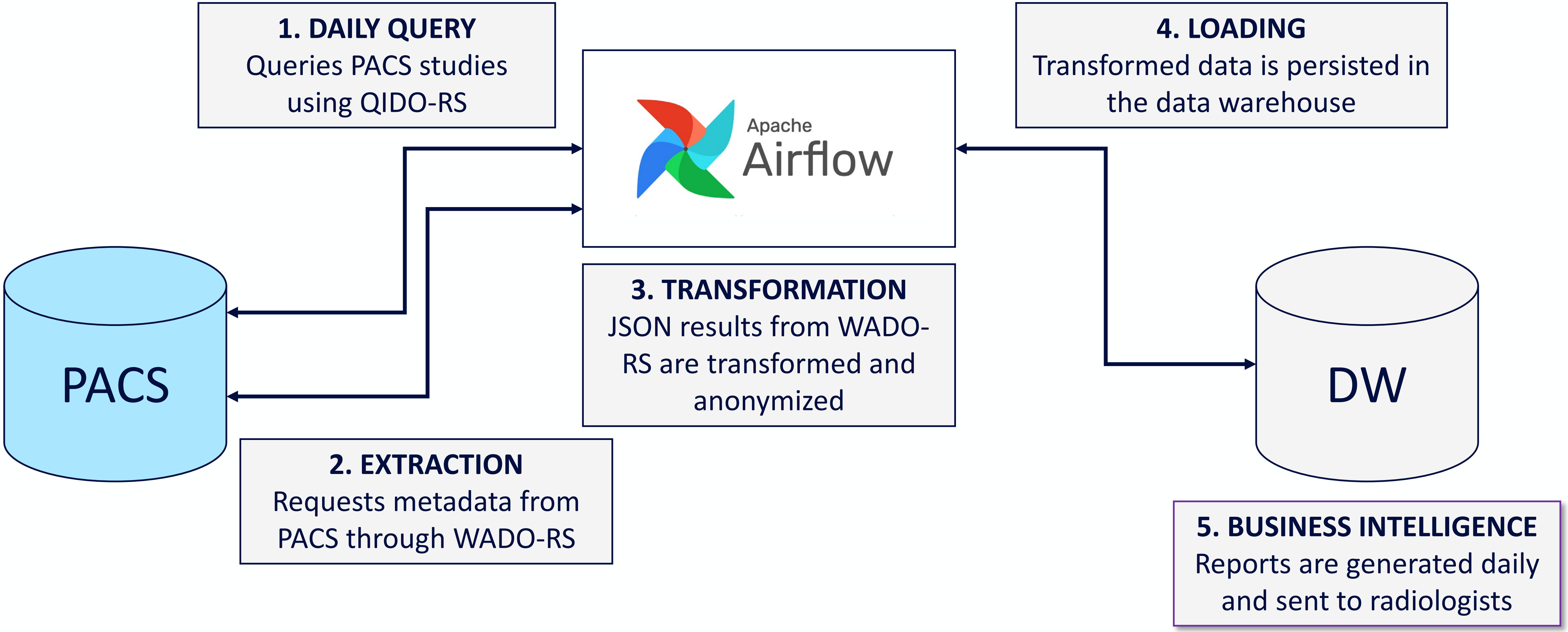
Methods

We developed an automatic pipeline using Airflow and DICOMWeb requests that queries our PACS through QIDO-RS daily.
All metadata is then retrieved performing WADO-RS requests.

DICOMWeb™ responses usually come in a nested json format. Those responses need to be flattened and theirs DICOM tag numbers converted to friendly names.

Then, converted data is normalized and stored in a data warehouse server.
Using BI Tools, reports are generated daily and submitted to radiology chiefs.

ETL Workflow



Results

As a Proof of Concept (PoC), we retrieved metadata from 11,249 lumbar spine MR studies, totalizing 70,874 series acquired in 63 scanners from our company.
All data were anonymized and stored in a data warehouse. We chose to analyze the Number of Averages (NEX) from each series, as this is known as having direct impact in study duration.

We identified 282 series in the protocols of 54 scanners with potential to be optimized.
Those protocols were adjusted according to radiologists' orientations and the mean of NEX was decreased from 1.80 to 1.09.

The optimized studies were then reviewed and validated by radiologists. By the end of the optimizations, the study mean duration was decreased by 39% without loss to clinical accuracy.

Sample Case

Conclusion

Analyzing technical parameters from scanners can be a challenge. Specially MR with its large number of parameters is commonly overlooked. Despite its difficulty, it is extremely important to monitor those parameters.

We believe an automatic protocol monitor system can help improve imaging quality, optimize technical parameters, and decrease the study length.
In our PoC, it was possible optimize lumbar spine MR protocols, reducing studies time length in 39%.

Further studies should be performed to refine the data analysis, leading to a more efficient management of studies protocols.
Studying other modalities, such as CT for monitoring radiation doses, for example, can bring benefits to patient's safety.

Thank you

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