Unlocking Medical Archives with Multi-Modal Content to Deliver Enhanced Analytics

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Abstract

A large number of healthcare institutions have significant stores of medical archives in their data centers, archive rooms and virtual records centers. Unfortunately, these archives are often kept only for administrative and or legal reasons and are not leveraged to enable differential diagnosis or operation efficiency. The traditional focus by academia and industry on analytics of textual data stored in databases, content management systems and the Web must also be augmented to handle multi-modal data that is prevalent in medical archives. We present technology that allows the extraction of the informational value derived from analyzing these multi-modal archives and the integration of this value into the healthcare entity's core decision support and research systems, in order to improve the entity's analytic capabilities.

Keywords:

Archives, Analysis

Introduction

The traditional view of archives has been that they are copies of *production data*, which are short-term in nature, are typically overwritten and are available when the production system fails (and thus helps in improving data availability). However, this is actually the classic definition of *backups.* Archives are moves or transfers of long-term information, which is periodically maintained, meant for retrieval and used to increase operational efficiencies and to comply with regulations. Archives are thus active in nature and can be leveraged to derive value when analytics are deployed over the archived content. Our focus is on analytics over archived multi-modal data such as diagnostic medical images and videos.

Methods

For this project, we used *Open Source* software components and developed specialized software to implement the Content Analytic Platform (CAP) – a framework that enables advanced analytics on an arbitrary archival system. Our work resulted in a CAP instance that enables enhanced analysis on archived cardiology data. For our instance, an Echo-Video Analytics Module was invoked to process Echo-Video archive files. This Analytics Module encapsulates logic to identify video frames, OCR text and extract features such as Ejection Fraction from each frame, etc. Diseases such as Congestive Heart Failure (CHF) are diagnosed based on the value of this feature. We then developed a simple application to aid in diagnosis support for use-cases such as finding related patient cases by features, e.g.: Given a case for a patient with CHF, find other related cases by querying features that indicate this disease.

The CAP architecture is depicted in Figure 1.

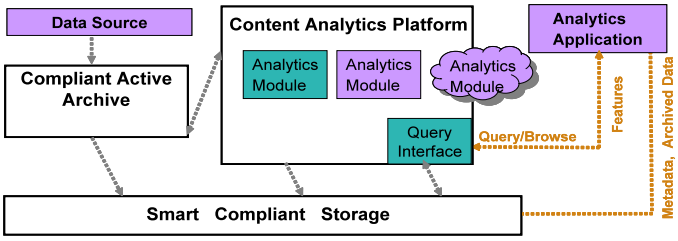

Figure 1-Cap architecture

Results

Our CAP cardiology instance illustrates the benefits that healthcare providers can gain from the analysis of multi-modal data (EKG's, Echo Videos, etc.) generated by PACS systems that are stored in archives. Examples include identifying patients with similar diseases, providing decision support for diagnostics and treatment, comparing results from the history of a patient, etc. Valuable lessons learned include:

- Our analytics used OCR techniques for feature extraction; far more sophisticated analysis is required on multi-modal data to assist in clinical research and decision support.
- Analytic modules geared towards learning disease information from samples provided, and algorithms that efficiently compare an existing patient study with other studies in the corpus to identify similarity characteristics are required.
- New indexing structures and efficient search schemes best suited to the modality must be developed.

Conclusion

Our work here has provided a valuable first in the field, a demonstrable win for vendors, providers, payers and patients. This system unleashes the power of medical archives, while leveraging open source technologies and bridging the gap between disparate archival solutions. The Content Analytics

Platform (CAP) allows value to be derived from archives of multi-modal data, which is of utmost importance in the Healthcare domain.