Medical Image Retrieval in Healthcare Social Networks

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ABSTRACT

In this article, the authors present a multimodal research model to research medical images based on multimedia information that is extracted from a radiological collaborative social network. The opinions shared on a medical image in a medico-social network is a textual description which in most cases requires cleaning by using a medical thesaurus. In addition, they describe the textual description and medical image in a TF-IDF weight vector using a “bag-of-words” approach. The authors then use latent semantic analysis to establish relationships between textual terms and visual terms in shared opinions on the medical image. The model is evaluated against the ImageCLEFmedbaseline, which is the ground truth for the experiments. The authors have conducted numerous experiments with different descriptors and many combinations of modalities. The analysis of results shows that when the model is based on two methods it can increase the performance of a research system based on a single modality both visually or textually.

KEYWORDS

Bag-of-Word, Latent Semantic Analysis, Medical Image Retrieval, Medical Social Network, Multimodal Fusion

1. INTRODUCTION

The explosion of medical information in the last 10 years over the Internet has made information seeking for both textual and visual objects a very hot topic of research. In the medical domain, in particular, the vast volumes of visual information produced every day in hospitals in connection with the existence of digital Picture Archiving and Communications Systems (PACS) make the need imperative for advanced ways of searching, i.e., by moving beyond conventional textbased searching towards combining both text and visual features in search queries. Indeed, biomedical information comes in several forms: as text in scientific articles, social networks, as images or illustrations from databases and Electronic Health Records (EHR). Although many methods and tools have been developed, still, we are far from an effective solution especially in the case of image retrieval from large and heterogeneous databases. One way towards the improvement of current retrieval facility is data fusion. Data fusion is generally defined as the use of techniques that combines data from multiple sources and gather that information in order to achieve inferences, which will be more efficient and accurate than if they are achieved by means of a single source.

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It is evident from the literature that there is a lot of room for improvement in image retrieval. For example, techniques for image annotation with semantic information, is an active research topic. Furthermore, given that the text accompanying the images is usually a short paragraph, techniques for documentation and query expansion may be needed to overcome the language ambiguity, such as polysemy and synonymy.

This article is an overview of the experience we have obtained through our participation in the imageCLEF in the last two years. In particular we present ways to improve retrieval performance by making use of textual as well as visual information. This information is extracted from an image itself and from textual descriptions like caption or from references to an image of an article, and ontologies. Thus, to achieve our goal we combine techniques of information retrieval, content-based image retrieval (CBIR) and natural language processing (NLP). Our objective is to aid diagnosis by finding similar cases for a patient using several resources in the literature and in databases of EHR. We conducted experiments in the imageCLEF database of the years 2015 and 2016 to see the truth of the ground.

To demonstrate our techniques, we have developed our own search engine, a hybrid system that uses both visual and textual resources. Our framework is built upon the Lucene search engine and provides several ways to combine textual and visual search results. The system is capable of: (i) starting a visual search (query by example) and applying relevance feedback with textual features that accompany an image; and, (ii) merging the results of independent text and image searches. The retrieved results can be viewed as thumbnails in a grid view sorted by relevance (Figure 1). Such a system may be used for computer-aided diagnosis, medical education and research purposes.

In Section 2, we give an illustrative example explaining the ambiguity that can engender bad consequences. However, in order to solve this problem, it has become imperative to create a collaborative space between the doctors of which we explain in section 3 the advantages and the works that have been treated in recent years in social medical networks. In sections 4, 5 and 6 we describe our method of searching multimodal information (text + image), followed by the section where we present our experimental results and finally the conclusions are drawn with proposals for further work.

Figure 1. Our medical image retrieval system on a text + image query
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