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An Ontology Based Framework for Retrieval of Museum Artifacts

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Abstract

This paper proposes ontology based conceptual framework for storage and retrieval of Digitized Museum Artifacts. The proposed framework uses ontology structure for automatic image annotation. It supports semantic retrieval by combining ontological concepts, visual and textual features automatically extracted from images and their textual descriptions. The Ontology-driven analysis module automatically generates annotation for domain objects. This paper also reports a new dataset designed for its evaluation. The dataset consists of images displayed in various galleries of Allahabad museum along with their textual description. We have collected 1200 images and extracted their visual and textual features for the purpose of retrieval.

Keywords: Image retrieval; Image analysis; Image annotation; Ontology; Information retrieval; Knowledge based system; Knowledge sharing; knowledge discovery.

1. Introduction

The recent growth in numerous key technologies has greatly simplified creation, processing and on line delivery of visual and textual content. This results in enormous growth in the amount of digital content available in unstructured and non-indexed forms on the web in personal as well as commercial collections. In order to provide access to this data to users we need tools and techniques to automatically analyze, index and manage the visual content. A desirable key functionality is to make the content access in terms of semantics it represents. However, there exists a significant gap between the desired semantic level of access and the existing image retrieval system. The existing

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image retrieval systems either use manually annotated keywords (keyword-based approach) or visual features for retrieval (Content-Based Image Retrieval). The keyword-based approach supports semantic retrieval but has several limitations. First, it is not scalable. Second, due to the subjectivity of the human annotator, the annotations may not be consistent or complete. Third, it may be infeasible to describe visual content simply using words. Content-Based Image Retrieval (CBIR) systems use visual features such as color, texture and shape for retrieval. A user formulates a query by providing examples of images similar to the desired ones. A retrieval model computes similarity between the query image and images in the database. The results are ranked based on the computed similarity values to perform retrieval. Although this approach is less time consuming and more user friendly[1], the representation of image using visual features only involves a loss of information which is referred to as semantic gap. One way to overcome this limitation is to integrate visual descriptors along with the available textual and ontological descriptions to support semantic retrieval[3]. The use of domain knowledge appears to be a promising way by which higher-level semantics can be incorporated into techniques that capture the semantics through automatic analysis.

In this paper, we propose a retrieval framework for museum artefacts. A museum preserves artefacts of scientific, artistic, cultural, or historical importance which attracts general public as well researcher and specialists. More and more museums are implementing digitization project to extend their reach beyond the wall. An online museum is not just a collection of artifacts but augments the presentation with useful textual description. Further, the artefacts are usually organized in different categories. Accordingly the digital counterpart of it will consist of images of artefacts and their textual and ontological descriptions. This underlines the need of a new form of retrieval and presentation method that can utilize the rich content of museum database to provide efficient access to cultural heritage content. In order to organize museum data in a meaningful manner so that the relevant and useful information for a user's query can be searched and retrieved, a domain otology is defined. The proposed framework combines ontological, textual and visual descriptors to support semantic retrieval.

The rest of the paper is organized as follows: section 2 briefly reviews existing work. Section 3 describes the proposed framework. In section 4, we discuss the dataset designed for the evaluation of the proposed framework. Finally, conclusions are made in section 5.

2. Related works

Efficient image searching, browsing and retrieval tools are required by user from various domain including, art, fashion, crime prevention, medicine, remote sensing etc.For this purpose many retrieval system have been developed. Which can be broadly categorized into text based and content based. Keyword based system use keyword to annotate each image in the database using keywords that are used in the retrieval process. This approach supports semantic but is criticized due to its subjective nature, being time consuming and expensive, further difficulty in describing visual feature using text appropriately[7].

To overcome the above disadvantage in text based retrieval system, content based image retrieval (CBIR) was introduced. In CBIR images are indexed by their visual content, such as color, texture, and shape for retrieval. These features can be extracted automatically. Images in the database are represented as vector of extracted visual features instead of textual annotation. User formulates a query by providing examples of images similar to the desired ones. The retrieval model compute similarities between images in database and the query representation, and rank results are based on the computed similarity values. The query, and retrieval models may a clustering module, which expedites searching in large image database. A detail survey of CBIR system can be found in [2]. In the past decade, a few commercial prototype systems have been developed based on CBIR paradigm, such as QBIC [4], Photobook[5], VisualSEEK [6].Although this approach is less time consuming and more user friendly, the representation of image using visual feature alone involves a loss of information which is referred to as semantic gap.