Chapter 1

Introduction

This chapter presents the motivation concepts for this thesis; moreover, it introduces the concept of content based image retrieval. Finally the chapter presents the main contributions of the research work and the thesis outline.

1.1 Research Motivation

Recent years have seen a massive growth of the storage of digital images. These large image databases will be useless unless they are stored and accessed using efficient techniques of searching, indexing and retrieval. Generally there are three ways for searching multimedia data:

1. Free Browsing: users continue browsing a multimedia collection until finding the desired image.

2. Text Based Retrieval: users use text retrieval techniques for searching a multimedia repository. These retrieval techniques rely on the keywords around the multimedia data and the filenames. Also some retrieval techniques rely on manually annotating images with keywords describing their content.

3. Content Based Retrieval: Users search a multimedia repository using information about the content of the query multimedia object. The search process uses signatures from the actual content of the query object to search for and retrieve candidate multimedia objects.

The first two searching techniques have several drawbacks. The Free Browsing techniques is time consuming and inappropriate for large scale multimedia databases. The text based retrieval techniques rely on the keywords around the images and the filenames, which produces a lot of randomness in the search results. Also some text retrieval techniques rely on manually annotating images with keywords describing their content. This has the drawback of producing inaccurate descriptions due to differences in human perception of images being annotated. Other drawbacks rise from differences in human culture and poor description of image content.

Text based image search engines are typically web-based services that collect and index images from other sites on the internet. Image searching is offered by general search engines, like Google or Yahoo, and by specialized image search engines - services devoted to the searching of images or multimedia. In addition, there are meta- search engines, which pass on search requests to more than one search engine and then bring back the results.

Sometimes people use 'Image Search Engine' to refer to collection-based search engines, services that index a single or small number of image collections, Large digital libraries, commercial stock photo collections, or community-based collections like Flickr that typically offer their own search engine-like facilities.

In order to overcome the limitations of text based image retrieval techniques, researchers started studying methods that efficiently and accurately index huge images repository. A new research area had been constructed by researchers named Content Based Image Retrieval (CBIR). CBIR techniques tries to index visual characteristics of an image; such as its salient, color, shape and textures to search for a specific image in a huge amount of images. Salient features describe the most complex and interest points or regions in an image [1]. Color features describe the color spatial structure of an image. Texture features describe the spatial variation

in pixel intensities of an image; it can be described by the coarseness, contrast, directionality, line-likeness and roughness of object surfaces [2]. The shape features describe boundaries or regions of different objects in an image.

The image search domains were classified as narrow domains and broad domains [3]. This classification holds until now and remains important for the sake of system design. In narrow domain search engines, images have less variation in terms of geometric transformations, occlusion between objects and changes in illuminations; so we have well defined visual features, for example face databases. In broad domain search engines, images have high and unpredictable variations of geometric, illumination and object occlusion characteristics. This research work address the broad domain search engines.

This thesis aims to address the following issues:

1. Improve image search results retrieved from keyword based queries by integrating image features. for achieving our goal, we address the implementation of a CBIR system that retrieves images from a professional keyword based image search engine as a first filtering stag, a second stage will arrange images upon their content to a given query image.

2. Improve the precision and recall of the best ranked image list retrieved for a query. To achieve this goal, the framework addresses the feature extraction and matching techniques.

1.2 Problem Statement

Keyword based image search is the most intuitive image query method given by professional keyword based search engines like Google and Yahoo. For extracting keywords, they use image surrounding text. However, images frequently lack descriptive text which degrades the accuracy of text-based searching.

A keyword based image search engine uses images descriptive text to provide an image dataset that are relevant to the vocabulary of the user. But one can view this dataset as a random image dataset which needs to be reranked based on a user supplied image containing the required objects that meet the user perception. For example the following dataset (figure 1.1) is the retrieved results from Google image search engine for the keyword "basketball".

(a) First 24 results (b) Next 24 results

Figure 1.1: Google image search results for the keyword "basketball"

Suppose the user intention of this query is an image containing only a basket ball. A user views this query retrieved results as a random retrieved set. This is because the search engine retrieves the images based on descriptive text that may be inaccurate and doesn't care about the content of these images. These random results can be used as a first web filtering stage. A second stage will be a content based image retrieval system that reranks the random dataset based on a user supplied sample image.