Chapter 8

Conclusion and Future Research Avenues

In the previous chapters, the proposed methodologies and their related works were discussed to search similar web images. In this chapter, we discuss about the conclusion of proposed methodologies and future research avenues for our work.

8.1 Conclusion

The existing web image search engines are designed to retrieve similar images based on keywords. These keywords are used to represent an image semantically. The use of a search engine may not represent the entire web community. The relevancies of search engines differ from one another in terms of their design and implementation to search and retrieve similar web images.

In this thesis, we have proposed methodologies for searching and retrieving images from web. Our work is broadly classified into three modules: Image Selection, Feature Extraction, and Indexing and Similarity measure modules. In Image Selection module, we have implemented agglomerative hierarchical clustering algorithm for selecting relevant images from the collected web images, based on the visual content. In Feature Extraction, we have proposed feature extraction techniques for extracting to reduce higher
dimensional space into lower dimensional space. In Indexing and Similarity measure, we have proposed search and retrieval methodologies to search similar images.

We have carried out a performance analysis of integrating various techniques to reduce search and retrieve similar images. A survey of existing techniques shows that many individual techniques are good in their own context. We have shown in our results that an integration of these techniques performs significantly better. In this context, we have proposed a few approaches to search and retrieve similar web images.

In Chapter 3, we explored hierarchical clustering approach to select web images based on visual content. We have carried out an experiment for evaluating collection of images based on visual content. The visual content of the images is used to automate the system to eliminate irrelevant images from collected images. The results of manual evaluation and the automated evaluation for selecting web images have been discussed. The precision of group A (relevant) images from automated evaluation system is increased by 1% over the precision of manual evaluation system. We observed and verified that the group A and group B images are classified properly in the corresponding groups. Based on the results, our proposed approach has obtained better results with image features than the manual evaluation.

In Chapter 4, we proposed color histogram features to retrieve similar web images. In this chapter, we have implemented block processing approach for extracting color histogram features. These features are integrated to achieve better performance and cluster for searching similar images. The similarity measure is used to find similar images within the cluster for the given input image. The proposed approach is to cluster images for reducing search time. Based on the results, we have achieved better precision and recall of the search system.

In Chapter 5, we proposed region based web images search to retrieve similar web images. In this approach, we extract color and texture features, these features are used for segmenting images. The segmented regions are used for constructing a region based visual dictionary. The dictionary is used for representing images semantically. In the retrieval phase, image searching is based on region features of images that contain
a particular building, a person, a generic object etc. The images are indexed using inverted indexing structure. We modified the inverted indexing structure to expand the initial query to retrieve more number of similar images. The Region-to-Region matching similarity measure is used to compute the similarity between the query image and the set of candidate images. The images are ranked according to the distance, then the similar images are returned to the user. Based on the results, we have shown that the proposed region based dictionary performs significantly better than the color histogram features. We evaluated the search system and showed that the results are significantly better compared to histogram features.

Finally, in Chapter 6, we have proposed web image search using bag-of-words approach. In this approach, we have proposed Dense SIFT features to obtain more descriptors from an image. The K-means and SOM clustering algorithm are used for constructing visual dictionary. The visual dictionary is used for representing web images semantically. For constructing visual words, we proposed an algorithm for selecting the initial code words. These code words are used for initializing the initial values of K-means and SOM clustering algorithm for constructing visual based dictionary. Modified inverted indexing is used to speed up the retrieval system and the similarity measure is integrated to rank the images. Based on the results, we have shown that proposed visual based dictionary performs significantly better than the color histogram features and region based visual dictionary approaches. We evaluated the search system and showed that the results are significantly better compared to region based dictionary approach with different sizes of descriptors.

In summary, we have presented in this thesis a performance analysis of integration of various solutions to retrieve similar images from web. In short, this thesis has addressed effectiveness and efficiency issues of searching images.
8.2 Future Research Avenues

The work presented in this thesis can be extended in a number of ways, some of which are listed here:

1. **Understanding Users and Queries:** Web image search engine users express their needs through queries. Understanding these queries and analyzing the behavior of image search engine users can be helpful in meeting their needs. In addition, by studying the intuition of the users, it may be possible to understand their queries to facilitate more functionalities to search the required images from the Web.

2. **Narrowing the semantic gap:** The people often use semantic concepts to retrieve similar images from the web. In text retrieval system, the surrounding texts of images are used for narrowing the semantic gap. However, it is insufficient to adopt metadata standards. In this connection, we proposed for constructing a region dictionary using bag-of-regions and visual dictionary using bag-of-words approach to represent an image semantically. The effective use of visual dictionary for illustrating the image data is still a challenging task.

3. **The need for standardization in image description:** In the web context, there is a vital need to define standards for image and data descriptors. This will allow search engines to identify relevant attributes with more precision and objectivity.

4. **The problem of high dimension data description:** One of the biggest challenges facing in web image retrieval is the curse of dimensionality which reduces the efficiency in both retrieval and indexing. The ways of avoiding this problem includes dimensionality reduction and feature subspace selection. This cannot be avoided, special indexing and retrieval techniques must be developed.

5. **Coverage of the Web:** Partial coverage of the web is a problem encountered by all kinds of web information retrieval systems. Development of effective traversing
techniques for understanding the entire structure of the web is essential.

6. Integration of different kinds of media: There are different kinds of media on the WWW such as text, images, videos, and audio. Most of the existing search engines support only one type of media, and little work has been done on the integration of different kinds of media in the same framework. This could allow for cross-media browsing to find composite media related to the same subject.

7. Offering browsing catalog: It is important for a web image retrieval system to offer a catalog that categorizes images by subject allowing users to navigate between them. Many web text retrieval engines propose such catalogs. However, in the field of web image retrieval, few systems offer this service and the proposed catalogs are limited. In this area, more work is needed.

8. Image classification: Image classification is the research area involved in the task of grouping the images into appropriate categories. Web image classification is a research area for automatic classification and organization of web image useful in many applications available online. Image mining is a recent area of research of web users on diverse topics. Most of the search engines use keywords to retrieve similar images. A study can be undertaken to propose a set of approaches that can efficiently classify images as subjective based images.
Authors Publications

JOURNALS


CONFERENCE PROCEEDINGS

First International Conference on Artificial Intelligence, Soft Computing 

Web Image Database”, International Conference on Web and Semantic 
Technology (WeST-2011), 13–14th July 2012, Chennai, India, The Proceedings 
in Communications in Computer and Information Science (CCIS), Springer ISSN: 
1865-0929.

International Conference on Emerging Research in Electronics Computer 
Science and Technology (ICERECT-12), 21st – 22nd December 2012, 
Mandya, India, The Proceedings of the Conference will be published by Springer. 
(Accepted).

International Conference on Control, Modeling, Computing and Appli-
cations, 28–29th December 2012, Dubai, UAE, The Proceedings of the conference 
will be published by Computer Science Conference Proceedings in Computer 
Science & Information Technology (CS & IT) series (Submitted).