Content Based Image Retrieval Using Clustering

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ABSTRACT

Content-based image retrieval (CBIR) is a widely accepted technique for searching images from large and unlabeled image databases. But users are not satisfied with the traditional information retrieval techniques, because the network and development of multimedia technologies are becoming more popular. So the content based image retrieval (CBIR) are becoming a source of accurate and efficient retrieval. In recent years, various techniques have been implemented to improve the performance of CBIR. Clustering deals with searching a structure in a corpus of unlabeled data. Clustering is an unsupervised method of classification but it is observed that whenever we provide a small amount of supervision to clustering, it improves the clustering performance significantly. In this paper, different clustering techniques are discussed and analysed. Also, we propose a new CBIR system that uses kernel mean shift clustering technique under semi-supervised framework. This method uses only pairwise constraints to train the clustering procedure. This is a non-parametric method, so we are not restricted to specific no of clusters.
Keywords: Content Based Image Retrieval(CBIR), Image retrieval, Semi-supervised clustering, Mean shift clustering, Feature extraction.

1. INTRODUCTION

Content Based Image Retrieval (CBIR) plays an indispensable role in the field of image processing. CBIR is used for automatic ranking and retrieval of images depending upon features of images. The features may be low level such as color, texture and shape or High level such as specific content of image. The high level feature depicts the need of user. A Single feature can correspond to only part of the image property. Because of this, multiple features are used to improve the image retrieval process. Recently, the research focuses on CBIR systems that is fetching the exact cluster of relevant images and reducing the elapsed time of the system. For this purpose, various techniques have been developed to improve the performance of CBIR system. Clustering is one of them. Clustering is the technique which is used to partition the data into groups of similar objects. It is also called unsupervised learning because a priori labeling of patterns is not available for grouping. It is used for the exploration of inter-relationships among a corpus of data, by arranging them into homogeneous clusters. The objective of applying clustering algorithms is to expose useful but unknown classes of objects. Clustering can be categorized into two groups: supervised (including semi-supervised) and unsupervised. It is observed that a small amount of supervision can increase the performance of clustering significantly. So, the focus is on supervised or semi-supervised clustering. The advancement in computing power and electronic storage capacity has led to an exponential increase in the amount of digital data available to users in the form of images and video. As a result, the search for the relevant information in the huge space of image and video databases has become more challenging. How to obtain accurate retrieval results is still an important problem and an active research area. A typical image retrieval system consists three major parts: i) feature extraction ii) high dimensional indexing and iii) system design. With the development of the Internet, and the availability of image capturing devices such as digital cameras, image scanners, the size of digital image collection is increasing rapidly. It is very essential to efficiently store and fetch images for different applications. For this purpose, many general purpose image retrieval systems have been developed. They are of two types: text-based and content-based. In text-based approach the images are manually labeled by text descriptors to perform image retrieval. It has two disadvantages. First one is that more human efforts are required for manual annotation. The second is the annotation inaccuracy due to the subjectivity of human knowledge. To overcome the above disadvantages in text-based retrieval system, content-based image retrieval (CBIR) was introduced. In CBIR, images are indexed by their visual features, such as color, texture, shapes. The CBIR mainly consists of two steps. First one is the feature extraction and second one is the similarity matching. In various papers different feature extraction techniques are used depending upon the low level feature or high level feature. The difference between the user's information need and the low level features extracted from images is called the semantic gap in CBIR system. The system is said to be efficient if this semantic gap is less. So, we propose a new CBIR system to avoid above problems. The propose system uses Kernel mean shift clustering. This system uses semi-supervised framework for mean shift clustering. Mean shift clustering is a powerful nonparametric technique that does not require prior knowledge of the number of clusters and does not constrain the shape of the clusters [1]. This paper provides a

comprehensive survey of all these aspects. This survey covers approaches used for extracting images to form clusters of relevant data and the mechanisms for improving the performance of CBIR systems.

2. DIFFERENT CLUSTERING TECHNIQUES USED IN CBIR

The goal of this survey is to provide a comprehensive review of different clustering techniques used in CBIR system. Clustering is a division of data into groups of similar objects. Each group, called cluster, consists of objects that are similar between themselves and dissimilar to objects of other groups. The hierarchical approaches demand human interaction to generate grouping criteria for clustering. This paper reviews and summarizes different clustering techniques. Deok-Hwan Kim and Chin-Wan Chung[5] have proposed content-based image retrieval method using adaptive classification and cluster-merging to find multiple clusters of a complex image query. When the measures of a retrieval method are invariant under linear transformations, the method can achieve the same retrieval quality regardless of the shapes of clusters of a query. Yixin Chen et.al.[6] have proposed cluster-based retrieval of images by unsupervised learning (CLUE), for improving user interaction with image retrieval systems by fully exploiting the similarity information. CLUE retrieves image clusters by applying a graph-theoretic clustering algorithm to a collection of images in the vicinity of the query. Clustering in CLUE is dynamic. Kambiz Jarrah et.al.[7] have developed a methodology for training adaptations of an RBF-based relevance feedback network, embedded in automatic content based image retrieval (CBIR) systems, through the principle of unsupervised hierarchical clustering. The self-organizing tree map (SOTM) has shown an effective behavior in minimizing human interactions and automating the search process by efficiently classifying an unknown and nonuniform data space into more meaningful clusters. Liu Pengyu et.al. [8] have presented an image retrieval system based on image content using fuzzy logic and proposed concept on partition the entire database based on content self-organized. They used modified fuzzy c-means(MFCM) clustering scheme to cluster the database before retrieval and defined a new method to determine the fuzzy weight. The MFCM reduces the time of clustering. To improve the retrieval effectiveness more, they have used interactive query (IQ) and presented a new relevance feedback (RF) framework. M.V. Sudhamani et.al.[9] have proposed technique for representing the significant image features is based on the mean shift algorithm. It is a simple nonparametric procedure for estimating density gradients. Liu Pengyu et.al.[10] have proposed modified fuzzy C-means (MFCM) clustering index algorithm, in order to reduce the time of clustering. MFCM is used to transform high-dimension feature space into lower-dimension space by using Karhunen-Loeve(K-L) transformation. It constructs the effective organization and increase retrieval speed. Zhou Bing et.al.[11] have proposed a content-based parallel image retrieval system to achieve high responding ability. This system is developed on cluster architectures. It has several retrieval servers to supply the service of content-based image retrieval. This system adopts the Browser/Server (B/S) mode. The users could visit this system through web pages. R. Chary et.al. [12] have presented an approach for Image Retrieval using cluster mean method using K-Means clustering techniques, where images are initially clustered into groups having similar threshold values. Image feature values are obtained from the images and stored into the database. Using image feature values we implemented propose methods and compared image feature values. This method provides faster image retrieval and also allows the search for most relevant images in large image databases. M. A. Bouker et.al.[13] have proposed an image retrieval system, which focuses on color indexing of images. A statistical algorithm called Mean-Shift is used to modelize the color distributions of images as two-dimensional Gaussian kernels. Akash Saxena et.al.[14] have proposed image retrieval system based on color and texture features of static image. This technique present very small amount of memory for features storage and a prominent rate of computation and will give good results in terms of accuracy. They have shown that k-means clustering is fairly useful for appropriate image retrieval queries. Abduljawad A. Amory et.al.[15] have proposed approach that compares one window from the query image to all windows in each image in the image database and returns the closet matching. This comparison is based on features vector of gray-level intensity for each window. They used K-mean clustering algorithm to separate each window into K clusters. Deepika Nagthane [16] has proposed four target search methods that are Naive Random Scan Method (NRS), local neighbouring movement (LNM), and neighbouring divide-and conquer (NDC), and global divide-and-conquer (GDC) methods. The target search methods uses the concept of voronoi diagram[17] approach to aggressively prune the search space and move toward the target image with minimum iteration. To improve the results K-means clustering technique is used. K-means clustering technique is helpful to reduce the elapsed time of the system.

3. PROPOSED METHOD

The proposed system uses kernel mean shift clustering technique with semi-supervised framework. Mean shift clustering is a powerful nonparametric technique that does not require prior knowledge of the number of clusters and does not constrain the shape of the clusters[1]. In this technique, the inherent structure of the data points is learned using a few user supplied pairwise constraints. The proposed system will produce the output as images which are relevant to the query Image. The block diagram of proposed system is given below.
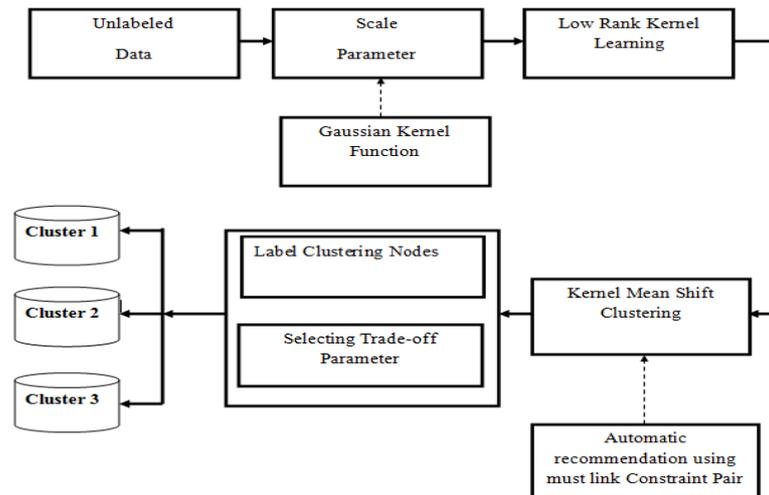
Figure 1. Block Diagram of proposed system

Above diagram(figure 1) shows how clusters are extracted from unlabeled data. First we apply scale parameter which helps to find out modes from dataset. For this purpose Gaussian filter is used. Then ranking is done using bregman divergence. After that Kernel mean shift clustering is performed and different clusters are formed[1]. In this way the proposed approach works.

4. CONCLUSION

In this survey the different clustering techniques are discussed, which are used in existing CBIR systems. Earlier CBIR systems consist of low level feature extraction such as color, texture and shape and similarity measures for the comparison of images. But later on different image features and clustering techniques are used for Image retrieval. It is observed that among all clustering techniques, K-Means is widely used clustering technique in the process of content-based image retrieval. K-Means performs efficiently and reduce elapsed time. But it is sensitive to initialization, shape of the clusters and outliers. Because of this, the proposed CBIR system uses semi-supervised kernel mean shift clustering method. Unlike the other methods, mean shift clustering does not need the number of clusters as input and can identify clusters of different shapes, sizes and density. Since locality is imposed by the bandwidth parameter, mean shift is more robust to outliers. This method is also suitable for large data sets[1].

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