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A Literature Review on Satellite Image Retrieval Techniques

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ABSTRACT
Today, Satellite Image Retrieval is a big issue to discuss. There is a huge amount of research work focusing on the searching, retrieval of images in the image database. The traditional satellite cloud image search method was based on the file name and the sensor parameters of every image. The disadvantages of this method are that it cannot describe the image contents such as shape, color etc. and also leads to the inconvenience in retrieving images. This Paper reviews all the techniques which could retrieve images from image database and also describe the image contents.
Keywords:- Image Retrieval Techniques, Satellite image retrieval.

I. INTRODUCTION

Satellite images have become a common component of our daily life either on the internet, in car driving and even in our hand-held mobile handsets. There is new image and video content appearing every second through multiple competing television and internet channels, Manual interaction with this large volume of data is becoming more and more inappropriate, which creates an urgent need for automatic treatment to store, organize and retrieve this content. [1] The traditional methods for retrieving images from geodatabases are: geographic location, date of acquisition and spectral /spatial properties of acquisition devices [2].Our needs from the satellite scenes are specific contents. Therefore we need to retrieve images that contain our intended contents.

There are other challenges in the field of satellite images itself [4].These images are georeferenced images; this means that all images form in reality a huge continuous image covering the entire earth surface. It is not always proper to deal with such content as isolated images.

Retrieval of data means to get desired data from the database and to reduce the semantic gap. It may image, text , audio or video as per requirement of user. The basic types of retrievals are mentioned in figure(1).

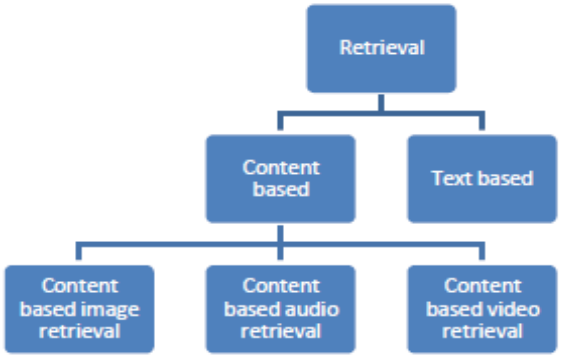

Fig. 1 Types of Retrieval

Previous method used for image retrieval is Text based image retrieval. The advantage of textual indexing of image is that it can provide user with key word searching, catalogue browsing and even with query interface. But the major drawback of text based image retrieval are, annotation depends on the person who adds it. [5] To overcome these disadvantages, many techniques were discovered.

II. FEATURE EXTRACTION

Image features affect every aspect of a retrieval system, and so it is important to carefully choose the right image features for any system. Most of the systems explore low-level image features such as color, texture, shape, motion, etc. because they can be computed automatically. Middle-level features like regions and blobs which can be generated without human assistance are used in object-

level image retrieval. We discuss here the characteristics of some of these features, focusing mainly on how they are extracted and compared in the earlier proposed work.

A. ***Shape based features***

The ability to retrieve by shape is perhaps the most obvious requirement at the primitive level. Unlike texture, shape is a fairly well-defined concept and there is considerable evidence that natural objects are primarily recognized by their shape [6]. A number of features characteristic of object shape (but independent of size or orientation) are computed for every object identified within each stored image. Queries are then answered by computing the same set of features for the query image, and retrieving those stored images whose features most closely match those of the query. Two main types of shape feature are commonly used – global features such as aspect ratio, circularity and moment invariants and local features such as sets of consecutive boundary segments [7]. Alternative methods proposed for shape matching have included elastic deformation of templates, comparison of directional histograms of edges extracted from the image, And routs as et al [8], and shocks, skeletal representations of object shape that can be compared using graph matching techniques. Queries to shape retrieval systems are formulated either by identifying an example image to act as the query, or as a user-drawn sketch.

Shape matching of three-dimensional objects is a more challenging task – particularly where only a single 2-D view of the object in question is available. While no general solution to this problem is possible, some useful inroads have been made into the problem of identifying at least some instances of a given object from different viewpoints. One approach has been to build up a set of plausible 3-D models from the available 2-D image, and match them with other models in the database. Another is to generate a series of alternative 2-D views of each database object, each of which is matched with the query image. Related research issues in this area include defining 3-D shape similarity measures, and providing a means for users to formulate 3-D shape queries [9].

B. ***Colour based Features***

Several methods for retrieving images on the basis of colour similarity have been described in the literature, but most are variations on the same basic idea. Each image added to the collection is analysed to compute a colour histogram which shows the proportion of pixels of each colour within the image. The colour histogram for each image is then stored in the database. At search time, the user can either specify the desired proportion of each colour (75% olive green and 25% red, for example), or submit an example image from which a colour histogram is calculated. Either way, the matching process then retrieves those images whose colour histograms match those of the query most closely. The matching technique most commonly used, histogram intersection, was first developed by *Swain and Ballard* [10]. Variants of this technique are now used in a high proportion of current CBIR systems. Methods of improving on Swain and Ballard's original technique include the use of cumulative colour histograms combining histogram intersection with some element of spatial matching, and the use of region-based colour querying. The results from some of these systems can look quite impressive.

In 2005, *Xiaojun Qi et al*. [11] propose a novel fusion approach to content-based image retrieval. In their retrieval system, an image is represented by a set of color - clustering-based segmented regions and global/semi-global edge histogram descriptors (EHDs). As a result, the resemblance of two images is measured by an overall similarity fusing both region-based and global/semi-global-based image level similarities. In their approach, each segmented region corresponds to an object or parts of an object and is represented by two sets of fuzzified color and texture features. A fuzzy region matching scheme, which allows one region to match several regions, is then incorporated to address the issues associated with the color/texture inaccuracies and segmentation uncertainties. The matched regions, together with the simple semantics for determining the relative importance of each region, are further used to calculate the region-based image level similarity. The global/semi-global EHDs are also incorporated into our retrieval system since they do not depend on the segmentation results. These EHDs not only decrease the impact of inaccurate segmentation and but also reduce the possible retrieval accuracy degradation after applying the fuzzy approach to the accurate segmentation for images with distinctive and relevant scenes. The Manhattan distance is used to measure the global/semi-global image level similarity.

C. ***Texture based Features***

The ability to retrieve images on the basis of texture similarity may not seem very useful. But the ability to match on texture similarity can often be useful in distinguishing between areas of images with similar colour (such as sky and sea, or leaves and grass). A variety of techniques has been used for measuring texture similarity; the best-established rely on comparing values of what are

known as second-order statistics calculated from query and stored images. Essentially, these calculate the relative brightness of selected pairs of pixels from each image. From these it is possible to calculate measures of image texture such as the degree of contrast, coarseness, directionality and regularity, or periodicity, directionality and randomness. Alternative methods of texture analysis for retrieval include the use of Gabor filters and fractals [12]. Texture queries can be formulated in a similar manner to colour queries, by selecting examples of desired textures from a palette, or by supplying an example query image. The system then retrieves images with texture measures most similar in value to the query. A recent extension of the technique is the texture thesaurus developed by Ma and Manjunath [13], which retrieves textured regions in images on the basis of similarity to automatically-derived codeword's representing important classes of texture within the collection.

In 2011, Xiang-Yang Wang [14] proposed effective and novel color image retrieval based on texture and shape. They firstly apply quantization algorithm for cluster merging. Second the spatial texture features are extracted using steerable filter decomposition. Finally they apply pseudo-zernike moments of an image for the shape descriptor. According to the author they provide an efficient and robust capability of image retrieval after applying the above techniques.

III. RETRIEVAL TECHNIQUES

A. *Content-based image retrieval*

To, overcome the difficulties of the text based image retrieval, a new approach of the image retrieval, Content-based image retrieval (CBIR) has been a major research area for the users of different fields of computer vision, image processing and information retrieval. CBIR approach of image retrieval is based on image features rather on textual annotations to search for an image. Feature is the representation of any distinguishable characteristic of an image [15]. The features in the images can be classified into three levels [16]. These are:

- Low level features: Colour, texture and shape are the primitive features of an image and can be extracted by information obtained at the pixel level.
- Middle level features: presence or arrangement of specific types of objects and can be extracted by collection of pixels that make an image.
- High level features: Includes the meaning associated with the combination of perceptual features. These features identify the meaning associated with the collection of pixels that make an object.

The basic components of the CBIR system are the feature extraction, storage of the images and the feature vectors and the similarity calculations between the images.

Kekre, Bharadi et al. have introduced Content Based Image Retrieval using Fusion of Gabor Magnitude and Modified Block Truncation Coding [17]. Gabor filters are a group of wavelets, with each wavelet capturing energy at a specific frequency and a specific direction. Expanding a signal using this basis provides a localized frequency description, therefore capturing local features/energy of the signal. Texture features can then be extracted from this group of energy distributions. And modified block truncation is used to retrieve color feature from image. They proved that the proposed system is giving higher Precision and Recall as compared to only Gabor and Only MBTC based CBIR. Gabor feature gives good response to texture of the image and Modified BTC give good response to color content of image.

J. Zhang and W. Zou [18] have presented a novel technique that employs both the color and edge direction features for Content-Based Image Retrieval (CBIR). In this method, a given image is first divided into sub-block which has the same size and then the color and edge direction features of each sub block can be extracted. Next, it constructs a codebook of color feature using clustering algorithm and then each sub-block is mapped to the codebook. The color feature is used to retrieve images, and the edge direction feature is the weight of the similarity measure for the color feature. Rose and Shah carried on a research project to improve the accuracy of CBIR Using Gradient Projections [19]; the image's structural properties were examined to distinguish one image from another. By examining the specific gray level of an image, a gradient can be computed at each pixel. Pixels with a magnitude larger than the thresholds are assigned a value of 1. These binary digits are added across the horizontal, vertical, and diagonal directions to compute three projections. These vectors are then compared with the vectors of the image to be matched using the Euclidean Distance Formula. These numbers are then stored in a bookmark so that the image needs only be examined once. A program has been developed for Matlab that performs this method of projecting gradients. Three databases were amassed for the testing of the proposed system's accuracy: 82 digital camera pictures, 1,000 photographic images, and a set of object orientated photos. The program was tested with 100% accuracy with all submitted images to the database, and was able to distinguish between pictures that fooled

previous CBIR engines. The weakness of this project was its color-blindness.

A CBIR method based on color-spatial feature has been proposed by Lei, Fuzong & Zhang[20] . They proposed a fast algorithm which could include several spatial features of color in an image for retrieval because except for the color histogram information, the position information of each color plays an important role too. These features are area and position, which mean the zero-order and the first-order moments, respectively. By computing the moments of each color region the similarity of two images according to the weight of each factor can be computed. In fact, these features are a kind of representation for image in the scale of low resolution, and the sample image given by a user is usually a draft drawn by hand. Moreover, when a user judges the similarity between two pictures, he will firstly judge them in coarse scale. In this sense, this method is close to the vision model of our eyes. Because the features are simple and can be calculated in fast speed, better result can be made easily through training.

Dr H B Kekre ,S D Thepade et al. introduced Image Retrieval with Shape Features Extracted using Gradient Operators and Slope Magnitude Technique with BTC [21] and tested on generic image database with 1000 images spread across 11 categories. The average precision and recall of all queries are computed and considered for performance analysis. Gradient operators used for shape extraction were Robert, Prewitt, Sobel and Canny which are known as 'MaskShape-BTC' CBIR techniques. The problem with these MaskShape-CBIR methods is the need of resizing the database images to match it with the size of query. This drawback is removed using proposed Mask-Shape-BTC-CBIR methods. In proposed image retrieval techniques the feature vectors are formed by applying the block truncation coding (BTC) on the shape image obtained using slope magnitude applied on gradient of the image in both horizontal and vertical direction. Y.N.Mamatha and A.G. Ananth worked on Content Based Image Retrieval of Satellite Imageries Using Soft Query Based Colour Composite Techniques. They realized that using colours as a content, content based image processing have been carried out for a sample of high resolution urban image and low resolution rural image scenes obtained from satellites.

A research paper on Content-based satellite cloud image retrieval by Deepak Upreti has been developed using gray level, texture and shape as retrieval features from the satellite image repository. The system allows the user to search for an image on the basis of any of the three features alone or in combination by assigning weights to the features. The histogram approach is used to extract the gray level feature, texture feature is extracted using gray level co-occurrence matrix method and the shape feature is extracted using the morphological operations. The images and the extracted feature vectors are stored in the Oracle 10g database. Euclidean distance metric is used to compute the similarity between the images. The system is robust as it provides search based on the multiple features. The performance of the system was evaluated by analyzing the retrieval results using precision. The proposed method of image retrieval performs well for the query image. The precision in retrieving the images is high in the proposed method as compare to the other methods of image retrieval.

B. *Modified Block Truncation Coding*

Block truncation coding (BTC) is a relatively simple image coding technique developed in the early years of digital imaging. This method first divides the image into small no overlapping image blocks. The small blocks are coded one at a time. For each block, the original pixels within the block are coded using a binary bitmap the same size as the original block and two mean pixel values. The method first computes the mean pixel value of the whole block and then each pixel in that block is compared to the block mean. If a pixel is greater than or equal to the block mean, the corresponding pixel position of the bitmap will have a value of 1, otherwise it will have a value of 0. The simplest extension was to view a color image as consisting of three independent grey scale images and apply BTC to each color plane independently. Most color images are recorded in RGB space, which is perhaps the most well-known color space [17].

C. *Pattern Generation For Texture*

Patterns are generated for extracting texture feature of image. Each pattern defines different formats of textue. The idea is to map the image equivalent to patterns and then the different texture pattern '16-pattern' generated using Kekre's transform matrix. Number of patterns can be generated using transform matrices namely 4 pattern, 16 pattern, 64 pattern. NxN matrix can be used to generate N2 patterns. For example, if we want to generate 16 pattern then 4x4 matrix need to be used. Element wise multiplication of each row of the transform matrix is taken with all possible rows of the same matrix.

IV. CONCLUSION

This paper includes review on different techniques of satellite image retrieval. This study helps reader to go

through different techniques in one paper. Every technique has their pros and cons so researchers can used this paper as reference for studying techniques for image retrieving. This paper contains data from others paper as it's just a review paper.

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