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Review on Content-Based Image Retrieval Reliance on User Intention

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Abstract*—The search engine returns thousands of images ranked by the keywords extracted from the surrounding text. It is well known that text-based image search suffers from the ambiguity of query keywords. The keywords provided by users tend to be short. They cannot describe the content of images accurately. The search results are noisy and consist of images with quite different semantic meanings. For example, if a user wants to search for an "apple" image, he/she may request a query search using the keyword "apple" to the corresponding image search engine. The meanings of the word "apple" include apple fruit, apple computer, and apple ipod. The search results will contain different categories, such as "green apple," "apple," "apple logo," and "iphone" because of the ambiguity of the word "apple". This leads to ambiguous & noisy search results which are not satisfactory to fulfil the user query request. In order to solve the ambiguity, additional information has to be used to capture users' search intention.
***Keywords*— Image Search, Intention, Visual, Web Image Search, Clustering, User Interface**

I. INTRODUCTION

Image searching techniques can be largely classified in to two types Text-Based Image Retrieval (TBIR) and Content-Based Image Retrieval (CBIR). Text-Based Image Retrieval (TBIR) uses text descriptions to get back appropriate images based on Time, location, events, and objects. Users type question keywords in the expect of finding a certain type of images. The search engine returns thousands of images ranked by the keywords extracted from the surrounding text. It is well known that text-based image search suffers from the ambiguity of query keywords. The keywords provided by users tend to be tiny. They cannot describe the content of images perfectly. The search results are noisy and consist of images with quite different semantic meanings. For example, if a user wants to search for an "apple" image, he/she may request a query look for using the keyword "apple" to the corresponding image search engine. The meanings of the word "apple" include apple fruit, apple computer, and apple ipod. The search results will contain different categories, such as "green apple," "red apple," "apple logo," and "iphone" because of the ambiguity of the word "apple". This leads to ambiguous & noisy search results which are not adequate to fulfill the user query request.

Content-based image retrieval (CBIR), also known as query by image content (QBIC) and content-based visual information retrieval (CBVIR) is the application of computer vision techniques to the image retrieval problem, that is, the problem of searching for digital images in large databases. The term has been used to explain the process of retrieving most wanted images from a large collection on the basis of syntactical image features. The techniques, tools and algorithms that are used originate from fields such as statistics, pattern recognition, signal processing, and computer vision. Extracting images based on image content involves following levels:

Level 1: Retrieval by primitive features such as color, texture, shape and spatial location.
Level 2: Retrieval of objects of given type. Example: find the picture of the flower.
Level 3: Retrieval of abstract attributes that involves high
level reasoning. Example: „find picture of a baby smiling‟. The paper is organized as follows. In section 2, the study of various techniques for effective image retrieval based on users‟ search intention will be introduced. Finally, section 3 is a conclusion.

II. RELATED WORK

A. Improving Web-based Image Search via Content Based Clustering

The main intention of content based image retrieval is that when a user submits a query image, it retrieves the images that are mostly relevant to the content.Nadav Ben et al [6] achieved the content based image retrieval by introducing a new approach name ReSPEC (Re-ranking Sets of Pictures by Exploiting Consistency).

ReSPEC is composed of two main methods. First, based on the user query image (keyword) the image search engine (Google, Yahoo,…etc) retrieves the images then, clusters the results based on extracted image features, and returns the cluster that is

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inferred to be the most relevant to the search query. Secondly, ranks the results that are most relevant to the user query images.

B. Image Segmentation

In image segmentation each images collected from the image search engine has been broken into regions of Image search Engine User search query Top image search result Image Segmentation Segment images into blobs Build Color Histogram for blobs Find the clusters with similar features Cluster blobs in feature spaces Re – Ranking Compute the mean in feature space Retrieve top images relevant to the

user search query resemblance, with the intuition that each of these regions is a separate object in the image by using a graph based approach. Each pixel is a node in the graph with undirected edges connecting its adjacent pixels in the image. Each edge has a weight encoding the similarity of the two connected pixels. The partitioning is done such that two segments are merged only if the dissimilarity between the segments is not as great as the dissimilarity inside either of the segments.

C. Feature Selection

In order to obtain a measure of how similar image blobs are to one another, good features are needed to represent the blobs. Color histograms in HSV color space used to represent the image features. To form a feature vector for each blob, histograms are built for the H, S and V channels, with 15 bins each, and then concatenated together to form a 45 dimensional

feature vector. Although histograms have clear advantage over taking the mean color of all the pixels in the blob, there is an inherent problem. For example, consider the following three histograms for hue:

X = (1; 0; 0; 0; 0; 0; 0); Y = (0; 1; 0; 0; 0; 0; 0); Z = (0; 0; 0; 1; 0; 0; 0).

It is clear that X and Y are more similar in hue. Nevertheless, the distance between X and Y,and X and Z are equal.

D. Re - ranking the Images

After obtaining the "significant" cluster in feature space, the mean is computed. The rest of the images are then resorted based on the distance of their blobs to this mean. Since each image could potentially contain more than one blob, the closest blob in each image is used. Chi-squared distance comparisons are used in the re-sorting because it is known that for histograms, a chi-squared distance measure yields better results than L2 distance.

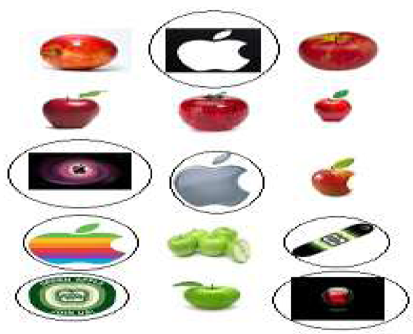

Figure 2 (a): Search result before ranking

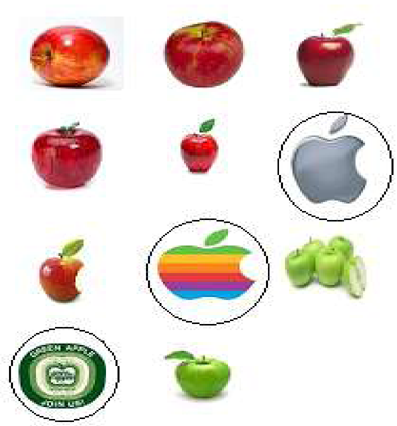

Figure 2 (b): Search result after ranking

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The result is a re-ranking of the images from the original search engine. Figure 2 (a), (b) shows the collection of images before and after re-ranking.

E. Mean Shift Clustering in Feature Space

The next step in the system is to cluster the blobs, according to their extracted features with the hope that the object of interest will form the largest cluster. Since some of the blobs will represent garbage, it is difficult to predict the number of clusters that are present. Hence, a standard clustering approach such as k-means is not appropriate. The mean shift clustering algorithm, which is an iterative gradient ascent method for finding local density maxima, was used instead. The main idea behind mean shift is to treat the points in the dimensional
feature space as an empirical probability density function where dense regions in the feature
space correspond to the local maxima or modes of the underlying distribution. For each data point in the feature space, one performs a gradient ascent procedure on the local estimated density until convergence. The stationary points of this procedure represent the modes of the distribution. Furthermore, the data points associated (at least approximately) with the same stationary point are considered members of the same cluster

F. Intent Search: Interactive On-line Image Search Re-ranking

The previous approach has some demerits as follows: 1. Very small set of personal photographs, and saw some promising results. Due to the fact that our feature extraction is limited to colour only, however, we found this to not be discriminative enough to sort large collections of highly variable photos. 2. Some irrelevant images appear after re-ranking.

In order to overcome these drawbacks Jingyu Cui et al [4] introduce a new approach that uses adaptive visual similarity to re-rank the text based search results. A query image is first categorized into one of several predefined intention categories, and a specific similarity measure is used inside each category to combine image features for re-ranking based on the query image and automatically implied user intention. In addition to searching a more flexible interface is provided to let users browse and play with all the images in the current search session, which makes web image search more efficient and interesting. This can be addressed using two interfaces which allow user to either re-rank in Live Image Search, or browse in Rank Collage.

G. Inferring User Intention

Human can easily categorize images into high level semantic classes, such as scene, people, or Object. Based on these general images are classified into typical intention categories as: 1. General Object. Images containing close-ups of general objects; 2. Object with Simple Background; 3. Scene. Scenery images; 4. Portrait. Images containing portrait of a single person; 5. People. Images with general people inside, and are not "Portrait". User query image Inferring User Intention Search Results Browsing by Rank Collage Online Live Image Search Re-ranking 1. General Object 2. Object with simple background 3. Portrait 4. People 5. Scene The attributes for intention categorization [3] includes:

1. Face existence - Whether the image contains faces. ("Face", "Portrait")
2. Face number - Number of faces occurred in the image. ("Face", "Portrait")
3. Face size - The percentage of the image frame taken up by the face region. ("Portrait")
4. Face position - Coordinate of the face center relative to the center of the image. ("Portrait")
5. Directionality - Kurtosis of Edge Orientation Histogram. The bigger the Kurtosis is, the stronger the image shows directionality. ("Scene", "General object", and "Object with simple background")
6. Color Spatial Homogeneousness - Variance of values in different blocks of Color Spatiality describing whether color in the image is distributed spatially homogeneously. ("Scene")
7. Edge Energy -Total energy of edge map obtained from Canny Operator on the image. ("General object", "Object with simple background") With these attributes, train a C4.5 decision tree on an
image set with manually labeled intentions. The training process decides decision boundaries of the intention categories in the feature space defined by those attributes, and intention of a new input image is easily decided by applying the rules of the decision tree to it.

H. On-line Live Image Search Re-ranking

After typing a query keyword, the original result of Live Image Search based on text is presented to user. The user can then drag an image to the "Key Image" pad, and initiate a content-based query. Our background algorithm infers the best Intention for the query image, and then gives the re-ranked results based on an adaptive feature set. The user can either drag another image from current result to the "Key Image" pad for another round of query, or drag it to the "Additional Images" pad to let the system update the results.

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I. Search Results Browsing by Rank Collage

User can switch to a Rank Collage view anytime to browse the whole set of images in current search session. All images are presented in a collage, with the images near the center being bigger and more relevant to user query, and images further from the center being less relevant. When a new image is dragged to the center, a new round of search is started with the new image as query. Endless zooming, various operations on a single image, and multiple search results side-by-side comparison are also supported.

J. Adaptive similarity

Designing a set of visual features to describe different aspects of image, how to integrate various visual features to compute the similarities between the query image and

other images is an important problem. An Adaptive Similarity is introduced to deal with a user always has specific intention when submitting a query image. For example, if the user submits a picture with a big face in the middle, most probably he/she wants images with similar faces and using face-related features is more appropriate. The query image is first categorized into one of the predefined adaptive weight categories, such as "portrait"and "scenery." Inside each category, a specific pretrained weight schema is used to combine visual features adapting to this kind of images to better re-rank the text-based search result. This correspondence between the query image and its proper similarity measurement reflects the user intention. This initial re-ranking result is not good enough and will be improved by the following steps

III.CONCLUSIONS

The techniques reveals that "IntentSearch: Capturing User Intention for One-Click Internet Image Search" proves more profitable comparatively than the other two techniques. This approach involves user to click in the first step without increasing users‟ burden. This makes it possible for Internet scale image search by both textual and visual content with a very simple user interface. Further optimization could be done to this technique improve the quality of the retrieved images.

Image search is a specialized data search used to find images. To search for images, a user may provide query terms such as keyword, image file/link, or click on some image, and the system will return images "similar" to the query. This paper presents an overview of various techniques for effective image retrieval based on users‟ search intention. The extensive study of these three

IV. ACKNOWLEDGMENT

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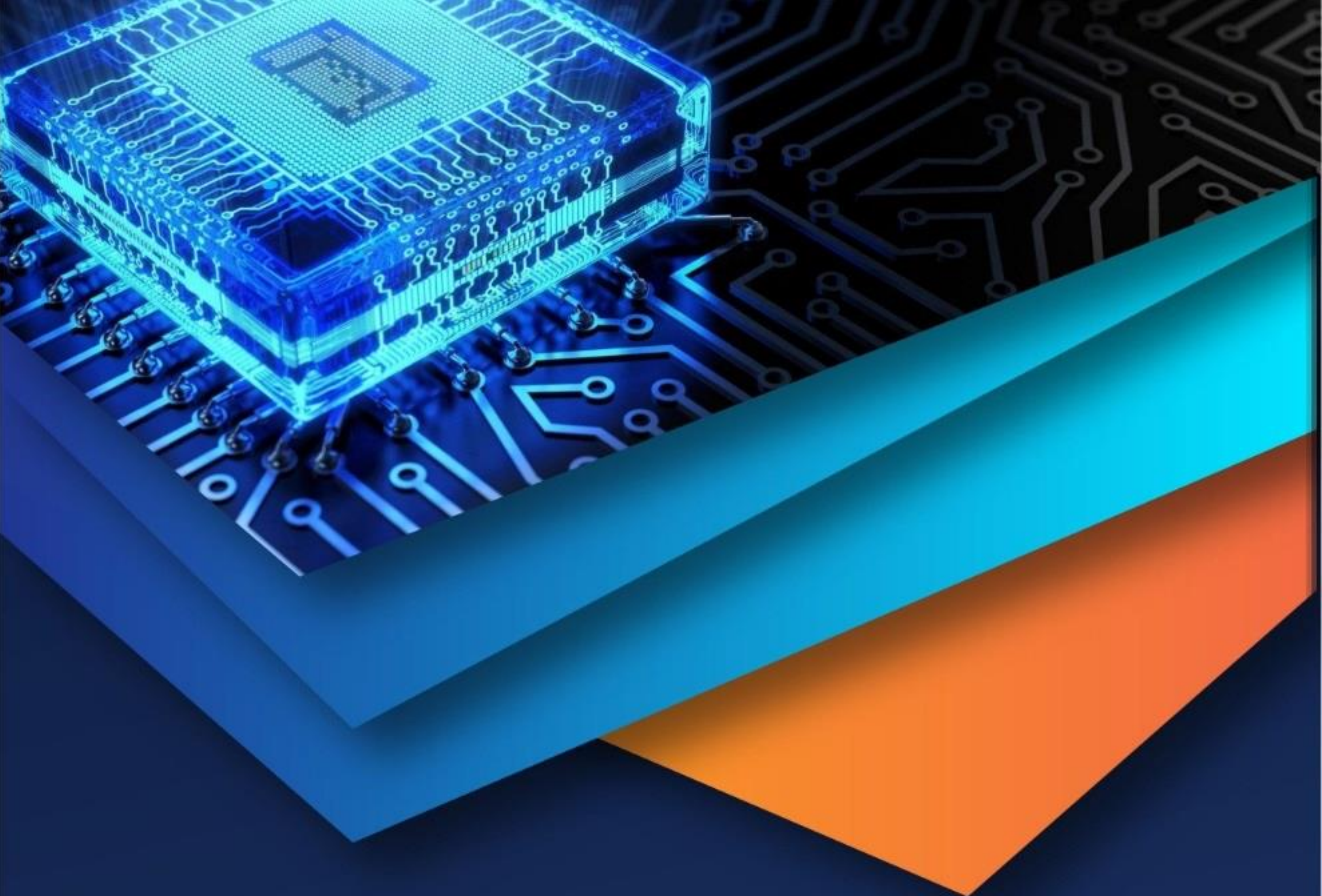

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