
Computer Graphics I

Literature Reivew II

# Image Annotation Techniques

*Author:*
Chang Liu

*Teacher:*
Dr. Haim Levkowitz

March 27, 2015

# 1 Overview

In this section, I'm going to present two papers that talks about the image annotation. As we all know that image annotation is becoming very popular nowadays, but automatic image annotation methods based on searching for correlations require a quality training image dataset.

For a target image, its annotation is predicted based on a mutual similarity of the target image to the training images. One of the main problems of current methods is their low effectiveness and scalability if a relatively large-scale training dataset is used.

So starting from this point, I'm going to do some paper reading and research on this topic and gives two seperated description about their techniques of image annotation.

# 2 Image Annotation

In this section, I'm going to talk about the technique that is used in the first paper **"ANNOR: Efficient image annotation based on combining local and global features"**, this paper is selected from Computers & Graphics, 2015. The main idea of this paper is a new approach named Automatic image aNNOtation Retriever (ANNOR) for acquiring annotations for target images, which is based on a combination of local and global features. According to their report, the approach gives a very good and precise result for image annotation.

# 3 ANNOR

Focusing on visual query forms, many content-based image retrieval methods and techniques have been proposed, but they have several limitations. On one hand, in query-by-example-based methods a query image is often absent. On the other hand, query by-sketch approaches are too complex for common users and a visual content interpretation of a user image concept is difficult.

Facing such a broad challenge and research focus, automatic image annotation is becoming the frontier of different fields such as image analysis, machine learning and information retrieval. In present, to create a general system for automatic image annotation based on object recognition is practically impossible. Even though many approaches have been proposed, there have been very few breakthrough in these fields.

After carefully analyzing the problem's source, a new approach ANNOR is proposed to solve it. ANNOR is short for the "Automatic image aNNOtation

Retriever", which is retrieve the image by combining the global and local features.

For a problem, there have been some problems that must be solved:

1) Which image representation is appropriate to describe image? The objects in images are often occluded and appear in poor lighting and exposure.

2) Which image features can be extracted to describe or characterize the visual content? A feature is represented by a numerical feature vector (descriptor), by which we are able to describe a part of image content. In general, there are three essential requirements for the descriptors, their degree of robustness, discrimination ability and efficiency. The robustness represents invariance to the geometrical changes (e.g., viewpoint, zoom, object orientation) and noise-like signal distortions. The discrimination maximizes difference among non-duplicates and minimizes difference among duplicates. The feature extraction and matching requires fast computation.

3) How much is the spatial and time complexity (computational cost) for a new method

In the paper the author proposes a method for automatic image annotation using relatively large-scale image training dataset. By combining local and global features to ensure robustness and generalization needed by complex queries, they focus more on performance and scalability. For indexing and clustering features, they use disk-based locality sensitive hashing. To obtain annotation for a given target image, the approach is based on the way how people manually annotate images.

# 4 Contribution

For this paper the most important contribution is that it gives us the key point that combines the global and local features together, by calculating the keyword of each image using these feature, we could get the most potential annotated keyword.

# 5 Comparable paper

For the second paper, I'm going to talk about the content of **"An evaluation of descriptors for large-scale image retrieval from sketched feature lines"**, this paper gives another view about the image retrieval method. Different from previous one, this paper mainly talks about the details about image retrieval towards a large-scale database.From the first page we know that a large-scale database could lead to a lot of technical problem when doing

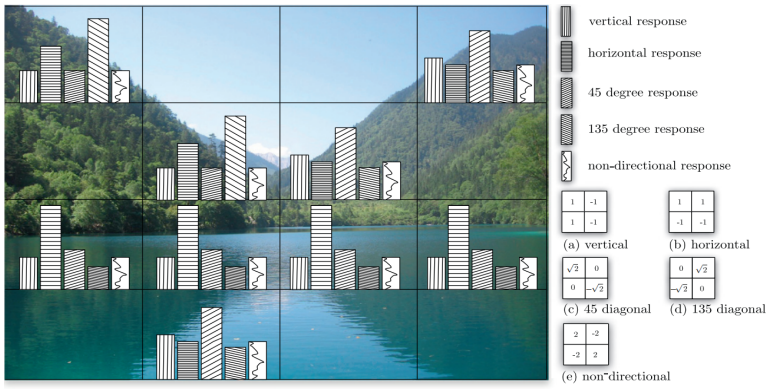
the image annotations, in this paper, however, we could know that for a large-scale dataset, it is also challenging to get a very efficient descriptor. In this paper, the author presents a system for a sketch-based image retrieval that yield interactive search results on a database of more than one million images By using both the ARP and EHD descriptor as a baseline for evaluation and comparing their performance to that of the Tensor and HOG descriptor, it shows that Tensor and HOG descriptor efficiently capture distribution of location and orientation of gradients in the images but differ in the way this information is encoded.

# 6 Descriptor

In the second paper, the author uses two descriptor that shows very effective in their paper, which is Tensor and EHD descriptor. In this section I will talk more about these two descriptors as they're used successfully in the first paper and shows a wide potential in future research.

## 6.1 EHD

EHD is the short form of **"edge histogram descriptor"**, it is proposed in MPEG-7 standard for texture image characterization, the following figure shows the EHD's function for distinguishing five types of edges:




The EHD represents the distribution of five types of edges in local image patches. As illustrated in the above figure, the image is subdivided into $k \times k$ non-overlapping cells. The edge distribution in each cell is characterized by a 5-bin histogram, distinguishing five different types of edges: vertical, horizontal, 45°, 135° and non-directional edges. A histogram is computed for each of the cells individually, resulting in a feature vector of size $5k^2$.

# 7 Tensor descriptor

The tensor descriptor is the system matrix which maximize the single vector's distance between the scalar image and the original image. Let $\mathbf{x}$ be a unit vector, which we want to define such that it represents the main direction in cell $C_{ij}$. As $\boldsymbol{x^T g_{uv}}$ attains a maximum if $\boldsymbol{x||g_{uv}}$ we pose the definition of $\mathbf{x}$ as the following optimization

$$x = \arg\min_{x \in \mathcal{X}} \sum_{i=1}^{n} (x^T g_{uv})$$

In order to detect similarly oriented image edges independently of the magnitude of the edges, we store the structure tensor normalized by its Frobenius norm, so that this descriptor has a tense representation of image's texture.

# 8 Summary

From the above section, I know that these papers have made a wide research on the topic of image annotation and feature descriptors. I select two of them because the first contains the annotation technique that interests me so much, the second one is chosen because they share the same descriptor that could enhance the representation of image, and it is credential for image annotations.

According to current research, image features and descriptors are two factors that are very important in today's image and graphic research. We all know that different features and descriptors could have great impact on the precision, so both the first and second paper gives the evaluation on the process, while the first one focus on combining the global feature and local feature together to achieve a good performance, the second one focus on selecting a better descriptors for image retrieval in a large dataset. Both of them have done great job in making the image processing jobs more efficient and precise. After reading these two papers, I have got to know better about how to improve the precision and efficiency for the images, and it's really a lot of help for me to the this kind of research.