K-Nearest Neighbors Relevance Annotation Model for Distance Education

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ABSTRACT

With the rapid development of Internet technologies, distance education has become a popular educational mode. In this paper, the authors propose an online image automatic annotation distance education system, which could effectively help children learn interrelations between image content and corresponding keywords. Image automatic annotation is a significant problem in image retrieval and image understanding. The authors propose a K-Nearest Neighbors Relevance model, which combines KNN method with relevance models. The model solves the problems of high computational complexity and annotation results affected by irrelevant training images when joint generation probabilities between visual areas and keywords are calculated. The authors also propose a multi-scale windows method and nearest-neighbors weighting method based on rank-weighting and distance-weighting. Experiments conducted on Corel datasets verify that the K-Nearest Neighbors Relevance model is quite effective.

Keywords: Distance Education, Distance-weighting, Image Automatic Annotation, Image Retrieval, Image Understanding, KNNR, Rank-weighting

1 INTRODUCTION

There are plenty of data resources on the Internet. With the rapid developments of Internet technologies, distance education increasingly becomes a popular educational mode. Distance education can not only help young people and adults access learning opportunities in a quick and easy way, but also can change the learning styles of small children. At present, small children learn objects by using several kinds of picture cards which types and number are very limited. Some kind of distance education system can help to solve this problem. Children and their parents can sit in front of a computer, they can upload any pictures, and then distance education system will return the keywords which could describe the contents of certain images. By this way, both images and corresponding keywords can be used to help parents teach small children to identify objects and keywords, and assist small children to learn the interrelations.
between objects and corresponding keywords. This distance education system is a kind of online image automatic annotation systems.

Image Automatic Annotation refers to automatically generate images’ text labels according to their visual contents. Early strategy of image annotation assigns one label to each image which is similar to the task of image classification. Now the task of image automatic annotation is to annotate different visual contents to corresponding images with different keywords. Thus, we can use relatively mature technologies of text processing to index and retrieve images. Traditional content-based image retrieval (CBIR) require users to submit an image or sketch as a query, and then extract bottom visual features of query image (such as color, texture and shape, etc.), finally retrieve images according to visual similarity between query image and image database. However, due to the Semantic Gap between underlying visual features and high-level semantics, performance of content-based image retrieval are unsatisfactory. On the other hand, if there are some annotations with images, users only need to submit the keyword to search, which is a much more convenient way and more in line with the search habits of majority users.

Current commercial image search engines such as Google, Yahoo! and so on, using natural language processing technologies to annotate images, which mainly use the context information, for example, image’s filenames, URL, ALT tags, anchor text as well as the surrounding text around images and so on. However, these methods do not use internal visual features of images. So annotation performance could not be satisfied. The research on image annotation in this paper is different from the methods of above commercial search engines. Image annotations are aimed at visual contents of images in this paper, which could be called content-based image annotation. Content-based image annotation has great meanings to build a new generation of image search engines.

In addition, image automatic annotation can also belong to the area of image understanding, which corresponds to the human understanding levels. Eakins (1996) divided image semantics into three levels, including: primitive features level, logical features level and emotional level. Primitive features level consists of bottom features such as color, texture and shape. Logical features level consists of object semantic and spatial relationships semantic. Emotional level consists of scenes semantics, behavior semantic and emotional semantic. Higher levels usually contain more advanced and abstract semantics than lower levels. While higher-level semantics require semantic reasoning from lower level. Image automatic annotation corresponds to the logical features level of image understanding, which mainly research on object semantics and spatial relationships semantic.

The main contributions of this paper include: We develop an online image annotation system which can be used for distance education. There are two problems of relevance models in image automatic annotation: one is high computational complexity, the other is annotation results affected by irrelevant training images when calculate joint generation probabilities between visual areas and keywords. We propose a K-nearest neighbors relevance annotation model which combine KNN method and relevance models to solve above problems. On the other hand, in view of the problems of serious semantic gap and annotation results inclining to background words when only use nearest neighbors method alone, we propose a multi-scale image windows method and two nearest neighbor weighting methods based on rank-weighting and distance-weighting to solve these problems.

The rest of this paper is organized as follows: Section 2 discusses the related work of image automatic annotation. In Section 3, we discuss our selections of annotation collections based on K-nearest neighbors. In Section 4, we discuss our KNNR image automatic annotation model in detail. In Section 5, we describe the datasets and experimental comparison. Final Section is the conclusions and future work.
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