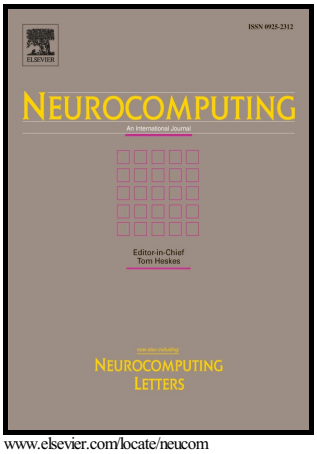

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The Distributed System for Inverted Multi-index Visual Retrieval

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Abstract

With the explosive growth of visual databases, it is infeasible to maintain the huge indexing structures within the memory of a single server. In this paper, a distributed visual retrieval system based on inverted multi-index is proposed to generate a huge codebook with very low memory consumption and time cost. In order to improve the performance of product quantization, a vector space decomposition strategy is performed by affinity propagation clustering. In the meantime, a distributed framework is introduced to inverted multi-index to improve the time efficiency. Our works are validated on the large scale database of INRIA Holidays and Flickr 1M. The results of our experiments indicate that the performance of PQ is greatly improved and the visual retrieval system is speeded up at comparable precision.

Keywords: Distributed Inverted Multi-index, APC-PQ, Visual Retrieval

1. Introduction

In recent years, local features are widely used to represent an image in content based image retrieval systems [1, 2, 3], e.g., video copy detection, mobile location search, mobile product search and web image retrieval. In the state-of-the-art visual search systems, the query processes can be mainly divided into two steps. Firstly, the local features are extracted and quantized into visual words [1, 2, 4, 5] for both query and reference images. Secondly, a realtime search is performed for every visual word based on its inverted indexing file [6][7][8]. Then the image retrieval is converted to a classic text retrieval setting, in which many techniques in text, like TF-IDF [9] , can be used in image retrieval as well. Further more, many approximate search techniques are introduced such as Vocabulary Tree [7], Approximate K-means [8],Hamming Embedding [10], Locality Sensitive Hashing [11] and their variances [8, 12, 13, 14].

However, the size of visual database is growing at explosive rates and it becomes incredibly expensive to maintain a visual search system in a single machine. Meanwhile, the dramatic increase of the queries also requires high query processing rates which is beyond the typical throughput of a single machine. However, few work attempts to handle the storage complexity to maintain the vocabulary and its inverted files accordingly. For instance, the scalable visual retrieval system usually needs to index huge amounts of reference images, e.g., millions of reference images online and their indexes, and the storage cost is up to more than 1 TB. Obviously, it is almost infeasible for a single server to maintain such a retrieval system in its memory.

Distributed search framework is a natural solution for this issue. By indexing and retrieving the vast image database in parallel, the advantages of workstation networks model can be made full used [15]. First, the networks of workstations are extraordinarily powerful and offer a cheaper alternative to parallel computers. Second, most workstation networks have a huge amount of memory and processors, both of which sit idle most of the time. Third, the switched networks allow bandwidth to scale with the number of processors and it is possible to do fast communication among workstations in a local network.

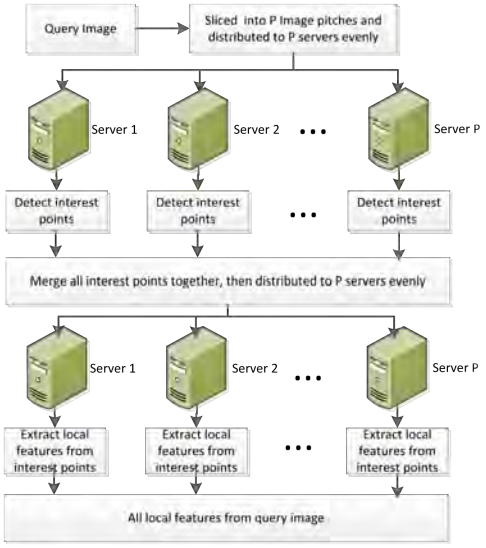

Figure 1: The first stage of the query process, including distributed interest point detection and distributed local feature description.

There is a large body of literature [16, 17, 18] on distributed framework applied in scalable information retrieval systems. For instance, to achieve efficient retrieval, a distributed retrieval system with a fine-grained, massively parallel and memory-

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