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A SCALABLE APPROACH FOR CONTENT BASED IMAGE RETRIEVAL IN PEER TO PEER NETWORK

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ABSTRACT

Peer-to-peer networking offers a scalable solution for sharing multimedia data across the network. With a large amount of visual data distributed among different nodes, it is an important but challenging issue to perform content-based retrieval in peer-to-peer networks. While most of the existing methods focus on indexing high dimensional visual features and have limitations of scalability, in this paper we propose a scalable approach for content-based image retrieval in peer-to-peer networks by employing the bag-of-visual words model. Compared with centralized environments, the key challenge is to efficiently obtain a global codebook, as images are distributed across the whole peer-to-peer network. In addition, a peer-to-peer network often evolves dynamically, which makes a static codebook less effective for retrieval tasks.

Therefore, we propose a dynamic codebook updating method by optimizing the mutual information between the resultant codebook and relevance information, and the workload balance among nodes that manage different code words. In order to further improve retrieval performance and reduce network cost, indexing pruning techniques are developed. Our comprehensive experimental results indicate that the proposed approach is scalable in evolving and distributed peer-to-peer networks, while achieving improved retrieval accuracy.

I. INTRODUCTION

1.1.What Is Image Processing?

Image processing is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it. It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or characteristics associated with that image. Usually Image Processing system includes treating images as two dimensional signals while applying already set signal processing methods to them.

It is among rapidly growing technologies today, with its applications in various aspects of a business. Image Processing forms core research area within engineering and computer science disciplines too.

1.2.Image Processing Basically Includes The Following Three Steps

- Importing the image with optical scanner or by digital photography.
- Analyzing and manipulating the image which includes data compression and image enhancement and spotting patterns that are not to human eyes like satellite photographs.
- Output is the last stage in which result can be altered image or report that is based on image analysis.

1.3.Purpose of Image Processing

The purpose of image processing is divided into 5 groups. They are:

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1. Visualization - Observe the objects that are not visible.
2. Image sharpening and restoration - To create a better image
3. Image retrieval - Seek for the image of interest.
4. Measurement of pattern – Measures various objects in an image.
5. Image Recognition – Distinguish the objects in an image.

1.4.Types of Image Processing

The two types of methods used for Image Processing are Analog and Digital Image Processing. Analog or visual techniques of image processing can be used for the hard copies like printouts and photographs. Image analysts use various fundamentals of interpretation while using these visual techniques. The image processing is not just confined to area that has to be studied but on knowledge of analyst. Association is another important tool in image processing through visual techniques. So analysts apply a combination of personal knowledge and collateral data to image processing. Digital Processing techniques help in manipulation of the digital images by using computers. As raw data from imaging sensors from satellite platform contains deficiencies. To get over such flaws and to get originality of information, it has to undergo various phases of processing. The three general phases that all types of data have to undergo while using digital technique are Pre- processing, enhancement and display, information extraction.

1.5.Characteristics of Image Processing

Before going to processing an image, it is converted into a digital form. Digitization includes sampling of image and quantization of sampled values. After converting the image into bit information, processing is performed. This processing technique may be, Image enhancement, Image restoration, and Image compression.

1.6.Image Enhancement

It refers to accentuation, or sharpening, of image features such as boundaries, or contrast to make a graphic display more useful for display & analysis. This process does not increase the inherent information content in data. It includes gray level & contrast manipulation, noise reduction, edge crispening and sharpening, filtering, interpolation and magnification, pseudo coloring, and so on.

1.7.Image Restoration

It is concerned with filtering the observed image to minimize the effect of degradations. Effectiveness of image restoration depends on the extent and accuracy of the knowledge of degradation process as well as on filter design. Image restoration differs from image enhancement in that the latter is concerned with more extraction or accentuation of image features.

1.8.Image Compression

It is concerned with minimizing the number of bits required to represent an image. Application of compression are in broadcast TV, remote sensing via satellite, military communication via aircraft, radar, teleconferencing, facsimile transmission, for educational & business documents, medical images that arise in computer tomography, magnetic resonance imaging and digital radiology, motion, pictures, satellite images, weather maps, geological surveys and so on.

- Text compression – CCITT GROUP3 & GROUP4
- Still image compression – JPEG
- Video image compression – MPEG

1.9.Advantages of Image Processing

- The processing of images is faster and more cost-effective. One needs less time for processing, as well as less film and other photographing equipment.
- It is more ecological to process images. No processing or fixing chemicals are needed to take and process digital images. However, printing inks are essential when printing digital images.
- When shooting a digital image, one can immediately see if the image is good or not.
- Copying a digital image is easy, and the quality of the image stays good unless it is compressed. For instance, saving an image as jpg format compresses the image. By resaving the image as jpg format, the compressed image will be recompressed, and the quality of the image will get worse with every saving.
- Fixing and retouching of images has become easier. In new Photoshop 7, it is possible to smoother face wrinkles with a new Healing Brush Tool in a couple of seconds.
- The expensive reproduction (compared with rastering the image with a repro camera) is faster and cheaper.
- By changing the image format and resolution, the image can be used in a number of media.

II. RELATED WORK

Our work is related to three major groups of research: content-based image retrieval, distance metric learning, and online learning. In the following, we briefly review the closely related representative works in each group.

A. Content-Based Image Retrieval

With the rapid growth of digital cameras and photo sharing websites, image retrieval has become one of the most important research topics in the past decades, among which content-based image retrieval is one of key challenging problems [1], [2], [3]. The objective of CBIR is to search images by analyzing the actual contents of the image as opposed to analyzing metadata like keywords, title and author, such that extensive efforts have been done for investigating various low-level feature descriptors for image representation [14]. For example, researchers have spent many years in studying various global features for image representation, such as color features [14], edge features [14], and texture features [15]. Recent years also witness the surge of research on local feature based representation, such as the bag-of-words models [16], [17] using local feature descriptors (e.g., SIFT [18]). Conventional CBIR approaches usually choose rigid distance functions on some extracted low-level features for multimedia similarity search, such as the classical Euclideann distance or cosine similarity.

However, there exists one key limitation that the fixed rigid similarity/distance function may not be always optimal because of the complexity of visual image representation and the main challenge of the semantic gap between the low-level visual features extracted by computers and high-level human perception and interpretation. Hence, recent years have witnesses a surge of active research efforts in design of various distance/similarity measures on some low-level features by exploiting machine learning techniques [19], [20], [21], among which some works focus on learning to hash for compact codes [19], [22], [23], [24], [25], and some others can be categorized into distance metric learning that will be introduced in the next section. Our work is also related to multimodal/multiview studies, which have been widely studied on image classification and object recognition fields [26], [27], [28], [29].

However, it is usually hard to exploit these techniques directly on CBIR because (i) in general, image classes

will not be given explicitly on CBIR tasks, (ii) even if classes are given, the number will be very large, (iii) image datasets tend to be much larger on CBIR than on classification tasks. We thus exclude the direct comparisons to such existing works in this paper. There are still some other open issues in CBIR studies, such as the efficiency and scalability of the retrieval process that often requires an effective indexing scheme, which are out of this paper's scope.

III. MODULES DESCRIPTION

3.1.System Construction

In the first module, we develop the system with the entities need to implement and evaluate our proposed model. First create 5 peer node(a,b,c,d,e) for each node can register n number of the user. Each user registers and login and upload image. Node A user upload image and can view images update, and delete and view deep details and gave feedback about images uploaded by node A. If he want to see other nodes images by search icon can get image.

3.2.File Publishing/Removing

When a new file is added, besides publishing an entry to the file index with PUT, the file owner will also extract and quantize the features to form codewords, then put them to the corresponding entries in the codeword index with PUT. When a file is removed from the file index (with no owner), the corresponding codeword postings will be removed from the codeword index.

3.3.Codebook Generation and Updating

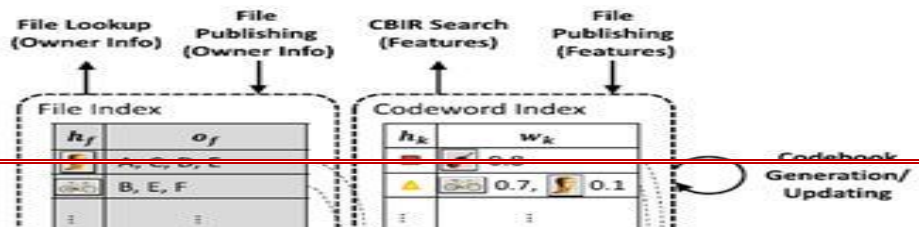
During an updating iteration, each codeword node pk decides whether its codeword k should be split/merged/unchanged based on the relevance information collected from past queries, and the current workload. After each iteration, the centroid coordinates and the codeword statistics needed for similarity measurement (e.g., document frequencies) will be broadcasted throughout the network, so that all the nodes in the network can have the same codebook. The iterative process runs continuously in order to maintain an updated codebook during data churn. The frequency of update iterations is determined .To split the codeword k into n codewords, pk randomly selects n1 neighboring nodes as new codeword nodes and sends the centroid coordinates to them. Once all the new centroids register themselves as codeword nodes, the descriptor associations of selected nearby partitions will be updated respectively similar to the file posting process.

3.4.BOVW Based Retrieval Process

BoVW based representation for the query, retrieving the postings via DHT lookup, and measuring the similarity between the query and candidate images. In large scale BoW based retrieval systems, index pruning has been used to reduce the retrieval cost. Its basic idea is to identify and discard the postings which are not likely to contribute to top results.

IV. SYSTEM DESIGN

Our Proposed System Architecture



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V. SYSTEM ANALYSIS

5.1.Existing system

- The existing systems adopt a global feature approach: an image is represented as a high dimensional feature vector (e.g., color histogram), and the similarity between files is measured using the distance between two feature vectors.
- Usually, the feature vectors are indexed by a distributed high-dimensional index or Locality Sensitive Hashing (LSH) over the DHT overlay In contrast to centralized environments, data in P2P networks is distributed among different nodes, thus a CBIR algorithm needs to index and search for images in a distributed manner. P2P networks are under constant churn, where nodes join/leave and files publish to/remove from the network, the index needs to be updated dynamically to adapt to such changes.
- Dexing and Locality-Sensitive Hashing. The high-dimensional indexing based approaches store the feature vectors in a data structure, usually a tree or a graph, to achieve effective search space pruning during retrieval. In structured P2P networks, the high-dimensional index is defined in a distributed way over the P2P overlay, dexing and Locality-Sensitive Hashing.
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5.2.Disadvantages of Existing System

- Even in a centralized environment, the performance of high-dimensional indexing suffers from the well-known “curse of dimensionality”.
- Even when one can update the hash functions with changing data, implementing it over the DHTs is very challenging. As the data is stored among nodes of corresponding hash ID, a 1-bit change of the hash function output will result in large portion of (if not all) data being assigned to a different node, causing heavy network traffic.

5.3.Proposed System

- In this paper, we present a novel method to dynamically generate and update a global codebook, which considers both the discriminability and workload balance.
- While processing queries, each node collects the relevance information and workload data. With the

relevance information, we maximize the information provided by the codebook about the retrieval results, thus minimizing the information loss incurred by quantization.

- With workload data, we aim to achieve a fair workload among nodes, thus avoiding overloading or underloading nodes. Based on these two criteria, the codebook partitioning is updated routinely by splitting/merging codewords, thus allowing the codebook to grow/shrink in accordance to the data distribution.
- To minimize the cost of codebook updating, the decision whether a codeword should be split/merged is taken by its managing node individually. Finally, the updates are synchronized across the network at the end of each iteration.
- As a result, the discriminability and workload balance is optimized continuouslywith the churn of the P2P network.

5.4.Advantages of Proposed System

- It is the first study to investigate scalable CBIR with the BoVW model in P2P networks.
- A novel objective function for codebook optimization in a P2P environment is proposed, which considers both the relevance information and the workload balance simultaneously.
- A distributed codebook updating algorithm based on splitting/merging of individual codewords is proposed, which optimizes the objective function with low updating cost.

VI. CONCLUSION

In this paper we present a bag-of-visual-words model based approach for content based image retrieval in peer-to- peer networks. In order to overcome the difficulty in generating and maintaining a global codebook when the BoVW model is deployed in P2P networks, we formulate the problem of updating an existing codebook as optimizing the retrieval accuracy and workload balance. As a result, the proposed approach is scalable to the number of images shared within a P2P network and the evolving nature of P2P networks. In order to further improve the retrieval performance of the proposed approach and reduce network cost, indexing pruning techniques are applied.We conduct comprehensive experiments to evaluate various aspects of the proposed approach while demonstrating its promising performance. In the future, we will investigate DHT specific optimizations for cost reduction, more advanced matching refinement and multi-modal fusion techniques in P2P networks, and extensions of this approach to other distributed architectures. In particular, for the CAN network, we can embed the index into the CAN overlay. That is, we make the CAN address space corresponding to our feature space, and replace the CAN zones with codeword partitions. Such an embedding will eliminate the overhead of an additional DHT layer, as we can implement the SPLIT/MERGE operations as a CAN zone split/takeover, instead of adding and removing entries on DHT.

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