International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-6 Issue-5, June 2017

QBIC in Peer –To – Peer Networks using BOVW Model and Split/ Merge Operation

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Abstract: The term QBIC refers to query by image content .it is also known as content based image retrieval. In QBIC the search analysis the content of the image instead of the metadata like keyword, tags or any descriptive information related to an image. The content refers to the main features that are differentiating one image with another image. So in this thesis work focus on how we can retrieve an image from the peer to peer network with low network cost by using QBIC approach. It mainly focuses on two things network cost and workload balance during image retrieval process. It also take consider to the dynamic creation and uploading into the peer to peer networks by using BoVW model and split/merge operation.

Index Terms: QBIC, BOVW model, Peer-to-peer networks, split/merge operation.

I. INTRODUCTION

In now days there are large variety of images are available on the internet. The similar images are annotation by using different keywords. While we are try to search any particular image that make irrelevant result , because having human annotation manually enter the image name, so it make irrelevant result. So the keyword based search that takes irrelevant result requested by the user also it take little more time for the computation. Each image is described with set of properties the properties include color, texture, orientation, shape or etc that can be derived from the image itself. For the effective search of an image using content of an image instead of using metadata like keyword or tags or any other descriptive information. For the effective searching and indexing of the image in the peer to peer networks using QBIC algorithm.

The peer to peer networks provide a scalable solution for sharing multimedia data such as audio, video, images across the network, while performing QBIC in peer to peer network is one of the challenging issues because of the data discriminality, dimensionality problem. The existing QBIC system adopts a global feature vector, i.e. An image is represented as a feature vector. E.g. is color histogram. The similarity between the images is measured by me3asuring the distance between the image feature vectors. The high dimensional indexing or Locality sensitive hashing methods are used for indexing the feature vector.

The query by image content method faces following issues

Manuscript published on 30 June 2017.
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- In contract to the centralized environment, in peer to peer networks the data is distributed among the nodes in the networks, so it need QBIC algorithm for effective search and indexing of images.
- In peer to peer networks under5 constant churn a node is leaves or join from the networks. Any file is added or published into the network, the corresponding changes should be updated into the networks, and otherwise it works in statically manner.
- unlike distributed servers/clouds, nodes in peer to peer networks have limited network bandwidth and computational power, thus the QBIC algorithm should keep the network cost low and the workload among nodes balanced.

Query By Image Content (referred to as QBIC in this thesis), which is based on automatically extracted primitive features such as color, shape, texture, and even the spatial relationships among objects, has been employed since the 1990's[4]. In the last ten years, a great deal of research work on image retrieval has concentrated on CBIR technology.

Some commercial products based on CBIR technology have come to the marketplace, well-known examples including QBIC[1].Image databases and collections can be enormous in size, containing hundreds, thousands or even millions of images. The conventional method of image retrieval is searching for a keyword that would match the descriptive keyword assigned to the image by a human categorizer. Currently under development, even though several systems exist, is the retrieval of images based on their content, called Content Based Image Retrieval, CBIR[5]. While computationally expensive, the results are far more accurate than conventional image indexing. Hence, there exists a tradeoff between accuracy.

The need for Content- Based image retrieval is to retrieve images that are more appropriate [1], along with multiple features for better retrieval accuracy. Usually in search process using any search engine, which is through text retrieval, which won't be so accurate. So, we go for Query By Image Content. Query By Image Content l also known as Content- Based Image Retrieval (QBIC) and content-based visual information retrieval (CBVIR) [2]. "Content-based" means that the search makes use of the contents of image themselves, rather than relying on human-inputted metadata such as captions or keywords [3]. The similarity measurements and the representation of the visual features are two important issues in Content-Based Image Retrieval (CBIR) [8].

Given a query image, with single / multiple object present in it; mission of this work is to retrieve similar kind of images from the database based on the features extracted from the query image [1].

Figure 1: Image various representation by using the feature as color

II. LITERATURE SURVEY

Content Based Image Retrieval (CBIR) is any technology that in principle helps to organize digital image archives by their visual content [9]. By this definition, anything ranging from an image, Similarity function to a robust image annotation engine falls under the purview of CBIR The most common form of CBIR is an image search based on visual .The increasing amount of digitally produced images requires new methods to archive and access this data. Conventional databases allow.

Conventional databases allow for textual searches on Meta data only [4]. Content Based Image Retrieval (CBIR) is a technique which uses visual contents, normally called as features, to search images from large scale image databases according to users' requests in the form of a query image.

Apart from the usual features like color and texture, a new feature extraction algorithm called edge histogram is introduced [10]. Edges convey essential information to a picture and therefore can be applied to image retrieval. The edge histogram descriptor captures the spatial distribution of edges [5].

This model expects the input as Query by Example (QBE) and any combination of features can be selected for retrieval [12]. The focus is to build a universal CBIR system using low level features. These are mean, median, and standard deviation of Red, Green, and Blue channels [13] of color histograms. Color feature is the most intuitive and obvious feature of the image, and generally adopt histograms to describe it. Color histograms method has the advantages of speediness, low demand of memory space and not sensitive with the images changes of the size and rotation, it wins extensive attention consequently [11]. Information for proceeding in the project are collected from different books such as Greg Pass, Ramin Zabih, "Histogram refinement for content based image retrieval" WACV '96 [6], Yong Rui, Thomas S. Huang and Sharad Mehrotra "Relevance Feedback Techniques in Interactive content based image retrieval .",1996 [7] and also from some IEEE papers and other online links.

1. Content-Based Image Retrieval Using Texture Color Shape and Region by Syed Hamad and Noor ul Amin, published on International Journal of Advanced Computer Science and Applications, Vol. 7, No. 1, 2016.

TABLE 1. Comparison study of first paper

Sl. no	Step	Method	Advantage	Disadvantage
1	Feature Extraction	Color : Coherence Vector	Due additive spatial information it is more efficient	Very much complex because of its high dimensionality
		Texture: Gabor Filter	Used for detection edge, line and different orientation	Only effective for manmade objects
		Shape:FFT	Used for efficient result	depend on the position
2	Similarity Measure	Histogram Intersection	computation of the similarity among color images	

2. Content Based Image Retrieval System Using SVM Technique, by Mohita Bansal and Balraj Singh Sidhu,published on IEEE Transaction on Circuits And Video Technology , 2014

TABLE 2. Comparison study of second paper

Sl. No	Step	Method	Advantage	Disadvantage
1	Feature extraction	Singular Vector Decomposition	Useful for Dimensionality reduction	It reduce the efficiency of image
		Principle Component Decomposition	reduce the complexity in image.	The covariance matrix is difficult to evaluated in a accurate manner.
2	Feature Selection	Leverage Score	It reduce the irrelevant portion in the image	Complex
3	classifiers	SVM	Easy to classify	The end user query can meet both requirements by low level features such as colour, shape etc is challenging and hard to articulate

3. Evaluating Bag-of-Words Representations in Scene Classification ,by Jun Yang, Yu-Gang Jiang and Alexander Hauptmann ,published on International Conference on Computational Intelligence and Computing Research , 2012

TABLE 3. Comparison study of third paper

Sl. no	Step	method	Advantage	Disadvange
1	Feature Extraction	Scale-invariant image regions	Easy to compute	Does not capture semantics
2	Quantization	Build frequency histogram		it does not capture position in text, semantics, co-occurrences in different documents, etc.
3	classification	Nonlinear SVMs	easily compute the similarity between 2 documents using it	

III. RELATED WORKS

BoVW model

The BoVW model is a bag of visual words. The each image is described with set of features. So the BoVW model is a Collection of featured vector. Each image is representing as a feature vector or visual words. Basically the BoVW model consist of following steps

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- ✓ Feature Extraction
- ✓ Quantization
- ✓ Codebook creation

1. Feature Extraction

The image is a collection of features. Each image is differentiated with other image depend on the features present in the image. The features of an image include color, texture, shape or any other important information that can derived from the image itself.

Depend upon the features extracted from the image there are different methods are used. Here basically the features are classified as two categories.

Key Features

The keyfeatures are very essential or important information that will be derived. Different algorithms used for deriving and identifying the keyfeatures uniform an image. For the extraction of keyfeatures there are two algorithms are used such as color histogram equalization and wavelet transformation. It first calculates the RGB value of an each pixel after calculating that value goes the histogram representation. From that we can calculate the intensity of the each pixel. There is a threshold value setting point is present. The pixel values what are they satisfying that threshold value go to the 1 state i.e., upper state the reaming go to the lower state i.e., lower it setting two values 0 and 1.

Local feature identification

The local features of images are the background information present in the image. The background information are identified by using the edge detector and segmentation etc..

2. Quantization

Quantization is the process of analyzing the feature vector. The feature vectors are one of the representations of an image. By analyzing the feature vector we can easily identify the similar values. The similarity can be measured by using cosine similarity

For example , v1 ={ a1,a2,a3,a4…} , v2 ={ b1,b2,b3, b4…} and v3 ={c1, c2, c3….} … these are the feature vector, and each vector consist of set of values. The similarity measurement will calculate how these points close to each other.

The cosine similarity is calculated by measuring the similarity between two vectors (or two documents on the Vector Space). It is actually a measure that calculates the cosine of the angle between these documents them. It can be seen as a comparison between documents. The magnitude of each word (Present in the document or may be in vector) count (tf-idf). After calculating the similarity making the clustering. Here using clustering algorithm is K-means clustering.

Clustering:

Clustering is the process of making different group, each group contains similar group of values.

K-Means Clustering:

It is one of the best approaches for making the clustering. Because it will take small amount of time for grouping as well as the similarity measurement.

3. codebook creation

In vector quantization we need to determine the reconstruction levels $\bar{r}_i$ and corresponding cells C_i. A list of reconstruction levels is called a "codebook" (CB). If there is L-reconstruction levels in the list it is referred to as an L-level codebook.

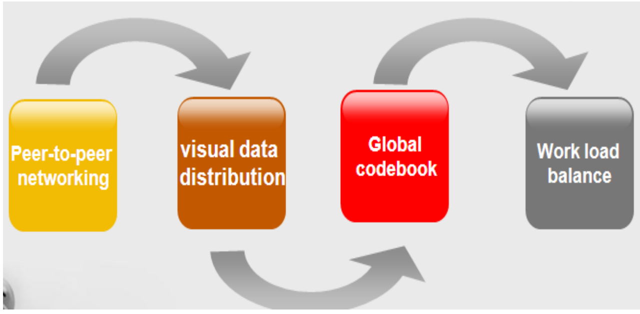

Figure 2: Problem definition of existing system

IV. PROPOSED SYSTEM

In the proposed system introduce one of the method is split/merge operation. It consider both the problem such as

- ✓ Data discriminality
- ✓ Workload problem
- ✓ Network cost reduction

The new method that take consider to these problems, while processing a query the relevant information as well as the workload information are collected by using this relevant information, the information provided by the codebook is maximized or minimized. It also reduces the quantization problem. The fair workload can be achieved by avowing overloading nodes as well as under loading nodes. By using these criteria, the codebook size is maximized or may be minimized, i.e. shrink or merge the codebook.

To reduce the network cost during the updating of the codebook, each node individually take the decision whether the codebook expanded or split depend upon the previously collected feedback values, after the end of the iteration it is updated to the whole network.

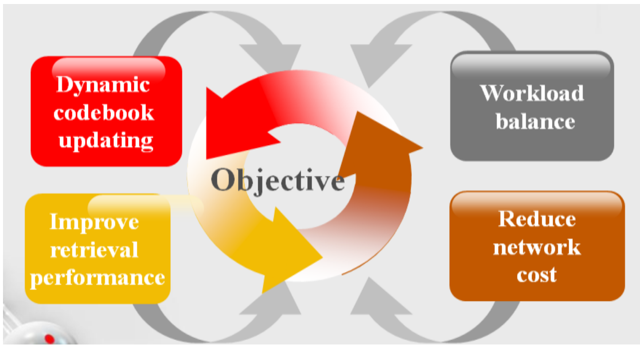

Figure 3: Main objectives of proposed system

New proposed method is split/Merge operation. It is used for the workload balance among the nodes and network cost during indexing and codebook updating and image searching time. The proposed system is divided as two phases.

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- **Phase 1**
  - Data base selection
  - Feature Extraction
  - Indexing
  - Codebook Generation
  - Codebook Updating

- **Phase 2**
  - Image Retrieval

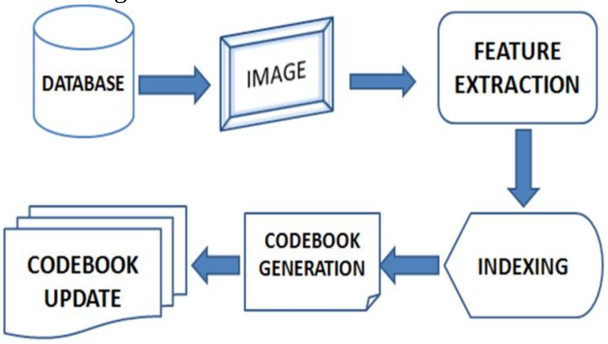

Figure 4: Flow design of first phase

Here basically two dataset for the processing

- ✓ Uk bench
- ✓ Holidays

Why using these DB instead of others????

- ✓ Uk bench consist of different size image
- ✓ Holiday DB consist of variety of images with different features

So I try to prove the efficiency of this project by using different database.

1. *Feature Extraction*

Depend upon the Feature extracted, choose different algorithms. The main features of an image is

- ✓ Texture
- ✓ Color
- ✓ Shape

2 .*Indexing*

- ✓ Providing unique id to the each features.
  - Global indexing
  - Inverted index
- ✓ Global Index is independently partitioned and placed away from the data on the nodes.
- ✓ Inverted index help to indicate each image with its corresponding collection of features id.

Figure 5: Global indexing of the feature vector

2. *Codebook generation*
   - Quantization
     - K-means
     - Sparse coding
   - K-means are used to grouping different index vector. Sparse coding used to set the limit.
     - VLAD
     - Fisher

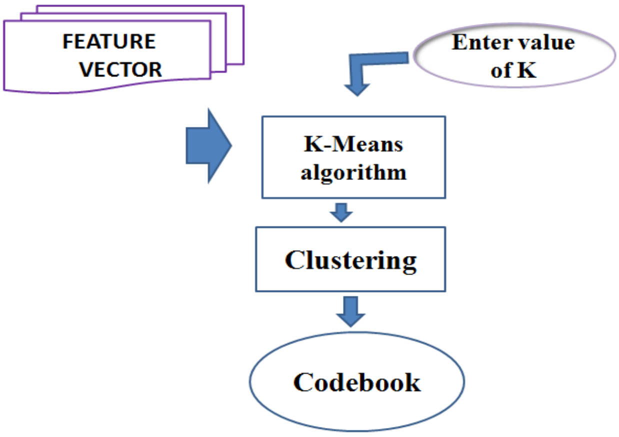

Figure 6: Flow design of codebook creation

3. *Codebook updating*
   - Dynamic updating
   - Split / Merge operation

- ✓ Main Objective
  - Workload balancing
  - Reduce Network cost
  - Codebook Information Maximization
- ✓ Codebook information maximization

  Q : Extracted Query information

  X: candidate image

  Y:Query information supported Features on X

  So the mutual information of x and Y is

arg min I(X; Y / Q)

K: codebook value

The probability of query is

P(Q)= 1 / |Q|

P(r/ x, Q), the relevance of x and Q, is given by:

$$\hat{P}(r|x, Q) = \begin{cases} 1 & \text{if } x \text{ is relevant to } Q; \\ 0 & \text{if } x \text{ is irrelevant to } Q; \\ P_u & \text{if relevance is unknown.} \end{cases}$$

Workload balance

The average workload difference for all codeword's in all queries is given by:

$$F(K) = \sum_{k \in K} \frac{s_k}{N} F(k).$$

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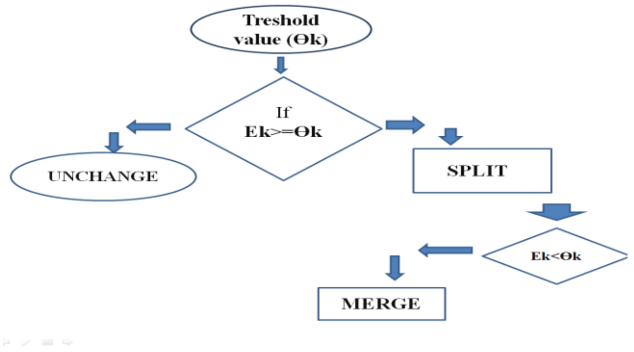

Figure 7: Split/Merge operation

Phase 2

The image retrieval is the main task of this work is effective manner. Here using one of the approach is split/ merge operation of effective searching as well as the indexing of the codebook.

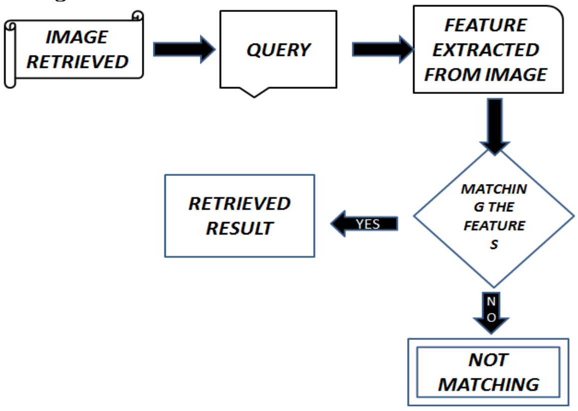

Figure 8: Design flow of phase 2

First provide the query is any node of the peer to per networks. After getting the query the corresponding index values are checked. If any node contain that particular code means send the control signal to that particular node finally get the result as soon as possible, here mainly concentrate on the network cost

V. ANALYSIS

For the analysis using two data set

Holidays*:*

U K Bench:

The UK Bench contains10, 200 images with four images per object in different conditions A benchmark dataset for object recognition. 10200 images of N=2550 groups with each four images at size 640x480. The images are rotated, blurred and have a tendency for computer science motives. The dataset is typically used for image retrieval, where one image of a group is used as query. In our experiments, an image is considered relevant to the query image if both of them come from the same object. The SIFT descriptors are used as local descriptors. The holidays dataset contains 1491 images with 500 queries and 991 corresponding relevant images. The number of relevant Images for each query varies from 1 to 11. The SIFT descriptors coming with the dataset are used as local descriptors.

Table 4.1Estimated per-node computation and network cost estimation of different BoVW steps

Dataset	Feature Extraction	Quantization	Codebook Updating
UK - Bench	0.188 s	1.168 s	1.456-80.913 KB
Holidays	0.554 s	2.818 s	1.280-35.641 KB

Ranged values indicate the best/worst values obtained with different methods and settings we evaluated. Feature Extraction: The average time to extract the SIFT features of an image. Quantization: The average time to quantize the SIFT features into codeword's. Codebook Updating-CPU: the average time to update the codeword on each node. Codebook Updating-Avg. Traffic: The average network traffic of all codeword nodes to update the codebook, assuming a cost of 160 bytes per descriptor.

VI. CONCLUSION

Content-based image retrieval in peer-to-peer networks by employing the bag-of-visual- words model and split / merge. A dynamic codebook updating method by optimizing the mutual information between the resultant codebook and relevance information. The workload balance among nodes that manage different codeword's. In order to further improve retrieval performance and reduce network cost, indexing pruning techniques are developed.

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