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Codebook creation in QBIC using BoVW model

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***Abstract*—The peer to peer network provide an efficient sharing of various multimedia data such as audio, video, image and any other data across the large variety of node. The application of QBIC in peer to peer network is a challenging and important problem. The QBIC means Query By Image Content. Instead of searching of image using keyword here using the content of an image. The contents mean it describes the image such as color, shape, texture, or any other relevant information derived from the image itself. By processing this QBIC in p2p networks the challenging issues are workload balance among the nodes and dynamic updating and creation of the feature vector. To overcome the problems in the existing system introducing a new method BoVW model. Another one problem faced by the QBIC approach is Data discriminality it's also overcome by using the algorithm of BoVW model.**

***Index Terms*—QBIC, BoVW model, Peer to Peer networks, Workload Balancing, Codebook Creation, data discriminality.**

I. INTRODUCTION

In the last few years, the rapid growth of the Internet has enormously increased the number of image collections available. The accumulation of these image collections (including art works, satellite and medical imagery) is attracting more and more users in various professional fields [2]—for example geography, medicine, architecture, advertising, design, fashion and publishing.

Meanwhile, the study of image retrieval, which is concerned with effectively and efficiently accessing desired images from large and varied image collections, has become more interesting and more challenging [1].

Image retrieval is concerned with techniques for storing and retrieving images both efficiently and effectively [2]. Early image retrieval methods locate the desired images by matching keywords that are assigned to each image manually. However, as a result of the large number of images in collections, manual processing has become impractical. As well, because we are unlikely to foresee all the query keywords that will be used in a retrieval process, it is impractical to assign keywords to every image, so the effectiveness of classic image retrieval is very limited.

Query By Image Content (QBIC), 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 also known as Content- Based Image Retrieval (CBIR) 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).

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]. The features like

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- RGB Color
- GCH (Global Color Histogram)

- LCH (Local Color Histogram).

II. RELATED WORK

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.

III. PROPOSED WORK

A. *BoVW model*

The BoVW model is a bag of visual words. 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

1. Feature Extraction
2. Quantization
3. 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.

KeyFeatures

The keyfeatures are very essential or important information that will be derived. Different algorithms used for deriving and identifying the keyfeatures uniform an image.

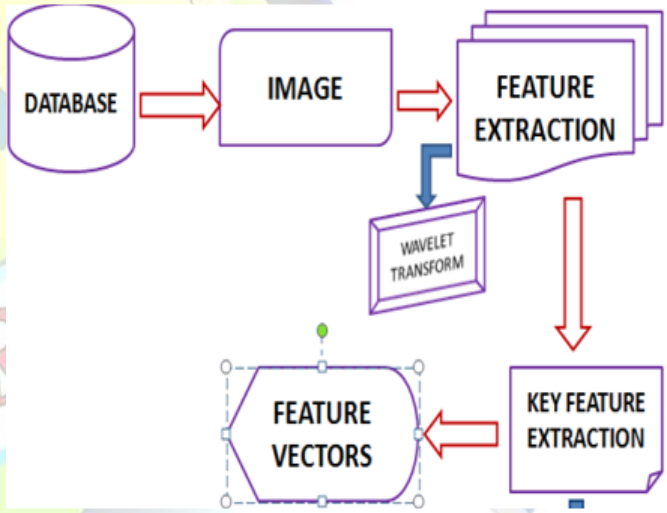

Fig 1: Feature Extraction

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 each pixel after calculating that value goes the histogram representation. From that we can calculate the intensity of 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.

a)

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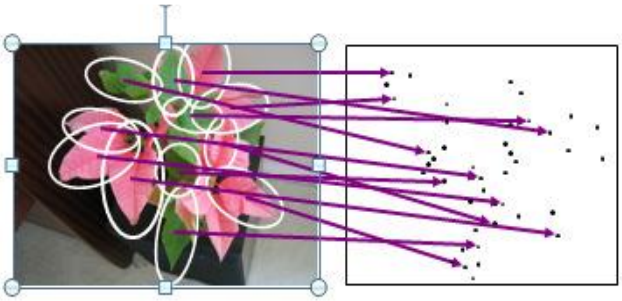

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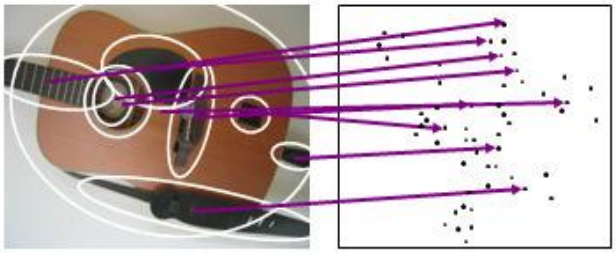

Fig 2: Feature Extraction and identification

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..

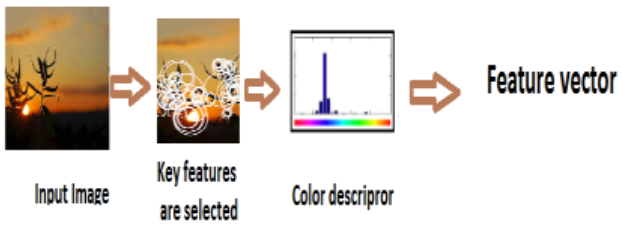

Fig 3: Feature vector creation

Fig 4: This figure illustrates the identification of keyfeatures and the local features. The keyfeatures represented by red color and background information represented by black circle.

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). [8] discussed about Improved Particle Swarm Optimization. The fuzzy filter based on particle swarm optimization is used to remove the high density image impulse noise, which occur during the transmission, data acquisition and processing. The proposed system has a fuzzy filter which has the parallel fuzzy inference mechanism, fuzzy mean process, and a fuzzy composition process.

The cosine similarity is calculated as,

First the equation for the dot product is,

$$\mathbf{v1.\ v2} = \sum_{i=1}^{n} \mathbf{ai\ .\ bi}$$

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$$= a1.b1 + a2.b2 + a3.b3 + a4.b4\ldots \quad (1)$$

Secondly the geometric definition of the dot product:

$$v1.v2 = \|v1\| \cdot \|v2\| \cos\theta \quad (2)$$

$$\cos\theta = \frac{v1.v2}{\|v1\| \cdot \|v2\|} \quad (3)$$

TABLE1
Symbols and definitions

Symbol	Quantity
$\sum$	Summation
$\cdot$	Dot product
v1, v2..	Feature Vector
$\| \|$	Magnitude
ai , bi	Features

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.

- ✓ Make initial guesses for the means $\mathbf{me}_1$, $\mathbf{me}_2$, ..., $\mathbf{me}_k$
- ✓ Until there are no changes in any mean
  - Use the estimated means to classify the samples into clusters
  - For i from 1 to k
    - ➢ Replace $\mathbf{me}_i$ with the mean of all of the samples for cluster i
  - end_for
- ✓ end_until

Algorithms:

- ✓ Place K points into the space represented by the objects that are being clustered.
- ✓ These points represent initial group centroids.
- ✓ Assign each object to the group that has the closest centroid.
- ✓ When all objects have been assigned, recalculate the positions of the K centroids.
- ✓ Repeat Steps 2 and 3 until the centroids no longer move. This produces a separation of the objects into groups from which the metric to be minimized can be calculated.

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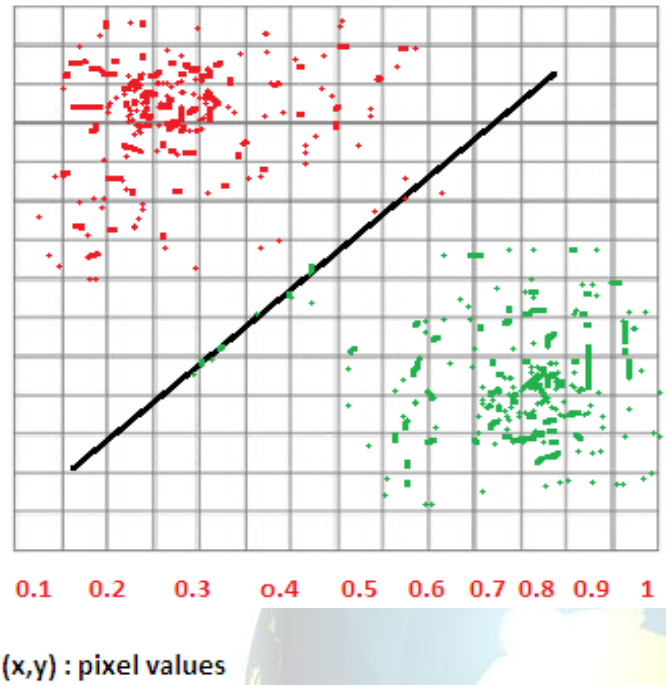

Fig 5: This figure illustrates clustering process, what are the points satisfy the threshold value that going to the upper half and remaining going to the down part.

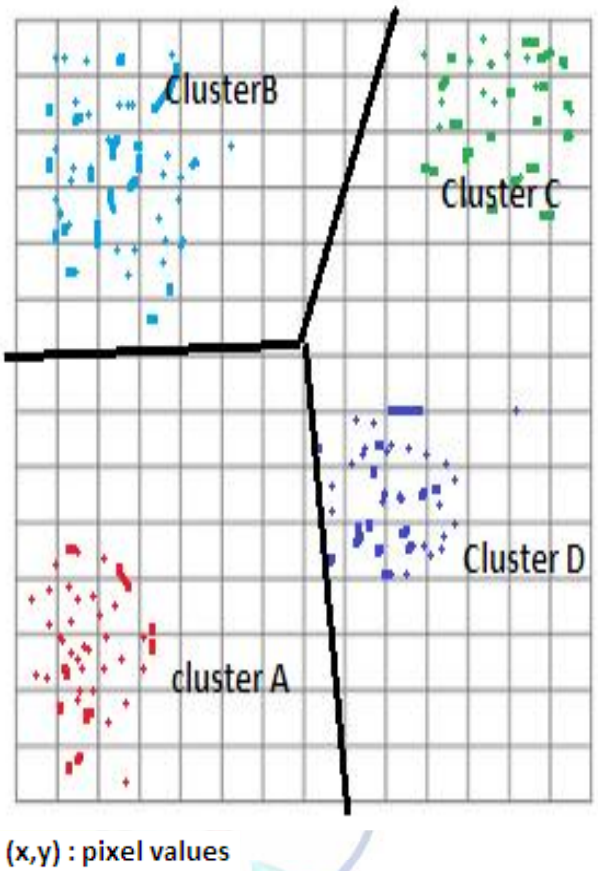

Fig 6: Each color dots represents individual clusters. It consists of 4 clusters.

3.codebook creation

In vector quantization we need to determine the reconstruction levels 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.

The CB is needed at the transmitter to quantize a source vector to one of the L-reconstruction levels and at the receiver to determine the reconstruction level from the received codeword. This implies that the same CB should be known both to transmitter and receiver. A codebook is a document used for implementing a code. A codebook contains a lookup table for coding and decoding; each word or phrase has one or more strings which replace it. To decipher messages written in code, corresponding copies of the codebook must be available at either end. The distribution and physical security of codebooks presents a special difficulty in the use of codes, compared to the secret information used in ciphers, the key, which is typically much shorter.

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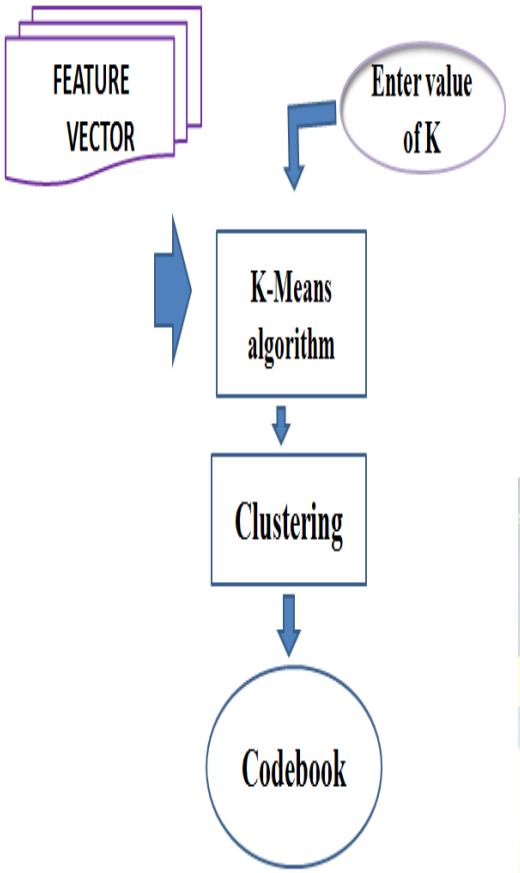

Fig 7: Codebook creation process

IV. EVALUATION

1. Experimental Evaluation

UK 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.

Holidays: It 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 2
Estimated 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.*

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V. RESULT AND ANALYSIS

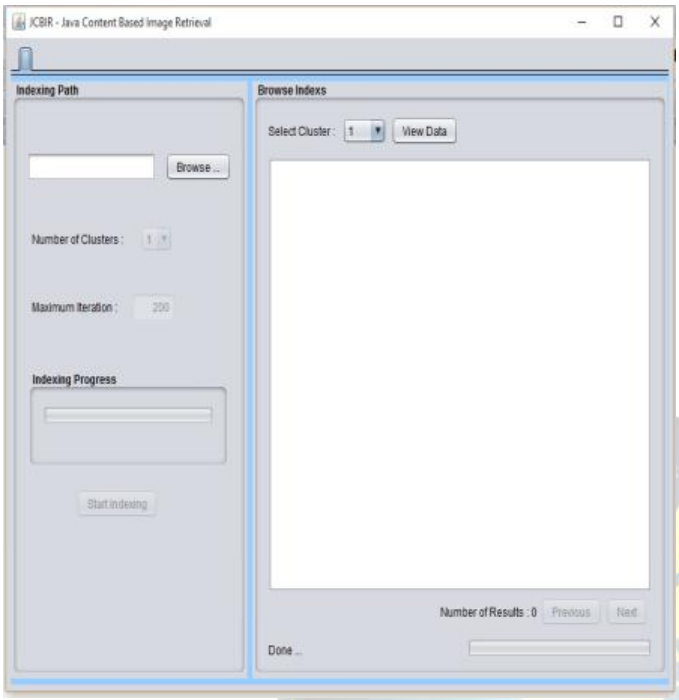

Fig 8: Indexing and image uploading page

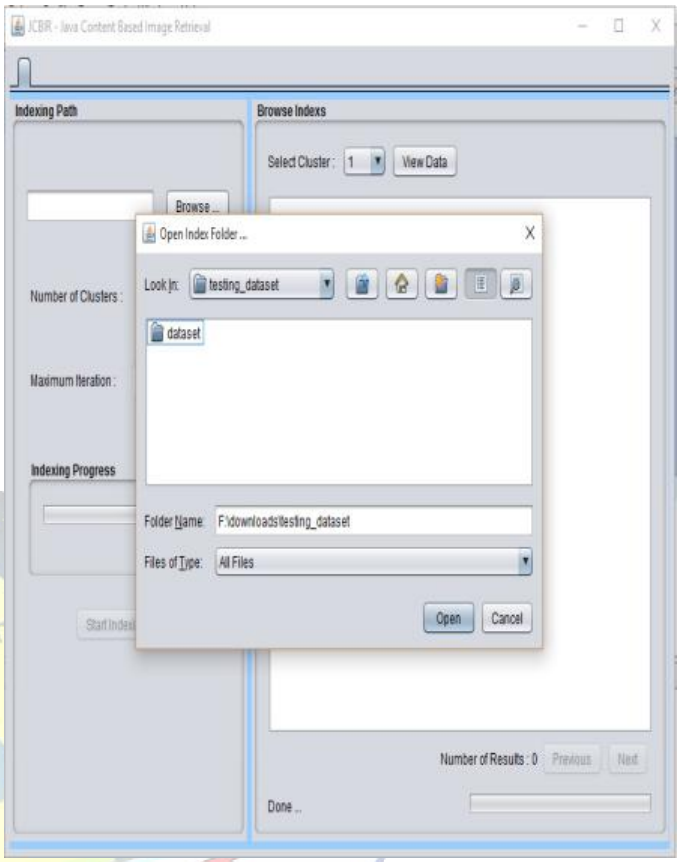

Fig 9: Image uploading process

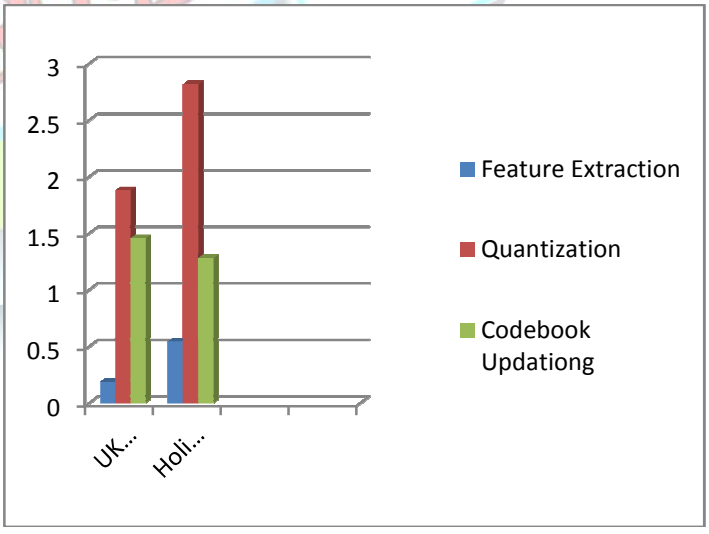

Fig 10: Analysis for time taken for each operation

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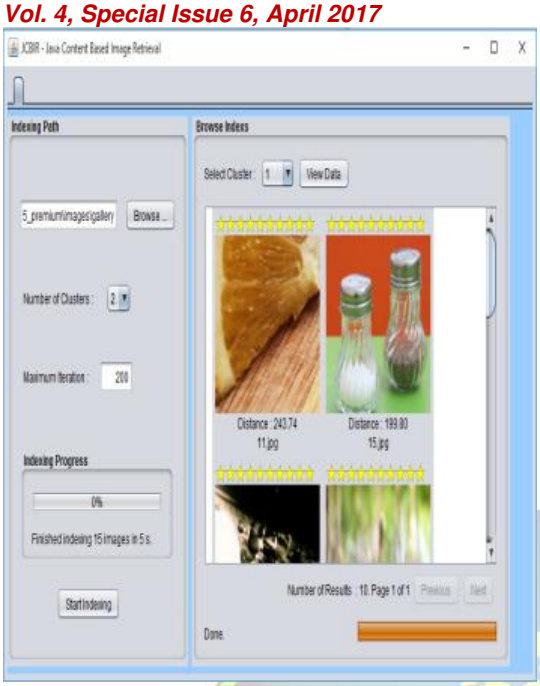

Fig 11: Similarity measuring and clustering

CONCLUSION

This paper introduces an approach of BoVW model, it is used for the effective creation of the codebook of set of image. The content based image retrieval or Query by image content is one of the most important methods. For this project using two datasets for analysis, holidays and UK Bench. The time consumption for each process in the BoVW model is effective. This method overcomes the data discriminality, dynamic feature extraction and clustering problem.

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