CS663 Course Project-Content Based Image Retrieval based on Histogram Refinement

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Abstract

Due to the increase in the amount of digital images on the web, their is requirement for content-based image retrieval methods. This work focuses on using histogram properties of an image for retrieval. As the histogram provides coarse characterization of an image, we are further splitting the pixels in a given histogram bin into different classes based on some property, this method is called histogram refinement. Here coherence of the pixels is used for further refinement. For comparative analysis one more method is considered based on color, texture and shape.

1 Problem Statement

In our work, we have implemented content-based image retrieval (CBIR) based on histogram refinement [2]. A colour image is converted to grayscale and then its intensity is uniformly quantized into 16 bins. Then we find the histogram of the image. Pixels in each of the 16 bins of the histogram is further classified as coherent or incoherent. In each of the 16 bins we have found out the coherent and incoherent clusters. Then 16 properties have been calculated based on the number, size etc of coherence and incoherence clusters.

Based on these 16 properties, image retrieval is done in 3 incremental stages. For comparison L1 distance is used [1].

For comparative analysis, color, shape and texture features are also considered [3].

2 Implementation

For testing purpose images provided by Wang et al. [4] and Li and Wang (2003) [5] is being used.

For finding the coherent and incoherent pixels in a bin, connected components are first found for pixels in a given bin. A pixel is classified as coherent if it is part of a connected component whose size is greater than or equal to τ [1]. In our case, we found $\tau = 500$ gave good results.

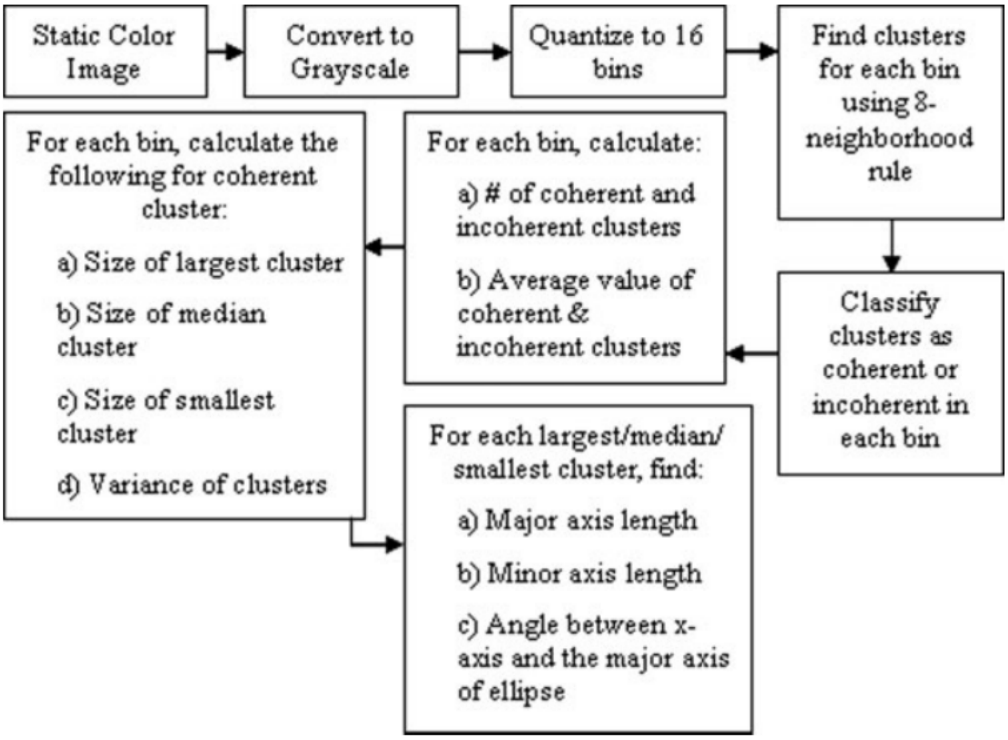

Figure 1. Block diagram of the feature extraction algorithm.

Figure 1: Framework

In terms of computational complexity, it is not very expensive. For each image it calculates 16×19 features.

In this case per image 256 color features, 28 shape features and 64 texture features are extracted. It is comparatively more computationally expensive than first method [3].

3 Experimental Results

For retrieval result on each of the classes, False Acceptance Rate (FAR) is calculated as a performance metric. This method is considered unsuccessful for a particular class if FAR is greater than 50%.

- **Histogram Refinement Method**

Class	FAR (%)
1 (People)	37.5
2 (Sea)	75
3 (Building)	37.5
4 (Bus)	25
5 (Dinosaurs)	0
6 (Elephant)	50
7 (Flower)	25
8 (Horse)	37.5
9 (Mountain)	62.5
10 (Food)	25

Some retrieval results are shown in figures below. The value stated below the images specify the distance of the retrieved image from the query image.

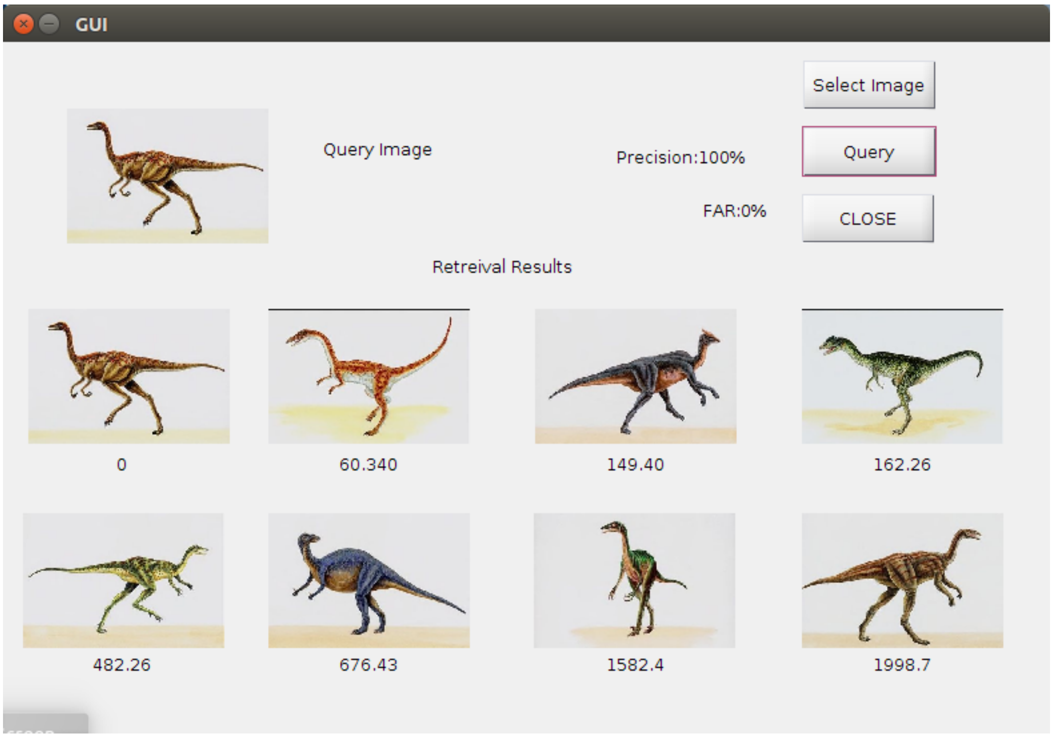

Figure 2: Retrieval Result in Dinosaur class using Histogram Refinement

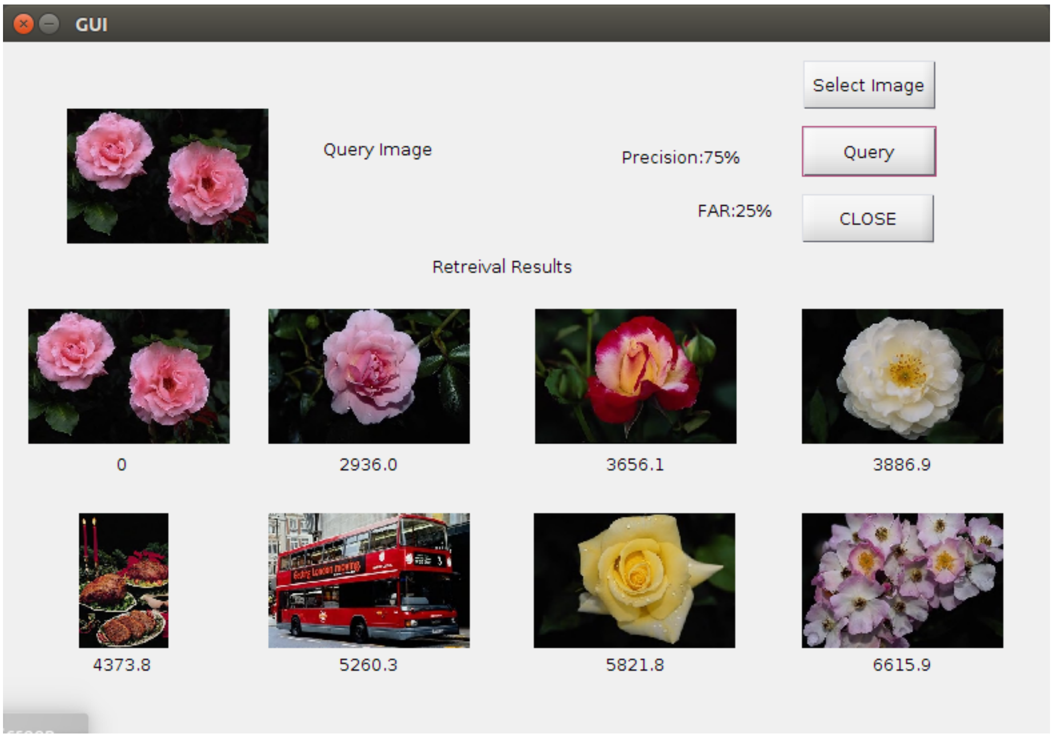

Figure 3: Retrieval Result in Flower class using Histogram Refinement

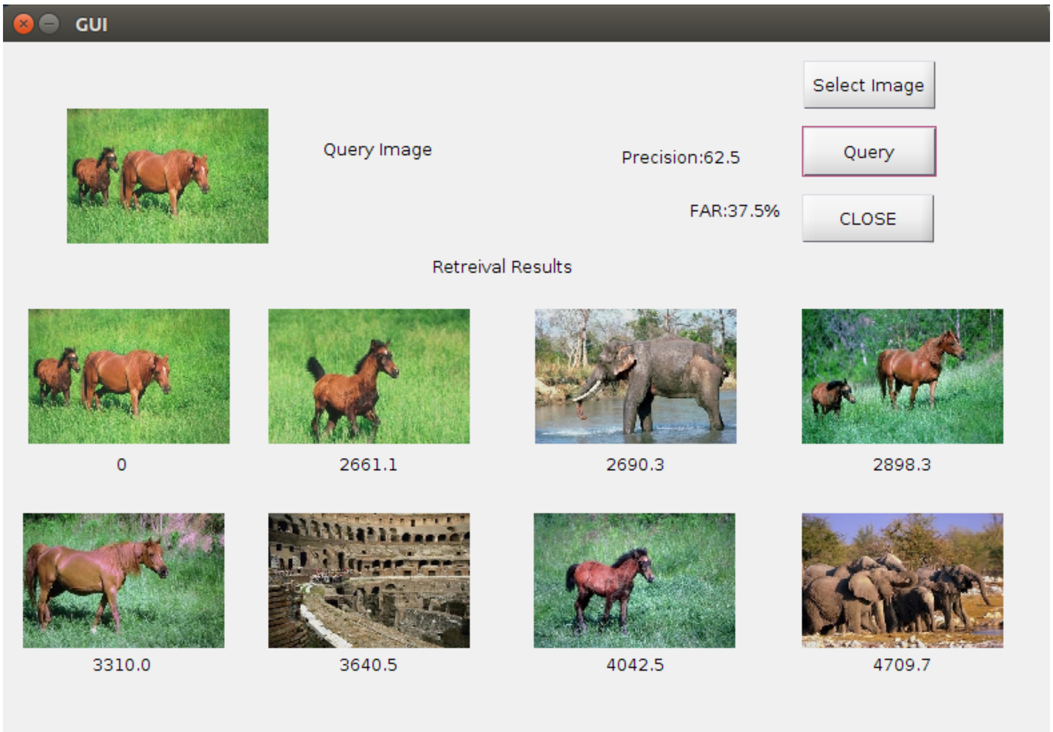

Figure 4: Retrieval Result in Horse class using Histogram Refinement

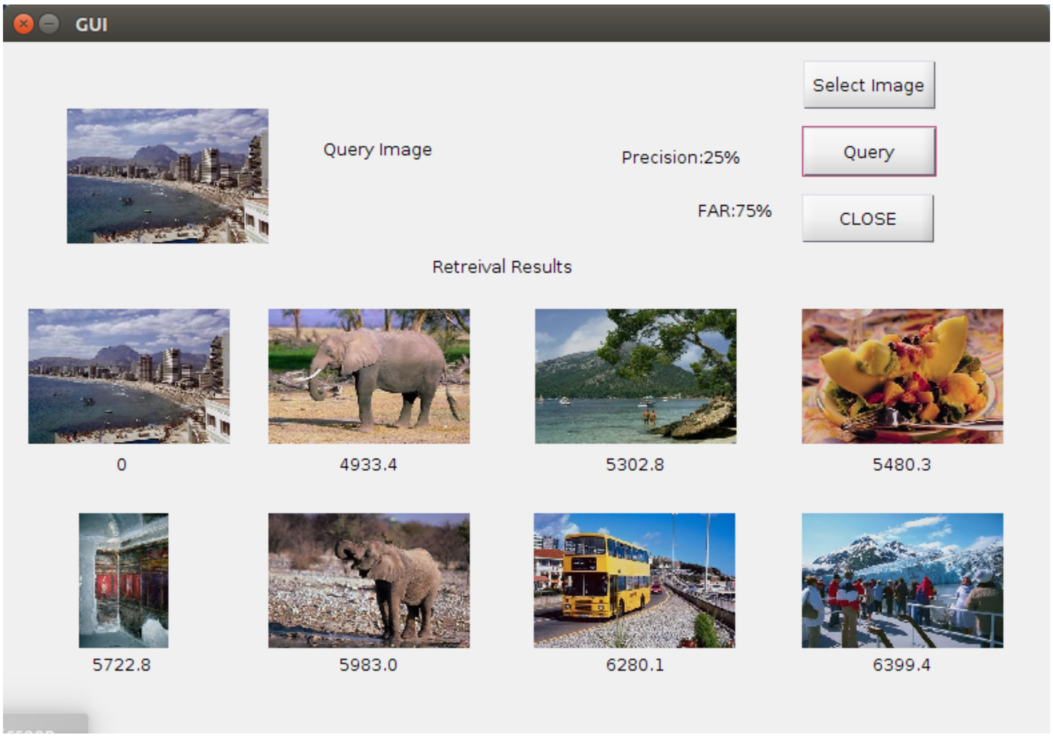

Figure 5: Retrieval Result in Sea class using Histogram Refinement

- **Shape, Color and Texture Method**

Class	FAR (%)
1 (People)	0
2 (Sea)	50
3 (Building)	12.5
4 (Bus)	12.5
5 (Dinosaurs)	0
6 (Elephant)	0
7 (Flower)	0
8 (Horse)	0
9 (Mountain)	37.5
10 (Food)	0

Some retrieval results are shown in figures below. The value stated below the images specify the distance of the retrieved image from the query image.

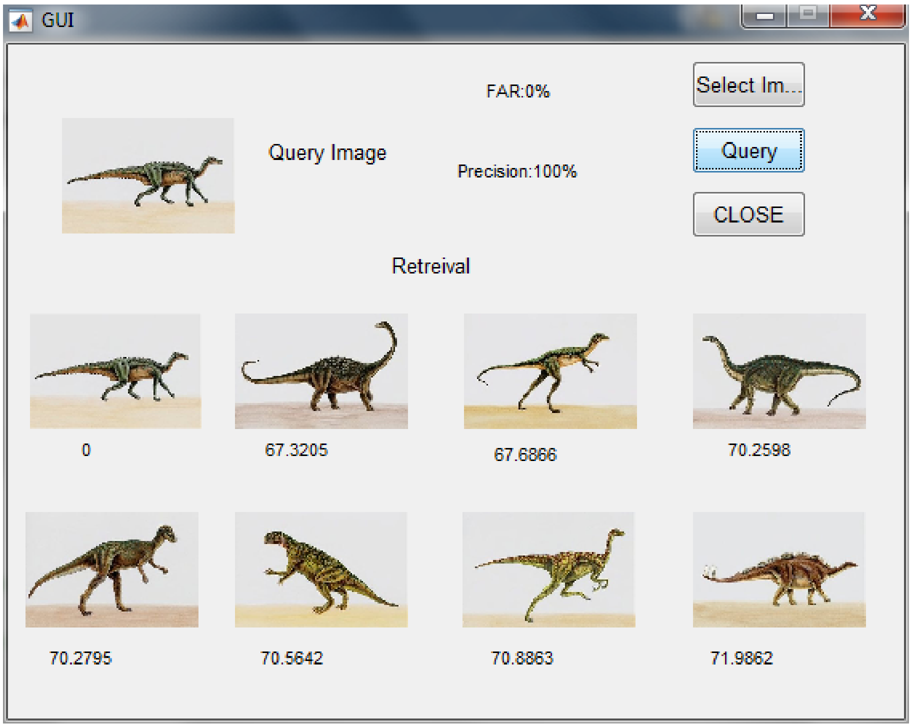

Figure 6: Retrieval Result in Dinosaur class using Histogram Refinement

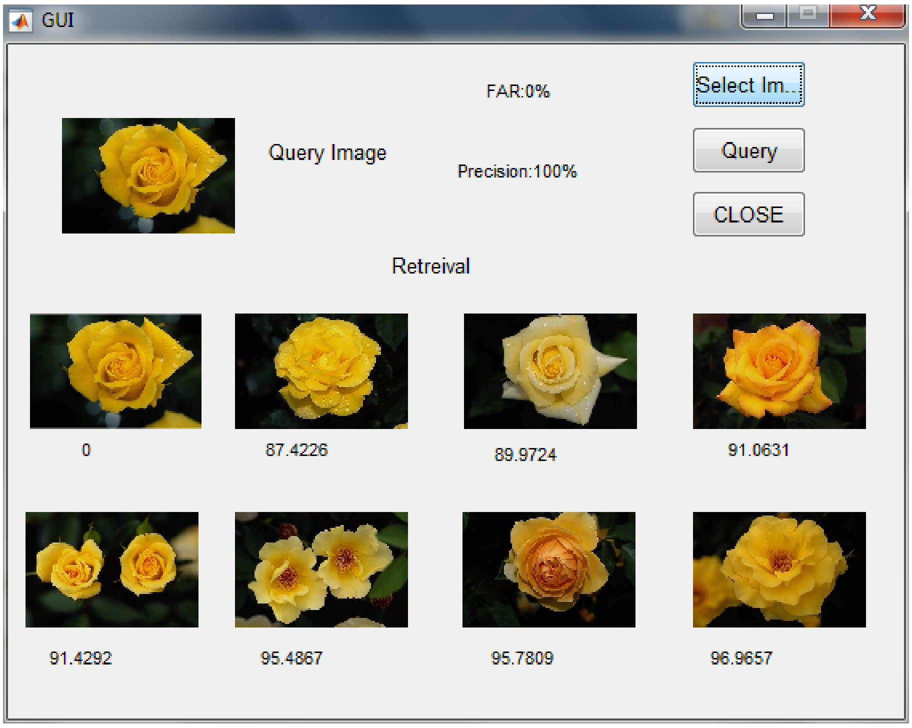

Figure 7: Retrieval Result in Flower class using Histogram Refinement

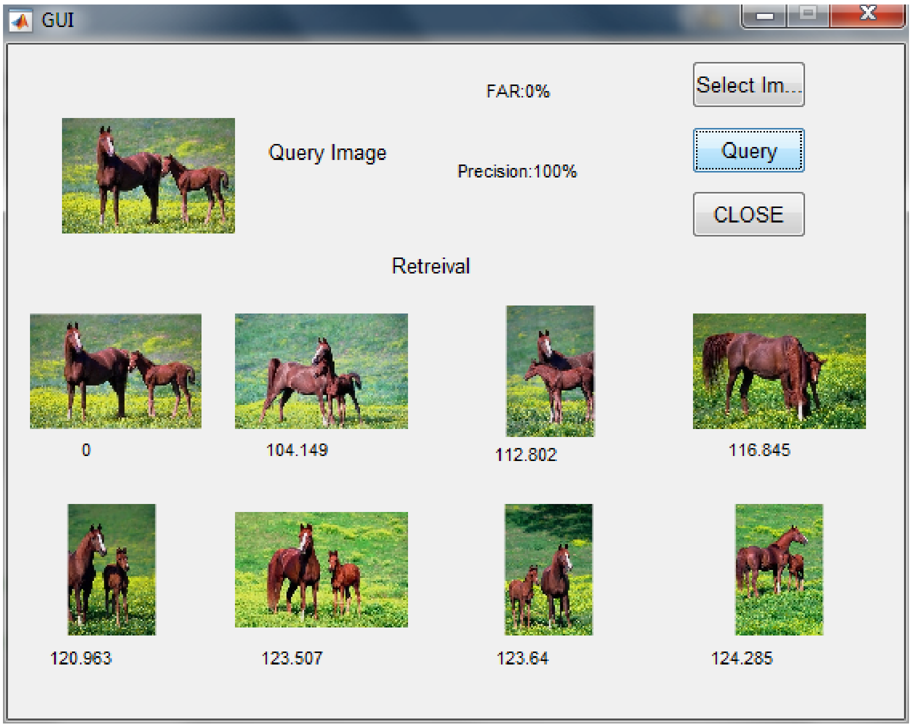

Figure 8: Retrieval Result in Horse class using Histogram Refinement

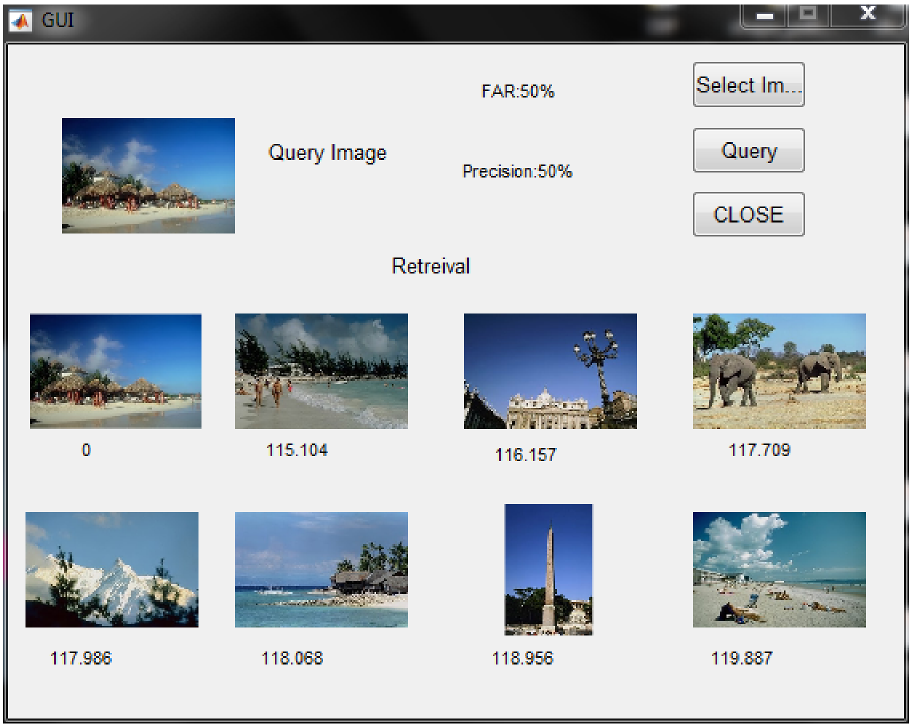

Figure 9: Retrieval Result in Sea class using Histogram Refinement

4 Interesting Observations

In our implementation, we saw that histogram refinement worked well for classes which doesn't have much variety in its images in terms of shape and size of the dominating object in the image. Also if there are not much details in the background.

It gave very good and consistent results on Dinosaurs class for this reason. And it gave acceptable consistent performance in bus and flowers class. Performance in mountains, sea and building class was not good.

In case of using shape, texture and color as features we get really good results except in case of natural scenery images i.e. mountains, beach. In case of natural scenery images it detects images in other classes also which have some scenery in the background.

5 References

[1] Jongan Park, Youngan An, Gwangwon Kang, Waqas Rasheed, Seungjin Park, and Goorak Kwon. 2008. Defining a new feature set for content-based image analysis using histogram refinement. Int. J. Imaging Syst. Technol. 18, 2-3, August 2008, pp. 86-93.

[2] G. Pass and R. Zabih, Histogram refinement for content-based image retrieval, IEEE Workshop Appl Comput, 1996, pp. 96-102

[3] R. K. Lingadalli and N.Ramesh, Content Based Image Retrieval using Color, Shape and Texture, IARJSET, Vol. 2, Issue 6, June 2015, pp. 40-45

[4] Jia Li, James Z. Wang, "Automatic linguistic indexing of pictures by a statistical modeling approach," IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 25, no. 9, pp. 1075-1088, 2003.

[5] James Z. Wang, Jia Li, Gio Wiederhold, "SIMPLIcity: Semantics-sensitive Integrated Matching for Picture LIbraries," IEEE Trans. on Pattern Analysis and Machine Intelligence, vol 23, no.9, pp. 947-963, 2001.