**GSLC ASSIGNMENT 3 (Pls refer to CO session 7, 8, 9) and ….**

https://socs.binus.ac.id/2017/05/10/image-search-by-content-using-bag-of-visual-words-paradigm/

In the bag of words (BOW) model, you first need to create what is called a visual codebook (or sometimes referred to as dictionary). You do this by:

1. Selecting representative images from an image dataset
2. Collect all the SURF descriptors from the images in 1)
3. Cluster these descriptors using K Means into k number of clusters where k is a number you set. The center of these clusters are the "visual words" i.e. representative features in your database of images.
4. For every image in the database, you are going to create a vector *V* that counts how frequently the different features in the dictionary occurs so each image would be represented by a vector in the form of: <# times feature 1 in dictionary occur, ... feature 2 in dictionary occur..., ..., ... feature k in dictionary occurs > i.e., a k dimensional vector. You obtain this vector for an image by:

4.1. Extracting SURF descriptors in the image

4.2. For each SURF descriptor in the image, find the closest cluster center (using Euclidean distance) in the codebook/dictionary and increment its corresponding count in the vector v by 1.

E.g., you have a 5 clusters dictionary (e.g., k = 5) and an image has 3 SURF descriptors. Two (2) of them are closest to the first cluster center and 1 is closest to the fifth cluster center. Your vector *V* would be *V* = <2, 0, 0, 0, 1>. Since *V* counts the number of times the representative vectors occur in an image, *V* is sometimes also referred to as a frequency histogram.

1. At this stage, you might want to normalize the histogram by dividing each entry by the sum of all the entries so that images with very different number of SURF key-points found can be made comparable.
2. Now, to compare 2 images, you compare this new vector *V* instead of the SURFT descriptors themselves. It is recommended to use cosine similarity to evaluate how close your query image with images in the database.