AN OPTIMIZED MKSIFT AND CLUSTER BASED CROSS INDEXING APPROACH FOR EFFECTIVE IMAGE SEARCH AND RETRIEVAL

A THESIS

Submitted by

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ABSTRACT

Due to the increasing demand for improved image indexing and retrieval approaches, image retrieval has become one of the important subjects in areas, like object recognition and artificial intelligence. Especially, Image retrieval on large scale image databases has attained more attentions, where mapping features into binary codes is showing great advancement. Most of the approaches represent the image using invariant local features adopting Scale Invariant Feature Transform (SIFT). In this research, two techniques such as, MKSIFT+ Cross indexing and MKSIFT+ cluster indexing have been developed for retrieving the suitable images from the database based on the query. In MKSIFT+ Cross indexing, a new approach for image retrieval, Multiple Kernel SIFT (MKSIFT) that extracts the features from the pre-processed input image. It utilizes the following steps of SIFT: detection of extrema, key point removal, orientation assignment, and calculation of descriptor, to extract the feature points. MKSIFT computes the keypoint descriptor with the introduction of exponential and tangential kernels, where the weights assigned to the kernels are selected by Particle Swarm-Fractional Bacterial foraging optimization (PS-FBFO) algorithm. Moreover, it performs a cross-indexed image search by converting the feature points of MKSIFT into binary codes.

The pre-processing is carried out to enhance the quality of the image by making the feature extraction process more reliable. Pre-processing helps the image database to attain more relevant images. It is required that, all the images that are to be processed should have equivalent height and width, even though the image can be of any size based on the acquisition device settings. The location and the scales of the images are identified by determining the stable features over all scales using the scaling function called scale space. Accordingly, the scale space is computed using the convolution of a Gaussian in the input image. Scale-space extrema is utilized in difference-of-Gaussian (DoG) function to detect the keypoint localization by convolving the function with the image. The extrema is detected by comparing the sample points with the

neighbours in the scale space. Once, the keypoints are identified, then the keypoints with low contrast are removed by performing a fit to the data for finding the location and the scale. Hence, the keypoint localization is evaluated based on the expansion of scale-space function, which is adopted using the Taylor series. Next is to perform the orientation assignment with respect to the keypoints based on the characteristics of the local images. The Gaussian smoothed image is selected based on the scale of the keypoint and hence, the magnitude and the orientation are calculated using pixel differences. The keypoint descriptor is calculated for each image, whose gradients are computed within the region around the keypoint. The Gaussian blur level of the image is selected by measuring the magnitude and the orientation of the image using the scale of the keypoint. MKSIFT approach introduces the multiple kernel functions, such as tangential and exponential kernels, which increases the variance by reducing the artifacts in the image. The PS-FBFO optimization algorithm is used select the weights optimally in the kernels. PS-FBFO is the combination of the objective function of PS and FBFO algorithm based on the kernel integration. The extracted features are then cross-indexed to transform the feature into binary codes for the retrieving process.

MKSIFT+ Cross indexing had complexity issues while dealing with the large databases, and hence, to avoid this, cluster-based indexing of binary MKSIFT codes is presented. In MKSIFT+ cluster indexing, the cluster-based indexing scheme uses the MKSIFT feature extraction, and the PS-FBFO optimization algorithm for extracting the useful features from the images. In the proposed cluster-based indexing scheme, the features are extracted from the image with binary MKSIFT codes. Also, the Bayesian fuzzy clustering scheme is employed for grouping the images in the database into several clusters. The search index is constructed for the user query based on MKSIFT code with each cluster group, and Bhattacharya distance between the cluster centroids and search index is calculated to identify the optimal cluster. Thus, the Bhattacharya distance measure identifies the similarity measure, and the cluster possessing with minimum distance is selected as the optimal cluster related to the user query. Hence, for retrieving the images that are related to the query of the user, the cluster group providing minimum distance is chosen as the optimal cluster. Here, the matching is done with the centroid of each cluster group rather than finding the distance measure with every image, and this reduces the complexity. The MKSIFT feature descriptors are integrated with the kernel functions to convert the feature descriptors into the binary code. The weights used for embedding the kernel functions with the MKSIFT feature descriptor are selected through the PS-FBFO optimization algorithm. The cluster based indexing scheme is incorporated with the MKSIFT to identify the suitable image set from the database based on the user query. Finally, the images present in the optimal centroid are retrieved, and forwarded as the search result to the user.

For the performance comparison, the experimental results evaluated regarding the parameters precision, recall and F-measure provided maximum mean precision of 0.89793, recall of 0.8625, and F-measure of 0.87716 for MKSIFT+ Cross indexing. For the MKSIFT+ cluster indexing, it is evident that the proposed cluster-based indexing scheme has achieved improved performance with the mean values of 0.923714, 0.8962 and 0.9065, for precision, recall, and F-measure, respectively.