Project 4
Image Retrieval

Brief

"Query by example" image retrieval: there is a large library of images; given an input image, need to find the images in the library that are similar to (belong to the same category to) the input image

Background: Caltech 101 (http://www.vision.caltech.edu/Image_Datasets/Caltech101/) is a well-known image data set consisting of 101 categories of images (plus a so-called clutter category), our experimental data are a subset of this data set

Data

Our data consists of 2,050 images that were selected from the Caltech 101 data set

Each image belongs to one of 41 categories (40 categories are meaningful, and 1 clutter category); each category has exactly 50 images

The size of each image is roughly 300 x 200 pixels

All images are colored, JPEG-formatted

Program

In this experiment, you should design and implement an image retrieval program

Given a lot of images, the program can build an image library in whatever way

Given an input image, the program can return K similar images in the library within a short period; K is a user-defined number; the returned images should belong to the same category as the input image; the returned images should be sorted so that the first one has the highest similarity to the input image, the second one has the second highest similarity, and so on; the runtime should be as short as possible

Evaluation

For each test image, use your program to return K (=10, 20, 50, 100) images; according to the true categories, calculate the following metrics

P@K: precision in top-K, is the percentage of correct results (i.e. the images of the same category) in the returned K images

R@K: recall in top-K, is the ratio of returned correct results (i.e. the images of the same category) to all correct results in the library (in this experiment, the number of all correct results is always 50)

F@K: F1-value in top-K, is the harmonic mean of P@K and R@K

MRR@K: mean reciprocal rank in top-K, is the average of reciprocals of ranks of the returned correct results. For example when K=10 and in the returned list, the correct results are $2^{nd},3^{rd},5^{th},7^{th},8^{th}$, then the MRR@10 is $\frac{1}{5}(\frac{1}{2}+\frac{1}{3}+\frac{1}{5}+\frac{1}{7}+\frac{1}{8})$, here P@10 is 5/10, R@10 is 5/50, F@10 is 1/6

Requirements

All the 2,050 images are used as a library

Use each image that belongs to a meaningful category (i.e. not clutter) to test your program and make evaluation (P,R,F,MRR@10,20,50,100)

Report the average evaluation results of each meaningful category (i.e. average of 50 test images of each category, report results of 40 meaningful categories)

Report the global average evaluation results (i.e. average of 2,000 test images, except the clutter category images)

Report the global average runtime (i.e. average of 2,000 tests)

Report

.pdf is best, .doc and .ppt are acceptable

English is encouraged

List all references

Source code is a plus