

Content-based Image Retrieval using an Improved Chain Code and Hidden Markov Model

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1. Introduction

Recently, as the information for multimedia is increased and used rapidly, the various content-based image retrieval (CBIR) methods are introduced. In typically, we consider the QBIC system by IBM, the CBIR system by Berkeley University, the Visual Seek and Web Seek by Columbia University, and Photobook by MIT. Most of these methods extracted the feature vector based on contents by the patterns, colors, and texture of image information to use it in searching.

In this paper we suggest the method approaching to new content-based image retrieval using the improved chain code and HMM. Hence in the suggested image retrieval system we extract the improved chain code, which is invariant in the rotation, movement, and accumulation from the divided images to use it as the observation value of HMM, and the parameter of HMM using Baum-Welch algorithm. We describe the method of the image query by computing the probability for the observation value to appear when the feature vector of query image is substituted to each HMM with estimated parameter in database.

2. Extraction of pattern using the improved chain code

Using the standard chain code we can easily extract the feature vector for the outline of image from the images segmented into the objects with similar patterns. But it has a defect about rotation, movement and scaling. Hence in order to solve these problems, we suggest the improved chain code to extract the efficient outline characteristic from the object. First we extract the 8-D chain code invariant to direction, movement and scaling by applying the resampling to divide objects. Then finally we extract the improved 8-D chain code by smoothing it and using the Gaussian filter to get

rid of the noise components implied in outlines. Figure 1 shows the improved chain code of dinosaur image obtained using the proposed algorithm and graph.

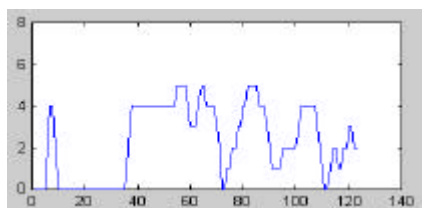


Figure 1. The improved chain code of dinosaur image

3. Experiments and Results

We performed the partition of object, the extraction of feature vector, the training of HMM and computing the appearance probability for query image to experiment the efficiency of content-based image retrieval method by the improved chain code and HMM suggested in this paper. We made use of Pentium PC and Visual C++ 6.0 to implement the algorithm.

Images of database is 256 color image with 120×80 pixel and these consist of 7 classes such as dinosaur, airplane, car, china, doll, duck and rose. In experiment we use the 8 states of HMM and performed the HMM learning using the extracted feature vector for each image in database. In this case we can consider the feature vectors as observation value of HMM and estimate the parameter of HMM by Baum-Welch algorithm. The method of query is to choose randomly a query image from database images, to substitute these in each HMM saved in database and to compute the probability of observation value's appearance. Figure 2. shows the performed results of suggested algorithm and in additionally shows three images with high probabilities chosen from each class.

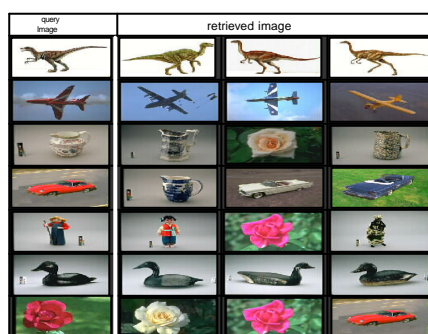


Figure 2. The result of query images using the proposed CBIR

REFERENCE

[1] Y. He and A. Kundu, "2-D Shape Classification Using Hidden Markov Model," IEEE Trans. on PAMI, vol 13, No. 11, 1991, pp. 1172-1191.