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Content Based Image Retrieval using Feature Coding

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ABSTRACT

Image is a collection of row and column that is called pixel values. The emerging task is to extract best matched image from large collection of database. Image retrieval is generally used in image processing, pattern recognition and computer vision. In many areas, CBIR technique is used such as medical, academic, art, fashion, entertainment. Image features such as color, texture, shape and size are used to extract all the relevant and irrelevant features of image. For this image classification, numbers of feature coding techniques are available. Comparatively Super Vector Coding (SVC) gets optimal result for image classification.

Keywords:- CBIR, Feature coding, Super Vector Coding (SVC), bag-of-features (BoF), image classification

1. INTRODUCTION

Content Based Image Retrieval is the application of computer techniques to solve the problem of searching for digital image in the large database. In Content Based Image Retrieval, images are retrieved based on features such as color, texture and shape. The CBIR system uses these features for retrieval of images and the technique for getting these features is known as Feature Extraction. For speeding up image retrieval in large databases and to improve retrieval accuracy, Image classification or categorization which is a machine learning approach, plays important role. In digital image classification, only gray values are used by the conventional statistical approaches for image classification. For better and efficient retrieval results different advanced techniques like Artificial Neural Networks (ANN), Support Vector Machines (SVM), Fuzzy measures, Genetic Algorithms (GA), and Genetic Algorithms with Neural Networks can be developed for image classification.

2. LITERATURE SURVEY

For gray scale images, Content Based Image Retrieval system using Accurate Legendre Moments (ALM) is proposed in [1]. In this for image classification, they worked on feature shape. A kernel function should be chosen with appropriate parameters, as SVM is a kernel method and the kernel function used in SVM is very essential in determining the performance. The challenging problem is the choice of kernel and tuning of appropriate parameters, for specific requirements of CBIR adapting SVMs such as learning with small sample. By employing Support Vector Machine (SVM) classifier, the image classification efficiency is improved. A non-parametric approach is used for content based image classification [3]. In this, classification system established that allows recognizing and recovering the cluster of a query image based on its content. CBIR system describes each image by automatically extracted set of features. Then, the feature vectors are given as an input to a classifier. The different descriptors and techniques are used by the processes of image feature selection and extraction such as Scale Invariant Feature Transform (SIFT), Bag-of-Words (BoW) and Spatial Histograms (SP). For the classifier, the Naive Bayes Nearest Neighbor (NBNN) algorithm, which belongs to the category of nonparametric classifiers, is used. Other classifiers used in image classification are also described briefly.

3. IMAGE CLASSIFICATION

Image classification is an emergent topic in pattern recognition and computer vision. The key component of image classification, the feature coding has been widely studied over the previous several years, and a number of coding algorithms have been projected. In paper [4], a survey on various feature coding methods is given along with taxonomy. Image classification is the technique to assign one or more category labels to an image. It is one of the most fundamental problems in computer vision and pattern recognition, and has a wide range of applications, e.g., video surveillance [5], image and video retrieval [6], web content analysis [7], human-computer interaction [8], and biometrics [9]. The bag-of-features (BoF) [10] derived from the Bag-of-Words (BoW) model in document analysis [11], is probably the most popular and effective image classification framework in the recent literature. In paper [2], SVM used as a classifier for classification of various categories of image and optimal result is obtained. Accuracy and error rate found for precise result. This method gives much better performance than the traditional method of image

retrieval. Using classification technology, image similarity achieved by combining multiple feature distances [25]. A new two-step strategy developed to handle the noisy positive examples, which incorporating the methods of noise tolerant classifier and data cleaning. To validate the effectiveness of the CBIR using SVM algorithm, the extensive experiments carried out on two different real image collections.

4. FEATURE CODING

To link feature extraction and feature pooling [23, 24], core component of image classification is used i.e. feature coding which greatly influences image classification in terms of both accuracy and speed. There are five basic steps in the BoF framework used for image classification, as follows:

1. Extract patches:
With the images as the input, the outputs of this step are image patches. Implementation of this process is done via sampling local areas of images usually in dense (e.g. using fixed grids) or sparse (e.g. using feature extractors).

2. Represent patches:
Given image patches, the outputs of this step are their feature descriptors (vectors). Implementation of this process is done via statistical analysis over pixels of image patches.

3. Generate codewords:
The inputs of this step are feature descriptors extracted from all training images and the outputs are codewords. The codewords are typically generated by clustering (e.g. K-means) over feature descriptors or codeword learning in a supervised or an unsupervised manner.

4. Encode features:
Given feature descriptors and codewords as the input, the output of this step is a coding matrix. In this step, each feature descriptor activates a number of codewords, and generates a coding vector, whose length is equal to the number of codewords. The difference of various coding algorithms lies in how to activate the codewords. All coding vectors form a coding matrix.

5. Pool features:
The input of this step is a coding matrix and the output is a pooling vector for each image, namely the final representation of an image. This step is implemented via integrating all responses on each codeword into one value. Classic pooling methods are average pooling (i.e., preserving the average response) and MAX pooling, (i.e., preserving the maximum response). Feature Coding generally categorized as (a) Global Coding and (b) Local Coding. *Global* coding is mainly designed to estimate the probability density distribution of features. It focuses on the global description of all features rather than each individual feature. There are two kinds of strategies in global coding:

- Voting-based methods [12] describe the distribution of features with a histogram, which carries the occurrence information of codewords. Such a histogram is usually constructed by hard quantization or soft quantization. Techniques used under this are Hard Voting (HV) and Soft Voting (SV).
- Fisher coding-based methods [13, 14] estimate the distribution of features with the Gaussian Mixture Models, consisting of the weights, the means and the covariance matrix of multiple Gaussian distributions, each of which reflects one pattern of features. In this, Fisher Kernel (FK) and Improved Fisher Kernel (IFK) methods are considered.
- Local coding is proposed to describe each individual feature. Three kinds of local coding methods have been developed:
- Reconstruction-based methods [15, 16, 17] use a small part of codewords to describe each feature via solving a least-square-based optimization problem with constraints on codewords. This covers three methods such as Sparse Coding (SC), Local Coordinate Coding (LCC) and Local-Constraint Linear Coding (LLC).
- Local tangent-based methods [18] derive an exact description for each feature through approximating the Lipschitz smooth manifold where features are located. In this two methods are described such as Local Tangent Coding (LTC) and Super Vector Coding (SVC).
- Saliency-based methods [20, 21] encode each feature by the saliency degree, which is calculated using the ratio or the difference of the distances from a feature to its nearby codewords. In this, Salient Coding (SaC) and Group Salient Coding (GSC) are described.

Table 1: summary of Characteristics of Coding Methods

	Robustness	Adaptiveness	Accuracy	Independency
Voting	✓	—	—	—
Fisher Coding	✓✓	—	—	—
Reconstruction	—	✓	✓	✓
Saliency	—	✓	—	✓✓
Tangent	—	✓	✓✓	✓

From table 1, Tangent -based methods performs better than other feature coding methods. There are two tangent based methods such as Local Tangent Coding (LTC) and Super Vector Coding (SVC). Super vector coding (SVC) inherits the main characteristics of the original local tangent-based coding and runs much faster. So, SVC selected for proposed system.

5. PROPOSED SYSTEM

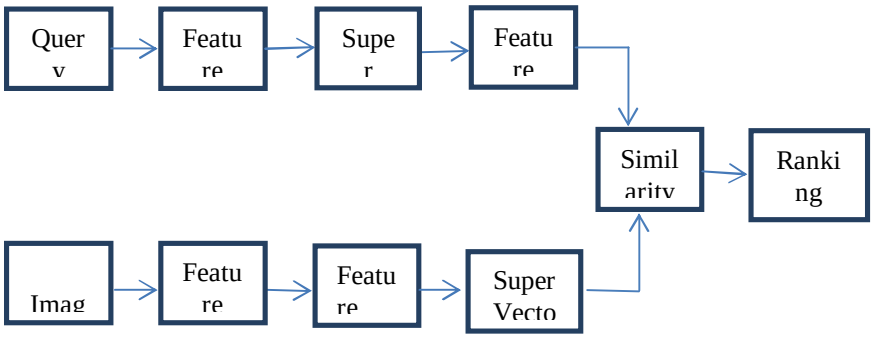

Figure 1: CBIR using feature coding (SVC)

In Proposed system, Content Based Image Retrieval (CBIR) system uses feature coding technique for image classification. As per paper [4], Super Vector Coding (SVC) is the best coding method among all the methods. In [22], using local visual descriptors a new framework i.e. SVC introduced for image classification. In this framework a non-linear feature transformation on descriptors performed, then aggregated the results together to form image-level representations, and finally a classification model applied. Novel solutions are suggested for these three steps which makes this approach more scalable in computation, and translucent in classification. This experiment determines that the anticipated classification method accomplishes the state-of-the-art accuracy on the distinguished PASCAL benchmarks. Each image represented by a set of local descriptors with their spatial coordinates. The descriptor can be any other local features or SIFT, which are computed from image patches at locations on a 2D grid. This image classification method consists of three computational steps:

1. **Descriptor coding:**

To form a high-dimensional sparse vector, each descriptor of an image is nonlinearly mapped. An innovative nonlinear coding method i.e. Super-Vector coding projected, which is algorithmic extension of Vector Quantization (VQ) coding.

2. **Spatial pooling:**

For each local region, to form a single vector, the codes of all the descriptors are aggregated. Then to form the image-level feature vector, vectors of different regions are concatenated. Pooling is based on a probability kernel incorporating the similarity metric of local descriptors

3. **Image classification:**

The normalized image-level feature vector fed into a classifier. The chosen Linear SVMs scale linearly to the size of training data. The work stresses the importance of learning good coding of local descriptors in the context of image classification, and makes the first attempt to formally incorporate the metric of local descriptors into distribution kernels. By placing all these together, the overall image classification framework relishes a linear training complexity, and also a great interpretability that is missing in traditional models. The most importantly, our method demonstrates state-of-the-art performances on the challenging PASCAL07 and PASCAL09 image classification benchmarks.

6. CONCLUSION

In this proposed work, content based image retrieval system is projected to overcome the problem of previous approaches. In this, CBIR developed using image classification approach, feature coding. We classify all the relevant and irrelevant images from feature database using feature coding technique. In this paper we use Super Vector Coding (SVC) for classification of various categories of image to find optimal result. This method is much better than the traditional method of image retrieval.

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