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Pattern Recognition Using Automatic Image Classification and Recognition Methods: A Literature Review

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Abstract

Extensive research and development has taken placeover the last 2 decades in the areas of pattern recognition and imageprocessing. Areas to which these disciplines have been applied include business, medicine, automation, military intelligence, communications, Industry and commerce and many others. Scale Invariant Feature Transform has attracted great attention in automatic image classification and Pattern recognition because of many of its advantages. This paper presents a review of recentdevelopments in pattern recognition methods in the field of image processing.

Keywords: Logo recognition, Image processing, Document retrieval, SIFT, Automatic image classification, Pattern recognition

Introduction

Automatic image classification and recognition is the research focus of the pattern recognition method in the field of image processing. Common used image features are color, shape and texture. Jain's boundary direction and Hu's invariant moment features, using template matching method to achieve recognition on the icon[1]; Eakins use circular features and the shape characteristics of the relative size and complexity to retrieve images[2]; Classification decision-making methods used in image recognition cover statistical decision-making, structural pattern recognition, fuzzy pattern recognition method and ANN method[3]. In recent years, support vector machines is proposed [4], this method can effectively solve the small sample, nonlinear and high dimensional pattern recognition problem. Wang Shoujue proposed a new theoretical model named biomimetic pattern recognition [5, 6]. Pattern recognition with local structure features and spatial topological relationship method iswith anti-jamming deformation in achieving good recognition results [7]. Comparison is made with the methods for effectiveness, versatility and better recognition results.

Image Classification and Recognition Methods

A. Shape based Retrieval

The Shape based Retrieval system achieves both desired efficiency and accuracy using two stage hierarchy: in the first stage, simple and easily computable shape features are used to quickly browse through the database to generate a moderate number of plausible retrievals when a query is presented: in the second stage, the candidates from the first stage are screened using a deformable template matching process to discard spurious matches. The proposed method matches filled-in query images against filled-in image from the database, thus using only the gross detail in the image. This method is robust under rotated, scaled and noisy versions of the database images [1].Effort needed for a manual retrieval from a large database, where as an automatic shape- based retrieval technique can significantly simplify the retrieval task.

Pros: An improved heuristic has been suggested for more accurate retrievals. This method is insensitive to variation in scale, rotation and translation.

Cons: It has no learning capability. It cannot improve its performance with time

B. Trademark images retrieval

Artisan system retrieves abstract trademark images by shape similarity. It analyzes each image to characterize key shape components, grouping image regions into families that potentially mirror human image perception, and then derives characteristic indexing features from these families and from the image as a whole. The evaluation is based on the retrieval effectiveness of the system onmore than 10,000 images from the UK Trade Marks Registry[2].This methods is general enough to handle any black and white image made up from a number

of regions with relatively from a well-defined boundaries.

Pros: Extension of earlier Content-based image retrieval system. This includes 2D engineering and architectural drawing and many clip art image as well as abstract trade mark images

Cons: This method is not capable of handling natural scenes or images, consisting mainly of areas of colors or textures with ill-defined boundaries. Not offering reliable enough performance.

C. Blind image deconvolution

Adaptive blind image deconvolution scheme based on fuzzy K-nearest neighbor (FKNN) algorithm is well known that, most point- spread functions (PSFs) satisfy up to a certain degree of parametric structure.The method estimates the blurring function througha process of neighbor generation, model matching, and fuzzy weighted mean filtering. The algorithm constructs the fuzzy modelset using the MAP (Maximum a posteriori)estimator. Thisfurther improves the convergence performance in blind deconvolutionprocess [3].Image restoration is an inverse process that attempts to estimate the original image from the degraded image.

Pros: It is effective in restoring degraded images where there is little prior knowledge about the blur.It is superior to AM (Alternating Minimization) in handling different parametric blurs.

Cons: The fuzzy blur estimate can be computed by the fuzzy weighted mean filtering and the performance can be enhanced as FKNN by providing robust estimate of the blur images.

D. Statistical Learning theory

Statistical learning theory includes both theoretical and algorithmic aspects. The goal of this overview is to demonstrate how the abstract learning theory establishes conditions for generalization which are more general than those discussed in classical statistical paradigms and how the understanding of these conditions inspired new algorithmic approaches to function estimation problems. This made statistical learning theory not only a tool for the theoretical analysis but also a tool for creating practical algorithms for estimating multidimensional functions [4].

Pros: It can be applied for various function estimation problems including regression, density estimation, solving inverse equations and so on. Mathematical results in statistical learning theory have a direct impact on algorithmic tools of data analysis.

Cons: It's a generalized approach.

E: **Logo retrieval**

Logo retrieval introduces a system architecture which aims at segmentation-free and layout-independent logo detection and recognition. Along with the unique logo feature design, a novel way to ensure the geometrical relationships among the features, and different optimizations in the recognition process, this system can achieve improvements concerning both the recognition performance and the running time. It is an effective approach on several sets of real-world documents and demonstrates the effectiveness of approach. Thissystem aims for a fast, segmentation-free and layout-independent logo detection and recognition on document images with three major contributions. First, a generic feature-based recognition scheme was put forward. Secondly, introduction of two kinds of logo features, shape descriptors of the connected components and line profiles which are simple and representative. Thirdly, a new concept named anchor line was introduced, which provides a novel way to reconstruct logo prototypes [5].

Pros: It is an effective approach for automatic logo detection and recognition. This approach can even work on text in the document images and achieve improvements concerning both recognition performance and running time.

Cons: By using the SIFT features, better performance can be achieved.

F:**Document Image Retrieval**

This presents a scalable algorithm forsegmentation free logo retrieval in document images. Thecontributions include the use of the SURF feature for logoretrieval, a novel indexing algorithm for efficient retrieval anda method to filter results using the orientation of local featuresand geometric constraints [6].

Pros: Logo retrieval can be performed with high accuracy and efficiently scaled to a large datasets.

Cons: Database size can be expanded to compare the performance of image retrieval to OCR.

G: Local structure and Topological relationship

From the perspective of human cognition and bio-mimetic pattern recognition principle, analyzing things local structural feature and the overall topological relationship is achieved by using ANN(Artificial Neural Network) and HMM(Hidden Markov Model). This method proposes a common pattern recognition method with a strong anti-interference and resistance to deformation reflects the characteristics of things which are similar to human cognition [7].

Pros: It achieves better effectiveness, versatility and recognition result by using slide window to construct spatial topological relationship. Hybrid model of ANN and HMM is used for local and global modeling

Cons: SIFT (Scale Invariant Feature Transform) can be incorporated into this work to enhance the

recognition rate and make this method more universal.

H: Texture Classification and Retrieval

Texture images can be characterized with key features extracted from images. The scale invariant feature transform algorithm is utilized to generate local features for texture image classification. The local features are selected as inputs for texture classification framework. For each texture category, a texton dictionary is built based on the local features. An adaptive mean shift clustering algorithm is run with all local features to generate key features (called textons) for texton dictionary. The texton dictionaries among texture categories are supposed be distinctive from each other to provide a highest performance in term of classification accuracy. The results indicate a high classification accuracies achieved [8].

Pros:SIFT algorithm and a framework for texture classification isused to achieve high classification accuracies is achieved.

Cons: The classification framework suffer with a big computational complexity

Conclusion

The above review describes various methods of automatic image classification and recognition. Above mentioned various methods have their own limitations. SIFT (Scale Invariant Feature Transform)is the research focus of the pattern recognition method in the field of image processing that has numerous key features that opens up unbounded horizons in automatic image classification.

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