Novel System for Color Logo Recognition Using Optimization and Learning Based Relevance Feedback Technique

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ABSTRACT

Logo recognition system deals with matching of the input trademark or logo with stored trademark images in database. This application, under CBIR umbrella, focuses on optimizing search through database by extracting minimum features from set of the images and using relevance feedback mechanism to identify the relevant images. Obtaining higher accuracy in retrieval process is the main challenge of the work. The retrieval results of CBIR system can be enhanced by using machine learning mechanisms with relevance feedback for Short Term Learning (STL) and Long-Term Learning (LTL). This paper proposes the relevance feedback system embedded with machine learning and optimization technique for logo recognition. Relevance feedback technique is used as baseline model for logo recognition. Feature set is optimized using particle swarm optimization (PSO) and search process is made intelligent by incorporating self-organizing map (SOM). These techniques improve the basic model as depicted in the results.

KEYWORDS

Content-Based Image Retrieval (CBIR), Feature, Logo, Particle Swarm Optimization, Relevance Feedback, Self-Organizing Map (SOM)

1. INTRODUCTION

Logo image retrieval is one of the applications under Content Based Image retrieval (CBIR) system. Content based image retrieval (CBIR) is image search in account of user’s interest based upon visual contents of an image. Most of the retrieval based CBIR applications entail image searching, image matching and image retrieval. Main challenge lies in converting high level semantic content of an image interpreted by humans to low level feature representation. Broad range of applications with these challenges in CBIR has created significant scope for research in pattern matching, recognition and retrieval of images in the system. An exhaustive database of existing logo image is generated which stores color, shape and texture parameters of image in form of feature vector. Query image is submitted to the system; features are extracted and matched with the features set of stored images. These extracted features dataset might contain some irrelevant and redundant features, not useful in
the retrieval process. Hence, feature set is optimized and retrieval accuracy is improved using Particle Swarm Optimization (PSO) technique.

Particle Swarm Optimization (PSO) is an optimization technique which uses a parallel search of multiple points that are altered inside the search space. PSO can be used to resolve different optimization problems as it is a population-based optimization technique. The advantage of PSO is its fast convergence when compared with other optimization techniques (Kameyama et al., 2006). This optimized database feature set is trained using the ANN based training i.e. Self -Organizing Map(SOM). The Self-Organizing Map is an unsupervised learning technique. The nonlinear mapping of a high-dimensional input space into two-dimensional grid of artificial neural units is the important property of Self Organizing Map. During the training phase of SOM, a topological map is formed which involves the mapping of input vectors near to each other in close by map units (Laaksonen et al., 2001). Feedback is taken from the user about the relevancy of the images retrieved by the Content Based Image Retrieval (CBIR) system called as Relevance Feedback (RF) (Pinjarkar et al., 2012; Su et al., 2011). The information from the feedback is used for the improvement of the query. The query improvement process has helped to improve the results of the image retrieval system in terms of image recognition.

Different learning mechanisms suggested by various researchers reduce the semantic gap between the low-level features and user perception of the images (Datta et al., 2008; He et al., 2003). Two types of learning mechanisms are: 1) Short term learning (STL) or intra query or in-session learning 2) Long Term learning (LTL) or inter query learning.

When RF information of a query is used for the query improvement process, it is termed as STL. When this information is maintained in the form of logs and is utilized to enhance the retrieval results of the next query sessions, it is termed as LTL (Hoi and Michael, 2004, Li and Allinson, 2008).

STL is implemented in query improvement phase of relevance feedback for a given query. Over the time, log of feedback information is maintained to deduce the navigation pattern by using LTL. This Relevance feedback algorithm has helped to bridge the semantic gap between the low-level features and user perception. The incorporation of optimization and machine learning technique at preprocessing stage has narrowed the search space and hence has reduced the computation complexity of the proposed framework, resulting in less processing time. The organization of the paper is as follows. Work done in this area is discussed in Section 2. The proposed approach and details about dataset used are presented in section 3. Section 4 analyses experimentation results and section 5 concludes the paper.

2. RELATED WORK

K. Kameyama et al. (2006) have suggested an approach using Particle Swarm Optimization (PSO) for tuning the parameters included in the relevance evaluation algorithm of a CBIR system, by optimizing them according to the appropriateness of the retrieved results. J. Laaksonen et al. (2001) have proposed self-organizing maps (SOMs) as a relevance mechanism for Content-Based Image Retrieval (CBIR). They have proposed the PicSOM CBIR system which illustrate the use of SOMs as a relevance feedback method. Rusiniol et al. (2011) suggested an efficient queried-by-example retrieval system for trademark images containing 30000 trademark images. Zhenhai Wang and Kicheon Hong (2012) have proposed a trademark retrieval algorithm combining the image global features and local features. Zernike Moments were extracted and sorted on the basis of similarity. The standard image set “MPEG7 CE Shape-2 Part-B” of 3621 trademark images was used as an image database. M. Bagheri et al. (2013) have suggested a system based on shape
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