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Efficient Retrieval of Face Image from Large Scale Database Using Sparse Coding and Reranking

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Abstract: ***Due to largely mounting of photo sharing in social network services, there is a strong need for large scale content-based face image retrieval which is enabling device for many emerging applications. It is very exigent to find a human face image from large scale database which might hold huge amount of face images of people. Existing methods regulate the location and illumination differences between the faces and abolish background contents while retrieving face images, which leads to decline the important context information. This paper intends to utilize automatically discovered human attributes that contain semantic signs of the face photos to recover large scale content-based face image retrieval. In this paper two methods are used to develop image retrieval in both offline and online stages, they are attribute-enhanced sparse coding (ASC) and attribute-embedded inverted indexing (AEI). Reranking is further used with these two methods to attain significant retrieval outcome. Proposed system exploits automatically discovered human attributes which balance the information loss and attain good retrieval performance compared to existing system.***

Keywords: Content-based image retrieval, face image, human attributes, sparse coding, reranking

1. Introduction

The unpredictable expansion of image data escorts to the need of explore and enlargement of Image Retrieval. Image retrieval is the field of study concerned with searching and retrieving digital images from a collection of database. However, Image retrieval survey moves from keyword, to low level features and then to semantic features. Compel towards semantic features is due to the problem of the keywords/text which can be much distorted and time consuming while low level features cannot always describe high level notions in the users' mind.

Large scale image search has recently fascinated significant attentiveness due to easy accessibility of huge amount of data. Since databases enclose even billions of samples, such large-scale search insists extremely efficient and precise retrieval methods. CBIR has many applications in different areas. For example, in forensics, it can help with crime investigation. The objective of face image retrieval is to resolve the ranking result from most to least related face images in a face image database for a specified query. For large scale datasets, it is essential for an image search application to rank the images such that the most relevant images are sited at the top.

However, all present CBIR systems tolerate deficient generalization performance and accuracy as they are not capable to produce a flexible relation between image features and high-level concepts. Earlier schemes employ low level features (e.g., texture, color, shape) to retrieve image, but low level features doesn't afford semantic descriptions of face and human face images generally consists of high level features (e.g., expression, posing). Therefore, retrieval results are intolerable as shown in figure 1.

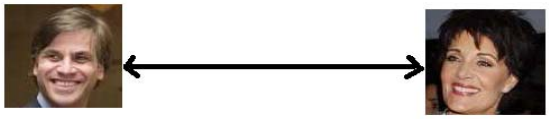

Figure 1: Two different people face images might be similar in low level feature space due to lack of semantic description.

To deal with this problem, two methods are proposed named attribute-enhanced sparse coding (ASC) and attribute-embedded inverted indexing (AEI). In this paper, low level features are integrated with high level attributes which provide semantic descriptions. Reranking is further used with these two methods to discard forged images and retrieve specific image results.

2. Related Work

This thesis is interrelated to different research fields, including CBIR, automatic discovery of human attributes and sparse coding. Content-based image retrieval (CBIR) has concerned significant deliberation over the past decade. Instead of taking query words as input, CBIR techniques directly take an image as query and seek to return similar images from a large scale database. Before CBIR, the conventional image retrieval is typically based on text or keywords. Keyword-based image retrieval has some boundaries, they are: Language and civilization variations always cause problems, the same image is usually text out by many different ways, Mistakes such as spelling error or spell difference escort to totally different results.

In order to conquer these restrictions, CBIR was first introduced by Kato [1]. The term, CBIR, is widely used for retrieving desired images from a large collection, which is based on extracting the features from images themselves. In general, the purpose of CBIR is to present an image

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conceptually, with a set of low-level optical features such as color, texture, and shape [2].

One major difficulty when creating CBIR system is to make a system general-purpose. CBIR for common function image databases is a highly exigent problem because of the enormous volume of the databases, the obscurity of accepting images both by people and computers, and concern of evaluating results properly. All these methods endure from low recall problems due to semantic gap. Semantic image presentations were initiated to bridge this semantic gap. In this paper, automatic discovery of human attributes are used to construct sparse codewords for face image retrieval operation, instead of using identity information which necessitate manual interpretation.

3. Problem Definition

Several schemes were introduced for face image retrieval, but all these techniques endure with some limitations. Previous mechanisms for face image retrieval stabilize the location and lighting differences between the faces and prohibit background contents. Such common approaches give up the important context information. Using automatic discovery of human attributes it is possible to balance such information loss. Existing methods uses low level features for face retrieval that have lack of semantic descriptions about face which escorts to poor results. Also all current retrieval systems struggle with low recall problems which diminishes the performance of the system. By concerning all these factors, this paper proposes two methods (ASC, AEI) which detect the human attributes automatically to resolve recall problems. Reranking method is united with these two methods to boost up system performance.

4. Proposed System

This paper intends to employ automatic discovery of human attributes which contains semantic signs of face image for efficient large scale face image retrieval. To improve CBIR two methods are used named ASC and AEI that combines low level features with high level concepts to afford semantic descriptions of face. Another technique named reranking is used with these two methods to improve the performance of retrieval system.

For each image in the database, initially apply Viola-Jones face detector [3] to discover the pose of faces. Active shape model [4] is applied to trace facial landmarks on the image. By using these facial landmarks, next align every face in the image with the face mean shape [5] using barycentric coordinate based mapping process. For each identified facial part, take out grids, each grid is represented as a square patch [6]. Extract an image patch from each grid and examine LBP feature descriptor as a local feature. After attaining local feature descriptors, quantize all descriptors into codewords by attribute enhanced sparse coding.

Attribute embedded inverted index is then construct for efficient retrieval. When a query image appears, it will experience the same procedure to attain sparse codewords and human attributes, and these codewords are used with binary attribute signature to retrieve images from large scale database, if those retrieving images contain forged images then apply reranking method to evade those forged images. Figure 2 demonstrate the framework of our system.

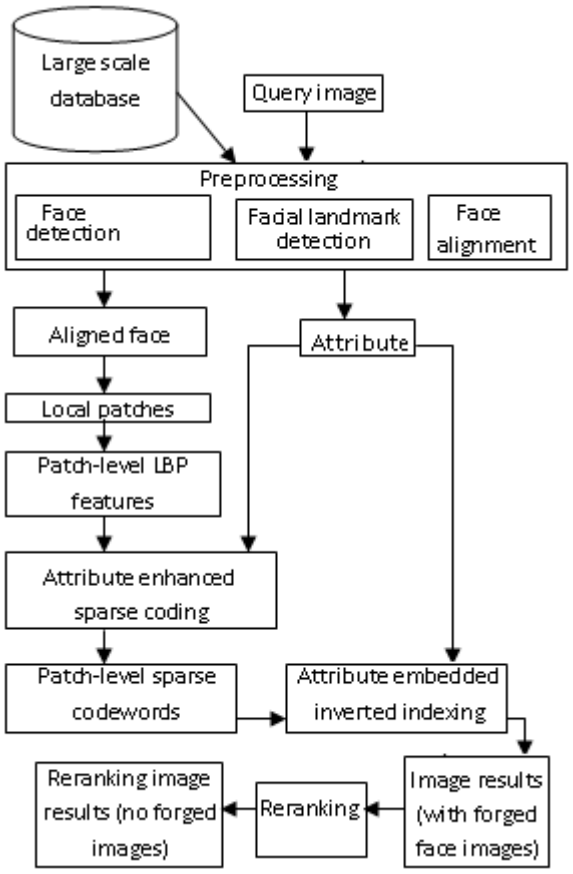

Figure 2: proposed system framework

4.1 Attribute Enhanced Sparse Coding (ASC)

The attribute-enhanced sparse coding is used in offline stage which describes the automatic detection of human attribute from the image and also generates the codewords to the image in the database by combining the low level features with high-level attributes to give semantic description about the face. By incorporating low level and high level attribute it is possible to get promising result to retrieve similar faces from large scale database.

4.2 Attribute Embedded Inverted Indexing (AEI)

In on-line image retrieval, the user can submit a query image to the retrieval system to search for desired images. Retrieval is performed by applying an indexing scheme to afford an efficient way of searching the image database. In the end, the system indicates the search results and then returns the results that are related to the query image. Attribute embedded inverted indexing collects the sparse codewords from the attribute- enhanced sparse coding and check the codewords with the online feature database and retrieve the related images similar to the query image.

4.3 Reranking

The fundamental proposal of reranking is to evade forged images present in database. A human face image employs

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very light and compulsive global signatures, so using reranking we can improve the accuracy but without trailing the scalability. Human images contain discrepancies provoked by changes in pose, expression, and illumination, taking all these intra-class variations into account, a technique called reranking is used to elude such discrepancies. Reranking is applied to set of retrieved human face images to evade forged images. Reranking technique is vibrant to erroneous images. Below figure shows how forged images are rejected after applying reranking method.

5. Experimental Results

We estimate and visualize results using real examples. Figure 3 illustrates the results of ranking images. Red boxes in the figure specify forged images. After using the reranking method majority of images are correct. In figure 4 the graph demonstrates how efficient the image retrieval is in the proposed method. In proposed system individual attribute detection can be done within few milliseconds, because here we are using automatic attribute detection.

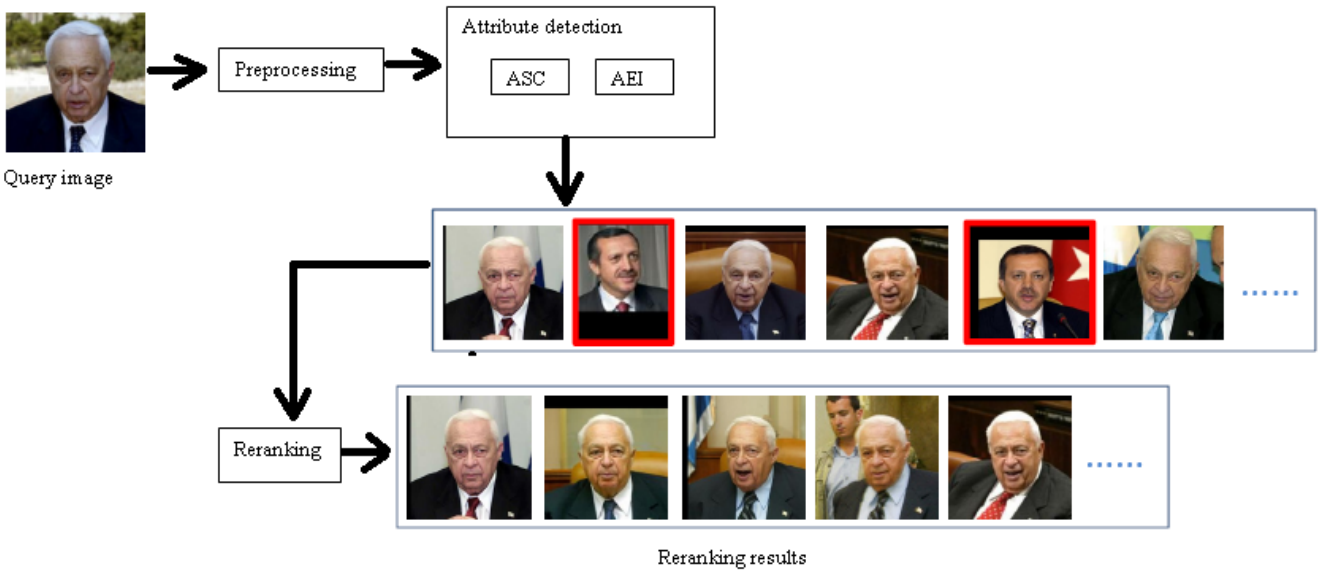

Figure 3: Reranking Image Results

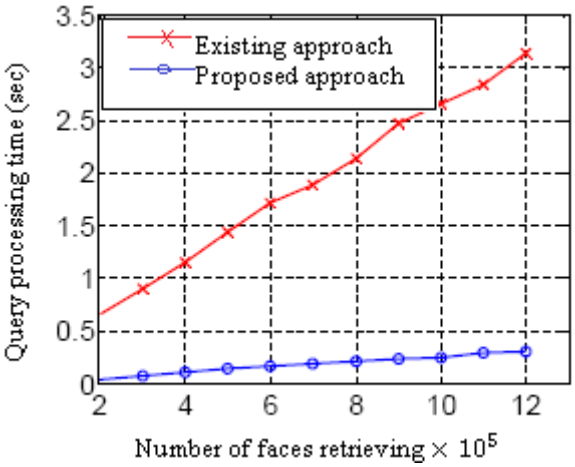

Figure 4: Query processing time per image

6. Conclusion

All current image retrieval systems standardize the position and illumination variations between the faces and abolish background contents while retrieving face images, which escorts to refuse the vital context information. In this paper, two schemes are projected and united to extend automatically detected human attributes to extensively develop content-based face image retrieval. This is the primary idea of uniting low-level features, high level attributes and automatic discovery of human attributes for content-based face image retrieval. Attribute-enhanced sparse coding is used in the offline stage and present semantic descriptions of face. Attribute-embedded inverted used in the online stage and ensures image retrieval. Finally, reranking method is used to discard forged images and obtain accurate image results.

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