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AUTOMATIC FACE ANNOTATION BY FEATURE BASED CLUSTERING ON WEAKLY LABELED FACIAL IMAGE

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ABSTRACT

An annotation can be referred to as metadata attached to text, image, or any other type of data, or a specified part of the actual data. In the digital imaging the term annotation is commonly used for visible metadata superimposed on an image without changing the underlying original image. Auto face annotation means labeling a human facial image automatically. It is beneficial to a number of real-world applications such as , social networks that can automatically annotate users' uploaded photos to facilitate online photo search and management tasks. This paper investigates the search based face annotation technique and a feature base clustering approach to perform annotation effectively.

Keywords— Annotation, Web Database, weakly labeled image.

INTRODUCTION

Data mining is the interdisciplinary subfield of computer science. It can be defined as analysis step of the "Knowledge Discovery in Databases" process, or KDD, and it is the procedure of discovering information in large data sets involving methods at the intersection of artificial intelligence, machine learning and database systems. Or it is defined as the automated discovery of previously unknown, essential and useful information from databases. The overall goal of the data mining process is to extract information from a data set and transform it into an understandable structure for further use. It involves database and data management aspects, data pre-processing etc.

Knowledge Discovery has been applied effectively to solve different problems. Examples include discovering rules of mass spectrometry from spectrogram data, assessment of credit card applicants , discovering rules for query optimization, diagnosing diseases from medical data , inferring risk profiles of insurance policy holders , and so on.

Image Mining can be defined as digging or mining images from huge databases. It focuses on pattern extraction, image data relationship, implicit knowledge which is not found in the images from databases or image collections. Image retrieval, data mining, image processing and

artificial intelligence are some of the methods used to obtain knowledge. These methods allow image mining to have two different approaches.

- To extract only from databases or image collections.
- Mines an abstraction of alphanumeric data and collections of image collections.

There are two major issues that will affect the image data mining process.

- The similarity matching process.
- The generality of the application area, that is, the breadth of usefulness of data mining from a practical point of view.

With image mining, considers four problematic areas associated with data mining: finding associations, sequential patterns, classification, and time series patterns. Automatic image annotation (also known as automatic image tagging or linguistic indexing) is the process by which a computer system automatically assigns metadata in the form of captioning or keywords to an image. This properties of computer vision techniques is used in image retrieval systems to organize and locate images of interest from a database. Automatic face annotation is beneficial to many applications. For example, with auto face annotation techniques, online photo-sharing sites[1] (e.g., Facebook) can automatically annotate users' uploaded photos to facilitate online photo search and management. Also, face annotation can be applied in news video areas to identify famous persons appeared in the videos to facilitate news video retrieval and summarization tasks [2].

Automatic face annotation is the automatic labeling of the human facial image. Lot of studies have been performed in this area. Classical face annotation methods [3] are treated as an extended face recognition problem, where it trains different classification models from a collection of well labeled facial images by employing the supervised or semi-supervised machine learning techniques [4]. But the "model-based face annotation" [5]techniques have certain limitations, in which they are time-consuming and expensive to collect a large amount of human-labeled training facial images.

RELATED WORKS

A. Graph Based Approach

First D. Ozkan et al. proposed a graph based method [6] to find the most similar subset of images among the set of possible faces associated with the query name. The most similar subset is likely to correspond to the faces of the queried person. When the similarity of faces is represented in a graph structure, the group of most similar faces will be the densest component in the graph. Represent the similarity of faces using SIFT (Scalable Invarient Feature Transform) descriptors [7]. The matching interest points on two faces are decided after the application of two constraints, known as geometrical constraint and the unique match constraint. The average

distance of the matching interest points are used to construct the similarity graph. The most similar group or set of faces is then found based on a greedy densest component algorithm**.**

The method proposed in this paper is not a solution to the general face recognition problem. Rather, it is a method to increase the retrieval performance of the person queries in the large datasets where names and faces appear together and where traditional face recognition systems cannot be used. It does not require a training step for a specific person and, there is no limit on the number of people queried.

B. Partial clustering and interactive labeling approach

Y. Tian et al.[8] proposed an interactive face annotation framework using unsupervised and interactive learning. There are two main contributions in this framework. In the unsupervised stage, a partial clustering algorithm is proposed to find the most evident clusters instead of grouping all instances into clusters, which leads to a better initial labeling for later user interaction. In the interactive stage, an efficient labeling procedure based on minimization of both global system uncertainty and estimated number of user operations is proposed to reduce user interaction as much as possible. The partial clustering algorithm automatically groups similar faces into several evident clusters, and groups dissimilar faces into a background cluster, called the litter-bin. After the partial clustering stage, uses an initial labeling procedure to annotate the retrieved clusters. Since faces in an evident cluster most likely belong to a single individual, user annotation interactions on these clusters can be significantly reduced. However, the workload of face annotation in the litter-bin is still huge.

Pair wise face similarity is important for overall performance improvement. This depends on discriminative facial features and stronger inferring from contextual information. The methods of partial clustering is not fully automatic. The major disadvantage of this work is that it requires users to annotate photos one by one. All the errors in the clustering need to be corrected one by one by the user. This system adopts a two-stage framework including a clustering stage and an interactive stage. It would be better to integrate the whole system in a compact way, thus eliminating user operations as much as possible.

C. Weak label regularized local coordinate coding approach

D. Wang, et al. [9] proposed a retrieval-based face annotation, a promising method in mining huge web facial images for automated face annotation. This annotation paradigm usually has two key challenges.

(i) How to efficiently retrieve a short list of most similar facial images from facial image databases

(ii) How to effectively perform annotation by exploiting these similar facial images and their weak labels which are often noisy and incomplete.

The method of WLRLCC algorithm mainly focus on tackling the second challenge of the retrieval-based face annotation paradigm. For this, they proposed an effective Weak Label Regularized Local Coordinate Coding (WLRLCC) technique, which uses the local coordinate coding principle in learning sparse features, and mean while employs the graph-based weak label regularization principle to enhance the weak labels of the short list of similar facial images.

The WLRLCC algorithm is limited by the discriminative ability of features; it would achieve a better performance on a special type of image annotation than generic image annotation problem.

D. Search Based Face Annotation

D. Wang et al.[10] proposed the framework of search-based face annotation (SBFA) which is implemented by mining weakly labeled facial images that are freely available on the internet. One challenging problem for search-based face annotation scheme is how to accurately perform annotation by exploiting the list of most similar facial images and their weak labels that are mostly noisy and incomplete. As a solution to this problem, they proposed an effective unsupervised label refinement (ULR) approach for refining the labels of web facial images using machine learning techniques. And formulated the learning problem as a convex optimization and develop effective optimization algorithms to solve the large-scale learning task efficiently.To further enhance the proposed scheme, also proposed a clustering-based approximation algorithm which can improve the scalability considerably. Despite the improved results, it has limitations in several aspects.

1. Assumed each name corresponds to a unique single person. Duplicate name can be a common problem in real-life scenarios.

2.The ability of CBA algorithm may be limited .

3. The Clustering Based Algorithms are still time consuming for handling large scale facial image database.

FEATURE BASED CLUSTERING AND SBFA APPROACH

In order to improve the clustering performance and to reduce the time consumption, we are proposing a new method for the clustering process. The steps included are

- Facial image data collection
- Face detection and facial feature extraction
- Clustering of facial feature points
- Face annotation

A. Facial image data collection

Search for a collection of facial images from the web by an existing web search engine (i.e., Google) according to a name list that contains the names of persons to be retrieved. As the output of this crawling process, obtains a collection of facial images, each of them is corresponding to some human names. These facial images are often noisy, which do not always correspond to the correct human name. Such kind of web facial images with noisy names known as weakly labeled facial image .

B. Face detection and facial feature extraction

This step extracts face-related data from the facial images, including face detection and facial region extraction. For face detection and facial features extraction, we adopted OpenCV toolbox, which is an open source tool contains algorithms for face detection and facial feature extraction. Using OpenCV toolbox, 66 feature points are obtained from a facial image and are stored in our database.

C. Clustering of facial feature points

When the feature points are extracted and saved to the database, next step is to cluster or group the obtained data according to the similarity. The facial feature points are represented as (x,y) coordinates. From the 66 feature points extracted, choose only the maximum (x,y) and minimum (x,y). These attributes are used for the clustering process. The images having similar coordinates are clustered together. When a query image is given for annotation, its feature points are extracted and saved to the database. From these points, the maximum and minimum attributes are chosen and compares with each of the existing groups. So that, form a matrix of containing number of columns same as number of existing groups, which indicates each groups. Initialize the matrix as zero. Then compare attribute values of query image with the existing group. If there exist any similarity in the attributes increment the value of new matrix by one. Finally, obtains a matrix by comparing the attribute values and the finds the column of matrix having maximum value. it indicates that the query image have greater affinity towards that group.

D. Face annotation.

Group having more affinity towrds the image is obtained by similarity checking. After finding the group or cluster of the particular image, annotation can be performed

PROPOSED ALGORITHM

Feature based clustering algorithm

Let G_1, G_2,..., G_n be the clusters, where each cluster contains *m* similar images with different poses

for *i*= 1 to *n*

for *j*= 1 to *m*

Retrieve all the feature coordinates (x_k, y_k) of each image in G_i

Select Max(x_k, y_k) and Min(x_k, y_k) of each I_j for each feature from those *m* similar images.

Generate the feature matrix M_k with the attribute Max(x_k), Max(y_k), Min(x_k) and Min(y_k).

end for

end for.

Image annotating procedure

Input: Query image

Output: Annotated image

For the query image , retrieve all the feature coordinates (x_k, y_k)

Generate the feature matrix

Initialize the Affinity_matrix A[*j*,1] with all values zero, where each row corresponds to the

Feature matrix for *j*= 1 to *n*

Compare (x_k, y_k)) with max(x_k, y_k)) and min(x_k, y_k))

if Compare (x_k, y_k) lies between max(x_k, y_k)) and min(x_k, y_k)) then, A[*j*,1]= A[*j*,1]+1

Find Max(A[*j*,1]) , which corresponds to image where $q \leq n$

Then it has maximum similarity with the cluster .

Label the query image with label of selected image. .

EXPERIMENTAL RESULTS

For the experimental analysis, we collected the human facial image with varying pose and illumination from the web. These images are stored in a file by giving corresponding names. The files contain multiple images of same person. After that, OpenCV toolbox is used to detect the faces. The non detected faces in this step will be ignored.

The proposed method takes all the 66 facial features for the analysis, while the old method of k means algorithm one takes only 6 features. All facial feature point can be represented as X and y coordinate and all that contains maximum and minimum point. The attributes 'Attrib 1 Min', "Attrib 1 Max', 'Attrib 2 Min', 'Attrib 2 Max' shows the X and Y coordinates of all the maximum and minimum points of facial features. The distance from the middle portion of face to its corresponding left and right parts is taken.

No. of facial image	Detected image		Time taken(sec)	
	K means Clustering approach	Feature Based Clustering approach	K means Clustering approach	Feature Based Clustering approach
180	160	175	28	15
315	220	280	40	16
427	290	365	68	16
469	340	420	73	30
531	400	470	83	32
585	480	530	92	32
709	580	621	110	47
750	620	655	143	52

Table:1 Evaluation of auto face annotation using K-means clustering and feature based clustering

When a query image is given, performs the process of clustering mentioned in the third step of the proposed method. After clustering we filter all the groups having affinity towards the given query image. And select the group having the maximum affinity value. Then annotate the image with the name of that particular group or person in that group. The experiments are conducted based on the time consumption of both the previous method of k-means clustering and proposed feature based clustering method.

Table 1 shows the evaluation result of the proposed method, which is compared with the existing K-means approach.

Fig.1 shows the detection rate of both the existing and proposed algorithms when the number of data increases. The X-axis shows the number of images and Y-axis shows the percentage of image detection.It show that the detection rate increases when the size of dataset increases. ie; the rate of occurrence of error decreases when number of images per person increases. And the proposed method is better than the previous method.

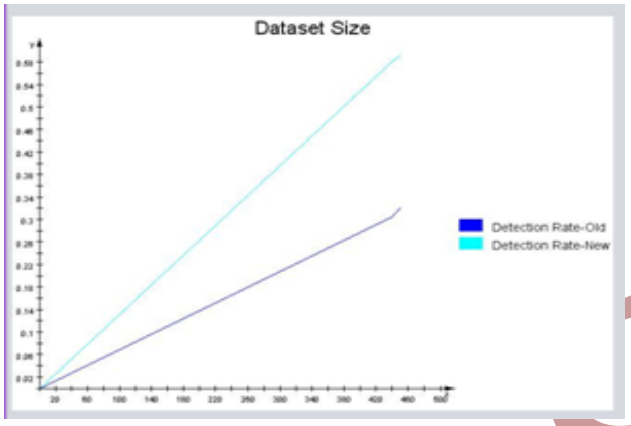

Fig. 1. Detection Rate

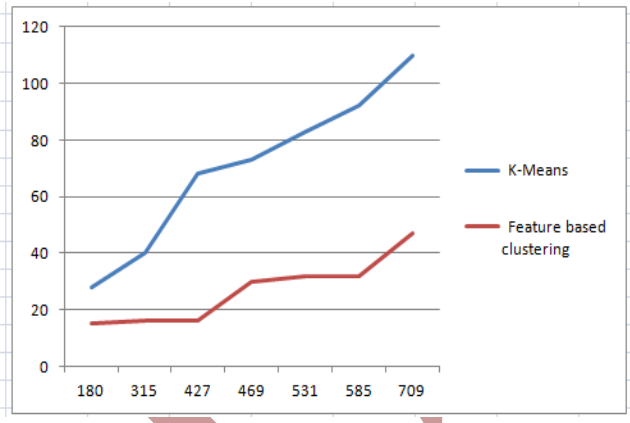

Fig 2. Time Consumption Analysis

From the experiments conducted using k-means clustering and feature based clustering, the results showed that the time consumption significantly reduced in the proposed feature based clustering. Fig 2 shows the time consumption of both the algorithms. The X-axis shows the number of images and Y-axis shows the time(seconds)

CONCLUSION

This paper investigated a new method of clustering facial features and search-based face annotation framework, it mainly focused on tackling the critical problem of enhancing the label quality . To further improve the scalability, proposed a clustering-based approximation solution,

which successfully accelerated the optimization task without introducing much performance degradation. From an extensive set of experiments, it is found that the proposed technique achieved promising results under a variety of settings. The experimental results also indicated that the proposed clustering technique significantly reduce the time for clustering and annotation and improves the annotation accuracy and decrease in error rate.

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