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Automated Face Annotation using Machine Learning Techniques for Refinement of Weak Labelled Images

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Abstract— Face annotation is the process of naming a person through his photo or person involved in video chat. Face annotation in images and videos enjoys many potential applications in multimedia information retrieval. Face annotation usually requires many training data labelled by hand in order to build effective classifiers. The complexity in face annotation is how to effectively perform annotation by identifying the person face. We propose Search/Query based face annotation scheme. First we retrieve a shortlist of Top k most similar images from weakly labelled image database. Then annotate the image by mapping image to the similar images that exist in image database. We use clustering based approximation algorithm to improve the scalability.

Keywords— Face annotation, weakly labelled images

1. Introduction

Due to the popularity of various digital cameras and the rapid growth of social media tools for internet-based photo sharing, recent years have witnessed an explosion of the number of digital photos captured and stored by consumers. A large portion of photos shared by users on the Internet are human facial images. Some of these facial images are tagged with names, but many of them are not tagged properly. This has motivated the study of auto face annotation, an important technique that aims to annotate facial images automatically.

Auto face annotation can be beneficial to many real world applications. For example, with auto face annotation techniques, we can identify criminal through his photo. Besides, face annotation can also be applied in news video domain to detect important persons appeared in the videos to facilitate news video retrieval and summarization tasks.

The existing object recognition techniques are used to train classification models from human images or an attempt to infer the correlation/ probabilities between images.

Presently Model based annotation uses similarity graph with random principles. The problem with existing solution is difficult to generalize when new persons are added. Scalability degrades when the size of the database is high.

Our framework mainly aim to assign a correct name labels to a given query facial image. We use Clustering Based Approximation to achieve scalability in identifying the person when there is more number of images exists in the database.

2. Related Work

Our work is closely related to several groups of research work. The first group of related work is on the topics of face recognition and verification, which are classical research problems in computer vision and pattern recognition.

The second group is about the studies of generic image annotation. The classical image annotation approaches usually apply some existing object recognition techniques to train classification models from human-labelled training images or attempt to infer the correlation/probabilities between images and annotated keywords. Traditional method uses Transductive Kernel Fisher Discriminant (TKFD) scheme,

The third group is about face annotation on personal family/social photos. The number of persons/classes is usually quite small, making such annotation tasks less challenging. These techniques usually achieve fairly accurate annotation.

In this project, first step is to collect images and store it to the database. The user will upload the query image and it retrieves a similar set of images. Then annotation is performed and then finally we compute face annotation performance.

3. Query/Search Based Face Annotation

The proposed framework consists of the following steps:

1. Facial Image Data Collection
2. Face Detection and indexing
3. User querying the image.
4. Similar facial image retrieval.
5. Face annotation
6. Analyzing the performance of face annotation scheme.

The First two steps are conducted before the face annotation. The First step we will collect the facial images. The second step is to face detect and indexing the facial features by using Locality Sensitive Hashing.

The third step user may upload the image and then similar set of images are retrieved and then annotation is also performed.

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Query Based Image Retrieval (QBIR) is implemented to provide the image based on the given person name.

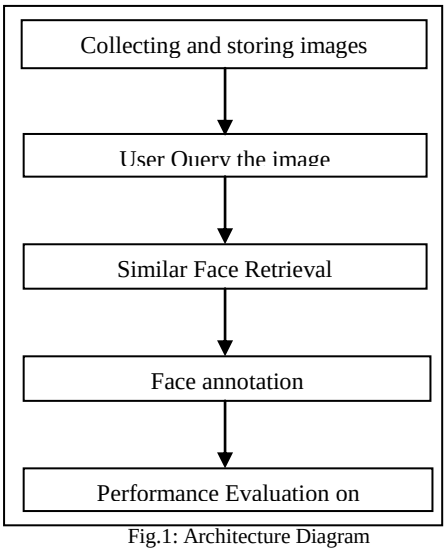

Fig.1: Architecture Diagram

4. Unsupervised Label Refinement by Learning on Weakly Labeled Data

4.1 Preliminaries

We denote by $X \in R^{nxd}$ the extracted facial image features, where n and d represent the number of facial images and the number of feature dimensions, respectively. Further we denote by $\Omega = \{n1; n2; \ldots; nm\}$ the list of human names for annotation, where m is the total number of human names. We also denote by $Y \in [0,1]^{nxm}$ the initial raw label matrix to describe the weak label information, in which the ith row Y represents the label vector of the ith facial image . In our application, Y is often noisy and incomplete. In particular, for each weak label value Yij, $Yij \neq 0$ indicates that the ith facial image xi has the label name nj, while $Yij \neq 0$ indicates that the relationship between ith facial image xi and jth name is unknown.

4.2 Bisecting K-means Clustering Based Approximation Algorithm

Input: $C \in R^{mxm}$, $q_c \in N$, $I_{loop} \in N$.
Output: Clustering result list L_{list}.
Add M_o to L_{list}; /* $M_{o\ contains}$ all the points */
Repeat
  Remove the largest cluster M_1 from L_{list};
  for **i**=1 to t do
    Bisect M_1 to $M_1^{(i)}$ from L_{list};
    Compute Sum of Squared Error (SSE_i);
 Select the result with the lowest SSE_i value;
  Add $M_1^{(i)}$, $M_2^{(i)}$ to L_{list};
Until $|L_{list}| = q_c$;

5. Experiments

The following Chart shows the Face Annotation Performance.

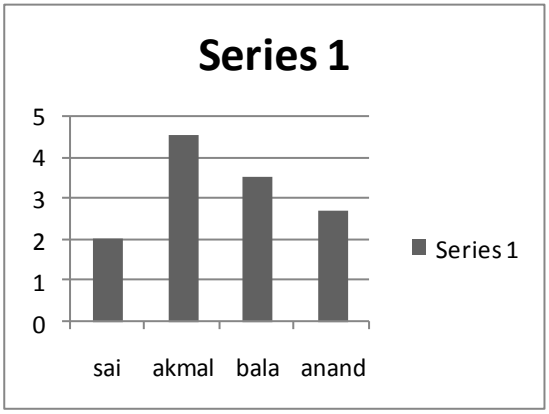

Fig. 2: Performance diagram

6. Limitations

Despite the encouraging results, our work is limited in several aspects. First, we assume each name corresponds to a unique single person. Duplicate name can be a practical issue in real-life scenarios. One future direction is to extend our method to address this practical problem. For example, we can learn the similarity between two different names according to the web pages so as to determine how likely the two different names belong to the same person. Second, we assume the top retrieved web facial images are related to a query human name. This is clearly true for celebrities.

7. Conclusion

This paper investigated a promising Search/Query Based Face Annotation framework, in which performance is optimized. From an extensive set of experiments, we found that the proposed technique achieved promising results under a variety of settings. Future work will address the issues of duplicate human names and explore supervised/semi-supervised learning techniques to further enhance the label quality with affordable human manual refinement efforts.

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