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Review Article

A Review on Semi-Supervised SVM Technique for Mining and Refining Weak Labels of Web Facial Images

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Abstract

Today's world is the world of smart phones, internet, multimedia which has made the art of capturing images or image data very immense as well as easy. This has flooded the web with the ample of images all over & the problem of annotating the images and labeling them arises too. Sometimes, it may happen that we may search the web for a person's image but we may get some different or irrelevant image because the labels of these images may be weak, noisy or with incomplete names. Therefore, this paper proposes to identify weak labeled images using the SBFA technique and refining these labels automatically through semi-supervised SVM (Support Vector Machines) method as because semi-supervised learning requires less human effort and gives higher accuracy and hence we chose this technique because it is expected to give better results when reviewed analysis with other unsupervised and supervised learning techniques. Moreover in order to tackle the problems of optimization and scalability we can use different algorithms to overcome them.

Keywords: *Annotation, SBFA, machine learning, SVM, S3VM, CBIR*

1. Introduction

In today's world of media and smart phones and the era of social networking, where photo tagging (J. Cui *et al,* 2007) and photo sharing have become popular. Therefore, this has motivated the concept of face annotation which helps the users to tag photos, share and search them online and annotate them easily. This can also be helpful in security purposes for identifying or retrieving the images of particular person from videos and news channels (Lei Zhang *et al*, 2003) or for other purposes. Therefore annotation of facial images and refining their weak labels serves as an important study.

We try to annotate images automatically from the web through the SBFA (Search Based Face Annotation) technique which is data driven and model free approach (Dayong Wang *et al*, 2014) whereas other classical approach faces some limitations as they are model based approaches and requires a large number of labeled training data which is time consuming, expensive and tedious (G Fabian *et al,* 2012).In this paper we try to focus on the refining of the labels through semi-supervised SVM method. Now the question arises that why to go for semi-supervised learning? The answer to this question could be as follows:

- Supervised learning algorithms require enough labeled training data to learn reasonably accurate classifiers; moreover the labeled data is expensive and scarce.
- In unsupervised learning we have abundant unlabeled data and can be easily collected but still there are very few ways to use them. (Campbell *et al*, 1998)
- Therefore, Semi-supervised learning allows us to take the advantage of the strengths of both supervised and unsupervised machine learning techniques to build better classifiers from large amount of unlabeled data and labeled data.

There are many other semi-supervised methods which can be used for refining the weak labels of web facial images but SVM when used under other optimization algorithms is expected to provide higher predictive accuracy and maximize the efficacy of learning and training models (Olivier Chappell *et al*, 2008)

The more review work related to this paper is organized as follows.

- Section II describes the overview of the SBFA paradigm.
- Section III reviews the label refinement of the weakly labeled images using the semi supervised SVM. Table I provides the analysis and comparison of various semi-supervised learning techniques.
- Section IV draws the conclusion to the review paper.

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Table 1 Analysis and comparison of various semi-supervised algorithms

Algorithm	Predictive Accuracy	Fitting Speed	Prediction Speed	Memory usage	Easy to interpret	Handles categorical Prediction
Tress	Medium	Fast	Fast	Low	Yes	Yes
SVM	*High*	*Medium*	*Good with few support vectors*	*Moderate*	*Easy*	*No*
Naive Bayes	Medium	Poor for Large Distribution	Poor	Low	Yes	Yes
Nearest Neighbor	Poor for High Dimensions	Low	Medium	High	No	Yes
Discriminant analysis	Varies according to models	Fast	Fast	Low	Yes	No

2. Overview of the SBFA paradigm

One of the drawback with classical face annotation is that, it does not scale well when the database contains large number of images also it is difficult to retrain the process if a new image gets added to the data set (Shalaka *et al*, 2014) Hence it is hectic, tedious time consuming and researchers are reluctant to go for this approach.

Due to the above limitations of classical face annotation, Dayong Wang proposed the SBFA framework based on CBIR (Content Based Image Retrieval System) (Dayong Wang *et al*, 2014; Lei Zhang *et al*, 2003; Y. Tian *et al*, 2007).

Under the SBFA paradigm we divide the tasks into modules as follows:

1) Collection of web images from the web into the database

We will collect some random images (Dayong Wang *et al*, 2014) of some celebrities or some known personalities from the www or IMdb which consists of irrelevant images with noisy or weak labels names.

2) Preprocessing on an image

Preprocessing technique will extract the details from the images like face alignment, detection of face, face region extraction, facial features etc. with the help of GIST feature extraction techniques.

3) Indexing on similar facial images

In order to differentiate the similar images from top-k listed images, indexing is done using LSH (Locality Sensitive Hashing) (D. Wang *et al*, 2011; W. Dong *et al,* 2008). With the help of this algorithm we can efficiently find similar entries in the database. Moreover this algorithm maximizes the probability of collision of similar items which is very effective for high dimensional vectors.

3. Refining the weak labels of images using Semi-Supervised SVM (S3VM)

- We have images that are filtered except with weak label. So the next task is to refine its label quality using SVM technique which can prove to be an effective method to enhance the label quality.S3VM is a binary classification approach (Jakob Verbeek *et al*, 2012) that aims at to take the relevant information from the unlabeled images and reveal structural information about the same (G Fabian *et al,* 2012). We can try to build SVM classifier that can predict the labels of unlabeled images with associated tags (Jakob Verbeek *et al*, 2012), then we use the output of the classifier on unlabeled data to serve as an input to another classifier based only on visual features.SVM maximizes the label quality between the two data sets of data of weakly labeled and another of unlabeled data (Olivier Chappell *et al*, 2008).However this gives rise to the QP problem and optimization problem to some extent (Campbell *et al*, 1998)

But again it can be easily resolved using various optimization algorithms such as SMO (Sequential Minimal Optimization) (Zhifei Song *et al*, CS44.), Gradient Based optimization (G Fabian *et al,* 2012)

Therefore, instead of using unsupervised technique for label refinement (Dayong Wang *et al*, 2014) we can chose to select semi-supervised method for refining labels and expect to maximize the efficacy of refining the labels of the images.

Conclusion

This paper reviews the need of annotating the images in today's technologically growing world. Moreover this paper also focuses on the accurate labeling of those noisy weakly labeled data images through SBFA technique.

Further to improve the label quality for annotating the images, semi-supervised technique (SVM) can be used rather than unsupervised learning or supervised learning because, The problem with unsupervised learning method is that, it proves to be erroneous to create classification models and density estimation models.

The problem with supervised learning approach is that, its performance fairly depends on the amount of labeled data, satisfactory performance is difficult to achieve if we have high quality labeled data and is usually expensive, tedious and time consuming for

large scale scenarios (Dayong Wang *et al*, 2012).Therefore we can chose the midway process i.e. Semi supervised learning method through SVM (R. Jin *et al*, 2009) which can combine the learning techniques of both supervised as well unsupervised techniques, where we can have some amount of labeled training data and classification models on which we can predict the class models for accuracy and also if the training data is new (unsupervised).It is most effective of other algorithm when compared with other supervised techniques, and can prove to be strong for optimization (Olivier Chappell *et al*, 2008) and scalability of image data as well.

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