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A collaborative approach for face verification and attributes refinement

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ABSTRACT

Face verification which aims to determine whether two given faces refer to the same person, and *human attribute learning* with the goal of extracting predefined describable attributes from face images, are two fundamental issues in a variety of applications (e.g., face tagging, attribute based face search). While advances in computer vision domain have resulted in a series of techniques for each of the two tasks, such techniques are usually prone to errors due to the large variation of faces in pose, expression, illumination, occlusion, etc. Different from most prior related works which focus on the two tasks separately, in this paper, we explore their relationships and propose a collaborative approach allowing them to interact with each other to iteratively reduce errors and uncertainties. The interaction is embodies in two processes, one is that the results of face verification can be leveraged to refine attribute values utilizing the random-walk model, and the other is that the attribute values can also be employed to improve the face verification performance through R-LDA model. The two interactive processes will continue to iteratively improve the performance of the two tasks, until the relative stable results are achieved. Experimental results on the real-world photo collections demonstrate the effectiveness of the proposed approach.

1. Introduction

The prevalence of digital cameras as well as the emergence of online media web sites such as Flickr, Picasa, Facebook, and Twitter, makes the creation, storage and sharing of multimedia content much easier than before, which leads to the explosion of massive media data. As the continually growing of the size of personal media collections, the problem of media organization, management and retrieval has become a much more pressing issue. Among most photo collections, human is usually the focus of images. To better understand and manage these human-centered photos, *Face verification* which aims to determine whether two given faces refer to the same person, and *human attribute learning* with the goal of learning some predefined attributes, such as gender, ethnicity, and hair color, to describe the faces, become two essential issues. Fig. 1 illustrates the simple example of the two tasks. While advances in computer vision domain have resulted in a series of techniques for each of the two tasks, such techniques are usually prone to errors due to the large variation of faces in pose, expression, illumination, occlusion, etc.

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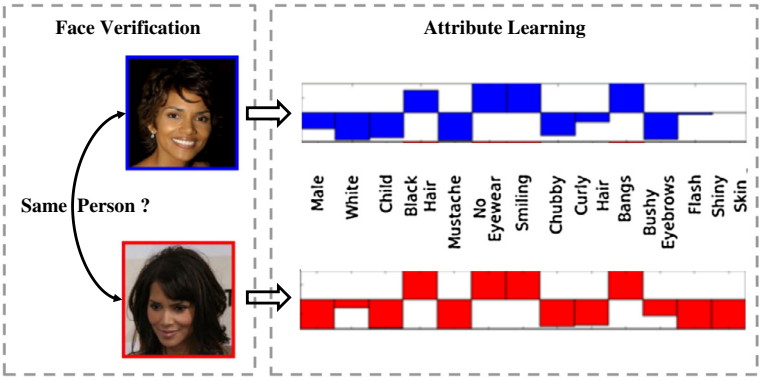

Fig. 1. Example of face verification and attribute learning.

Face verification is the fundamental problem for face recognition/clustering which has attracted much research attention in the last two decades. Facial appearance based verification is the most conventional approach. It has been extensively explored and significant progress has been achieved [1,2,4,15,17,24]. These standard approaches are able to achieve good performance under the controlled conditions, but tend to suffer dealing with the uncontrolled situations where faces are captured with a large variation of pose, expression, illumination, etc. These nuisance factors might cause the differences between faces describing the same person captured in distinct conditions to be larger than those between two different people in similar conditions.

Human Attribute learning becomes an active topic during the recent several years. The first online attribute service system is proposed by Kumar et al. [11], which provides 73 trained SVM classifiers to predict 73 types of human attributes, including "black hair", "big nose", "wearing eyeglasses", etc. This system allows users to upload the targeted photos, and then automatically return the extracted faces and the corresponding attribute values in an acceptable accuracy. However, when dealing with low quality photos or lateral faces, this system might fail to detect faces or return incorrect attribute values. Besides, due to the limitation of learning strategies and attribute diversity, errors and uncertainties are still inevitable. Fig. 2(a) illustrates the example of attribute errors, where one face has not been detected, and "age" attribute of the other face is incorrectly estimated. Therefore, the original attribute results obtained from SVM classifiers need to be refined before the further applications.

Although the performance for each of the two tasks is far from satisfaction in the real applications, we discover that the two problems are highly related and their collaboration can facilitate the performance enhancement. For example, face verification results can be improved with the consideration of human attributes. If obtaining accurate attribute values, some

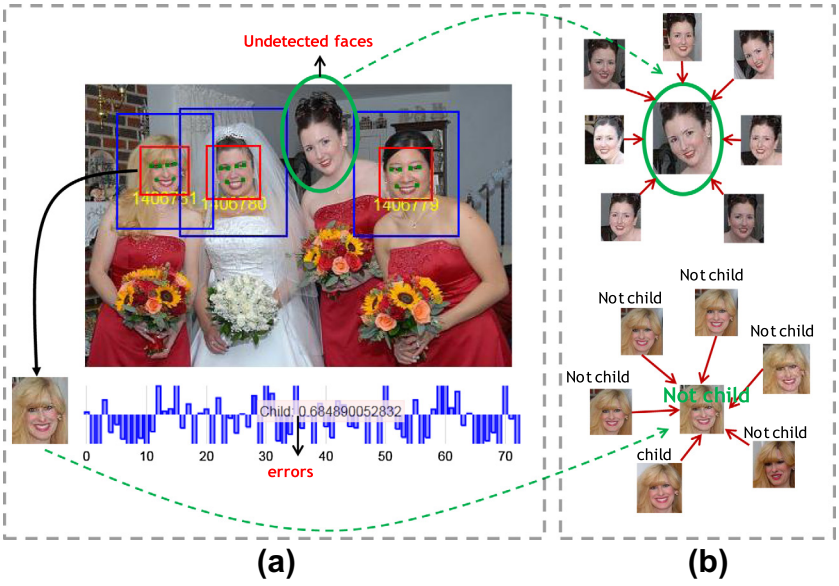

Fig. 2. (a) Example of attribute errors. (b) Reduce uncertainties using neighbor faces.