# IS THERE ANY HOPE FOR FACE RECOGNITION?

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## ABSTRACT

Automatic recognition of people is a challenging problem which has received much attention during the recent years due to its many applications in different fields such as law enforcement, security applications or video indexing. Face recognition is a very challenging problem and up to date, there is no technique that provides a robust solution to all situations and different applications that face recognition may encounter. This position paper will address the question: is there any hope for face recognition? In a general context, I believe that face recognition in complex scenarios will remain unsolved for the next years. However there might be hope for specific contexts and applications if some techniques are further studied, developed and combined.

## 1. INTRODUCTION

Almost in any face recognition application, a face detection stage is needed. Although face detection poses also a very challenging problem, many techniques have been proposed with enough success to consider face detection a very mature field of research. However, although it is clear that face detection is far from being solved, it will not be considered in this position paper. For more information about the state of the art in face detection, the reader is referred to the excellent review done in [1].

Face recognition can be divided into two basic applications: identification and verification. In the identification problem, the face to be recognized is unknown and is matched against faces of a data base containing known individuals. In the verification problem the system confirms or rejects the claimed identity of the input face. Although differences may exist, this position paper will address the general problem of face recognition and no particular distinction will be made among the two problems as the challenges and the used techniques are basically the same.

## 2. FACE RECOGNITION APPROACHES

Face recognition approaches on still images can be broadly grouped into geometric and template matching techniques. In the first case, geometric characteristics of faces to be matched, such as distances between different facial features, are compared. This technique provides limited results although it has been used extensively in the past. In the second case, face images represented as a two-dimensional array of pixel intensity values are compared to a single or several templates representing the whole face. More successful template matching approaches use Principal Components Analysis (PCA) or Linear Discriminant Analysis (LDA) to perform dimensionality reduction achieving good performance at a reasonable computational complexity/time. Other template matching methods use neural network classification and deformable templates, such as Elastic Graph Matching (EGM). Recently, a set of approaches that use different techniques to correct perspective distortion are being proposed. These techniques are sometimes referred to as view-tolerant. For a complete review on the topic of face recognition the reader is referred to [2] and [3].

## 3. FACE RECOGNITION *EASY* SCENARIOS

Broadly speaking, the approaches proposed in the last years have been able to *solve* specific still face images recognition applications. Examples of scenarios where face recognition achieves very good results are given in Figure 1 and Figure 2.

Although many details are being skipped (quality and size of the data base, scaling, feature extraction, face detection, etc.,) it can be considered that in such scenarios the face recognition problem is very well focused and *almost solved.*

Figure 1. *Easy* scenarios in face recognition

Figure 2. *Easy* scenarios in face recognition

## 4. FACE RECOGNITION DIFFICULT SCENARIOS

When the scenario departs from the *easy* scenario, then face recognition approaches experience severe problems. Among the special challenges let us mention: pose variation, illumination conditions, scale variability, images taken years apart, glasses, moustaches, beards, low quality image acquisition, partially occluded faces etc. Figures 3, 4 and 5 show different images which present some of the problems encountered in face recognition. An additional important problem, on top of the images to be recognized, is how different face recognition systems are compared. For details see [2].

Figure 3. Difficult scenarios for face recognition

Figure 4. Difficult scenario: low quality face image with beard and glasses

Figure 5. Difficult scenario: low quality image with multiple faces

It is accepted that in these difficult scenarios, the face recognition problem is very far from being solved.

## 5. A POSSIBLE WAY OUT FOR DIFFICULT SCENARIOS

In search of finding solutions for difficult face recognition scenarios, some help is found in two broad areas: video-based face recognition and multimodal approaches.

### 5.1 Video-based face recognition

Initially, face recognition systems focused on still images. However, during the last years research on face recognition in image sequences has gained much attention, although nearly all systems apply still-image face recognition techniques to individual frames. In addition to its broader number of applications, video-based face recognition provides several advantages over still image-based face recognition [2], [4]:

- Good frames can be selected on which to perform the recognition stage.
- Video provides temporal continuity which allows reuse of recognition information obtained from high quality images in processing low quality frames.
- Video allows tracking of images such that facial expressions and pose variations can be compensated for, resulting in improving recognition.
- Motion, gait and other features can help a video-based face recognition system.

On the other hand, before video-based face recognition techniques may be used, some other difficult issues need to be tackled:

- Video-base segmentation.
- Face tracking.
- Video-based feature extraction.
- Low quality compressed images depending on the application.

In spite of these difficult issues, I am convinced that video-based face recognition has a tremendous potential and will signify a step-ahead in the field. Up to date results look very promising [2], [4].

### 5.2 Multimodal approaches

Video-based face recognition systems bring other features which can help to alleviate the problem: speech and audio. If the information is in the content, why not to use it? The fusion of different information brings new problems but brings new solutions as well. There has been already a big effort in this direction which is also very promising [2], [5], [6].

## 6. IS THERE ANY HOPE FOR FACE RECOGNITION?

Is there any hope for the difficult scenarios? The answer is YES. We all know of an image processing system that has an impressive performance for all kind of scenarios: the human visual system (HVS). If it can do it, a computer should be able to do it also. The problem is to find out how. The answer is to fully understand the HVS. Many face recognition researchers are doing a very good job in the pixel domain. However, I believe that much more effort should be put in knowing the HVS and its influence on face recognition. Although there has been a lot of work trying to understand the HVS, not enough cooperative research has been conducted between the computer vision, signal processing and psychophysics and neurosciences communities. A strong effort needs to be done sharing results, experiences and planning future research within these three communities. For previous work on the topic, see [7].

All in all, is not it true that MP3 exists because we have been able to understand part of the human auditory system?

## 7. CONCLUSIONS

Face recognition has been and will continue to be a very challenging and difficult problem. In spite of the great work done in the last 30 years, we can be sure that the face recognition research community will have work to do during, at least, the next 30 years to completely *solve* the problem. Strong and coordinated effort between the computer vision, signal processing and psychophysics and neurosciences communities is needed.

## 8. REFERENCES

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