Bureau d’Etude

Sujet n°3:

Extension d’un système de reconnaissance faciale aux visages portant un masque chirurgical

DEL GUIDICE Pierre-Antoine
L3 informatique 2022
Université Paul Sabatier
Jean-Denis Durou
IRIT, équipe REVA (durou@irit.fr)

Présentation du sujet

Eigenfaces for Recognition

Matthew Turk and Alex Pentland
Vision and Modeling Group
The Media Laboratory
Massachusetts Institute of Technology

Abstract

■ We have developed a near-real-time computer system that can locate and track a subject's head, and then recognize the person by comparing characteristics of the face to those of known individuals. The computational approach taken in this system is motivated by both physiology and information theory, as well as by the practical requirements of near-real-time performance and accuracy. Our approach treats the face recognition problem as an intrinsically two-dimensional (2-D) recognition problem rather than requiring recovery of three-dimensional geometry, taking advantage of the fact that faces are normally upright and thus may be described by a small set of 2-D characteristic views. The system functions by projecting face images onto a feature space that spans the significant variations among known face images. The significant features are known as "eigenfaces," because they are the eigenvectors (principal components) of the set of faces; they do not necessarily correspond to features such as eyes, ears, and noses. The projection operation characterizes an individual face by a weighted sum of the eigenface features, and so to recognize a particular face it is necessary only to compare these weights to those of known individuals. Some particular advantages of our approach are that it provides for the ability to learn and later recognize new faces in an unsupervised manner, and that it is easy to implement using a neural network architecture. ■

INTRODUCTION

The face is our primary focus of attention in social intercourse, playing a major role in conveying identity and emotion. Although the ability to infer intelligence or character from facial appearance is suspect, the human ability to recognize faces is remarkable. We can recognize thousands of faces learned throughout our lifetime and identify familiar faces at a glance even after years of separation. This skill is quite robust, despite large changes in the visual stimulus due to viewing conditions, expression, aging, and distractions such as glasses or changes in hairstyle or facial hair. As a consequence the visual processing of human faces has fascinated philosophers and scientists for centuries, including figures such as Aristotle and Darwin.

Computational models of face recognition, in particular, are interesting because they can contribute not only to theoretical insights but also to practical applications. Computers that recognize faces could be applied to a wide variety of problems, including criminal identification, security systems, image and film processing, and human–computer interaction. For example, the ability to model a particular face and distinguish it from a large number of stored face models would make it possible to vastly improve criminal identification. Even the ability to merely detect faces, as opposed to recognizing them, can be important. Detecting faces in photographs, for instance, is an important problem in automating color film development, since the effect of many enhancement and noise reduction techniques depends on the picture content (e.g., faces should not be tinted green, while perhaps grass should).

Unfortunately, developing a computational model of face recognition is quite difficult, because faces are complex, multidimensional, and meaningful visual stimuli. They are a natural class of objects, and stand in stark contrast to sine wave gratings, the "blocks world," and other artificial stimuli used in human and computer vision research (Davies, Ellis, & Shepherd, 1981). Thus unlike most early visual functions, for which we may construct detailed models of retinal or striate activity, face recognition is a very high level task for which computational approaches can currently only suggest broad constraints on the corresponding neural activity.

We therefore focused our research toward developing a sort of early, preattentive pattern recognition capability that does not depend on having three-dimensional information or detailed geometry. Our goal, which we believe we have reached, was to develop a computational model of face recognition that is fast, reasonably simple, and accurate in constrained environments such as an office or a household. In addition the approach is biologically implementable and is in concert with prelimi-

Différentes étapes à développer:

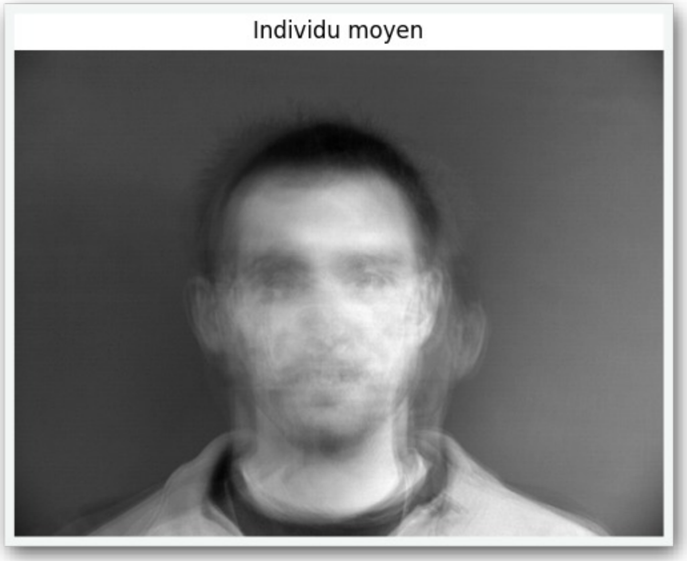
Apprentissage:
-calcul du visage moyen
-soustraction du visage moyen aux autres visages
-calcul de la matrice de covariance
-calcul des valeurs et vecteurs propres à partir de cette matrice
-calcul des composantes principales des images
-projection de celles ci sur les vecteurs propres (eigenfaces)

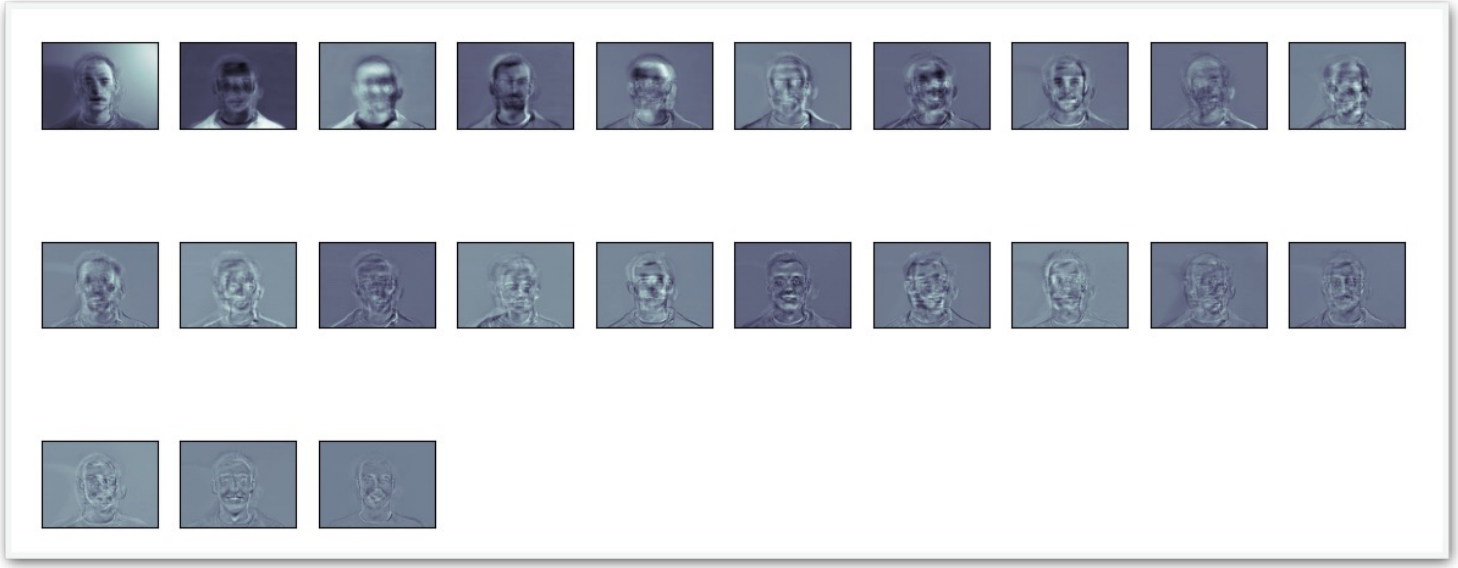
Reconnaissance:
-soustraction du visage moyen a l'image
-calcul des composantes principales
-projection de celles ci sur les vecteurs propres (eigenfaces)
-calcul de la distance euclidienne de l'image aux images d'apprentissage
-si la distance minimale est inférieure au seuil l'individu est reconnu

Plan

- Partie 1: analyse en composantes principales
- Partie 2 : projection des images sur les eigenfaces
- Partie 3 : restauration d'images dégradées
- Partie 4 : application à la reconnaissance de visages
- Mise en relation des différentes parties pour répondre au problème initial

Partie 1: analyse en composantes principales

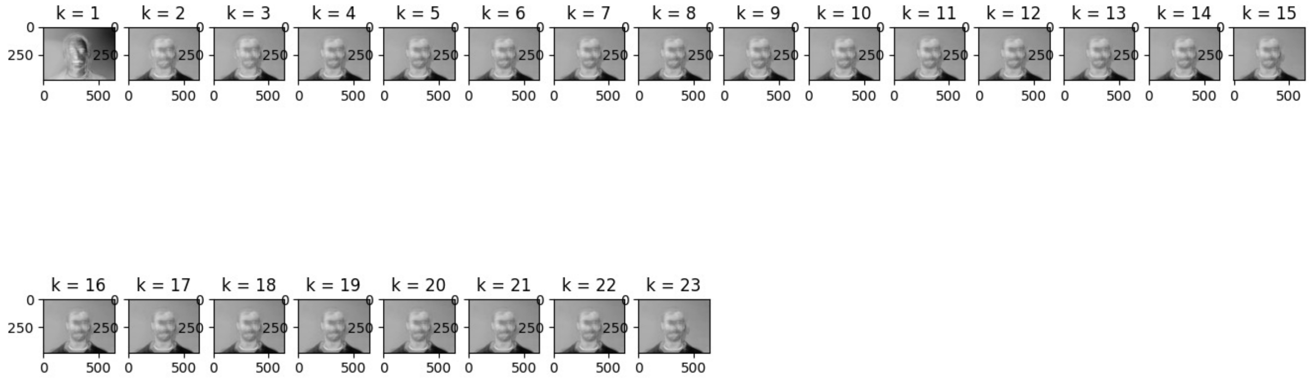




Eigenfaces

Partie 2 : projection des images sur les eigenfaces

Exemple de reconstruction d'un visage:



Partie 3 : restauration d'images dégradées

→

Partie 4 : application à la reconnaissance de visages

Cas ou l'image tirée ne fait pas partie de l'ensemble d'apprentissage:

→

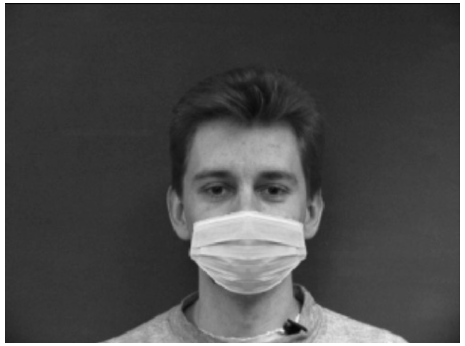
```
7.329338937929453e-10
individu non trouvé
```

Cas ou l’image tirée ne fait pas partie de l’ensemble d’apprentissage:


```
6.538035561619131e-21
individu trouvé
```

Mise en relation des différentes parties effectuées auparavant pour répondre au problème initial de reconnaissance faciale d’un individu masqué

Exemple avec l’individu 2 masqué:



Individu trouvé

```
1.5431516041476974
individu trouvé
```

<u>Bilan</u>