A supervised image recognition approach to diagnose dental diseases

Oscar de Felice[1] and Gustavo de Felice[2]

[1] *via dei Genovesi 92, 09124 Cagliari, Italy*
[2] *via Silvio Pellico 12, 84073 Sapri, Italy*

(Dated: September 6, 2019)

The main goal of this document is to describe the idea of image recognition to determine whether a patient may have some odontoiatric disease. Briefly, we aim to use a machine learning approach, training an image recognition algorithm over an image database, labelled with the diseases and use the fitted model to predict whether a new image has the features characterising a specific illness. The idea is to give suggestions to doctors alerting them when an image is found with an high probability of a disease. The approach is general, however

INTRODUCTION

An important issue to face since the birth of image recognition techniques is the detection and classification of objects in digital images. Obviously, objects can be classified by several aspects, *e.g.* colours, textures, shapes, position within images, etc.

Recently, there have been several satisfying examples of the use of such approach [**?**]. Even back to the early 2000's, one can find contributions to the applications image recognition to medical diagnostic systems [**?**].

I. A WARM-UP EXAMPLE: FACIAL RECOGNITION

Just to illustrate the method, we want to describe a simple image recognition algorithm. The basic idea is to detect faces in pictures. This is a typical example of supervised learning algorithm, largely used in social networks.

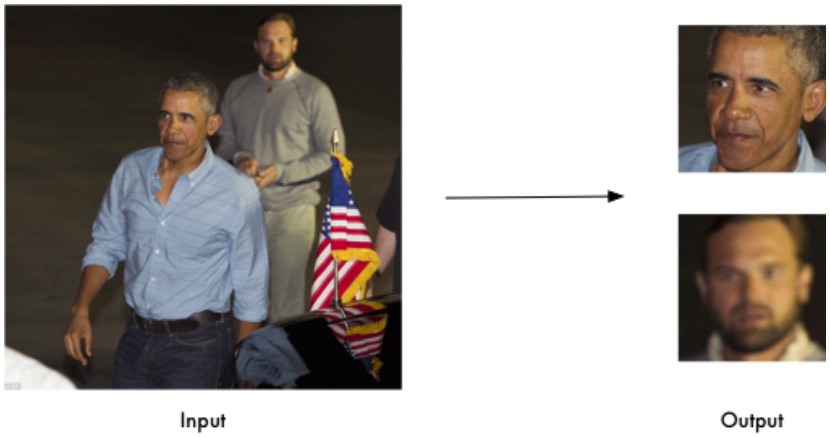

Figure 1: Working scheme of the face recognition algorithm.

[1] *e-mail*: oscar.defelice@gmail.com
[2] *e-mail*: gustavo@dottordefelice.it

A. Understanding how face recognition works

II. OVERVIEW OF DIAGNOSTIC SYSTEMS BASED ON AUTOMATIC IMAGE RECOGNITION

In this section we review the general scheme of diagnostic systems based on a machine learning approach. In particular, we are going to expose the working mechanism of image recognition algorithms applied to medical diagnosis.

A. Shape characterisation

Mathematically, images can be thought as sets of connected points in a two-dimensional space $\mathcal{F}$, often (and also here) approximated in a discrete binary space. People do not perform image classification directly on $\mathcal{F}$, since this task is computationally really expensive ($\sim \mathcal{O}(n^2)$), where each image is made up by n pixels. The representation of an image can be modified by an image transformation, by mapping the space $\mathcal{F}$ to a – typically smaller – feature space $\mathcal{F}'$.

B. Gauged Supergravity

Isometries

Magnetic gaugings

III. THINGS TO KNOW

A. Attractor mechanism for AdS black holes

B. The topologically twisted index

The topologically twisted index at large N

C. Dyonic $ISO(7)$ supergravity

Appendix A: Reduction from $E_{7(7)}$

Appendix B: Reduction to the $SU(2)$-invariant sector

---

[1] C. Beltrán Castañón, J. Fraga, S. Fernandez, A. Gruber, and L. da F. Costa, *Biological shape characterization for automatic image recognition and diagnosis of protozoan parasites of the genus eimeria*, Pattern Recognition, 40 (2007), pp. 1899–1910.

[2] P. Arena, A. Basile, M. Bucolo, and L. Fortuna, *Image processing for medical diagnosis using cnn*, Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment, 497 (2003), pp. 174–178.

[3] D. Comaniciu, P. Meer, and D. J. Foran, *Image-guided decision support system for pathology*, Machine Vision and Applications, 11 (1999), pp. 213–224.

[4] D. Ushizima, L. da F. Costa, E. Gil Rizzatti, and M. Zago, *A texture approach to leukocyte recognition*, Real-Time Imaging, 10 (2004), pp. 205–216.

[5] A. K. Jain, R. Duin, and J. Mao, *Statistical pattern recognition: A review*, IEEE Trans. Pattern Anal. Mach. Intell., 22 (2000), pp. 4–37.

[6] A. Jalba, M. Wilkinson, and J. Roerdink, *Shape representation and recognition through morphological curvature scale spaces*, IEEE transactions on image processing : a publication of the IEEE Signal Processing Society, 15 (2006), pp. 331–41.

[7] H. Chen, K. Zhang, P. Lyu, H. Li, L. Zhang, J. Wu, and C.-H. Lee, *A deep learning approach to automatic teeth detection and numbering based on object detection in dental periapical films*, Scientific Reports, 9 (2019).