Chapter 3
Soft Computing Techniques for Human–Computer Interaction

Oscar Déniz
Universidad de Castilla-La Mancha, Spain

Gloria Bueno
Universidad de Castilla-La Mancha, Spain

Modesto Castrillón
Instituto Universitario de Sistemas Inteligentes y Aplicaciones Numéricas en Ingeniería, Spain

Javier Lorenzo
Instituto Universitario de Sistemas Inteligentes y Aplicaciones Numéricas en Ingeniería, Spain

L. Antón
Instituto Universitario de Sistemas Inteligentes y Aplicaciones Numéricas en Ingeniería, Spain

M. Hernández
Instituto Universitario de Sistemas Inteligentes y Aplicaciones Numéricas en Ingeniería, Spain

ABSTRACT

Soft computing aims at using tricks or shortcuts that do not provide optimal solutions but useful approximations that can be computed at a reasonable cost. Such approximations often come in the form of heuristics and "rules of thumb." Computer vision relies heavily on heuristics, being a simple example the detection of faces by detecting skin color. Another approach that may also be considered as heuristics is the use of inductive learning, where the idea is to emulate humans in the sense that achieving certain skills require gradual learning. Thus, we would not make an effort to articulate solutions as equations, rules or algorithms. The solution would instead be sought automatically by feeding the system with training examples that would allow it to classify new samples. This chapter describes two successful applications of such soft computing approaches in the field of human-computer interaction, showing how the clever use of heuristics and domain restrictions can help to find solutions for the most difficult problems in this field.

DOI: 10.4018/978-1-61520-893-7.ch003

INTRODUCTION

For many problems in computing we can find solutions that are optimal in some sense. Brute force search or analytical solutions provide such optimality. However, the cost involved often makes this approach intractable, especially for some difficult problems. Within computer vision, for example, some problems like face detection and recognition are considered particularly challenging. The 'hard computing' approach of searching for optimal solutions is in such difficult tasks unfeasible not only because of the cost involved (images are typically treated as points in a high-dimensional space) but also because we do not know very much about how humans accomplish the tasks (Deniz et al, 2007). Think for example in face recognition, we recognize people's faces everyday without effort. Such good performance is probably associated to the automaticity of the ability, which can be carried out even unconsciously. Because of that we cannot articulate the features or procedures involved.

As opposed to hard computing, 'soft computing' aims at using tricks or shortcuts that do not provide optimal solutions but approximations that can be computed at a reasonable cost. Often, the term used is heuristics. Heuristics are "rules of thumb", educated guesses, intuitive judgments or simply common sense. They are used in many domains. Antivirus software, for example, use heuristic signatures to look for specific attributes and characteristics for detecting viruses and other forms of malware. Computer vision also relies heavily on heuristics, being a simple example the detection of faces by detecting skin color. Obviously, this approach does not detect all the faces that may be present in an image, although it detects most of them very quickly.

Another approach that may also be considered as heuristics is the use of inductive learning. The idea is to emulate humans in the sense that achieving certain skills require gradual learning. Thus, we would not make an effort to articulate solutions as equations, rules or algorithms. The solution would instead be sought automatically by feeding the system with training examples that would allow it to classify new samples.

As in other "classical" soft computing techniques like genetic algorithms and fuzzy systems, inductive learning and heuristics aim at giving inexact but useful solutions to problems that are too complex to have a reasonable cost, analytic solution.

A central ability in human-computer interaction is human perception. As mentioned above, however, our perception abilities are mainly unconscious. This chapter describes two successful applications of soft computing in human-computer interaction, showing how the clever use of heuristics and domain restrictions can help to find solutions for difficult problems in this field.

EYEWEAR SELECTOR

The first application is a hardware-software system, intended for use at optical shops, which allows individuals to test different models of spectacles in a sort of real-time video mirror. The optical market is nowadays saturated with an increasingly complex array of lenses, frames, coatings, tints, photochromic and polarizing treatments, etc. The number of clients can grow only if the selection process is shortened or automated. A number of deployed systems have already demonstrated that eyeglass selectors can increase sales and customer satisfaction (Morgan, 2004).

From a research viewpoint, such systems represent an interesting application of Computer Vision, Multimedia and Human-Computer Interaction. The Augmented Reality, see a survey in (Azuma, 1997), of watching ourselves and try different "virtual" spectacles can be achieved by combining computer vision and graphics. The Magic Lens and Magic Mirror systems, for example, use the ARTag toolkit (Fiala, 2004), which mixes live video and computer-generated graphics. People