Seminar: Emotions in robotics[*]

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ABSTRACT
Human are socially evolved beings. They bath permanently in a world ruled by subtle rules and is used to communicate with is pairs using almost unconscious non-verbal signs. When it comes to designing machines able of smooth interactions in highly socialized environment, such as hospitals or schools, it seems obvious to the designers that such machines should be able to get accepted as "social peers". These machines use many techniques to communicate their affects and fitness to the environment. These techniques can be divided in 2 categories: facial emotions and posture/behavioral emotions. These 2 groups together form a consistent set of expressions susceptible to carry an emotional content.

1. BENEFITS OF EMOTIONS
1.1 Are emotions useful for the livings ?
If asked about the most obvious difference between a human and a machine, most people will answer that humans are able to have feelings and emotions. Some interpretations of the Darwinian evolution theory even suggest an important role of the emotions in the survival of the species. Because only the most fitting elements of a specie are able to breed, it seems that emotions are useful for the livings [2, p.33].

Cynthia Breazeal suggest that emotions are the privileged motivation system of complex organisms [1, p.105]. A positive emotion reward a satisfying state while a negative emotion encourage the organism to make that emotion to stop [1, p.106]. For Buck, emotions and motivation are the 2 sides of a same coin [2, p.29].

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Even if humans cannot be directly compared to animals, even the most complex ones, they seems to use emotions the same way. However humans tend to use their emotions in a more social way[4, p.558]. In fact, social interactions are enjoyable for most people [1, p.16]. Aristotle said that "human is a social animal". Humans is permanently surrounded by an environment full of conventions, habits and custom, rules of courtesy, etc. Whoever fails or refuses to follow those implicit rules will appear inappropriate and akward.

If the privileged environment for most humans is the human society and if those societies rules are mainly emotional, it seems obvious that robots designed to behave in such environments should pack an extensive emotional interface.

1.2 Scope of emotions for robots
The emergence of printed circuits and miniaturization of them, combined with great progress in the domain of materials brought within the reach some applications still unthinkable a few years ago.

However, during decades, robots were confined to industrial uses and giving them some emotional features seemed akward. They were hardly used for something else than replacing humans in dangerous, delicate and repetitive tasks.

But applications for them changed and robots get out of manufactures and incorporate social environements such as schools, hospital, etc. [6, p.78] Facing new challenges, robots have to be adapted to fulfill their new tasks. Gradually, robots leaves theirs industrial and production purposes for entertainement tasks [6, p.64].

Robots have since been used successfully in assisting the elderly. They have proven that they can help elderly to stay longer at home [5, p.27]. Some applications have been suggested or studied in the domain of emergecy and the army.

1.3 Purposes of emotions in robots
Designing robots able to exibit some kind of emotions has a lot of benefits. Communicating emotion has a motivationnal value in the first place: people tend to interact more with a robot displaying emotions [4, p.559]. More interestlingly, robot showing affects have a great chance of being treated as social peers by humans: emotions make them more lifelike and vivid [1, p.15].

Another benefit is about the emotional content of conversations: human communication imply more than just conversational content. Human communications have strong emotional groundings [2, p.3]. Emotions can help building a conversational and relational background too [4, p.558].

It should also be mentioned that most people enjoy social (and thus emotional) relationship, even if they are virtual. It has been noticed that most people tend to consider their computer has a human being. It has been said that the more rapid evolution of technology compared to human evolution is the most likely cause [1, p.15].

2. ARTIFICIAL EMOTIONS
2.1 Theoretical model
When one wants to implement emotions in a machine, he has to initially opt for a theoretical model as a base for the implementation. We assume that the underlying theoretical model does not play any role in emotion recognition as long as it is realistic [4, p.559]. We then talk about generative model, as opposed to the explanatory model [4, p.560]. In other words, we leave to the psychologists and neurologists question of "why" to focus on the "how".

Several models have been suggested and are used in various implementations. Among them the model of Scherer proposes a solution based on 3 components [4, p.559]:

1. Emotions: emotions in the common sense of the term, brief sensations or feelings.

2. Moods: they are durable emotions, feelings extended in time and which have a strong influence in future behaviors and perceptions.

3. Attitudes: these are feelings directed at someone. Love is an attitude for example.

The Russel's model was used for the robot Kismet.

Russell suggests a very simple model in which emotions have only two dimensions [4, p.559]:

1. Valence: how good or bad is an emotion. An emotion can be neutral too.

2. Arousal: strength of the emotion.

The main difficulty in developing a model is to make it realistic while they underneath phenomenons are still poorly understood. The competition of emotions is another difficulty: how to be well aware of sensations paradoxical without diluting them [4][p.560]?

2.2 Technical aspects
With no less than 17 muscles to perform a simple smile, the face human body is extremely good at communicating emotions.

In addition, the face is the seat of the main organs of communication: mouth, eyes and ears. It is then natural that
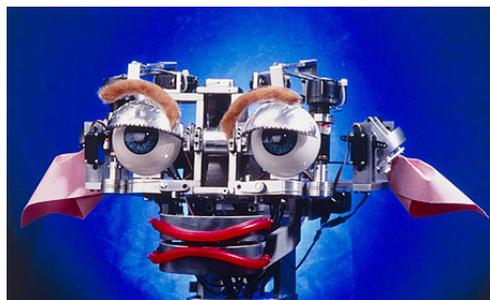

Figure 1: Kismet astonishing face (displaying anger)

robot's designers have been interested in equipping their creation with animated faces.

Some organs are particularly promising emotions: eyes and the mouth. These are particularly expressive in Kismet:

C.Breazeal suggests that facial animation helps to strengthen the sense of a conversation and improves it [1, p.157]. This allows also to speak directly to the listener and thus strengthen the link, the quality of conversation and connection between contributors [1, p.85].

However it was suggested that the focus of work in robotics on the facial expression of emotions has led to neglect the other vectors of emotions [3, p. 84]. Among these other indicators of emotion are:

1. Movement: the speed, fluidity of movements, presence or no breaks, etc.

2. Posture: near or far, curled up, open, etc.

3. Orientation: face-to-face, free, disinterested, etc.

4. Color: light use of color, LED, etc.

5. Sound: intonation of synthetic speech, noise, rattling, music, etc.

Interestingly, Argyll suggests that non-verbal and non-facial communication is more reliable[1, p.85]. This is probably due to the fact that in our society, concealing our emotions is a rather common thing and generally an important factor of social survival.

3. CONCLUSION
The robots are made to be increasingly present in our life in decades to come. Those who were at first very simple tools are probably destined to become helpers and daily companions, the fault including an aging population in industrialized countries.

Under such conditions, it is clear that robots will have to be able to interact smoothly, with sensitivity and flexibility with people when performing tasks usually devoted to humans. The implementation of emotion in robots who come into contact with people has proven its worth in many studies so it is likely that research will continue in this direction.

The challenges are still numerous enough and paradoxically does not depend only on hard sciences: psychology and neurology have yet to bring a lot of clarification on the functioning of the psyche while sociologists should still fine-tune the social model of emotions.

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