ACCEPTABILITY IN INTERACTION
From Robots to Embodied Conversational Agents

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Keywords: Embodied Conversational Agents, Acceptability, Companion robot, Emotions, and personality.

Abstract: This paper will propose to increase the traditional definition of system acceptability to take into account the heavy interaction between a man and a real or virtual system. We introduce the notion of "socially credible" which describes the need of emotions and personality in intelligent environment. This notion is measured by experiments using a plush robot Emi and a virtual embodied conversational agent.

1 INTRODUCTION

The rapid development of modern information technologies, information systems and intelligent environment brings both opportunities and challenges to contemporary organizations. One of the major problems of these technologies is: what are the different factors that impact the user acceptance? Indeed what ever are the qualities of the intelligent environment, if it is not used because it is perceived by the user as non useful, then the developed system misses its goal.

In this paper, we want to focus on the factors usually retrain to approach the problem of technology acceptance. Has we will show, they are not longer enough if we look to systems having a heavy interaction with human. By heavy interaction we mean, interaction with an intelligent environment which changes the quality of the human life: for instance at home for disabled people. In this case the problem is not to perform a task but to "feel good". This interaction introduces a new dimension which it not any more functional but psychological. The problem then is to build the intelligent environment tp become "socially credible".

In this paper we will introduce the traditional parameters of acceptance: utility, usability and social acceptance. These parameters are enough to model the acceptance of systems used for a short time but we will explain why it is necessary to introduce a new parameter. In a second part we will propose our implementation of the social credibility based on knowledge and values representation, and on interaction based on emotion and personality. Finally we will report some preliminary experiments on a robot and ECA to illustrate the approach.

2 INFORMATION TECHNOLOGY ACCEPTANCE

In this first section we want to introduce the major models of acceptance technology and discuss their limits.

2.1 Technology Acceptance Model

The Technology Acceptance Model, first introduced by Davis in 1986, proposes that applications usage and adoption can be predicted based upon the factors of perceived ease of use and perceived usefulness Davis in 1989.

Based on this first work Nielsen in 1993 proposes the model of acceptability (figure 1) and expresses that "User interfaces are now a much more important part of computers then they used to be".

In this model we can see that the fundamental points are utility and usability which implied that the intelligent environment in which the human is living must be well done from a technical point of view. In

Pesty S. and Duhaut D. (2011).
ACCEPTABILITY IN INTERACTION - From Robots to Embodied Conversational Agents.
In *Proceedings of the International Conference on Computer Graphics Theory and Applications*, pages 365-370
DOI: 10.5220/0003405703650370

robotics or virtual environment this means that the system must provide functions that are efficient and sure

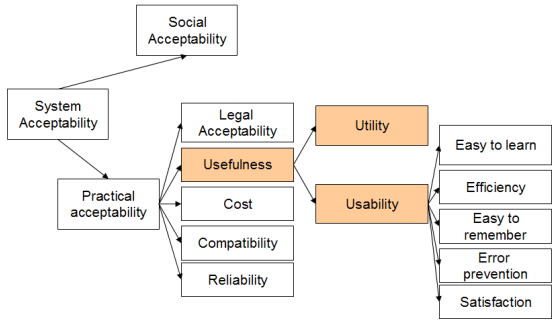

Figure 1: J. Nielsen 93 Acceptability model.

In this model the box "social acceptability" is mentioned but not really developed..

2.2 Theory of Planned Behavior

In his work Ajzek in 1985, introduces the theory of planned behavior from which a description social acceptability can be derived (figure 2).

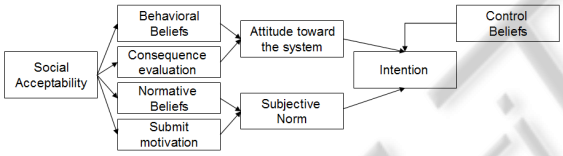

Figure 2: I. Ajzek theory of planned behaviour.

Venkatesh in 2003 proposes to unified Unified Theory of Acceptance and Use of Technolog (UTAUT). His work is based on eight models reviewed are the theory of reasoned action, the technology acceptance model, the motivational model, the theory of planned behavior, a model combining the technology acceptance model and the theory of planned behavior, the model of PC utilization, the innovation diffusion theory, and the social cognitive theory.
Here again there is limit in this approach and this limit is that the model does not take into account the heavy interaction that human have with the intelligent environment including a companion robot.

2.3 Socially Credible

If a system must be credible to interact with in the day life, it is necessary to take into account the human specific dimension: emotion and personality. This means that we cannot have a single device used with success by everybody because each of us is different.

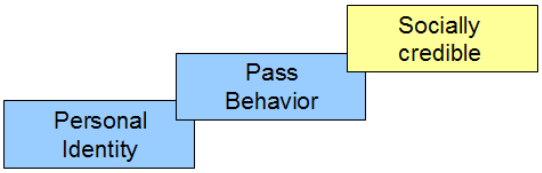

Figure 3: Human identity and feelings.

It is then necessary to deal with the personal identity and the history of the person which is already described in works on social psychology but also to build an intelligent system which can be perceived like a social creature having its own identity and personality. We will propose some way to implement this and some preliminary experimentations will be presented in the next sections.

2.4 Acceptability in Interaction

Based on the three previous approaches it is possible to summarize it in one final model in which we add the socially credible factor in figure 4.

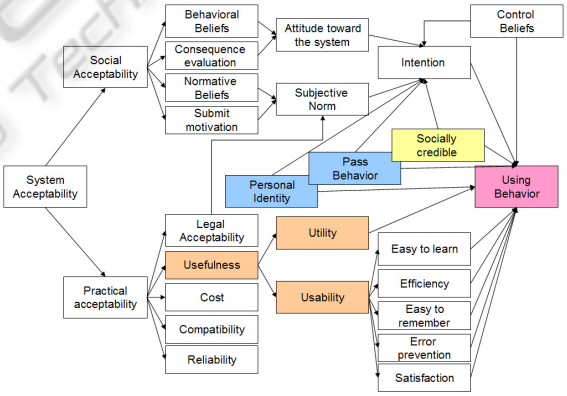

Figure 4: Full model for human acceptability for systems with interaction.

Introducing this in the model we have to think about: how can we realize such credible social interaction. The next section will expose the four main parameters used in our projects.

3 BUILDING SOCIAL CREDIBILITY

If a system is socially credible then we can interact with, having the feeling that it is a kind of "human species". For this, the system must share we the human some knowledge and values and must be able to express things with personality and emotion.

3.1 Sharing Knowledge

The knowledge shared with the human is divided in three levels.

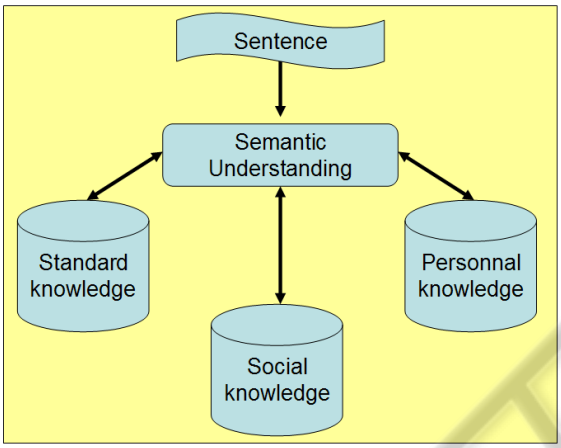

Figure 5: Three kind of knowledge

The first level is connected to a standard knowledge. This is the first data base to develop and this is currently an active research part. Moreover, this level often generates an action on the environment from the robot. This part of the knowledge is implemented in all the personal robots and is used to understand the meaning of everyday sentences.

The second level requires the robot to search for information to understand the sentence. This means that it must have access to social knowledge and in this case, the internet is a good means for carrying out this type of research. The difficult part here is to filter all the information to obtain what is relevant.

The third level requires that the robot learn the personal history of the human from the human. This is possible only by a dynamic acquisition of information. The sources of this information can be multiple: family, doctor, friend, neighbor. This personal knowledge is the fundamental issue to be in empathy with someone.

3.2 Sharing Values

Working on the semantic of the sentences is not enough to provide a social interaction. For instance if the robot tells the human: "You are right and I agree with you" then in the impact of this sentence on the human we can distinguish different levels.

At a first level the robot expresses that it agrees with the action performed "because it is the right action at the right time at the right place". But this does not build empathy it is just sympathy, a good friend approving your action.

At the second level the robot expresses empathy by saying that it feels the same emotion of the human and that it is sharing it. Here the robot shares the emotion associated to the action performed by the human. This second level is empathy but is very limited in the time, it is just focused on the local action.

At a third level the same sentences can mean that the robot agrees on the fact the human is reliable, offering security "because it is the right action at the right time at the right place", and the human s always like this. This means that the robot feels confident with the human. In this case the empathy is enduring. The reason is that the underlying message is sharing values with the human.

To build this kind of interaction, to each kind of knowledge standard, social, personal we must build "meta semantic information" where a list of values must be coded.

What Kind of Values can we Retrain?

In D.L. Liedner & all 2006 looks for the linkage between information technology acceptance and culture. For this purpose they show that some cultural value can be retrained and we think that they are the good departure point to code the knowledge has described previously.

Those values are:

Equality	Subordination
Progressivism	Conservatism
Community	Isolation
Sympathy	Antipathy
Emotionality	Sensibility
Optimism	Pessimism
Freedom	Enslavement
Superiority of culture	Inferiority of culture
Deterministic	Uncertainty
Objective	Subjective
Neutrality	Partiality
Progress	Retreat
Adventurous	Routine
Glamorous	Dull

Known	Unknown
Order	Chaos
Friend	Enemy
Mythical	Factual
Rationality	Subjectivity
Virtuosity	Basic needs
Aesthetic	Practical

Having this list of values the idea is to code all the words of the used language between the human and the robot by and static value or a function on the model used to code emotions Le Tallec & all 2009.

3.3 Emotion in Communication

In the EmotiRob project we already coded emotions in sentences and we believe that on the same ideas it might be possible to code values defined in the previous section.

Coding Emotions in a Sentence

The language is coded has follow Le Tallec & all 2009:

<noun> coded by a static emotional number « à priori »

Wolf = -2 very negative emotion

Mother = +2 very positive emotion

<adjective> coded by a function

Pretty = X → X + 1 this adjective increases the positive number of the associated noun

<verbe> coded by a function

Break(X,Y) = (X,Y) → –Y breaking something inverse the broken thing

*Have(X,Y) = (X,Y) → X*Y* the friends of friends are friends …

With this kind of knowledge representation it has been possible to test 178 sentences manually coded by 5 different persons. The response of the system is more than 90% in concord with the reference sentences.

The idea behind the language is to allow expressive communication between not only software agents but also between human and agents. This language takes into consideration aspects such expectations, conditions of success, among other characteristics that are present in human communication. In Berger 2005, the conditions of success and satisfaction are explicitly defined as well as the elements from the conversational background. The thirty two formalized conversation acts are:

Assertive: confirm, deny, think, say, remember, inform and contradict;

Commissives: commit oneself, promise, guarantee, accept, refuse, renounce and give;

Directives: request, ask a question, suggest, advise, require, command and forbid;

Declaratives: declare, approve, withdraw, cancel;

Expressives: thank, apologize, congratulate, compliment, complain, protest, greet.

Connected to this five class of behaviour Berger 2006 define some logical rules to know when one of them as to be applied.

3.4 Personality in Communication

The personality is expressed in the computation of the emotions. So a computational model of emotion is developed in Dang in 2008.

Definition of emotion: an emotion is the process that characterizes the human body's response to a stimulus or event.

By *stimulus* or event we mean: external changes in the environment of the body, absence of external changes in the environment although one expected, and internal body changes.

By *human body response* we mean: physiological changes inside the body, external expressions of the body and also … no change.

Based on this definition we propose the following model in Fig.6.

In this model Sensation is the basic starting point. The sensation is generated by an event, something which really exists or not, but which generates a physiological change in the body and/or by sending subjective information (from Intuition) to the sense-organs: touch, hear, see … This sensation will be processed in two ways.

First, the Physiological Interpretation will directly interpret this initial signal into a body reaction (the heart races …) and will also alert the module Behaviour.

On the other hand, the Cognitive Interpretation will interpret the signals received from Sensation into cognitive information about the environment situation.

The Behaviour will then calculate the response from the information coming for the perceptions based on the Internal Cognitive State. This response is sent to the Body where the physical reaction will take place.

The MBTI model of personality, proposes four categories to build personality. Our model completely covers these four categories. The first one is the attitude splited in Extraversion (E) or Introversion (I). In the generic model this particular feature is integrated in the Mood and Behaviour modules. Secondly, perception category of the MBTI is completely covered by the generic architecture.

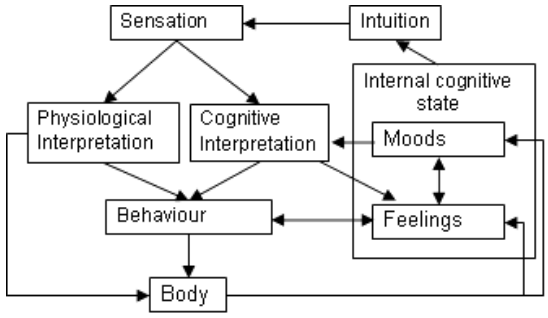

Figure 6: The Grace model of emotion.

The Sensing is constructed with the two Interpretation modules and the Intuition by the Intuition module. Then, the third category is decisions: Thinking (T) or Feeling (F). We cover these two approaches by the way that the Behaviour module of the generic model is coded. Last category of MBTI - Judging (J) or Perceiving (P) can be coded at the Interpretation level. In fact, it is a level of interest for the sensation that will be used. For instance, a sensation directly concerning a person will be more interesting for someone who is Perceiving.

4 EXPERIMENT

In this part we want to report on the introduction of a part of the socially acceptable parameters defined previously, in real systems : one robot and one ECA.

4.1 On Emi Robot

The Emi robot is a fully autonomous robot designed in the ANR EmotiRob project to build emotion interaction with children.

A full description of the robot and its realization can be find in Saint-Aimé 2010. It is a 10 degree of freedom robot : 2 for the eyesbrow, 4 for the mouth, 2 for the head and 2 for the body (pan-till).

In this first experiment we want to measure the recognition of emotion on the Emi robot (figure 7). For this experiment, children around 10 years old are the human users which, for a series of sentences given, will determine the emotion expressed by the robot. We used the Wizard of Oz technique to make the child believe that EmI it understanding the dialog.

Saint-Aimé 2010 shows that the emotion recognition is very good and that the behavior of the robot is credible. One question is not solved behind this result is what is the part is the human

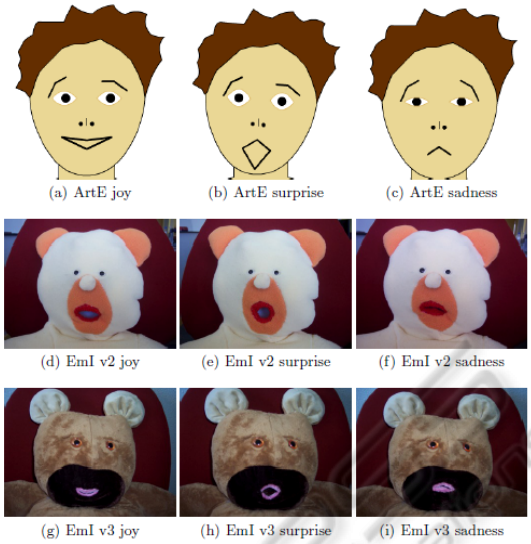

Figure 7: Emi robot and simulator.

believes in this result. Indeed the human can see in the robot what he is expecting even is it is not the real intention of the robot.

4.2 On ECA

The general goal of researchers in the field of Embodied Conversational Agents (ECAs) is to develop interactive systems that are more natural and easy to use, closer to the human user. ECAs must be *credible* or "believable", the most general of these terms, used to describe anything we accept as true, even in the absence of absolute proof. Ortony 2003 said that a major question is how to make an agent a *believable* agent. Bates 1993 explained the crucial role of emotion in believable agent. Thus, ECAs must be endowed with refined communicative capabilities and the challenge is to build ECAs, which are capable to reason about emotions, to predict and understand human emotions, and to process emotions in reasoning and during the interaction with a human user.

In the ANR CECIL project (Complex Emotions in Communication, Interaction, and Language), we endowed an ECA with the capabilities to express its emotions by means of different modalities including facial expressions, gestures, and language. We merged speech act theory, emotion theory, and logic.

We used the logic in order to provide a systematic analysis of expressive speech acts, that is, speech acts that are aimed at expressing a given emotion (e.g. to apologize, to thank, to reproach, to rejoice, to regret, to deplore, etc.). A description of the expressive speech acts can be found in Guiraud

2011. We put forward a *Multimodal Conversation Language* that enables agents to form expressive dialogues, mainly deliberative dialogue such as negotiation, advice seeking, bargaining and setting up appointments. Part of the thirty-two expressive conversation acts described in Berger 2005 has been used to constitute this language. We are currently experimenting the language on small dialogue scenarios between the Greta ECA (figure 8) and a human user. A preliminary evaluation of this experiment shows that the agent communicates its emotions during the interaction and tends to be "credible" with regard to the human user.

Figure 8: Greta ECA see Guiraud 2011.

5 CONCLUSIONS

In this paper we propose to discuss social credibility for human acceptance of intelligent environment. We propose to implement this with three different levels of shared knowledge, values representation in knowledge and with emotion and personality expression in communication. We report on some preliminary experimentation in this field.

ACKNOWLEDGEMENTS

A part of this work has been realized with the support of the French ANR agency under the Psirob project and the CECIL project.

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