From Extensity to Protensity in CAS: Adding Sounds to Icons

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Abstract. Being aware of the gap between technological offers and user expectations, the paper aims to illustrate the necessity of anthropocentric designs ("user-pulled") and to reveal the dangers of current ICT designs ("technology-pushed"). Since the gap is deepened because of insufficient innovative use of new agent-oriented technology potential, an affordable manner to "invent new Computer-Aided x" application domains is proposed. To substantiate the approach, the domain must be challenging, easy to implement and "as humanist as possible": Computer-Aided Semiosis (CAS). On this background, the paper also presents a new and challenging concept in IT applied research, borrowed from psychology and meant to assist the process of semiosis: protensity. If the prior researches focused on images and implicitly on extensity (i.e. extensity versus image-based messages; protensity versus sound-based messages), the idea is to extend CAS through innovative attributes, in line with music-oriented user expectations. Thus, the paper refers a newcomer in agent-oriented technology: the Protensional Agents (i.e. interface agents represented on the screen as pseudo-avatars). The paper concludes that CAS is a pathfinder for other researches in this field and the concept of CAS could be used for immediate applied research. Moreover Smart DJ is a good example also for the applicability of CAS in the field of protensity-based messages.

Keywords: Computer-Aided Semiosis (CAS); Anthropocentric trans-cultural interface (ATCI); Protensity; Virtual Disc Jockey (VDJ).

1 Introduction

A relevant indicator of the relationship between users and agent technology is that even very educated people don't realise the peculiarity of the frequent question (with a lot of variants): "What agent is better?" Strange is not the question itself (for instance, the price-performance ratio can be critical for anyone) but from the weird prioritisation: very few users ask such questions after having answers to more burning ones such as: "What could I expect from agents?" or, at least, "If I need something, how could agents help?". Scared by esoteric acronyms, "technology-pushed" users are sure that some of these unknown beasts will invade their lives (the only palliative: choose a palatable

one). Such "technological determinism" is not distinctive for agents but here the impact is paramount. In this regard, Protensional Agents (PA) could indulge user's demand by introducing protensity-based semiosis [7], [11] in communication. As Dunlap depicts in [9] "extensity is related to space as protensity is to time"; therefore one can assume that if protensity is more likely to be related to sound-based messages due to its progress in time [7], extensity subsequently can be considered an important characteristic of image-based messages (see Section 3). Hereby, extensity can be associated to images taking into consideration the mechanism through which the human body can easily be aware of being burned, to give just an example, in a blink of an eye, owing to the nervous system. In the same manner an image-based message would transmit an idea in a split second helping this way the user to understand the transmitted message; accordingly, "a picture is worth a thousand words and an interface is worth a thousand pictures" [12] as Ben Shneiderman inferred.

User impact of agent technology. Oddly, some of the user impact of ICTs (Information and Communication Technologies) stems from reversing three questions: "What for?" (the aim: the needs to be addressed); "What?" (the architecture: prospective application portfolio, features, pros and cons, etc.); "How?" (the structure: technological basis best suited to the applications). Thus, the paper tries to redress the balance from an end-user stance, proposing a user-centred one: "What for?" (to get help easy, fast and almost for free); "What?" (the new application domains become affordable); "How?" (a rather different stance: users should impose their needs instead of surrendering to ICTs). Hence, the negative impact of ICTs is partially rooted in the uncertainty caused by the inability to assimilate the magnitude, complexity, diversity, and pace of new ICTs (above all, agents [1]). On the other hand, increased possibilities to interact with other humans or agents have a definitely positive impact. Clearly, such features widen substantially the field of existing application domains and ease the emergence of new ones (as shown below). Thus, the impact (positive or negative) is wrongly attributed to agent technology per se, since it is due rather to its applications.

Motivation. The myth of "inexorable technological determinism" (never truly dead but revived by each powerful technology, such as agents) can be expressed as "modern technology is dangerous for human values; hence, it should be avoided or at least denounced". As "Zeitgeist"-component, such myths, widening the gap, impair trans-disciplinarity [10]. A possible solution: an anthropocentric perspective.

To be relevant the endeavour should address a noteworthy real-world problem: Trans-cultural interfaces, i.e. interfaces able to merge the two complementary premises of a communication between humans belonging to different cultures within the EU: preserve cultural identity; create a common denominator between national identity and the European one. The threads (connotation: train of thoughts) try to explain the need as well as the principles of user-centred design, considering the macro-features promoted by agent technologies. The trends take into account the near future, extrapolating current developments. Finally, describing the threats is the very means to give a warning that the ground is treacherous. To be credible the caveat shall refer to well known and blatant situations; hence, the approach must be based on (counter)examples from a challenging, easy to implement and "as humanistic as possible" domain. Unable to find an appropriate domain, the paper proposes an original, non-existing one: Computer-Aided Semiosis (CAS).

History. The history (before 2004) of this undertaking includes three distinct but inter-related fields: anthropocentric systems; affective interface agents; threats related to the deepening divergence between ICTs and their end users. (Twelve related papers are referred to in [2].) The history (2004-2007) includes some papers in Romanian and calls to more political will to confront the threats regarding e-democracy and trans-disciplinarity [3], [6], [10]).

After the WSEAS Conference in Crete (July 2007), where non-algorithmic e-Learning [16] and CAS were rather loosely related – through their similar approach to visual ontologies – the research attempts now to bring the two fields closer, via a long-range, agent-oriented undertaking: protensity-based semiosis (a main target of [8], described in [7], having e-Learning as application sub-domain [4][5].

2   Approach: Examples Not Models

Why "examples"? Why can the ideas not be exemplified, as usually, by a functional application and why is it necessary to resort to small pieces of virtual applications as examples? Because of:

- "e-Zeitgeist" repercussions: any application shall be a) "just in time", b) extend-able for global use, and c) responding to a socially significant, genuine, and rele-vant user request/need.
- Commercial inefficiency of "solutions in search of problems": before any request, applications must be designed and eventually implemented as fractions with a lim-ited scope, having just enough functionality to become suitable examples. Any pol-ished design is counterproductive.
- The previous reasons are even more pertinent for an innovative domain yet in em-bryo where the request itself is fuzzy.

Why Computer-Aided Intellectual Activities (CAx)? There is always a "new fron-tier" (new research horizons at hand): as regards anthropocentrism in IT an old battle-field exists from the early 70's. Thus, the role of algorithmic reasoning transcended the borders of narrow data processing, penetrating "Computer-Aided x", where x stays for almost any intellectual activity. As a result, "algorithmic reasoning", instead of being perceived as a side effect of "analogue humans loosing the battle with digital computers", became a deeply rooted reasoning paradigm. (Thus, an innovative ap-proach is welcomed [6].)

Why Trans-Cultural Interfaces? The reasons are linked and somehow embedded. The essential one is that ICTs (mainly broad-band) allows an easy implementation of multimodal interfaces. Besides, the broader "Perceptual Bandwidth" (name for the palette of sensorial experiences accessible to humans) obtained as a consequence al-lows the use of also other languages than the spoken/written ones (for instance, body language) [1].

Because users could be assisted by agents in many intellectual activities a sine-qua-non step is to develop affordable and purely software agents able to interpret, evaluate and process protensional and extensional information contained in multimodal mes-sages – in both image-based and sound-based messages.

Such agents must have a "human-like" temporal dimension, action-oriented and highly personalized.

3   Architecture

 In the intention to narrow the existing gap between the two stances – the technocetric perspective and the anthropocentric one – tools must be created to make the most of AOSE. Main macro-architectural feature: translation will progress from textual, semantically correct, to multimodal, culturally adequate, based on common concepts and "grammar" (rules to combine them into meaningful sentences).

The ATCI should be able to "translate" the terms using tools designed by a trans-disciplinary team. The example in Figure 1 illustrates a correspondence depending on the conversation context (for instance the moneybag put at the right of the apple symbolises a stock exchange context for Apple Computer Inc., Figure 1.a, whereas the same moneybag at left symbolises the market price, Figure 1.b).

The apple is chosen as (counter)example since:

- As an item per se (fruit) it is known all over Europe (apple = pomme, Apfel, mela, manzana ...).
- Being known from prehistoric times it generated a lot of metaphors, symbols, sayings and even traditions (apple alone = fruit, associated with snake = temptation, associated with arrow = struggle for freedom or even the image of Wilhelm Tell).
- Linguistic and/or cultural differences are imprinting a particular style in speaking (connotations, subtlety of language) and, moreover, the use of such metaphors stemming from different cultural environments and heritages. Some of them are common to almost all European peoples (e.g. the apple symbolising or suggesting: temptation, computer logo, and so on, see Figure 1 and 2).
- Nevertheless, some of those metaphors are rooted only in some regions or, if they are widespread, they are relevant only for subpopulation with a higher degree of education; thus trans-cultural interfaces help against distorting the "intentions" (according to Eco: "intentio auctoris", "operis" and "lectoris"). Otherwise, the 'intentio lectoris' could be so altered that the communication process is a failure [2] (see Figure 2).

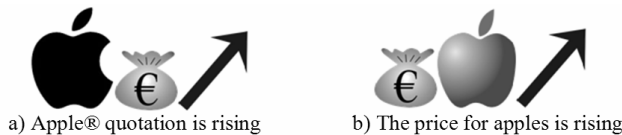a) Apple® quotation is rising   b) The price for apples is rising

Fig. 1. Two ways to 'translate' the item apple as 'common denominator' metaphor

- Figure 2 is meant as a counterexample, revealing the necessity of anthropocentric interface design. Thus, if the conversation context is "struggle for freedom" the cultural differences between the continental German cultural tradition and the English one cannot be neglected: the apple (suggesting Wilhelm Tell) had to be put in correspondence with a bow (suggesting Robin Hood); otherwise, treacherous equivalence can destroy the communication process.

a) Wilhelm Tell   b) Robin Hood

Fig. 2. A third way to 'translate' the word apple. The apple and arrow icons usage taking into account cultural differences.

Considering the fact that people from different countries tend to accept diverse kind of icons depending on the nature of their design (from realistic to abstract), the images in Figures 1 and 2 are only partially abstract. Special attention must be paid when designing such an interface, first of all to the icon sets used. As shown in [13] icons are straight-forward when they represent nouns or objects but rather hard to understand when representing actions or verb forms. Also, designing new icons can be a threat because they can lead to a potentially confusing situation where different symbols have the same meaning or, vice-versa, have different meanings in different cultures; thus, existing icons should be used whenever possible. That is why transcultural interfaces are difficult to conceptualize albeit they are easy to implement.

Figure 1 is somehow inspired also from ancient Maya communication techniques, where more subtle differences can be expressed: semantic value is assigned to the iconic space itself. The icon relative position has *syntactic* role (in line with ontology rules) and *semantic* role for CAS (to reduce the differences between 'intentio auctoris' and 'intentio lectoris') as depicted in the Figure where the icon pairs 'moneybag + apple' and 'apple + moneybag' have different meanings. This kind of multimedia ontology based on visual rules can be further enhanced by using animations instead of images.

Recent Modelling. The last developed model is a VDJ (Virtual Disc Jockey) [7] as a response to the modern tendency in music devices to be designed for a larger audience.

Smart DJ should show that *music* and *agents* are linked through their intrinsic *process* nature and as a result, both *semiosis* and *protensity* become vital in agent-oriented research. *Smart DJ* can automatically choose the songs that are going to be played by "hearing" and interpreting the audience's reaction to the type of music previously played.

It uses a microphone to listen to the sounds emitted by the audience/listeners and tries to determine if they mean acceptance (applauses) or rejection (hoots) of the most recently played song.

When a song is accepted or rejected, Smart DJ analyses its attributes to find out the cause (pace, rhythm, etc.). This real time adaptability can be done for example, by playing another song that has one or more similar attributes and observing the audience's reaction it must be interpreted accordingly. Of course, the lack of any reaction (considering in this context, total or partial silence) must be interpreted [7] [8].

Another model illustrating – albeit implicitly – protensity based semiosis is VISON (*VIrtual SOcratic Nurse*) [4] [5].

Both VDJ and VISON are modelled with user-friendly interfaces and agent-oriented software.

4   Conclusions and Intentions

The modular nature of the experimental model at this stage does not allow drawing clear cut conclusions as regards end user evaluations. Thus, the conclusions refer to the approach and the architecture.

- Agent technology, as both stage and trends, is in line with user information and communication requirements. It increases substantially the effectiveness of existing CAx domains and facilitates the emergence of new ones.
- The new domain of CAS responds to actual trans-cultural communication needs for both wide-ranging EU targets and confined bilateral translation. Research in this area must be trans-disciplinary (if not yet in content, at least in spirit and profile) and anthropocentric (in perspective).
- Users should press for a brand certificate ensuring "User-Need inside" (instead of "Intel inside"), to be awarded only when the interface is designed involving them from the beginning (applying the Scandinavian method or the ethnographical one).
- Protensity as message attribute is a motivating research topic both per se (in particular, for music-related activities) and as test bench for agent-oriented software. In this context, the VDJ toy-model presented shows that the approach is both workable and affordable with scarce resources because – albeit quite simple – the VDJ reacts in a relevant manner to audience stimuli.
  The following intentions are strongly dependent on possible collaborative work:
- Refining the "apple" example and proposing other relevant pairs of (counter) examples, based on "visual ontologies" shared by agents and humans.
- Founding a framework for CAS as CAx research sub-domain and in particular for: a) helping simultaneous translations in EU meetings; b) improving current e-Learning interface agents (i.e. considering eMaieutics to be more than a starting point in this trial).
- Developing more advanced models of Protensional Agents for different music-related user activities like a *virtual guitar teacher* or a *virtual musicologist* [7], [8].

Acknowledgements

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