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INTENTION MODELING: A SEMIOTIC VIEW

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ABSTRACT

Human intentions are vague and, in most cases, unpredictable. To create a model adequate enough to create a uniform representation for human intentions, it will be necessary to incorporate semiotics (the study of communication) into already existing methods.

KEYWORDS

Semiotics, Intention Modelling, Intention Processing, Resource Description Framework (RDF).

1. INTRODUCTION

In cognitive psychology an intention refers to the thoughts one has before producing an action (Wegner 2002). In regard to a system, a user intention is what the user expects a system to do. Users have many ways of displaying intentions, which leads to a great deal of ambiguity. Intention modelling is a relatively new field that is concerned with producing clear representations of intentions that a system can understand. Notable fields for intention modelling are web applications (Chen 2002), internet security (Spyrou 1996) and animation (Badler 1993).

This paper aims to provide another perspective on intention modelling by introducing the concept of semiotics, the study of human communication.

Semiotics, in short, is concerned with the study of signs (symbols, and their representations, such as visual depiction) and their effect on social life, and it encompasses verbal and non-verbal communication. It was independently "discovered" by a Linguist, Ferdinand de Saussure, and a Logician, Charles Sanders Pierce in the early 1900's. Their work was further extended by Ronald Stamper who proposed the 6 level semiotic framework (Stamper 1991), that will be discussed in the next section. Semiotics has been applied in a variety of areas, notably media studies and social sciences. It has also started leaving its mark in the computing world resulting in the emergence of computer semiotics (Andersen 1990).

There are many benefits of using semiotics in this area, as the transmission of intentions into a system is a form of communication, and many methods of human communication are applicable to human computer interaction.

Previous work (Connolly 2001) in semiotics and human computer interaction (HCI) considered how the principles of user system interface design (USID) fit into Stamper's framework of organisational semiotics. This was done by applying the levels of the framework to the most popular guidelines for HCI, Shneiderman's golden rules (Shneiderman 1998), and Shneiderman's Object Action Interface (OAI) model. The overall aim of this paper was to build an evaluative framework that could tell what a good user interface was or how well a specific user interface communicated.

1.1 Aims

The aims of the present paper are two-fold:

- To create a model that represents the user's needs.
- To use the model to communicate the user's needs to the system.

2. METHOD

The present paper seeks to extend the work of Connolly et al. (2001) further by considering the role of user intentions in regard to the system and how a semiotic framework would facilitate this. The main difficulty in dealing with intentions is that there are numerous ways to state them, and in most cases the methods of stating them are very vague. For example, a person can communicate that they want to be warm in many ways, either by shivering, or saying "I am cold" or just saying "I want to feel warm". It is difficult to extract the intention from those actions or words, without understanding the context, because in most cases, the stating of the intention and the actual intention are two very different things.

Previous examples of intention modelling show that intentions can be gathered and used in many ways. For example in the works of Spyrou et al (1996) and Chen at al (2002) intentions are gathered by observing users' behaviour on a computer and using pattern recognition. In AnimNL (Badler 1993) instructions (from user manuals) are used as well as training sets. Collagen (Rich 2001), a project by MERL ,achieved goals by collaboration: user and computer pooled their knowledge and worked together towards a similar goal.

All the above are practical techniques of working with intentions. But a clear communication model is needed to understand the intention first, which is where semiotics comes in useful.

As discussed in the introduction, semiotics encompasses verbal and non-verbal communication, making the semiotic framework adaptable in so many areas. The framework this paper is concerned with is Stamper's (Stamper 1991) model, it terms of which all types of communication are divided into six levels:

1. Social World: The social context of the interaction.
2. Pragmatics: The resultant achievement of the user's intentions that lie behind and motivate the communicative activity.
3. Semantics: The meaning of the communicated message.
4. Syntactics: Elements, structures and rules that form expressions.
5. Empirics: The physically observable activity. In the case of interpersonal communication this consists of the movements of speech organs, the acoustic patterns in the speech signals and the neural activity in the auditory system. In the case of computer based communication this extends to the movements of the fingers in activating the keyboard and the electrical signals that flow within the system and across the network.
6. Physical: The physical support or basis for the communication. In the case of interpersonal (human-human) communication this is the anatomy and the physiology of the speakers and the air between them. In the case of human-system communication this extends to the hardware of the networked system.

Intentions are analysed at the levels of the Social World and Pragmatics. These supra levels (Connolly, 200?xxx) are where communication context forms part of the analysis and an intention could be seen as a desire to change the current context, for example:

- "I want to be wamer" introduces the fact that the room is cold – contextual information and expresses the desire to change the temperature.

- "I want to watch the football" suggest that the television is not currently showing the football and that the channel needs to be changed.

In order to realise a successful implementation of an intention modelling system, a computing environment is needed that involves its users in many forms of communication. For our purposes we consider ad-hoc collections of computing devices that are working together to support users within their environments. Therefore a simulated house was created to test these ideas. The reason for choosing a house is that it contains a large collection of devices that can be combined in many different ways and provide numerous plans to choose from at any possible time.

The devices could consist of:

- Traditional computing devices - PDA, PC.
- Home entertainment devices - DVD, TV, Hi-Fi, etc.
- Other home electronics: security, cooking, washing.

We anticipate expandable computer systems where, newly purchased devices carry within themselves semantic information to describe the services they offer. This information is then shared with the other networked devices, and between them they can maintain a knowledge base of information about their capabilities and about the environmental context. A common network infrastructure is required that allows for all devices to communicate and for dynamic connection and disconnection. The nature of this infrastructure is beyond the scope of this paper.

The intentions of the system's users can be interpreted as additions to the context. An AI system can interpret the changes to the context-base and, from this, instruct the devices to change their behaviour so that the desirable state can be achieved.

For example: the system can monitor the current temperature and the desired temperature, and control the heating system. If the user makes a sign indicating the intention "I wish it were warmer", either by speaking or pressing a suitable button, then the context will change and the desired temperature would go up. The AI would then need to reunify the context, but adjusting the heating systems to warm up the room.

A successful system would be able to capture an intention, give it a uniform representation, then proceed to breaking it down into simple commands understood by the system.

The intention modelling would need to be separated into two sections. First, intention capture is concerned with inferring the intention (whether it be speech, action or command-line based) and all the information about it, then giving it a formal representation. Second, intention processing takes these representations of knowledge and converts them into commands understood by the system.

Many factors affect the way intentions are processed. A rule-base is needed to store information about how things work in this specific environment; this starts with a set of basic rules but expands through practice. Some form of machine learning will be needed to learn from a user's behaviour. Also, for a realistic discourse between user and system, information about the environment needs to be shared between them, and therefore a context-base will also be needed. In the case of a house, the context-base stores information about what devices are located in the house and what is their status.

A lot of information is stored and passed around in this system. This information needs to be stored in a meaningful fashion, which is why the Resource Description Framework (RDF) was selected as a method of storage. This is a meta-model language that stores both the text and its meaning. It stores information as a collection of triples made up of a subject, predicate and object. This allows the system to have some knowledge of self and the ability provide information when needed.

To demonstrate how these components will work with each other, take the example of this intention:

- "I want to watch BBC1 in the lounge."

To analysis this statement we split it into parts:

- "I want" which indicates a desire and therefore an intention that something be changed.
- "to watch BBC1" to see a particular TV channel.
- "In the lounge" in a particular room.

This can be represented as the following triples:

- User watch BBC1
- User in Lounge

These can be conbined with information in the context-base describing the location which would hold technical information such as:

- BBC1 isA Channel
- Tuner for Channel
- Tuner sends AudioStream
- Tuner sends VideoStream
- Tuner canbesetto Channel
- TV accepts AudioStream
- TV accepts VideoStream

And contextual information such as:

- TV in Lounge
- User in Lounge

This leads to an intelligent system making the following actions: changes to the context are shown in brackets:

- Set Tuner BBC1 (Tuner setto BBC1)
- Connect Tuner VideoStream to TV (Tuner sending VS) (TV receiving VS) (VS is VideoStream)
- Connect Tuner AudioStream to TV (Tuner sending AS) (TV receiving AS) (AS is AudioStream)
- Power Tuner on (Tuner is on)
- Power TV on (TV is on)

3. CONCLUSION

The semiotic approach allows the context and the intentions of the communication between the user and computer system (or systems) to be considered separately from the formal mode of communication, which forms part of the lower semiotic layers.

There are several advantages to be gained through adopting a semiotic approach to intention modelling:

- The semiotic framework accommodates any mode of communication (Connolly 2002) whether it be speech-based, action-based or command-line.
- The framework applies equally well to user system interaction as to communication inside the system (including communication across a network).
- The framework encompasses all the different facets of communication (including the context) and not just the physical hardware aspect, and it covers all forms of language (natural, formal or nonverbal).
- Semiotics naturally accords with the holistic, systems approach to problems and their solutions.

The main limitation is that semiotics does not offer any specific method of system implementation. However, within the organisational semiotic community, much work has been done on producing and enhancing frameworks and procedures for the requirements-capture and modelling stage of the system development process, for example the works of Liu et al. (2000), (2001) and Charrel et al. (2005). In the course of the present research project, it is our intention to further this work by developing semiotically-inspired methods to support the actual implementation of systems.

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