SEMIOTIC APPROACH FOR THE DESIGN OF ADAPTIVE GRAPHICAL USER INTERFACES USING UNIVERSAL NETWORKING LANGUAGE

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The growing Internet infrastructures are providing a larger platform for communication among people across the world. The technological advances and the socialization of Internet have challenged web developers to search for new strategies to help the communication among people from different countries. It is a fact that a gap exists between the information and culture in different languages. In order to overcome the language barrier, the Universal Networking Language (UNL) emerges as a new technology that can reduce this problem. Furthermore, the ultimate goal of UNL is to expand education and business opportunities around the world, through a mutual understanding among different cultures based on the translation of the textual media available on the Internet. Although most of UNL infrastructure and architecture is already designed, it is still at an early stage of development. One of the challenges to be achieved during this development process is how to represent the distribution of the same textual content in different languages, considering all the elements of a Graphical User Interface (GUI). It is a huge step for those who are used to deal with GUI for standard web pages to start working with Adaptive User Interfaces (AUI) for different cultures and languages. A GUI that uses UNL technology request a more organized flow to allow users interacts with the application in a friendly and effective way. The authors believe that it is possible to generate a framework to UNL GUIs design, based on semiotic studies for standard GUIs design, besides the requirements for the UNL system. Considering that semiotics covers a diversity of sign-usage like images and texts, it is helpful to the task of interface design. In the case of UNL interfaces, it may contribute to the proper design of textual content, menus and labels, representing the best way to identify the interface elements meanings for a universal understanding. This work presents a semiotic approach for UNL interfaces. It aims to help designers in the creation of more accessible interfaces for UNL applications.

1 Introduction and Motivation

Semiotics has been helpful in providing theories for the user interface design. Therefore, it may be helpful in defining the properties of the UNL system and situating its special interface issues in the context of HCI-systems. Although impressive research about semiotics approaches to user interface design has been made and analyzed, a few number of articles has been leaded introducing UNL technology in order to give a briefing of its task performance. A sort of consideration has being established, but no position have already been verified about the design of a GUI application that uses UNL technology. This new technology aims to share information and provide a common communication environment for different language, but how to assure that this communication will cover well the diversity of special signage of all different languages?

The interface between man and computer works as the interaction media that makes possible this communication. Since this communication is basically visual, the graphics have been playing the most important role to the user-interfaces evolution, which migrated from command-line to desktop metaphor, creating the GUI. To go further, many people expected that "purely visual communication", without the use of words, could become an international auxiliary language, to whom Horn (apud Jacobson, 2000) calls "Universalits". However, says Horn, purely iconic languages do not usually catch the meaning of the information. In fact, the use of graphics is extremely important to communicate, but the most of the concrete information can be communicate only by textual media. It means that the main GUI paradigm still remains on the textual capability and that language is an essential factor to achieve that.

According to Andersen [2], semiotics is an abstraction of individual disciplines such as linguistics, art theory, drama theory and film theory. Since it can be considered a "multimedia" discipline and so computers are, it is useful in designing computer interfaces. However, new technologies such as UNL normally have their own unique interface (or communication) requirements, and it takes time to discover

what they are. Therefore, since a coherent framework is needed to describe then, semiotics can help to achieve it.

Today, any kind of visual and textual information can be communicated to the world through the Internet, independent of the traditional mass media. However, according to Della Senta (1999), at present, most information materials, scientific, technical and educational, are written in English or in a few other languages. While this benefits millions of people, millions more are denied access to these information materials, because they do not speak the required languages.

Considering that a UNL GUI must be adaptive, in order to migrate the information from a specific original language to a requested one, it is necessary to study how make standard GUIs' design principles applicable to them.

This paper emphasis is on sharing ideas about a semiotic approach to the development of UNL GUIs, not only as a try to find a solution for UNL interface systems, but as a way to point up a subject that must be more explored in advanced Interface studies: how to achieve an efficient interface design for AUI. The complexity of AUI was considered by Wayne Iba, Haym Hirsh, & Seth Rogers: "We broadly define adaptive user interfaces as any system that is intended to help a user accomplish some task, and that autonomously modifies its behavior as a result of actions taken by the user."

Among it we believe that the UNL system is a good case to be studied as an AUI, because it introduces a new point of view: it is not a case that the user, developer or administrator has the power to customize the interface, allowing it to be adaptive, but it is a case in which the one user must receive the information transformed without be aware of it, necessarily. Facing such fact we believe this article can contribute for the creation of a UNL GUIs' semiotic framework, as one of the main goals for Tissiani's thesis research. Using the Jakobson's communication model to analyze the HCI approach to interface development, we explain how communication aspects have to be considered by designers of UNL user interfaces.

2 UNL Definition and its Interface Aspects

The UNL is still at an early stage of development and has been rarely found in the literature. A few number of documents were published and their authors have described or simple investigate UNL issues. The reason we adopted the UNL as the main topic of this paper is because 1) we believe UNL is an emerging technology that will be largely used in the Web and; 2) UNL applications require user interface specific techniques during the design process.

One of the main purposes of UNL concerns on sharing information and providing a common educational environment across different languages. According to Della Senta (1999) "The Universal Networking Language is an electronic language for computers to express and exchange every kind of information. The UNL represents information, i.e. meaning, sentence by sentence." Sentence information is represented as a set of directed binary relations, each between two of the concepts present in the sentence. Concepts are represented as character-strings called "Universal Words (UWs)". UWs can be annotated with attributes which provide further information about how the concept is being used in the specific sentence. A UNL document, then, will be a long list of relations between concepts.

It can be said that its main purpose is create documents in UNL format, as a common language to exchange information through computers and generate the conversion to the natural language, with a high degree of precision. "The UNL system allows people to communicate with peoples of different languages in their mother tongue." (Della Senta,1999).

UNL consists on a UN (United Nations) global project of digital and linguistic inclusion. However, its relevance consists not only in the social aspect, but also in the technological one, since it proposes international standards for knowledge representation. In order to achieve a universal standard for UNL content representation, we propose to review some important semiotics theories to motivate a user-friendly interface from the technical processes behind the stage of an UNL application.

3 GUIs and its Aspects for UNL Applications

In order to enhance its use and aesthetic, the GUI may be based on solid interface design principles to provide, otherwise, visual consistency, user control and feedback (Apple, 1996). Besides that, an efficient user interface is the one that allows people to work with the application easily and in an intuitive way, increasing the users satisfaction associated to the work performance (Ambler, 1998).

Therefore, the first step to achieve a successful GUI is guarantee its main qualities: the functional and aesthetics ones. The aesthetic aspect has to do with the satisfaction of the user and is largely important on his acting. At the same time, the functional aspect can be understood as the usability aspect, which concerns the main goal of Human Factors discipline.

3.1 Usability

The usability is described as the main quality of a GUI. Shackel (1993) defines usability as the "capacity of the interface to be easily and effectively used by humans, where 'easiness' is related to a specific level of subjectivity of the evaluation and 'effectiveness' to a specific level of performance."
However, the Human Factors discipline proposes several usability related goal, including the ones listed by Shneirderman (1998): proper functionality[1], reliability, availability, security, data integrity[2], standardization, integration[3], consistency and portability. The most of these goals depends on common issues to be applied for a UNL GUI. For instance, functionality can be assured by usability conditions, since integrity, readability and control depend highly on a consistent visual structure (Mullet, 1996), as well as we can consider that reliability, availability and security depend on the same. However, to achieve an efficient UNL GUI, we must consider special issues regarding AUI. In this case, standardization, consistency and portability are not only necessary to cause benefits on increasing the learning times and annoying dangerous errors across different formats, software versions, platforms or hardware (Shneirderman,1998). For a UNL GUI, these tasks presents other meanings like 1) standardization is needed to assure a common user interface for the multiple languages that a UNL system can display; 2) consistency is the key attribute that may guarantee the visual unit in terms of layouts, color, typography and so on within the multilingual application and 3) portability is the biggest challenge to be achieve in a UNL GUI, since it refers to the potential of convert data and share the same user interface across multiple application environments.

3.2 Standard GUIs design rules applied to the design of UNL GUIs

Shneiderman (1998) give a tip for user interface designers that is very useful in the case of UNL GUIs design: "try to predict subjective satisfaction or emotional reactions". It makes us to remind that many users do not approve the idea, that had been implemented by some international websites, of recognizing his IP, carrying out a special website in his/her official country language, rather then the original one. In the case of a website that uses UNL technology, we believe that the user may have the option of visualizing the original website in its native language, as well as in any other language, and not only in his official country one. It implies that the user may have control on what he wants to see and that he will be secure of all its contents, since he will be able to check its consistency.
Control and consistency are only two of the eight golden rules, presented by Shneiderman (1998) based on his earlier studies. We consider that these are the rules that can assure a successful interface. We consider these rules can help formulate the proposed framework in order to achieve a UNL GUI guideline (Tissiani, 2002/1). They are: 1) Consistency; 2) Shortcuts; 3) Feedback; 4) Closure; 5) Error; 6) Reversal of actions; 7) Control; 8) Reduce short-term memory load.

4 Semiotics Approaches to UNL GUIs Design

Considering that semiotics covers a diversity of sign-usage like images and texts, it is helpful to the task of interface design. In the case of UNL systems, it may contribute to proper design and represent its user interfaces for a universal understanding.
Our first observation regarding the semiotics contributions to UNL GUIs design is that UNL system's communication is a special kind of communication, which, in some way, can be more similar to computer-computer communication than human-computer interaction. Likewise, we feel the need to study semiotics in order to reach the right concept of communication for this case: the human-computer one.
The processes of communication that are investigated by semiotics methods are both the representation and the interpretation ones. According to Andersen (2000), the computational context can be analyzed by semiotics through the representations (the algorithms and data structures as signifiers) as well as through the user's interpretation of these representations (user representations and domain concepts as signified). "Thus, only those parts of the computational processes that influence interpretation, and only those parts of the interpretation that are influenced by the computation, can be analyzed by semiotic methods" (Andersen, 2000). Therefore, we believe that a semiotic study is quite relevant to the conception of UNL application's user interfaces. For instance, depending on the development of the UWs, its dictionaries and

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[1] (Proper functionality): "what tasks and subtasks must be carried out". (Shneirderman,1998).
[2] (Reliability, availability, security and data integrity): "(…) commands must function as specified, displayed data must reflect the database contents, and updates must be applied correctly. (…)Protection must be provided from unauthorized access, inadvertent destruction of data, or malicious tampering." (Shneirderman,1998).
[3] (Integration): "can be considered the integration across application packages and software tools." (Shneirderman,1998).

the other UNL components of an application, its content representation can generate different kinds of interpretation by the user.

Moreover, semiotics theories can help not only to increase communicate in UNL systems by appropriate HCI techniques, but also by an adequate study of its programming. To Philip Armour (apud de Souza, 2001) the software is not a product, but a media, where our knowledge is encoded. We believe that in the case of a UNL system this insight is quite applicable and that is one of the reasons why we need to study semiotics to improve the power of UNL system's communication.

4.1 A model of communication

Ronald Jakobson proposed a model based on his earlier studies on linguistics that has powerfully affected communication related disciplines since its first publication in 1960 (Jakobson apud de Souza, 2001). In his work he identifies six basic constituent elements of natural communication: 1) sender, 2) receiver, 3) message, 4) context, 5) medium and 6) code.

Using the Jakobson communication model, we observe how its communication functions can be well applied in the human-computer interface design and we propose that some of its functionalities may be better studied and evaluated in order to achieve an interface effectiveness to an UNL system. According to De Souza (2001), Jakobson "called our attention to the fact that natural language can be used to achieve specific functions associated to each one of these constituents". For example, we can use language to check if the receiver and the sender are functional, and so on.

We think that all of this communication functions are pertinent in the case of a UNL GUI. However, in agreement to Scalis i (2001) that proposes in her thesis research "A Semiotic Communication Model for Interface Design", based on Jacobson´s model, we consider that the function of the sender must be better studied in a HCI perspective, specially in the case of UNL interface design. Therefore, we will make a sort of consideration about this factor.

It is a fact that there isn't any communication without a receiver and that the meaning of a message is defined by the receiver's interpretation (Scalisi, 2001). Therefore the receiver plays a central role in our field of research as well as Scalisi (2001) proposes to the field of HCI in general. Since HCI has extensively studied the user as the center of design process, we think we can take their methods for better reconize the user and develop his interface in an effective way, like the user observation, usability evaluations, cognitive studies on human understanding, etc.

Semiotic HCI defines interfaces as messages sent by the designers to the users (de Souza, 1993). But, in the case of an UNL GUI, will the user perceive that the designer is the sender or they will think that the real sender in this communication is the computer? According to Scafisi (2001), "The interface system is a world of signs in which we operate and manipulate, but sometimes computer also "speaks" to us (…) The point is that we should better clarify to the user, through the interface, the characteristics of this special sender (the computer) in order to avoid interaction problems derived from the misunderstanding of the sender's function." Our research aims to point the designer and the computer's function as the sender of the message in a UNL GUI, in order to avoid user's meaning misinterpretation.

4.2 A Propose of an Evaluation Method

According to de Souza (1993), "given the nature of computing machines, we can rightfully expect semiotics to have a word to say not only about HCI, but also about programming and computing as a whole" (de Souza, 1993). Moreover, de Souza (1993) says that the notion of computational communicability is the property of software that efficiently shows to users its underlying design intent and an interactive principle, which means that the designer must efficiently transmit the message to users, allowing then to interpret meanings in a consistent way.

Based on this notion, we believe that the best way to improve our knowledge about the UNL GUIs requirements, in order to achieve a good communication between designers and users, is to propose an evaluation method. This evaluation is based on de Souza´s method (2001) and may tell designers how well their message is getting across to users, as well as identify communication breakdowns that may appear during the interaction with an UNL system. "As in most evaluation methods, the test involves a set of tasks, and a digital recording of all users' interactive moves to achieve the goal associated to each task". (de Souza, 2001).

The evaluation may take place within a case study that is to be presented at ICTE 2002 (Tissiani, 2002/2). The case study brings UNL into an application, which has been developed for a Distance Learning course, by both Virtual Reality Laboratory (LRV) and Distance Learning Laboratory (LED) at UFSC. It has been implemented modules that allow the visualization of the program in three languages: Portuguese, Spanish and Italian. Our future work is to model the evaluation method proposed and apply it to the interface application.

5 Conclusion

By putting in evidence some questions about a semiotic approach for UNL GUIs design, this paper presents the earlier studies that compose the main subject of Tissiani's thesis research. The research emphasis is on sharing ideas about a semiotic approach to the development of AUI as a way to point up a subject that must be more explored: how to achieve an efficient interface design for AUI that autonomously adapts its appearance as a result of system's actions and not by user's one.

We establish Shneiderman's taxonomy as the basis for the HCI case study diagnosis and we propose an adaptation of de Souza's method of communicability evaluation, based on Jakobson´s one, as the model to analyze the case study. The semiotic approach may support an effective study of UNL GUI design, and guarantee the activeness of usability and the assuredness of the 8 golden rules exposed in section 3. As a result, the research may collaborate to establish assessments criteria's for the design of UNL GUIs, in the form of a guideline.

Starting from the issues presented, it is possible to describe a number of techniques that may also be considered in order to help the construction of the proposed guideline. Some of the techniques that can complement this study are listed bellow:

- **Graphic Design Principles**: Since language can also be considered a graphical media as well as images, the UNL GUI principles may be based on graphical design. Studies on visual communication discipline are essential to assure both an efficient communication from designers to users as well as from the user interaction back to the system. The theoretical approaches to graphical design include insights on layout, colors, typography, signs and all the specific screen elements common for different languages.
- **Cognitive aspects and Ergonomics:** The study of appropriate colors, fonts, forms, icons and other elements of design that better work as international standards. Moreover, these elements may assure the screen to be easily readable, besides helping those who have some visual disability. Visual aspects related to cognition should also be carefully designed in order to obtain a satisfactory rate during the use process.

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