Gathering Interaction, Interface and Aesthetics Considerations in Product Design

Analyzing devices related to the accessibility of heritage

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***Abstract*—Interaction aesthetics is a substantial part of the design process of products and devices, especially those related to enhance the accessibility of heritage. This paper offers a perspective on the breadth of the concept interactivity through an extensive literature review and analysis of some of the areas closely linked to the concept: the wayfinding experiences, the visual and tactile perception of devices and the computers' user interfaces. All these will help to evaluate the efficiency of existing products, in order to outline some directions that allow designers to develop new devices that make information and cultural content accessible to all users. We analyzed the most common devices used in cultural heritage sites, based on various parameters relating to the level of interactivity. The main results show that most devices are dynamic and designed to facilitate mobility, but they are not interactive. Therefore, designers must continue their work in this direction.**

Keywords- aesthetics; interactivity; interface design; product design; built environment

I. INTRODUCTION

The concept of interactivity has become worn and trivialised in recent years, due especially to the enormous quantitative leap in the field of domestic technology. Any electronic device with an interface appears to take on the characteristic of being interactive, and the term is often simply a feature added to product advertising as a commercial strategy. Many of these devices are presented as being accessible and interactive, but in most cases the relationship users manage to establish with them hardly helps to access content or understand the device, so that sometimes the activity of the device is limited to offering a simple reactive response to a stimulus. This lack of definition of the term creates difficulties when it comes to assessing, comparing or questioning interactivity as a quality in object design. It also comes into serious conflict with interaction aesthetics because the opportunities for developing the aesthetic component will depend on factors intervening in the interactive process (object-user-context).

In view of the above, there is a need therefore to establish the limits of the term interactivity and study its real scope for the user in the process of relating to objects and the contents they offer. This work aims to reflect the concepts which intervene and merge in the subject of interaction differentiating three main levels to which the term refers, for better understanding of its particular interest for proposing or considering interaction aesthetics as an integral part of the design process.

Another stage of research and analysis would attempt to focus on the design of accessibility products, which provide an appropriate level of interactivity required to ensure that specific groups of users can use and understand given contents. Nowadays, accessibility involves planning interactive resources. Designing access to a functional, cultural or information resource involves considering the real figure of the user. Users can only participate in content and enrich their knowledge by establishing interaction with devices and experiencing correct feedback. It is worth asking to what extent current devices effectively ensure that access and which devices are more suitable in certain situations.

By identifying and clarifying interaction types, it will be possible to organise typologies of accessibility products in general and consider in particular products intended to bring heritage sites closer to the visitor.

The structure of this paper starts with the definition of interactivity and the study of the relationship with the concept of wayfinding. Then we analyze the influence of aesthetics in the interactive experience and the connection between accessibility, interface and interaction design. Finally, the paper ends with a classification and analysis of the most common devices related to accessibility to heritage. The strong and weak points in each design can be observed and identified to establish directions for future projects.

II. DEFINITION AND LEVELS FOR INTERACTIVITY

The simplified idea of interactivity as a stimulus-response cycle is very widespread but is somewhat limited as it identifies reaction with interaction without considering the extent to which feedback is involved. Any interaction refers to an information exchange and this happens when a user input has to produce a device output which in turn will condition the following input. Researchers who have referred to this basic interaction model include Maldonado and Bonsiepe, who proposed the idea of the feedback loop

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between machine and user [1]. Norman's more recent interaction models are based on that same idea [2].

Interactivity is a complex concept related to communicational exchanges which can involve human, objectual or electronic agents at the same time. Shedroff refers to the need for at least two independent participants in any interactive process, so that the response generated by one action provides relevant information and motivates a subsequent action [3]. Rafaeli has defined interactivity as 'an expression of the extent that in a given series of communication exchanges, any third (or later) transmission (or message) is related to the degree to which previous exchanges referred to even earlier transmissions' [4].

In view of the above, interaction can be defined as a process of continuous action and reaction between two or more agents who participate alternately, helping to create experiences through the information exchange.

Taking into account these theories which relate feedback to the interactive process, very different situations can be found. In particular is the fact that firstly many objects are used in a basic, unilateral way, without exploiting their particular features. Secondly, other products and devices intended to make content accessible do not offer the possibility of establishing a valid dialogue between user and system.

In a first step towards establishing a classification of interaction levels, there is an interesting proposal [5] that distinguish between two types of systems: static systems, which cannot act on their own or influence the environment and dynamic systems which act and influence the environment, either from mere reaction to a stimulus or from a more complex interaction. Thus, objects which admit manipulation and react to it are dynamic, although not all such objects can be considered interactive, because guaranteeing user response is not enough.

Another main characteristic of interactivity is the opportunity for the user to act on all the agents involved in the process. As Liu and Shrum [6] pointed out interactivity can be defined as 'the degree which two or more communication parties can act on each other, on the communication medium and on the messages and the degree to which such influences are synchronized' (p. 54). Similarly, Bettetini's definition highlights the multidirectionality of interactions, the user's active role in choosing the required information and the particular pace of communication [7]. Three typologies of interactivity can be established according to these agents:

- According to the level of control over structure and content [8]: reactive, where the user has little control over structure and content; coactive: provides control over sequence, pace and style; proactive: control over structure and content.
- According to the relationship between messages [4]: not interactive: a message does not relate to a previous message, reactive: a message relates only to the previous message, interactive: a message relates to the previous message and preceding messages.
- According to the participant agents [9]: user-machine interaction: the computer must respond to user actions, user-user interaction: communication between persons, user-message interaction: skill of the user to modify messages.

Thus, any discussion of interactivity involves considering these three areas and qualifying the degree to which the user manages to influence and modify each aspect related to the process.

Interactivity, as a communication-related phenomenon, is linked to the acquisition of knowledge and the development of cognitive skills [10], and so it is important to ensure correct design of interactive resources. From the point of view of the product, interaction is the physical relationship a user establishes with a given device or object and therefore interactive design must consider various disciplines such as usability and ergonomics.

Usability brings us back again to a broad conceptual framework. Its definition [11] shows that interactivity and usability share the same consideration towards the figure of the user, whose special features should be studied to gain a better understanding of the interactive process.

III. INTERACTIVITY AND WAYFINDING

Wayfinding originally meant orientation in an urban environment by interpreting signs [12] and has been expanded to include all inner orientation strategies in an architectural space [13], with reference to maps and directories. Assimilating this information is key for making decisions about where and how to move around and putting the decision into practice. Arthur and Passini define these two stages in the process highlighting the formulation of cognitive strategies inherent in complex decision-making [14]. Thus it can be said the appropriate design of a wayfinding system can facilitate cognitive accessibility to an environment.

Wayfinding resources can be architectural, graphic, auditory or tactile and therefore the range of competencies covers all disciplines working with these resources. These subjects have been studied by architecture with more focus on the legibility aspects of the built environment, aspects of image and structure [12][15], geography developing symbolic content [16], environmental psychology which has investigated perception of the environment [17], cognitive representation and orientation of behaviour processes [18][19] and many others. Each of these different approaches is nourished by references and research from complementary approaches.

Ensuring accessibility to informative content requires devices (static or dynamic) able to notify users of specific information efficiently. In interactive devices, the interface must show the user what actions are available at all times in order to establish a dialogue with the content or activate a helpful response for subsequent decision-making. This process is also key for developing teaching resources, as user learning depends on establishing correct feedback through the interaction.

Therefore an interactive environment requires a sensory map (visual, auditory and/or tactile) which shows users the content and/or actions to be taken and guides them through the process. The wayfinding concept applied to orientation in

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a physical space may seem insufficient to establish parallels with interactivity applied to electronic devices as this happens more dynamically in a conceptual space where users do not have to move around a physical space, but around information. Nevertheless, to navigate and access information the user adopts similar behaviours to those based on feelings of confidence, efficiency, effectiveness, exploration or enjoyment, depending on user intention and the characteristics or conditions at each moment [20].

So, the concept of interactivity is linked to wayfinding in that users must be able to access and explore different alternatives or information from an interface on the path to making decisions towards an action and must obtain a response from the device which orients them.

IV. AESTHETICS AND INTERACTIVE EXPERIENCE

Aesthetic components are immanent specific values characteristic of design activity, capable of increasing the potential for interaction with objects. The conception of a product must integrate aesthetics in a way which is intrinsic to its functional resolution and that involves bearing in mind the elements which secure particular emotions. Danielle Quarante clarifies the factors which determine these elements and appeal to different orders: purely emotional factors, related to subjectivity; cognitive factors concerning our knowledge and culture; intellectual factors, which lead to the logical satisfaction of understanding a product; and psycho-physiological factors which lead to aesthetic pleasure in relation to the quality of our perceptions [21]. Aesthetic features are certainly not quantitative but related to taste, pleasure, sensation and many other individual, social, cultural and historical parameters which merge in the special poetics of the object.

The degree of satisfaction users obtain from interacting with a product is structured on different levels: all experiences a user has with a product influences to some extent the degree of realisation and development of the ego, touching its different facets [22]. These experiences can be related to the different types of pleasure products can provide: physical, psychological, social and intellectual [23][24], differentiating a lower or physical level and a higher or mental level [25].

At this point it is worth offering some considerations on visual and tactile perception. In recent decades we have extended the field of action and our perception has evolved in these areas as a consequence of the technological revolution and materials engineering which enhance the qualities of objects and environments favouring orientation, use and legibility of the built medium, enabling more spontaneous use. Although emphasising visual factors, in the 1960s Lynch was already pointing out the significance of these factors with reference to the built environment [12]: 'Structuring and identifying the environment is a vital ability […] Many kinds of cues are used: the visual sensations of color, shape, motion, or polarization of light, as well as other senses such as smell, sound, touch, kinesthesia, sense of gravity, and perhaps of electric or magnetic fields' (p. 3).

Pallasmaa's contribution is important as it argues for the primacy of the sense of touch as the first contact with the medium on which all the other senses are based [26]. He also refers to the role of peripheral and unfocused vision in our experience of the world and how it integrates us in the space: 'The very essence of experience is moulded by hapticity and by unfocused peripheral vision [...] In addition to criticising the hegemony of sight, the very essence of vision must be reconsidered' (p. 10).

When we attempt to reflect these issues concerning the different levels of perception individuals obtain from their relationship with the physical medium, then the variety and diversity of stimuli and responses to which they are exposed immediately becomes apparent. The question is how designers can implement what is truly meaningful [27][28] to establish an optimum emotional relationship between user and product or environment.

The concept of aesthetics applied to interactive products is a complex term, but necessary to establish an essential affective link between object and user. In this meaning, it is important to emphasise that aesthetics is not only based on the sensations deriving from surface appearance [29], but is conditioned by empirical factors related to use and function closely linked to a specific user and the task to be performed. As stated in recent researches [30], this interaction is also linked to product personality, which is important in order to make a consistent use. The interactive event provides the user with an expansive perception of the product which goes beyond the perception based on its appearance as it also concerns psychological and cognitive aspects related to achievement of the task and possible output.

V. ACCESSIBILITY, INTERFACE AND INTERACTION DESIGN

We have seen that by interacting with a device it is possible to consult and handle the information it contains, making accessible its functions, the tasks it can carry out and the knowledge it offers. Defining the concept of accessibility is not an easy task, as it depends on the specific context in question. We can consider accessibility as the set of all those conditions in the surrounding environment and the user which favour the achievement of a goal, whether it be economic, social, or in the case of our study, cultural.

One of the most significant agents for accessibility is interface design, which is the key to appropriate interaction. We can initially consider the interface as a multiple space between two agents which enables communication by performing codification and decodification operations, thereby guaranteeing an information exchange. Limiting the definition for electronic environments, Mandel [31] defined the interface as 'both computer hardware and software which presents information to users, enabling them to interact with the information and the computer' (p.14), thereby defining it as a medium through which users and computers communicate with each other, that is, the main agent for human-computer interaction.

The concept although with nuances between authors, refers to two key ideas: the interface as contact surface or place between two entities which are not necessarily physical [32] and as key agent in the exchange of information between the user and the computer, enabling a

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communication relationship to be established. As Gui Bonsiepe (1999) has pointed out [33]: 'A human interface is the sum of communicative exchanges between the computer and the user. It is what presents the information to the user and receives information from the user' (p. 42).

The interface is a common space for both interactors (a logical mechanical entity and an organic one), it determines the typology of the actions and therefore the nature and scope of the communication. Multisensory experience (visual, tactile and sound resources) will give greater scope to the interface, while extending its use to more users.

The construction of the interface involves considering such diverse fields as those touching users' perceptive, psychological and cultural peculiarities, the technical limiting factors inherent in the nature of the interface and the establishment of a structured taxonomy of the tasks it will enable. Thus, Rheingold maintains that the interface should be transparent, that interaction should not take place on the programme, but on the task itself [34]. Bonsiepe coincides with Rheingold and adds that the interface is nothing more than an intangible tool whose true raison d'être is to help users build a personal mental model to help them understand how the program functions, but without manipulating it directly [33]. Far from being a one-way communication system, an interactive interface -which now integrates both visual and audio signals- proposes a game with users which opens and amplifies their cognitive abilities [35] hence its importance for the subject of this study.

A. *Interface design: related concepts*

There are studies on interface design in the literature dating from the 1970s [36], followed by Apple publications [37], Open Software Foundation [38], IBM [39] and Microsoft [40][41]. All these studies highlight the importance of users as active participants in the design of any communication system, since knowing their modus operandi will enable a more efficient interface system to be generated thereby guaranteeing better accessibility to content.

User acceptance of the interface largely depends on its practical operational ability. This concept known as cognitive compatibility [42] refers to complex information processing, accepted as a determinant part of human behaviour since the cognitivism emergence in the 1960s.

Bruce Tognazzini [43] proposes 16 principles for interactive graphic interface design, that are based on the design of tasks to help users achieve certain goals. Cooper [44] provides another approach to interaction design, based on prior identification of user goals and designing the simplest route to achieve them in five stages, applying the five interaction design activities defined by Gillian Crampton and Philip Tabor [45]: understanding, abstracting, structuring, representing, and detailing.

Above all these considerations, other authors [46] highlight the importance of matching user's expectations and actual experiences in interactive systems in order to guarantee a pleasant interactive process. These ideas refers to artistic spheres, but can be applied in all fields related to computer interface, because both interactive artwork and HCI aesthetics design 'focus on users' perceptions and psychological states during experience' (p. 526).

In short, we can say space for interface design is in the combination of user knowledge and goals, the tasks to be carried out and the necessary tools for that purpose.

B. *Basic guidelines*

We can state that treatment of the image, text and navigability must ensure formal and semantic unity throughout the interface. A solid organisation of content, tasks, functions and an appropriate navigation architecture, will speed up users' knowledge of the system. The practice of object-action syntax, the introduction of browsing and the adoption of graphic vehicles familiar to users also intervene to accelerate the learning required for control. Thus a space of action for the designer is establish where ordering logic and economy of resources should be directed at promoting communicative efficiency.

VI. CLASSIFICATION OF DEVICES RELATED TO THE ACCESSIBILITY OF HERITAGE

It is clear that many of the devices used in cultural sites don't guarantee a regular level of interactivity for all users. Disability or physical limitations prevent access to culture or understand the contents on equal terms, since these users assume a different perception of the environment, so that the most common interaction mechanisms implemented in the heritage access devices may no longer be effective.

Realizing the importance of this issue, and considering the information previously treated, we have carried out a catalog of all accessibility related devices in the market, used in both cultural spaces as in other social areas. This section discusses a selection of the most common devices used in cultural enclaves. The aim is to establish a classification based on various parameters relating to the level of interactivity studied in previous sections, and thus better understand the scope of each of them, their limitations and appropriateness of their use for the fields of cultural heritage.

For this purpose we have considered four parameters. First, the static or dynamic nature of the device, depending on the response to external stimuli and the ability to provide feedback to the user. Secondly, a classification based on the type of output information: touch, sight, hearing, as well as those designed for solving mobility problems. The third classification refers to passive or active nature of the device: input device, if it is able to receive new information for treatment and subsequent response, or output device, if only sends information to the user. Finally, a classification based on the level of interactivity within the parameters discussed in the literature review: according to the actors involved, according to the relations between messages, and according to the control over the writing and content.

The results show that about half of the main devices used in cultural heritage sites present a dynamic behavior, that is, they have an output reaction caused by an input of the user. Many of these devices are designed to facilitate mobility, or require visual perception for use. Similarly, there are very few devices that offer full interactivity with the information they present: in most cases they only offer a reactive

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response to user action, but they don't allow to interact with content. Thus, it remains necessary to focus the work of design in this field, in order to create applications that guarantee access to useful content and an appropriate response to a specific requirement.

TABLE I. CLASSIFICATION OF DEVICES RELATED TO THE ACCESSIBILITY

Device	Classification																
	Related to response[a]		*Related to perception*[b]				*Input / output*[c]		*Related to interactivity level*								
									Actors[d]			*Messages*[e]			*Control*[f]		
	r_1	r_2	p_1	p_2	p_3	p_4	i	o	a_1	a_2	a_3	m_1	m_2	m_3	c_1	c_2	c_3
Pictograph	•			•				•			•	•			•		
Information pannel	•			•				•			•	•			•		
Brochure	•			•				•			•	•			•		
Wheelchair		•				•	•	•	•			-	-	-	-	-	-
Walker	•					•		•	•			-	-	-	-	-	-
Ramp	•					•		•	•			-	-	-	-	-	-
Railing	•					•		•	•			-	-	-	-	-	-
Tactile paving	•					•		•	•			•			-	-	-
Adapted elevator (accessible buttons)		•				•	•	•	•			•			-	-	-
Interactive table		•		•	•		•	•	•					•		•	
Adapted counter	•			•		•		•	•			-	-	-	-	-	-
Tactile model	•		•					•	•			-	-	-	-	-	-
Tactile image	•		•					•	•			-	-	-	-	-	-
Audio description		•			•			•	•			•			•		
Audio guide		•			•			•	•			•				•	
Video guide		•		•				•	•			•				•	
Digital talking books		•			•		•	•	•					•		•	
Anti-obstacles lenses		•			•		•	•	•				•		•		
Ergonomic keyboard		•	•	•		•	•		•			•			-	-	-
Virtual keyboard		•		•		•	•		•			•			-	-	-
Braille keyboard		•	•				•		•			•			-	-	-
Signaling hardware		•	•			•	•		•				•		•		
Scanner: audio output		•			•		•	•	•				•		•		

a. r_1 estatic, r_2 dynamic; b. p_1: tactile, p_2: visual, p_3: audio, p_4: mobility; c. i: input, o: output; d. a_1: user-device, a_2: user-user, a_3: user-message; e. m_1: non interactive, m_2: reactive, m_3: interactive; f. c_1: reactive, c_2: coactive, c_3: proactive

DISCUSSION

The quality of being interactive is frequently used to describe very different products and in some cases, in a contradictory way. If the term is overused, improperly used, or without reference to usability features, it can result in an initial sensation of rejection of the product. So, there is an obvious need to clarify what we mean by interaction as a first step towards specifically assessing this characteristic with quality criteria in different types of objects or interfaces.

This paper has attempted to offer a perspective on the breadth of the concept of interactivity through an extensive literature review and analysis of some of the areas of study closely linked to the concept.

In the last decade it can be seen that most studies related to interactivity focus on technological resources mainly in relation to the use of computers and graphic interfaces for digital applications where the visual and sequential organisation of the perceptive scene is particularly important. However, in order to highlight the role of people in this process it has been considered important to recover classifications which contemplate the set of participants in the process: people, messages and message structure. According to these agents three levels of interaction are established, which could guide methodical and empirical analysis of products and devices already implemented. Any device that focus on disabilities can be studied from this point of view, examining their potential for interaction.

The review of other concepts and research related to interactive experience enables observation of the size and interest of this topic of study for architects and designers and the importance of aesthetic components as an inescapable part of objects and places.

With regard to the design of user interfaces for computers, interaction aesthetics is a determinant element in the nature of the dialogue between user and information, opening a broad field for artistic practice based on multimedia experiences or providing the user with more efficient access to information.

In the literature reviewed, we found there are numerous interaction studies based solely on visual attributes, ignoring elements that could enhance the interaction or lead to the development of new uses for interfaces. The wide expressive range of the movements of the human body, for example, can be used to establish a more dynamic relationship with the devices: speech, hands and finger movements to point or to drag objects, can certainly promote more intuitive contact with the contents and should be taken into consideration in any attempt to improve accessibility.

All these approaches link multisensory perception, aesthetics and interaction as a substantial component in all kinds of products, places and services directed at people.

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This idea must be kept in mind when designing for accessibility or for disabled people.

We conclude this paper by stating that some major challenges for interactive product design in the XXI century include studying the potential of interactive images, incorporating the tactile qualities of materials, using the expressive and movement qualities of the human body, and giving the user the ability to discriminate between information, making content more pleasant and accessible.

REFERENCES

[1] T. Maldonado and G. Bonsiepe, "Science and Design", *Ulm 10/11, Journal of the Ulm School for Design*, pp. 8-9, 1964.

[2] D. A. Norman, The Design of Everyday Things. Basic Books: New York, 2002.

[3] N. Shedroff, N., Experience Design 1. Indianapolis, Indiana: New Riders, 2001, p. 142.

[4] S. Rafaeli, "Interactivity: From new media to communication" in Sage Annual Review of Communication Research: Advancing Communication Science: Merging Mass and Interpersonal Processes, vol. 16,1988, pp. 110-134.

[5] H. Dubberly, U. Haque and P. Pangaro, P., What is interaction? Are there different types? Retrieved February 2, 2010, from http://www.dubberly.com/wp-content/uploads/2009/01/ddo_article_whatisinteraction.pdf.

[6] Y. Liu and L. J. Shrum, "What Is Interactivity and Is It Always Such a Good Thing? Implications of Definition, Person and Situation for the Influence of Interactivity on Advertising Effectiveness", Journal of Advertising, vol.31, n.4, 2002, 53-64.

[7] G. Bettetini, "Tecnología y comunicación", in Las nuevas tecnologías de la comunicación, G. Bettetini and F. Colombo, pp. 15-38. Barcelona: Instrumentos Paidós, 1995

[8] D. M. Rhodes and J. W. Azbell, Designing interactive video instruction professionally", Training and Development Journal, vol. 39, n.12, 1985, pp. 31-33.

[9] C-H. Cho and J. D. Leckenby, "Internet-Related Programming Technology and Advertising", Proc. 1997 Conference of the American Academy of Advertising, M. C. Macklin, Ed. Gainesville, FL: American Academy of Advertising, 1997, pp. 162-179.

[10] P. Barker, "Designing Interactive Learning", in Design and Production of Multimedia and Simulation-based Learning Material, T. De Jong and L. Sarti, Eds. Dordrecht: Kluwer Academic Publishers, 1994.

[11] International Standard, ISO 9241-11:1998(E). Retrieved July 13, 2009, from http://www.idemployee.id.tue.nl/g.w.m.rauterberg/lecturenotes/ISO9241part11.pdf

[12] K. Lynch, The Image of the City. Cambridge: The MIT Press, 1960.

[13] R. Passini, Wayfinding in Architecture. New York: Van Nostrand Reinhold, 1984.

[14] P. Arthur and R. Passini, Wayfinding: People, Signs, and Architecture. New York: McGraw-Hill Book Companies, 1992.

[15] J. Weisman, "Evaluating Architectural Legibility: Way-Finding in the Built Environment", Environment and Behavior, vol. 13, 1981, pp. 189-204.

[16] D. Lowenthal and M. Riel, "The nature of perceived and imagined environments", Environment and Behavior, vol.4, 1972, pp. 189-207.

[17] L. M. Ward and J. A. Russell, "Environmental Psychology", Annual Review of Psychology, vol. 33, 1982, pp. 651-689.

[18] A. Stevens and P. Coupe, "Distortions in Judged Spatial Relations", Cognitive Psychology, n.10, 1978, 422-437.

[19] P. W. Thorndyke and S. E. Goldin, "Spatial Learning and Reasoning Skill", in Spatial Orientation: Theory, Research, and Application, H. L. Pick and L. P. Acredolo, Eds. New York: Plenum Press, 1983, pp. 195-217.

[20] Y. Wang, "Taxonomy of Wayfinding Experiences", Design Principles And Practices: An International Journal, vol. 1, n. 2, 2007, pp. 83-91.

[21] D. Quarante, Diseño Industrial, Elementos Introductorios. Barcelona: Ceac, 1992.

[22] A. G. Greenwald, "A social-cognitive account of the self's development". In Self, ego, and identity: Integrative approaches, D. K. Lapsley and F. C. Power, Eds. New York: Springer-Verlag, 1988, pp. 30-42.

[23] L. Tiger, The pursuit of pleasure. London: Transaction Publishers, 1992.

[24] P. W. Jordan, P. W., Designing pleasurable products: An introduction to the new human factors. London: Taylor & Francis, 2000.

[25] Seligman, M. (2002). Authentic happiness: Using the new positive psychology to realize your potential for lasting fulfillment. New York: Simon & Schuster.

[26] J. Pallasmaa, J. Los ojos de la piel. Barcelona: Gustavo Gili, 2006.

[27] A. Antonovsky. Unrevealing the mystery of health – how people manage stress and stay well. London: Josey Bass, 1987.

[28] S. Ilstedt-Hjelm, Making sense. Design for well-being. PhD thesis. Stockholm: NADA, Royal Institute of Technology, 2004.

[29] W. C. Chang and T. Y. Wu, "Exploring types and characteristics of product forms", International Journal of Design, vol.1, n..1, 2007, pp. 3-14.

[30] P. Desmet, J. C. Ortiz and J. Schoormans, "Product personality in physical Interaction", Design Studies, vol.29, n.5, 208, pp. 458-477.

[31] T. Mandel, The element of user interface design. New York: Wiley, 1997.

[32] B. Laurel, "What is Interface?", in The Art of Human-Computer Interface Design, B. Laurel, Ed. New York: Addison Wesley, 1990.

[33] G. Bonsiepe, Del objeto a la interfase. Buenos Aires: Infinito, 1999.

[34] H. Rheingold, "An interview with Don Norman" in The Art of Human-Computer Interface Design, B. Laurel, Ed. New York: Addison Wesley, 1990.

[35] T. Leary, "The interpersonal, interactive interdimensional interface", in The Art of Human-Computer Interface Design, B. Laurel, Ed. New York: Addison Wesley, 1990.

[36] W. J. Hansen, "User Engineering Principles for Interactive Systems", in Fall Joint Conference Proceedings, vol. 39 Moltvale: AFIPS Press, 1971, pp. 523-532.

[37] Apple Computer, Inc., Apple Human Interface Guidelines: The Apple Desktop Interface. Massachusetts: Addison-Wesley, 1987.

[38] Open Software Foundation, OSF/Motif style guide. New Jersey: Prentice Hall, 1992.

[39] IBM, Object-Oriented Interface Design: IBM Common User Access Guidelines. Carmel: Que, 1993.

[40] Microsoft Corporation, The GUI Guide: International Terminology for the Windows Interface. Redmond: Microsoft Press, 1993.

[41] Microsoft Corporation, The Windows Interface Guidelines for Software Design: An Application Design Guide. Redmond: Microsoft Press, 1995.

[42] J. Nielsen, Usability engineering. Boston: AP Professional, 1993.

[43] B. Tognazzini, "First Principles of Interaction Design", 2003. Retrieved February 2, 2010, from http://www.asktog.com/basics/firstPrinciples.html.

[44] A. Cooper, R. Reimann and D. Cronin, About Face 3: The Essentials of Interaction Design. Indianapolis: Wiley, 2007.

[45] G. Crampton and P. Tabor, "The Role of the Artist Designer", in Bringing Design to Software, T. Winograd, Ed. New York: Addison-Wesley, 1986.

[46] Z. Bilda, E. Edmonds and L. Candy, "Designing for creative engagement", Design Studies, vol.29, n.6, 2008, pp. 525-540