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Immersive virtual reality environment as a strategic tool to enhance the user experience

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Abstract: The use of technological tools is increasing rapidly, especially, in design field. This paper discusses the relevant factors of interaction design associated to the use of new technologies. The research has explored the potential of using virtual reality system to discusses the role substantial that designers must be consider such as: cognitive aspects, human factors, as well as use of new strategic tools to improvement the user experience. Particularly, in the implications for the development of interactive technologies based Immersive virtual reality environment. Through a bibliographic review, provide theoretical elements to development of virtual environments constructed to enhance the communication of information to a better engagement in the experience to its visitors. Therefore, also describes principles for systems based on a user-centered approach, the impact of interaction design in the context of information communication for immersive virtual reality (VR) systems allowing investigating the methods to enhance systems based in the user experience.

Keywords: interaction design - virtual reality - user experience - technological tools.

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Introduction

Technological advancement and the democratization of access to information through the global computer network propitiate new forms of communication, learning and the demonstration of products, systems and services, enabling companies to invest in technologies for improvement of innovation to influence the satisfaction of users. Currently, sites, mobile apps (smartphones and tablets) and multi-touch display systems are solicited more and more often for representation of design projects and the conception of new products that use digital interaction and virtual immersion.

Jerald *et al.* (2016) defend that designers must understand human perception and apply it to virtual reality, in order to project experiences that would be comfortable, by creating systems of quality VR. With the advent and diffusion of these technologies, it has become possible to create viable and sustainable solutions that facilitate comprehending and viewing a tridimensional form in its conceptual perception, enabling previous analysis, which allows a better perception of the visual properties of said form. This has an enormous relevance regarding large urban construction, which demands great investments, planning, environmental impact and sustainability. Virtual Reality (VR) makes the planning and urban management of cities possible with environments built virtually in 3D, and platforms that make tridimensional mapping of cities facilitate their visual perception, especially in works of grand scale dimensions. The perfection of VR also creates new business opportunities through digital product simulations, much used in civilian construction, providing previous visual experiences to the users of the enterprises through the mediation of virtual 3D immersion that enables the experience of tridimensional virtually built environments, generating new ways of visualizing and communicating information. Berg & Vance (2016) suggest that these systems must be projected in a way that stimulates an immersive experience for the human senses, so that they may appear natural to the user. Additionally, this technology involves the development of an environment where people can learn, be taught and be helped in vehicle conduction simulators; plane piloting; in the medical area – learning experiences involving great risks in the real world; as well as the building of a virtual reality for the early diagnosis of phobias. In this way, technological advancement contributes to new initiatives for the solution of day-to-day problems by means of creative interaction methods that improve users' experiences.

According to Tai (2017), the advancement of sciences and engineering allows design to use multi- and interdisciplinary knowledge to aggregate value to the innovative creation

of products, which are more and more varied. Accompanying the evolution of technology enables the designer to be up to date regarding the materials, the new possibilities and new techniques in his field of work. All this advancement in science and technology implies new possibilities for the designer in his way of thinking, acting, and in the processes of design. Thus, the knowledge necessary for the conception of new products that make use of new technologies, in the last decades, has created new opportunities for the designers, who are focusing on developing products based on the experience centered on the user, developing more and more effective products. This technological expansion has been incentivizing the dissemination of interaction design, which has recently been combining the physical and the digital worlds, or introducing the user to a complete virtual immersion, and this is being addressed in many different ways, resulting in virtual reality systems of increased and mixed realities with wearable and tangible interfaces.

Design, Communication and Information Visualization

Concerning the aspect of problem solving, designers deal with day-to-day problems of human beings with their artifacts, their interactions and their expectations of well-being by creating production systems meeting the demands of society, or generating new opportunities through the creativity they possess to solve a given problem. It is precisely in this context of structuring the interaction between user and product that the relevant role of design inserts itself. This approach between product and user has made the concept distance itself from functionalism, formerly defended by a few schools (Bonsiepe, 2015; Manzini, 2008; Bürdek, 2006; Löbach, 2001).

In the theoretical field of design, the digital systems as well as the physical artifacts generate communication and "by communicating information, the objects speak of themselves", meaning they refer to the level of the speeches that surround their insertion in the world (Cardoso, 2012: 112). The author states that design can attribute meaning to artifacts, which are generally associated to abstract concepts, and through this, they become artifacts with aggregated value. In face of this, it is possible to make the analogy that through the definition of their appearance, or their visual features, virtual environments can communicate information regarding their meaning and their relationship to users, and even influence these users. Thus, the designer may induce the user through virtually built environments because they carry information that is associated to its appearance and its context. Depending on the appearance and its meanings, the developed product may have a personality, which enables its exposition to the scenario where it will be introduced, "as it is with the human personality, so should all the aspects of design, once they are determined, support the structure of the intended personality" (Norman, 2008: 77-78). Krucken & Trusen (2009) address communication as a strategic way to expose the qualities of the product or service, attributing value to an artefact and to its perceived quality. The authors affirm that the communication strategy is an effective way to expose information.

Coll and Monereo (2010) assert that information and communication technologies are associated to technological resources and are widely being used in several human activities,

principally education. A great part of the population disposes of technological resources, whether through devices or simply by means of knowledge through the worldwide computer network, which affected people's lives by means of a new technological paradigm, causing changes in the social, economic, political and cultural scopes. In this way, internet not only constitutes a communication tool, but also offers search processing and transmission of information, offering a complex global space for social and educational action. Paes & Irizarry (2016) declare that human factors, cognitive aspects related to the use of technological tools, and virtual reality systems, contribute to improve the learning of creative thinking and decision making in design. The authors claim that models based on virtual environments built in virtual reality can support the communication of information and learning, as well as highlight relevant aspects of the context one attempts to represent, preserving or communicating an idea in particular.

The arrangement of the figure and the visual elements of the composition may be determinant for a correct and satisfactory solution of the organization of information, and deserve our special attention because, like other factors, the visual elements stimulate sensations and stir feelings. According to Tai (2017: 117), "People receive stimulation and information thanks to their perception, which is comprehended as the capacity to receive and understand information through the many senses the human being possesses". The *table 1* (below) features characteristics of an analysis of a communication design product.

Table 1. Analysis of a communication design product. Source: adapted from Tai (2017: 49)

Aims	Sales, attractiveness, marketing, fixation in memory, highlight, identification
Factors	Conditioning factors that influence the final configuration (social, economic, cultural, psychological)
Esthetic-visual aspects	Use of visual elements (color, texture, tone, shape, images and graphism) and of communication (language, typography, image, composition, expression).
Targeted public or readers	Age group, sex, preferences, necessities and demands.
Process and techniques	Of creation, development and production (from design to final product, techniques, methods, technology and materials).
Material	Types of material used, their traits and qualities (thickness, format, consistency).
Results	Verified with user (reaction, influence, consequence).

When it comes to interactive and dynamic systems, the goal of information visualization usually is to amplify human cognition for a better comprehension of the system, improving decision making and system explanations, as well as providing insight. The majority of visualization research "is focused on the development of algorithms and interactive techniques to allow people new ways to explore and visualize data" (Rogers *et al.*, 2013: 183). In virtual reality systems, the more common information representation techniques part from software that use 3D modeling for a faithful portrayal of reality. In 2013, Samsung pioneered the development of systems that aid the treatment of phobias, known as "befearless". The project simulates reality in 3D, in order to allow people to confront their fears in safe scenarios through practice and the achievement of goals. The company called upon volunteers to participate in trainings where they used Samsung Gear VR simulating a conference, which aids the building of confidence to face real-life situations.

Virtual Reality as a Strategic Technological Tool

Virtual Reality – VR figures as an advanced interface for computational applications, where the user can interact with and use computer generated graphic simulations, giving the experience of interacting with a virtual environment that gives the sensation of being virtually real. This computational tool based on VR technology must collect, store, recover and distribute knowledge in order to become effective, otherwise, it will make understanding difficult or even become useless. Sherman & Craig (2013) define four key elements of virtual reality experience (See Table 2):

Table 2. Four key elements of virtual reality experience. Source: Adapted from Sherman and Craig (2003)

Virtual World	An imaginary space manifested many times through a means. A description of a collection of objects in a space and the rules and relations that govern these objects.
Immersion	The sensation of being in an environment; it may be a purely mental state or it may be realized through physical means.
Sensorial Feedback	The VR system supplies the user with direct sensorial feedback based on his or her physical position. It is the visual sense that receives feedback, although there are VR environments that exhibit exclusively tactile experiences.
Interactivity	Interactivity happens more promptly with the addition of computers that include simulations. The capacity of affecting a computer-based world describes a form of interaction.

For Nielsen (2014), there are many ways to build a computational environment. One of them is the abandonment of the real world, enabling the artificial world so that all the user sees are the images projected by the system. A few less immersive VR interfaces can be built by projecting them on walls. The author emphasizes that there is a great future in games and certain specialized tasks such as remotely controlled surgeries. Rogers *et al.* (2013: 17) understand interaction design as follows: "Part of the process of understanding the users consists in being clear about the main objective of developing an interactive product". The author states that one of the main aims of interaction design is reducing negative aspects of user experience (frustration, vexation) and at the same time enhancing or improving positive aspects (fun, commitment). The basic concern is the development of easy, efficient interactive products that are pleasant to use – parting from the users' experience. We understand as interactive products all the classes of interactive or technological systems, environments, tools, applications, services and devices. In the book entitled The VR Book: Human-Centered Design for Virtual Reality, Overview, Jerald *et al.* (2016) precisely organize the challenges, experiences, perception and interaction of these systems and how their wrong usage may contribute to frustration and even illness. This comprehension comes from the collection of factors connected to the principle of design and real users.

> Virtual reality (VR) can provide our minds with direct access to digital media in a way that seemingly has no limits. However, creating compelling VR experiences is an incredibly complex challenge. When VR is done well, the results are brilliant and pleasurable experiences that go beyond what we can do in the real world. When VR is done badly, not only do users get frustrated, but they can get sick. There are many causes of bad VR; some failures come from the limitations of technology, but many come from a lack of understanding perception, interaction, design principles, and real users. (Jerald *et al.* 2016:1).

Merriam-Webster (2015) defines virtual reality as "an artificial environment experienced through sensorial stimuli (such as images and sounds) provided by a computer and actions which partially determine what happens in the environment" (Jerald *et al.,* 2016: 9). Thus, virtual reality is defined as a computer generated digital environment that can be experienced as if it were a real environment. Ivan E. Sutherland was the idealizer of the first interactive graphic system, which interprets drawings as input data and makes associations with known topologies, generating new drawings.

The first use of the term Virtual Reality dates to the 1970ies, when researchers felt that they needed to differentiate the new computational interfaces known as third generation interfaces. Virtual reality features in studies from various fields linked to interactive systems, but since the cognitive aspects connect to the process of product design based on user experience, both are linked in order to integrate the user as the main source in their processes. With each passing year, the necessity of research in this area increases. A new necessity emerges with each technological discovery and with each necessity go fields to be explored, making this field of study sustainable by the argumentation that it is a necessary research and relevant in the field of design and in other fields related to design.

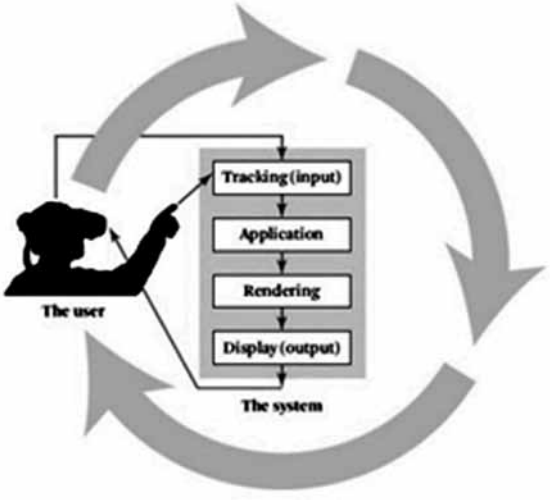
The use of virtual reality as a strategic tool can be integrated into many fields and sub-

fields of research, aiding learning, and helping in the development of projects as well as in the rehabilitation of patients in treatment. Mineev (2017) analyzes how virtual immersive reality is efficient in educational games and works on many aspects, such as: combination of learning; perception of learning and motivation. The author verified a perceived efficiency in the results of the participants of the VR group. Alshaer et al. (2017) have analyzed perception and behavior in a wheelchair-simulator through VR. The study counted with 72 participants and discovered three factors: perception, behavior and field of vision. The results point to guidelines, which may orient future VR simulators based on the behavior and perception of the users. Dias (2016) has analyzed how users accomplish tasks together or through collaborative work and made use of virtual environments for remote communication between users. An architecture of a behavioral model was implemented in the author's results in order to validate them.

Fernandes (2015) proposes the use of VR for a simulation in the rehabilitation of motoric aftereffects of strokes, evaluating electroencephalographic activities in patients who have had these lesions through the use of games based on virtual reality. It was concluded that it is possible to use Virtual Reality for the rehabilitation of the superior members of patients who have had a stroke. Soares (2015) has researched functional mobility, using exercise programs that used VR for the physical rehabilitation of the elderly. The results show that virtual games stimulate physical activity, increasing motivation and attention, and making the therapeutic process more pleasant and enjoyable.

Wilson & Soranzo (2015) made a review of the current uses of immersive VR environments and psychological research. The authors focus on the field of visual perception, sketching out advantages and disadvantages of the use of this kind of technology in the field of psychology. In his dissertation, Aseeri (2003) mentions that his main objective is to demonstrate the advantages of recent developments in mobile devices applied to VR, including multi-touch screens and monitor screens, especially in smartphones as input and output devices. In his results, he concludes that the use of mobile devices facilitates interaction tasks, and all participants agree on the usability for virtual environments. Guimaraes (2004), in his thesis, presents environments for the development of VR applications based on computer clusters, "VRCluster". The limitations presented by the period of this study are clearly seen by the fact that immersion was made in caves with stereoscopic visualization, through shutter glasses. Its result involves resources connected to hardware, software and perception; however, it was limited by the technology available at the time. We chose to present this thesis in the *corpus* of this item to characterize the evolution and continuity of the line of research adopted in this field. Through this, we hope to show the evolution of technology and its availability in current times. Thus, the use of VR refers to an interactive and immersive experience based on computer generated three-dimensional graphic images (See Figure 1).

The Virtual Reality experience is fundamental hence, it is important to search for creative and productive ways to use it, stimulating the users more and more. Communication in reality systems consists in hardware + operational systems = sensorial experiences.



Tracking (Input)	Collects user data such as where user's eyes are located, where his hands are located, and button pushing.
Application	Includes none-virtual world rendering aspects, including dynamic geometry updates, user interaction and simulation of physics.
Rendering	The transformation of a friendly computer format into a friendly format that makes the illusion of some form of reality and includes visual and auditory rendering.
Display (output)	Age group, sex, preferences, needs and demands.

Figure 1. Human/machine communication through hardware. Source: Jerald (2016, p. 31)

It is the task of the reality system to communicate the application with its content effectively and intuitively to the user, as if the user were interacting with the real world. The interaction between human and system is achieved through hardware devices. When projecting for VR, a designer is normally concerned with communicating the relationship between the communication of the interactive system and the VR experiences, which, when they are well projected, can be thought of as a collaboration between man and machine, software and hardware, working together to provide intuitive communication.
Psychologically, the immersion in Virtual Reality is equivalent to being in a different place from where a person is physically, which may or may not be a representation of the real world. In order to feel like he or she were in another place, however, the user needs to understand certain concepts (Jerald *et al.*, 2016). To Margolin (2014: 139) "by extending the domain in which we conceive and plan, we extend the limits of the practice of design". In this way, ever more simulating reality in VR systems, and the user experiences total immersion in the other environment, together with hyper-reality, which, after Baudrillard (1983), is called simulacrum, which means that the representation of the real substitutes reality itself, or, the boundary between the artificial and the real becomes invisible. There are several types of interaction that focus on the experience of the user.
The users interact with a system/product through four essential types of interaction, called: instruction, conversion, manipulation and exploration, that can be used mutually, in other words, the user can interact with a system based on different types of interaction. Thus, deciding beforehand the types of interaction together with the users can help the designers to formulate in a more efficient way interfaces and systems for a better experience for the user. AVCs are usually classified in the interaction of Exploration: a style in which the users move in a virtual environment or a physical space. Virtual environments include 3D worlds and systems of enlarged reality and of virtual reality (Rogers *et al.*, 2013: 47).

Cognitive Factors

The phenomenon of perception is the result of interpretation by the human senses – vision performs a major collection of information – of the environment in which the individual is inserted and the interpretation it receives from external and internal stimuli, which influence behavior in the process of perception. The information received from these environments can be more than the individual is able to assimilate; therefore, it is divided in smaller groups. There is a criterion of interest, which allows that the individuals ignore or absorb the information with a smaller or greater grade of interest (Paes, Irizarri, 2016). Therefore, the quality of interaction can, in developed systems, be influenced by the affectivity that perception causes in activities, tasks or work. This influence is interrelated with the four basic elements of ergonomics (man-task-machine-environment).
Perception is connected to research in various areas of design, which tries to find means of discovering insights into its processes. Design is ever more interested in the field of perception, to reveal with this the potential of visuality. According to Bonsiepe (2011: 39) "[…] enormous design possibilities are opening exactly for the type of design that is con-

nected to the mastering of perception, to reveal the potential of visuality". Virtual images used in medicine (imaging technologies) are cited as an example of the revaluation of the visual dimension and its new significance. For Tai (2017: 117) "People receive stimuli and information thanks to their perception, which is understood as the capacity to receive and understand information through the various senses the human being possesses".

The author stresses that, though the interactive systems stimulate various senses, vision is, without doubt, the principle focus, and establishes visual communication as the center of attention for the approach of this process of the reception of information, since virtual immersion happens through the visual reception of information with the help of devices put on the eyes, which always create two poles: the sender and the receiver.

The result for a good interaction between systems (user and products), where the first uses the product and the advantages offered by it, the second exercises effects and influences which generate negative and positive situations, respectively, in diverse situations. The receiver, when he receives the message, is conditioned to diverse factors that serve as "filters" of content (decoded or not), which make him accept them or not. "This process normally is immediate, although it may last seconds or minutes" (Tai, 2017: 121); therefore, a person can like something or not, according to his perceptive filter. Still following the author, the factors which condition the filters of people are: cultural, social, economic, religious, ideological and psychological. Consequently, the receiver reacts to the content feeling compatibility, consonance, credibility, empathy, recompense, interest, but still influenced by their personality, mental flexibility and particular situation. In face of this, according to Tai (2017), six points have been extracted and punctuated, according to environment, communication and perception (See Table 3).

Thus, designers can use combinations so that users may perceive them more effectively. "Perception refers to how information is assimilated from the environment by the various sense organs – eyes, ears, fingers – and transformed into experiences with objects, sounds and tastes" (Rogers, 2013:71, apud Roth, 1986).

The representations of information must be projected in a way that allows them to be perceptible and recognizable in different media.

The user must be able to distinguish the icons and the graphic apprehensions easily; (I) Borders and spaces are effective visual forms in the grouping of information, which make the perception and location of items easier. (II) Sounds must be audible and distinguishable so that the user can understand what they represent. (III) The voice exit must allow users to distinguish the words that are spoken and enable them to comprehend their meaning. (IV) The text must be legible and distinct from its background. Through perception, the senses can be tricked in the case of special perception which involves the shape of objects and the depth in which they are inserted in space. It is comparatively easy to "trick" the user in interactive systems aimed at his vision, because they interact in order to maintain a specific point of view for the user, highly explored in virtual reality systems where the user is completely immersed in a virtual world and many times multiple sense modalities are used, working together to supply the user with a perception of time and location in space.

Perception of space does not only happen through vision, though it is the most precise modality, however, modalities that involve hearing may bring about more precise effects

Perception of Stimulus	People receive stimuli and information thanks to their perception, which is understood as the capacities to receive and understand information through the various senses the human being possesses vision, audition, touch, sense of smell and taste.
Communication and Perception Process	The process of communication occurs between a sender (emitting transmitter) that passes messages and a receiver (recipient) who receives it. Where the first can be anybody or any person or means of communication, object or environment, while the second selects, decodes, interprets the stimuli of various sources (light, color, shape, sound) and understands according to its capacity.
Reception of Stimuli and Messages	The information formed by the visual graphic elements and transmitted by the sender is a conjunction of stimuli and messages, normally and intentionally created by the designer to generate effects, and even to persuade people to certain aims. The messages transmitted to the brain are: processed, decoded, filtered, selected and interpreted. With this, the individuals react according to their sensations, cognitive perception, personality, emotions, values and esthetic perception. The reactions manifest themselves in attitudes and behaviors.
Information that Generates Effect	The information formed by the visual graphic elements and transmitted by the sender is a junction of stimuli and messages, normally and intentionally created by the designer to generate effects, and even to persuade people to certain ends
Perceptive Filter and the Conditioning Factors	When he receives a message, the recipient is conditioned by diverse factors and begins to filter, letting the messages pass or not. This is called process of selection of perceptive filter. The conditioning factors for this are: cultural, social, economic, among others ideological and psychological.
Interpretation and Understanding of the Message	In the process of communication, the message provokes a reaction on the psychological and behavioral levels in the receiver, after having decoded, interpreted and understood that message in its own way.

Table 3. Environment, Communication and Perception. Source: Adapted from Tai (2017: 115-122).

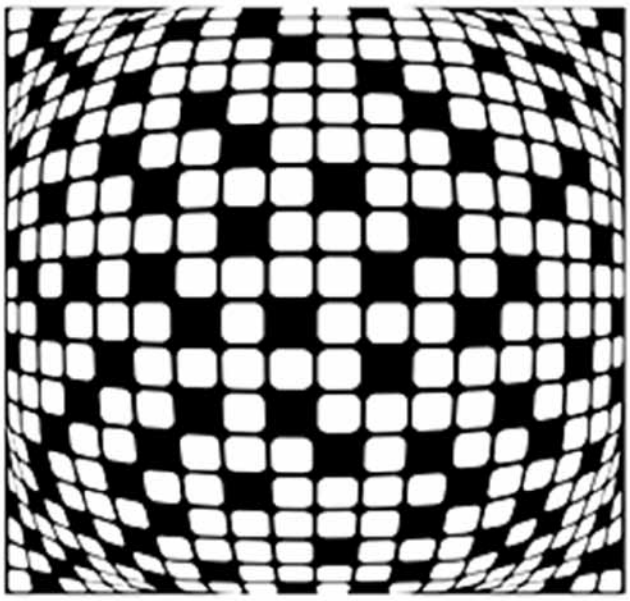


Figure 2.
Perception of space.
Source: (Jerald et al., 2016.p. 118)

especially for long distances. Below follows an example (See Figure 2) of an image that supplies this sensation of "tricking the senses" in relation to form and depth, where the center seems closer than the extremities due to the presented graphic disposition. One of the challenges met with in VR systems is the natural perception of space in the immersive environments, as well as the creation and exhibition of contents. Nevertheless, not all VR exhibitions need to be truthful, as opposed to projects destined for architecture, automobiles, the military and medical areas, where the perception of the distance and size of the objects are fundamentally important for the user's understanding.

Perception of time can be manipulated and distorted under certain circumstances. The experience of time can be divided in: (a) estimated duration, (b) order/sequence, (c) anticipation/planning for the immediate future. Psychological time can be considered a sequence of moments, whereas the perceptive moment is the smallest psychological unit of time the observer can feel. Thus, these aspects can be evaluated in determined events – which happen in time at a specific location, perceived with a beginning and an end. Apparently, many applications are being developed to aid treatments, which demand a waiting time from the users, and through the help of these systems its mitigation is effected (Jerald *et al.,* 2006).

Interaction Design (ID)

Rogers *et al.* (2013: 8) qualify interaction design as "projecting interactive products to support the way people communicate and interact in their daily lives, weather at home or at work". Thus, it is the amplification of the way in which people interact and communicate, creating user experiences. Many terms have been used to describe what is being projected to human/computer interfaces, but interaction design is currently used as a broader term, which possesses its: methods, techniques and frameworks for theoretical and practical sustentation, involving interactive systems with user experiences. Initiatives emerge through ID with the intention of resolving day-to-day problems by promoting creative interaction methods in social areas in a sustainable manner, and which try to meet human well-being, and its products or interactive systems are evermore present in people's daily lives. Rogers et al. (2013: 17) comprehends design interaction as follows: "Part of the process of understanding the users consists in being clear about the main objective of developing an interactive product".

One of interaction designs main objectives is to reduce the negative aspects of user experience (frustration, vexation) and at the same time improve the positive aspects (fun, commitment). It is basically about the development of easy and efficient interactive products, which are pleasant to use – parting from the users experience. We understand interactive products as all the classes of interactive and technological systems, environments, tools, applications, services and devices. The result for a good interaction between systems (user and products) in which the first uses the product and the advantages offered by it, the second exerts effects and influences, which respectively generate negative and positive situations in diverse situations.

It is known that images are used a lot for the improvement of visualization conditions, persuasion and of information for various ends. On the other hand, virtual environments amplify the users' capacity to evaluate by using multi modal interactions, with the help of three-dimensional software technology, which make realistic photographic images with difficult distinction between what is real and digital. Many products, such as smartphones and social media sites, which need the users' interaction, were projected mainly having them in mind. Others were not. These were projected to execute definite functions, even if they work effectively, this changes, when we analyze these interaction processes in the real world, and new ways to project interfaces are immerging.

According to Burdea & Coiffet (1994), virtual reality assumes an important role, since it is advanced computational interfaces which have been suffering changes due to the technological advancement that has, since the 1990ies, provided the conditions for the execution of interactive graphic computation, and which today comes to the level of hyper-reality, which, according to Tiffin (2001), is the combination of virtual reality, artificial intelligence and human intelligence combined with the technological capacity, forming a complex, but more natural system, in its access for users. Although it is a very diffused technology, it has not entirely been implemented in society yet. One of the main points when dealing with VR is the interface, which allows the user to be in an immersive system through devices, which by making interactions through multi-media techniques, meaning through three-dimensional representations possible, meet equipment such as glasses,

Visibility	The more visible the functions are, the better the user will know how to proceed.
Feedback	Refers to the return of information concerning which action was done and what was achieved, permitting the person to continue the activity. Such as: audio, tactile, verbal, visual, or combinations of these. Its correct use can supply the necessary visibility for the interaction of the user.
Restrictions	Determines the forms of limiting the types of interactions of the user that can happen in a determined moment. Such limitations lead to the user making mistakes in the selection of options or interpretations.
Consistency	Refers to projecting interfaces in a way that similar operations happen and similar elements are used for the realization of similar tasks, and some of its benefits are: learning and facility of use.
Affordance	This is the term used to refer to an attribute of an object that allows that people know how to use it and allows its obvious perception, and making its interaction easy.

Table 4. Principles of design for interactive product users. Source: Adapted from Rogers (2013: 25-26)

helmets, gloves, and many studies try to analyze causes of discomfort and interaction difficulties. There are several goals of the experience of the user that have been explored in interaction design that touch desirable as well as undesirable experiences.
The following table represents the principles of design based on the experience of the user that use interactive products. Being clear about your objects plays a very important part in developing interactive products based on user experience. The goals of usability aim at specific criteria, like efficiency, while the goals of experience of the user aim at explaining the nature of the experience of the user (See Table 4).

Conclusion

Technological convergence and the democratization of information propitiate new tools, which help or improve the development of computer systems, like those of the technology of virtual reality, that use interactive systems based on the control and influence of the cognitive human aspects. In this way, the knowledge of cognitive processes –which involves processing through perception; the human factors– becomes indispensable for designers, and this involves the physiological and psychological aspects for a greater efficiency of the interaction between user and system. Parting from the experience centered on the user, successful products are created. A better experience makes interaction more agreeable, just as in the use of virtual reality; a badly projected system can bring frustration and rejection of the approached product or system. The use of these technological tools has intensified in the most varied areas as: entertainment, games, even collective scientific experiments in collaborative environments; in medical and dental applications focusing on the user's perception of those cognitive changes that, through the use of systems of virtual reality in its procedures, can entail the mitigation of time in users/patients, as well as in the architecture and design of products, constituting veritable laboratories of research and new experiences. This study raised important questions about how the use of technological tools can help in principles of design, in processes of interaction, and help to think during, before and after, for a better user experience. This research points out that the users have a fundamental role in the development of more efficient products.

In the face of this information, the necessity of the strategic use of technological tools for more adequate solutions becomes perceptible, and for this, guidelines of process are necessary that facilitate the development of these systems/products as a category of differentiated products. In this context, strategically used technological tools are capable of promoting betterment in the process of design and the communication of information. This implies diverse solutions and possibilities in the field of design. The technology of virtual reality is a powerful tool for simulating our reality and investigating the behaviors, as well as in influencing the human senses, reaching perception through immersion factors.

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Resumen: El uso de herramientas tecnológicas está aumentando rápidamente, especialmente en el campo del diseño. Este artículo analiza los factores relevantes del diseño de interacción asociado al uso de las nuevas tecnologías. La investigación ha explorado el potencial del uso del sistema de realidad virtual para analizar el rol sustancial que deben considerar los diseñadores, tales como: aspectos cognitivos, factores humanos y el uso de nuevas herramientas estratégicas para mejorar la experiencia del usuario. Particularmente para el desarrollo de tecnologías interactivas basadas en un entorno de realidad virtual inmersivo. A través de una revisión bibliográfica, se proporcionan elementos teóricos para el desarrollo de entornos virtuales construidos para mejorar la comunicación de la información, para una mejor participación en la experiencia de sus visitantes.

Palabras clave: Diseño de Interacción - Realidad virtual - Experiencia de usuario - Herramientas tecnológicas.

Resumo: O uso de ferramentas tecnológicas está crescendo rapidamente, especialmente no campo do design. Este artigo analisa os fatores relevantes do design de interação associado ao uso das novas tecnologias. A investigação explorou o potencial do uso do sistema de realidade virtual para analisar o papel relevante que devem considerar os designers, tais como: aspectos cognitivos, fatores humanos e o uso de novas ferramentas estratégicas para melhorar a experiência do usuário. Particularmente para o desenvolvimento de tecnologias interativas baseadas num entorno de realidade virtual imersivo. Através de uma revisão bibliográfica se brindam conhecimentos teóricos para o desenvolvimento de entornos virtuais construídos para melhorar a comunicação da informação, para uma melhor participação na experiência de seus visitantes.

Palavras chave: design de interação - realidade virtual - experiência de usuário - ferramentas tecnológicas.