Virtual Architecture; a Human-Machine Interaction

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The current article approaches interaction between architecture and machine in one of its several dimensions, namely computer technology and virtual reality. We begin with an introduction to complexity sciences and continue with a brief description of Systems Theory and Cybernetics, leading to the notion of virtual reality and cyberspace.

The approach to the virtual architecture presented in this article covers three scopes:

1) *Virtual reality technology: a tool for visualization of architectural imaginations*
2) *Influence of virtual reality and cyberspace concepts on architectural imaginations.*
3) *Virtual architecture as a set of rules for organization of cyberspace.*

Keywords: System Theory, Cybernetics, Virtual Reality, Cyber Space, Virtual World, Virtual Architecture

1. Complexity sciences; the heart of postmodern world

In 1963, Edward Lorenz, a meteorologist at M.I.T., was trying to utilize computers for weather forecast when he incidentally discovered that fundamental phenomena existing in the nature have a chaotic character. Lorenz realized that natural realities are very sensitive to the initial conditions, i.e., due to the positive feedback, minute changes in the conditions (or constituents) may lead to large variations in the outcome as a whole. This intrinsic character of the nature, referred to as the Butterfly Effect, denotes the non-linearity of the natural phenomena. Further studies have revealed that these phenomena in fact are chaotic systems which may never be limited to cycles, and may never have maxima/minima which impose only local and limited effects. [1]

Inefficiency of the simplicity paradigm for the description of abovementioned characteristics of natural phenomena has pushed the scholars towards the complexity paradigm. Therefore, the universe, as it appears from the standpoint of complexity sciences, is a world in which existing realities are affected by self-organization and self-similarity. Understanding composite realities which are formed, altered, and developed under the influence of these concepts, on one hand, and the increasing necessity of modeling these realities, on the other, requires a new way of thinking and a new logic which is known as fuzzy logic.

2. Systems; flowing blood in arteries of complexity thinking

The necessity to monitor, control and regulate the phenomena, the main characteristics of which are the organized complexity and interdependence of the whole and its parts, have caused the appearance of two new branches of science, the systems theory and cybernetics. These two branches constitute the area of academic research which incorporates traditional disciplines, and deals with virtual realities on the basis of an organized complexity paradigm. The systems theory and cybernetics are similar in a sense that they are both interdisciplinary complex sciences and investigate a problem of the organization and structure of a phenomenon as a whole, without addressing its parts and sub layers. However, the two approaches have some minor differences.

2.1. The systems theory

The history of this science dates back to the 1940-50s, when scientists such as Norbert Wiener and Claud Shanon (mathematicians), W. Ross Ashby and Ludwig Von Bertalanffy (a biologists), Jay Forrester (professor of management at M.I.T.), and Waren McCulloch (a neurophysiologist) laid the basis of a new branch of science after conducting a series of interdisciplinary studies. The new science revolved around the pivotal idea that a set of common principles and relationships govern the complex phenomena of different variety. Consequently, we can explain, analyze, and control complex phenomena on the basis of these special principles and concepts, independent of the branch of science to which they belong. The systems theory was conceived as a reaction to reductionalism. In reductionalism, a phenomenon is explained by simplification into a similar phenomenon, whereas systems theory proposes a meta-method which ensures the unity of different sciences. Furthermore, the systems theory focuses on the arrangements and relationships between the elements of a complex phenomenon rather than the characteristics of the individual elements.

System is a central concept of this theory. According to the definition, system is a group of interactive elements which establish interconnections based on a set of mutually dependent relationships and form a balanced whole towards a specific and determined goal. A system usually features independent characteristics as a result of the interactions between the elements, which are not necessarily found in its individual constituents. In other words, system is independent of the concrete essence of its individual elements and is in fact a special organization which is based on interaction and connectedness. With this in mind, we can treat the systems theory as a transdisciplinary study of the abstract organization of phenomena, independent of essence, type or scale of their spatial-temporal existence. Consequently, the systems theory pursues the common issues among all complex phenomena, while trying to construct mathematical models for describing them. Therefore those holistic concepts and principles which form the common basis of various disciplines become the factor of unity among them. Obviously, if we can fathom this aspect, we can scientifically analyze and overcome the problems of different subjects which are reducible to a single system. [2]

2.2. Cybernetics

Similar to the other complexity sciences, cybernetics was born at the time of a growing need for the new methods to address the problems of organized complexity. It was the time when understanding, control and regulation of the interdependence of elements and structures of complex systems became the main goals of science. Cybernetics can be considered the generalization of the concepts in the systems theory (e.g. input, output, process, feedback, and control) and their conveyance from the phenomena of the engineering world to the phenomena of other systems, such as organic systems, abstract intelligent processes, and language.

Although this word was first used by Plato in the meaning of “to lead” or “the art of ruling”, its usage in the meaning of “the study of methods for controlling and ruling complex systems” is modern and dates only several decades back. The evolution of the modern meaning of this word can be investigated at three stages. Each one of these stages, which lasted for about ten years, is a result of multiple interactions among human, machine, and society. Note that M. I. T. has played a key role in this process.

The first stage of this evolutionary pathway began in the 1940s. During this period, the generalization of two ideas of feedback and determinacy from machines to living organisms paved the way to automation and finally the invention of the first computer. Since 1950s the second stage of this procedure is characterized by a return from living organisms to machine. During this period, the concepts such as memory, pattern recognition, and learning formed the basis for advancement towards the central concept of environmentally adaptive phenomena. During the early 1960s, the third stage of the evolution of cybernetics was inaugurated – this time, moving again from machine toward living organisms. During this period, by benefiting from the characteristics of living organisms such as neurology, perception, and vision mechanism, and their generalization to machine, cybernetics experienced a rapidly growing success in industry, society, and ecology, denoting that the understanding and simulation of cerebral mechanisms by machines are possible only via continuous cooperation among various sciences. [3]

Cybernetics in its contemporary form, known as second order cybernetics, is based mainly on Claud Shanon’s information theory. The main objective of second order cybernetics is to develop interactive models for optimizing transmission, control, and processing of information. Thus, cybernetics can be viewed as a discipline of effective organizing which is the art of leadership, regulation, moderation, and stabilization of organized complex systems. It is focused on system’s functions, rather than their construction, and secures a regulated and reproducible behavior against chaos and essential disorder governing such systems. Cybernetics is aimed at the preservation of a system in permanent balance and attempts at studying effects of system inputs on the system itself in order to gain expectable and stable outputs.

3. Cyberspace and the technology of virtual reality

As mentioned above, cybernetics and especially second order cybernetics define themselves as sciences of information and communication. The matters of crucial importance here are the ways of data accumulation and the kind of relationship it is engaged in. The complex network of information stores and communication channels, which entails on humans and machines, has created a shared medium which allows its residents to control not only other residents and their surroundings, but also the outer – the real – world. This world, often referred to as cyberspace, is a place where exchange of information takes place. The live and vivid communication between human and machine results in the creation of three-dimensional, continuous space, liable to the motion and manipulation of the user much in the same way as is observed in the real physical world. Residents and elements existing in this space are called virtual realities.

Cyberspace is a hypermedia network in which various relations and links are connected together by the aid of different types of media and by the way of hypertext software. Hence the user is enabled to move within this space in a non-linear manner, manipulate a database by using software, have telepresence or be engaged in a teleoperation. Today cyberspace as a more general form of interconnected data is affected by computer technology. Whatever the presupposition of cyberspace may be, it is definitely not the storage of passive date such as a library. Moreover, a cyberspace navigator can establish a kind of connectedness with the real world via the channels of cyberspace. With this in mind, we can envisage cyberspace as a space full of electronic data which can be changed and dominated. So, cybernetics clearly expresses two ideas:

- idea of navigation through a space of electronic data;
- idea of control which is achieved by manipulating data.

"Space" is a key word here. Conceptually, space is an unlimited expanse, housing lots of things which cannot be perceived simultaneously. This definition is a perfect match to a vast, interwoven network of different data types. Moreover, the word "space" connotes the idea of movement, diversity of situations and places, and finally a type of geometry with such concepts as distance, direction, and dimension, which also suits our purpose right. With this in view, the hypermedia network of humans, machines, and information resources can truly be called "space", the space which is created and developed in the virtual world of computer networks and which enables virtual life.

To sum up, cyberspace is the continuous network of communication channels, including phone networks, television, databases, web-pages, and other information resources and shared media, through which cyberspace resident can control the environment of another resident, the space itself and its existing things, or the real world and its existing things.

4. Virtual architecture; design in the era of complex communications

Architecture as a discipline of designing and organizing space is undergoing notable transformations nowadays. Undoubtedly all approaches to architecture are affected by technology used for its imagination, visualization and realization. In this regard, Martin Heidegger's doctrine of the essence of technology implies that technology is not exclusively a tool, but it rather has an ontological nature and relates to how the universe appears in the eyes of human. [4]

The technology of virtual reality makes its mark on architecture in three arenas. First, the communication and information technology provide a medium for designers to create a new world via imagination. In fact, virtual space is considered a prelude to artificial environment, transmitting the space-related experiences from real world to the world of virtual realities.

The second arena of the influence of the virtual reality technology on architecture is creation of perceptional spaces in the newly developed perceptional-experimental fields, resulting in unconventional thought and imagination processes. From this point of view, virtual architecture provides a tool for realization of designs free from real world restrictions (e.g. gravity, friction, form, light, and heat) through the use of concepts and endless forms closely associated with cyberspace. This leads to the notion of transarchitecture and the appearance of architectural ideas fundamentally different from those constructible in the real world. Virtual architecture, therefore, promotes the notion that free design within cyberspace, which represents an expressionistic formalism, bases a fluid or materialless architecture. The use of formless spaces implies the ideology that the real world is far more mysterious than what is conveyed by the mere facts.

Finally the third arena of interaction between architecture and technology of virtual reality is the design of cyberspace itself. The information space is on its way to replace the real space, thus, its configuration in the form of computer presentations can be considered as an alternate view of virtual reality, highly regarded for financial investments. Real-world simulations within the cyberspace accommodate more and more of real life activities everyday, necessitating the architectural formulating of this new space. A global life in virtual reality is not far from realization and very soon the conventional architectural spaces will loose their functionalities. Electronic activities such as e-businesses, e-learning, e-government and many other virtual operations pave the road towards an electronic life which requires a new architecture for designing, organizing and defining three-dimensional environments within the virtual space.

The three arenas are further discussed below:

4.1. Virtual architecture; an approach to visualization and realization of physical architecture

Utilizing virtual reality technology as a flexible design medium enables architects to visualize their ideas in a revolutionary way to further improve and develop them prior to construction in the real world. In this respect, software play a vital role in efficient realizations of the projects at various stages, from drawing and modeling to project management and control. As a result, the nature of architectural design and even spatial-physical status of architectural offices have experienced a significant change.

Since the Renaissance, standard methods of architectural design, based on drafting and drawing, have become an essential part of architecture. Limitations of traditional methods of architectural design cause models to be used only for geometrical-formal presentations. Many more architectural qualities such as light, shadow, materials, colors, etc. which have undeniable effects on the final quality of design, are actually being forgotten, or are involved in decision-making with minimum effect. However, the progress in design techniques, from blue prints to the virtual reality technology for visualization of architectural ideas, has provided the designers the possibility of alternating spatial and formal elements and patterns through interactive experiments to overcome the abstractions due to limitations in the visualization of ideas, and to interactively assess multifarious qualities.

In conventional design methods, models and drawings can present only few of project aspects. Thus, a large part of the design must be processed in human mind and the extent of presentable architectural information is greatly reduced. In contrast, virtual technologies transform notable volume of mental processes to external processes and facilitate decision-making. In addition, traditional models can be reused to a much lesser extent compared to new virtual models. Accordingly, alterations and improvements of the ideas in the traditional models face more difficulties, whereas virtual technologies,

while visualizing multiple factors mentioned only in textbooks, present testable, changeable and improvable models for content and quality evaluation of the projects at minimum cost.

Virtual technology may be utilized at different stages of the project. Two-dimensional drafting and three-dimensional modeling during design as well as still frame and real-time rendering during the presentation are the most basic functions offered by virtual reality in architectural design. Other common assessments offered by this technology prior to construction in the real world include static modeling, structural load bearing computations, dynamic modeling, and study of structures' behavior against wind, waves, and earthquake. In addition, time studies and project management, project measurement and assessment, provision of status list, etc., are activities which are facilitated by using computer software.

In short, technology of virtual reality, as a form of transparent communication medium, provides the opportunity of a complete immersion of senses in another reality. Virtual technology, a simulation of reality as a collection of interactive information, creates a medium which gives the designers the capability of direct manipulation of an object, placing the designer in a virtual world equipped with all of the senses present in the real world. Therefore boundaries between reality and imagination melt away, and buildings become inhabitable in the virtual world before their construction.

4.2. Virtual architecture; imagination of a new space-time in the era of multimedia

If we allusively accept the Heideggerian doctrine that adequate thinking about the essence of technology not only enables thinking about art but also requires it, we can conclude that an instrument for visualization of architectural ideas is not merely a tool, but rather a method towards an openness which presents totally different aspects of the essence of the subject investigated. [5] Although it is impossible to imagine Brunelleschi and Alberti without perspective, Loos and Le Corbusier without film and train, and Venturi and postmodernism without television and automobile, still the simulation technology of the 1980s and the technology of virtual reality of the 1990s can be considered a turning point in the application of instrument and its ascendancy.

Siegfried Giedion believes that a new image of architectural space is a byproduct of optical revolution and an increasing interaction between exterior and interior spaces. He claims that the concept of motion is a new phenomenon fundamentally rooted in modern conception of space. [6] Although a conception of space-time dates back at least a hundred years, it was only during the past two decades that the visualization of this dimension has broadened the horizons of human knowledge about the universe. While Giedion speaks about the phenomenon of motion as an effective force for shaping a new tradition in architecture, only fifty years later, architects and artists of the age of virtual reality have to deal with an experimental area where multiple forces alternatively and continuously cut each other.

Cyberspace is a multidimensional field of forces. For this reason, the metaphor of space and spatiality seems inadequate, because cyberspace and virtual realities which exist in it create a kind of complexity of a network, understanding of which through exclusively spatial images and pictures seems too difficult. Hence two new concepts of hyperspace and topology are employed to facilitate understanding of the inner logic of cyberspace. While it is impossible to explain the two concepts themselves completely, they help to percept the complexity of networks. They are all the more efficient as instruments to understanding artworks connected with cyberspace and virtual reality.

4.2.1. Aesthetics of new space-time

The constitution of space and time in computer-based environments may be imagined as cutting, folding, bending, and stretching the procedure and current of time and continuity of Euclidean space. Such an experience can be considered as a machine-made topological experiment which leads us towards a type of emerging machine-made aesthetics. The main characteristics of machine-made creative works in cyberspace are multifarious states of intervention, operation and production which emerge in sequence. Here machine is not merely a technical set but is a collection of heterogeneous elements relating a generative imbalance to a structure.

Presence and connectedness can be identified as two main categories of computer-based art in cyberspace. By changing the vertical presentation paradigm and moving toward the horizontal paradigm of connectedness and distribution, they trigger a dreamlike state which allows a telepresence of an artwork – a great step against a classic modernist tradition at the area of cybernetic art. With this in mind, and considering such concepts as data storage, creation of defocusing, changeable identity, and interactive forms, a dialogue between the aesthetic and social requirements of cybernetic art opens endless horizons for artistic and communicative forms. Because each happening is a unique event which is shaped through the cooperation between an artist and an audience in a certain performance, formal strategies, which usually appear in the form of non-linear expressive happenings and driven from abovementioned concepts, are difficult to be defined. Therefore a cybernetic artwork as a continuously reproducing object, by coaxing immediate and motivating interactions via an amazing combination of people, things, events, and narrations through the audience's active cooperation, attempts at expanding our consciousness about new space-time. So, cybernetic art is first and foremost a dynamic and fluids becoming, in which an artist and an audience form, perform, and interpret, while affecting each other in a changing environment. Further on we will try to explain some of the essential aesthetical concepts of cybernetic art.

Integration

Cybernetic art is nothing but a combination of artistic forms and computer technologies in order to present a hybrid form of expression aimed at reflecting the spirit of time. With this in view, a kind of intermedia comes into being which allows a number of combined shapes, through which it accelerates the speed and energy of our time.

Interactivity

Cybernetic art is a kind of an artistic experience allows a user to manipulate a medium and create his/her individual experiences in it. Such an experience can be considered a result of a symbiosis of human and media, which is formed through incorporating a medium's abilities as a contributor and cooperator in a creative process. In the future, the interface of this art, based on unrestrained interaction, will form communicative properties, challenge experimental forms and conventional relations, and defy old paradigms by introducing new strategies such as indeterminacy, chance, and accident as a necessary part of artistic composition.

Hypermediaism

Hypermediaism is an endeavor to facilitate the cooperation between an artist and an audience by linking together separate media and creating hyperlinks which form a fluid and open environment. The main characteristics of hypermedia are its innate dynamism and the capability of rapid transformation and development.

These qualities enable a meaningful transmission from standard hierarchic data toward interactive texts. The result of this metamorphosis is called hypertext. Hypertext creates a complex network of lexias which a reader can freely select and render according to his own understanding, and infuse new meanings and interpretations to them. This situation, which is called intertextuality, is the result of the reader's free ability of reading and explaining of this network, and consequently shattering the linear organization of the text.

Immersion

The belief that computers can convert the abstract realm of mathematical data into a habitable world is a culmination of cybernetic aesthetics. A virtual journey to a virtual destination by an interactive medium through a three-dimensional, simulating environment creates a sensation of complete immersion and multisensible interaction. By entering the virtual world, we suspend our traditional beliefs and come across new types of forms and literatures.

Residents of the virtual land which are known as post-humans inhabit the world where fluid architectural spaces and unlimited, endless areas are created at the crossroads of computer networks. With their changeable and flexible identities; different conceptions of time and its relation to space and constituent spatial elements; substitution of hieratic, predetermined systems for a free and non-linear choice; and many other properties and abilities, post-humans are completely immersed in an environment totally different from our logical expectations of the real world – an environment in which a fluid, liquid and imaginary perspective is irrelevant to any rational limitations of Euclidean geometry.

Cybernetic conceptualization of sensation and perception, and machine-made construction establishes a set of conceptual instruments for imagining and building territories in cyberspace in order to convey a feeling of the complete immersion in virtual world. Hence science and art converge toward a new spatial poetics which announces the creation of the world which has comprehensive and objective interaction with the residents who are immersed in it. The bodies and minds of these residents are restructured according to cybernetic aesthetics, which therefore holographically experience pure perception of space-time in a three-dimensional place.

4.2.2. Architecture in the new space-time

Although initially the aforementioned concepts conveyed the notion of new space-time and its aesthetics in architectural discourse as limited to bending, converging, twisting and other spatial effects, they seem to nourish more complex and attractive ideas related to architecture in multidimensional space-time.

By introducing tectonics of technological spaces, architectural design in cyberspace moves toward a new architectural discourse which is known as transarchitecture. Hence the idea of establishing autonomic but completely architectural spaces in virtual environment is put forward. Moreover, it has secured its position as a climax of the evolution of the history of architecture since modernism. Therefore what we call transarchitecture, liquid architecture or extreme intermedia does not only imply the topologic manipulation of forms and development of new concepts of space, time, form, structure and construction, but it also presents new definitions of happenings and connectedness. Hence not only architectural forms, but also dwelling patterns are being criticized. Following this criticism, axioms such as Euclidean geometry and inevitable constraints such as gravity loose their former determinacy, and instead tectonics of space is being defined by such concepts as non-Euclidean perception of space, algorithmic genesis, morphogenesis, and zero gravity. The products of such mentality are neither logical nor rational, nor predictable, nor oriented to a special user, nor based on such elementary architectural aspects as structure, environment and efficiency. Instead, these products are the hybrids produced by cultural fragmentation, information explosion, and the spirit of digital media. By using hypersurfaces, transarchitecture creates an

invisible information framework which is known as immaterial matter. This immaterial matter, which is an outcome of data about light and topology of objects and their motion, has common aspects with electronic and cybernetic space. Truly it is possible to call fluid architecture in cyberspace “architecture of immateriality”; this is mere form, light, and evolutionary connection of various, numerous, and abstract issues.

The ideas of permanent and controllable changes, multiple interactions, and complex sets of parameters are considered essential elements of an architectural experiment by transarchitects. So transarchitecture is a procedural operation aimed at formal developing and monitoring changes in space and its residents affected by form. Transarchitecture can be considered as transmutation and transgression which is impossible without computer technology. The technology of virtual reality enables it to build objects and spaces which otherwise cannot be transformed directly from the realm of imagination to reality. It is so because the environment in which these objects are produced essentially differs from the real world. Nevertheless, what is mostly important here is the possibility of new imagination which was formerly unattainable. In other words, transarchitecture is not merely the product of using computer and virtual technologies, but rather a simultaneous challenge of architecture and medium, and design and machine. Therefore transarchitecture is not merely a presentation of divergence of material and immaterial, trope and real, and lots of other mutually exclusive attributes which can be combined as possible and impossible. Rather, the departure point of transarchitecture is the convergence of these concepts and their exploration in interactive form. Nevertheless, the essence of reality as a boundary between the realms of possible and impossible has not changed; rather, it is this boundary that has been altered. Finally, transarchitecture can be considered as the architecture which defines an intellectual dwelling place through numerical rapid prototyping and morphogenesis tectonic. Transarchitecture has suggested liquid architecture to create a space which breathes, pulsates, and itches for transformation. The product of this architecture is a building without rooms, doors, windows, ceilings, and floors. Instead, any space is located exactly where a user needs it, and is shaped exactly in a way the user wants it. Hence the possibility of establishing any kind of non-linear telecommunication at any moment is ensured for the user, and s/he immerses in the world of light and form. [7]

Trans-architects treat this new discourse from the viewpoint of dematerialization of the design process; by this act, architecture is transformed into a data and information current, and gradually loses all elements which in the past were its inseparable attributes.

4.3. Virtual architecture; designing cyberspace

The rapid growth of virtual reality technology in all aspects of life brings this question to the minds that: what makes the human of the future abandon the cyberspace if all human senses and needs necessary for sustaining and enjoying life are simulated in the virtual world?

Today, virtual technology is at the beginning of its progress and its main applications have not appeared completely yet. At any rate, integration of virtual reality technology and its necessities with the human society seems inevitable, suggesting the formation of a new society which belongs to the era of information and communication technology called “virtual communities”. Building blocks of these societies are virtual buildings which owe their existence to information exchanges. Libraries, schools, museums, workplaces and especially retail stores and entertainment places currently available in the internet mark the beginning of virtual building constructions. Also e-mails and on-line services, newsgroups, multi user dungeons (MUDs) and many other cyberspace activities require architecturally designed spaces.

During its history, architecture has faced trends and styles; methods have been created, grown and evanesced in relation with different philosophies and social needs; however, all architectural styles had common grounds, namely designing the artificial environment and building the container of human social life. But nowadays the formation of cyberspace, and consequently virtual communities, has given rise to new architectural demands. Hence design of the artificial environment as the distinctive aspect between architecture, sculpture and painting has been challenged; therefore a new type of architecture has been created as a result of technological developments in e-life.

Cyber space has evolved from a text-based two dimensional medium into a three dimensional interactive world in view of the requirements of the new era. Relatedly, architecture, as the method for organizing space in response to a need, must then be revised due to the changes in nature of the place from material to materialless and evolution of needs from analog to digital. Furthermore, architecture is considered with deeper perception of the world, requiring a revision on the traditional definition of the space because of the growth of networks and their increasing pressure on social life. As such, designing the materialless places not only has become possible, but also it is necessary for efficient and effective application of virtual spaces.

Cyber space can be regarded as a virtual inhabitable environment. Social and spatial investigations for organizing the life in networks have shown that the virtual environment is similar to the real inhabitable environment. In other words cyberspace is not merely a technology; rather it is transformed into a new reality in modern life where numbers have replaced the brick and mortar, thus requiring design and organization. However, the concept of habitation remains as establishing a meaningful connection between human and environment. It is because of such a connection that identity is formed as a sense of belonging to a specific place within an unlimited environment and location is specified as an image of a place. Identity is defined by the shape of a space and addressing a specific location requires a perception of the order in

that space. Therefore all formal design principles (such as rhythm, scale, symmetry, unity and etc.) as well as all conceptual design basics (such as principles of behavior- environment, path finding, readability, legibility, territoriality, privacy, personal space, Gestalt psychology and etc) maintain their status as the foundations for the creation of a perceivable and inhabitable space in the virtual world.

Good understanding of human-environment interactions, specialty in organizing space and in relating functions with spatial organization, comprehensive understanding of design process and its executive steps, and expertise in transforming initial matter to functional elements are skills which help architects have a better perception of spatial problems in comparison to other specialists. Hence the problem of enclosing, visualizing and expressing a specific location within an immeasurable environment of virtual networks first and foremost is an architectural problem.

However, for the best outcome, the architects must be familiar with the nature of the space and its habitants. This is particularly important in the case of virtual world because virtual space does not exist in a specific location due to its lack of physical form. The virtual space is a void environment which is immeasurable, unlimited, and placeless, and without gravity, friction and major or minor climate until an artificial object is posed there. Thus, geography as a science of mapping the relative locations of entities in the real world is not applicable to the virtual world. In other words, no coordination systems exist in cyberspace; things do not take any places; and there are no neighbors in virtual world. Therefore, the fundamental questions faced by the architects of the virtual space are: how does architecture function in cyberspace? And what are design and construction elements in virtual space? [8]

The answer to these questions requires metaphorical interpretations of physical structures because sustaining an environment and connecting with it heavily depend on human perception of space. Metaphorical use of concepts like orientation, navigation, transition, enclosure, scale and etc., along with the new interpretations of the reference point avail the real world architectural vocabulary to the virtual environment, bridging the gap between the design concepts for the two worlds. The virtual design, just like the physical design, involves several steps from problem definition and analysis of requirements to selection of resources, identification of solutions, and finally realization of ideas, indicating that the use of word “design” for programming and spatial organization in both virtual and physical environments generally refers to the concepts of problem solving and creativity.

The cyber-architect’s task is developing techniques for combining our new body, “cyborg”, with new architecture of “city of bits”. Although fundamental changes in the concepts of time and space along with formation of new concepts like format and mapping highlight the differences between the nature of virtual and physical environments, respect for the environment remains the main strategy for design in both worlds. [9]

Understanding the nature of the virtual environment is the first step towards design of this space. Note that it is the nature of an environment that sets the initial conditions for its possible functions, providing opportunities for the residents and designers. For instance the nature of virtual environment avails more efficient and cost effective control on design processes including monitoring, corrections, and rapid observation of feedbacks in comparison to physical environment. Accordingly, value and importance of architectural metaphors are doubled in organizing virtual space because abstractness of virtual environment further complicates understanding its nature. Virtual space design concepts such as the extent of quantitative relationship between information and its accessible layers, organization of similar functions, and connectivity to the network are metaphors for architectural concepts like circulation, realm, privacy, personalization, and ownership.

Because of this metaphorical relationship, virtual reality is in parallel with the real world rather than being a substitute for it. The virtual world is constantly growing and expanding with time; it has evolved from a science fiction to a place which offers a new and alternative meaning for existence. Inhabitants of this land do not transfer their data in the form of abstract digits and numbers any longer; instead they use spatial metaphors like web pages and web sites: The language is language of place and the reality is reality of space.

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