<u>İSTANBUL TECHNICAL UNIVERSITY ★ INSTITUTE OF SCIENCE AND TECHNOLOGY</u>

AN ARCHITECTURAL APPROACH TO CYBERSPACE: TRANSARCHITECTURE

MASTER THESIS

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Department: Informatics

Programme: Architectural Design Computing

Supervisor: Assoc. Prof. Dr. Arzu ERDEM

FEBRUARY 2007

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<u>İSTANBUL TEKNİK ÜNİVERSİTESİ ★ FEN BİLİMLERİ ENSTİTÜSÜ</u>

SİBERUZAYA MİMARİ BİR YAKLAŞIM:
ÖTE-MİMARLIK

YÜKSEK LİSANS TEZİ

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PREFACE

I would like to thank

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my dear family for their love, support and encouragement.

to my father...

December, 2006 Nizamettin Hakan YARDIM

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COMPENDIUM

3-D	: Three Dimensional
3DS	: Three Dimensional Studios
ARPA	: The Advanced Research Projects Agency
CAD	: Computer Aided Design
CP	: centa - Poise
CVE	: Collaborative Virtual Environments
HMDs	: Head-mounted Displays
IP	: Internet Protocol
IT	: Information Technology
MIT	: Massachusetts Institute of Technology
MB	: Megabyte
MPH	: Miles per Hour
MHZ	: Megahertz
MUD	: Multi-User Dungeon
N	: Natural Numbers
NASA	: National Aeronautics and Space Administration
NURBS	: Non Uniform Rational Basis Spline
PC	: Personal Computer
TCP	: Transmission Control Protocol
UCLA	: University of California, Los Angeles
VPL	: Visual Programming Language
VR	: Virtual Reality

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SİBERUZAYA MİMARİ BİR YAKLAŞIM: ÖTE-MİMARLIK

ÖZET

Yeni bir çağa, dijital bir çağa, girmiş bulunmaktayız. Teknolojik gelişmeler ve bilim kurgu, mimari kuram ve mimarlık teoremine yeni fikirlerin eklenmesine sebep oldu; çünkü bu iki olgu daima yaratıcılığımız için itici bir güç olmuştur.

Bilgisayar teknolojilerindeki gelişmeler, mimari süreç ve kuram içerisinde yeni öncülerle beraber yeni yaklaşımların da ortaya çıkmasını sağlamıştır. Etkileşim terimi 1980'lerden itibaren dijital çağın arkasındaki ana düşünce olmuştur.

Günümüz mimarlık kuramı, uzay, gerçeklik ve deneyim üzerine yeni anlayışlar sunmaktadır. Artık mimarlık, farklı disiplinlerin kesişim noktası olarak görülmeye başlanmıştır. Bunlardan bazıları mimarlığın kendisi, mühendislik, IT uzmanlığı, dijital artistlik-tasarım ve kullanıcı faktörü olarak sıralanabilir. Bu yeniçağdaki mimarlık çok daha etkileşimlidir. Öyle ki, kullanıcıya tasarım sürecinde dahi müdahale olanağı sunabilir. Bu olgu kendini en çok siberuzay mimarisinde göstermektedir. Bu yeni sahanın olanakları henüz tam olarak anlaşılabilmiş ya da araştırılmış değildir. Ancak Marcos Novak gibi öncüler ilk adımı atmıştır.

Sanatın, bilginin ve teknolojinin birleşimi olan mimarlık, kendisini yeni bir safhaya taşımıştır: Öte-mimarlık. Mimarlığın ötesindeki mimarlık olarak öte-mimarlık, siberuzay içerisindeki görsel çehreyi potansiyel düşsel formlarda aramaktadır. Siberuzay içerisindeki bu görsellik, bağlanırlık ve etkileşimin saf, sanal topolojik formunu almaktadır. Kendisi de bir tür mimarlık olan siber uzay, mimarlığın ötesine geçmeyi amaçlayan Öte-mimarlığı kucaklamıştır.

AN ARCHITECTURAL APPROACH TO CYBERSPACE: TRANSARCHITECTURE

SUMMARY

We are entered into a new age, a digital age. Technological developments and science-fiction caused that new ideas are involved into the architectural discourse and into the theory of architecture because those were always an impulsive factor for our imagination. Developments in computer technologies caused to come out new approaches with new frontiers in the architectural process and in discourse. The term "interactivity" became the main idea behind the digital age of architecture since 1980's.

The new contemporary architectural discourse is introducing a new understanding of space, reality and experience. Today, architecture is thought to be a cross-section of different disciplines. Some of those can be assumed as architecture, engineering, IT (information technology) expertising, digital painting and designing, and users. Architecture in this new age is much more interactive and it allows also users to cooperate during the design process. This is mostly noticeable in cyberspace architecture, which still waits for further explorations. This new territory's possibilities are not fully understood or explored. However, frontiers like Marcos Novak are introducing us the first steps.

As a fusion of art, information and technology, architecture evolved itself into an upper stage: TransArchitecture.

As "architecture beyond architecture", TransArchitecture is searching the visible aspects in cyberspace in potentially fantastic forms. Within cyberspace, this aspect is taking on the form of a purely virtual topology of connectivity and interactivity. As cyberspace itself is architecture, it embraces TransArchitecture for oncoming developments.

1. INTRODUCTION

1.1. Aim of the Thesis

Architectural evolution entered into a new age, a digital age. Since 1980's, new ideas are involved into the architectural concepts and into the theory of architecture especially with technological developments and with science-fiction, which was always an impulsive factor for our imagination.

The Information Age, like the Industrial Age before it, is challenging not only how we design buildings, but also how we manufacture and construct them. In today's world, the digital media and information technology is to be thought essential for architecture. They are influencing architectural design process and also the discourse. The digital technology of this new era has rearranged the design process. Today's architects are highly dependent on CAD systems and on other manufacturing programs. Schools, institutes and also other research centers are also encouraging the developments and the use of technology. There is also a highly developed industry.

Developments in computer technologies caused to come out new approaches with new frontiers in the architectural process and in discourse. The term "interactivity" is the main idea behind the digital age of architecture. The new contemporary architectural discourse celebrates this new term while introducing a new understanding of space, reality and experience. This new understanding is a result of researches on virtuality and cyberspace.

Architecture becomes a cross-section of different and unpredictable disciplines in order to achieve the interactivity. Some of those can be assumed as architects, engineers, IT (information technology) experts, digital artists and designers, and users. Architecture in this new age is much more interactive and it allows also users to cooperate during the design process. This is mostly noticeable in cyberspace architecture, the architecture of a new dimension-a new world, which still waits for further explorations. This new territory's possibilities are not fully understood or explored. However, frontiers like Marcos Novak are introducing us the first steps. As a fusion of art, information and technology, architecture evolved itself into an upper stage: TransArchitecture, architecture beyond architecture, is an architecture of invisible scaffolds (Novak, 2003). In this paper, it is aimed to examine the term "TransArchitecture" and what king of differences it brought to the architectural understanding after 1980s, during and after the digital revolution. While favoring the architecture in/of cyberspace, Marcos Novak's new discourse also favors new realities in cyberspace as a second existence for our imagination. Therefore, we can also have an idea about the affects of TransArchitecture on people.

1.2. Scope and Limitations

This thesis aims to give a general understanding to TransArchitecture and its effects. Therefore, it does not have an intention to prove the discourse behind it. This thesis will guide the reader through the digital age and consequences of it. Afterwards, it will give information about virtuality and cyberspace because these are the main ideas which feedbacks the idea behind TransArchitecture. These concepts and events will also be explained to build a general background Then, the reader will be explained what TransArchitecture is and how it is understood today. While doing this, some examples created by Marcos Novak will be shown and explained.

2. ARCHITECTURE IN DIGITAL AGE

Today, it is clear to the understanding and satisfactory to the judgment that the digital media and information technology have great influence on architectural design process. Architectural design, practice, fabrication, construction, and manufacturing are highly dependent on digital technology. The digital technology of this new era has rearranged the design process. This caused a dramatic change to how we operate as architects. Paperless studios and virtual design studios have been introduced as new computerized studios in many architectural schools as new ways of practicing and teaching architectural design.

Since the concept of computer-aided design (CAD) was introduced in the 1960's, the architecture was involved into an evolution-like changing. In 1963 Ivan Sutherland's Sketchpad program, the first interactive graphical design tool, demonstrated that computers could be used for drafting and modeling, not only for number crunching. Technological leaps and new innovations in computer hardware and software technology also quickened the evolution in an unstoppable way. CAD became more important in architectural practice. This caused that it became a design tool during the 1980's. However, it was the 1990's when CAD systems were thought to be an indispensable architectural tool in design process.

In 1980's and 1990's, the main role of CAD was to transform hand-made drawings to digital. Nevertheless, it was inevitable that some visionaries noticed the power and possibilities of CAD (Mitchell, 1977; Negroponte, 1970). Terms like 3D-modelling, visualization, simulation, analyzing design solutions and quality, and generative systems to produce new design solutions were discussed since 1960s and 1970s. However, computer technology was not ready for mass production and mass distribution. These terms were only tested in laboratories during the "pre-history" with expensive main-frame and mini-computers.

The late 1990’s was the time when people talked about the concept of 4D-modeling. 4D modeling means to combine 3-dimentional modeling with the time factor. This was the period when CAD systems became a tool of construction companies and builders. Soon after introducing 4D, a natural step to 5D-CAD was made. 5D-CAD was a combination of a 3D-model, time factor, and cost factor. The evolution of CAD from 2D-drawing towards unnumbered n-dimensions has been noted in 2002 (Lee, 2002).

Virtual reality (VR) itself also changed the way we look to CAD. Since 1990’s, it expanded computerized 3D-modelling and its visual characteristics from "how it looks" towards "how it feels and sounds". According to Savioja (2003), VR has also offered valid tools for architects to present designs and also to communicate about the design issues with other project participants (Savioja, 2003). The next step of VR concept is augmented reality which concerns with aspects of modeling, imaging, mobile technologies and active communication with the models and the real world (Kieferle and Wössner, 2003; Kieferle and Wössner, 2001; Wössner, 2004).

As the computer technology developed, the way of simulating 3D design was changed from box-like parallel-piped forms to mathematically defined 3D curved forms from 1960’s to 1970’s. Nevertheless, to model mathematically defined 3D curved forms with CAD systems was very expensive, and it could be only done in research laboratories and universities with expensive mainframe machines. Therefore, we cannot talk about the usage of such a CAD system in an every-day architectural design, but in unique, specified, prototypal case studies and research examples.

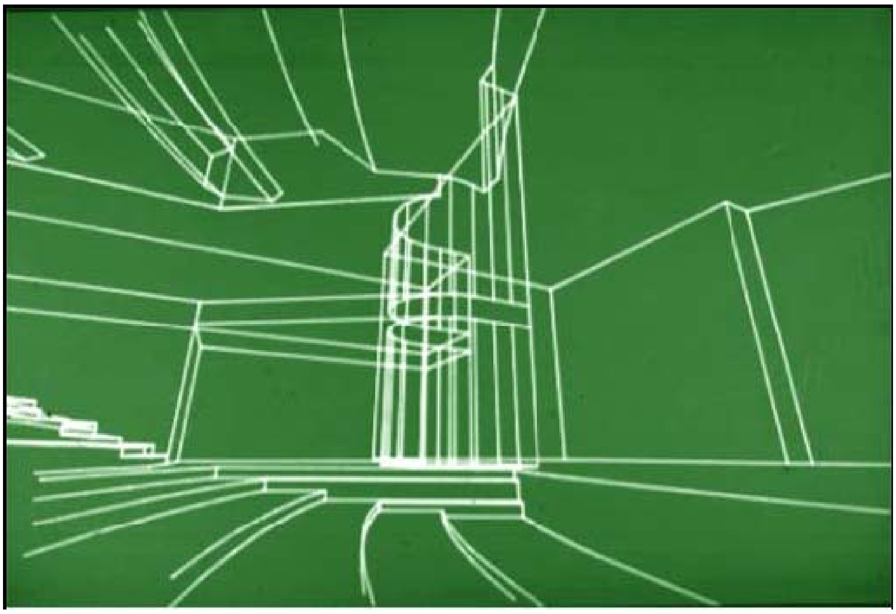

Figure 2.1: One version of the main hall of Helsinki opera house modeled with Proj-program by Tapio Takala. Straight and curved lines could be modeled spatially in 3D, though yet without volume modeling (Penttilä, 2006).

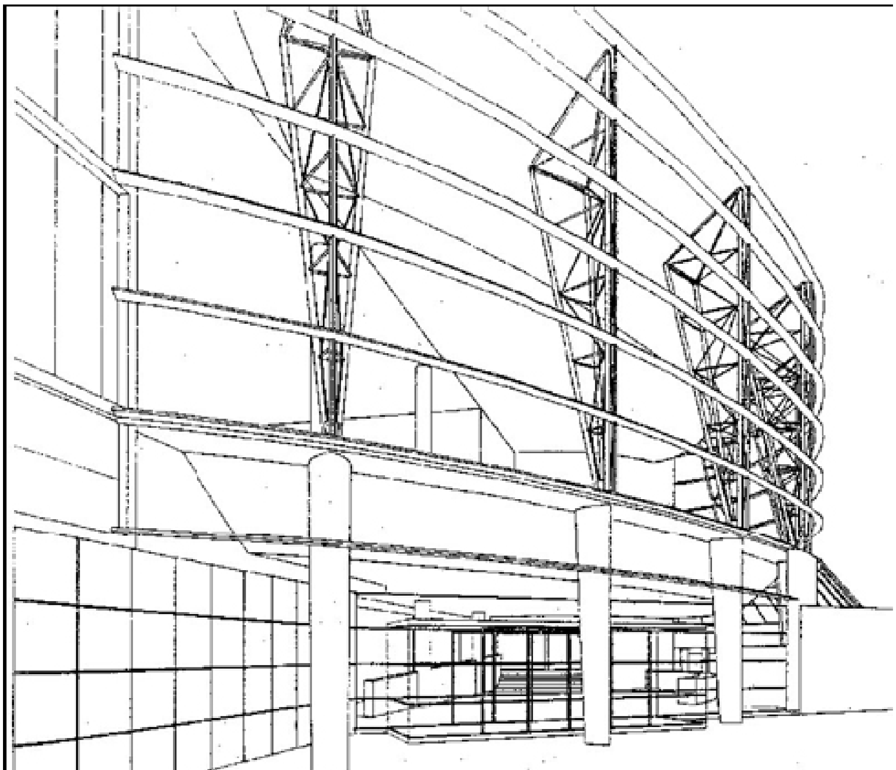

Figure 2.2: 3D-spatial modeling example by architect Pekka Salminen 1992. He was one of the earliest Finnish pioneers in using CAD. He has used 3D-modelling extensively in his architectural production (Penttilä, 2006).

Since 1980s, CAD systems became very essential as a tool in architectural offices. The main reason was also developments in computer hardware and software. Using

CAD systems in such offices also caused a chain reaction and this caused that more functional features were added in CAD-systems. Today’s CAD systems can handle also non-linear free forms, such as curves and curved surfaces. Though CAD tools to manage orthogonal architecture have been available since the 1960s, tools to manage non-perpendicular architecture are also available to design more complex buildings today.

As Chiarella (2004) mentions, the advent of B-spline curves and then NURBS-surfaces, which can be defined as non-uniform rational B-splines, in CAD-systems has released our contemporary CAD-tools from the leash of perpendicular axial 3D-shapes (Chiarella, 2004).

As we discuss the interaction between architecture and CAD system’s evolution, we can confess that CAD-systems' evolution has followed the needs of architecture. Therefore architecture is a main impulse behind the CAD.

According to Asanowicz (2004), the imagination in design was boosted with the ability to model flexible, curved, and "liquid-like" shapes with CAD. In virtual environments, which can be created in VR; these abilities made it possible to create forms and structures which are not dependent to gravity or real materials' characteristics. Therefore, it leads to nonrealistic, non-buildable designs. Although these design samples do not have economical value for some groups, the studies about concepts like free form design are highly regarded in architectural schools (Asanowicz 2004).

Besides being regarded in educational platform, some examples of such digital experiments became "iconic" 3D-artifacts, which have artistic value even as themselves. Such projects were shown by the works of Greg Lynn and Kivi Sotamaa.

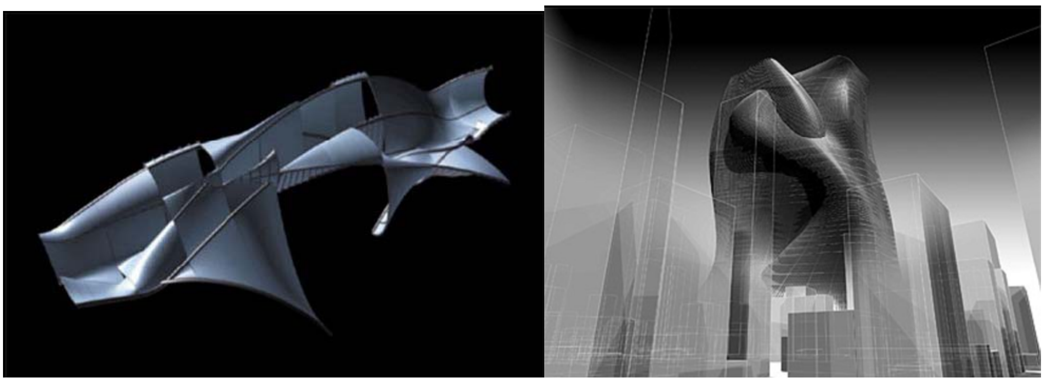

Figure 2.3: (left) Projects from Greg Lynn (Form) and Kivi Sotamaa (Ocean-North) (right) (Penttilä, 2006).

Flexible and liquid forms and geometrical shapes are easy to handle with today’s 3D-CAD-system tools. These design tools vary from Catia to Maya, Rhino and

Autodesk's 3ds. These products bring new possibilities of digital creation of forms which are geometrically free. Today, this ability is encouraging many architects to build curvilinear and non-Euclidian. As Kolarevic (2003) states, the architects of this movement represent an ideological, conceptual and formal break with the building tradition (Kolarevic, 2003). They use the classical, or representational, approach to architecture. Leach (2004) points one of these architects. Frank Gehry can be seen as one of the architects that can be placed in the classical appearance orientated digital architecture (Leach, 2004). Frank Gehry uses high-end CAD-tools and product collaboration tools. Both of these are essential parts of Gehry's way of working.

Besides, Gehry Technologies became a high-tech consulting company and service provider as a distributor for developments done by Gehry for commercial platforms since 2002.

Figure 2.4: Curved exterior walls of the Walt Disney concert hall in Los Angeles by Frank Gehry in 2000 (Penttilä, 2006).

Gehry prefers to use a tactile physical model instead of a digital manipulation of surfaces. He uses of digital technology as a translation of physical models into digital information for the final fabrication of the building (Kolarevic, 2003).

However, in spite of the fact that computer-aided design technology has been adopted almost universally as the predominant means of production in architectural practice, its use merely represents the commercialization of the simplest and most obvious application of information technology in architectural design - the automation of traditional processes like drafting, modeling, and communicating - without adding value to the practice and its products (Kalay, 2004). As a result, most architectural design solutions are still crafted manually, much the same way they have been for the past 500 years.

“Beyond the fact that over the past decade a new generation of avant-garde architects is pushing digital technology to its limits, so far it has had relatively little qualitative impact on the profession of architecture at large. In general, information technology has improved the efficiency of designing buildings, when in fact it has the potential to reinvent the architectural design process itself (Kalay, 2004).”

In many cases, the computer and CAD systems have been used to replace the manual tools of the architect during the production process of traditional architectural drawings. Hereby one of the major advantages of using the computer is neglected. There is the possibility of generating geometric forms that are not directly controlled by the designer, but by computer software. Greg Lynn is one of the first architects to use animation software for generating form. He uses force fields to generate and transform structures (Kolarevic, 2003). Bernhard Franken & ABB Architekten’s BMW Pavilion can be mentioned as an example for such a design process. Two spheres lying apart from each other were used to generate the form. A force field generated on computer draw them closer to each other. The spheres moved and they melt together into a unified form. While using this method to generate completely free forms, it can also be used to determine actual loads on the building, such as wind-loads. So, the generated form will get more project-specific.

Although Complex forms and shapes can make construction process much more complex and unconventional, CAD systems with computer-aided manufacturing tools have made it possible and much easier (Kolarevic 2001). As Kolarevic (2001) states, digitally produced mass customization and computerized production of building elements can even allow unique design objects to be produced almost as easily as mass-producing and duplicating similar objects with the help of computer-numerical-controlled production, CNC-tools.

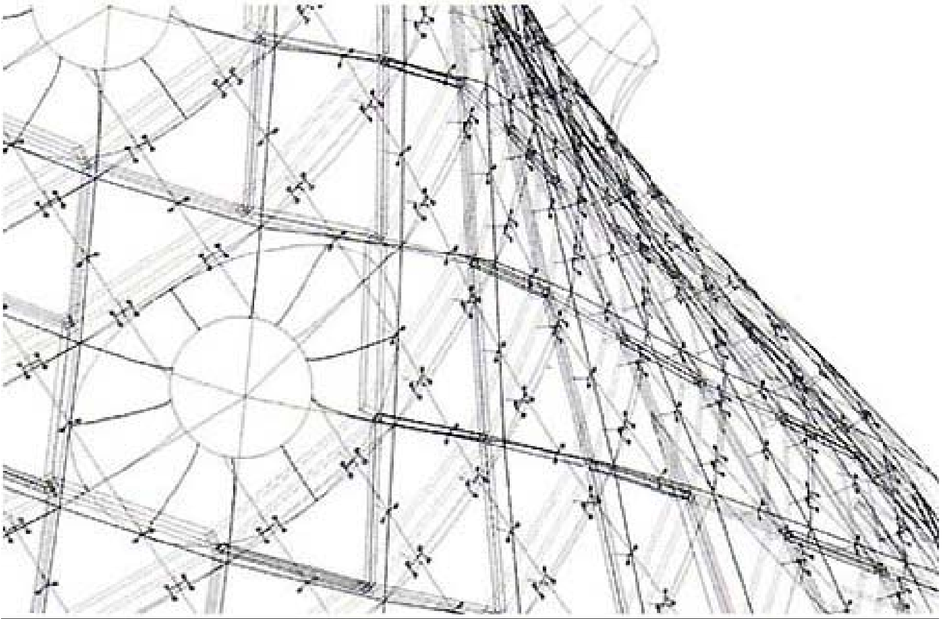

Figure 2.5: Overall building shape and exterior detail from Graz arts house in Austria by Peter Cook & Colin Fournier in 2003 (Penttilä, 2006).

Besides, there are some other features of CAD systems. They simulate the air movement in a room caused by the air conditioning system (Savioja, 2003) and calculate and show visually virtual acoustics and sound (Lokki, 2002). In the area of technological aspects of a building such as construction, acoustics, lighting, and climate, digital tools can provide great possibilities for calculation, exploration and simulation of this instant and future condition. It can also be used as engineering optimization.

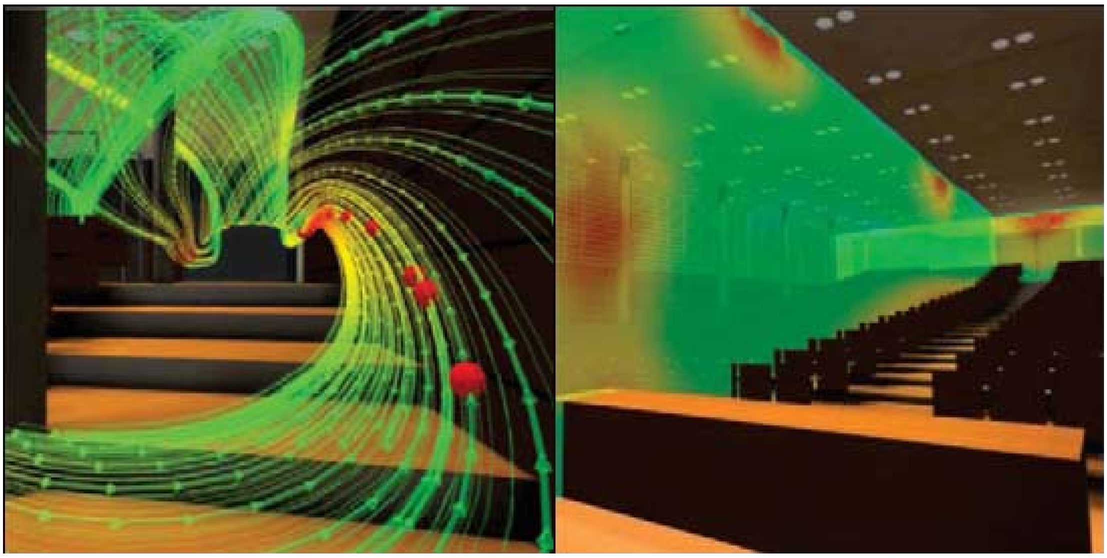

Figure 2.6: Particle paths and air flow analysis from virtual CAD-models, HUT Hall (Penttilä, 2006).

City Hall of London, which was drawn by Foster and Partners, can be shown as an example. In this building, solar studies were made to investigate how the sunbeams will be distributed over the building's surface. Besides, different shapes are tested in relation to the acoustics of the interior, before the final shape of the building is found (Whitehead, 2003). According to Kolarevic (2003), the digital tool provides what seems to be the notion of the digitally based techniques so that we can talk about a shift from making of form to the finding of form (Kolarevic, 2003). The word "finding" does not mean that the optimal shape is supposed to be found and copied directly from a technical computer program. This would be a mechanical solution because the architect would not have any influence on the computer-generated design result. Therefore, the process has to contain computational technical aspects as well as architectural aesthetic considerations (Leach, 2004). The computer should be perceived as a collaborative partner and it should support the architect with technical guidelines through the process.

Today, CAD-tools are very essential so that the management of current building activity is not even possible without it. CAD systems allow design and engineering for construction companies with maximum coordination. Therefore, it shortens the project schedule while providing savings. This is the reason of why construction companies are interested on CAD, 3D-modelling and also product modeling.

As Kolarevic (2003) states, with the help of 3D modeling and drawing programs most complex building concepts can be realized. Nevertheless, the first fascination of the new geometrical possibilities is decreasing (Kolarevic, 2003). Architecture in digital age has to be thought as a new way of considering architecture. It should be seen as a clear and logic result of a hybrid-process.

2.1. New Concepts of Spatiality

2.1.1. Virtual Reality

Virtuality is a term that was once used by Ted Nelson to refer to the "conceptual structure" of an electronic literary system in which ideas could be freely exchanged and linked to one another. Virtuality can be the new description for genesis in cyberspace. It is the boundary between real and virtual world.

At the beginning of this section, it is investigated how virtual reality defines itself. For this reason it has to be done a search in the very beginning of our virtual reality understanding which we also call as "internet". Internet is the most common term that most of the people recall when we talk about cyberspace and virtual reality. As a commune of a collection of approximately 60,000 independent, inter-connected networks that use the TCP/IP protocols and that evolved from ARPANet of the late '60s and early '70s, "The Net" is a worldwide system of computer networks providing reliable and redundant connectivity between disparate computers and systems by using common transport and data protocols.

The term 'Virtual Reality' (VR) was initially coined by Jaron Lanier, founder of VPL Research in 1989. VR is a way of interaction. We can visualize and manipulate what we make visual. In order to interact with, we are in need of computers and extremely complex data. In their work "Literacy in Virtual Reality: a New Medium", Sherman and Craig (1995) described virtual reality as a medium composed of highly interactive computer simulations that sense the user's position and replace or augment the feedback of one or more senses. It gives the feeling of being immersed, or being present in the simulations.

Simulations are artificial situations or environments which are imitating or estimating how events might occur. Virtual reality offers with its visualization capabilities a saver, not-expensive and more interactive way to simulate real-world conditions. Because of its programmable and flexible architecture, new pre-designed or pre-thought situations can be added to the simulations. Virtual reality can be used to create realistic world simulations. But, its real power lies in creating these interactive real-world and fantastic-world simulations for everyone who can attain it.

As we mention worlds created in VR, we also have to declare that each world in each reality needs a space and place. As the architecture has always been defined and perceived as the art of places, in the physical world, places differ from spaces by including social and cultural values, besides spatial configurations (Kalay, 2004). This definition of place also gives an idea about the key elements in the formation of places. In general, places are the spatial environment. People inhabit the environment and they are interacting.

Norberg-Schulz (2000) describes the art of places with the word "totality". Besides, place deals with "the experience of living". According to Steele (1981), the concept of a sense of place can be described as: "Setting + Persons = Sense of Place". The term "setting" refers to the "surrounding" (spatial setting) and "context" (social setting).

As Kalay (2004) states, we design virtual worlds by place making instead of by page and document making. Our social and cultural behaviors are organized around spatial elements of the physical world. So, we can adopt these patterns of behaviors to virtual worlds in order to have the same potentials for conception and interaction that the physical world exhibits. By doing so, we can reduce the cognitive efforts needed to inhabit the worlds. The analogy provides a base to understand and further extend the use of these networked environments. Besides, experiences gained from virtual worlds bring new understandings to dimensions for exploring architectural design.

Hyperarchitecture (Puglisi, 1999), information architecture (Schmitt, 1999), and liquid architecture (Novak, 1992) can be shown as examples.

Nevertheless, designing and creating place in virtual worlds differ from creating place in the physical world. One of the major differences is caused by the medium in which the place is created. Virtual worlds are networked environments. So, they can be accessed only via computers. Secondly, designing virtual worlds in VR do not need to obey the law of physics. According to Kalay (2004), there are four criteria for virtual place making:

• Functional virtual places: places provide ambient environments for certain intended activities online, which offers the reason or purpose for being there.

• A sense of location: places provide relative locations, and locations create a context for the intended activities to occur. A sense of location helps to recall our traces in the virtual worlds, and these traces help us to differentiate one place from another.

• A sense of presence: places involve some kinds of engagement with objects and people. Through these interactions, a sense of presence is provided.

• Uniqueness of virtual places: virtual worlds afford a variety of experiences different from our physical experiences; for example, virtual worlds have unique ways of transportation from place to place using hyperlinks.

As we create places (spatial environments), we begin to criticize presence in VR. Experiencing your own presence in VR is like the process of discerning and validating the existence of self in the natural world. This is what we engage in since birth. A sense of presence in a virtual world causes the feeling like you exist within but as a separate entity from a virtual world that also exists. The experience of presence can be enhanced if other beings exist in the virtual world. These being can vary from other participants to intelligent agents which are artificial intelligences. The sense of presence becomes more powerful if they also seem to recognize that you exist. It may be enhanced if the virtual environment itself seems to acknowledge your existence. Besides; 3D images and sounds, photorealism, tactile and force feedback also support the feeling of personal presence. According to Fisher (1990), a central NASA objective in VR research can be shown as an example. They are trying to develop a new kind of interface that would be very closely matched to human sensory and cognitive capabilities. As John Walker at Autodesk Inc. (1990) states:

"The richness and fidelity of a cyberspace system can be extended by providing better three-dimensional imagery, sensing the user's pupil direction, providing motion cues and force feedback, generating sound from simulated sources, and further approximating reality almost without bounds."

As we can notice, the researches for VR technology and simulating presence caused to shape different types of approaches to VR. These can be classified as immersion VR, desktop VR, second person or unencumbered VR, and telepresence.

Immersion VR uses head mounted displays. These artificial “organs” include one monitor for each eye. Besides, sound and position trackers are also used to place the participant inside a virtual environment. Immersion VR can cause a powerful feeling of “being there” because the virtual world appears to respond to head movement in the way the natural world does. You move and the virtual world looks like it stays still. Three hundred participants in Autodesk's cyberspace rated "being inside" the virtual world as the most compelling aspect of the experience (Bricken, 1991).

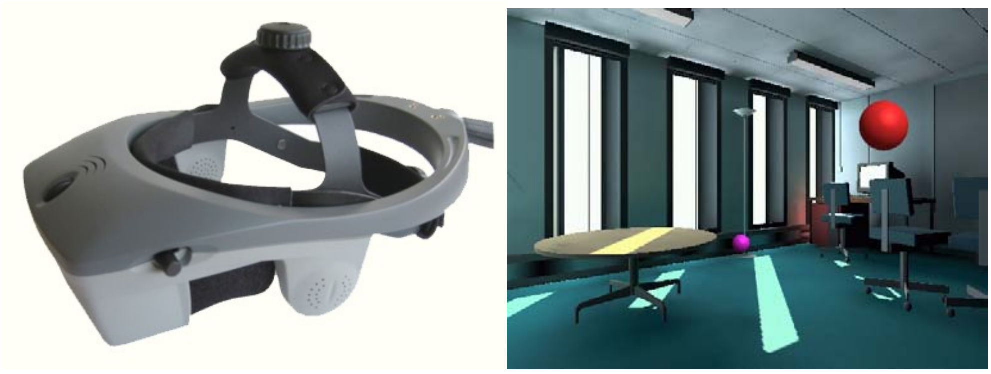

Figure 2.7: Example for Head mounted display (HMD) and the vision transmitted through HMD (Bungert, 2006).

Immersion VR worlds are 3 dimensional. The time-lack between images sent to the eyes creates a perception of depth and dimension. As the participant moves, all of the information has to be recomputed for the new position of the participant. The 3-D graphic VR worlds are usually made up of polygons. They are texture mapped and different algorithms are used to create more or less realistic shadows and reflections. In addition, 3-D sound generators simulate spatial locations of sound sources according to the participants’ current location. A next step for perception can be seen as data gloves. New wireless data glove systems are fully instrumented gloves that provide high-accuracy joint-angle measurements. They are using proprietary resistive bend sensing technology to accurately transform hand and finger motions into real-time digital joint-angle data. They feature two bend sensors on each finger, four abduction sensors, plus sensors measuring thumb crossover, palm arch, wrist flexion, and wrist abduction. Data glove systems have been used in a wide variety of real-world applications, including digital prototype evaluation, virtual reality biomechanics, and animation. For animated movies, video games, and cartoons, artists and designers can quickly create realistic finger and hand movement in MotionBuilder software like Alias’.

Figure 2.8: Example for Data Glove (Immersion ®, 2006).

Frequently, being inside a virtual world is accompanied by a dynamic, artificial representation of some part of you-- most often, a computer generated hand. Meredith Bricken (1991) describes the experience of watching her dynamic self-representation hand within a virtual world as "convincing evidence that you're there."

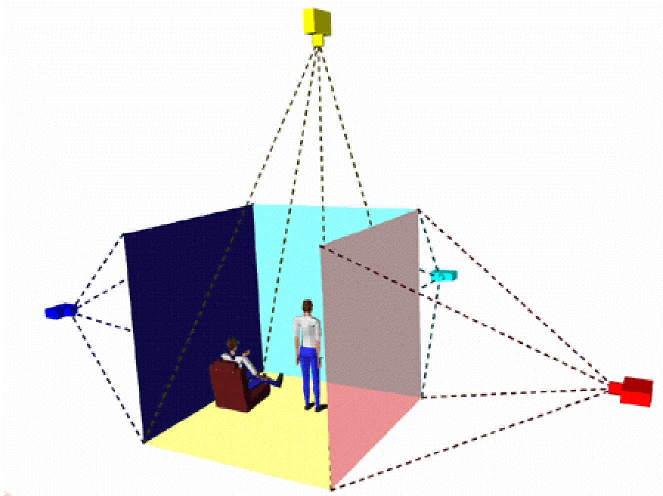

Figure 2.9: Schematic principle of CAVE System (Fathom, 2006).

Another form of immersion VR is caves. Early versions of these technologies were demonstrated at SIGGRAPH '92 in Chicago. “Cave Automatic Virtual Environment” is developed in the University of Illinois at Chicago and provides the illusion of immersion by projecting stereo images on the walls and floor of a room-sized cube. Several persons wearing lightweight stereo glasses can enter and walk freely inside the CAVE. A head tracking system continuously adjusts the stereo projection to the current position of the leading viewer.

Desktop VR systems depend on computer screens. The idea behind it is to get free from the difficulties and highly technological needs of head mounted displays. Even if the images are shown on a 2-D display, they are 3 dimensional. As the virtual world exists in 3 dimensions, participants can navigate in 3 dimensions around in the world. One of the famous examples is BattleTech in Chicago. Since August, 1990; the BattleTech Center in Chicago has been transporting visitors to the year 3025, placing them in control of BattleMech robots at war in a computer-generated terrain amidst computer-generated weather conditions. Another example of desktop VR is CAD packages like Virtus Walkthrough which allow users to navigate around the 3-D worlds they have modeled. As these forms of VR need less specific technology, they are also less expensive and more common.

An alternative approach to immersive VR is what Michael Miller calls "second person VR" (Kruger, 1991). The “second person VR” differs from the immersive VR in the way that you know you are there (in VR) because you see yourself as part of the scene. There is a blue background in the room. The participant has to stand in front of it. He also faces a monitor and TV camera. On the monitor he sees himself. However; instead of being in front of the blue background, the participant sees a combined capture of himself and of a graphic or combined video/graphic virtual world. Edge detection software keeps track of his location and movement and allows you to interact with graphical objects on the screen. The “second person VR” uses the idea behind "seeing is believing" to create a sense of being there.

Telepresence VR uses cameras, microphones, tactile and force feedback and other devices. Besides, these have remote control capabilities and allow the user who is located at one site to move their head or hands to control robots and sensors at a remote location, experiencing what they would experience at that remote site. "Microteleoperation" can be shown as a good example for this. It uses a microscope and micromanipulator to give the operator a sense of presence and the ability to act in a microscopic environment (Robinett, 1992).

"Virtual reality" is a kind of reality that has the effect of actual reality but not its authentic form. That means, it is a kind of simulation or substitute, but one with potency and validity. It gets close to the real thing. In its effect on people, it begins to become practically the real thing. In this concept, we may ask ourselves what really “real” is in order to decide whether virtual reality is real or not. In the movie “Matrix” which was directed by Watchowski Brothers in 1999, the question “What is real” and “How do you define real" was answered by Morpheus at one point. The answer was simple: "If you're talking about what you can feel, what you can smell, what you can taste and see; and then real is simply electrical signals interpreted by your brain.” As this answer shows, virtual reality can become as real as what we call “real”. It is only a matter of time and technology.

Reality and virtuality are not only subjects of discussions that we talk about since '70s but a much older and deeper subject in philosophy. “The Allegory of the Cave” written by Plato in his work “Book VII of The Republic” shows how realty is dependent to the surrounding and perception, and how easily we can be confused about reality. Plato describes a cave where we can find prisoners who have been there from their childhood, and have their legs and necks chained so that they cannot move.

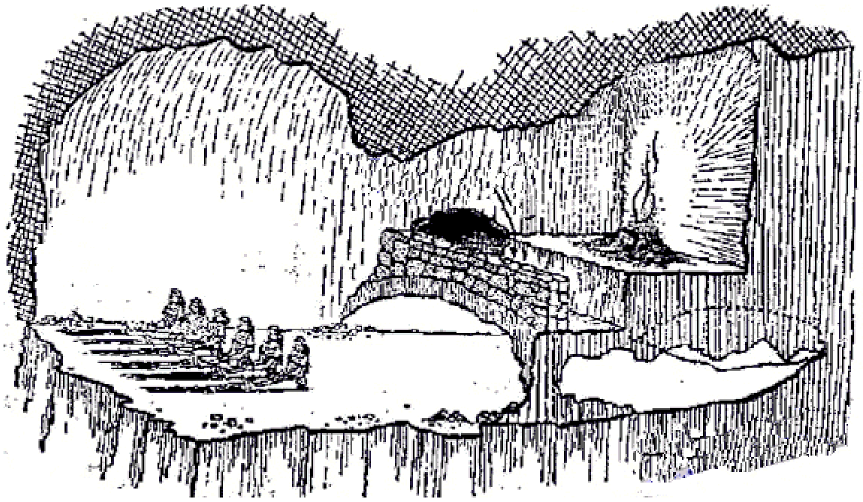

Figure 2.10: Drawing of the Plato’s Cave (Lightmodulator, 2006).

They are chained so that they are being prevented from turning round their heads. Above and behind them, there is a fire which is blazing at a distance. Between the fire and the prisoners, there is a raised way. It is built a low wall along the way, like the screen which marionette players have in front of them, over which they show the puppets. The prisoners can only see their own shadows, or the shadows of one another, which the fire throws on the opposite wall of the cave. What they can hear is their own voices and echoes of puppet players. This place is now the reality of the prisoners with all of the shadows and echoes. If a prisoner is released, he will turn his neck round and walk and look towards the light. This will cause sharp pains because the glare will distress him, and he will be unable to see the realities of which he had got used to in his former state. After that, someone will tell him, that what he saw before was an illusion. The first reaction of the prisoner would to ignore the reality because he would fancy that the shadows which he formerly saw were truer than the objects which are now shown to him.

As described above, Reality is what we can perceive. “Virtual reality” can be as real as “reality”, especially when we use it on patients who are in need of psychological treatment. PC based virtual reality systems are used for treating individuals suffering from a fear of flying. Patients wear a head mounted display and are immersed into a virtual 3-D world where they find themselves in an airplane.

Figure 2.11: 3D Replica of an Airplane (VRLab, 2006).

The patient will accept the 3D virtual world as real and at the beginning; he or she will act in the way as he would act in a real situation. After a period of time, the patient will accept the situation knowing that he or she is not in a "real" danger. But, what made the difference? At the beginning, the patient gave reaction to the first impressions, which are in this case "being in an airplane" and "height". However, the lack of perception will take all the fear away so that the patient will notice that he or she is not endangered. The motive of the action shows us that perception is the one what makes something real or not. Therefore, virtual reality can be accepted case sensitively as real as real world (http://vrlab.epfl.ch/~bhbn/psy/index-VR-Psychology.html).

2.1.2. Cyberspace

Benedikt (1992) explains cyberspace in his work "Old Rituals for New Space: Rites of Passage and William Gibson's Cultural Model of Cyberspace":

"The realm of pure information, filling like a lake, siphoning the jangle of messages transfiguring the physical world, decontaminating the natural and urban landscape, redeeming them, saving them from the chain-dragging bulldozers of the paper industry, from the diesel smoke of courier and post office trucks, from jet fuels fumes and clogged airports, from billboards, trashy and pretentious architecture, hour-long freeway commutes, ticket lines, and choked subways… from all the inefficiencies, pollutions (chemical and informational), and corruptions attendant to the process of moving information attached to things – from paper to brains – across, over, and under the vast and bumpy surface of the earth rather than letting it fly free in the soft hail of electrons that is cyberspace."

William Gibson (1984) was the first person who introduced the word "cyberspace" in his work "Neuromancer". As the inventor of this term, he defined cyberspace as a consensual hallucination, experienced daily by billions of legimitive operators, by children being taught mathematical concepts. This experience was lived in every nation. With its unthinkable complexity, cyberspace meant to be a graphic representation of data abstracted from the banks of every computer in the human system." Lines of light ranged in the nonspace of the mind, clusters and constellations of data. Like city lights receding.... (Gibson, 1984)"

Relying on this quotation, cyberspace can be defined as a total interconnectedness of human beings through computers and telecommunication without regard to physical geography. From the beginning of ARPANet on to the evolution to internet, the number of personal computers interconnecting via cyberspace was and still is increasing in an unstoppable way. What made cyberspace to diffuse into our lives so rapidly? The answer to this question can be given by the development process of computer technology, especially of personal computers (PCs) and of standardization of network systems.

Computer network systems developed rapidly as computer's hardware systems became much powerful enough. As the equipment of computers goes down in price, many different companies began to set up their own network systems. However, these networks could not communicate with each other. The reason was that there did not exist standards and that the networks were highly specialized. After a while, The US Department of Defense was interested in using these systems. In order to achieve a usage of those systems, they needed a method for interconnecting all of these networks. This was the very fist example of so called "the net". This first networking system research was called as "the Advanced Research Projects Agency" (ARPA). Arpanet was one of the first networks which was sponsored by ARPA. ARPA also developed software for networking, such as Internet Protocol (IP) and Transmission Control Protocol (TCP). As the standardization was sufficient, internet technology was developed for public usage as an open system. An open source of data and information was now available for the users. As The National Science Foundation noticed the importance of Internet to science, they began funding Internet and TCP/IP technology. In 1983 the Internet connected 562 computers; this number was at the end of 1993 over 1,200,000 computers. By September 2002 the Internet reached two important milestones. This can be thought as the genesis of cyberspace in the way most people figure out:

- 200,000,000 IP HOSTS
- 840,000,000 USERS

Existence in cyberspace can only be discussed if we can find an answer whether cyberspace itself exists or not. Cyberspace can be thought as a matter of science and technology and is strongly connected to those. Kofahl and Segraves (1975) claimed in their work “The Creation Explanation” that mathematics and the logical principles of science are part of cyberspace. As mathematicians do not believe that they are continually creating or inventing new laws of mathematics and new properties of numbers, they tend to believe that they are discovering existing truth. Because of these, Kofahl and Segraves (1975) strongly suggest that cyberspace exists independent of human minds and therefore it was not invented by human minds.

“It existed before man came on the scene. If cyberspace has existence independent of human minds, how can its origin and existence be explained? How can something that consists entirely of mental concepts and processes exist without a mind that is its repository that knows it? Since cyberspace is evidently infinite, how can it exist except in an infinite Mind who is its Author? The existence of the universe supports the real existence of cyberspace and of a Mind that conceived and created the universe. (Kofahl and Segraves, 1975) “

Lessig (1999) accepts cyberspace as a sum of “many places” with non-identical characteristics. These “many places” differ in fundamental ways. The cause of these differences is the people who populate these places because these people are participants of different communities in real space. While the architecture of the cyberspace (Internet) equalizes people, it also is embodying us with attributes that we may or may not have in real space. Besides, the number of identities in cyberspace created by individuals of “real world” is unlimited.

In a forum organized by a website so called “MotorHome Magazine”, the answer to the existence in cyberspace was given in an indirect way. The question given to the participants was simple: “why do you post?” Maybe the most interesting answer was given by a participant with the nickname “Palehorse” (2003):

"I post because it's there / I post, therefore I am"

As this quotation shows, cyberspace shapes our way of thinking about existence while we “try to shape” it.

While we create identities in cyberspace, we must get aware that these identities exist. We are creating not only a virtual reality in cyberspace, but a reality separate and distinct from our own which can be called as an alternate dimension. These new dimensions with cybernetic identities can be observed easily in Multi-User Dungeons online games (MUDs) where participants rely solely on plain text (Turkle, 1995).

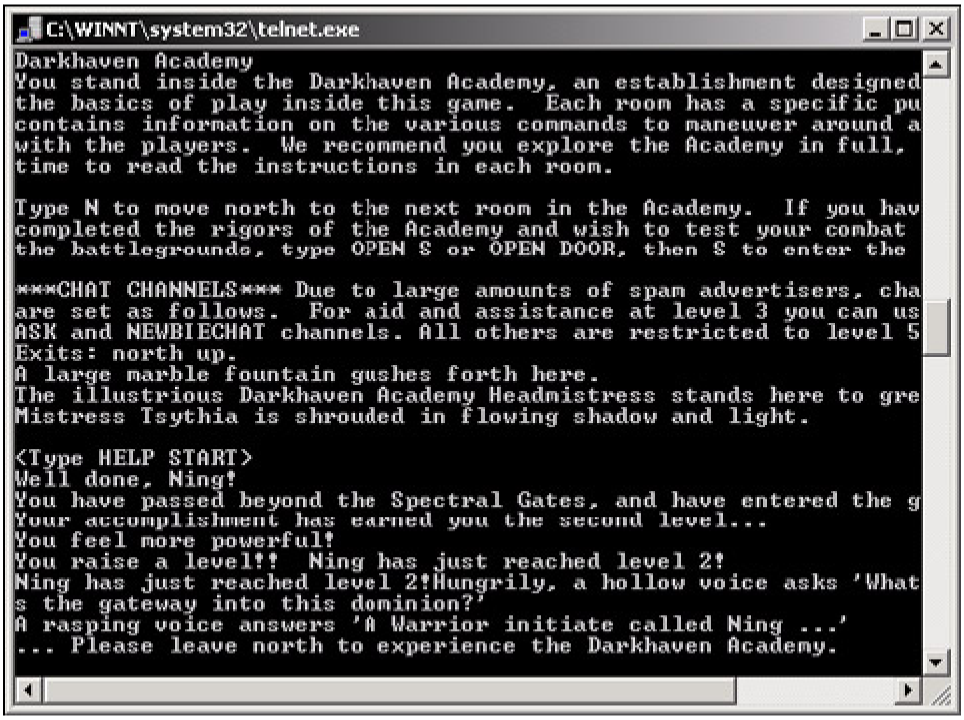

Figure 2.12: A MUD example (Mad Computer Scientist, 2006).

They are living laboratories for studying the first-level impacts of virtual communities (Rheingold, 2000). The characters' physical identity in these games is described via text. In the text-based virtual worlds, words are the only matter because the creation of the worlds depends almost exclusively on the use of words. The virtual worlds and their components are described using texts. People connect to a shared networked environment to interact with the environment and each other by using text commands. MUDs are widely recognized as the first generation of shared networked environments. It was developed as a place for the role playing game Dungeon and Dragon. During the game, the character’s personalities (personalities of avatars) are revealed through dialogues with other users. The user can become whoever she or he imagines herself to be. This new character is “real” for other participants as they can only communicate or interact with it. “MUDs are part of the latest phase in a long sequence of mental changes brought about by the invention and widespread use of symbolic tools (Rheingold, 2000).”

2.2. State of Being in Between [Physical / Virtual]

Mixed Reality allows us to explore new forms of art, entertainment, performance and culture. In order to build an interaction between people in shared places, Mixed Reality spaces have to build an awareness of the notion of connections and layers between real and virtual spaces. According to Milgram (1994), there has been a growing interest in techniques for combining real and virtual environments to create mixed realities–spatial environments where participants can interact with physical and digital information in an integrated way. As a result, Mixed Reality is generally concerned with integrating of virtual spaces into real, physical space. By doing this, it aims to create an environment that enables the users in shared and remote physical spaces to interact and communicate through their natural senses. The computer and cyberspace are not only tools anymore but a space that is to be entered in. They become a physical space filled with data where we can navigate through the furniture of data. The visitor’s navigation and exploration of this virtual space is connected to real space and to other participants. Therefore, data is organized spatially and revealed as the user navigates the space (Milgram, 1994).

The basic concept of the Mixed Reality stage can be exampled as a room filled with data. The “room” itself stands for physical interaction space. However, the furniture itself consists of data which is totally virtual. It is a spatially organized information space. In order to make the data stored in it visible, the participant has to move in the combined real-virtual space and interact with other participants. In these circumstances, we can talk about filling and extending the physical space with virtual space.

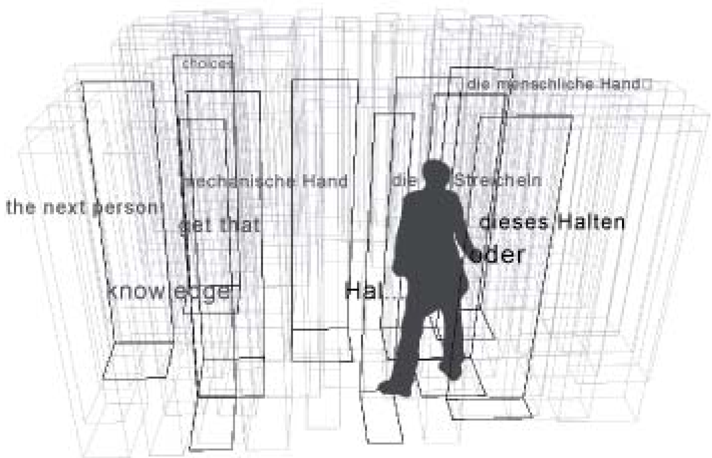

Figure 2.13: Information space in Mixed Reality (Strauss, 1999).

In this concept, the user’s movement in physical world triggers sounds in the virtual space. At the same time, this sound is emitted into the physical space. For the user, there is an invisible field of sound in the physical space because his movement in physical causes the sound, and the sound is also heard in the physical space. If sounds are substituted with data of an information space, this can illustrate the realization of the basic idea of using virtual data for filling real, physical space.

Mixed Reality also looks for answers to some questions. To explore the boundaries between real and virtual, Mixed Reality needs a free body interface. Besides, it is questioning the info-communication space and suppressing the mediating role of the computer into background awareness.

Mixed Reality refers to environments that are able to combine real and virtual objects with visual representation of real and virtual space. This can be imagined as the interconnection of the real and the virtual that produces a new framework for communication and interaction possibilities. The components of digital and physical information are merged in different degrees in information space. This creates a situation that connects the users with each other.

There are varieties of approaches to create shared mixed realities like augmented reality, augmented virtuality, tangible bits and Mixed Reality boundaries.

Behind the idea of an augmented reality lies overlaying and registering different textual and graphical digital information onto a real world scene so that the digital information appears to be attached to the physical objects. With the help of a see–through head–mounted display (HMD), the digital information will be introduced. Besides, it might be remote so that it is viewed on a video display that is also enhanced with digital information. The Shared Space System and Studierstube are some of the early examples. With the help of The Shared Space system, users can share virtual objects across a physical table top; The Studierstube differs as the virtual objects are also displayed in a physical space between multiple users. Both of these systems uses see–through head–mounted displays. Responsive Workbench (Krueger, 1995) is another approach to a shared augmented environment. The Responsive Workbench also uses a physical table displaying virtual objects. Nevertheless, these objects can be manipulated by data glove or stylus. The Responsive Workbench differs from the "Shared Space System" and the "Studierstube" by using shutter glasses rather than HMDs. So, the table itself becomes a screen for stereoscopic back-projection.

According to Milgram (1994), augmented virtuality starts from a virtual world and then refers to representations of physical objects within it. These might take the form of textured video views or 3D visualization of remote physical locations (Reynard, 1998). The "Freewalk System" can be examined as an example. In this system, the view of participants' faces on their avatars is displayed with video textures (Nakanishi, 1996).

There are also differently oriented systems like the Communication Wall (Breiteneder, 1996). Two halves of room which are spatially separated is joined by augmented reality and virtual studio techniques. The remote part is projected on a wall-size display. For the participants, this display causes an illusion of a continuing room. They can communicate like sitting face-to-face at different sides of a table.

According to Ishii (1997), the approach of tangible bits needs the use of graspable physical objects to interact with digital information. These objects are called phicons. Moving phicons (physical models) across a table top can enable the user to access a digital map that is projected onto it (Ishii, 1997). The perception of the user can be increased with the use of ambient display media. Sound, light and airflow can be used to provide more awareness of background information. Reflections of water ripple on the ceiling can show the volume of network traffic. In the Cybercity system, another approach was given. By moving the "virtual finger" through the streets of a map which is projected on a table, the user could navigate through a wall projection of a 3D city model.

There is a transparent boundary between physical and virtual spaces. The spaces are not overlaid but they are distinct and contiguous. The occupants of this shared physical space can see as avatars within a collaborative virtual environment into the next–door virtual space and can communicate and interact with its occupants. Next, the occupants of the virtual space can also see back into the physical space. Mixed Reality places equal weight on physical and virtual environments. Therefore, it considers how virtual and physical space can be accessed from the other. While using multiple Mixed Reality boundaries together, it tries to connect many physical and virtual spaces so that they become a part of a larger Mixed Reality environment (Benford, 1996).

With the help of the "wearable computing system", the user can become mobile while being a part of both virtual and physical environment. The user can be free to move and act in a real world while staying informed with a wearable display system (Mann, 1996). There are six different classes of MR interfaces according to Milgram's approach to define taxonomy of Mixed Reality:

1. non-immersive, monitor-based video displays with overlaid virtual image components

2. Immersive HMD-based video displays

3. See-through HMD video displays

4. Virtual see-through HMDs via integrated video camera

5. Primarily virtual display environments with overlaid video "reality"

6. Completely virtual projection-based environments immersing user and surrounding reality as a whole (Milgram, 1994).

There are five different technological approaches for simultaneous presence of multiple geographically distant participants in a shared space. These are:

1. Mediaspaces,

2. Spatial video conferencing,

3. Collaborative virtual environments,

4. Telepresence systems,

5. Collaborative augmented environments (Milgram, 1994).

In order to talk about a mediaspaces, we need to talk about an enhancement of existing workspaces with integrated audio and video communication. This is similar to multimedia conferencing system. Nevertheless, it supports social browsing, peripheral awareness and the establishment and maintenance of long-term working relationships between users who are physically separated.

The term “spatial video conferencing” is also a kind of video conferencing system. However, it tries to introduce support for determining gaze direction. The users of this system can distinguish whom one is gazing.

The collaborative virtual environments (CVEs) refer to computer generated spaces where each user has his graphical representation. The user can control his or her viewpoint and interact with other participants or various data. Such spaces can be seen as shared virtual worlds.

Telepresence systems allow users to experience a remote physical space through computer and communications technologies. The user can view the space; navigate through the space, and also interact with objects in the space. Views of a real world scene are overlaid in a virtual environment. After that, some dynamic links are installed between them. See-through head-mounted displays or graphics on video screens are also be used (Ishii, 1997).

3. TRANSARCHITECTURE AS AN APPROACH TO CYBER-ARCHITECTURE

3.1. Marcos Novak and TransArchitecture

After the revolutionary developments in computer technology in 1980’s, the question that most of the people asked was how it could be possible that information can be spatialized, and what could it mean. Once proper tools were developed for interacting with information on the spatial level, what sorts of creative processes would arise. From the experimental engineering of Richard A. Bolt and his team at MIT in the 1970's to the artistic explorations of Marcos Novak and his architecture of virtuality, the questions of spatiality and spatial computing have opened up previously unknown modes of thinking and interacting: "TransArchitecture".

Marcos Novak graduated from Ohio University with a specialization in computer-aided architecture and he remained faithful to this field. He tried to narrate his futuristic ideas wherever he could. This can be seen while working at the Center for Advanced Inquiry at the University of Wales and leading the TransArchitecture Foundation in Paris or teaching at the University of California and Ohio State University. His works have been essentially virtual. His work is so advanced in this field that he is regarded as the “pioneer of the architecture of virtuality” according to the organizers of the International Architecture Exhibition in Venice.

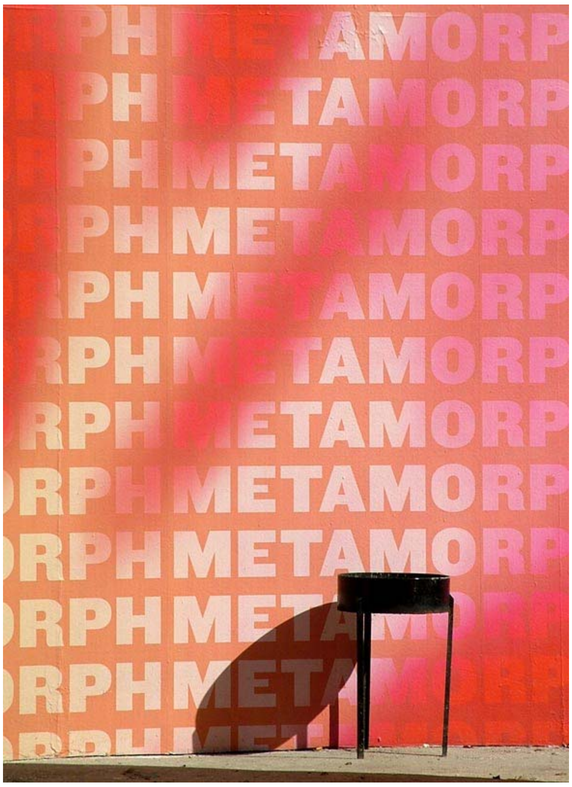

Figure 3.1: Poster of the 9th International Exhibition in Venice (Venicebiennale, 2006).

Marcos Novak is a traveler through alien architectural terrains. His seminal work has included many virtual architectures and essays that are crucial to those architects who are interested in the swiftly blossoming architectural cybertheory (Spiller, 2000).

For Michael Benedikt's "Cyberspace: First Steps" Novak wrote in the chapter "Liquid Architectures in Cyberspace" that "cyberspace is architecture; cyberspace has an architecture; and cyberspace contains architecture (Novak, 1991)."

Therefore, TransArchitecture is not only a step in the architectural evolution but also a "must" for exploring this new realm.

Novak is known for projects which in their name give hints that they consist of a futuristic and technological elements. "Sensor Space", "Transmitting Architecture", "Liquid Architectures", "Metadata Visualization", "Echinoderm", AlloBio" and "Alienwithin" just to name a few of those.

The term TransArchitecture was contributed to international architectural discourse in the mid of 90's, and it stems from a discussion between architects and designers. They were influenced by their experience with computer technology during the design process. This caused that they developed new concepts of reality, time, space, shape, structure, and construction. During the design process, they combined design and machine, and they caused a shift from "form and space" to "process and field".

"TransArchitecture, architecture beyond architecture, is an architecture of heretofore invisible scaffolds. It has a twofold character: within cyberspace is exists as liquid architecture that is transmitted across the global information networks; within physical space it exists as an invisible electronic double superimposed on our material world (Novak, 1996)."

Besides being an architect, an artist, a composer, and a theorist, Marcos Novak also describes himself as a "transarchitect" because of his works with computer-generated architectural designs. He employs algorithmic techniques to design actual, virtual and hybrid intelligent environments. He designs spaces and the objects that fill and create those spaces directly in virtual reality. Whereas an architect is interested mainly in the economy of construction, the transarchitect explicitly invokes his space to perform and transform, as an immersive, interactive, lively creation in 3-D virtual space. Marcos Novak originated the concept of TransArchitecture and the study of a dematerialized architecture for the new, virtual public domain. Therefore, his immersive, 3D creations can response to the viewer, and they are transformable through user interaction. Exploring the potential of abstract and mathematically conceived forms, Novak has invented a set of conceptual tools for thinking about and constructing territories in cyberspace (Novak, 2004).

TransArchitecture can be seen as a threshold. It changed our understanding of spatial perception. It is the next step of evolution. Via TransArchitecture, we evert virtuality; we conceive algorithmically (morphogenesis); we model numerically (rapid prototyping); we build robotically (new tectonics); we inhabit interactively (intelligent space); we telecommunicate instantly (pantopicon); we are informed immersively (liquid architectures); we socialize nonlocally (nonlocal public domain). Through the use of the computer and its ability to completely ignore the laws of physics, new forms can be created. Novak calls these liquid architectures, since they combine time and space with little or no rational constraints (Spiller, 2000).

The results of his studies has led him to create previously unimaginable, unfathomable objects in virtual space, and then have them milled into real works of art that can be touched and experienced in the real world. This is an architecture that exist both 'here' in the physical world and 'there' in the virtual world, forever transverging the boundaries between the imagination and the possibility of creation. His current work is to do with "eversion", his word for the casting of the virtual onto the actual. This is where the most fertile work in architecture in the future will be, in the crazy interstitial worlds where substance and absence are blurred (Spiller, 2000).

“The printed book took place of architecture; then, the computer took place of the book. In the space of virtual dimensions that has been created, architecture has arisen anew as TransArchitecture: an architecture beyond architecture, mediating the transition between actual and virtual in the manner that conventional architecture mediated between knowledge and experience, humanity and nature, inside and outside, public and private, need and excess. TransArchitecture is the architecture of hyperlinked hyperspace” (Novak, 2003).

TransArchitecture exists in cyberspace as liquid. We can imagine that the word TransArchitecture refers to a higher concept which consists of digital architecture, especially the liquid architecture. Novak introduces the concept of "liquid architecture” as a fluid, imaginary landscape that only exists in the digital domain. This new type of architecture does not hold to the rules of Euclidean geometries, and from the expectations of logic, perspective, and the laws of gravity. Novak views TransArchitecture as an expression of the "4th dimension" that incorporates time alongside space among its primary elements. Novak's liquid architecture bends, rotates, and mutates in interaction with its visitors. In liquid architecture, "science and art, the worldly and the spiritual, the contingent and the permanent" converge in a poetics of space (Novak, 1991).

"Liquid architecture is an architecture that breathes, pulses, leaps as one form and lands as another. Liquid architecture is an architecture whose form is contingent on the interests of the beholder; it is an architecture that opens to welcome me and closes to defend me; it is architecture without doors and hallways, where the next room is always where I need it to be and what I need it to be (Novak, 1991)."

3.2. Tools of Creating TransArchitecture

Cyberspace itself is never static. It always changes. As Maude-Laure Ryan mentioned, the multidimensional exploration of a virtual text can never be complete because its fluid architecture rebuilds itself continually (Ryan, 1999).

Depending on Marcos Novak, cyberspace itself is architecture. Besides, cyberspace has an architecture and cyberspace contains architecture (Novak, 1991). He claims that virtual environments have as a result emerged as aestheticized renditions of the architecture of our creative and mnemonic states. Therefore, virtual environment is an imaginational space which can be also seen as the space of the dream, or the memory. Because of this, TransArchitecture itself is an intersection of real and virtual, and a tool for inserting ourselves into the cyberspace. In "Culture After Humanism", Iain Chambers writes:

Within architecture itself the metaphysical marriage of thought and technology today carries a new name: TransArchitecture... TransArchitecture seeks to overcome the distinction between the physical and the virtual through the transmutation of design and project, architecture and habitation, into information. It believes [like Paul Virilio] that information is the third dimension of matter (after energy and mass) (Chambers, 2001).

However, TransArchitecture itself also depends on specific tools which also characterize it. Some of those can be mentioned as "morphogenesis" via algorithms, "rapid prototyping", "robotic construction", "intelligent spaces via interactivity", "pantopicon via instant telecommunication", "immersion and eversion", and "nonlocal public domains". Nevertheless, without the developments in computer technology we could not speak of a "TransArchitecture". It is the ability of computer software to ignore the laws of physics and Euclidian geometry which makes cyberspace architecture conceivable (Spiller, 2000).

Algorithm is one of the impulsive tools for creating TransArchitecture. Abu Abdullah Muhammad Ibn Musa al-Khwarizmi was the first person who introduced the mathematical concept of algorithm. He was born at Khwarizm which is located today in Kheva, Uzbekistan, and died c.840 CE. The word Algebra is derived from the title of his book Al-Jabr wa-al-Muqabilah.

The Turing Machine is the precursor of both computer software and hardware. It was first proposed by Alan Turing as he published a paper on Hilbert's problem in 1936.

A by-product of this mathematical work was the first machine-based model of what it means for a function to be computable, and the description of what is now called a Turing machine. He attempted to give a mathematically precise definition of "algorithm" or "mechanical procedure". These simple abstract devices are one of the earliest and most intuitive ways to make precise the intuitive idea of computability and the underlying logic is closely connected to the later development of computers.

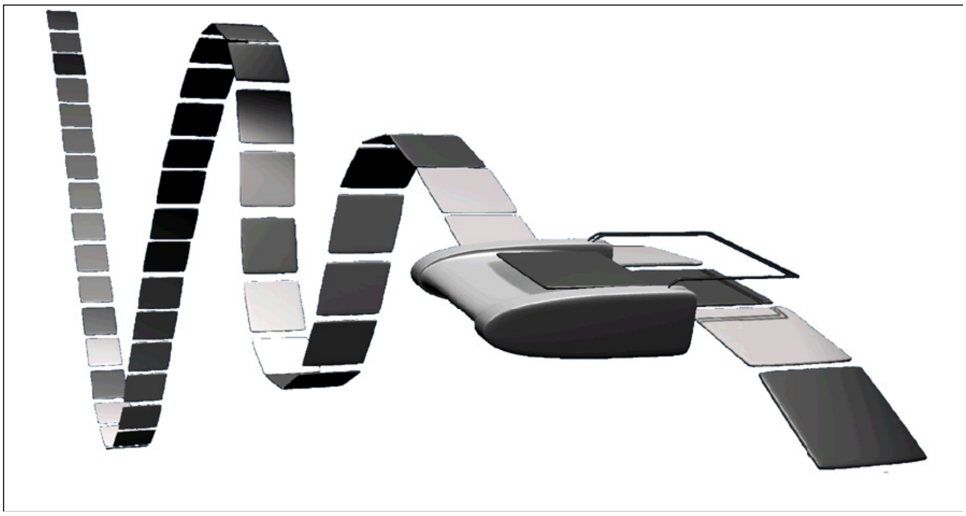

Figure 3.2: Visualization of Tuning Machine (Himmelblau, 1998).

According to Peter Anders, an algorithm is a step-by-step process leading to a solution. It is a logical equivalent to many procedures we use to generate many artifacts. Given instructions with the appropriate materials, we could build a house, a car, even an artwork. The algorithm for production is distinct from its product. Today, it is an intrinsic part of collaborative disciplines like design, engineering and architecture. In fact, we could argue that the relationship between instructions and product is as natural as life itself - that computer algorithms are a pale shadow of material processes underlying the organic world (Anders, 1998).

While mentioning that TransArchitecture uses algorithms we should also be aware that all computer-assisted art is algorithmic to some degree since software itself is based on algorithm. In this general setting every data takes the form of a finite sequence of bits and that is why it can be coded as a natural number. Hence, a program p can be viewed as partial function on the set of natural numbers N with output out ϵ N as result of a computation of the input in ϵ N that is p(in) = out.

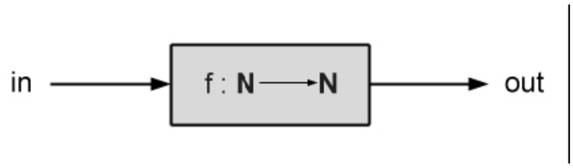

Figure 3.3: Functional description of program (Himmelblau, 1998).

It is this abstract setting for a computing device that facilitates the principal question of computability, i.e. for which (partial) function f exists a program p such that **f(in) = p(in)** for every valid input in ϵ N.

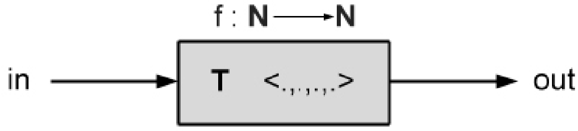

Figure 3.4: Algorithmic description of program (Himmelblau, 1998).

Today, computers are still used as an efficient tool for representation through drafting and modeling. Therefore, only a digital model of the design gets build up using standard and primary forms within the CAD-software. There are also a set of different possibilities of modification of these forms.

According to Piegl and Tiller (2000) all the geometric information in a computer-aided environment is based on the use of non-uniform rational Bezier splines which can be called as NURBS (Piegl, 2000). A NURBS can be defined as a smooth curve from a start point A to an endpoint B. This smooth curve has a set of attracting control points (Pi) and some corresponding weight functions (Wi). These points are regulating the degree of attraction. As the NURBS is defined by the graphical representation of an output of inputs of these points and weight functions every production of a NURBS is an algorithmic transformation of an input which can be controlled by mouse and keyboard. Therefore, it is an activation of a specific Turing machine.

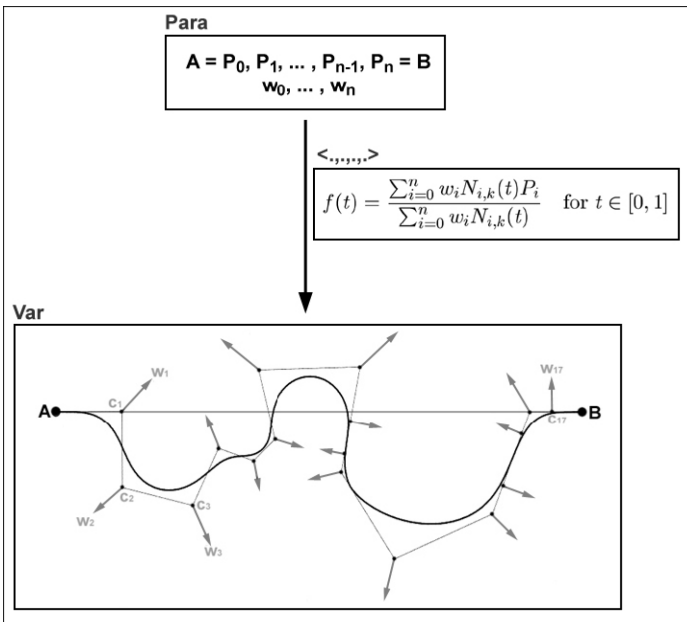

Figure 3.5: Program structure of NURBS calculation (Himmelblau, 1998).

The threshold to digital design in architecture is a result of the conscious overcoming of the traditional level of representation. This can be achieved with the use of computers as design tools. If we analyze developments in architecture after 1980s we can distinguish three degrees of computational awareness of acquisition of the machine into architectural design. These are the operative, the parametric, and the algorithmic.

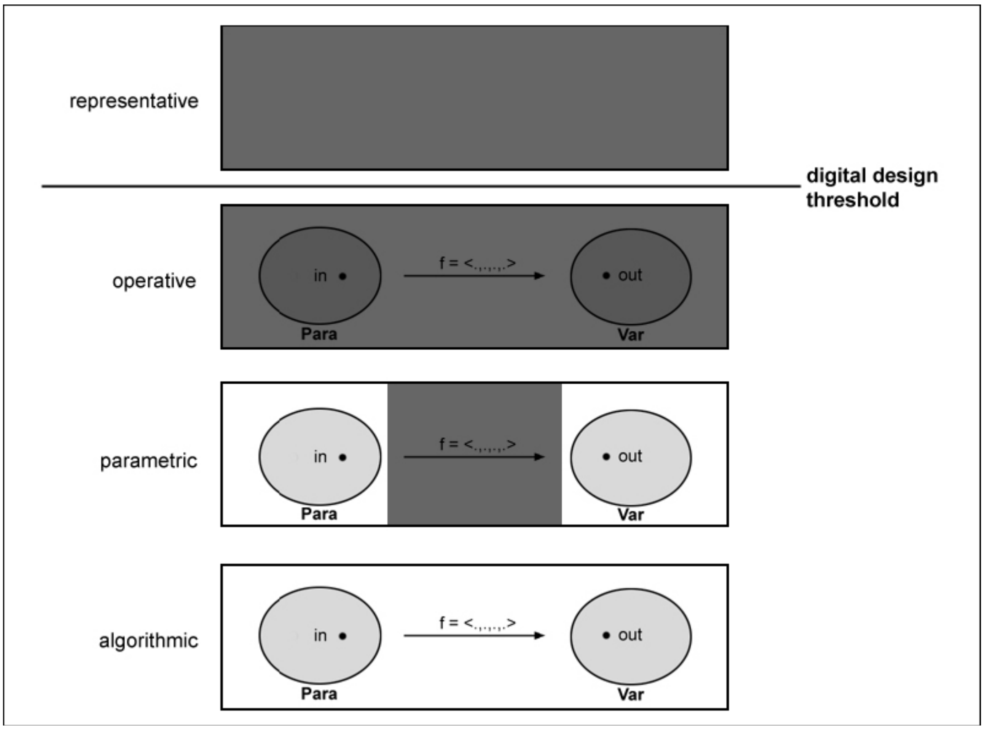

Figure 3.6: Levels of algorithmic awareness (Himmelblau, 1998).

With the help of NURBS-geometry, the parametric awareness was supported and developed. This awareness caused a shift of interest from drafting and modeling towards a more mathematically based view on architectural design. As every NURBS object is defined by control points and weights the data are not fixed and can be changed throughout the whole design process. Therefore, parametric can provide a range of possibilities. It can replace stable with variable, singularity with multiplicity (Kolarevic, 2003). The International Terminal of Waterloo Station in London by Nicholas Grimshaw and Partners can be shown as an example for this. The design consists of thirty-six dimensionally different but identically configured three-pin bowstring.

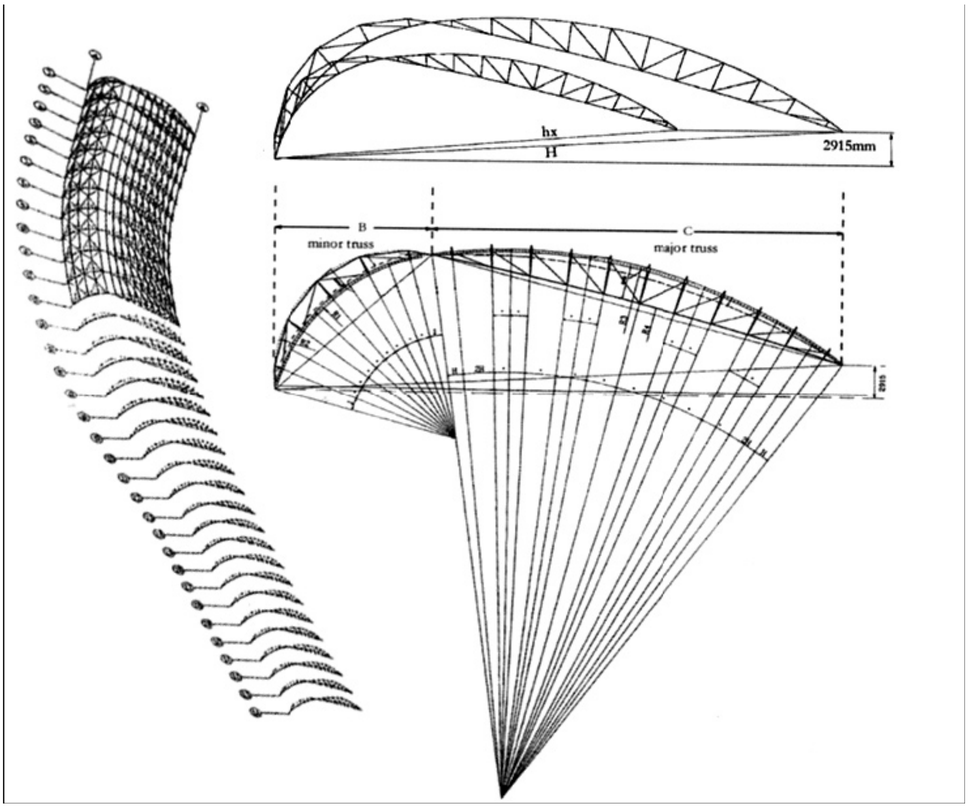

Figure 3.7: Nicholas Grimshaw and Partners: International Terminal, Waterloo Station, London, UK, 1993 parametric definition of truss geometry (Himmelblau, 1998).

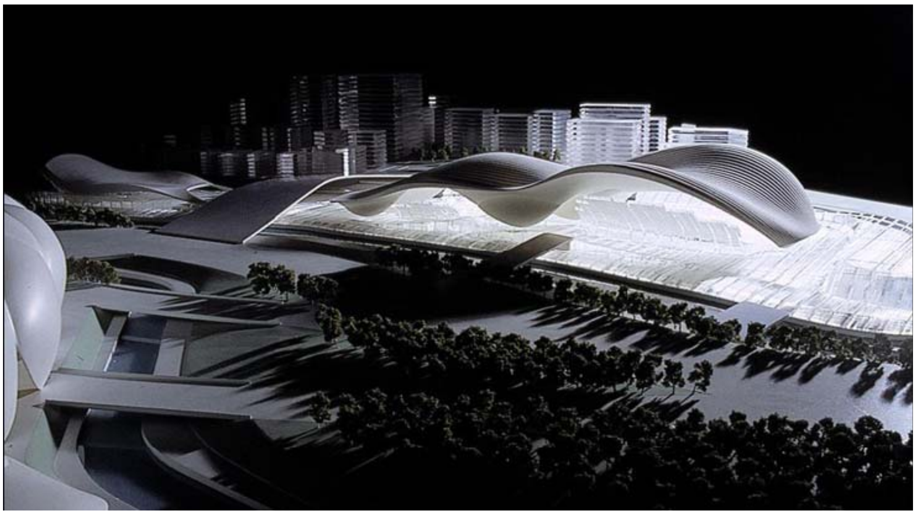

Figure 3.8: Zaha Hadid: Aquatic Center, London, UK, 2005-09 Geometry of roof out of simulation of behavior of fluid by means of animated particles (Himmelblau, 1998).

As Greg Lynn's project for the Port Authority Gateway and the Aquatic Center by Zaha Hadid show, one of the most popular ways of using parameters in contemporary architecture is adding time as primal parameter to the design. Morphing, key frame animation, kinematics, force fields, or particle systems are time-based techniques. They are used in the design process to deform a given NURBS-geometry by changing some specific parameters over time.

The strength of the computer lies in the flexible series of commands and logical procedures. These can instantly transform it from one function to another. Nevertheless, architects generally has to use fixed Turing machines on the operative as well as one the parametric level because programs are developed for a very general or for a very specific usage (Silver, 2006). This was the reason of why some architects tried to create their own codes for their specific needs. Projects like the British Museum Great Court Roof by Norman Foster and Partners, the Serpentine Gallery Pavilion by Toyo Ito, or Ocean North's design for the Music and Art Center are some examples (Szalapaj, 2005).

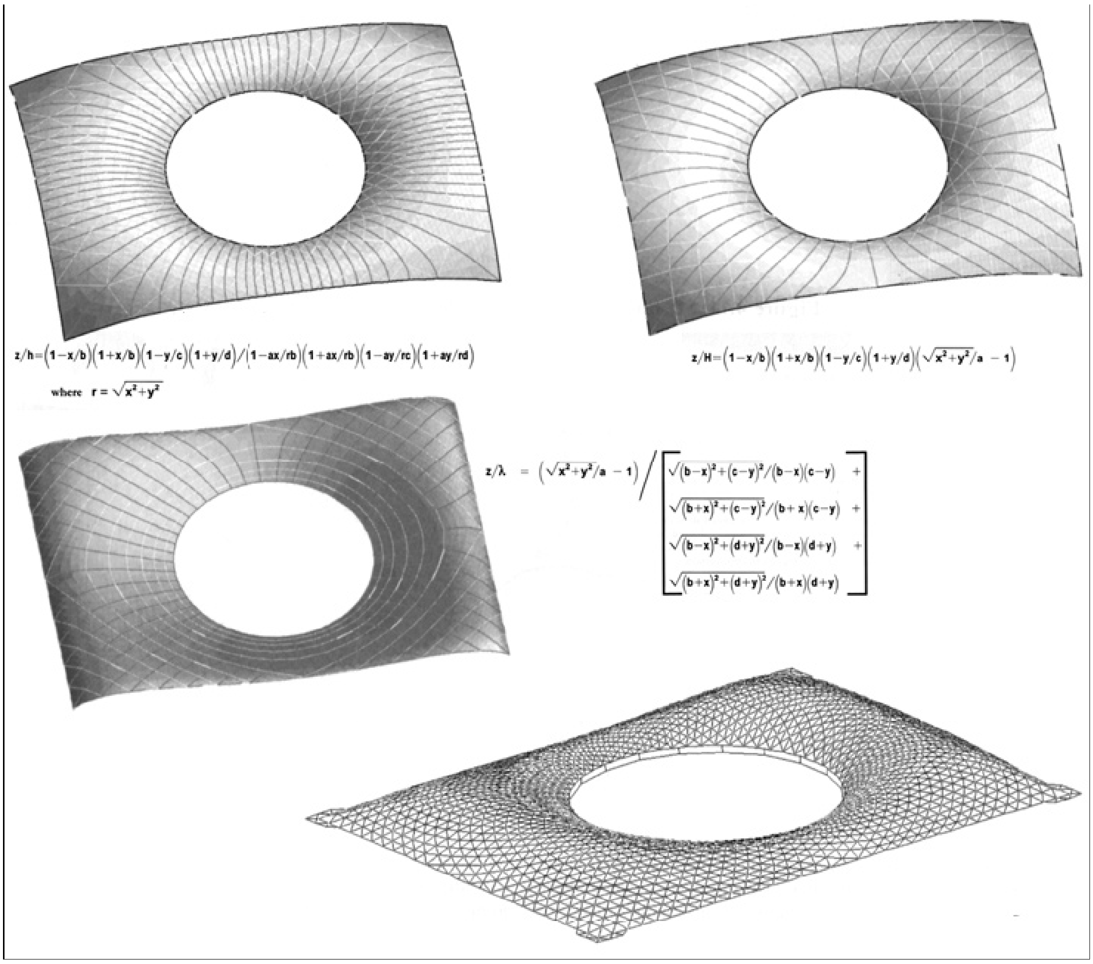

Figure 3.9: Norman Foster and Partners: Great Court Roof, British Museum, London, UK, 1999-2000 (Himmelblau, 1998).

Today, what is needed is a conscious consideration of the machine in order to be able to reinvent the design process in architecture and use the computers creatively. This is what the Turing model stands for. In addition, what is needed is a conscious differentiation between computation and computerization. As Tenzidis mentioned:

"While computation is the procedure of calculating, determining something by mathematical or logical methods, computerization is the act of entering, processing, or storing information in a computer or a computer system. Computerization is about automation, mechanization, digitization, and conversion. Generally, it involves the digitization of entities or processes that are preconceived, predetermined, and well defined. In contrast, computation is about the exploration of indeterminate, vague, unclear, and often ill-defined processes; because of its exploratory nature, computation aims at emulating or extending the human intellect. It is about rationalization, reasoning, logic, algorithm, deduction, induction, extrapolation, exploration, and estimation. In its manifold implications, it involves problem solving, mental structures, cognition, simulation, and rule based intelligence, to name a few (Terzidis, 2006)."

The very close relation to human endeavors caused that the question of computation existed already long before there were any computers. It is rooted in mathematics of antiquity. To make algorithmic thinking more effective in architecture is not only a way to utilize computers in the design process but also might be the key to develop a new theory of digital architecture. Therefore, a first step towards such a theorizing would be a stocktaking of contemporary architecture from an algorithmic perspective.

According to Marcos Novak, forms are never manipulated through manual corrections in TransArchitecture. Therefore, special algorithms and mathematical formulas can be used to generate them. Algorithms can be adjusted to produce different results. Besides, Novak's data-forms are "transmissible". He means that his data-forms can be compressed into algorithmic codes for transmission to fabrication sites, machines or to virtual environments (Novak, ZeichenBau: Virtualités réelles, TransVienna).

Marcos Novak's algorithmic TransArchitecture can be seen as a parametric design process. In his algorithmic explorations of "tectonic production" using "Mathematica" software, Marcos Novak (1996) constructs mathematical models and generative procedures that are constrained by numerous variables initially unrelated to any pragmatic concerns. Each variable or process is a 'slot' into which an external influence can be mapped. These can be statically or dynamically. In his explorations, Novak is less concerned with the manipulation of objects and more with the manipulation of relations, fields, higher dimensions, and eventually the curvature of space itself.

Nowadays, Marcos Novak is involved in the nanotechnology. He is concerned with genetic algorithm and its usage in architecture. According to Frazer (1995), evolutionary architecture proposes the evolutionary model of nature as the generating process for architectural form. Therefore, architectural concepts can be expressed as generative rules. Computer models can be used to accelerate and test their evolution and development. For generating new forms, a code script of instructions can be written in a genetic language. This language can also describe the main concept. This new prototypical forms can be simulated in new computer models. With the help of genetic algorithm, very large numbers of evolutionary steps can be generated in a very short time. The main characteristic of genetic algorithm is a string-like structure. This can be seen as chromosomes. Genetic algorithm allows us reproduction, gene crossover, and mutation. In the process of genetic coding, the central issue is the modeling of the inner logic. According to Christian Möller; in genetic algorithm, a stream of spatial units which are defined by the task's specifications flows into the predefined, invisible world. These spatial units can be thought as molecules whereas the specifications of the task can also be called as spatial agenda. As this spatial agenda is transferred onto the computer system, these spatial units (molecules) are distributed according to their genetic entry and to their respective function. The spatial units are given different characteristics according on their usage. Each spatial unit in question must be placed in the proximity of the other related units in a degree of relatedness to a functional area. While some of these units have to come together and build a surface and a facade in order to contact the outside space, some have to be part of seamless series of links like entrance, foyer, and reception area. Then, a population of overall spatial units generated in this manner can then be tested and valued in terms of quality. If a space is not able to take its genetically prescribed spatial place next to related spaces within the population, then the overall result is unsustainable. However, if the system has found a population that has scored sufficiently well, then it appears on the screen and a possible solution in the form of a 3-D mass model will be shown to the user. From now on, the user can influence the evolution of the model. Various mass models, parts of which have been assessed as good, can now inter-breed. This user controlled process of mutation can be applied to any number of generations according to the concept, which is then advanced further by conventional means.

As examples for usage of algorithm in TransArchitecture, two demonstrations of Marcos Novak can be examined. These are “Paracube” and “Data Driven Forms”.

For the project “Paracube” (1997-1998), cuboids were defined by six parametric surfaces. Each of these parametric surfaces has its own coordinate system. The parametric equations of each surface were arranged to cause reactions or permutations on adjoining surfaces if there is a variation on a particular surface in order to create a topological cube.

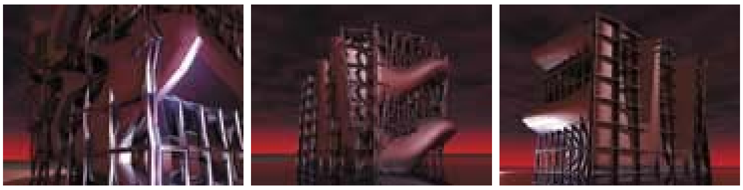

Figure 3.10: Paracube (1997-1998) (Novak, 2006).

The parametric cuboids were manipulated to create two forms. These are a skeletal frame and a smooth skin. While the parameterization allowed the smoothness of each element to be defined and manipulated through computational formulas, the frame was derived from the same process. The skin was computed at high smoothness and the skeleton at low smoothness. The skeleton was then mathematically extruded into the fourth dimension by adding a fourth coordinate to every three-dimensional point. Thus, points became lines, lines became polygons, polygons became cubes and cubes became hypercubes. The resulting four-dimensional object was rotated about a plane in four-dimensional space according to the appropriate matrix transformations. This transformed object is then projected back into three-dimension space. It became a space-frame of variant dimensions. The skin was not extruded into the fourth dimension. However, it remapped to create a rippling, non-homogeneous surface.

In the project “Data Driven Forms” (1997-1998), the model is the result of deriving forms from fields of found data. As spatial models, the forms explore two concepts. The delamination of passage from one data set to another and arbitrary cross-fade between data sets. An algorithmic function is extracted from linked Web pages as two sets of points in the three dimensional matrix.

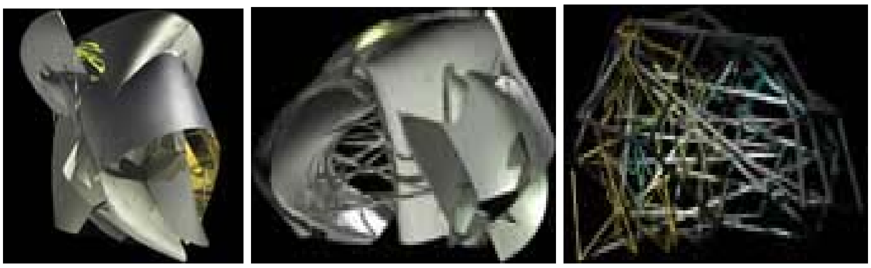

Figure 3.11: Paracube (1997-1998) (Novak, 2006).

Using spline-based interpolation, two sets of curves were generated. From further functions, the two sets of intertwined surfaces, or "lamina", were formed. A series of crossing links (cross-fades) were then enframed between the conjoined surface-forms, producing a rich enmeshing of distorted frames and surface modulations.

3.3. TransArchitecture vs. Architecture

Axioms toward Newspace:

10. Art is the road building habit. It aims to build the edge of thought.

09. Architecture is the art of the elaboration of inhabitable space, beyond mere accommodation, in the direction of excess over need.

08. Elegance is the achievement of maximal effect with minimal effort.

07. Both cyberspace and bodyspace are real and physical, and both are inextricably intertwined with the virtual.

06. Cyberspace is constituted by information technologies; body-space is augmented by information technologies.

05. Immersion is the transition from bodyspace to cyberspace; Eversion is the transition from cyberspace to bodyspace.

04. Space and time are no longer separate, not even in the vernacular sense: a space-time vernacular has developed.

03. Hence, we must speak of a vernacular of augmented space-time, of body-space-time and cyberspace-time.

02. Augmented space-time encompasses the full continuum from body-space-time to cyberspace-time.

01. This new continuum is Newspace-time, or newspace, for short, the space proper of TransArchitecture.

00. Beauty is objective; meaning is subjective. Both are relational. (Novak, 1998)

A new concept is rising in architecture. It is dynamic and time-like. It is capable of moving, flexing and reconfiguring itself through globally networked control mechanisms.

Marcos Novak became the most visible proponent of cyberarchitecture. His greatest achievement is his use of non-Euclidean spatial concepts and algorithmic unfolding. This means, he is using mathematical modeling of data space navigable computer environments to create unexpected futuristic forms (Jodidio, .2003). Marcos Novak's animated mathematical forms which are created in the virtual reality derive from the manipulation of mathematical fields.

The new constructs made via this new architecture can maybe be "plugged into" the information networks like internet and can be manipulated through remote control and interaction of different participants and users. Marcos Novak quotes in his work “TransArchitecture and the transmodern” that after a century of surprises; architecture faced the greatest surprise of all: the development of an unprecedented form of urban and architectural digital space, a global, non-physical public space, and place after territory. Even though the infrastructure for this non-local public domain was already well under construction, it had yet to receive the attention of an informed and critical architectural discourse. Even without architects, numerous highly populated multi-user virtual environments already existed. As an example, he mentioned Alphaworld which alone had a population of over 200,000 users. The question was: “Where are the architects?” Conceived of and built by a group of architects, this time-like architecture, namely TransArchitecture, is thought to become a norm in a not too distant future.

Architecture and cyberspace are no longer connected only in theory, but are already part of one another because one moment's vision is the next moment's fact. Novak voices that for the first time in history; architecture has become transmissible and is already architecture-in-cyberspace. Our institutions and identities have already dematerialized. Therefore, we are already particle-selves, we are already cyborgs, and we already live in a rhizomatic multiplicity of globally mediated mindspaces (Novak, 1996).

Charles Jencks presented a logical framework of different “trends” and “traditions” of architecture in his book “Architecture 2000”. He presented two frameworks. One of those was derived from Claude Levi-Strauss’ structuralist system of classification. It was leading to a map of “Evolutionary Tree to the Year 2000.” The other was a “cluster” of six traditions. (Jencks, 1971) Jencks’ classification system makes it very clear that a trend is a “framework of continuities”. Jencks says that there are many inexorable trends, which will continue unless we decide to do something radical about to change them. The importance of these cannot be valued too highly. The reason is that besides affecting our future lives, they underlie our assumptions and actions in a very basic way. If trends did not exist, we would have to invent them. Because, they constitute that common framework of continuities, on which we speculate and act (Jencks, 1971).

Bringing together a series of works of architecture, we can show a new trend for cyberarchitecture emerging with specific and identifiable set of characteristics: “TransArchitecture”. With this new concept, we managed that digital virtuality pass beyond its limits. Digital virtuality is not limited to cyberspace anymore. ”Eversion” is the term employed to describe a motion complementary to the familiar notion of immersion. Whereas “immersion” describes a vector moving from ordinary to virtual space,”eversion” describes the counter-vector of the virtual leaking out into the actual. Eversion predicts that the content of augmented reality and ubiquitous computing will be the population of the physical world with phenomena and entities first encountered in virtual space (Novak, 2006).

Virtuality forms a new “zeitgeist” that has manifestations in every aspect of our existence. This is enabled by the ubiquity of computation. Besides creating a new virtual public space for architecture, we also have altered the ways in which we inhabit actual space. The spatial and temporal terms by which we live are all increasingly intelligent, non-contiguous and non-retinal. They also exist in electronically mediated non-Euclidean multidimensional curved spacetimes that overlap our familiar Euclidean reality (Novak, 1996).

Dealing with TransArchitecture also caused a new understanding of time and space. According to Lynn, there is obvious aesthetic fallout of spatial models. This is the predominance of deformation and transformation techniques available in a time based system of flexible topological surfaces. However, these are not aesthetic choices but technical statements of the structure of the topological medium (Lynn, 1999). We live in an age of tele-presence and networked virtual worlds. We are connecting us at light speed and in real-time. Therefore, concepts like space, time and materiality suffered dramatic changes.

Through digital communication opportunities and transportation technologies, we have moved far beyond the 2 MPH speed of a walking human being to 186,000MPH speed of radio waves and telecommunications. This caused that we have moved from populating space to populating time. According to the Theory of Relativity, as speed increases, space contracts and time expands. Since movement takes precedence over stillness and approaches speed of light, events become “space-time-like” and “time-like”.

Kas Oosterhuis quotes that the architecture finally becomes truly time-based. That it is no longer a simulation. Not only in the isolated sectors of the design process but in the experience of the space itself. Space communicates actively with the users of the space in real time. Users know each other, whereas space and people are becoming linked through a complex series of networks. The knowledge of people is only meaningful because of the connections with other brains. There does not exist something like an independent brain. Knowledge, consciousness, wisdom, innovations, emotions are only possible by their connection to other people (Oosterhuis, 2006).

The reality of cyberspace is time. Today, we live in a world which is framed between zeros and ones. This causes that things become time-like. As the computers are about time and not space, time is the parameter that determines the value in today's world. We use terms like MHZ, MB/Sec, 56K BAUD, real-time (1/10th of a second), nanosecond, and refresh-rate. According to Peter Zellner, "time, perhaps once seen as an impediment to building, a source of delay and decay, has assumed a decidedly intimate role in an architecture that engages in a kinematics sculpting of space. Today, time and movement have been instrumentalized in architecture with the aid of powerful animation software, which have enabled architects to develop dynamic, mutable and evolving design techniques and new spatial paradigms (Zellner 1999)." As Novak writes in his work "Building the Edge of Thought", Architecture arises from excess over need. The extra effort added over and above the satisfaction of the limited requirements that establish the excuse for the effort involved in any complex construction. If interactivity and connectivity characterize the new technologies, what must be learned is how to provide interactivities and connectivity that provide excess over need. Therefore, we need TransArchitecture as a time-like architecture of time like events (Novak, 1996).

TransArchitecture deals with a realm that has gone beyond space and time. Today's world is built on networks of time-like events. These are organized, coded, folded, unfolded and experienced simultaneity. Most of the world of architecture still depends on the Cartesian and Euclidian concept of space. Nevertheless, TransArchitecture embraces a different metaphysic and a different approach to architecture. TransArchitecture goes beyond the architecture itself and uses non-Euclidian spaces in order to create new perceptions.

This new approach also changed the meaning of context. Architecture as we know is still depending on the conventional notion of place. This notion is a construct of physical, local and immediate environs. The parameter "time" was treated as linear within a static set of spaces. For TransArchitecture, time is non-linear. The notion becomes a construct of virtual and physical at the same time; it is global and it depends on real-time environs. Therefore, context evolved into con-techst.

Peter Zellner notes that "our international telecommunication networks have become characterized by agitated, irreversible super-connections that operate outside conventional human understanding of time and space. We no longer communicate with friends, family or associates exclusively in a particular place; rather, we communicate both in the local context and across time zones and cultures. A seamless virtual geography of informational interchange has replaced locale as an indicator of space and rearranged 'natural' temporal sequences along the earth's surface…Hybrid space architects claim this ambient, symbolically rich and multidimensional world-space as an extraordinary context for architectural exploration (Zellner, 1999).”

Architecture has always been concerned with space, spatial configurations, spatial transformations and spatialization of intangible realities of human worlds. We are being morphed into cyborgs. The space we inhabit, the buildings and the entire urban environment are also transforming. Circulation systems are being replaced by telecommunication systems. Traditional building types become obsolete. Office floors raised, old copper wires dug up and replaced by fiber optical cables, as catalogue shelves in libraries are replaced by computer terminals and so on. Of course, it is inevitable that a new way of thinking has to be manifested. TransArchitecture can be transmitted, remotely accessed, published, projected, compressed, encoded, licensed, rebooted, archived, upgraded, evolved, interfaced, compiled, flexed and folded. Christian Pongratz and Maria Rita Perbellini (2000) quotes in their work “Natural Born CAADesigners”:

“’Trans’=neither modern nor post-modern. The term ‘TransArchitecture’ is intended to break down the polar opposition of physical to virtual and propose in its stead a continuum ranging from physical architecture to architecture energized by technological augmentation to the architecture of cyberspace (Pongratz, 2000).”

Marcos Novak’s TransArchitecture uses algorithm for morphogenesis. It depends on mathematics and formulas. Algorithms are also used to achieve a quick solution and a rapid prototyping. This new intelligent spaces depend on instant telecommunication (pantopicon) (Novak, 1996).

Table 3.1: Modernist Architecture and TransArchitecture (Lee, 2002).

Modernist Architecture	**TransArchitecture**
Space	Space + Time
Materiality	Softeriality
Pure, minimal	Hybrid, Messy, optimal
Mass production	Mass customization
Transparency	TransPRESENCE
Form	inForm
Resistance	Response
What does a brick want to be?	What does a vector want to be?
Zeitgeist	Datageist

TransArchitecture of data-driven, kinetic and responsive realms needs new definitions for context, place, orientation, boundary, space, adjacency, contiguity, connectivity and materiality. Much research and experimentation needs to be done in that direction in order to get a better understanding of TransArchitecture. Instead of putting together spaces, connecting them, transforming them and configuring them, the new architecture (TransArchitecture) puts together space-times, transforming them and configuring them.

Table 3.2: Post-modernist Architecture and TransArchitecture (Lee, 2002).

Post-Modernist Architecture	**TransArchitecture**
Mannerist complexity	Cybernetic complexity
Decorated shed	Data shed
Historicism	Ahistoricism
Communication and double coding	e-Communication and e-coding
Text	Techst4
Context	Con-techst
Learning from Las Vegas	Learning from Lagos and Alias®
Timeless	Time-like
Space-like Architecture	Time-like Architecture
Blank, ornate, textured surface	Dynamic, interface, techstured surface
Grounded, founded, static structures	Connected, plugged, kinetic structures
Civil engineering	Mechelectronic engineering
Figure - ground	Field-space-time
Site	Sci-te
Metaphorical, representational	Hyperlinked, presentational
Nostalgia	No-stalgia

Table 3.3: Architecture in General and TransArchitecture (Lee, 2002).

Architecture in General	**TransArchitecture**
Passive Resistance	Active Response
Analog memory	Digital ± analog memory
Local Vs Remote	Local ± remote
Euclidean	Non-Euclidean
Nouns	adjectives Verbs
Revolution/Retro-volution	E-volution
Configure space	Configure space-time
Master Drawings	Virtual master models
5-100 MPH	186000 MPH
Slow	Fast
Here Vs There	Here ± There
Space is	Space is simulated / projected
Being	Doing
Shape grammar	System grammar
Linear, sequential, simple order	Nonlinear, rhizomatic, complex

As we compare architecture and TransArchitecture, we can determine the basic differences between these two concepts. The main difference emerges in the understanding of process. Architecture in general has a very slow-working process. Nevertheless; in TransArchitecture, we can talk about a very fast process development because of rapid prototyping. Architectural process is also linear and simple order. However, TransArchitecture favors a nonlinear, rhizomatic, and a very complex process. The complexity comes from the idea of being digital, being non-

Euclidian, active response; and from the understanding of space-time, being remote, and system grammar.

3.4. Works of Marcos Novak

As a transarchitect, Marcos Novak uses nanotechnology. His TransArchitecture depends on mathematical algorithms, neurons and atomic particles which can be manipulated via user interaction. The algorithm is used to create buildings with built-in central nervous systems. The idea behind TransArchitecture made Marcos Novak the pioneer of his field. His work is so advanced in this field that he is regarded as the "pioneer of the architecture virtuality" according to the organizers of the international Architecture Exhibition in Venice (Jodidio, 2003). According Thomas Markussen and Thomas Birch, Marcos Novak has proven his ability for gazing into the future architecture. This is an ability of prophetic proportions, which has given him a unique authority in the world of architecture (Markussen, 2005). As Novak uses nanotechnology for his TransArchitecture, he insists that nanotechnology is about to change architecture completely. In his opinion, it will be possible to design buildings that adjust and alter themselves for different needs of the users in real-time. This new neuroarchitecture will replace bricks and mortar with intelligent, plastic nanomaterials, keeping the central nervous system of the building informed on inner and outer influences. This can be thought as a replica of an organic neuro-system, a replica of human body (Markussen, 2005).

To discuss the concept of TransArchitecture in depth, two special works of Marcos Novak are chosen for further explorations. The reasons for focusing on these specific examples can be summarized as follows:

Both "AlloBio" and "Eduction-Alienwithin" were sensational projects on their time. "Eduction-Alienwithin" was the dominant factor for choosing Marcos Novak as a frontier by the curator of the Venice Biennale of Art in 2001. Both of these projects depend on transvergence while interacting with its users. They also use rapid prototyping and algorithm. Besides, while exploring these two projects, we will be given hints of developments in the meaning and technology of TransArchitecture.

3.4.1. Eduction-Alienwithin

While AlloBio gives hints of interaction of the "building" with its environment, the project Eduction-Alienwithin shows us the possibilities of user interactions. This project was first presented at the Venice Biennale of Art 2001. Eduction received great interest and support and was also shown in Florence and at Erice-lab in Sicily at the Second International Congress on Psychology and Virtuality.

The aim of Eduction: the alien within (Rome, Berlin, Baguio, etc) is to integrate the virtual into the actual. To do that, it draws out and echoes certain characteristics of a given location. Eduction is constantly evolving. It is integrating new aspects of the unseen, the unconscious and tangible spatial features such as the architectural environment and historical imprints that located and generated within a given space. La Villette is an ideal venue, as its architecture and historical context and usage form a source that can be integrated into Eduction, bringing together for a moment the past, present and future.

The performance involves volunteers from the audience who have to take place in different tests to establish their susceptibility to hypnosis. Those who pass the tests perform various exercises including hand levitation and hallucinated electro-magnetic attraction. Once they are responding correctly, they are each shown to a sensor that casts an invisible shape: a correspondence or feed-back loop is initiated between the "space of mind" and the space between the volunteer's hands, triggered and mediated by corresponding sounds that react to "pressure" exerted on the invisible space.

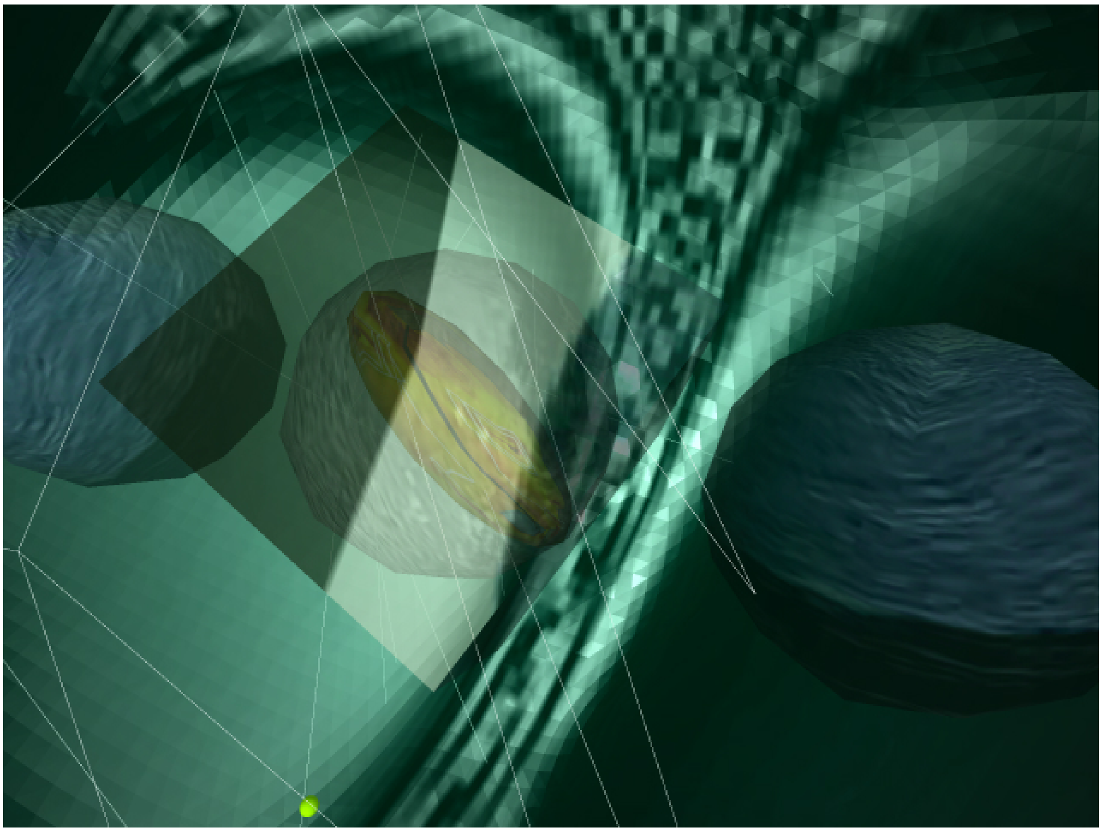

Figure 3.12: Eduction: Alienwithin (Novak, 2006).

The volunteer who responds most favorably to this kinesthetic-to-subconscious test is then given suggestions of catalepsy, in which the mind instructs the body to transmute into a solid substance. As the final preparation for the eductive process, the subject falls into a state of temporary amnesia and agnosia, and fails a test of self recognition in front of a mirror.

Having gone through this preparative sequence and freed of the controlling limitations of his conscious mind, the volunteer is ready to be driven into the navigable mind-space of Eduction. The audience is treated to the same navigations as the volunteer, although at a removed level of conscious immersion. The volunteer's journey can be experienced on a large overhead screen, and through a 6-channel sound system. His or her facial expression, as it distorts to the sounds emitted from the navigation, can also be seen on lateral screens.

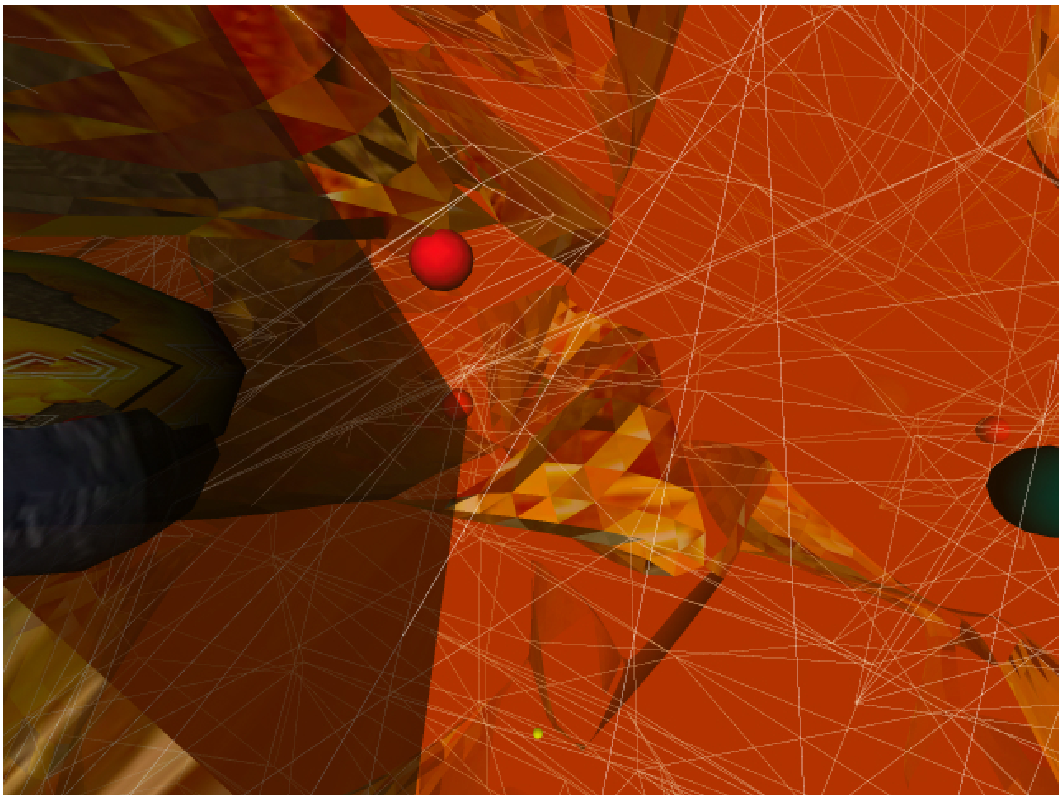

Figure 3.13: Eduction: Alienwithin (Novak, 2006).

Sounds and images taken from the volunteer are fed back into the eductive mindscape in real time, so a correspondence is developed between the present, personal and actual, and the virtual, immersive and unconscious. Once the journey has been completed, the volunteer is returned to a normal state of consciousness.

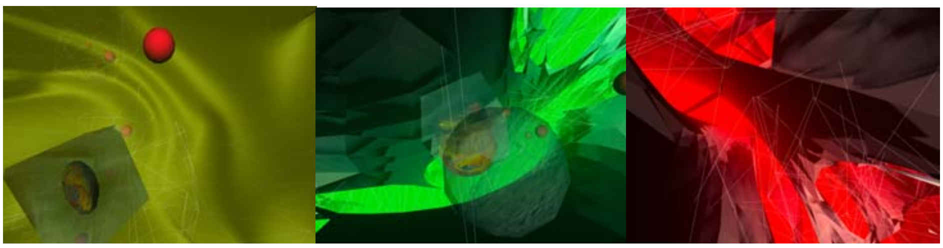

Figure 3.14: Eduction: Alienwithin (Novak, 2006).

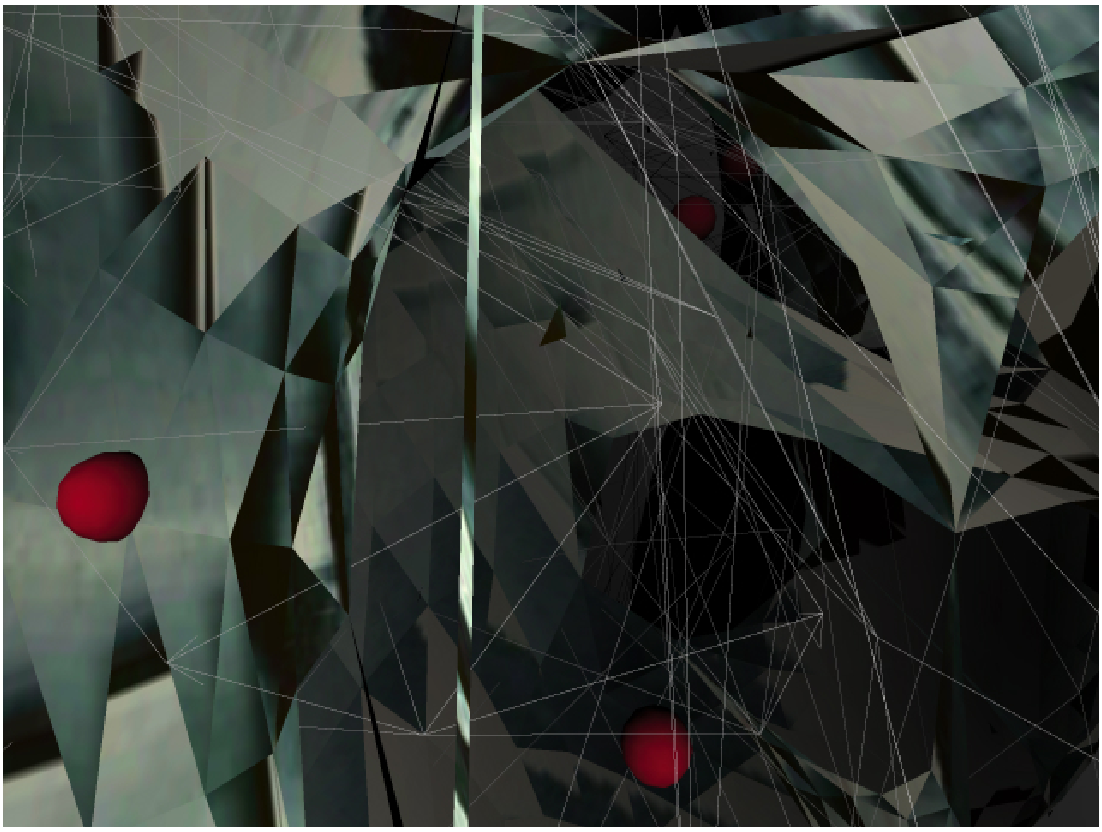

Figure 3.15: Eduction: Alienwithin (Novak, 2006).

A private debriefing also allows us to incorporate newly explored aspects of the deep unconscious into Eduction. This information, that includes sensory as well as mental impressions, becomes a building block to our interface between deep virtuality and the collective mind.

3.4.2. AlloBio

This project was first shown at the Architectural Biennale in Venice in 2004. The "AlloBio" notion is derived from Greek. It describes an alien architecture which is crossing the line between the living and the dead. The aim of the project AlloBio is to create an architecture which can grow up and evaluate. It is imagined with living and morphing construction materials. The creation is using nanotechnology and biotechnology. This work is a thought of architecture which is global and which depends on a present, pre-prepared matrix.

Figure 3.16: AlloBio (Novak, 2006).

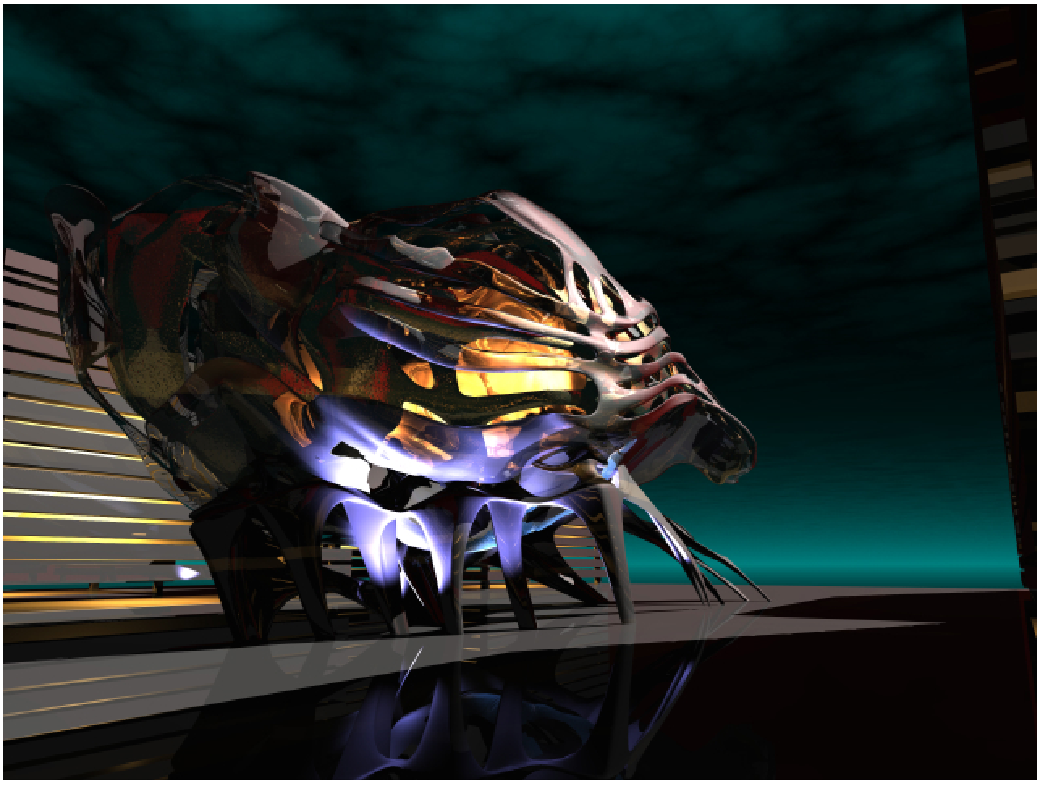

Figure 3.17: AlloBio (Novak, 2006).

An intelligent building, which can react to human behavior, was only designed by the integration of enormous amounts of electronic installations and computers within the buildings. But body of the AlloBio building can respond because it is alive and sensitive.

The organic surfaces within the buildings are covered by optical-fiber sensors. They are able to react to fluctuations in the given parameters, determined by the algorithm, such as changes in pressure or temperature, by morphing themselves. This architecture can be imagined as a biosphere that grows and develops with its inhabitants and other outside influences. With its quick-acting nervous system, it differs from a plant and creates animal-like reflexes, which are enabling AlloBio to react instantly to threats, such as earthquakes.

“But it has fiber-optic sensors everywhere so you don't even have to touch it, it's inside a biosphere and you can just approach it, and as you interact with it, you modify the biosphere. Even though we're building it as an interface for the biosphere it's actually part of this project called Transaura -- which posits that a building will have a second skin of interactivity. So what I'm doing with my students, at this moment, is building interfaces for these spheres that eventually will be the devices by which the brain-data gains control; to actually make the virtual world, we have been looking at external skeleton-structures and biological forms such as diadems, plankton and echinoderms. We have been developing these in the form of rapid prototypes, based on a bio mathematical language derived from these skeletal studies (Markussen, 2005).”

4. CONCLUSION

A new world is arising. This is an age of highly digititalized minds and identities. We can exist mentally in a different way. We can exist as ourselves while creating new identities for other participants of this new cyber-community. As highly intelligent creatures, we always want to go beyond ourselves. This is not only a case for physical world but also for our mental and imaginary world. Therefore, we imagine, we dream, and we follow the paths leading to our dreams. People are noticing that cyberspace and virtuality can and will become the right place for fulfilling our dreams. They support our imagination and through realization of our dreams we become satisfied. In cyberspace, we can be whoever we want and act in this way without any limitation. We find new ways of communication with other people. These other participants of cyberspace can be anywhere on earth and so the geographical location and distance looses its importance. We leave to get information, but we become a part of information itself. This new reality increases its dominance through the developments in tools for perceptions like HMDs. As these tools become more accurate, virtual reality and cyberspace gets more real.

In this existence of interaction, architecture, which was always an enterpriser and frontier of human being's development, has failed. Until TransArchitecture came to the scene, we could only speak of architecture without architects in cyberspace. Spaces in cyberspace were developed and designed by members of other disciplines. The reason for this was that architecture was reliant to the reality, materiality and to its traditions. Although modernity tried to change the idea behind "locality", architecture generally favored local versus global. However, people for whom this architecture was created became more and more global throughout the digital age. The power of architecture on general people diminished. So, we suddenly bean to live in an age where architects lost their ascendancy. While human being celebrated a faster, non-Euclidian, digital world, architecture still was limited by the boundaries of a static, Euclidian, analog reality. Architects still favored logic, perspective, and the laws of gravity. Architecture was still dependent on the conventional notion of place. This notion is a construct of physical, local and immediate environs. Besides, parameters like "time" were treated as linear within a static set of spaces. This caused that traditional building types become obsolete. Architecture did not want to be caught by the wind of change. This nearly built a taboo in architectural discourse.

Architects throughout the world thought that researches and enthusiasm about the virtuality and cyberspace were only a fancy trend that would be forgotten in a few years. Nevertheless, the truth was different. They did not notice that cyberspace itself was and still is architecture. Therefore it should have and contain architecture.

Cyberarchitecture is a creation of the evolution. As the printed book took place of architecture, the computers and digital technology took place of the book. As the users know each other, whereas space and people are becoming linked through a complex series of networks, we noticed that knowledge, consciousness, wisdom, innovations, emotions are only possible by their connection to other people. Virtual reality in cyberspace takes effect as a medium into different realities in order to bring individuals closer to a social world –a pot- where symbolic and real melts in. As virtuality got more a part of our daily life, more architects had the desire to explore this new habitat. So, in order to become not a follower but a frontier, some architects had involved ideas and theories beyond the borders of architecture. To do that, they had to understand that cyberspace itself is never static and it always changes. The discourse changed while evolving architecture into TransArchitecture. From that time on, we can speak of architecture beyond architecture. Therefore, TransArchitecture can be seen as a threshold.

With the help of TransArchitecture, architecture spatialized information. This brought new developments about new concepts of reality, time, space, shape, structure, and construction. During the design process, they combined design and machine. Now, we can speak of a shift from "form and space" to "process and field".

TransArchitecture tries to overcome the distinction between the physical and the virtual. To do that, it transmutes design and project, architecture and habitation, into information. Today's architecture tries to design algorithmically (morphogenesis); to model numerically (rapid prototyping); to build robotically (new tectonics); to inhabit interactively (intelligent space); to telecommunicate instantly (pantopicon); to inform immersively (liquid architectures); and to socialize nonlocally (nonlocal public domain). Now we can say that architecture finally becomes truly time-based.

The way that Marcos Novak show us through the TransArchitecture had also caused to come out new ideas like liquid architecture, swarm architecture, augmented reality, and mixed reality. As we conquered the virtual reality, we developed new ideas, especially ideas about implementing designs made for cyberspace into the real world. Now, we are trying to build new buildings with new forms which were ever thought to be applicable. The opposite, namely to implement real world architecture into virtual reality, was only a tutorial to explore the possibilities of cyberspace. Whereas liquid architecture thought to be a fluid, imaginary landscape that only exists in the digital domain, some architects like Oosterhuis are trying to implement it into the real world. We begin to see previously unimaginable, unfathomable forms and designs which are not only a mental experiment, but realized projects. Immersion, which is the transition from bodyspace to cyberspace, and eversion, which is the transition from cyberspace to bodyspace, occurs continuously. Such projects are existing both 'here' in the physical world and 'there' in the virtual world, forever transverging the boundaries between the imagination and the possibility of creation.

Today, we talk about genetic algorithm and nanotechnology neurons and atomic particles which can be manipulated via user interaction. Today’s experimental researches will become future’s common use. It will be possible to design buildings that adjust and alter themselves for different needs of the users in real-time and in real world in the future. This new neuroarchitecture will replace bricks and mortar with intelligent, plastic nanomaterials. Genetic algorithm will be used to create buildings with built-in central nervous systems. Such a nervous system will perceive inner and outer influences, and it will determine the needed changes. After that, it will form the building according to the requirements. Architecture will no longer be the science of designing spaces, but a collaborative science of space designing, nanotechnology, and genetic algorithmically developed artificial intelligent.

We are at the edge of such an era. This can be the possibility to get rid of static designs created with bricks and concrete. Such new technologies can open new gates to the understanding of architecture. TransArchitecture can and will take its rightful place while evolving architecture into this new era. And so, our minds can search for new realms to walk on.

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