

# Evolution of Media for Early Design Stages

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## ABSTRACT

In this paper the evolution of media used at early design stages will be considered. In traditional methods of searching and presenting the design idea, the basic tool used was the graphic representation. Implementation of new digital techniques in 60s - 70s focused on the mathematical way of representation. These methods were “not architect friendly” (lack of graphic representation traditionally used by architects). As a result, the development of methods for digital support of form searching was terminated. The computer was used as a tool for drafting. Creative usage of computers for form searching through sketching on the display was extremely difficult. The computer could be described as an “incompatible pencil”. Only in recent years can we see new efforts in this area of design methodology. Thanks to new technical possibilities we have a new chance for changing the process of designing. New kinds of software and hardware let us use the computer not as a pen, but as a medium. In this paper different new ways of form searching will be considered (from very simple method as the scansketches to very complicated ones, such as the generic algorithms). At the end, the influence of new media on the process of design will be presented.

## 1 THE EARLY DESIGN STAGES

### 1.1 Creation

The basic conditions of creation are intuition, that is the ability to foresee without trying to understand, and imagination, that is the ability to create certain images in our mind. Therefore, the core of creation is based on creating an idea in our thoughts, which had never before been brought to life by anybody, as well as images, which are not associated with any past experiences. (Maslow 1962)

”The coincidence is the central category (...). The coincidence is an early, especially turning point of the great process of evolution...” (Lem 1964). The creation begins as a strange occurrence, which is undefined in a multiple way. We do not know what set of elements we have at our disposal and, on top of that, we do not know the pattern of transformations, which we have ourselves triggered, As Rychter wrote: “Creating means synthesising, composing, constructing a entirety from elements. But often the starting point, the finish, the middle stages and methods ore fuzzy, vague, ill-defined - are all yet to be discovered or conceived. It is like groping in a dark labyrinth, searched and created at the same time. There are many branches to discover and explore, many dead ends forcing retreat, no guarantee of a solution, and even no clear idea of what a solution

might be. It is a trial-and-error, generate-and-test, back-and-forth, top-down and bottom-up, global and local, inductive and deductive, rigorous at times and fuzzy most of the time, amoeba-like process or bunch of processes.” (Rychter 1995)

Creation is the process of the ideal model “making real”. The process of object modelling, during which we are dealing with its “recreation”. The specific character of the composing activity of the architect is connected with the methods and measures of modelling and presenting the object designed. Every type of creation has constructed the proper means of expression and its own methodology, perfected with every generation. Architectural creation is also characterised by its unique method of communication. It includes a very specific lexicon, both verbal and graphic.

## 1.2 Communication

An idea practically does not exist unless it is communicated. It needs to be expressed through some medium for it to be of any use. A design solution is the communication of an idea. The act of communication, its nature, its style, is deeply linked with design. The art of communication is inseparable from visual thinking, which is an attribute of creative thinkers. The natural and obvious medium for expressing visual thinking is graphic communication. With people inclined to concrete visual thinking, a drawing plays the role of a catalyst. With its help, visual pictures formed within the architect’s mind change and become more precise. Simultaneously, as a feedback, drawings reflect our memory, complementing spatial pictures already conceived in it. On the other side, designers inclined to abstract thinking prefer to present their ideas through scale models. Such method of design influences characters of a form in more degree that using a drawing. The image of the designed object (formed within our memory as a sequence of visual pictures) is immediately preserved as a scale model. That influences the character of the form and shapes it out.

## 2 PENCIL AS A TRADITIONAL TOOL IN THE PROCESS OF DESIGNING

Maybe the drawing is the most obsessive temptation of the mind...and should we speak of the mind at all.” (Valery 1993)

The sketch is usually perceived as the most important element of the process of creation. Sketches best correspond to the specifics of the future object search form, due to the quick materialisation of the idea invented. Sketching could be considered as the creative search. For hundreds of years, sketches have been the link between ideas and reality of architecture. Most architects believe that designing is impossible without sketching. They expressed their resort by means of sketches on a piece of paper, with each stage characterised by a specific type of sketching forms. The first drawing is a blurred and imprecise image of the construction, reflecting only its main idea. During designing, the creator gradually fulfils picture of a form. Defused, imprecise object image, expressed by pictograms, transforms into more and more defined drawing of the

form. The whole process is individual; it evolves differently in each architect's mind. (Asanowicz 1999)

The manual drawing is a very broad term. It is confirmed by the analysis of the works of great architects. Each of them has their own favourite way of drawing, a favourite drawing tool. Le Corbusier and O. Nimeyer use a drawing pen, L. Khan – charcoal, K. Tange and Mendelson – a brush. The tool used determines the form of the sketch.

As Terentius said – “Duo cum faciunt idem, non est idem” (When two do the same, it is not the same).

Even the same architect designs each next project in a different way. Each time the eye and the hand materialise the designer's concept differently. Also differently carried out is the process of visual evaluations of drawings and its transformation. But the history of architecture provides evidence that graphics techniques used in the creative process of design, were an inseparable component of the whole process itself.

### 3 DIGITAL TOOLS IN DESIGN

#### 3.1 **Mathematical methods of design**

Implementation of the new digital techniques in 60s – 70s underlined the mathematical way of representation. Different methods for elaborating functional solutions were developed. These methods were really useful for the process of searching, but unfortunately were “not architect friendly” (lack of graphic representation traditionally used by architects). This determined a negative opinion the designers had about these methods. Developing methods for digital support of form searching at the early design stages was terminated. Computer was used as a tool for drafting.

#### 3.2 **Mouse-sketching**

“At the conceptual design stage, a paper sketch has no scale; it is a doodle. From this the design develops, often in unexpected ways, as the sketch is overdrawn and modified. Trying to use programs such as AutoCAD for this, which require hard lines of a known length and direction, is an unnecessary restriction upon the architect. In this case, a graphics package may be much more appropriate. It has been said that trying to draw with a mouse is akin to sketching in charcoal whilst wearing boxing gloves. Considerable difference may be achieved by the use of a graphics or paint package with a pressure sensitive stylus, rather than a puck or mouse. The package, Fractal Design Painter, is recommended for its ability to mimic natural media and the ability to record and playback animated sketch sessions. (...) Once the concept has been developed, the design can be transferred, (not directly unfortunately) to a CAD package, such as AutoCAD, for more formal modelling. (Knight 1996)

As we see, traditionally, CAD software has mimicked the hardware tools (pencil,

paper, paint brushes) used in the practice of architecture. Unfortunately, creative usage of computers for form searching through sketching on the display was extremely difficult. The computer could be described as an “incompatible pencil” - it cannot be used as a pencil for sketching. Comparing the computer to a pencil or a technical pen is a mistake. Of course, when we elaborate technical documentation we usually use a computer as a technical pen. But it is not enough that one could expect from such an advanced technology.

#### 4 NEW WAYS OF IDEA SEARCHING

Thanks to new technical possibilities we have a new chance for changing the process of designing. New kinds of software and hardware let us use the computer not as a pen, but as a medium for form searching. CAAD is transforming into CAAC (Computer Aided Architectural Creativity) environment, which could assure the possibility of dynamic transformation of conceptual space and visualisation of creation processes. Such activity should be based upon two principles:

- 1) Dynamic development of idea - creation of abstract visual models and their transformation. The transformation procedures come to use when a model does not conform to the architect's concept.
- 2) The dynamic perception of creation process - memorising the consecutive stages of transformation and creating sequences of idea.

The visualisation of the idea by computer media opens new creative possibilities due to its specific ability to dynamically form the design idea, as well as to visualise the spatial and temporal processes. Such application of the computer determines the need for new media in the process of creation. Let us forget about the pencil. The pencil is incompatible. That will be the Added Value created thanks to the use of the computer the design process. (Asanowicz 1997)

##### 4.1 2D scansketches

In this method different objects are first scanned. For example, small pieces of colour paper pieces of wood, old leaf or beads. That way, a series of scanned images was obtained. The images were achieved by coincidence, however not without the intervention of the authors, who were responsible for choosing the amount and the quality of the elements used. Images best satisfying the imagined ideas of the authors were selected and they were later subject to computer graphic processing. After a number of transformations, bit maps corresponding to the already shaped idea of form were obtained. (Asanowicz 1999) Due to the fact that linear graphics is the simplest and most often used means of representation in the creation of architectural forms, the processing of scansketches has in each case come down to obtaining linear image. The transformation ran from colour planes to linear compositions (figure 1).

## 4.2 3D-scans

The availability of 3D digitising or scanning affords a greater freedom of movement between real and digital modelling environments. “A sculptural approach to form-making can emerge where further and quite different manipulations to the original object

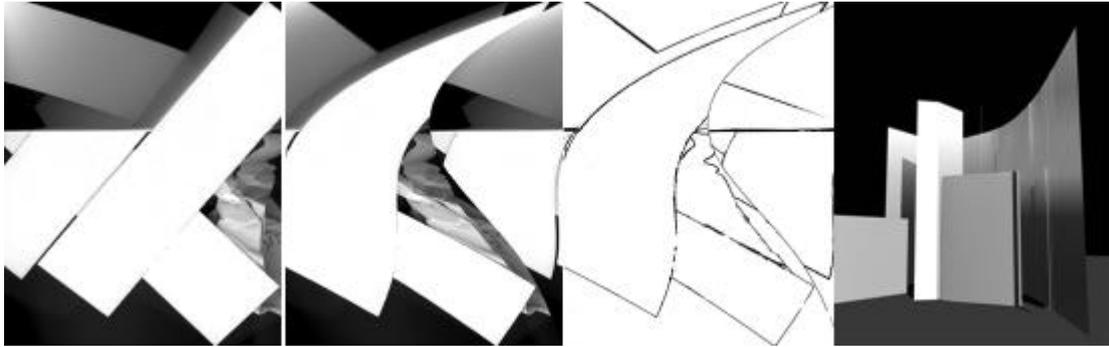


Figure 1: Scansketches

shape can be highly controlled in digital environment. The relationship to “real” and “virtual” domains is as intimate as the designer may wish.” (Burry 1997)

Gehry uses the 3D digitizer to transcribe the formal surface qualities of handmade models directly to the computer. His first experiment with the computer was a large fish sculpture for the Barcelona waterfront in the 1992 Olympic Village. “Gehry began modelling the fish sculpture in wood and metal. With the CAD software Catia, he then developed models for the woven steel surface panels and supporting steel strakes of the sculpture.” (Novitski 1992). The second time was during the designing of the Walt Disney Concert Hall in Los Angeles.

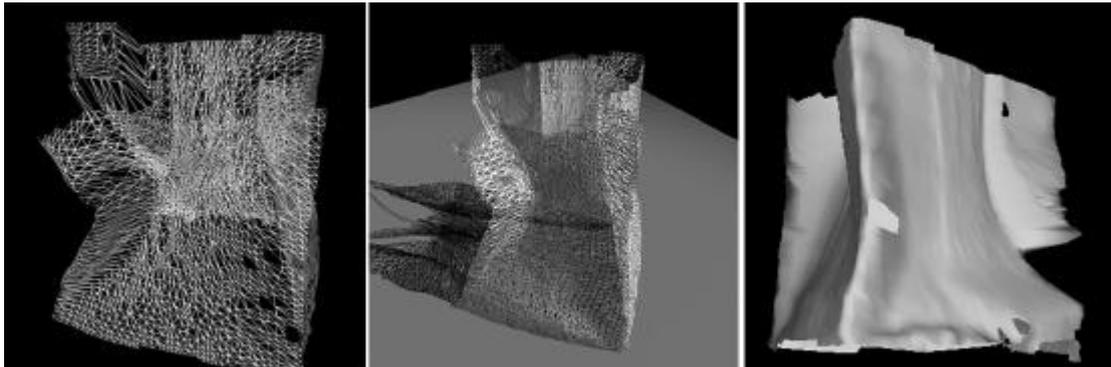


Figure 2: 3D-scan – transformation of the cube

The design began with Gehry's physical model of metal and heavy paper curves. Using the 3D digitizer, key points on each curved surface were entered into the Catia

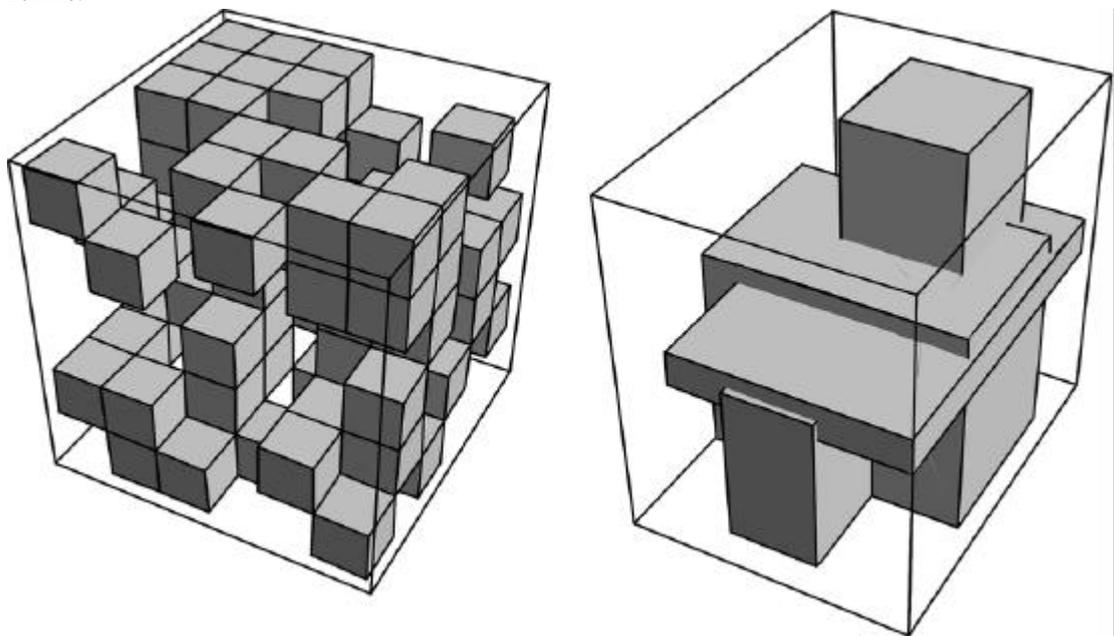
CAD system. Catia has the capacity to define every surface mathematically and store the associated databases of technical information. Thanks to Catia, 3D forms may be moulded or carved.

Similar results can be obtained using a 3D scanner. The transposition of the digital spaces of spatial forms makes their later transformation possible. It is possible to scan not only the handmade models but also other forms, such as a squashed box or a leaf, which then become the inspiration for creating a purely architectural form. Such efforts, being the further elaboration of designing by scansketches, undertaken at the Department of Architecture in Bialystok, seem to be very promising (figure 2).

#### 4.3 Random function

Searching for the idea in the buzzing, i.e. where we have just thought that there is nothing there, has become a new creation process. The theory of chaos makes it possible to search for the form in the chaos of incidental elements or systems with the use of random function, which helps generate both two- and three-dimensional spatial structures.

The Webster dictionary defines randomness as “lacking a definite plan, purpose, or pattern”, and also “being or relating to a set or to an element of a set each of whose elements has equal probability of occurrence”. In this method of creation forms are not born in the architect’s mind but they are produced by the computer. The architect only chooses, evaluates and transforms this form. The architect as a cybersculptor defines the direction of changes and interactively transforms the primal forms.



Author - Z. Rychter

Figure 3: **Searching in chaos**

Accidental juxtapositions of these forms can be examined for valid and possibly unsuspected alternatives. „In the first stages of design, for example, it’s a fact that graphic routines of purely aleatory forms can be defined and modified more easily than procedural oriented artefacts.” (Monreal 1992) For creating spatial compositions of boxes Rychter used Mathematica software. (Rychter 1995) In result, he has achieved the diversity of different forms. The picture bellow presents two of these compositions, which have “an individual, artistic look” (figure 3). As we can see, from the point of view of shape creation and compositional work, implementation of random function offers great possibilities.

#### 4.4 Fuzzy modelling

In the creation of the architectural form, the first drawing is a fuzzy, imprecise image of the object, barely reflecting the general outline of the idea.

If we are doing conceptual work, it is more difficult to make just a hint or suggestion of something with the computer than when doing it by hand. A computer wants to render real things. It is extremely difficult to create a drawing that hints at a basic form or idea. Computer drawings are too finished to use at this stage. “With fuzzy modelling the form of design is expressed in less crisp but still explicit terms, essentially similar to the manners of architectural sketching. The starting point is awareness of the existence of canonical forms, which crystallise a cultural view of an entity. Fuzzifying these canonical forms involves the addition of tolerances. These define the allowable variation in the position or structure of the canonical form.” (Koutamanas 2001) In result we have received a picture similarly to an architectural sketch (figure 4). At the same time, however, fuzzy graphics is a sort of an effort to draw back from the imitation of the reality and to move on to its digital simulation.



Author - A. Koutamanas, 2001

Figure 4: **Fuzzy digital sketch**

## 4.5 Genetic algorithms

In this method the evolutionary model of nature as the generating process for architectural form is proposed. The main goal of this method is “to achieve the symbiotic behaviour and metabolic balance that are characteristic of the natural environment in the built environment, the evolutionary model of nature is proposed as the generating process for architectural form.” (Frazer 1996) This attempt breaks the basic paradigm in the creation process. According to Daru: ”The designer creates by establishing the evolutionary rules and making choices among the architectural creatures emerging in rapid fire mode through the synthesis performed by the machine. Natural selection is a metaphor: in fact designer plays Nature (or God).” (Daru 1997) Concepts are described in a genetic language which produces a code script of instructions for form - generation by computer. The computer can be used not only as an aid to design in the usual sense, but as an evolutionary accelerator and a generative force. (Frazer 1996) Very large numbers of evolutionary steps can be generated in a short space of time and the emergent forms are often unexpected.

The creative power of natural evolution is emulated by creating virtual architectural models, which respond to changing environments. Computer models are used to simulate the development of prototypical forms. These forms are something like idea-product, not a finished form. (Sodu 1999)

## 5 DESIGNING IN VIRTUAL SPACE

“What does virtual reality mean?” Virtual reality is practically real but it isn't.” (Robert

### 5.1 Phanthomatics

In 1964, Lem wrote in his ”Summa Technologiae:” The problem which awaits is: how to create the realities for the intelligent beings existing in them, in any way indifferently from the normal reality but subject to different laws (...). Is it possible - we may ask - to create an artificial reality, completely similar to the natural one, but one that cannot be by any means differentiated from it? The first topic - the creation of worlds; the second - the creation of illusions. But perfect illusions” (Lem 1964). Lem entitles his deliberations devoted to this subject ”Phanthomatology”. Phanthomatics in Lem's view means the creation of a two-way connection between the artificial reality and its recipient. In other words, phanthomatics is an art with a feedback. There are no ”exits” from the world of the created fiction into the real world. As an example of how phanthomatics works, Lem presents a situation in which a man is placed in the middle of an illusionary chamber or temple, where with every movement of the head or eyes he should perceive what he would perceive if he were in a real surrounding. The computer should immediately answer to each man's

behaviour.

## 5.2 Virtual Reality

At the ECAADE Conference in Eindhoven in the year 1993 after putting my eyephones on I found myself in an inexistent kitchen where G. Smeltzer was preparing an inexistent toast for me. I have kept the picture of that event in my mind until the present day.

The first stage of VR activity is the construction of a multimedia presentation of any environment, which is directly presented to the viewer's senses by means of cyberhelmets and gloves. The second is the interactive introduction of the human reaction to this multisensual representation. Reactions are the answer to the initial impressions and are taken into consideration in further projections – reaction of the VR system. In effect, it seems to the person that he/she is entering into a new reality, which is the result of a synergy between the model of a particular environment and the activity of the person. The person can experience things and phenomena which are not happening in real life, with regard to which, nevertheless, he / she takes an active position.

VR is the direct technical broadening of the thinking processes taking place in designing. The visions of the mind take on shapes, which change as we wish almost simultaneously with our thinking. It is possible to work with VR by taking advantage of the possibilities of introducing the contents of the broadened mind and sharing one's product of the thinking process with associates. VR makes it possible for people to meet and work together in virtual communities. (de Kerckhove 1995)

VR models are described with the Virtual Reality Modelling Language (VRML), an evolving standard that could transform the way we experience three- and more - dimensional space. With VRML models, different kinds of information can be combined to visualise interdependencies. This development has added a new meaning to the notion of space. The architectural space as we know it from physical environments is supplemented by a virtual space. In VRML models, the boundary between the representation of physical sites and imaginary, virtual sites is vanishing rapidly, resulting in a new reality. (Schmitt 1999)

The illusion of physically being inside a virtual space is wonderfully disorienting. As a three-dimensional space for visualisation three-dimensional digital space, a VR would seem perfect for architectural exploration. It allows one to enter, through the monitor screen into the "computer world", where an interaction with the forms present there is taking place. It turns out that apart from these virtual forms, nothing else exists. Designers and users of the world, which they have created, by receiving new experiences and new means of interaction become a new generation of the inhabitants of cyber worlds. Art, including architecture, starts to exist in different dimensions.

### 5.3 Direct design

In designing we always have a certain space at our disposal, be it two- or three-dimensional. Our designing activities always take place in space, which creates very definite borders for our search. In traditional designing, we used to work in a two-dimensional space, whereas in virtual space we are dealing with 3-D. We can create spatial forms filling the VS with all sorts of shapes, keeping the maximum interactivity of the creation process. The idea of Direct Design emerged as a result of the analysis of using VR as a tool for visualising architectural designs.

There are no obstacles in designing in Virtual Space – a space that is a full-scale space – by transforming the elements of the form. Such attempts have been made by, among others, the Bauhaus University in Weimar and TU Eindhoven, where it was possible to create spatial compositions in real time and in a real virtual space. Produced forms are then subject to further transformations in virtual space. The architect as a cybersculptor defines the direction of changes and interactively transfers the primal forms. A problem with the interface emerged. The manipulation of objects in space requires the development of a system menu other than that used in a 2D space. At the same time, the transformations of solids in Virtual Space with the use of the traditionally used manipulators turn out to be somewhat imprecise.

The condition for the effective functioning of cybernetic space is the proper presentation of information, reflecting the natural dispositions of the human. We can only satisfy the condition when the human uses the semantics of the natural language, making use of the verbal means of communication. The interface, in which there is a majority of sensual elements over signs, is close to the natural means of human – machine communication not only due to ergonomic reasons. In case of inter-human contacts, perceiving, hearing gestures or other signals accompanying the language of the conversation is as important as understanding words. Such a change in the interface is presently possible due to the increasing calculating power of computers. Until now all efforts to develop the interface were focused on giving the information the biggest possible visual form. Owing to the graphic imaging of information, the user received an interface, which was much richer than in the case of textual communication. Presently, the H-C multisensoral interface uses the senses of hearing and touching on top of the sense of sight. As a matter of fact, the role of these senses is beginning to grow. As Negroponte said: “The idea is simple: speaking, indicating and looking should jointly create a multi-modal interface, which to a lesser degree functions on the basis of sending messages to and from (the basis of interface with a time division), but rather resembles a human face-to-face conversation.” (Negroponte 1997) Owing to the participation of all senses, it is possible to broaden the human cognitive scope and deepen its intensity. It seems that the solution to this problem can be sought in course of the implementation of an intelligent system of the recognition of speech. The steering of the transformation of solids with the use of voice will make it possible to create the most natural type of a human - computer communication environment. It will require a number of experimental works as the new way of

communication will probably cause the need to implement changes in the used software. (Asanowicz 2001)

## 6 CONCLUSION

1. "Architecture exists in another reality from our everyday life and pursuits. (...) The quality of architecture does not lie in the sense of reality that it expresses, but quite reverse, in its capacity for awakening imagination. (Pallasmaa 1986).

A common aesthetic factor in virtual architecture regarding the visual and multisensoral is the new way in which human perception can be stimulated by creating the conditions in which the metamorphosis of form, the immateriality of objects, the paradox of image and reality in illusions and, above all, the unseen aspects of our universe can become perceptible. This is the area of VR in which important developments can be expected, particularly through the possibilities of acting the images of virtual objects or creating a human interface. The architectural exploitation of these new perceptual, cognitive and interactive possibilities has only just begun.

Are the methods and tools new ways of communicating our artistic senses or are they something more? If we refer to Strzeminski and his fundamental work "The Theory of Seeing", in which he analyses the evolution of human sight over history, the answer to the above question is "no". Strzeminski in 1951 wrote: "Let us assume a defined type of a visual consciousness - and we will have a defined type of visual art. (...) Each type of visual consciousness requires its own corresponding means of expression. Each visual phenomenon is expressed only by means of the established components of the form, capable of expressing it. Each new set of the means of expression is at the same time a new set of formal means. The changes in the formal means result, therefore, from the change in the type of seeing, establishing the relationship between man and nature. The quantity of the conscious components of seeing decides about the creation of new means of expression and new formal sets. In order to see the new content of the new topic, the method of observation is to be changed." (Strzeminski 1974).

Virtual images are not only new ways of re-presentation. Their uniqueness is a result of the introduction of a new means of presentation. We are dealing here with a brand new method of the existence of the image, which has until now been unknown in civilisation and which does not have any analogies in the material foundations. These images go beyond our reality and imply the consequences, going beyond our consciousness. As J. Baudrillard said, "We will never have to produce the real again..." (Baudrillard 1988). 2. In the art of painting, one picture can include different techniques (water-colour, collages, hand drawing). But it is the meeting of tools only. The message is the same because the tools do not change the message. On the other hand, in case of connecting the digital media in the new space of creation, the message could be changed. We receive a new quality. Handmade sketches or/and all kinds of sketches (hand and digital) illustrate our ideas. It is not reality. It is quasi-reality, an approach to reality only.

Nowadays, the Virtual is much more Real than the old Real ever was.

The developed cybernetic human-computer interface creates a new type of experience, reaching far beyond the normal cognition. The simulation of reality in the form of VR gives the human new means of cognition. It is not yet known whether the conclusion is positive but despite our assessment, it is a fact. As S. Lem says – one cannot get mad at evolution.

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