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History of Visualization in Order to Communicate in Space

1. Introduction – Communication in space utilizing the computer

Development of new techniques and digital media technologies have caused a paradigm shift in the display and presentation of architecture. Computers permit modeling of dynamic processes and create variations of conceptual ideas on the basis of parameters and algorithmic rules that allow development of new forms of architectural space. As an interactive process, these models allow relevant parties to experience architectural concepts and consequences prior to implementation; forces and energy characteristics can be simulated and interactively experienced.

Computer simulations as new forms of communication, allow demonstration of spatial experiences and new perceptions previously physically impossible. Projects of the Bauhaus-University Weimar interdisciplinary Master degree programme, MediaArchitecture can be displayed in an exemplary way.

The project 'CSCW-Media space' was produced under the Chair of Computer Supported Cooperative Work (CSCW) and the Chair for Presentation Methodology in the masters course MediaArchitecture (in the winter semester of 2007/08). The project's focus was to simulate a common spatial context in realtime to bridge the physical distance between working partners in different real-world locations. In achieving this,

'CSCW-Media space' created both a virtual shared information space and interaction paradigms for tackling group work on shared tasks (Fig. 1).

Impuls.Bauhaus is a Master Thesis project of the Master degree programme MediaArchitecture under the supervision of the Chair of Building Morphology and the Chair of History and Theory of Cultural Techniques. It demonstrates data structures of historical Bauhaus protagonists and their international social networks thereby showing the worldwide effect of the Bauhaus movement along with relationships between individuals. In order to realize this, the authors developed, in collaboration with art historians, the Impuls.Bauhaus-Research Platform, a database in which all of the relevant information is gathered. In the second stage the Impuls.Bauhaus-Exhibition emerged which enabled one to explore the Bauhaus masters' social network with the aid of an interactive exhibition architecture. Here, the gathered chronological and geographical information of the periods of life are also presented in space with the aid of interactive informational graphics.

Figure 1: CSCW computersimulation 2008, Hai Bihn Nguyen, Dario Navarro Sandoval, Jing Zhao

Figure left: „Bauhausbühne" computersimulation 2008, Yusuke Takeda

Figure 2: „Impuls Bauhaus" visualization of data structures 2009, Andreas Wolter, Jens Weber, Foto Tobias Adam

Figure 3: „Impuls Bauhaus" interactiv table 2009, Andreas Wolter, Jens Weber, Foto Tobias Adam

Figure 4: „Impuls Bauhaus" exhibition 2009, Andreas Wolter, Jens Weber, Foto J. Weber, A. Wolter

The core of the exhibition is represented by a large touchscreen that also reacts to the placing of objects. Also search results, like that of the social contact of Bauhaus founder Walter Gropius which reached Bauhaus masters in all continents, are displayed visually on the interior walls of the White Cube (Fig. 2-4).

2. Virtuality of architectural space in the medium of presentation

„Today architecture is a computer simulation as a matter of course, also with regard to its forms of production and representation." [1]

The definition of simulation plays a fundamental role of media design. Simulation as a technique of pretentiousness and reproduction generates the illusion of reality.

For the recipient, an impression arises of being physically present in virtual space and able to immersively design, interact and communicate. In doing do so, the architectural presentation does not only stand as a representation for the built or the to be built reality but rather generates its own immersive experienceable spatial reality. The image of the architectural space can result with various methods and techniques, perspectively, panoptically, axonometrically, congruently, similar, affinely or topologically in order to achieve spatial impressions. Therefore, the image is only one possible form of simulation. With the emergence of digital media we no longer understand under simulation of virtual space its venerable technology but rather, the creative modeling of complex structural shapes and dynamic processes in virtual building models. The media of presentation, the venerable and the digital, can communicate architectural space as virtual, physically vacant space. This view is attended by the observation of architectural space as a medium in interaction with other media [2].

Essential aspects for simulations, are not only the techniques that serve the forming of the media themselves, like the targeted use of light or the precise engineering of surface and material, but rather all technologies, which form the deception and comprehension of perception in communication through the stimulation of the senses, influence on the stand and view point, location of the horizon, movement guidance, perception of distance and proximity, the possibility of interaction, through media transfer and referring indication and image systems.

The spectrum of traditional display and presentation media of architecture ranges from the language, the script, the print or the

book, via the drawing, the image and the film all the way to model making. This way every medium of presentation has specific possibilities to fixate and communicate a spatial idea. As an example of venerable architectural presentation I present the Newton Cenotaph from Etienne Louis Boullée from 1784, which simulates the infinite and open space in the medium of architecture using an astronomical model. The displayed architectural vision shows virtual realities, which in the built reality would have evolved in their entire magnitude [3].

The «virtuality technology« of the new media enables the digital transformation, construction and simulation of reality models, which find distribution independent of location or time. With VR-Simulation it is even possible to experience spatial surroundings polysensorially, immersively and interactively. Models of the materialistically bound reality are coded and generated as graphic models of reality. Virtual spaces of data from physique, energy, life and environment can be updated as computer generated continual spatial geometry or rather topology as an image or spatial physical product. In the age of digital media, screen and display complement the media structure of architectural space and lead to a new manifestation of „augmented reality", „mixed reality" and „intelligent environment".

The MediaArchitecture project 'Ion' was produced by the Chairs of Building Design, Computer Science in Architecture and Interface Design in the masters course MediaArchitecture. It is an interactive virtual environment that uses the sounds and movement of users as input parameters for generating virtual cities. The movements of visitors are tracked with a video camera and motion-tracking-system. Acoustic signals are recorded using a microphone. The data is then saved in a database and sent to 3D-visualization software (Quest 3D) to generate an abstract, architectural shape. The design and location of the visual shape in virtual space reacts to sonic information (volume, frequency) and the position of the visitor. The installation creates a medial illustration as metaphor for shifting urban structures (Fig. 5 and 6).

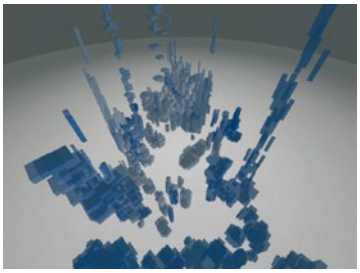

Figure 5 and 6: „Ion"interactive virtuell environment 2006, Lorená Diaz, Alexander Baumann, Jens Weber, Andreas Wolter

3. The historical change of presentation media

Every technological and cultural change was connected to the development of new media of presentation and communication. These respectively structure new possibilities of design, planning

and communication in architecture and have an influence on the new forms of architectural space. If we look at history, the development of the written and the bound word reach back into the roman age. Handed down to us are the "The Ten Books on Architecture" (33 B.C.) from Vitruvius, which already, as a medium of presentation, defined the design and the implementation as well as the communication from architectural space.

In the Middle Ages the verbal language, mnemonic memories and script were the media of transmission and distribution of technical, scientific and architectural knowledge. They enabled the forms of symbol representation, allegory and metaphor, which had a major impact on architectural space at the time. The verbal transfer, also in the process of building, was complemented with simple geometric drawings, diagrams and schemes. Such representations were preserved through Mathias Roriczer (1486) from Conrad Roriczer (1459, Kathedrale Regensburg) [4]. Retrospectively, the gothic cathedral can be viewed as an example for a "highly-developed pre-electronic information system", which conveyed the visualization in built space. The colored glass windows with the comprehensive image cycles enabled the orchestration of a glance into the artificial world, comparable with a monitor image or a »media facade«.

In the age of the renaissance, the medium of the book moved into the foreground with its new possibilities of mechanical reproduction for the pictorial presentations and distribution of forms of architecture and their standardization. Victor Hugo discussed in his book „Notre Dame de Paris" 1832, in the chapter "This will kill that", retrospectively the thesis that the "new" medium of the printed book kills the building. He even says that the slow "death" of architecture in the 15th century began with Gutenberg's invention of the printing press. With the omnipresence of the printing press after 1450, architecture was relieved of the title as the "mother of art" and the "old" medium was conceived in the code of the "new" medium. Hugo speaks of architecture as a language, as text and "solid book of mankind". "As a printed word, the thought is more imperishable than ever. It has grown wings; it has become untouchable, indestructible." [5]

Mario Carpo describes in "Architecture in the Age of Printing" [6], how the medium book describes and communicates architecture with text and image through new codes. As an example the published in six parts book "L´Architettura" (1537-1551) from Sebastiano Serlio is mentioned. It was conceptualized for application in the practice of the design process as well as for

the architecturally theoretical presentation. The possibility of the technical reproducibility of architectural images was the prerequisite for the standardization and reproduction of architectural elements. Carpo writes: "It was in the pages of the printed book that the modern standardization of vision celebrated its first triumph" [6]. The perspective illustration was thereby a supporting aspect. The central perspective and the analytical projection enabled the calculable spatial perception and presentation of architectural space. This way it had a large influence on its order and structure. The concept was presentable as a spatial illusion from one focal aspect.

There is a direct relationship between the spatial perspective perception of people and the perspective presentation and projection. Erwin Panofsky speaks of a "perspective spatial assumption", in which the image changes into a "window" which allows us to view that space with our imagination. The sight of the view of the materialistic image carriers is thereby completely replaced by the idea of a transparent layer through which we imagine to look out in to a conceived space. Elena Esposito remarks: "The central perspective enables the creation of a uniform, independent fictional space – in other words to clearly […] separate the observer's field of perception." [7]

The manifold forms of perforation of space and image appeared historically very early in architecture and formed a climax with spaces of illusion in the baroque era. The perspective image was presented with the wall and ceiling painting in the built space. During perceptivity, the illusion of being physically present and able to move freely is activated. In the church San Ignazio with the ceiling illustration (1691-94) from A. Pozzo, the technique of simulation is the perspective painting, which spatially embraces the observers standpoint and movements as well as guiding the view.

Numerous ideal concepts to the point of modernity, e.g. the Cittá nuova from A. Sant´Elia, update social and architectural ideas and utopias in perspectively presented reality.

Other image or rather simulation techniques like photography, panoramic picture, film, computer animation or immersive interactive virtual networks have caused a comparable change of communication and architecture. In doing so, they communicate, generate and at the same time compete against architecture.

O. Grau writes: "The apparent a historical illustrative thought of virtual reality is, like the panorama, based on a decided historical art tradition of immersive illustrative form. […] In its idea […] it

spans back to antiquity and is again virulent with the immersive strategies of VR-art of the presence.“ [8]

4. Communication from movement in space

With modernity and the development of new techniques and technology, a change in the occidental perception of perspective thinking and seeing to a seeing in movement has happened. The incorporation of the observer’s movement and the simulation of movement enable a radical development in the medium of architectural space.

Photography becomes an essential medium of presentation from snapshots of movement in space. L. Moholy-Nagy´s first book “Painting, Photography, Film” (1925) shows the experimental association with the new technical media that had an influence on the presentation and development of architectural space in the design process. With the emergence of photography, architecture and architectural space becomes a spatial and chronologically unconfined available object of perception, presentation and communication. With photography and film, mediums of presentation became available around 1900, which made the relationship of spatial and chronological continuity visible. In this relationship, the moment of movement in the presentation is constituted. The comparison with the painting from Marcel Duchamp newly shows how the old medium is taken up into the code of the new medium.

László Moholy-Nagy was perhaps one of the Bauhaus master artists who worked most closely with the artificial potential of “new” media such as photography, film and light projection.

While at the Bauhaus, Moholy's teaching in a diverse range of art fields – including painting, sculpture, photography, photomontage and metalwork – had a profound influence on many of his students. Simultaneously he experimented with new and unusual production processes in his own work, such as the exposure of photographic paper over-layed with objects to create what he called Fotogramms, an exploration of the flux and motion of the photographically captured objects.

In the exhibition room of the presence 1930 Moholy-Nagy exclusively showed technically produced images in the form of photographic reprints, slide projections and the Light-Space-Modulator as an apparatus to demonstrate light and movement phenomena. The 'Light-Space-Modulator' (light requisite for an electrical stage) [9] realized by Moholy-Nagy (1922-30), was the

first ever kinematic sculpture, a new connection between art, technology and material. Within this piece the static principles of the art work were exchanged for dynamic motion. Moholy-Nagy himself described this kinetic sculpture, this unified work of art composed of colour, light, and movement, which appears as a synthesis of his artistic ideas, as an apparatus for the demonstration of the effects of light and movement. Central to the piece is its revolving metallic sculpture, which acts as a catalyst for directed light sources to synthesize artificial projected structures, architectures of light and shadow, which represent virtual paths of motion in space-time. The kinetic sculpture out of chromed steel, aluminium, glass and externally illuminated synthetics relates to the surrounding space through light reflexes. Not only the modulation of the light is important but rather the constant process of visualizing is revealed. In 1930, Moholy-Nagy captured the movement and light effects from his apparatus in the film 'Light play black-white-grey'. The title of his book 'Vision in Motion' (1947) is a synonym for simultaneity and space-time; a means to comprehend the new dimensions of vision he was exploring.

Until the emergence of film technology, the movement itself could only be implied and not replicated as an image sequence [10]. The images of film "[…] are an item of a consecutive reorganization, by which a new image can arise from any point of the preceding image. The spatial organization therewith loses its privileged directions […] in favour of a nondirectional space, which continuously changes its angle and coordinates, interchanging its verticals and horizontals" [11]. Erwin Panofsky (1892-1968) investigates, in "Style and Medium in the Motion Pictures" (1934), how physical movement through space changes the perception of space [12]. He uses film as a possibility of sensing movement and speaks of "dynamisation of space and spatialization of time".

5. Interaction of presented and built reality

As an example of digitally generated architectural presentation I show the extensively published design for the Science Centre in Wolfsburg from Zaha Hadid from the year 1999 in order to explain the interaction with built form. With the aid of the computer the urban spatial reality of the globally industrial location with the virtual spaces of automobile movements and the development of knowledge and technology become a

simulated reality design of artificial dynamic of knowledge, progress and spatial architectural form. Metaphors of dynamic and continuity, like the geometric deformation and unfolding of lines, surfaces and cones in space, the perforation of outside and inside or the dissociation of casing and surroundings, promote the immersive perception of the presented artificial world. The virtual spaces of complexity of light, colour and metaphor of this architecture become a precise spatial model of communication.

The presentation can generate and visualize architecture out of virtual and in return communicate it as virtual space.

In all eras and cultures there was an interaction of presented, built and perceived reality. In other words the interrelating dependence of physical, virtual and communicated reality. New techniques of snapshots of the photo, its mounting in film, superimposition, X-ray photograph, diagram, editing technique or the light modulators from Moholy-Nagy have influenced the design of architectural space and its virtuality. The development of the conceptions of the »flowing« continual or »transparent« architectural space go along with the appearance of new media of presentation and communication.

The architecture from Le Corbusier, especially the Villa Savoye, allows the recognition of the relationship to film as an adequate medium of presentation. The inhabitant in the movement of »promenade architecturale« acknowledges the film like image sequence. The concept of spatial continuity has its origins in the perception and presentation of movement. It becomes effective in the continuity of spatial sequences, of polyperspective spaces, of interior and exterior space, of spatial boundaries and their surfaces, of computer generated spatial geometry, or from »transparent« spaces. Ambiguity of the boundary in »transparent« architectural space is used.

In the present context, digital and electronic media present a challenge for architectural space by further drawing attention to this pluralization and to architecture's manifold functions in modern society. Media façades and the creation of virtual and simulated architectures raise further questions about architecture's role in the age of electronic media and initiate a complex dialogue between medial and architectonic space.

6. Outlook

The new possibilities of having access to digital media over all other media of presentation, releases a change in the perception

and the communication through and over architecture. Architecture with its virtuality can be digitally communicated independent of location or time in the medium of electronic networks. Today, through digital networks together with the corresponding visualizations media, we can design or experience decisions, actions and communications. Architecture itself is a spatial medium of communication that presents reality and its meaning (Fig. 7).

Figure 7: „Bauhausbühne" computersimulation 2008, Yusuke Takeda

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