Is there a way to create a softer, more human interface to the building through computing?

by Levan Asabashvili

In the essay I'll try to discuss the possible ways of using computers for creating sensitive, user oriented architecture that could respond to the growing demand to it of being more human.

If we trace the long way of development of architecture and technology, we will discover that they always develop in parallel to the progress of a culture. As Peter Cook states [1] Architecture has a culture of responding to society where it exists, it is a mirror of society and is always responding to every shift of its pattern. There have been many changes in architectural paradigms in the history of our civilization. They were caused by the shifts in the political and social systems and innovations in science and technology. The last fundamental shift occurred recently when in the end of the 20th century computers were introduced in almost every field of human activity. introducing new technologies has caused the shift not only in the whole working and production processes in number of professions, but it changed fundamentally the whole perception of modern social organization.

During the process of total computerization intelligent machines were introduced also in architectural practice, but even today in the most of the architectural offices computers are being used as the facilitators for modeling the forms of complex geometry or as the pure medium for visual representation and documentation of architectural elements such as building layouts, elevations etc. Only some of the most innovative visionaries of architecture have understood that computers have much more potential beyond visual description of architecture.

With the advancement of computer sciences and introduction of computers and new communication technologies in different disciplines, there have appeared new concepts of emergence and complexity. The new sciences of complexity are impacting entire modern social relationships. Now it is obvious that the society is moving from the linear to more complex, chaotic organization. This shift of paradigm is immediately touching the new generation of architecture which is also moving from linear to non-linear complicated system of programmatic and physical organization. The new generation of architects is trying to use the full potential of computation techniques. In the process of designing and manufacturing architecture programming has become a powerful tool for investigating the new world of virtual environments.

Architects are using the most up to date concepts from the computer sciences, mathematics and robotics as well as biology earth study etc. for generating new forms of spatial and programmatic agendas. The number of latest ideas is used such as emergence theory, self organization, cellular automata, Lindenmeier algorithms of growing plants etc. Researchers are actively investigating living organisms and natural processes and are trying to learn from them how to perform the architecture in the more effective way. This information is put into computers via various programming languages. Advanced computation and fabrication tools enable architects to simulate the input information in special parametric software systems, to create their own worlds with innate laws and behavioral patterns different from our physical world. The output enables architects to search for original solutions of their design problems. They are exploring environmental issues through simulation of the information gathered in the particular sites and their ecosystems in order to generate environmentally responsive architecture, personalized to the site and context, which will operate cost and energy

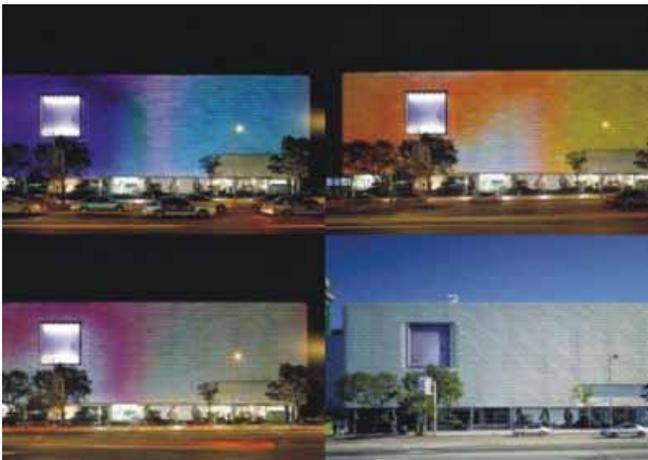Pic.1 Yokohama International Terminal   FOA

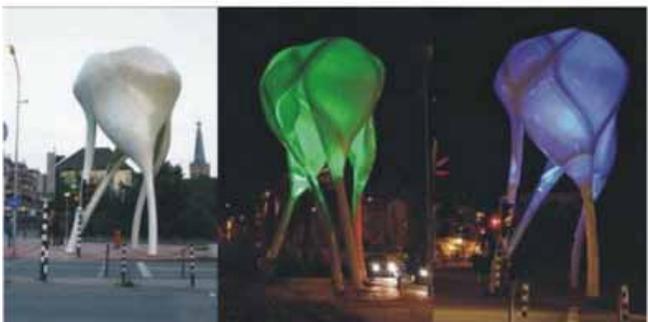Pic.2 Acoustic barrier Utrecht   ONL

Pic.3 Web of North Holland   ONL

Pic.4 Galeria Department Store   UN studio

Pic.5 D-Tower   NOX

intelligent, responsive to the physical environment where it exists. It is being more and more interactive, adapted to the needs of its users and to the possible change of demand.

The new type of architecture created through these highly complicated techniques deals with the complex social and organizational structure where it exists, with a growing demand on flexible, easily transformable, smart spaces. For instance modern business is no more satisfied with the existing inert composition of office space. It needs more elastic, responsive spaces for effective business operation [2].

There already exist some excellent built examples of computer generated design. They immediately became landmarks and operate successfully in their environments such as FOA's Yokohama International Terminal **(pic1)** which was formed through computer simulation of various visitor flows, or an example of parametric design such as Acoustic Barrier Utrecht designed by ONL **(pic 2).** There are conducted researches of pedestrian movement and how people use buildings and urban environment. After, this information is modeled and simulated in special software and the output results are used for planning various projects of urban or building scale [3]. One of the successful products of this research is the location of millennium bridge in London studied in the Space Syntax Laboratory.

There exist also some realized projects built with the idea of intelligence that can be perceived as early efforts of building clever structures such as Web of North Holland designed by ONL **(pic 3)**, Galleria Department Store of UN Studio **(pic 4)**, the lively façade of which generates a mother-of-pearl effect during the day and changes the color of the surface according to the program in the night. Or highly innovative work of NOX such as D-Tower **(pic 5)**, the structure created by computer aided design and manufacturing process, which is sensitive to the incoming information from the questionnaire web site created together with the structure. The structure changes the color according to the responses put

Pic.6 Joe & Joe   NOX

Pic.6 Son-O-House   NOX

in the questionnaire, the interactive sculpture Joe & Joey is also an example of intelligent form interacting to the phone calls of viewers **(pic 6)**, or Son-O-House the body responding with the sound to the movement of visitors **(pic 7)**.

Despite the consistent evolution of new computer generated architecture, the great amount of the research and projects are still remaining unrealized. There have emerged young practices specializing on emergent architecture such as DECOI, R&Sie[n], Kokkugia, Evan Douglis studio, SIAL and many others.

The Idea of intelligent structures may seem new, but if we look more carefully we'll discover that it is a long time since there have been existing number of examples when architecture performs better through programming, for instance buildings with automatic heating systems programmed to work according to the outside-inside temperature variation or electrical devices that are coded to light when the user is entering the space without being ordered to do so. Also automatic doors, all kinds of detectors, roofing and sun protection systems, elevators etc. are the early examples of how the building can perform better with intelligent machines.

The current development of information technology and the growing dependence of our society on the new technologies enable us to predict the future of our world in which computers and natural environment will exist alongside, almost blurred in each other.[4] If we think about the ongoing growth of world population and the urbanization scale, it will be clear that in the future architecture will play more and more important role in the sustainable development of our civilization and it will be strongly entwined with new technologies and achievements of science. I think creative engagement with modern technologies is crucial for the architects to change the role of architecture from the passive form towards the interactive structure. Architecture in the future must no more be the lifeless object to which users are trying to adapt. Computation and technological equipment enable us to create intelligent responsive spaces. For inspired people computation and employment of modern technologies opens the way towards the vast unexplored world of virtual environments, which they will try to implement in the real world. I think feeling the gap between virtual and real will be the main challenge for the future professionals.

There is already occurring this phenomenon of blurring the borders between architecture and other disciplines. It is obvious that in the future architecture and advanced sciences will be more and more connected and next generation of architects will have to adapt to these conditions. As Neil Spiller states, *Architects can no longer respect boundaries between disciplines; unbelievable opportunities can be gained from interdisciplinary polycontexturalism.* He believes that: *The new architects will consist of ecological wefts, technological distortions and, here and there, digital necromancy.*[5]

About the responsive environments Patrik Schumacher wrights: *it is not necessary to assume that architecture will be able to successfully claim the field of "responsive environments" as its own territory. Instead "responsive environments" might become an independent field and it might become*

a field of collaboration between industrial design and interaction design. He thinks that the *most architectural space will become responsive and be animated through intelligent kinetic capacities.* He adds that *what emerges is a new era within architecture or between architecture and some other disciplines, which will have a big market in the future.*[6]

Architects already have access to innovative production lines based on the robotics and artificial intelligence where they can produce advanced models of computer generated architecture as well as real scale building elements. In the future, the development of production technologies will enable us not only to create architectural projects by scripting but to build directly on site programmed physical shapes [7].

It will be possible to build the whole genome of the structure like living organism, which is acting automatically according to the information encoded in its genes. e.g. the building which opens and closes the different parts of its body with the change of daytime and the light available. The building, that is able to act according to the movement, preferences and even the mood of its occupants inside it; intelligent bodies that change the shape, texture and color according to the environmental conditions e.g. weather, wind direction, traffic, air quality etc. changing the consistency of its surface and behaving according to the various possible situations programmed in advance. The structures with their processors will be connected to the internet transferring the necessary information. There is a potential of planning entire intelligent cities responding to the various currently unsolved urban issues.

May be the next step in the science will be integration of computers with living organisms. This can have enormous impact on our civilization. In this condition one of the most ambitious aims of the future architects may be to have possibility of programming and controlling the growth process of living organisms. There has already been conducted researches in biotechnology and nanotechnology with an aim to create artificial biomaterials as spider silk chitin etc. and it is obvious that in the future we will be equipped with more powerful tools of scripting the growing processes of living organisms as well as of coding their shapes and behavioral patterns. These types of building-organisms will grow from the cells according to the information put into its genes. The growth process will be controlled by computers. There can be many alternatives of growing such organisms from different materials adapted to different environmental conditions and programmatic agendas. Building organisms will have kinetic capacity, they will respond to environmental shifts or user demand. These structures will be totally biodegradable. In this process computers will have the crucial role as tools for programming and controlling this process and as integrated intelligence for these structures.

Today the question is posed whether this emerging trend is only a fashion in architecture which will be no more in favor after some time, or it is a complete shift of the paradigm and the way we perceive the built environment?[8] I believe that intelligent machines are shifting the way we identify not only architecture but they are altering thoroughly the organizational pattern of the whole society for ever and the future of architecture will be strongly entwined with computation and other advanced sciences in order to respond to the shifting complex character of the future programmatic organizations.

Now the designers have possibilities to animate architecture. This has never been possible in the past. Programming is a tool through which a whole perception of architecture and tectonic can be changed. Architecture, new technologies and computer sciences together have enormous potential for shaping new, absolutely different world of human habitat. I believe future architecture will have ability to become more human, environmentally responsive and sustainable and our civilization will be able to cope with the current environmental problems without withdrawing from the latest achievements of

science. Even more I strongly believe that the future of human and earth is unimaginable without intelligent machines and built environment.

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