The formation of the scope of architectural design in the context of using information technology

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Abstract. The article is devoted to an actual problem of determining the characteristics of formation and development trends of information space architecture. Using in architectural activities computer technologies has significantly changed the possibilities for architecture in general. This concept allows us to understand the importance and necessity of finding new trends in the scope of architectural design. The purpose of the article is to determine the overall direction of creating objects in the architecture and urbanism, which use the latest information technologies and resources. The leading approach to the study of this problem is based on the methods parametric modeling, information technology and virtual reality when forming the scope of architectural design. As a result of the research we defined innovative approaches to the scope of architectural design in the context of the use of information technology. Materials can be useful for the theory and practice of forming the environment which opens completely new possibilities in architecture and construction.

1. Introduction

The rapid progress of information technology and telecommunications helps to ensure that information is one of the main economic resources of society development in new conditions.

The advent of digital technologies, using technical means opened completely new possibilities for architecture. Use of computer technologies in architectural activities, significantly changed the possibility of creating an architecture in general. Such technologies give rise to phenomena of cyberspace and network space, united in the term “info-space”. Some forms the provision of information and organization of her consumption in connection with the development of information technology can be introduced when you create the corresponding objects in the architecture. Study on the interaction of modern information technologies and architect that uses these technologies in their activities, is relevant for the organization of architectural design.

2. Statement of the problem

To determine the characteristics of formation and development trends of information space becomes useful to consider the thrust of creating objects of architecture and town planning that use the latest information technologies and resources. This concept allows you to not only understand the importance of and the need to mainstream the global information system, but also to determine common approaches in this context to the formation the scope of the architectural design.
3. Materials and methods

This problem has attracted many professionals involved in the formation of informational space of architecture in the context of a global information system and proposes concrete solutions and numerous developments performed within the framework of this concept [1], [2], [4], [5], [8], [9], [10]. The architecture becomes relevant concepts such as interactivity, virtual space, adaptability, transformation, mobility, etc. in connection with the attempt to adapt the information space to new living conditions.

3.1. Formation the scope of hybrid architectural design

In accordance with the demand of time, there is separate info-space in a category of architectural design based on the use of the possibilities of modern digital technology. In the architecture there is the informational approach as the interconnection of two spaces: architectural and information. To connect the digital world to the real world means consideration of the interaction of these two models, models of language communication and the architectural design process model [1].

In this regard, design methods, as an alternative to the established architectural form, imply an integrated space that interactively interacts with environment. This space has the ability to adapt and combine real and virtual elements, as well as constant motion, depending on changing conditions. This is due to the fact that living space ensures the flow of everyday life of people currently undergoing significant changes under the influence of development of information technologies.

New information technologies are changing our perception of the architectural design. This follows from the differences between the computer and the human mind, causing a problem of their combination. It is believed that the computer has a discrete action algorithm and mind - analog. The process of formation and perception of architecture is between the situation of real and virtual, as well as the analog and digital method of creation. There is therefore a need to create the scope of design in which the formation of the inhabited space will be seen as an integrated process that binds the ingredients listed above [2].

The process of architectural design is a multi-level, there is no single universal tool and means for solving all project tasks. This necessitates the development of a new coherent hybrid scope of architectural design. It goes beyond the restrictions imposed by the physical design process and creates “multi-distributed”, supported by the computer technology scope of design. The result is merge and hybridization of the object, space, process and scope of design, which includes the means of submission of project ideas, project process management tools, processes and information management systems [2].

This principle can be realized in the virtually real project space, the main elements of which is information and interface, which defines a way of communicating in a hybrid scope of architectural design. The scope of architectural design plays the role of an active facilitator, bringing together three main elements - the real environment, human and computer. In this case, both the component designer and computer are becoming one - a kind of hybrid [2].

This approach differs from traditional in attempts to replace the prevailing professional actions technological solutions, as the integration potential of technology with corresponding human needs. In this case, the hybrid scope of design stimulates the emergence of ideas in ways that are impossible in a normal physical workspace.

3.2. Formation the scope of hybrid architectural design

Virtual reality is an artificial 3D world-cyberspace, created using a computer and perceived by a person by means of special devices. It is associated with interactive technologies and provides interaction between people through three-dimensional images that illustrate the dynamics of real life [3].

Another aspect of the implementation of the concept of virtual reality is virtual design, including the design of virtual objects, often reflecting the reality. Great interest and usefulness are caused by virtual design applications for architects who require software tools that allow you to apply them when designing a virtual reality [4]. One of the most effective means of tackling this problem is the use of virtual prototyping systems.

Using virtual reality technologies, architects and designers can design, build and test a virtual object without making paper images and different layouts, as well as models in full size. The use of virtual models can substantially reduce the cost of creating costly physical mock-ups. In addition, gives the
designer a real opportunity to try out different options, all of them in detail analyzed and chosen as the best.

One of the techniques to cover the entire range of necessary activities is **simulation modeling**, which can be used in architecture and construction. In this case, this process is carried out through a set of mathematical tools, special computer programs and receptions that are using information technology for modeling in the “simulation mode” of structure and function of complex process [5].

Improvement of technologies of design work gives rise to the introduction of information technology and integrated automated systems of architectural design based on the create of building information model objects designing at all stages of their life cycle.

Computer modeling can be used to enhance the imagination and make his available effects, convincing and active. According to the researchers, “simulation modeling as a special information technology consists of the following main phases” [6]:

- **Structural analysis of processes** in which the formalization of the structure of a complicated real process is carried out by its division into functions according to the scenario.
- **Formal description of the model** is a graphic representation of the simulation model and each component of the modeled process.
- **Building models** as transferring and editing links in the form of an assembly model, as well as lapping of the parameters.
- **Conducting intermediate experiment** to optimize certain process parameters.

Due to the interaction of digital modeling and “info-model”, designing goes to a whole new level. By organizing and generating settings of factors, we can create a model based on the use of integrated principles, which lay in the digital modeling program [1].

### 3.3. Formation the scope of hybrid architectural design

In the design process for a complete view of the object, it is necessary to create a system of communication between participants of the project process. The use of information technologies when developing of buildings in the complex geometry requires creation of a unified system of integration of data obtained during the design process, and streamlining information model. These models contain all data related to the geometry of the building, function, materials, maintenance and many others.

The solution to the problem of the design objects of architecture and town planning lies in **parametric design**, based on the establishment of a mathematical model. This allows making changes to the settings of object and relationship between them on the basis of the overall algorithm, which is a basic template for creating a particular object [7]. The use of parametric modeling design opens up completely new possibilities in architecture until the creation of the “living model” as the computer objects that are in a dynamic state of constant changes, defined by participants in the construction process [8].

Design is just one of the steps when creating architectural objects and is not a result of the professional activities of an architect. When solving creative tasks along with heuristic methods of creating architectural objects we used “information technology” design methods [9]:

- **Geometrical method** (characterized by way of creating architectural objects using the work with geometrical ideal forms and their transformations).
- **Parametric method** (allows you to create any complexity static form by creating aggregate points in space, each of which sets the parameters of coordinate).
- **Algorithmic method** (allows you to work with parameters in the given dynamics, where the framework is not a form of surface and the structure of its organization). Through a change in the structure we change the shape of the object itself.

The possibility of digital design is almost unlimited and acts at all stages of project forecasting and creating architectural object: from sketch to construction management. This has resulted in a new approach to the design, associated with the method of **script technologies**, with their own algorithms
and processes. An architect as a designer-director organizes the process of architectural object creation and its life-activities. This technology is embedding scheme “script” in the design process consisting of the elaboration of project concept, concept creation script and writing it [10].

Such approach provides the opportunity to lay in the design process more data, allowing getting the maximum project taking into account many factors. After creating the virtual models, we modify project documentation and create a material model.

Use of “script technology” gives greater efficiency by cutting costs during both the design and the production. In addition, this leads to entirely new directions in architecture, such as interactive and genetic architecture, based on complex processes and interactions. Depending on the model “scripts” can be genetic, online interactive and interpreting or have signs of different models [10].

Using the development of Nano-technologies and Nano-robotics allows you to use the method of creating structures that can be replicated. This will build the self-replicate structure that can produce their own copies made of the same material as the same replicator [11]. Application of technology of nano-robotics and replicators in the formation of architectural design and management self-replicate structure opens a new direction in the construction industry.

The property of interactivity in the parametric approach forming architectural objects is evident in the use of digital technologies to provide new methods of modeling [8]:

- **Combinatory modelling** (implies design using model item parameters and relations between these parameters).
- **Script method of modelling** (based on variations of the scripts codes and possible manipulation of options settings of architectural form to input and output).
- **Morphing** (computer animation is based on a technology that generates Visual effect that creates the impression of a smooth transformation of one object to another).
- **Topological morphogenesis** (the basis of forms is its continuous deformation and mutability occurring's without breaks and providing).
- **Analogy modelling** (analogue, as an object or a technical solution to the same destination, is close to set of essential attributes and is often used in conjunction with the notion of prototype).
- **Plastic modeling** (plastic transformation of digital models of physical environment).
- **Nano-kinetic modelling** (represented by the adaptive systems as kinetic, interactive and informative wrappers).

The development of modern information technology and improving computer technology allow you to use in the architecture the information modeling methods associated with the parametric approach. Here the architecture becomes interactive, virtual and adaptable.

**4. Discussion of the results**

New approaches to formation of info-space as a separate category of architectural environment are identified in this review in the context of the following described tendencies:

1. **Formation of the scope of hybrid architectural design.** The establishment of a global information system in the context of the identification of new approaches to its formation requires the development of new coherent hybrid scope of architectural design. In architecture there is a new information approach to the interconnection of two spaces: architectural and informational.

2. **Interactive technologies in the context of virtual reality.** Virtual design involves designing virtual objects, often reflecting the reality. One of the effective means to resolve this problem enables you to cover the whole range of activities, the use of virtual prototyping and simulation modeling as the special information technology.
3. *The techniques of parametric design*. Parametric design uses information technology design methods: geometrically, parametrically and algorithmically. Embedding a “script” in the design process, consisting of design concept, concept creation script and writing the script, leads to the emergence of new trends in architecture, such as interactive and genetic architecture. The formation of architectural design using self-replicating structures opens a new direction in the construction industry.

5. Conclusion
The development of modern information technology creates opportunities and conditions to search for innovative approaches to the organization of architectural space, new tools and techniques of artistic expression in architecture. Thus, the scope of architectural design in the context of a global information system is updated as new types of technical means. To remain viable in a rapidly changing technological and social context, the architecture must increase participation in research, revise its fundamental goals and develop creative strategies, adequate new tasks.

A new approach to architectural design in connection with the global information system will bring together through the existing network scientists, engineers and other experts dealing with professional challenges in this area. The results of the study could be useful for the theory and practice of shaping space habitats to open up completely new possibilities in architecture.

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