USING VIDEO AND COMPUTER TECHNOLOGIES FOR APPRECIATION OF
THE INTEGRAL BEAUTY OF ARCHITECTURAL OBJECTS
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Abstract

The paper is devoted to finding the aesthetic value of architectural objects and it is the continuation of works /1/ and /2/ executed before. In those the following concepts had been developed:
a) dot estimation of beauty of an architectural object;
b) function of beauty,
c) integrated estimation of beauty of an architectural object.
The integrated estimation of beauty doesn't depend upon the choice of a point of observation and can serve as an objective measure of beauty of an architectural object.

1. An architectural object here is understood either as a separate building or as a compact ensemble of buildings perceived by the spectator as a single unit. The concept of beauty of an architectural object reflects its visual appeal, a degree of an aesthetic influence on the observer at visual perception of the architectural object.

Let's suppose that the architectural object A can be perceived by an observer from each point of territory of perception T. Let us represent A by a flat area on a plane, and we shall introduce on T a polar system of coordinates with a pole O, which is taking place inside A. For each point P from T, it is possible to establish in some system of readout a numerical meaning \( F(P) \) – a function of beauty of the object when it seeing from P.

We suppose, that the value \( F(P) \) is in direct dependence on an intensity of a flow of beauty, which comes from A to P. In turn, the intensity of this flow depends: a) on the quality of the object (its beauty); b) on the distance of a point of observation from the object; c) on the angle, under which the object is observed. This intensity of a flow of beauty coming in the given point P we shall name as a dot estimation of beauty of the object in point P. The dot estimation can be determined by an expert method, for example, by a team of experts, which can view a physical model from the given point either directly or with the help of video-technologies. If there are appropriate programs, viewing and estimation can be realised with the help of a computer.

The set of all dot estimations in the whole territory of perception T represents a function of beauty \( F(P) \), which characterises an aesthetic value of the architectural object for area T as a whole. The function \( F(P) \) is a function of two variables \( x \) and \( y \). Its diagram represents a surface, which is located above T (a surface of beauty). It is possible to suppose this function continuous. Points in which the function \( F(P) \) achieves the greatest meaning are points of the best perception of the object. Let's remind, the continuous function achieves of greatest meanings either in points of its maximum or on the border of area of the definition (in our case – on the border of T).

The integrated estimation of beauty of an architectural object is determined as a double integral from the function of beauty on area T:

\[
K(A,T) = \iint_T F(x,y) \, dx \, dy .
\]
It represents a numerical measure of aesthetic value (beauty) of the architectural object. This estimation does not depend on accident or arbitrariness of a choice of a point of viewing. In the polar system of coordinates the estimation $K(A,T)$ will be:

$$K(A,T) = \int d\phi \int r F(r, \phi) \, dr.$$  \hspace{1cm} (2)

Let us note, that the numerical value of the estimation $K(A,T)$ is equal to a volume of a body limited by a surface of beauty and by a territory of perception $T$.

**Estimation of beauty of an architectural object depends upon on accident or arbitrariness of a choice of a point of the observing.**

2. For definition of $F(x,y)$ the following method is offered. The physical model of the researched architectural object is established on a rotating platform. A pole of polar system of coordinates $O$ is combined with an axis of rotation of the platform. The rotation of the platform at the angle $\Delta \phi$ is made either by the step-by-step electric engine at submission of a managing signal or by hand.

The equipment for shooting settles on a separate platform, which under an action of the other step-by-step electric engine can move to and fro along a straight bar on step $\Delta h$. If there is a technical opportunity, the straight movement of the camera can be replaced by making optical or computer's panorama. It is obvious, that the rotating of a physical model, replaces detour of the camera around of the object, which is rather difficult for carrying out.

*Figure: The photo of a student's educational project*
The described mechanism has two degrees of freedom. It allows to look through breadboard models or to make their shooting from different directions $\phi$ and from various distances $r$. Thus there is an opportunity to look through the object from all $T$, or, shooting from each point to receive a slide-film for estimating the object.

The set $m \times n$ of pictures of the object ($m$ – number of steps of a distance, $n$ – number of steps of an angle) we shall name as a video file $W_{A}(m,n)$ of an architectural object $A$. If various projects, which are competing among themselves, are compared, their video files should be created under the same standard, which includes the same points of shooting, constant conditions of lighting, use of the same equipment and so forth. For increasing of reliability of estimation, it is desirable to carry out sessions of estimating the given object by the same expert several times, and as result of an estimation of each picture, to take average size of an estimation of this picture.

When working with the expert group it is necessary to observe unity of its list for all objects participating in a competition. As a final result for an estimation of the separate picture it is natural to calculate its selective average estimation taking into account all experts. Extreme (marginal) estimations can be rejected. For increasing of reliability of the estimation it is possible to use other standard methods of mathematical statistics.

The set (file) $\Omega(m, n)$ of expert estimations for a video file $W_{A}(m, n)$ represents meanings of function of beauty $F(r, \phi)$ in points of shooting for object $A$. With the help $W_{A}(m, n)$ it is possible for example to reveal the best (advantageous) points of the review of the given object and to find out the worst.

Now with the help of the formula (2) it is possible to find the integrated measure of beauty $K(A, T)$. As the function $F(r, \phi)$ is given numerically in points of shooting, instead of (2) for a finding $K(A, T)$ the formula of numerical integration is used:

$$K(A, T) = \Sigma \Sigma F(r_i, \phi_j) \Delta \phi \Delta r.$$ 

It is possible to automate finding value of $K(A, T)$, either by having written the appropriate cyclic program which is carrying out summation or by using one of the numerous applied programs of numerical integration.

**Conclusion.** It is obvious, that it is impossible to apply the above-stated method in order to compare objects various in their functional purposes, place and time of their construction or to objects which belong to a different cost categories etc. However these methods can be used when comparing the competing projects of the same building, and also – for numerical estimation of the student's educational projects.

Let us note also, that using an estimation $K(A, T)$ by architects at a stage of designing can be useful for improving of the project's quality.

References (in Russian)