Graphic-analytical method in architectural assessment urban visual environment

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Abstract. Not only chemical or physical pollution is a problem for environment. The visual environment pollution becomes irreversible problem. Because of the basis of modern construction is the principles of simplified modeling. A lot of same elements on the facade of high-rise building create an unfavorable environment for visual perception. It can leads to visual deterioration, mental health and other health concerns. There are not enough accurate methods for visual aggressiveness assessment. In this article we offer use graphic-analytical method for determine the degree of aggressiveness of building's visual environment. As the result, we determined the percentage of same elements on the facades of two buildings by using a grid.

1 Introduction

The ecology of the urban environment today is a field of attention not only for scientists, but for the whole society. However, problems of chemical, physical and other types of pollution of the environment are mainly considered. In addition to these, there is the problem of aggressiveness of the visual environment. V.A. Filin,D. Sc. in Biological Science gave an explanation of the relationship between visual pollution of the urban environment and deterioration of vision, mental health. Methods of visual determination of environmental pollution are not currently developed or give an inaccurate assessment. In this article, we want to consider the possibility of using the graphic-analytical method to assess the visual condition of the urban environment. With its help it will be possible to objectively assess the visual ecology of a modern city and characterize its impact on a person [1].

The problems of visual perception of the environment have been studied in Russia and abroad since the 80s of the 20th century. Frans W. investigated the relationship between the level of illumination and the ability of people with impaired vision to detect and recognize objects in a realistic visual environment. He concluded that when we try to find the best coverage for orientation and daily activities, we should optimize it for both visual acuity and contrast sensitivity [2].

The spatial interaction of visual attention and saccadic eye movements was investigated by Heiner Deubel in a dual- task paradigm that required a target-directed saccade in combination with a letter discrimination task. The results favor a model in which a single

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attentionai mechanism selects objects for perceptual processing and recognition, and also provides the information necessary for motor action [3].

A major problem that a visual system faces is how to fit the large intensity variation of natural image streams into the limited dynamic range of its neurons. The results show that fast gain controls indeed keep the response within the dynamic range of the cells and that a large part of this range is actually used for packing the information in natural time series [4].

In Experiments 1-3, Marisa Carrasco monitored search performance as a function of target eccentricity under display durations that either allowed or precluded eye movements. She concludes that stimulus size, orientation and spatial frequency influence the extent of the eccentricity effect and the efficiency of search performance [5].

The percept of self-motion through the environment is supported by visual motion signals and eye movement signals. The interaction between these signals by decoupling of the eye movement and the pattern of retinal motion during brief simulated ego-movement on straight or circular trajectories was studied. It was suggested that bi-circular and bi-radial flow components contribute primarily to percepts of heading and path curvature, respectively [6].

An unresolved question is how much information can be remembered from visual scenes when they are inspected by saccadic eye movements. The results show that the visual memory that was reflected in the recall reports was not utilized for the immediate decision about where to look in the scene. Visual memory can be excellent, but it is not always reflected in oculomotor measures, perhaps because the cost of rapid on-line memory retrieval is too great [7].

Articles of A.A. Golubnichy devoted to the assessment and classification of aggressiveness of the urban visual environment. The author proposes a method of quantitative estimation, based on the photographic fixation of elements of the urban development environment with further overlapping of the grids, the determination of the number of cells with the presence of visually indistinguishable objects and calculation of the aggressiveness coefficients according to the formulas [8-10].

The questions of the features of human perception of the environment and objects have been investigated from various sides with reference to the current needs of research of various scientific areas [11-21, 35].

The proposed design solutions today tend to only exacerbate the aggressive nature of the visual environment, filling it with the typical elements of the wall panels, window imposts and other structures [22-25].

When our eyes are tracking a target that is moving in front of a structured background, global motion of equal speed is induced in the opposite direction. Our experiments further characterize this asymmetry in visual motion processing and provide a preliminary explanation for the accuracy of the pursuit system despite self-induced motion [11].

The receptive fields of visual cortical neurons are bidirectionally modified by sensory deprivation and experience, but the synaptic basis for these changes is unknown. He suggest that experience-dependent changes in NMDAR composition and function regulate the development of receptive field organization in visual cortex [12].

To quantitatively assess the model performances, eye movements were recorded while naive observers viewed natural dynamic scenes. Conclusions are drawn regarding both the influence of low-level visual features over time and the central bias in an eye tracking experiment [13, 34].

In paper « Visual stress theory and its application to reading and reading tests» Wilkins Arnold, Huang Jie and Cao Yue present a theory of visual stress. The theory is applied to the assessment of symptoms of visual stress and its treatment with coloured filters. They have learned the influence on people of visual stress [13].

In the article of V.S. Gozyumova, N.R. Stepanova «About the city as a habitat» tells how in the modern world there is an active development of cities. There are more and more megacities. A metropolitan person is different in comparison with a city man, and all the more so from a person living in a rural environment. The environment affects the psyche, behavior and even the well-being of a person. This work is aimed at review of cultural and historical objects of the city of Yekaterinburg, which form the perception of man and the craving for the beautiful [26].

The of Article Novikova Yu.V. «Psychophysical features of perception of a homogeneous environment» considers the visual environment and its strong impact on the human condition, acting as an environmental factor. It is also said that a modern uncomfortable environment requires a person to create a new behavior strategy. New unusual sensory images, not corresponding to the previous experience, create tension in the psychophysiological state. The abundance of smooth surfaces without decorative elements, facing tiles and glass as decorative elements, extensive asphalt coatings form a homogeneous visual environment. The paper presents the results of a study on the perception of a homogeneous visual medium [27].

In the article of Garipova S.R. «Assessment of visual pollution in the urban environment: issues of methodology and research results in the city of Ufa» on the basis of the proposed VA. Filin's theory of the influence of a visual environment on human has developed a methodology for assessing the video pollution of architectural objects and neighborhoods in the urban environment. Psychological aspects of perception of objects of architecture with different video ecological characteristics are studied. The results of the estimation of video pollution in the districts of different period of Ufa are presented. Some ways to improve the visual environment of the city are discussed [28-32].

The purpose of this article was assessment of the possibility of using the graphoanalytic method for determine the degree of aggressiveness of building's visual environment. The following tasks were set for this:

1. Determine the necessary parameters for the construction of grids;
2. Using the example of a real building, determine the degree of aggressiveness of its visual environment;
3. Compare using this method 2 buildings of different number of storeys.

2 Materials and methods

To research the degree of aggressiveness of the visual environment, a comparison was made between two buildings located at the addresses Gzhatskaya 22 and Polytechnic ul. etc. We photographed the facades, and we also photographed the view that opens before the person when he comes out of the entrance.

In Autodesk AutoCAD, after obtaining the angles of the camera and breaking it into angles of 3 degrees, we built a grid (fig. 1). Next, we inserted each photo into the grid and marked cells containing two or more identical identical objects. Further, the percentage of hit for each element of the same type and the overall percentage of aggressiveness were calculated.

To build the grid, the camera angles from which the survey was taken were taken. Then they were divided into angles of 3 °. This angle was taken based on the criterion of aggressiveness of the visual environment according to Filin (occurrence of two or more objects of the same type in the field of view of less than 3 degrees) [33]. The vertices of the corners are located at a distance equal to the distance of the camera from the building. The lines drawn from the points of intersection of angles of 3 ° and the size of the photo form the basis of the grid.

During the imposition of a grid on the photo of the building, controversial issues appeared. One cell got several kinds of the same type of elements, then in one cell we put two marks of different colors. Each color is responsible for its element (stained glass, glazing, balconies, windows, tiles).

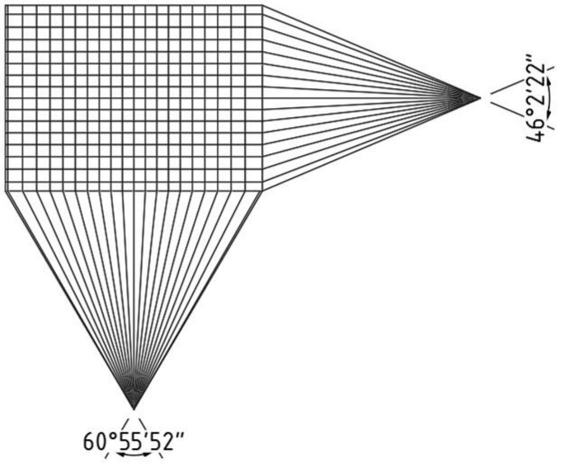
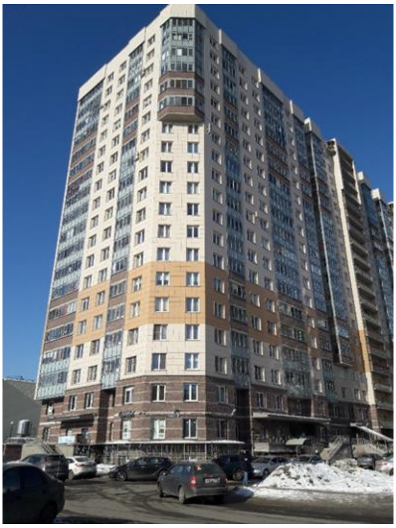


Fig 1. Grid diagram

3 Results

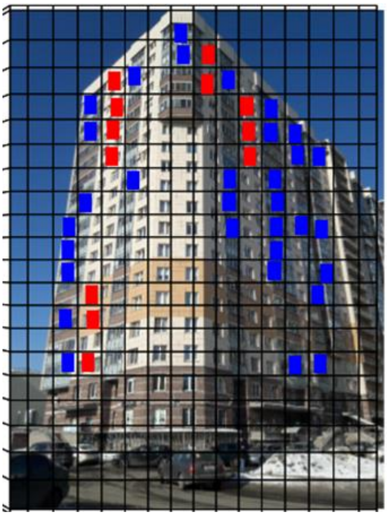
By applying this grid to each of the photographs and labeling the cells with repeating elements, the following results were obtained (fig. 2-6). The total number of cells and cells marked with different markers was calculated and their ratio to the total number of cells was found.



a)

b)

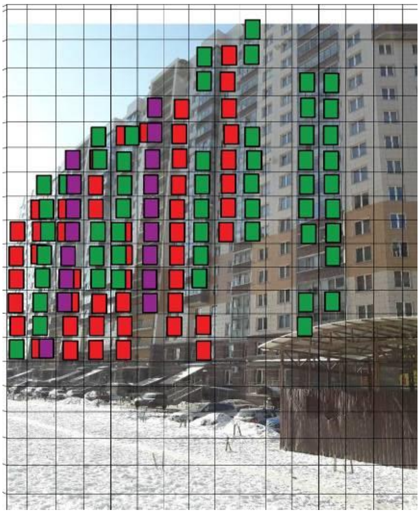
Fig 2. The view of buildings: a) multi-storey building; b) scientific research building of the Polytechnic University



a)

b)

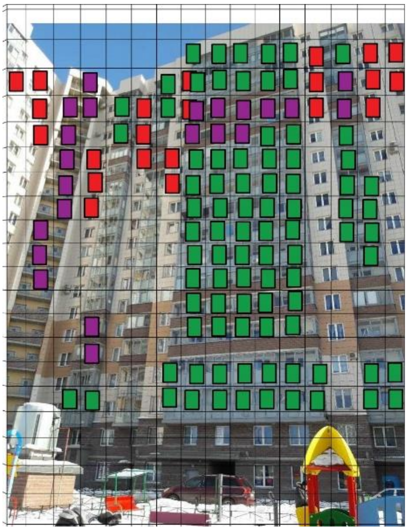
Fig 3. The results of the assessment of the environment, the percentage of aggressiveness according to the Filin criterion: a) R_{agr}=5%(windows) +13%(glazing) =18%; b) R_{agr}=18.4%(tile) =18.4%



a)

b)

Fig 4. The results of the assessment of the environment, the percentage of aggressiveness according to the Filin criterion: a) R_{agr} =22%(windows) +24%(glazing) +8%(balconies) =54%; b) R_{agr} =4.8%(tile) =4.8%


a)


b)

Fig 5. The results of the assessment of the environment, the percentage of aggressiveness according to the Filin criterion: a) 8%(windows) +31%(glazing) +8%(balconies) =47%; b) R_{agr}=1%(windows) +4%(glazing) +13%(wall) =18%


a)


b)

Fig 6. The results of the assessment of the environment, the percentage of aggressiveness according to the Filin criterion: a) R_{agr}=8%(windows)+10%(glazing)+7%(balconies)=25%; b) R_{agr}=9%(tile) +25%(glazing) =34%

4 Discussion

Depending on the distance (S), the aggressiveness coefficient will change. As the distance between a person and a building decreases, the number of repeating elements in one cell will decrease, hence the aggressiveness ratio will decrease:

$$R \sim S \quad (1)$$

In this study, we did not consider in detail this relationship. However, in further studies, it would be reasonable to find a refined correlation between the distance from the building and the aggressiveness of its visual environment.

Very often the elements of the same type of windows, balconies and glazing are repeated, because the basis of modern construction is the principles of simplified modeling. This problem can be neutralized using different types of elements, making accents on any separate parts.

As a result of comparison of the two different buildings, a regularity of the direct proportional dependence of the degree of aggressiveness on the number of floors (N) was found. It is quite obvious fact, since an increase in the number of floors increases the distance from the observer to a building surface:

$$R \sim N \quad (2)$$

Thus reduce the aggressiveness of the visual environment can decrease the number of storeys of buildings. In addition, buildings with a small number of floors, even with a large length, can neutralize the aggressiveness of the environment by green plants, as they cover the repetitive elements of the building and relieve stress. Another solution to the problem is the creation of large visual dominants on the upper parts of the building, overlapping arrays of repetitive objects.

As previously stated, Golubnichii A. calculated the aggressiveness coefficient for paving slab by using graphic-analytical method [8]. Previously, such calculations for buildings have never been carried out.

These courtyards as in fig. 5. are particularly dangerous with accommodation in their playgrounds, because around them there is a continuous aggressive visual environment that can be harmful to children for a long time

5 Conclusions

In the course of this study, the degree of aggressiveness as the percentage of aggressiveness of a typical modern high-rise building and a low building was calculated. We came to the conclusion that, to date, the environment is also negatively affecting a person, among other things.

This method can be used to assess the visual environment. It needs further development. Among other things, it is convenient as it can be automated with the help of software based on the recognition of similar objects.

We also determined that the aggressiveness of the visual environment is proportional to the distance from the building to the observer and the total height of the building. The study of these dependencies will be devoted to our further work. To reduce the risk associated with a decrease in the level of public health, it is necessary to revise the principles of modern construction. We offer next activities:

1. Construction of low-rise buildings instead of high-rise buildings. Buildings with heights of up to 20–25 meters are preferred, since such buildings can be surrounded by trees, which will soften the environment;
2. Use large visual dominants in architecture, which could overlapping an arrays of repetitive object;
3. Use in architecture instead of single-leaf elements varied decor.

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