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## **RECURSIVE SYSTEMS IN ART AND DESIGN: QUESTIONS OF CLASSIFICATION**

*Abstract: The recursion concept and feature of the recursive systems is exposed in the article, the attempt of their classification is done. Visual recursion is considered as the method of harmonization of in-spatial environment. The types of the visual recursive systems (planar, volume-spatial, combined) are first analyses in the art and design.*

*Keywords: recursive systems, recursion, art, design, classification*

**Statement of the problem.** At the present stage of design culture arises the problem of finding creative visualization techniques, ways to build expressive images, new concepts. Admission replay systems within the same system in the design of objects provide the appearance of original compositions. In terms of mathematics and geometry, such systems can be identified as recursive. But mostly designers use recursion unconsciously, not knowing either its nature or content. The question of the relationship recursive contents and their use in different spheres of life led to the emergence of various types of recursive systems. However, individual studies do not allow to fully describe the essence of the phenomenon of recursion in general and the use of design features in particular which caused relevance of the chosen topic.

**Analysis of recent research and publications.** Recursion is used in mathematics, computing, three-dimensional modeling and topography has different specific manifestations in psychology, art and design.

The first mention of recursion as a mathematical method associated with the name Leonardo Pizanskoho (Fibonacci), because the sequence of Fibonacci numbers is given recurrence relation [5]. Albrecht Dürer and Leibniz developed many aspects rekursyvnosti ideas. Functions of self-similar objects studied in the late XIX - early XX century. Henri Poincaré, Felix Klein, Pierre Fatou and Gaston Julie. In 1960 Benoit Mandelbrot began to study the phenomenon of self-similarity, using the word "fractal" as a name for the self-similar objects based on recursion [5]. The modern scientist S. Vasilenko suggests additive recursion [2]. The concept of recursive topological spaces and the theory of recursive metric spaces is investigated E.Latkinym [4], the synthesis of the virtual environment of recursive division of the objective space is considered in terms of 3D-modeling. Recursion has been applied in the exploration of the underlying processes of the human psyche. The new direction of cognitive psychology - recursive model V.Dmytriyevskym described in terms of mental functioning [3].

Using the recursive method in various fields of culture gave rise to the following definition of recursion as inductance thinking (philosophy) metaproza (in literature), Miz en abim (in art) [8], Droste effect (in design) [7]. Study of texts recursive structure stories devoted to the work N.Styekolnikovoyi [6]. Sebastian Feb. explores the display and use of recursion in the video. [8]

So historiographical analysis demonstrates the lack of scientific development topics of research are fragmented, presenting only examples of recursive systems, there is no work that disclose the question of their use in the design.

**The wording of Article goals.** Objective is to study the characteristics of recursive systems in art and design and try their classification. The objectives of the work are: 1) to consider the visual recursion as a means of harmonizing the subject-spatial environment, to detect its expression in art and design, 2) the types of visual recursive systems.

**The main part.** Recursion (from Lat. Recursio - cycle of) - a process of repetition by the same similarity, that is the replay system within the system, or the flow of the system in itself [5]. When recursion is broadly understand this way of organizing the system in which it is at certain moments in its development, which are determined by its rules, can produce (cause) changed their copies to interact with them and incorporate them into its structure [1]. The simplest physical example of a recursive system is a reflection of the object in two strictly parallel mirrors. So we can talk about recursive visual system and its role in design culture.

Visual recursive system - a system in which the repetition of an image forming composition of the same image. Location of the system allows to differentiate recursive copies of the nature of existence in space. Recursive system can be of three types: planar, three-dimensional and combined.

Plane recursive systems observe mainly in art and graphic design. Associated with semantic and energy content, designs on ceramics Tripoli flow with each other and themselves with themselves (Fig. 1:1, 2). The first paintings using recursion is the triptych "Stefaneski" Giotto di Bondone. It shows how Cardinal Stefaneski gives the same triptych of St. Peter. An example of the first deliberate creation of recursive system is "Portrait of Arnolfini marriage" Jan van Eyck (Fig. 1:4). On the wall hangs figures portrayed a small convex mirror, which can see who draws the artist. This effect is used in their works Johannes Gump ("Self-portrait in front of the mirror"), Diego Velazquez ("Las Meninas", where in a mirror in the background appear the King and Queen, which depicts the artist), Jan Vermeer ("Allegory of Painting"), Norman Rockwell ("Triple Self-Portrait"). Recursive image contains most of lithographs and etchings Mauritsa Escher are circular closed system (Fig. 1:3).

In graphic design recursion was first used in the design of packaging Droste Cocoa in 1904 The packaging depicts a nurse holding a tray with cocoa package with the same nurse with a tray (Fig. 1:5). This led to the emergence of the concept of "Droste effect", which introduced a sports journalist, poet and translator Nico Shepmaker in the late 1970s [7]. In 1929, a similar picture appears on the packaging of peanut butter of "Spicy": Girl looking at the packaging, which depicts the same girl. A new wave of popularity Droste effect accounts for 1950-1960-ies

(cover edition of Seventeen, musical disc case). In 1969, the album cover of the band Pink Floyd issued recursive files, but on each iteration level picture is somewhat different. Today planar recursive systems are widely used in photography.

Space-dimensional recursive system monitors even the simplest architectural buildings, elements of which are characterized by alternating mutual coordination of respect to the chosen axis. There are three kinds of recursive systems: open, closed and illusory. Open recursive system (appearance of three-dimensional systems are clearly showing signs rekursyvnosti) - a stepped pyramid rows of seats amphitheater (Figure 2-1). Having recursive interior spaces that are only in terms or "breakdown" structures justifies the existence of a closed recursive system (Figure 2-2). Provides visual illusions illusory appearance and existence of a recursive system resulting from rhythmic repetition of structural elements (arches, columns) in the long-term redu

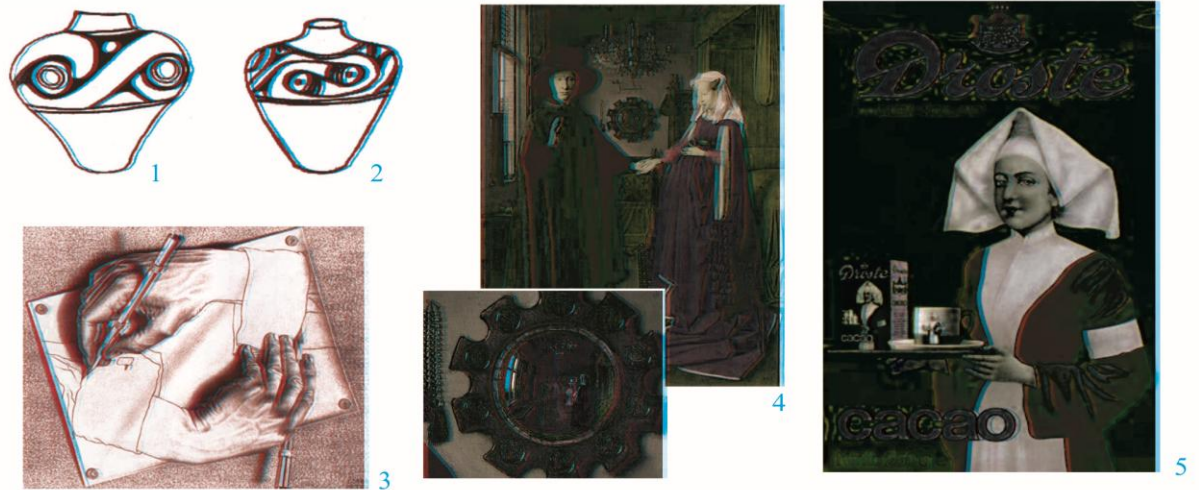


Рис. 1. Площинні рекурсивні системи: 1, 2 - трипільські орнаменти; 3 - М.Ешер "Руки, що малюють"; 4 - Ян ван Ейк "Портрет подружжя Арнольфіні"; 5 - упаковка какао "Droste"



Рис. 2. Об'ємно-просторові рекурсивні системи: 1 - піраміда майя у Чічен-Іцу; 2 - винний льох; 3 - ілюзорна система (арки); 4 - рекурсивні стільці; 5 - кімната в кімнаті



Рис. 3. Комбіновані рекурсивні системи: 1 - мозаїка у Соборі Св. Софії (Стамбул); 2 - зовнішня реклама

ction (Fig. 2:3).

Visual three-dimensional recursive systems have proliferated in the design of industrial design, furniture and interior environment. Recursive chairs that are

inserted into each one, decreasing at the same time (Fig. 1:4), doors for people of all growth, tables, etc. decide whether a rational organization of space.

The design of modern interior recursion acts primarily by environmental organizations: the room in the room (Fig. 2:5), a project architect Davis Jameson "matryoshka House", in which the internal space so formed that contain each other the most confidence.

Manifestation of recursion in the moment of transition of three-dimensional shapes in planar or otherwise indicate a so-called *combined recursive system*. Thus, the medieval frescoes and mosaics depict donors that the hand of Christ or the Virgin thumbnail image of the house in which the present work (Fig. 3-1). Three-dimensional structure of the building interacts with the system backup - the image plane.

Recursion in today's world there are limits to different environments: an object printing facility and artificial environment are the system copies. Combined recursive systems often have facilities for outdoor advertising, in which the printing image is fed to the flat background space environment (Figure 3-2).

In terms of recursive systems are linear and circular.

Linear recursive system is simple if the system repeats itself in the middle. Depending on the characteristics of its copies can enter and exit at any point of the system. Number of copies and variations of behavior determined by the rules of the system (its purpose, function). Different numbers of copies of the system at different levels of branched defines a recursive system.

Type system, subsystem (copies) of which stem from one another and themselves off or cause the existence of ourselves, we will call a closed circular recursive system. In contrast, an open circular - is a recursive system, subsystem which consistently cause the existence of each other, but not the same. Such modified (essentially) copies can exist and develop in parallel in different ways to interact with each other, when there is a causal chain of behavior.

Different versions of the system behavior up to an open circular systems cause division in the last three subtypes: 1) full unlocked - with the presence of all the elements of the logical chain of copies exist, and 2) unlocked complete with an additional element - a type of circular system in which one of the copies in a separate point in its development by the rules of the system, causing the existence of another - more. Thus, the background picture in the mirror displays characters and objects that are "behind the scenes" (Fig. 1:4, 3) an open part-time - logical chain can be traced, but one of the subsystems deliberately or intuitively removed from the system.

**Conclusions.** Recursion method performs comprehension of reality (in philosophy, mathematics, computing, modeling, culture), it appears as a manifestation (Miz en abim, Droste effect, metaproza) or there is both a method and as a manifestation within one system (design environment ). The nature of existence in space recursive system is polygonal (products of graphic design), three-dimensional (architectural objects), combined (objects outdoor advertising). In terms of existing linear and circular recursive systems, each of which has its own variations. The versatility and variety of system copies the

behavior is a powerful source of finding original concepts. At the present stage of design culture recursive systems are used in construction and design environment, graphic design.

**Prospects for further research.** Further direction of research is to identify compositional features of different types of recursive systems.

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### Аннотация

*Склярєнко Н.В., Гєгер А.Д. Рекурсивные системы в искусстве и дизайне: вопросы классификации. В статье раскрыто понятие рекурсии и особенности рекурсивных систем, сделана попытка их классификации. Визуальная рекурсия представлена как способ гармонизации предметно–пространственной среды. Впервые проанализированы типы визуальных рекурсивных систем (плоскостная, объемно–пространственная, комбинированная) в искусстве и дизайне.*

*Ключевые слова: рекурсивные системы, рекурсия, искусство, дизайн, классификация.*

### Анотація

Скляренко Н.В., Гегер А.Д. Рекурсивні системи в мистецтві і дизайні: питання класифікації: у статті висвітлено поняття рекурсії та особливості рекурсивних систем, зроблено спробу їх класифікації. Розглянуто візуальну рекурсію як засіб гармонізації предметно-просторового середовища. Вперше проаналізовано типи візуальних рекурсивних систем (площинна, об'ємно-просторова, комбінована) у мистецтві та дизайні.

Ключові слова: рекурсивні системи, рекурсія, мистецтво, дизайн, класифікація