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TYPOLOGY OF CODING SYSTEMS IN GRAPHIC DESIGN

The aim of the study is to develop a typology of coded information, namely for barcode and QR-code, for further application in design.

Methodology. Analytical, structural, and complex approaches, as well as art history methods, including comparative analysis, have been used.

Results. The analysis of coded information has been carried out, the typology of coding systems for different types of design has been developed on the basis of the analysis. The functional purpose of barcode and QR-code has been studied. Methods, types, and ways of coding information have been defined. It has been found that coded information with the help of various additions and transformations determines the nature of object perception in different spheres of human life and the variability of their use. Particular attention is paid to the use of code in various types of design. The analysis of coded information in different types of design is presented. The sequence of development of the artistic and graphic process of code creation has been traced. The importance of using coded information for further formation and improvement of design objects has been proved.

Scientific novelty. For the first time, a typology of coded information for different types of design has been developed.

Practical significance. Types and kinds of coded information are described, ways of its visualization are allocated. The results of the study can be used for further study of coded information, as well as serve as a theoretical and practical material for the training of design professionals.

Keywords: code; coded information; barcode; QR-code; code typology; coding systems; coding systems typology.

Introduction. The use of communication and information technologies, global distribution, and unrestricted access of people to the Internet have led to multiple increases in the amount of information. The pandemic has made adjustments and exacerbated the problem of contactless information transfer, especially in public places. The main advantage of barcodes and matrix codes is fast decoding by scanning devices, including the camera of a mobile phone, and the high content of information encoded in the code.

The problem of the need to develop a typology of coded information is related to the processes of formation of society visual culture, which are closely related to the development of science, technology, and engineering. Matrix codes and barcodes surround us everywhere, they can be found on industrial goods, advertising, printing, in the menus of restaurants and cafes, and more.

Relevance is due to the systematization and development of typology for further application. The study covers not only the work of the designer but also involves users where the work never ends.

Analysis of previous research. Today, coding is a promising topic that is intensively developed in software, but from the design point of view, this issue is superficially covered in the literature.

The study of software and mathematical construction of modern communication networks, some aspects of optimizing their structure and parameters were studied in the works of M. Hanks [1], L.I. Malyavkin [9]. Instead, J. Shieh, J. Zhans, Y. Lia, C. Lin [5] reveal the problems of 3D modeling of matrix codes in their work.

Problems of art design ensuring the reliability of diagnosing complex intelligent systems were studied in the works of O.V. Lesiuk, A.O. Dvoretska [8], B.Yu. Zhurakovsky, N.M. Dovzhenko [6], I.V. Opanova [10], Ya.V. Sokol [12].

However, the current work in the field of information coding and transmission does not take into account a number of key features related to human behavior, which should be taken into account when creating code and its implementation in real life. In turn, the basics of information and psychological behavioral aspects of consumer perception were studied by G.A. Kukharev, N.V. Kakhyieva [7], S. Shapovalov [13]. Instead, the visual side of coding information has been left without sufficient attention from scientists.

The above works of scientists on the subject helped to conduct a structured study because their study provided basic information for the research, however, the analysis of all available sources did not reveal a holistic study or development of coded information typology in design.

Statement of the problem. The aim of the study is to develop a holistic typology of coding systems in design on various grounds: by type and type of coded information, by visualization method, by scope, by coding methods, by functions, etc.

Results of the research. Typically, the typology of coding systems is described from a technical point of view, for example, Hill Gareth and Whitty Mark considered the process of embedding QR-code in the image, but did not take into account its appearance for the consumer [2]. Recently, designers are increasingly looking at coding systems as a field for design, and the code itself as a design object. This provides a basis for creating a typology of coding systems from a design standpoint.

According to the type of information coding, codes are divided into barcodes and QR codes (QR-code). Barcoding of information is a bar code that combines the technical means of applying the information to the media and its reading from the appearance of the code [4]. Linear codes are read in one position – horizontally. The most famous are the following linear symbols of encoded information: EAN, UPC, Code39, Code128. Linear codes allow you to encode a small amount of information (20–30 ordinary digits) using simple barcodes, which are inexpensive end products in use.

QR-coding is a matrix coding of information, which is based on a mathematical formula, ensuring the preservation of large amounts of information with a visual image in the form of black pixels on a white background [3]. Two-dimensional code is read using special programs. The code is decrypted both horizontally and vertically. The QR-code can encode numbers, letters and the Chinese Kanji script of up to three pages. The most common two-dimensional codes are DataMatrix, QR-code, Micro QR, MaxiCode, Microsoft Tag, Aztec Code, PDF417. The basic visual structure of any matrix code is formed by three squares, so its main advantage is easy recognition by the camera of a mobile phone or tablet.

Barcodes and matrix codes by type of coded information are linear, the appearance of which are parallel lines of different thickness (Fig. 1), two-dimensional (Fig. 2) and three-dimensional (Fig. 3). Creating them is a complex process that allows you to create a work of art with the help of design tools from the usual codes.

Mostly linear codes are created to identify different products, such as products that are manufactured on an industrial scale. They are most common due to ease of use and low cost. They are also used to mark various documents. To be able to visually check the code, a numeric equivalent is printed below it. There are general requirements for their creation, which define the international standard ISO 15394-2000 [2]. That's why, when creating codes, designers must adhere to the established requirements for the code to be not only beautiful but also effective.

Linear barcodes are usually the key to finding small numerical values and are present in various spheres of human life (trade, accounting, government agencies, banks, etc.). Two-dimensional matrix codes can perform an identical function, taking up much less space, or act as a stand-alone carrier of a large

amount of encoded information. They are presented in a holistic and structured database, for example, two-dimensional codes are used to highlight "Favorites" in Google search results.

Two-dimensional codes can be printed on documents in the form of labels, for example, encoded cargo information, declaration, biometric data, passport data (state application "Action"), etc. Matrix codes are much more resistant to damage than linear codes. It is worth noting that the two-dimensional code components are well recognized by laser scanners and cameras on mobile phones or tablets.

The design of two-dimensional codes makes them suitable for 3D design, including 3D printing, so such three-dimensional matrix codes are used as decorative elements, mainly in public places. They form a different view of the codes. Three-dimensional codes are a new source for the development of coded information. When creating such a code, the encoded information becomes important, because in this case, it is impossible to replace it [3].

3D codes are embedded in different objects or areas with minimal shape changes. They are reliable because they are resistant to damage, difficult to break and reproduce. These codes are not limited to planar surfaces, so they can be embedded in both straight and curved shapes. 3D codes are created from homogeneous materials and scanned with standard devices for reading encoded information. Three-dimensional codes, for example, are created with the help of seasonal plantings of flowers or bushes, formed from any improvised materials, or created with the participation of people. It is worth noting that such codes are best decoded from a height, so they are designed for recognition from high-rise buildings, aircraft windows, and more.

As a result of the research, it has been established that linear and two-dimensional, and three-dimensional codes are divided into graphic, subject, and spatial coded information according to the method of information visualization. The graphically encoded information is represented by flat codes on a three-dimensional plane, which is a stable form of code with the addition of any graphic components (spot, line, silhouette, accent, dot, etc.).

Object-encoded information is placed or created from objects, it will have a relief that can be felt by touch. For example, earrings, pendant or bracelet, a belt with coded information that carries information about the owner, codes made by Lego designers, which inform consumers about new products in the company's products, and so on.

Code, an element of the spatial environment, is formed due to deep-spatial transformations. Such transformations take place with the help of material objects or elements, as well as the intervals of space between them. The sense of depth and space of the code is enhanced when additional elements are added. Spatial coded information involves placing the code in space on a three-dimensional form that can be viewed from all sides.

According to the method of encoding information, codes are divided into alphabetic (system of letters), digital (system of numbers), formulaic (recorded, programmed alphanumeric character systems), iconic (pictures or hieroglyphs that allow you to visually obtain information about the subject), raised dots (system of convex points, Braille code). The coding method is basic because the creation of a visual image of the code is possible only with respect to its integral structure.

The separation of coded information is a basic component of the typology of coding systems. Therefore, *according to their functional purpose*, they can be divided into adaptive, integrative, identification, aesthetic, informative, constructive, communicative, hedonic, and prognostic. Typically, any code combines two to five functions.

The above information is summarized in the form of a block diagram, which is presented in Figure 4.

Fig. 1. Linear code on the package, 2016

Fig. 2. Two-dimensional code in outdoor advertising, 2017

Fig. 3. Three-dimensional code as an element of the interior, 2019
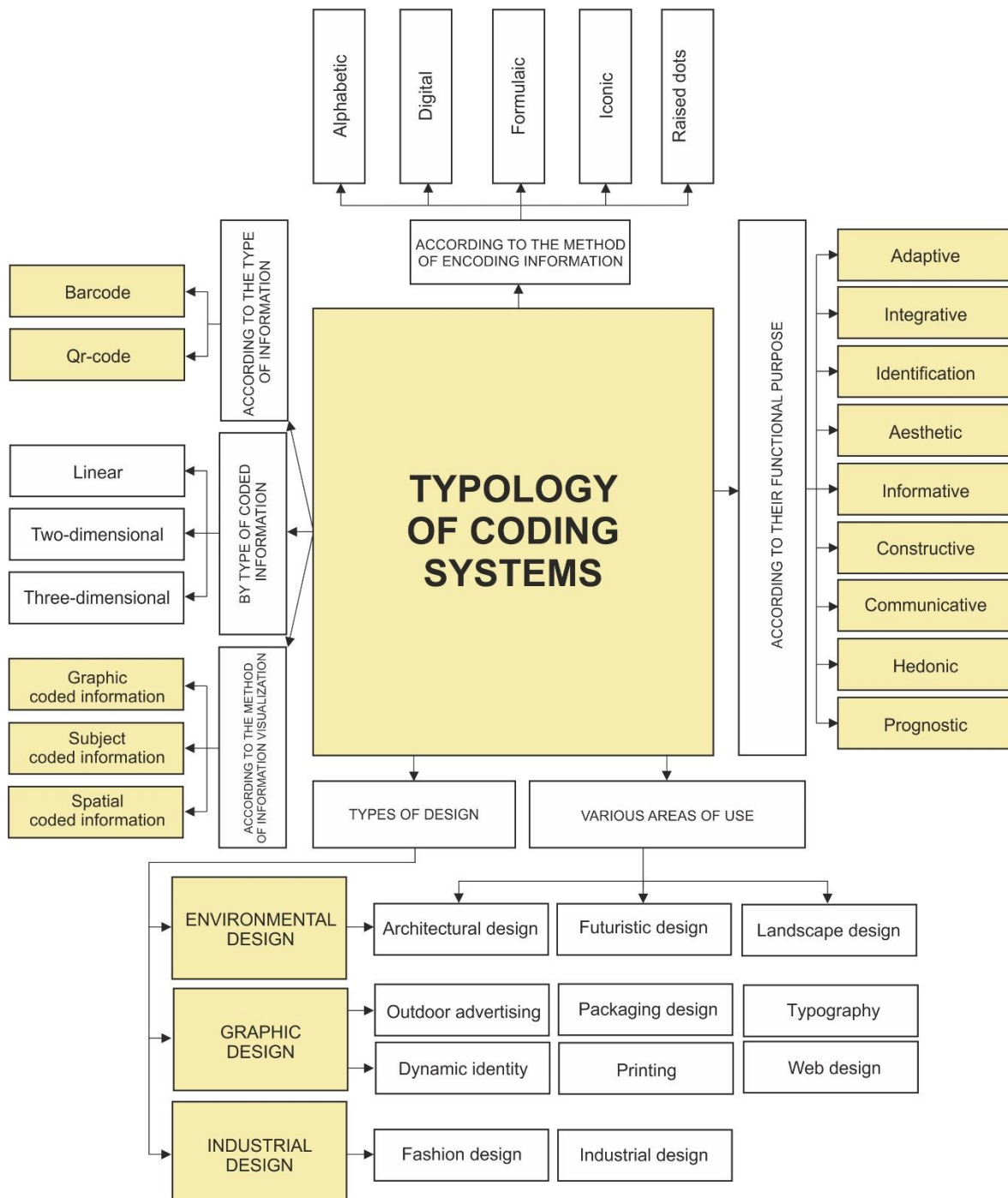

Fig. 4. Typology of coding systems

Coded information becomes an important means of design in all *types of design* (graphic, industrial design, environmental design), which is reflected in various *areas of use* (web design, dynamic identity, outdoor advertising, packaging design, printing, architectural design, industrial design, landscape design, futuristic design, fashion design).

In graphic design, the concept of coding is closely related to web design and the creation of a corporate identity – a dynamic identity. In modern web design, compositions with codes are mostly created in the digital world of technology. They are presented on the sites in the form of coupons, bonuses, discounts, or contact information, mostly represented by matrix codes (Fig. 5a). The set of text, graphics, language indicates the formation of new content of the information message. The emergence of coded information is associated with the development of hypertext navigation. Web pages have become interactive, receiving content (content), which is replaced depending on the conditions and/or actions. Dynamic codes allow you to quickly change information, "adapt" to your visitors, responding to their actions.

Changes in the field of visual communications are associated with the emergence of a new direction of graphic design – dynamic identity [5]. A feature of identity is the ability to use the external characteristics of the object to convey a large amount of information to the user concisely and extravagantly. For example, the dynamic identity of the Tula region, Russia (Fig. 5b). It consists of five matrix codes of different colors, which represent the main activities of the region: projects in urban space, infrastructure, management, culture, information projects. A symbolic icon is inside, revealing the activities of each group of the projects.

Coding is now narrowly used in font compositions (Fig. 5c). It is based on changing the image and color of the basic structure of the letter depending on the direction of work at a particular time. Today, coding is widespread in outdoor advertising, which is developing on the border of information and noninformation designing. Advertising in the environment is one of the most popular types of outdoor advertising. Advertising is placed on billboards, public transport stops, roofs and walls of houses. For example, Victoria's Secret lingerie advertising (Fig. 6a).

Due to the rethinking of code as a means of composition in the design of outdoor advertising objects, it became possible to create dynamics in the objects of the subject-spatial environment. This is due to the use of dynamic contextual properties of the environment, such as a pedestrian crossing in the form of a barcode, which is located near the mall, informing people about the discounts that apply today. Coded information is the basis for packaging design. One of the classic ways to implement the code in the package is the ability to identify it at the checkout for faster customer service. The code finds its external manifestation in the graphic means of packaging design, creates a unity of product and design code (Fig. 6b). The emergence of dynamic codes is becoming a new trend in the design of printing products (Fig. 6c).

Industrial design involves the use of code on a large scale. Such developments are usually made in industrial conditions. A common trend is the use of coded information in the design of industrial design objects (Fig. 7a). In fashion design, codes are often used on the clothes or bodies of models (Fig. 7b) to better reveal the designer's intention. The challenge is to make the code not only aesthetically pleasing but also easy to decode.

In the design of the environment, the code image on architectural objects is used exclusively for advertising purposes, mainly on large LED screens (Fig. 8a). Landscape design objects are created by people to spread information that can be seen from a height (Fig. 8b). The use of codes in futuristic design has become widespread due to the COVID19 pandemic as it is an effective way to transmit large amounts of information contactless through small code images, which, as practice shows, is quite effective (Fig. 8c).
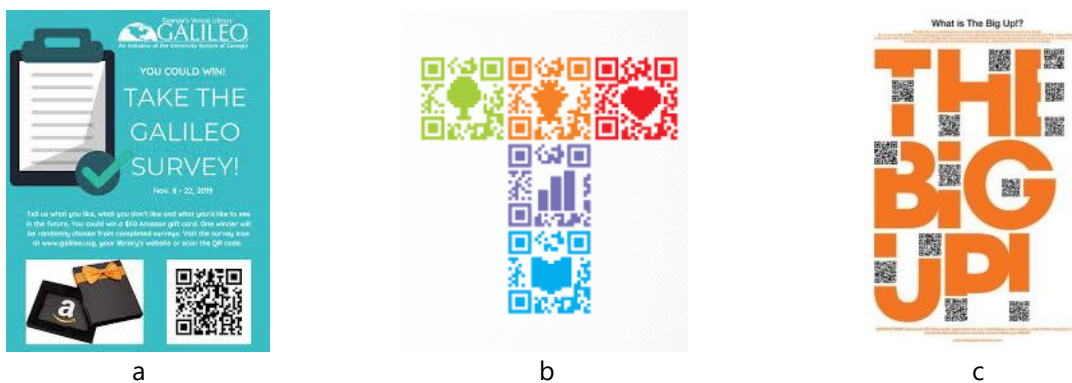
a   b   c

Fig. 5. Examples of codes in graphic design: a – discount coupon of Amazon online store, 2017; b – dynamic identity of the Tula region, Russia, 2019; c – font composition of QR-codes, Big Up, USA, 2020

a   b   c

Fig. 6. Examples of codes in graphic design: a – underwear advertising by Victoria's Secret, 2018; b – packaging of McDonald's products with the use of codes, 2020; c – Card electronic business cards with the use of code, 2017

a   b

Fig. 7. Examples of using codes in industrial design: a – room design based on the matrix code, Antoine Peters, 2017; b – outerwear, designer Julie Helles, 2018

a   b   c
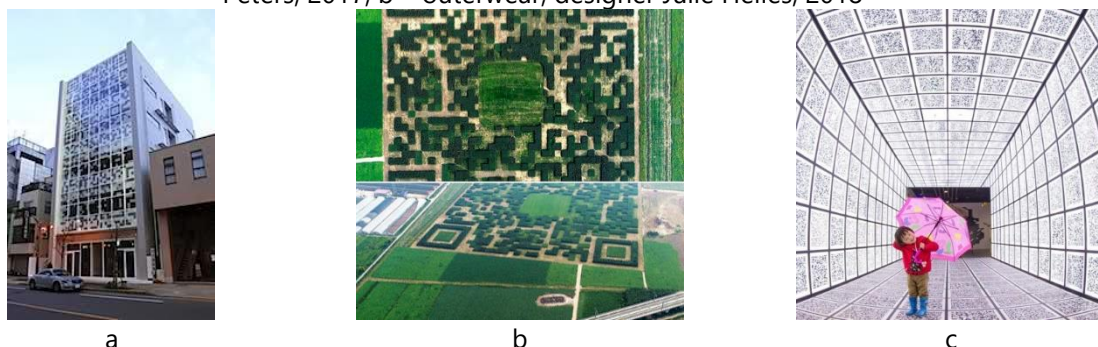
Fig. 8. Examples of codes in the environmental design: a – House N Building, Tokyo, Japan, 2017; b – landscape code, Baoding, China, 2017; c – a library with a game room based on QR-codes, Jinan, China, 2019

In the study, the coded information has been considered as a field for design, and the code itself is presented as a design object. This afforded ground to a typology of coding systems from a design standpoint.

Conclusions. The study shows that the codes do not lose their relevance today. Line codes are widely used in commerce to identify goods, and matrix codes are used in public places to distribute large amounts of information to visitors, such as a menu encoded in a QR-code. Thus, it has been researched that the typology of coding systems includes types of coded information (barcodes and QR-codes), types of its coding (linear, two-dimensional, and three-dimensional), and ways of visualization of coded information (graphic, subject, and spatial coded information). These components form a holistic view of the code as a holistic system. They are based on methods of coding the information (alphabetical, digital, formulaic, iconic, raised dots) and complement the functions (adaptive, integrative, identification, aesthetic, informative, constructive, communicative, hedonic, prognostic). Codes are used in graphic design, namely in web design, dynamic identity, typography, printing, outdoor advertising, packaging design. In environmental design, they represent architectural, landscape, and futuristic design, while the industrial design is represented by industrial art and fashion design. The typology proves that today coded information is a promising direction in design. A holistic typology of coding systems has been developed, which allows further research in the field of graphic design.

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ТИПОЛОГІЯ СИСТЕМ КОДУВАННЯ У ГРАФІЧНОМУ ДИЗАЙНІ

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Мета дослідження – розробити типологію кодованої інформації, а саме для barcode та QR-code, для подальшого застосування у дизайні.

Методологія. Застосовано аналітичний, структурний та комплексний підходи, а також мистецтвознавчі методи у тому числі порівняльний аналіз.

Результати. Здійснено аналіз кодованої інформації, на основі чого розроблено типологію систем кодування для різних видів дизайну. Досліджено функціональне призначення barcode та QR-code. Визначено методи, види, типи та способи кодування інформації. Виявлено, що кодована інформація за допомогою різноманітних доповнень та трансформацій визначає характер сприйняття об'єктів у різних сферах життєдіяльності людини та варіативність їх використання. Окрему увагу приділено сферам використання коду у різних видах дизайну. Представлено аналіз кодованої інформації у різних видах дизайну. Відстежено послідовність розробки художньо-графічного процесу створення коду. Доведено важливість використання кодованої інформації для подальшого формування й вдосконалення дизайн-об'єктів.

Наукова новизна. Вперше розроблено типологію кодованої інформації для різних видів дизайну.

Практичне значення. Описано види та типи кодованої інформації, виділено способи її візуалізації. Результати дослідження можуть бути використані для подальшого вивчення кодованої інформації, а також слугувати теоретичним та практичним матеріалом для підготовки фахівців з дизайну.

Ключові слова: *код; кодована інформація; barcode; QR-code; типологія коду; системи кодування; типологія систем кодування.*

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