

Living Visual Communication Design Toward to Sustainable Development: Conceptual Framework and Ecological Strategies



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ABSTRACT

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In this study, the attention is focused on the essence of integrated living visual communication design. It contains plant and biological components that cause the design system transformation and ensure dynamic visualization of the images. The methodological concept of the study is based on systematic and interdisciplinary approaches, which allow to assess living visual communications as integrated design systems. The author's methodology includes analysis and systematization of examples; the formation of the integrated design model is based on an associative-metaphorical approach and substantiation of development strategies of ecological visual communications. The study resulted in the development of two groups of visual communication systems, namely green visual communications and biological visual communications. Their visual language was created on the base of such processes as landscaping, facing, encapsulation, energy recovery, and self-organization. The developed model of integrated design of living visual communications allows to put together artificial and natural components using their associative similarities. This model is considered an instrument for decision-making that is aimed at the implementation of ecological innovations into the design of dynamic visual communications. This study broadens the possibilities of using the living organisms in design and substantiating eco-strategies of communication design development in the context of forming designers' creative potential.

1. INTRODUCTION

The formation of communicative space in today's changing environment is associated with the search for new methods of effective visualization of information. Nature, whose objects are used as a model [1] in various spheres of human life, including science, art and design, helps to solve this problem. In the last decade, a radical restructuring of visual communications, which is associated with the active introduction of living natural components, such as green plants, animals, bacteria, has been witnessed. Such creative images attract the attention of consumers and provide an increase in visual communication [2]. In addition, the presence of living organisms and plants in design products today is assessed not only as an aesthetic experience, but also as an innovative way to reveal the ecological content of design [3, 4]. It makes designers sustainability-oriented and responsible for creating the harmony between artificial and natural environments [5].

The essential issue, which is raised in new case studies, is the ways to use design as a possible driving force that has a positive impact on the environment [3, 6]. Most researchers focus on studying the role of green technologies in the urban environment [7], including green walls [8-10] and green roofs [11]. Other researchers consider nature as a source of inspiration to create living materials, which are becoming

more popular in modern design [12]. Designers integrate living organisms such as bacteria, algae, fungi and plants, creating a new design landscape where biology and design combine to explore an alternative design perspective with living organisms [4]. As a result, the attention is now focused on a gradual transition to more environmentally friendly practices towards design for environmental sustainability [3, 4, 13, 14]. For the present, such scientific studies include the fields of materials science, industrial biotechnology and design of industrial products, but they are not related to the design practices in the field of visual communication. Moreover, scientific research proves that in the conditions of unstable development of society and variability of the external environment, strategic planning of development of living design systems becomes necessary, minimizing the budget and use of natural resources.

In addition, to form the theoretical basis of the study it is necessary to analyse the information in various areas at the intersection of biology and design, including Biodesign [15], Green Conceptual Design [14], Green Advertising Design [16, 17], Green Architecture [18], Green Marketing [19], and Bioprinting [12]. The analysis and evaluation of a significant number of sources of an interdisciplinary nature allow to gather together scattered examples of living visual communications – from art installations and advertising

exhibitions to industrial designs and landscapes. They demonstrate a wide range of possibilities to implement live organisms to the products of communicative design that will provide the effective long-lasting existence of visual communication design and help to harmonize the interaction between a person and the environment. Furthermore, such an amount of information defines the focus of the research as the necessity of the conscious design of harmonious interconnections between people and the environment and emphasizes pronounced ecological value and powerful social and communicative influence. On the other hand, there are still the issues regarding the creation of the theory of integral design of visual communication with the focus on the eco-innovations. Thus, the objective of the case study is to form the concept of integral design of live visual communications and to explain the content of eco strategies, which are aimed at sustainable development. Therefore, the focus is transferred to three research tasks.

The first one is to analyse the ways to create live visual communications. The analysis of dynamic interactions and their diversity will allow to expand the understanding of the influence of eco-components on the visualization of images.

The second one is to form a model of integrated design and emphasize the promotion of ideas for raising environmental awareness and increasing social communication through the visualization of natural interactions.

The third one is to substantiate eco-strategies for the development of visual communications, which help to outline the most acceptable areas of future design activities using components of wildlife. Understanding the essence of living experience can create a basis for a large-scale investigation research on the effectiveness of perception and impact of living visual communications on the psychological and emotional state of human being and the environment.

Moreover, the work will contribute to the development of the theory of design of dynamic visual communications and at the same time, it will be an effective way to stimulate the environmental intentions of society and create environmentally conscious attitude to the environment on a global scale.

2. METHODOLOGICAL CONCEPT

The author's research methodology is based on an interdisciplinary approach and a systematic vision of the processes of human interaction, nature and design. It contains 3 stages.

1) The first stage is the collection, analysis and systematization of samples of different types of visual communications, including living natural objects. Our study covers 233 samples that use viable organisms. All of them come from different countries of the world in the last 10-15 years and are presented on the Internet as advertising materials. All cases are grouped by type of living organisms in the objects of visual communication: 1) with plant forms, in particular with moss (N = 28), grass (N = 44), trees, shrubs, fruits (N = 62), seeds (N = 42), landscapes (N = 30); 2) with animals, including insects (N = 11), fish (N = 1), birds (N = 2), mammals (N = 2); 3) with bacteria and fungi (N = 11). Despite the small number of samples, they are important practical resources and tools for the analysis and construction of innovative design spaces aimed at harmonizing the relationship between man and nature [20]. In addition, each

example is a unique embodiment of a dynamic visualization of problematic issues.

At this stage, system thinking and system analysis are important [21]. They allow us to evaluate live visual communications as integrated design systems that have an interdisciplinary nature.

2) The second stage of the research is aimed at identifying ways of dynamic visualization of images, which are formed on the basis of the integration of objects of artificial and natural environment. The formative changes of living organisms, which are visualized through colour, texture, size, as well as their behavioural transformations, including movement, food and reproductive processes, are pointed out at this stage. An important point of the study is the analysis of dynamic interactions in the context of natural laws, based on the use of the system dynamics approach [22]. Described ways of information visualization will allow to formulate the concept of ecologically-oriented dynamical message.

In addition, the attention is focused on the conceptual analogies between objects, events or structures [23], which lead to the formation of a dynamic visual image. The similarity between artificial and natural objects based on an associative-metaphorical approach is evaluated in the study. The obtained information allows to create a model of integrated design. This model is the first step towards the conceptual formation of eco-strategies based on the combination of radically different scenarios of coexistence of artificial objects and the natural environment.

3) The third stage is the creation of strategies for ecologically oriented development of society. They are based on imitation of the form, function, activity of nature processes and can help designers to develop eco-projects [1]. This contributes to the formation of systematic design thinking as part of the project process, which will change the consciousness and actions of consumers in relation to the environment.

3. RESULTS

As a result of the study, two groups of living visual-communicative systems, which differ in the type of living organisms included in their composition, are pointed out. These are green visual communications formed on the basis of plant forms and biological visual communications as a result of involving living organisms, in particular bacteria, fungi, sets of insects (ants, bees, flies, and cockroaches), fishes, mammals (Table 1) in the process of design. A brief description of the ways of forming their visual language is given below.

Table 1. Some examples of living visual communications

Example	Description and source
	First in the world Green Water Billboard, Pasig river, Philippines, Manila, 2015 [24]
	Gillette World's Biggest Shave, London, Great Britain, 2011 [25]



Tree – Book – Tree “Mi Papá Estuvo en la Selva”, made by Gusti and Anne Decis, Argentina, 2015 [26]

Glowing Billboard *Tropicana*: Energy Naturelle powered by oranges, DDB Paris, Paris, France, 2011 [27]

Germ Board, Lifebuoy Magic, Uruguay, 2015 [28]

City light with mold “Knowledge becomes obsolete. Come for fresh”, Kyiv, Ukraine, 2018 [29]

First in the world billboard made of living bees “Save Our Swarm”, Great Britain, Devon, 2010 [30]

Billboard “Nouvelle Soft” is a huge feeder with seeds for birds, Great Britain, 2014 [31]

Advertising on sheep, farmer James Metcalfe, Great Britain, North Yorkshire, 2011 [32]

the idea of natural products by decorating with live plants (e.g., a billboard made of fresh McDonald’s salad; a Beck’s beer poster, etc.) or by correcting the shape of the three-dimensional structure of a natural object (e.g., trimmed bushes in the form of large cups of Lipton tea). Designers also implement creative concepts by trimming grass coverings (e.g., we see associations with shaving in advertising BiC, Japan, 2009 and Gillette, UK, 2011 [25]).

Another way to use the facing is to supplement existing natural objects, including trees or shrubs, with artificial elements. Then plant forms are transformed into contextual green design systems, evoking certain associations (e.g., a fork is used instead of a tree trunk in the advertising of a vegetarian restaurant Tibits, Switzerland [35]).

The method of facing also allows to focus on the vital processes of biological organisms in order to study them. For example, demonstration of the behavioural mechanisms of ants (Sugar Free Ants Campaign, India [36]), cockroaches (billboard with the letters E.Coli, Dallas, USA, 2011 [37]), fish (advertisement of Fisch Franke restaurant “Fresh as can be”, Frankfurt, Germany, 2009 [38]) has become a clear example of the formation of environmental thinking through design. In addition, designers use live animals and insects as a mobile free innovative visual media (flies at the Frankfurt Book Fair, Germany, 2009 [39]; colour advertising on sheep’s bodies, UK, North Yorkshire, 2011 [32]).

In recent years, visual communications have evolved into large-scale environmental projects aimed at protecting insect populations around the world. Important eco-design systems are hotel billboards for bees and butterflies in the Netherlands and Sweden (e.g., McDonald’s bee hotels, Sweden, 2019 [40]), mini-reserves created in 2019 on the green roofs of Utrecht bus stops in the Netherlands, which support biodiversity, retain fine dust and rainwater.

Method of encapsulation. One way to create living visual communications is to encapsulate living biological cells in an inanimate matrix. Recent developments in bioprinting methods outline the prospects for biodesign [12]. In this way, green moss graffiti is created in design and architecture [18]. Moss is regenerative, meaning it regenerates, develops, changing its spatial organization over time. In the design of printed products and some industrial products, such as business cards, books, children’s toys, writing utensils, etc., a common way is to insert live seeds into the design system. This allows to change their structure and functions during or after the use (e.g., trees can be grown from the book “Mi Papá Estuvo en la Selva”, Argentina, 2015 [26]).

The method of energy recovery. Living organisms are a kind of energy system, the power of which designers can use to visually communicate with consumers. For example, a giant multi-cell battery of oranges, which illuminates the sign, experimentally proves the possibility of obtaining energy from plant forms [27]. However, the method of energy recovery is used as an innovation in design systems with biological organisms [41], and is a promising tool for the development of renewable energy sources based on the synergy of scientific methods [42].

The method of self-organization. The main feature of the activity of biological organisms is the ability to self-organize, which becomes a design characteristic of the visual-communicative system. In this case, the study is focused on the synthesis of scientific and artistic concepts, based on the scientific experience of various specialists.

Live bacteria and fungi have the greatest potential for

3.1 Methods of visualization of living visual communications

Method of landscaping. A new direction in the design of visual communications was the use of green design systems for vertical and horizontal landscaping. Along with the aesthetic and advertising function, they provide important ecosystem services, promote biodiversity and social values [33]. The use of other green visual communications results in improved environmental performance (e.g., Coca-Cola and WWF air purification billboard, Philippines, 2011; the horizontal water billboard “Clean River Soon” that absorbs wastewater and treats the Pasig River in the Philippines, 2015 [24]).

The method of landscaping is also used for the formation of landscape visual communications, which can be read from a height. Green trees and various species of plants are used as a material with a unique texture for creating thematic compositions, including inscriptions or images on large areas (e.g., a picture made of rice sprouts of different varieties, Inakadate, Aomori, Japan [34]).

The method of facing. This method of visualization is common in the design of both groups of living design systems and is represented by the largest number of samples. Most green design systems of a commercial nature seek to convey

creating dynamic attractive forms of visualization as material for dynamic visualization of information. The principle of living aesthetics is taken into account in the design process and is used to denote aspects of life, in particular the type, degree and duration of changes in a living artefact over time [4]. The first example of living biological visual communications in the world was a billboard for Steven Soderbergh's film "Contagion", developed by designers, microbiologists and immunologists in 2011 [4]. The demonstration of unusual shapes and colours is associated with a dynamic but controlled process of structural and colour transformations of bacteria. Such changes last only for a certain period of time due to the life cycle of microorganisms. However, transformations of the visual image perfectly convey the content of the concept, increasing the effectiveness of perception (e.g., Germ Board, Lifebuoy Magic, Uruguay [28]). Consequently, the associativity of the figurative solution that conveys the socio-cultural value of the visual message comes to the fore. For example, the idea of aging information and the ephemerality of knowledge was conveyed by Ukrainian designers in the form of city lights with the mold "Knowledge becomes obsolete. Come for fresh" in 2018 [29].

An innovative way to obtain a dynamic information message is to use sets of ants and bees, which are self-organizing systems with complex collective behaviour. The most common model of self-organization of these social insects is to increase the threshold value of the stimulus, in particular the pheromone or changes in food resources [43]. Thus, ants and bees are used by designers as a material for "painting" (e.g., ants in the advertisement of natural sugar substitute Sugar Free, India [36]; the world's first bee billboard "Save Our Swarm", UK, 2010 [30]). A similar way of dynamic visualization of information according to natural laws is typical in living design systems that use birds in the UK [31].

Therefore, the ways of information visualization, which are used while designing dynamical visual communication systems of two groups, form the unique language of informative message. The common thing for the live visual communication creation is the successful use of possibilities of natural potential, namely, aesthetic appearance, processes of growth and regeneration, behavioural mechanisms, energy capacity of selected living components. However, the selection of the most suitable way of visualization is based on the law of associative similarities between the objects of artificial and natural environments, which requires the collective co-creation by specialists in various fields. So, each method of visualization described is a new problem for research, which is distinctly systematic and requires the use of design thinking aimed at sustainable development.

3.2 The model of integrated design

In order to universalize the process of creating dynamic visual communications, an integrated design model was developed (Figure 1). Green components and biological organisms in the structure of visual communications are considered as dynamic and temporal living materials open to change [41, 44]. They provide the formation of the visual language of living artefacts [4].

The model demonstrates the possibility of integrating artificial and natural objects based on associative similarity. Associations with the form, functions and content of the communicative processes of natural objects allow the use of

appropriate visualization methods to implement the concept. The parameters determined by the laws of nature, are considered as a matrix suitable for interpretation according to the basis of associative similarity. Due to this, it is now possible to model various forms of dynamic visual communications at three levels of design: 1) elemental; 2) structural; 3) behavioural. Consider the design processes on each of them.

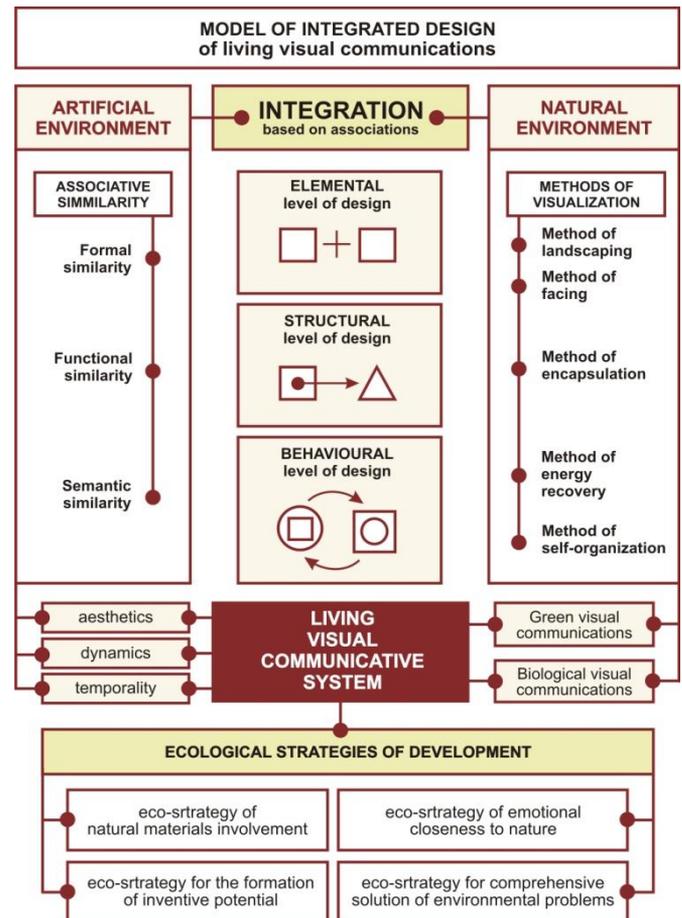


Figure 1. The model of the integrated design

The elemental level of design allows to form an integrated design system by combining material and natural objects on the basis of formal similarity, meaning analysis of the appearance of objects. The content of the elemental level is manifested through the successful use of composite tools and techniques for landscaping and decoration, which demonstrate the long-term visual dynamics of the natural development of a living organism.

At the structural level, parameters that reflect the structure of the event or process have the important role. In this case, the dynamics is a consequence of the functional transformation of the design system. The content of the structural level allows us to consider objects and phenomena in a system of a higher hierarchical level. Designs at this level are characterized by the involvement of interdisciplinary links on the principles of mutual penetration using encapsulation methods. An illustrative example is the possibility of growing plants from seeds added to printing and industrial products, which reveals the multifaceted potential and multiplicity of functions of the newly created design system. Functional similarity (processes, forces of interaction) is the basis for creating a concept. The interaction of natural and artificial

components allows to transform space due to the formation of a dynamic space-time structure, the development of which is synchronous with natural processes.

Behavioural level of design is formed on the basis of comparison of associative image and behavioural mechanisms of living organisms. At this level, designers use the features of self-organization of living organisms, creating a continuous pattern of events that becomes part of the formation of visual and communicative space. The pattern is a set of processes related to content compositionally, constructively and functionally during the interaction with the environment and human. Changing the parameters of the development of living visual systems over time, i.e. temporality, poses a problem of maintaining the living environment by providing nutrients [4]. This will extend the life of visual communications and ensure the integrity of the perception of space, forming an emotionally coloured experience [45].

The variability of living design systems and their ability to adapt to a constantly changing environment is provided by the methods of transformation. Dynamic transformations are associated with the transformation of individual elements or their combination within a defined structure, transformation of the integrated structure and transformation of content and image. At each level of design, the researched methods form a dynamic visual image, which becomes simultaneously a field for communication, a powerful tool for versatile visualization of information and a basis for larger-scale interdisciplinary research towards sustainable development.

4. DISCUSSION

Living visual communications are evaluated as a fourth-order design system that includes objects and interactions whose properties reveal essential qualities and capabilities [21]. Such visual communications become an integrated fragment of natural, social and cultural reality. They become dynamic due to the natural growth, development and behaviour of eco-components and are seen as an integrated part of the communication strategy.

Knowledge of the provisions of integrated design will harmonize human relations with the environment due to the fact that humanity today is faced with the problem of a new organization of society. This involves the formation of new thinking and behaviours conducive to the environment, aimed at environmental sustainability and sustainable development of society [3, 19, 35]. Therefore, the search for and formation of environmental strategies for the development of communicative design as part of the model of integrated design is one of the main tasks of modern design theory and practice.

4.1 Ecological strategies of the development of visual communications

Eco-strategies are considered as a holistic set of measures of an innovative nature aimed at increasing the environmental potential of visual communications for the sustainable development of society. Four types of environmental strategies, which are conceptually united by the idea of ecological innovations aimed at reducing the negative impact on the environment by radically changing the project process, are distinguished in the study (Figure 1).

1) Strategy for involving natural materials in design. The

peculiarity of this eco-strategy is the use of natural resource base for finding creative design solutions that strive for natural versatility. Eco-design is based on the desire to assimilate with nature, a significant increase in the rate of natural resource restoration, conservation of biological objects and their habitats. Therefore, the developed model of integrated design can be adapted to a specific area. Since the uniqueness of the natural characteristics of the environment determines its inherent design solutions under certain conditions, it is now possible to predict systemic environmental changes in a broader space-temporal context and features of emotional and aesthetic human perception of the subject-spatial environment. Such steps towards the integration of natural, aesthetic and socio-ecological interactions form the concept of sustainable development.

2) Strategy of emotional closeness to nature. The formation of ecologically oriented behaviour by means of design is based on taking into account the positive effect of natural components of the design system on the psycho-emotional state of man [16]. Emotional closeness to nature is considered to be the strongest emotion in the relationship between people and nature; it forms a positive mood and has a calming effect [46]. This strategy speaks to the visual emotional appeal of modern live visual communications and is an indicator used for predicting friendly behaviour in the environment. For example, people's attention is drawn to the unusual appearance and behaviour of living organisms in information messages, the ability to pet animals, feed birds, water the flowers on billboards, or plant seeds and care for them.

Within the framework of this strategy, the processes of integration of science, art and design based on an interdisciplinary approach can become a promising direction. This will lead to the emergence of integrated bio design systems that have a powerful art-relaxation potential. These include creating drawings based on bacteria, observing fish, bees or birds, and more. This strategy can be the basis for large-scale research of ecological design objects in the direction of art therapy and art relaxation.

3) Strategy for comprehensive solution of environmental problems. This strategy involves the systematic design and evaluation of environmental solutions through live visual design systems. They become part of universal natural processes of purifying air, water, and improving the general ecological situation. Green roofs, green lawns and green walls are some of the many tools to mitigate and eliminate the impact of human activities on the environment. The positive impact on ambient temperature, noise level and air quality, which contributes to the promotion of human health, is one of their advantages [8, 9, 47].

Research and development of natural processes, which demonstrate the synergistic effect of the underlying idea, allow to form the foundations of environmental thinking, behaviour and culture and unobtrusively convey them to the consumer. Thus, the design of living visual communications, aimed at sustainable development, allows to work for the long-term perspective, helping to solve environmental problems [19]. As a result, this study reveals the ecological essence of the systematic design of dynamic visual communications.

4) Strategy for the formation of inventive potential. The use of biological organisms and environmental technologies can be useful for the formation of inventive potential [3]. Natural objects and phenomena play an important role in this as a source of inspiration for solving problems. Bio-inspiration underlies the broader category of Bio-inspired Design, which

uses the features of biological systems to create visual analogies [1, 48].

In the proposed model of integrated design, bio-associations are used not only in the context of environmental aspects of design but a wide range of socio-cultural aspects of design is taken into consideration. Therefore, living systems of visual communication are considered as experimental spaces, suitable for research, creative experiments and social interactions at the same time.

In addition, the strategy of building inventive potential is connected with rethinking the process of educating designers, which requires the integration of basic and applied sciences in order to create environmentally friendly technologies [49]. The designer becomes a mediator in the field of sustainable development, forming a new design path that can address global challenges [5, 50]. The strategy aims to encourage designers to intensify systematic biodesign thinking [4], which will open opportunities for future research.

Thus, each eco-strategy can be considered as a template that helps to set the direction of design, which designers will perceive as a guide to action. Such an approach will lead to rethinking design as an interdisciplinary practice, that requires the involvement of scientists from various fields of life in the implementation of design projects.

5. CONCLUSIONS

In this work the essence of designing living visual communications, in the structure of which plant and biological components are integrated, has been revealed. The natural features of eco-components determine the dynamic, temporal and aesthetic properties of two groups of living design systems, such as green visual communications and biological visual communications. It had been proved that nature as a source of inspiration allows us to use the possibilities of formative and behavioural transformations of living organisms for dynamic visualization of information messages. The formation of the visual language of each living design system is a unique design experiment and covers the following methods: landscaping, facing, encapsulation, energy recovery and self-organization. These provisions underlie the model of integrated design of living visual and communication systems.

The possibility of creating various forms of dynamic visual communication by integrating objects and processes of artificial and natural environment at the elemental, structural and behavioural design levels is substantiated in the work. This is based on associative similarity in appearance (formal similarity), functions and behaviour (functional similarity) and essence (semantic similarity) using different methods of visualization of the artistic image. The developed model radically changes the perception of visual communications from individual objects to long-term dynamic system processes that form alternative ecological visual-communicative spaces. As a result of understanding the design practice, eco-strategies for the development of communicative design, which can direct the activities of designers to systematically solving global environmental and social problems by means provided by nature, are offered.

Along with this, designing green visual communications and biological visual communications requires taking into account the following limitations:

- the necessity of involving a team of specialists from various fields, including designers, ecologists, biologists,

immunologists, and others for development;

- experimental limitations that do not always immediately give the expected result, but require additional scientific research, creative searches and analysis of social interactions;
- creation of appropriate conditions to support the development of living organisms and constant care for the visual and communication system.

This study is the basis for a larger study on the effectiveness of living visual and communication systems and their impact on human behaviour and consciousness. The possibility to draw attention of researchers, practicing designers, teachers and students to the problems of using living organisms in the design of visual systems as one of the ways to overcome the disharmony between the natural and material world is a valuable contribution of this study. It lays the foundations for a discourse aimed at fostering sustainability-oriented behaviour through project activities. Consequently, the study is also a starting point for further discussion of future research on the theory and practice of communicative design towards sustainable development.

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