

A New Biomimicry Tool for Visual Design: Three Categories and Their Suggestions

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Abstract

Designers are always looking for inspiration for their designs, and many disciplines use natural inspiration to innovate, a practice often referred to as "biomimicry". This paper reviews the existing literature on biomimetic design thinking, discusses the use of biomimicry as an auxiliary tool for visual designers' creative development, and puts forward three directions and suggestions for the visual design of biomimicry tools. This provides visual designers and students with a new thinking to expand the space for creative development.

Key words: biomimicry, visual design, tool, analogy

Introduction

The creative and innovative potential of biomimicry [1] has made it identified as a promising subject for future environmental response development [2] [3]. In the past ten years of research, biomimetic design has been generated by bionics in engineering, architecture, industry and other disciplines (Bar-Cohen, 2005), and some thoughts on biomimetic design have been confirmed [4] [5] [6] [7], all these studies provide a certain basis for bionic design. Based on the previous research on biomimetic design, this paper reviews the biomimetic design methods, processes and tools, as well as the future trend of biomimetic design, so as to provide a basis for the discussion of biomimicry as an auxiliary tool for the creative development of visual designers.

Biomimetic Design Thinking

Biomimetic (Bionics/ BIO-inspired) design is to establish a link between biology and related disciplines, and find solutions and methods to solve problems through the exploration and interpretation of life phenomena [8]. The following is a review of biomimetic design methods, processes and tools.

A. Design Methods

The method of biomimetic design thinking can be defined from the broader sense and narrow sense perspectives. The broader approach is to make cross-domain analogies of biological knowledge, while the narrow approach is to summarize laws and principles from nature.

Broader Sense Biomimetic Design Method

In a broader sense, biomimetic design method uses behavior, function, color and appearance as connecting elements to make cross-domain analogy of biological system knowledge [9] [10] [11] [12], knowledge transformation of biological knowledge [7], namely the transformation of natural data into various human life application designs and inventions [13]. In terms of biomimetic design, analogy method can help generate innovative design concepts [14] [15], the key is to find a link between design problems and biological prototypes through similarity (analogy), so similarity theory to study similar phenomena is an important reference theory [8].

Through the analysis of the bionic design cognition research and the general design cognition literature, it is found that there will be an analogy distance between the design problem and the biological prototype [14] [15] [16] [14], that is, surface similarity analogy (close distance analogy) and surface dissimilarity analogy (long distance analogy). When discussing the application of analogy in bionic design, Benyus [1] divided biomimetic design into three levels, from shallow to deep biomimicry (i.e., form, process and ecosystem). Shallow bionics form the first layer; The second level is the imitation of natural processes; The third level is to simulate the natural ecosystem, that is, in the design process, the natural environment will not be damaged from the extraction of raw materials to the update or reuse of products [17]. Close analogies are mostly kept in the shallow layer, while deep biomimetic design applications may need to dig out more remote analogies. Some biomimetic design researchers argue that "if there is no deeper and more sensitive connection between human beings, nature and the built environment, any suggestion of sustainable design will ultimately be incomplete and therefore unsuccessful" [18].

In the process of analogy, different knowledge structures of different disciplines, different knowledge emphases in different fields and different functional terms connect the cross-domain knowledge transfer and communication creation [10] [12] [19] [20] has become a challenge for all disciplines to face the biomimicry problem. For example, the "transport" function may have different meanings in biology. Although plants do not move, they can be used as a source of transportation inspiration by dispersing seeds [21]. Some researcher found it necessary to affix "creative development" to "functional state" with a fixation system [21] [22]. This biomimetic design method is widely used in the field of engineering design.

Narrow Sense Biomimetic design Method

In a narrow sense, Biomimetic design method is the law and principle of beauty that human beings observe, analyze and summarize from the nature, which can be specific to the simulation of biological ecology, behavior, function, material and system. They are mostly close superficial imitations: for example, Greek philosophers discovered that nature contains principles of harmony, opposition and order; The Egyptians discovered the concept of proportion in crystals, shellfish, and flowers. Sullivan (1956-1924), an architect, puts forward the concept of form follows function [23].

B. Design Processes

Biomimetic design processes are based on two starting points with different terms : (1) problem-driven processes [24] [6], top-down processes [25] and Biomimetics by analogy [19]. (2) solution-driven process [6] [24], bottom-up processes [25] and biomimetics induction processes [19]. The former starting point is the "from problem to biology", process. For example, the head of Japan's bullet train solves the noise problem by redesigning the kingfisher's beak to make it quieter, faster and more energy efficient [26]. After a point of departure from the observation of the nature is the process of "from biology to application", a help understand, lotus self cleaning ability has been found to be using its skin small bumps, make the drip collecting pollutants after rolling down from the leaves, the biological effects can design application on self-cleaning paint, glass and textile. Both of these starting points may involve iterative cycles from problem to solution (or solution to problem), but they follow two different patterns [6].

From Problem to Biology

The biomimetic design process of "from problem to biology" is the starting point for designers to identify a problem and solve subsequent problems [4] [6] [19], they usually use function terms to describe their problems (for example, stop bullets), in order to find the biological source of inspiration, designers will be given to issue "biology", namely to a wider range of biology terms definition (such as the biology is what features they can prevent, bear and heal the damage caused by impact?) . Designers use a lot of strategies, based on the problem of "biological", looking for biological sources associated with design issues at hand, then the study of biological information in more detail, and then extract solution target problems related important principles and mechanisms of abstraction, and applied to the design of experiment solution [27].

From biology to application

The biomimetic design process of "from biology to application" [4] [6] [19] is inspired by the observation of nature, which led to the emergence of technology. Designers start from a biological interest source, understand or study their biological sources to the depth necessary to support the extraction of deep principles from them; And then they found human problems, and this principle could be applied to these problems; Finally, they applied this principle to develop a design solution to solve the identified problem [27].

Design processes in the "from problem to biology" category are mostly used to help inspire and solve practical problem applications, while the "from biology to application" category is mostly used to promote innovation and development. In nearly 10 years of observation, Cohen [20] from the literature reviewed the multiple biomimetic design process, the repetition of the biomimetic design process found literature stage and Sartori [28], and other people's research is consistent, whether it is started in the problem or solution, the process of the common stage includes: problem definition, biological system search, system analysis and migration.

C. Design Tools

Designers usually do not store a large amount of biological knowledge in long-term memory. According to observations made by Goel et al. [27], they often use interactive analog retrieval [12] to search for biological cases similar to the target problem. So the researchers found that the bionic database is the necessary tools, bionic designer biomimicry research institute provides designers with AskNature online library [28] and developed related tools (classification/taxonomies, methodology), as well as education materials and consulting services Biomimicry 3.8 [26]. Users can search for an organism or a function according to the online open database of AskNature [28], and discover interesting problems or research in this way to solve strategies.

IDEA_INSPIRE is an interactive tool for biomimetic design developed by [29] et al. to generate solutions for product design. DANE is another interactive computing tool for bionic design. It is somewhat similar to a natural engine and provides a framework for users to access the architecture, behavior, and functional model design case library containing biological and engineering systems [7]. The benefit is that it constantly allows designers to write and input models such as new systems, and user search results can be presented to users in a variety of media. Sarkar and [29] found that graphical representation of biological systems could generate more and better design ideas than textual representation in the design of interactive biomimetic design tools.

In addition to these tools used online, [30] presents designers with a newly developed specialized tool card that expands the designer's solution space and provides a simple starting point to solve problems. By biomimicry institute [26] and dell heineken cooperative development of biomimicry deck - "Biomimicry + Packaging Innovation Toolkit, is to promote the Packaging designer's creative exploration and solution to Packaging design and development tools, in order to unlock, promoting Innovation of new ideas, and to promote Packaging design creative sustainable solutions in essence.

Future Trend

"In the future, human will face three problems: life itself is actually algorithm, life is a process of continuous processing data; the separation of consciousness and intelligence; with large data accumulation of the external environment will than we know more about yourself. What about the three problems, and how to respond, will directly affect the development of future human" [31]. We have found that there are more and

more commercial implementations, including more and more robots, toys and movie themes, which appear and behave like biology [2]. Therefore, we can think of nature as a catalogue with 3.8 billion years of research and development experience. They are novel to us because we have never seen them as models before [1]. Evolution has solved many of nature's challenges, leading to effective materials, structures, tools, mechanisms, processes, algorithms, methods, systems and many other benefits[32], and has provided great potential for inspiring new functions of future technologies [2]. "The greatest innovation of the 21st century will be the intersection of biology and technology, and a new era is about to begin" (Jobs, 1955-2011) .

The modern subject classification system is becoming more and more detailed, and the interdisciplinary integration is becoming more and more complex. Thinking about bionic design will be integrated with various disciplines, so as to further explore the systematicness, reliability, rationality and variability of natural creations. Biomimetic design infuses the systematic wisdom of life into the design of everything from carpets to cities, and dozens of research centers around the world have begun to bring engineers and biologists together and encourage them to engage in cross research. With the human knowledge system is more and more complicated and systematic, the proposition of nature and our own design to understand the deeper, the future every important biomimetic design with mechanical, electronic, optical, thermal, biology, materials science, art, psychology, sociology and so on analysis research, become the interdisciplinary comprehensive application [8].

Use biomimicry as a useful tool for visual designers

Biomimicry has been widely used in engineering, architecture, products and other fields [7][33][34][35] [36][37]. In general, biologists lack knowledge of design and engineering, and engineers and designers lack knowledge of biology. Therefore, the connection between interdisciplinary knowledge transfer and communication and creation has become a problem that all disciplines need to discuss in the face of bionic thinking [10][12][20]. In the past decade, more and more cross-field studies connecting biology with various disciplines have been proposed and bionic design strategies for some related disciplines have been formulated [4][7][36][38]; however, the research on bionics in the field of visual design has not yet been clearly proposed.

In addition, when using bionic design methods for creative thinking, the bionic design database [28] is an essential tool for designers. Researchers have sorted out and developed online search [28] and interactive software [7]. [29] or biomimicry card [30]. Biomimicry.net and other databases are used as tools in engineering, architecture, products and packaging. However, to some extent, bionic design of different disciplines can speak different languages, have different views on design, have different restrictions on design problems, and have different resources to realize abstract design concepts[10]. For example, buildings usually focus on how to use physical space and architectural structure. Engineering and product design focus on optimizing functions, values, appearance and materials,

while visual design focuses on optimizing information transmission. Therefore, when bionics database is used by designers of various disciplines, there are both overlapped and different emphases and link languages, but as a special tool of visual bionics design, it is still vacant.

This thesis put forward for the development of visual design biomimetic tool the following three directions and Suggestions: first, many bionic cases biological information is very useful for inspired designers, but the main challenge in the field of vision could be the existing tools more focus on the structure of the knowledge of biology and engineering, links, and the lack of links in the design of visual language, as a result, the use of visual language to link biomimicry knowledge will make the tools more effective; Secondly, as biomimicry research is often interdisciplinary application, when it is used by visual designers, some cases of related research will enable designers to get more intuitive visual experience and clearer inspiration. Therefore, more biomimicry interdisciplinary application cases should be provided to visual designers. Third, the existing biomimetic design tools and related databases, such as as visual designer creative development want to supplement the tools, the biological knowledge and related cases should be used visual design language integration and classification, in order to make its knowledge for visual designers as needed to quickly retrieve and effectively use.

Future Study

The future research will be conducted in the following three directions: first, as mentioned above, subjects will extend the concept of creative conception to the middle and late stage, and may encounter new problems and discoveries in the process of concept realization; Secondly, the tools to inspire visual design creativity with bionics will be developed in the next research. Finally, visual designers want to find more new creative sources when they are committed to breaking through the mediocrity and stylization of information transmission. I believe that future research will find a new vision of visual design at the interdisciplinary intersection.

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