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# ALGORITHM-AIDED DESIGN: NEW MODE AND INSIGHT FOR GRAPHIC DESIGN

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*Algorithmic Graphic Design (AAGD) is explored, providing a revolutionary understanding and innovation in the process, methods and tools of graphic design. It was determined that AAGD is characterized by a logic-oriented approach, infinite design alternatives, complexity, randomness, precision, and an interactive design process. A systematic categorization and analysis of the characteristics of AAGD can contribute to further research on the theoretical and practical aspects of AAGD and provide graphic designers with new design ideas and opportunities.*

***Key words:*** *AAGD, algorithm-aided, graphic, design, characteristic.*

## INTRODUCTION

An algorithm is a well-defined set of instructions that specifies a series of operations to be performed. It typically involves a range of inputs, processing steps, and desired outcomes in the planning process, intended to solve or describe a specific problem (Fig.1). Algorithm-aided design (AAD) is an approach to creating and designing with the assistance of computational algorithms, using computers and software. Designers use algorithms to explore new possibilities and generate design alternatives. Specific design parameters or constraints are necessary to identify algorithms for describing design problems.

AAD emerged in the early 1960s and was derived from the development of

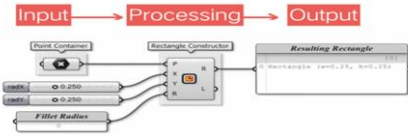


**Fig. 1.** Algorithm structure [5]

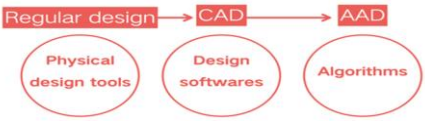


**Fig. 2.** The revolution of design tools [4]

computer-aided design (CAD) systems. CAD emphasizes assistance in the design process, transferring the physical design process to design software on the computer. However, AAD is characterized by automatically generating design results driven by algorithms (Fig.2).

Graphic design involves the use of graphic design elements and principles based on visual art to combine information, symbols, typography, text, font, images,

and other visual materials to create artistic, functional, and communicative visual works. The scope of graphic design includes logo design, branding and identity design, advertising design, packaging design, print design, digital media design, illustration design, etc.

Digital design tools and methods have become deeply embedded in graphic design. Digitalization is increasingly common in graphic design. A variety of software and tools, such as Photoshop, Illustrator, InDesign, Sketch, etc., have improved the efficiency, diversity, and flexibility of design performance. AAD can be integrated into graphic design in various ways by using computational tools and algorithms to aid in the graphic design process, such as generating complex patterns or textures, optimizing the layout, etc.

**PURPOSE**

The integration of algorithm-aided design (AAD) and graphic design, specifically referred to as algorithm-aided graphic design (AAGD), is both necessary and feasible. It represents a crucial approach to advancing digital design, eliciting substantial innovation and inspiration in graphic design from multiple perspectives, including design modes, methods, and tools.

Identifying the salient characteristics of AAGD has fundamental implications. Researchers and designers can better understand its potential impact on the field of graphic design, as well as identify opportunities for innovation and improvement. Furthermore, a deeper understanding of AAGD's characteristics can inform the development of new tools, techniques, and methodologies that will enhance the design process and improve design outcomes.

**RESULTS AND DISCUSSION**

AAGD has emerged as a revolutionary paradigm in the field of graphic design, which offers a number of unique characteristics and advantages from various perspectives. The systematic exploration of the distinctive characteristics and benefits of AAGD constitutes a fundamental and critical research direction, as it provides a solid foundation for the continuous innovation and practical applications of AAGD in the field of graphic design.

1. Logic-oriented design

The fundamental characteristic of AAGD is its logic-oriented design, which involves a general process that includes clarifying design conditions and constraints, determining design parameters, constructing algorithmic logical structures, and obtaining targeted design results. In contrast to traditional graphic design, which aims for a limited number of design outcomes, AAGD prioritizes the construction of algorithms as the core task of design, shifting the design goal from being result-oriented to being process-oriented and logic-oriented. This represents not only a technological innovation but also a paradigm shift in design thinking, necessitating designers to possess a more rational and in-depth understanding of design conditions and problems, rather than relying solely on their imagination to achieve a finite number of design outcomes.

2. Endless design alternatives

AAGD prioritizes the description of the forming process and constructs it into an algorithm. The algorithm consists of a variety of input parameters. When the

parameters are changed, the design result will also be changed following the algorithm's execution. The entire process is dynamic and variable, with computer automation as its driving force. Theoretically, AAGD has the capacity to produce an infinite number of design results, in contrast to traditional graphic design processes, where designers are limited by their imagination and efforts. This traditional approach may not necessarily lead to optimal design solutions. Conversely, the infinite and diverse design results enabled by AAGD offer designers a wealth of options, rendering it easier to identify the best design solutions and obtain optimal design results.

3. The complexity of design outcomes

When using AAGD for design, designers focus on the development of algorithmic rules. After formulating the rules, the computer takes over and automatically performs the operations. In most cases, designers cannot accurately imagine the specific design results. Computers have powerful iteration and calculation capabilities, enabling them to achieve iterative and creative results beyond the human imagination. The design outcomes can exhibit a level of complexity that surpasses traditional design. The manifestation of such complexity brings forth a unique aesthetic quality that undoubtedly brings visual novelty and impact to graphic design. It may even be defined as a new visual style.

4. The generation of randomness

In the process of graphic design creation, random patterns, shapes, or layouts are often required to achieve a sense of freedom and randomness. However, manual random creation is often limited by weak or insufficient randomness. AAGD provides dedicated modules and algorithms for generating random sequences. This randomness is produced by mathematical methods, which enable designers to modify random factors, generate new random results, and ensure sufficient random effects and degrees through algorithmic iterations. The randomness brought by algorithms is more agile and natural than artificially created ones.

5. Interdisciplinary design application

Graphic designers often create visual images from their minds through sketches and drawings. These visual images are usually derived from natural phenomena, cultural symbols, or existing works of art. In AAGD, algorithms are used to describe certain principles and problems, and different disciplines' knowledge and principles can be reflected through algorithms. A multitude of algorithms sourced from various disciplines are available for generating patterns and optimizing layouts. For example, the Cellular Automata algorithm is developed for biology which is now usually used to generate complex patterns. The application of algorithms has established connections between graphic design and other disciplines, resulting in significant enrichment and expansion of the sources and methods of generating visual materials. This has led to the creation of more innovative and distinct design tools for designers.

6. Interactive design process

In AAGD, various related design properties are consolidated into design parameters, which can be adjusted and combined by designers to evaluate the

effectiveness of design outcomes and select the optimal solution from numerous design solutions. In traditional graphic design, the design process is generally one-dimensional, with limited design iteration and largely reliant on manual execution. Adjustable parameters and iterative algorithms endow AAGD's design process with strong interactivity Which allows designers greater freedom to focus on design evaluation issues.

7. High-precision design outcomes

In AAGD, the generated graphic objects are usually described by mathematical models rather than sketches or hand-drawn images, resulting in precise dimensions and accuracy. This feature ensures that the graphics obtained from AAGD not only serve as visual images but also as data files. Within the entire graphic design system, visual elements often need to be created as actual display props, such as exhibition boards, products, furniture, promotional items, etc. Graphic design outcomes that can be used as high-precision data files can directly interface with the manufacturing process, enhancing the integration and efficiency of the entire graphic design system. The precision of AAGD will create a kind of unique design aesthetic.

**CONCLUSIONS**

AAGD has transformed the traditional graphic design mode, process, and tools, as it is logic-oriented and integrates knowledge from multiple disciplines to construct design algorithms that generate an infinite number of design alternatives with the adjustment of design parameters. The entire process of AAGD demonstrates a dynamic interaction. These design alternatives exhibit characteristics of complexity, randomness, and precision, presenting a distinctive visual style. Research on the methodology and application mechanism of AAGD is vital and essential for the upgrade of graphic design and is also an inevitable trend in the artificial intelligence ages.

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