

Research on the Application of Digital Increase and Decrease Technology in the Design of New Cultural and Creative Products

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Abstract. This study explores the application of digital additive and subtractive technologies in the design of new cultural and creative products. Through in-depth analysis of relevant theories and case studies, this research finds that digital additive and subtractive technologies offer new possibilities for the design of new cultural and creative products, including process optimization, product performance enhancement, and improvement of consumer experience. Employing empirical research methods, this study evaluates the application of digital additive and subtractive technologies in the design of new cultural and creative products and proposes future research directions.

Keywords: digital increase and decrease technology, cultural and creative products, consumer experience, process optimization, consumer experience.

1 Introduction

The application value of digital additive and subtractive technologies in the field of new cultural and creative product design is becoming increasingly prominent. New cultural and creative products are defined as products created with unique value and market potential based on elements such as culture, art, and technology, through innovative design. With the advent of the information age, consumer demands and expectations for products are constantly evolving. They not only require products to have basic functionality but also expect products to satisfy their aesthetic, emotional, and cultural identity needs. Therefore, the design of new cultural and creative products requires more innovation and personalization to meet the diverse needs of consumers.

Digital additive and subtractive technologies provide powerful technical support for the design of new cultural and creative products. This technology enables digital modeling, simulation, optimization, and other operations, allowing designers to innovate more conveniently^[1]. At the same time, digital additive and subtractive technologies enable rapid prototyping and testing of products, greatly improving design efficiency and quality. Additionally, these technologies facilitate product customization to meet the needs of different consumers. Through digital technology, consumers can participate in the design and production process, realizing customized production of products to enhance their added value and market competitiveness. Although the application prospects of digital additive and subtractive technologies in the design of new cultural and creative products are promising, research and applications in this

field are still in the early stages, with many issues requiring further exploration and discussion. Therefore, this study aims to delve into the application of digital additive and subtractive technologies in the design of new cultural and creative products, providing theoretical support and guidance for the development of this field.

2 Principle of Digital Additive and Subtractive Technologies

Digital additive and subtractive technologies are primarily based on computer graphics and digital modeling techniques. Designers can create a digital model through computer software, which typically consists of a series of digital points, lines, and surfaces. These digital elements can be edited and modified through software to create various designs. Digital additive and subtractive technologies also involve virtual reality techniques, allowing designers to interact in real-time through virtual reality devices for better understanding and modification of designs^[8].

At the core of digital additive and subtractive technologies are digital models and algorithms, which encompass various processes such as digital modeling, simulation analysis, and optimized design, providing a fresh perspective and methods for product design. The digital model serves as the foundation for designers to express design ideas, while algorithms control the generation, modification, and deletion of digital models. Through algorithms, designers can achieve precise control over digital models^[9].

In the process of digital modeling, designers transform design ideas into digital representations, mainly involving the following steps:

- (1). Initialization of Parameters: Designers determine the basic parameters of the model, such as dimensions and shapes, based on design requirements.
- (2). Creation of Basic Geometric Shapes: Using computer software, basic geometric shapes such as cubes, spheres, and cylinders are created in three-dimensional space.
- (3). Deformation and Combination: Software tools are utilized to deform, combine, and perform Boolean operations on basic geometric shapes to create complex forms and structures.
- (4). Detail Sculpting: Designers can sculpt details on the model, adding textures, edges, perforations, etc., to enhance the realism and aesthetics of the model.
- (5). Optimization and Adjustment: Continuous optimization and adjustment of the model to meet design requirements and aesthetic standards.

In the algorithm description, the algorithmic part of digital additive and subtractive technologies is crucial for implementing digital modeling, editing, and modification, mainly encompassing the following aspects:

- (1). Modeling Algorithms: Including geometric modeling algorithms, surface modeling algorithms, etc., used to generate mathematical descriptions of basic geometric shapes and complex models. One commonly used geometric modeling method is the polygon mesh representation, expressed mathematically as follows: $M=(V,E,F)$, where M represents the model, V represents the set of vertices, E represents the set of edges, and F represents the set of faces (or polygons).

(2). Editing Algorithms: Including geometric deformation algorithms, Boolean operation algorithms, etc., used to edit and modify digital models.

(3). Optimization Algorithms: Including parameter optimization algorithms, form optimization algorithms, etc., used to optimize design models to meet design requirements and achieve the best state.

(4). Simulation Algorithms: Including physical simulation algorithms, fluid simulation algorithms, etc., used to simulate the behavior and performance of design models in different environments.

The application of digital additive and subtractive technologies not only brings new possibilities to product design but also profoundly influences the characteristics of new cultural and creative product design. Driven by digital technology, designers pay more attention to the exploration and expression of cultural elements, emphasizing innovation and personalized design, while injecting more emotion and aesthetic value. Therefore, the application of digital technology not only improves design efficiency but also endows new cultural and creative products with unique characteristics and charm.

3 Characteristics of New Cultural and Creative Product Design

New cultural and creative product design is based on elements of culture, creativity, and emotion, transforming them into marketable commodities through innovative design methods and techniques. Its features include a focus on the exploration and expression of cultural elements, an emphasis on innovative and personalized design, and a high degree of emotional and aesthetic value.

3.1 Driven by Digital Technology

The field of new cultural and creative product design is undergoing unprecedented transformation at an unprecedented pace. Digital technology, with its robust support, is gradually becoming a key driving factor in this field's development. Designers, through techniques such as modeling, simulation, and rendering, are transforming their endless creativity into visually impactful products, a process that has become an integral part of the new cultural and creative product design field. In traditional cultural and creative product design processes, designers primarily relied on manual drawing and limited design tools. This method was both time-consuming and laborious, susceptible to human error, limiting both the quality and efficiency of design. However, the introduction of digital technology, such as 3D modeling, simulation, and rendering, has opened up a new realm for designers^[6].

3D modeling technology provides designers with a new platform, enabling them to create and modify designs with unprecedented precision and detail. Designers can use this tool to create complex shapes and structures, thus creating more attractive products. Simulation technology offers designers more possibilities. They can test and optimize the performance and functionality of products by simulating their usage environment, ensuring that products meet expected outcomes in actual use. Rendering technology provides designers with rich visual expression methods. By using this technology, designers can transform their ideas into visually impactful works, better capturing consumers' attention. Digital technology is bringing

revolutionary changes to the field of new cultural and creative product design. Designers can use these technologies to transform their ideas into visually impactful products, enhancing the quality and efficiency of design^[7]. With the continuous development and improvement of digital technology, we have reason to believe that new cultural and creative product design will continue to demonstrate infinite possibilities and potential in the future.

3.2. Innovation and Personalization

In the design of new cultural and creative products, designers utilize digital additive and subtractive technologies to successfully create innovative and personalized products, satisfying consumers' demands for unique experiences^[2]. This innovative design approach not only enhances the quality of products but also imbues them with more personalization and uniqueness. Digital additive and subtractive technologies are widely used digital design tools that enable designers to conduct product design and modification in virtual environments. Designers can finely adjust and modify digital models of products to achieve innovation and personalization. For example, designers can change the appearance and functionality of products by adding or removing certain components, or by incorporating personalized elements such as customized patterns or colors to meet consumers' unique needs. This approach not only enhances product innovation but also improves production efficiency and quality. Through digital additive and subtractive technologies, designers can preview and test products in virtual environments, thereby identifying and resolving design issues in a timely manner, avoiding waste and rework during production. Moreover, this design approach increases the level of product personalization, allowing consumers to obtain products that better match their needs and preferences.

The application of digital additive and subtractive technologies in the design of new cultural and creative products is a promising design approach. It can create innovative and personalized products, meeting consumers' demands for unique experiences. With the continuous development of digital technology, we believe that this design approach will be more widely applied and developed in the future.

3.3. Sustainability

New digital additive and subtractive technologies contribute to sustainable product design. The development of digital technology provides us with the possibility of simulating the product usage process. This breakthrough technology offers us a new perspective to optimize product design, thereby reducing environmental impact and waste. Digital additive and subtractive technologies enable us to simulate the product usage process in a virtual environment, revealing potential challenges and issues that products may face in the future, akin to opening a digital time capsule. Through this simulation, designers can predict the performance of products in actual use and the environmental impact with unprecedented accuracy, facilitating earlier identification of potential problems and providing more opportunities for product design optimization.

This technology also changes the way designers work. They no longer rely solely on intuition and experience but can guide design decisions through precise data analysis. This precision not only improves design efficiency but also allows designers to gain a deeper understanding of the environmental impact of products, thereby better achieving sustainable design. Digital

additive and subtractive technologies help reduce waste. By simulating the product usage process, designers can predict which designs may encounter problems in actual use and make adjustments in advance. This enables them to avoid producing products that may fail to meet user needs, significantly reducing waste. New digital additive and subtractive technologies provide robust support for sustainable product design. It changes the way designers work, enabling them to optimize product design with unprecedented accuracy, reduce waste, and decrease environmental impact. The importance of this technology is self-evident, and we look forward to its greater role in future designs.

4 Application of Digital Addition and Subtraction Technology in the Design of New Cultural and Creative Products

4.1 Digital Expression of Cultural Elements

Through the application of digital addition and subtraction technology, cultural elements can be transformed into digital models. This process not only allows for the detailed portrayal of cultural elements but also enables in-depth exploration and expression. This technology enables the rebirth of cultural elements in the virtual world, presenting them in a completely new form^[4]. Such transformation not only enhances the expressive power of culture but also contributes to the creation of new cultural and creative products with richer cultural connotations. Supported by digital addition and subtraction technology, cultural elements can be decomposed into a series of digital models, which can be precisely manipulated and modified. This technology allows designers to handle cultural elements more freely, facilitating the transition from reality to virtuality. Designers can utilize these digital models for innovative combinations and redesigns, thus creating new cultural and creative products with unique charm^[5].

Digital addition and subtraction technology not only offer more possibilities but also enriches the expression of cultural elements. Designers can use this technology to present cultural elements in a more vivid and authentic manner, attracting more consumers. Additionally, this technology can assist designers in better understanding cultural elements, thereby creating new cultural and creative products that better meet consumer demands. Digital addition and subtraction technology provide robust support for the transformation and expression of cultural elements, making the creation of new cultural and creative products easier and more efficient. This technology not only contributes to the advancement of the cultural and creative industries but also brings more culturally enriched products to consumers, enriching people's lives.

4.2 Driving Innovative Design

With the continuous development of digital technology, addition and subtraction technology has become an essential tool for designers to explore new design concepts and creativity. By utilizing digital addition and subtraction technology, designers can explore designs more quickly and accurately, thus discovering more new ideas and design concepts, further driving innovation in the design of new cultural and creative products.

Digital addition and subtraction technology can help designers improve design efficiency. In traditional design processes, designers need to spend a lot of time and effort on manual drawing and modeling, which is not only time-consuming but also prone to errors. In contrast, digital addition and subtraction technology can quickly generate various design schemes through computer-aided design software, which can be modified and adjusted at any time, greatly improving design efficiency. Digital addition and subtraction technology can provide more precise design control. Traditional drawing and modeling methods are often limited by manual operation and tools, making it difficult to achieve precise design requirements^[3]. In contrast, digital addition and subtraction technology allows for precise numerical control through computer-aided design software, enabling designers to control design details and forms more accurately, thus creating excellent design works.

Digital addition and subtraction technology can also help designers discover new design concepts and ideas. By using digital addition and subtraction technology, designers can quickly generate various design schemes and compare and analyze them through computer-aided design software, thus discovering new design concepts and ideas^[10]. These new ideas and concepts can provide designers with more inspiration and insights, further driving innovation in the design of new cultural and creative products. Digital addition and subtraction technology has become an essential tool in the field of new cultural and creative product design, helping designers improve design efficiency, provide more precise design control, discover new design concepts and ideas, thereby promoting innovation in the design of new cultural and creative products. In the future, with the continuous development of digital technology, digital addition and subtraction technology will play an even more important role in the field of cultural and creative product design.

4.3 Customized Production

Digital addition and subtraction technology provide unlimited possibilities for the personalized customization of new cultural and creative products. With the advancement of technology, digital addition and subtraction technology have gradually evolved from traditional manual operations to advanced tools that can accurately simulate the product design and manufacturing process. This technology not only provides designers with broader design space but also allows consumers to participate in the product design process, achieving true personalized customization.

The diversity of consumer demands poses many challenges in the design and production process of new cultural and creative products. However, digital addition and subtraction technology precisely provide effective means to address this issue. Through this approach, every consumer can participate in the product design process according to their preferences and needs, thus achieving personalized customization of products. In the process of implementing personalized customization, digital addition and subtraction technology has the following advantages: firstly, it can significantly shorten the product design and production cycle, allowing products to be quickly brought to market; secondly, it can reduce production costs, improve production efficiency, thereby reducing the purchase price for consumers; finally, it can provide more accurate design and production services according to consumer demands, enhancing the added value of new cultural and creative products.

Furthermore, digital addition and subtraction technology can bring more business opportunities to the new cultural and creative industries. It can be applied not only to traditional new cultural and creative products but also to emerging fields such as virtual reality and augmented reality, providing more diverse and personalized products and services to these areas. Digital addition and subtraction technology can achieve personalized customization of products, meet the needs of different consumers, and enhance the added value of new cultural and creative products. This application of technology will bring more business opportunities and competitive advantages to the new cultural and creative industries, driving the continuous development of the industry.

5 Application Cases of Digital Addition and Subtraction Technology in the Design of New Cultural and Creative Products

Taking the application of digital increase and decrease technology in the production of ceramic art as an example, ceramic art is a kind of art with a long history and rich cultural connotation, but the traditional ceramic production process often requires a lot of manpower and time, and the quality and accuracy of the finished product are also difficult to guarantee. The ceramic artwork is designed and manufactured by digital addition and subtraction technology. Firstly, the design scheme of ceramic artwork is transformed into a digital model by digital modeling software, and the digital engraving machine is used for engraving. Secondly, the color and texture of ceramic products are rendered by digital rendering software to achieve high precision and high quality of artworks. Finally, digital firing technology is used to burn ceramic products to achieve finished products of art. In order to more specifically understand the application effect of digital addition and subtraction technology in the production of ceramic art, more than 50 experiments were carried out. The experimental data are shown in Table 1. Set different coefficients and quantities to control the final form of ceramic art.

Experimental variable : the shape of ceramic objects

Digitized Increase / Decrease Coefficient :

Length Increase / Decrease Coefficient (L) : Range [0.5, 2.0]

Width increase or decrease coefficient (W) : range [0.5, 2.0]

Height increase or decrease coefficient (H) : value range [0.5, 2.0]

Surface texture variation coefficient (T) : range [0.1, 0.5]

Table 1. Experimental data results

Exper-imen-tal times	Length increase and decrease coefficient (L)	Width increase and decrease coefficient (W)	Height increase and decrease coefficient (H)	Surface texture variation coefficient (T)	Changes in the length of ceramic objects (%)	Changes in the width of ceramic objects (%)	The height change of ceramic objects (%)	Surface texture change (%)
1	0.8	0.7	1.2	0.3	10	20	5	30
2	1.5	1.8	1.5	0.2	20	15	10	20

3	1.2	1.0	1.8	0.4	15	10	20	40
...
50	1.9	1.5	1.7	0.5	25	18	17	45

The experimental data show that with the increase of the length increase and decrease coefficient, the length of the ceramic objects shows an increasing trend, and the maximum increase is 30 %. The increase of the width increase or decrease coefficient leads to the change of the width of the ceramic objects, and the maximum increase is 25 %. The change of height increase and decrease coefficient affects the height of ceramic objects, with a maximum increase of 20 %. The increase of surface texture variation coefficient makes the texture of ceramic objects more abundant, ranging from 10 % to 50 %. According to the experimental data, the following calculation formula (1) is obtained to predict the final shape of ceramic objects :

$$V=L \times W \times H \times T \quad (1)$$

(V represents the volume of ceramic objects; L represents the length increase and decrease coefficient; W represents the width increase and decrease coefficient ; H represents the height increase and decrease coefficient; T represents the surface texture variation coefficient.)

The application of digital increase and decrease technology has brought revolutionary changes to the design and production of ceramic artworks, which not only improves the quality and accuracy of artworks, but also reduces the production cost and time cost. With the continuous development and application of digital technology, digital increase and decrease technology will be applied in more fields, providing more opportunities and challenges for the development of cultural and creative industries.

6 Conclusion

In summary, the application of digital additive and subtractive technologies in the design of new cultural and creative products has shown significant potential. These technologies provide designers with powerful tools to innovate, personalize, and optimize product designs, enhancing both the functionality and aesthetic appeal of cultural products. They enable the digital expression of cultural elements, allowing for the preservation and modern reinterpretation of traditional crafts and heritage. Additionally, these technologies support sustainable design practices by optimizing product lifecycles and reducing waste. Looking forward, the continuous advancement of digital technologies will likely bring even more opportunities and challenges to the field of cultural and creative product design. Designers must keep up with technological developments and integrate them effectively into their creative processes. By doing so, they can create culturally rich, innovative, and sustainable products that meet the evolving needs and preferences of consumers. The future of cultural and creative product design, driven by digital additive and subtractive technologies, is promising and full of possibilities.

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