

An investigation on the influence of interactive aesthetics in virtual industrial design

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Abstract—Virtual reality (VR) is an emerging technology that creates a three-dimensional virtual environment. It emphasizes user's experience on immersion, imagination and interaction. Some research demonstrates that aesthetic used in VR design could enhance interactivity between virtual body and environment. Aesthetic design on industrial design emphasizes the product appearance rather than function or usability. However, there is little research in aesthetic contribution to industrial design in virtual reality. From the perspective of aesthetics, the paper outlines the aesthetic studies to a virtual reality and product design. Based on the user experience of perception, it analyses a model of aesthetic perception of industrial design in virtual environment, which provides a general guidance for virtual industrial product design.

Keywords- aesthetics, virtual reality, interactivity, industrial design

I. INTRODUCTION

In the past decades, virtual reality technology has been used in the field of industrial product design. Virtual reality (VR) uses head-mounted displays (HMDs) to create a potentially different way of displaying virtual environment. As a popular visualizing design tool, VR technology has been used to explore design prototyping, visualization and communication in industrial product design. It has being employed to decision making in design, evaluation, and training processes across multiple disciplines [1]. Both industrial and academic communities have contributed to a large knowledge base on numerous virtual reality topics, which involve technical advance and aesthetics. Technical advances have enabled designers to explore and interact with data in a natural way; while aesthetic contribution to product appearance has been demonstrated to impact on product performance or price attributes [2]. Yamamoto and Lambert [2] argue that visual aesthetic can be reflected in many consumer experiences, such as fashion and arts, however, it also has significant in industrial products such as automobiles, home appliances and transportations. The aesthetics in industrial design emphasizes a sense of beauty and users' psychological and emotional needs for products. Aesthetic principles have been used in virtual industrial design, which should follow the beauty of product.

Aesthetic approach to industrial design involves two aspects: functional beauty and the beauty of form. In the conventional design, function plays an important role, which

allows users to use the product effectively and efficiency. It meets the actual needs of users in daily life. Functional beauty is an important factor in industrial design, as its well-designed function is considered as a source of positive (or negative) aesthetic value, in which aesthetic theory includes art, the everyday, animals and organic nature and environments and artifacts [3]. The functional beauty has a long tradition within aesthetics, from classical ancient philosophy to contemporary aesthetic theory [4]. The outcome is both impressive and insightful in the way it brings together considerations from aesthetics and philosophy of science to a comprehensive and unified account of aesthetic experience. The beauty of form is subjective perception, which can design industrial products with combination of various methods. It provides users a sense of beauty and enhances user's satisfaction with the products, which includes consistency, balance, scales, contrast and rhythm.

Aesthetic of virtual reality emphasizes an immersion into a world of numbers that appears in forms, images, and sensations, which involve a virtual body and interactions with avatar [5]. Different from other types of digital technologies, VR has a special kind of interactivity, in which virtual body is an entity that is exceptionalized through interaction. Carroll (2008) investigates the photorealistic virtual reality to create "engaging" experience rather than traditional human-computer interaction approaches that "primarily focused on the performance and efficiency issue of the technology" [7]. Carroll's study highlights a concept of "aesthetic interaction", which examines the role of narrative in VR and the visual-narrative employed the use of aesthetics to "engage" the spectator in its process of storytelling.

However, there is little research related to aesthetic experience of industrial product design in virtual reality. This paper will firstly address the virtual reality used in industrial design, the concept of functional beauty and then aesthetic perception for product design. It aims to investigate a potential on aesthetic model influencing virtual industrial design.

II. VIRTUAL REALITY AND INDUSTRIAL DESIGN

Virtual reality (VR) is a new technology emerging at the end of the 20th century, which integrates digital image processing, computer graphics, multimedia technology, sensor technology and other information technologies. Research suggests that the advantage of VR is able to create the users

experience of immersion, interaction and imagination. Where human-computer interaction in virtual reality is considered as a natural interaction, users can interact with the computer through head-mounted helmets and gloves. The virtual environment created by the computer can make the users' experience a sense of presence and becomes a part of the virtual environment. In the last two decades, VR technology has been extendedly used as a tool in the field of industrial design and industrial training and education. For example, Wald et. al [8] proposed a ray tracing based virtual reality framework that supports direct ray tracing of trimmed freeform surfaces. Many car manufactures adopt VR technology to design and test vehicle system in real-time performance parameters.

Research on VR applied to industrial design focuses on the following aspects: Firstly, virtual reality in industrial design emphasizes an aesthetic convergence, which involves design methodology based on a multidisciplinary approach using VR as a tool [9].

Secondly, one of the primary goals of VR technology applied in industrial design highlights an alternative aesthetic and interactive sensibility for real-time, interactive, 3D computer graphics [10]. It is important to design an immersive virtual space to allow users to shed their ways to observe the world.

Thirdly, virtual industrial design is a new design method of product development based on computer using virtual reality technology. The effective application of industrial design can establish a virtual realistic world and users can conduct relevant research and better understand the relationship of products. For the industrial products, VR can offer the ideal unconstrained interface for free artistic practice and bridge the gap between creative experimentation and precise manufacturing-oriented modelling [11].

Lastly, VR can be used as a general design tool focusing on the decision making process in product development projects. Berg and Vance's research demonstrates that immersive VR technology can effectively assistant designers and engineers to identify design issues and potential solutions, which cannot be sorted out using traditional computer tools [12]. Their study shows that participants are being encouraged an increased sense of team engagement through virtual environment.

III. AESTHETIC AND VIRTUAL REALITY

Aesthetic examines subjective and sensori-emotional values, or sometimes called judgments of sentiment and taste [13]. It is the study of beauty and taste. In virtual environment, aesthetics is considered as user perception for immersion, interaction and imagination. In this sense, aesthetic approach to virtual reality has value to positive side of user experience. This aesthetic experience is defined as the "lively integration of means and ends, meaning and movement, involving all our sensory and intellectual faculties is emotionally satisfying and fulfilling. Each act relates meaningfully to the total action and is felt by the experiencer to have a unity or a wholeness that is fulfilling" [14]. This statement highlights felt life is critical important in aesthetic approach to product design. This is defined as pragmatist aesthetics by Petersen et al. However, virtual

industrial design emphasizes the interaction in user perception. Petersen et al. argue that there are two aesthetic perspectives. The first focuses on creating involvement, user experience, surprise and serendipity in the interactive; the second focuses on promoting bodily experiences and symbolic representations interacting with the system [15].

These are a growing interest in the aesthetic of interactivity in industrial product design. It suggests a response of need for alternative frames of reference in interactive systems design and alternative ways of understanding the relationships [16]. Wright, Wallace and McCarthy (2008) argues that aesthetic of interactive design in VR involves three themes: (1) a holistic approach in which a user with emotions and thoughts focus on design; (2) a constructivist stance wherein user's self is seen as continuously engaged and constituted in making sense of experience and (3) a dialogical ontology that self, others, and technology are constructed as multiple centers of value. Based on three themes, researchers critic into the aesthetic of interaction and suggest a concept of "sensibilities" for designing aesthetic interaction.

Virtual reality has aesthetic characteristics of technology. Technology provides usability for the realization of virtual industrial design, through the computer system, can create a set of dynamic, audio and video functions in one of the three-dimensional space environment, and give a sense of immersive, fully mobilize users to participate in the interaction. The technical aesthetic embodied in the industrial design is mainly manifested in the aspects of modeling, vision and hearing, which not only makes effective use of science and technology, but also enhances its artistry and good users' experience. The technical aesthetic of industrial design can effectively enhance the aesthetic value of industrial product design and play a positive role in increasing economic benefits. In industrial design, the full integration of aesthetic theories, such as technical aesthetic is conducive to the optimization of labor productivity and the promotion of the economic development and scientific and technological advancement.

Although the virtual reality design takes the technology as the important support and shows the strong technical aesthetic characteristics, from the perspective of the form of expression, the design has the artistic characteristics of modeling. According to art theory, design is a special form of artistic activities. In industrial design, relevant personnel must carry out visual design on layout, structure, material, texture and other aspects, giving users a strong visual impact. Thus, industrial design contains aesthetic characteristics of artistic beauty. In the industrial design, we strive to set up an immersive virtual reality world for users, with three-dimensional visual effect, artistic expression, appeal and artistic beauty.

IV. AESTHETIC AND VIRTUAL INDUSTRIAL DESIGN

In Figure 1, a conceptual framework displays the relationship between the virtual reality, industrial design, aesthetic experience, and virtual aesthetic approach to industrial design. In this model, it is clearly shown that virtual aesthetics approach to industrial design draws from virtual reality technology, industrial product design and aesthetics. The characteristics of three fields are combined together to

construct the essential properties in aesthetic approach to virtual industrial design. The immersion, interaction and imagination are fundamental to virtual reality; while usability, effectiveness and efficiency are basic to industrial product design. These are also linked to judgment of aesthetic and user experience. Thus, from this conceptual model, aesthetic approach to virtual industrial design not only presents aesthetic values in virtual environment, user interaction and imagination but also usability and effectiveness.

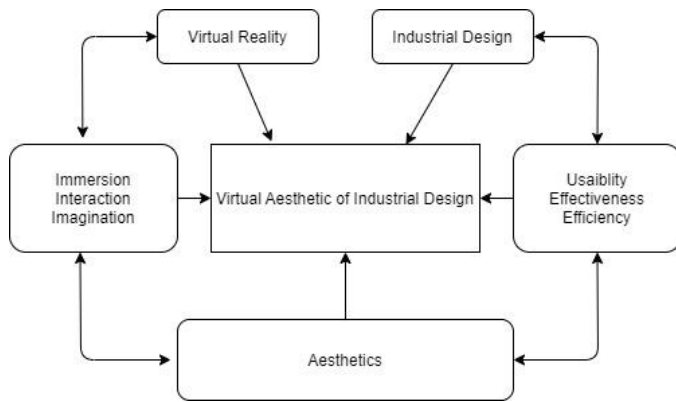


Figure 1. The model of virtual aesthetic of industrial design

This model can be used to inform the design principles for industrial design in virtual reality. It could be a valuable design framework for design of industrial products with characteristics of immersion, interactivity and imagination.

V. CONCLUSION

This paper presents an overview of interactive aesthetic that explores user's perception and experience in the virtual environment for the field of industrial design. Traditional industrial design emphasizes function and usability. Using virtual reality to industrial design emphasizes the immersion, interactivity and imagination. Aesthetic plays an important role in the design of virtual industrial products for its positive values. Functional beauty is a kind of aesthetic experience for the appearance of products. The beauty of form emphasizes the subjective perception, which evokes a sense of beauty and enhances user's satisfaction with the products. At the last, it concludes a conceptual model of virtual aesthetic in industrial

design, which integrates the characteristics of VR, industrial design and aesthetics.

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