Study on the Impact of Morphological Evolution on Household Electrical Appliances Product Style

Can-qun He\textsuperscript{a}, Zhang-yu Ji\textsuperscript{b}

\textsuperscript{1}College of Mechanical and Electrical Engineering, Hohai University, China
\textsuperscript{a}hecq@163.com, \textsuperscript{b}113925724@qq.com

Keywords: Household Electrical Appliances, Morphological evolution, Product style.

Abstract. Related product information about Haier refrigerators are collected, and morphological characters of the refrigerator main panel are extracted, carry on analysis of a large amount of statistical data. Relationship between refrigerator morphological evolution and the era of consumption demand as well as the relationship between refrigerator morphological evolution and design style are discussed by sorting out morphological evolution of modeling elements such as the line features and section ratio of the different kinds of refrigerators so as to study the impact of morphological evolution on household electrical appliances.

Introduction

Product morphology is external characteristics demonstrated by the product. Morphology of any product is the carrier of cognitive function and aesthetic function. People can identify different products according to product morphology and gain different visual perception and psychological feelings from congeneric products, which reflect product style to a certain degree. Therefore, product morphology is the key factor in determining product style. Good morphology not only meet the purchase demands and emotional needs of consumers but also can create a brand image, deliver the brand design philosophy and form the own style of the brand.

The Necessity of the Study on Household Electrical Appliances Morphological Evolution

With the improvement of substance level, the aesthetic taste of people’s consumption has been inspired and higher requirements on aesthetics of consumer products are put forward relatively\textsuperscript{[1]}. Household electrical appliances which belong to consumer products and allow people to free themselves from the heavy, trivial and time-consuming housework create a more comfortable living and working environment for mankind and have become necessities of the modern family life. Consumers’ aesthetics of household electrical appliances has gradually changed, which reflects changes of consumer demands for product style and also leads to the corresponding changes of household electrical appliances product morphology. In order to design more household electrical appliances which meet consumer demands and create more market sales profits, it is necessary to study on household electrical appliances morphological evolution.

The Research Basis on Refrigerator Morphological Evolution

It takes refrigerators as the research object and explores the impact of product morphological evolution on household electrical appliances product style. It is focused on the following three aspects. Firstly, the refrigerator has been throughout all levels of social life today. Secondly, the evolution of refrigerators are typical and representative in all aspects of the design of household electrical appliances, which can reflect the impact of era on household electrical appliances. Thirdly, the morphology of refrigerators is relatively simple and distinctive, which is easy to extract and analyze characteristics. Conclusions are more reliable and promotional.
As the leader of Chinese national brands, the sale of Haier refrigerators in China’s refrigerator market has remained at the forefront in recent years. Its development and evolution process are an important reference and guidance for the design of product style of refrigerators. This study analyzes their evolution trend under the influence of era and their product style according to Haier refrigerator morphological evolution and illustrates the characteristics of product modeling style evolution under the influence of consumer demand.

3. The Extraction and Analysis of Morphological Characters of the Refrigerator Main Panel

3.1 Product Modeling Style and Feature Elements

Product modeling features can be understood as modeling elements and their mutual combination relationship, which is modeling principles (refer with: Fig. 1). Basis elements such as straight lines, curves and planes and surface features all have their own style. When they form product profiles, local features and detail features through the corresponding modeling principles, their style imageries interact and merge with each other to form a new style imagery and thus contribute to the formation of product style.

![Figure 1. The form of modeling features.](image)

According to the form of modeling features, extraction of refrigerator morphological feature lines in this study is based on the refrigerator main panel. It gives priority to the line and plane elements in the modeling features elements, choosing typical products and extracting their relevant feature lines from the perspective of the refrigerator panel division ratio and according to classification of different types and the order of market. These feature lines largely reflect the modeling style of the refrigerator brand. It analyzes and studies the differences of modeling design style by extracting and comparing these feature lines.

3.2 The Analysis of Haier Refrigerator Morphological Features

3.2.1 Haier Side-by-side combination refrigerator Whose Doors are Up and Down

As shown in Fig. 2, the proportion of total height and width of Haier side-by-side combination refrigerator whose doors are up and down remains at 3:1. Taken the refrigerator as a whole, the ratio of the upper part of the frozen volume of total volume decreases year by year. From 2007 to 2012, the edge of the main panel of this refrigerator was mostly circular surface and the handle was the form of
non-hidden concave. In the recent two years, the refrigerator main panel lines have become simple. The panel is mostly vertical and the handle becomes hidden gradually.

3.2.2 *Haier Side-by-side combination refrigerator Whose Doors are Left and Right*

As shown in Fig. 3, the division proportion of left and right of Haier side-by-side combination refrigerator whose doors are up and down is unchanged and remains at 1:1.33, close to $\sqrt{2}$. The proportion of total height and total width is also unchanged and remains at $\sqrt{3}$. The refrigerator display is transversely placed at the starting point of human visual rule basically (Upper left quadrant). In the past two years, the display has become the concave arc and been located at the division of left and right. The round chamfer of the handle is smaller and lines become simple. The form of the handle was explicit from 2005 to 2013. With the emergence of the hidden handles in the past two years, the handles of Haier refrigerators have gradually become hidden.
3.2.3 Haier Three-door Refrigerator

As shown in Fig. 4, the first layer of a three-door refrigerator is a cold storage layer, the second layer is a fresh layer and the third is a frozen layer. The basic position of the intermediate fresh layer of this refrigerator was almost the same from 2007 to 2014. The morphology of the early refrigerators was slightly complicated and the early refrigerator doors were the design of large rounded arc. Lines become simple later and the panels become flat. The proportion of total height and total width remains at 3:1 since 2009. The handles of Haier three-door refrigerators always remain hidden style.

![Figure 4. The morphological evolution of Haier three-door refrigerator front view.](image)

The Relationship between Refrigerator Morphological Features and Design Style

Haier refrigerators have experienced changes of demands in the Chinese market during their own development process and are also influenced by the design style of refrigerators from other countries in the world. Thus they form the unique morphology and style features.

4.1 The Analysis of Refrigerator Morphological Features

Through the study of the morphological evolution of the refrigerator main panel, it is found that refrigerators in different periods have a certain degree of similarities which are reflected in the following aspects.

Firstly, the overall proportions of various types of refrigerators are similar. The proportion of total height and total width of side-by-side combination refrigerators whose doors are up and down and three-door refrigerators remains at around 3:1.

Secondly, in the modeling of refrigerators, lines are responsible for dividing the body, mostly straight division, which reflects the simplicity and reliability of refrigerators as large white household electrical appliances. The horizontal dividing line is usually used to divide different functional areas, which optimizes the height of the refrigerator and increases the stability visually\(^2\).
Thirdly, in the design of the side-by-side combination refrigerator whose doors are left and right, the position of the display remains unchanged and is in line with the characteristics of human visual flow.

Lastly, in the design of the side-by-side combination refrigerator, the division proportion of left and right of refrigerator’s doors is \( \sqrt{2} \). \( \sqrt{2} \) is the frequently-used Root-Mean-Square in design geometry allows that the refrigerator has dynamic equilibrium beauty of harmony and coordination. At the same time, the \( \sqrt{2} \) rectangle proportion is the basis of the European System of DIN paper size. The standard system is concise and lively and its special regularity can maximize the use of paper with no waste. It can also maximize the use of the refrigerator panel material when used in the refrigerator panel, which is economic and environmentally friendly.

4.2 The Relationship Between Refrigerator Morphological Features and Design Style

Different styles of refrigerators have different forms of plane and line elements, which result in different psychological effect and aesthetic features. The early design of Haier refrigerators was good at using curved surfaces and large rounds, which was gorgeous and elegant. It gave a sense of intimacy and had feminine characteristics. The late design gradually tends to be more simple straight line style. In the constituent elements of the refrigerator, the handle plays the role of the line and the line plays the role of transversal and segmentation in the modeling. Generally, the handles with different curves can easily bring different image feelings to people\[^{[3]}\]. The evolution of Haier refrigerator handles is gradually in harmony with the overall style and the design style becomes simple. The initial explicit handles evolved into built-in handles and the hidden handles have been used gradually in the past two years.

The classification of morphological evolution of refrigerator brand main panel and the similarities between morphological features and design styles reflect the cognitive function of refrigerator morphological features. People can judge whether the product is a refrigerator through these characteristics. Similarly, the classification reflects the morphological features and unique brand styles of different brands, which forms the brand’s own aesthetic features. By this consumers can have a clear perceptual imagery and the brand's unique modeling design style can be identified.

The Elements Affecting the Refrigerator Morphological Evolution

5.1 The Effect of Consumer Demand Changes on the Refrigerator Morphological Evolution

5.1.1 The Visual Aesthetic Needs of Consumers

With the social and economic development, consumer’s demands for the products will gradually expand when the basic material needs of consumers are satisfied. Therefore, consumers expect more attractive products during the consumption process to meet their visual aesthetic needs. Meanwhile, with the gradual saturation of the consumer market, the market has gradually developed into the consumer-oriented phase and manufacturers have targeted to improve the appearance of products to meet consumer’s demands. The most intuitive way of improving the appearance of products is to change the past changeless and indifferent industrial morphology, making the products have richer aesthetic features and thus meet the visual aesthetic needs of consumers\[^{[4]}\].

Ten years before, the consumer tastes of design was subject to indifferent industrial products brought from the mass production and almost at a standstill\[^{[5]}\]. While the development of productivity provides people with better material conditions to meet the survival needs so that people have the ability to pursue other goals beyond survival, which is also the basic of the emergence and development of the design\[^{[6]}\]. Consumer demand for beauty embodied in the product design is the needs of product modeling beauty and thus the refrigerator morphology changes with the change of era consumption demand.
5.1.2 The Living Habit Change Demand of Consumers in Different Times

With the further improvement of the quality of life, food shelf life is no longer the only factor whether the refrigerator can extend the shelf. Consumer’s demands for refrigerators have gradually developed into a new pattern, including a large capacity, freshness, nutrition, health, environmental protection and other aspects. Currently refrigerator products have entered the peak period of upgrade and the upgrade of market consumer demand pulls the products to upgrade to high-end product mix. In addition, emerging consumer groups who are mainly the generation after 80s have higher requirements on the brand and quality of refrigerators. They want a refrigerator with a more refined food preservation function and the refrigerator is more intelligent, healthy, qualified and fashionable at the same time. Based on consumer different requirements on preservation of different food, the overall capacity and morphological segmentation of refrigerators also change. Now, the appearance of large capacity refrigerators such as side-by-side combination refrigerators whose doors are left and right or multi-door refrigerators meets consumer demand for the storage of various and numerous food\(^1\). Under this market demand, more humane large-capacity and multi-zone refrigerator is the trend and consumer demand for high-end refrigerators is also growing.

Moreover, since there is a growing emphasis on the decoration of living environment, colorful space decoration makes the original monotonous refrigerators incompatible with the environment. Therefore, considering the collocation of refrigerators and exquisite renovated space also affects the refrigerator morphological evolution to some extent\(^1\).

5.2 The Effect of Design Style on the Refrigerator Morphological Evolution

Design relies on the era. With the emergence of various refrigerator brand and increasingly fierce market competition, refrigerator morphology and style also evolve along with the change of the era. In order to accommodate the needs of large-scale industrial production, simple and practical design has been the trend. Apart from this, the domestic consumers are affected by Scandinavian modern design style and become more interested in simple and practical design style. Thus, in the early design of Haier refrigerators, use of curves and other sleek style styling elements and the curved surface construction design based on curved surface and other polyhedron facets gradually evolved into simple straight line style later. Haier refrigerators convey more high-quality preservation function and superior quality of refrigerator products through its more simple and clean appearance.

Summary

Information that refrigerator modeling style conveys to consumers contains brand value, cultural connotation, personality and social trends even the emotions and values that the refrigerator wants to express themselves. For designers, modeling is one of the important communication channels between designers and the public and design style conveys the designer’s own design ideas and values\(^7\). Refrigerator appears to be a simple geometry. However, how to reflect the design style and product style continuity of a particular brand on the simple geometry and how to meet the aesthetic needs of consumers while ensuring that consumers can accurately identify the brand will be a challenge for designers.

Acknowledgment

This study is financially supported by Basic Study Funding of Central University (2013B34214) and Project of Scientific Study on Higher Education of Hohai University(20141205).

References


