Application of Design Geometry in Minimalist Style Product Design

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Abstract. From the historical overview of design geometry, this paper briefly introduces the current popular style of product design—minimalist design. The emphasis is laid on the analysis and research of design geometry in the minimalist style product design, leading to the contemporary designer’s concern and thinking about design geometry. Thus, this paper establishes the importance of design geometry in minimalist style product appearance design.

1. Introduction
In the complex information age, people have to perceive and contact increasingly jumbled information, data, emotions, etc. More and more people choose a MINIMALIST lifestyle to relieve pressure, abandon flashiness, and return to simplicity and purity. Minimalism style has been favored by modern man. Minimalism was born in the 1960s. Its design concept advocates removing decoration, retaining basic functions and focusing on product details to enhance function and aesthetics so as to achieve the effect of “Simplicity but not Simplicity”. It encouraged designer to pursue the most concise artistic effect in artistic creation, simplify the shape into the most basic simplified geometric form, and give priority to the single color such as black, white and grey, integrate the space into the simplest two-dimensional style, create an atmosphere of PURE NIHILITY without emotion, rendering and space, and give the audience the most essential and pure visual experience. Minimalist style products are simple and delicate in appearance, focusing on the proportion and composition of product modelling. Round, square and triangle are the main contour lines and its product modelling is concise and harmonious. This coincides with the design method advocated by design geometry. By using design geometry to deal with the relationship between the proportion and scale of minimalist style product design, the product can achieve visual coordination and beauty. This paper analyses the application and influence of design geometry in product appearance modeling through the following classical minimalist style products cases.

2. Conceptual Theory of Design Geometry
2.1. Design Geometry in Nature
From the 20th to the 16th centuries B.C., a recorded proportion of gold section on the megalithic stone pillars. After that people in different industries have applied the golden section to sculpture, painting and architecture. There are also examples of golden section in nature, such as the proportion of human face and body, the proportion of salmon body, the spiral growth of sunflower and pine cone.
2.2. Golden Section Proportion
The beauty of golden section proportion can be appreciated from both nature and man-made goods. Many other golden section shapes can be obtained from the original golden section rectangle, such as golden section triangle, golden section ellipse, golden section helix and various dynamic rectangles of golden section.

2.3. Root Rectangle
The proportion of root-2 rectangle is similar to the golden section ratio. It can be infinitely divided into smaller equal-ratio rectangles. A root-2 rectangle can be divided into two equal small root-2 rectangles, and can also be divided into four equal smaller root-2 rectangle. The paper size system of German industrial standard adopts root-2 rectangle. This standard system is not only convenient, but also makes the best use of paper without any waste. Root-3 rectangle, root-4 rectangle and root-5 rectangle can also be divided into smaller similar rectangles like root-2 rectangle. These root rectangles can be divided both horizontally and vertically. There are many examples of root rectangles in life and nature, such as beehives, snowflakes, etc[2].

3. Classic product analysis of Design Geometry in Minimalist Style Product

3.1. Bauhaus
It can be said that the establishment and development of Bauhaus led to the rise of minimalist style. Just like the slogan LESS IS MORE which was raised by the designer Mies van der Rohe, minimalist style advocates the design concept of FUNCTION FIRST and SHAPE SIMPLICITY. Bauhaus advocates taking science and rationality as premise, standardization and unification as design criterion, and product form as determined by product function[3]. Its design mostly takes simple geometric figure as design element and carries on certain arrangement and combination. For example, the MT8 Bauhaus metal table lamp shown in Figure.1 has a simple shape, which is composed of a semi-circular lamp shade, a cylindrical lamp post and a disc lamp chassis. From the lamp chassis to the bottom of the lamp shade is a root-2 rectangle. A golden rectangle is formed from the lamp chassis to the middle of the semi-circular lamp shade, and the length of the lamp rope is equal to the radius distance of the lamp shade. Due to the appropriate proportion and minimalist style, it has become a representative work of Bauhaus style, which can be seen in many modern lamps.
3.2. Braun
German Ulm Design Institute inherits and improves the rationalistic design principles of Bauhaus Design Institute. The cooperation between German Braun Company and Ulm Design Institute has successfully expanded the minimalist design. This cooperation has produced fruitful results, so that Braun design is still regarded as one of the representatives of minimalist products. As Braun Designer Dieter Rams mentioned in the Ten Design Standards, “Good Design is Minimalist”, many of Braun’s excellent product designs show the characteristics of centralized function and simple shape[4].

The most typical product is SK4 record player designed by Dieter Rams and others in 1956. As a classic work of simple design of Braun Company, its greatest feature is its unique shape. The external form of the product is a simple right-angled white hexahedron, consisting of an openable transparent plexiglass cover and a white metal box. As shown in Figure.2, the overhead area of the metal box is composed of two squares. The area of the gramophone record is a standard root-2 rectangle. The center of the circular turntable of the record is at the center of the square on the left half. A golden rectangle is formed from the center of the record to the left boundary of the box. The distribution of panel keys is regular and orderly. As shown in the side view of Figure.3, the whole area of the metal box is composed of a root-2 rectangle and a square. The window-shaped ventilation groove is designed as three squares of the same size. The height of the upper glass cover is equal to the distance from the ventilation groove to the boundary of both sides of the box. The whole product is simple and elegant in shape and delicate in structure, which breaks the aesthetic standard of people and thus gained the reputation of SNOW White’s COFFIN.

3.3. Apple
Apple’s product design is deeply influenced by Dieter Rams. It follows and pays tribute to Braun’s minimalist design style. Minimalism is also the core force Apple adheres to and the foundation of its future development. Apple’s products look exquisite and simpler, showing the aesthetic significance of design geometry.

As shown in Figure.4, Apple’s first-generation iPod product is a golden rectangle with symmetrical left and right sides. The bottom part of the product screen is a square. The center of the three concentric circles that make up the button is located at the intersection of the diagonal lines of the square[5]. Its simple and unique shape and humanized operation mode were once sought after by people.
Another example is Apple's iMac Intel i7 computer. As can be seen from the main view of this compact computer in Figure.5, the front frame of the whole computer is a root-2 rectangle shape. From the top to the bottom of the black display frame, the shape is a golden rectangle. The Apple logo is at the diagonal intersection of the lower white rectangular panel. As can be seen from its rear view in Figure.6, the parallel line at the connection of the computer bracket coincides with the horizontal central line of the overall shape. The bottom width of the computer bracket is one quarter of the width of the computer display screen. The Apple logo on the back is located at the diagonal intersection of the rectangle above the computer bracket. The overall shape of the computer is symmetrical, giving a sense of order and symmetrical.

The whole form of the iPhone 4 in Figure.7 is a rectangle composed of two squares. The Apple logo is located on the diagonal intersection of the upper square. The main display area of the screen is a root-2 rectangle. The center of the circular key is located at the diagonal intersection of the rectangle at the bottom of the display screen. The diameter of the key is the same as the width of the auditory hole.
3.4. Other Minimalist Style Products

In addition to the representatives of the minimalist style products mentioned above, there are also excellent NO DESIGN products like MUJI. Figure.8 is a MUJI CD player. The front of the player is modeled as a square. The CD slot is at the intersection of the square cross diagonal lines. Surface decorative holes are arranged in a radial manner with the intersection point as the center of the circle, and the four corners are round chamfers of equal size. The distance between the four circles and the intersection of the diagonal intersection of the square form a root-2 rectangle. The whole appearance of the product is simple and elegant, creating a tranquil and peaceful mood. This concise geometric design greatly improves the product identification of the MUJI.

Philippe Starck, known as the design genius, designed many products in a minimalist way. These products have a single shape, but they attach great importance to the use of geometric shapes. Their design is simple and functional. His Juicy Salif Citrus Juicer is novel and unique in shape, without any redundant decoration. In the top view of the juicer shown in Figure.9, the three supports of the juicer form an equilateral triangle, and the top part of the juice extractor is a fan of 12 sizes with the same 30 degrees. Figure.10 is the side view of the juicer. The top of the head and the support is in the golden ellipse. The drop point of the juice extracted by the juicer is in the center of the golden ellipse. The head contour of the juicer is also a golden ellipse. The contour edge line and the big golden ellipse from two golden rectangles. The distance from the bracket to the big golden ellipse is equal to the distance from the bracket to the head of the juicer, which is one fifth of the width of the whole composition. The shape of the juicer is a perfect example of applying design geometry to the minimalist style of product shape. The product has great artistic appreciation value.
Dyson Air Multiplier is also a minimalist style design product. Its unique structure principle, simple and generous shape, is the combination of science and art. Figure 11 The product is mainly composed of upper outlet component and lower motor module. The outlet is round in shape and the front view of the motor module is a root-2 rectangle. The diameter of the outlet and the base form a square, and the upper rotating point of the product is at the intersection point of the cross diagonal line of the square. The lower three keys are equal in size, circular, and equal in diameter to the height of the outer frame of the base. The overall form of the product is simple, fashionable and proportionally coordinated, which is popular indeed.

4. Conclusion
Through the analysis of the above classical minimalist style products, we can find that with the development of society and life, minimalist style products are still popular. Good design depends on many design principles[6] and designers can reasonably apply design geometry to minimalist style product modelling according to the needs of minimalist style product modelling while considering the design principles of humanization and technology of products to add visual aesthetic sense to products and enhance the aesthetic value and appreciation value of products.

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