Modeling Design of Instrument Panel

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Abstract. The basic requirements of instrumentation modeling, composition and layout, representation of functional areas, color, text, graphic symbols and signage, materials and coloring technology are discussed. The panel modelling should meet the following basic requirements, that is, the needs of product function, the needs of product uses, quick recognition, adaptability, artistry, and easy installation, adjustment and maintenance; The composition and layout of the panel are mainly panel composition of characteristic rectangular and panel composition of non-characteristic rectangular; The functional area of the panel can be divided into six types: wireframes, brackets, color blocks, spaces, segmentation lines and volume and surface; The color of the panel should consider its main color and matching color; Words, graphic symbols and signs on the panel, as well as the materials and coloring technology used in the panel are also factors that must be considered. The selection of materials is very important.

Keywords: modeling design; instrument panel.

1. Introduction

For instrumentation, panels are used to install control function elements and display function elements. It is a set of keys, knobs, indicator lights, display disk, jack, signage, model and other devices. The panel is the pivot of human-machine information transmission and exchange, is the window of human-machine dialogue, and is the most frequently operated component. Like the face of the product, its panel is the visual center of the entire product, is the core part of product modeling, it will made an important and deep impression on you. Therefore, modeling design of instrument panel greatly affects the using performance and sales of the whole product and we must attach great importance to it [1].

2. Basic Requirements for Panel Modeling

Before proceeding with the modeling design of instrument panel, we must analyze the basic requirements that the panel should meet [2].
1) It should meet the needs of product function
Product function plays a leading and decisive role in the panel structure and modeling. The panel structural, shape and color should meet the functional requirements.
2) It should meet the needs of product uses. The layout of functional components should be reasonable and logical. Their size, shape, position and color should conform to human physiological, psychological habits, to easy to observe, operate, to make people not easy to fatigue, no mistakes, safe and reliable use.
3) It should be quick to recognize. The text, symbols, display, etc. on the panel must be clear, concise, easy to understand, easy to recognize, and fast to read so as to increase efficiency of use.
4) It should be adaptable. Here refers to the adaptation to environmental conditions, it can adapt to mechanical environment (sufficient strength and stiffness, reliable connection, vibration resistance, etc.), climate environment and electromagnetic environment, it can also meet the requirements of corrosion prevention.
5) It should be artistic. The composition, layout, color, and texture of the panel should give people artistic appeal, they have a sense of the times, and should be consistent with the style of the entire machine.
6) It should be easy to install, adjust, and maintain.

3. Composition and Layout of Panel
To design the panel as a decorative painting with reasonable layout, pleasant color and convenient operation, the composition and layout of the panel are the core issues in the modeling design. Composition and layout should start from the operation of the product itself, and using the certain expression to achieve the purpose of clear instructions and clear at a glance. Composition and layout should guide the people sight line to flow according to the operation procedure, so as to maximize the convenience of users.

Composition refers to the reasonable segmentation of the face plate. Segmentation is based on aesthetic principle and fractal segmentation rule. In addition to meeting the aesthetic requirements, the composition must be closely combined with the functional requirements of the panel, so as to achieve both aesthetic and internal and external coordination, mutual correspondence, reasonable distribution and easy operation. Only in this way can the composition get good results [3].

1) Panel composition of characteristic rectangular
The panel shape is (or is approximately) a square, a medium rectangle, a \( \Phi \) rectangle and a root-mean-square rectangle, called a characteristic rectangle. Panel composition of characteristic rectangular can be divided according to the "fractal segmentation rule" [1], which can achieve better composition effect. This method is especially suitable for instruments with many operating indicators on the panel.

2) Panel composition of non-characteristic rectangular
The panel that is not a characteristic rectangle is non-characteristic rectangular panel, which is also the most common panel. Its basic principles of composition are:
(1) To avoid monotonous and rigid equivalence segmentation;
(2) The asymmetric segmentation method should be adopted, but the balanced effect of layout should be paid attention to.
This method is the easiest to achieve both harmony and contrast, both change and unity, both natural and vivid visual effects, as shown in Figure 1. It divides the plane into four unequal areas, so that the size of the area has both contrast and overall coordination, to give people a sense of beauty.

![Figure 1. asymmetric segmentation.](image1)
![Figure 2. oblique segmentation.](image2)
![Figure 3. curve segmentation.](image3)

(3) Use of oblique line segment
The oblique line gives people a sense of motion and strength, as shown in Figure 2. This composition can achieve dense contrast, balance, stability and rhythm.

(4) Use of curve segmentation
Figure 3 shows curve segmentation. This kind of segmentation can make the plane composition not only get active dynamic feeling, but also have quiet and stretching visual effect. It looks flexible, exciting and harmonious atmosphere, and produces implicit aesthetic feeling. This segmentation also have flexible changes and exciting, harmonious atmosphere, to produce implicit aesthetic feeling.

In the composition of the specific instrument panel, the reasonable layout should be carried out according to the function of the product and the number of components. It can be a single method or a combination of various methods, but no matter how to layout, we should pay attention to the following issues:
A. The hierarchical relationship of the panel. To highlight the theme is the primary problem to be solved in the design of instrument panel. Subject plays a decisive role in composition and object plays
a foil role. Subject refers to the main functional part, that is, observation center. The key to highlight subject is to deal with the hierarchical relationship of the panel plane, so that the panel presents the effect of three-dimensional space.

Generally speaking, the strong contrast part should be regarded as "foreground" (such as button, knob, name, model, sign, etc.); the medium contrast part or less stimulation part should be regarded as "middle" (such as text, symbol, etc.); and the soft and implicit part should be regarded as "background" (such as bottom, display screen, etc.). This treatment can make the panel level clear and improve the artistic effect of modeling.

B. The position relationship of the panel plane. The different plane positions of the top and bottom, left and right give people different feeling effect.

C. Blanks in panel layout. The layout of words and symbols on components of the panel should not fill the whole panel with full or even layout, to make people feel overcrowded and breathless. Appropriate blanks such as scattered, sparse, close, real, virtual, should be left, which can eliminate the monotony of the panel and leave room for its functional expansion. The blank is equivalent to the background, which serves as a foil to the panel and enhances the theme.

4. Form of Functional Area of Panel

In addition to conforming to aesthetic principles, the composition and layout of instrument panel should be in line with the operator's human functional characteristics, to make the operator easy to use and obtain the highest operational efficiency and accuracy. Special attention should also be paid to the intrinsic connection of indicators and adjusting control buttons. The various components on the panel should be arranged according to the functional area, that is to say, in accordance with the operator's operational logic. Six forms of expression are generally used in the design of instrument panel to highlight the characteristics of operation function and logic rules. They are:

1) Functional areas are distinguished by wireframes (see Fig.4).
2) Functional areas are distinguished by brackets (see Fig.5).
3) Functional areas are distinguished by color blocks (see Fig. 6, where R is red, B is blue, Y - yellow).
4) Functional areas are distinguished by blank spaces (see Fig.7).
5) Functional areas are distinguished by segmentation lines (see Fig. 8).
6) Functional areas are distinguished by volume and surface (see Fig. 9).

The above-mentioned forms of functional areas should be flexibly applied according to the actual situation and the needs of modelling. Wireframe method and bracket method are simple in modeling design, various in technological means and have good appearance effect. Wireframe method and blank space method are suitable for the same or similar size and shape of components. Bracket method and segmentation lines method are suitable for the case of more types of components, larger differences in
size and shape. Color blocks method and blank method are suitable for the case of using touch switch. Volume and surface method is mostly used for engineering plastic panel of injection moulding, to rich in it layers and three-dimensional sense. Components in each functional area should be fully separated. The more spacing, the less interference, which helps to enhance memory, improve operational efficiency and accuracy.

5. The Color of the Panel
The panel is the "face" of the instrument. How to deal with the color is not only related to the function and use of the product, but also has a great impact on the moulding[4].
1) Main color of panel
Generally, the panel uses mostly cold tone or neutral tone and other monochrome, to give people a concise, elegant and generous feeling. Monochrome is not monotonous, because there are other colors on the instrument panel, such as indicator lights, buttons, signs and so on, which can make the overall color still rich. Of course, when considering the panel main color, the color of the whole machine always is pay attention to harmony.
2) Color matching of panel
There are many components and character symbols on the instrument panel for users to observe and use. This requires that the color of the panel be cordial and pleasant, lively and generous. Usually, the color with slightly higher purity and moderate value can be chosen.
3) Attention points of panel coloring
(1) Large-side harmony and small-side contrast
For larger instruments and meters, the overall color harmony should be adopted, while the small area contrast color should be used on the panel.
(2) Harmony in comparison.
For middle or smaller instruments and meters, large contrast can also be used to achieve harmony and unity.
(3) The texture of the panel
The texture of the panel should be fine, dull or matte and soft. It is necessary to avoid the appearance of glare-producing electroplated parts on and near the panel, so as to avoid strong visual stimulation.
(4) Corporate image (CI)
It is imperative that modern enterprises must fix a main tone in the product, which is conducive to the sales and display of the product.

6. Words, Graphic Symbols and Signs on the Panel
The design of instrument panel aims at communicating with people and conveying functional information of products. This kind of communication and convey is mediated by words, graphic symbols and signs, so it is also very important for their design[5].
1) Word. The words on the panel should be clear, standard. Other descriptions and figures should be typesetted with standard Chinese bold and Song-style photographs, except that the trademark is a special graphic or text for registration. The English letters should be isoline of different sizes and thicknesses to form a rhythmic composition.
2) Graphic symbol. Various types of graphic symbols are widely used in modern indicative means. It replaces and supplies transmission of text signals with a highly generalized, concise and vivid graphical language. It is intuitive and you know what it means when you see a graphic symbol. It has a strong versatility and is not limited by the country, region, language and cultural level. Many graphic symbols have become the common language of users. Most graphic symbols have national standards, so national standards should be adopted in design.
3) Sign. Here is the trademark and nameplate of the product. A trademark is a commodity mark and cannot be changed at will. A nameplate is a product model and name. They are well designed and play a good decorative role and a strong role in publicity, so we must also attach great importance to them.
7. Panel Material and Its Coloring Technology
The main materials for making instrument panel are aluminum plate, engineering plastics and plastic-bonded aluminum sheet[6].
1) Aluminum plate. This material is the most widely used in instruments. Different texture panels can be obtained by electrochemical treatment, dyeing, sandblasting, wire drawing, polishing and painting. Aluminum plate is light in weight, long in life. Its treatment methods are simple and varied, suitable for single piece, small batch and large-scale production. The common coloring processes have fine printing and offset printing.
2) Engineering plastics. Engineering plastics of injection moulding can be made into convex and concave three-dimensional panels, which has the characteristics of soft color, harmonious pattern and various colors. It is also a widely used on instrument panel, but it is not suitable for single piece and small batch production, because the cost of manufacturing a set of moulds is very high. Common coloring processes are: PVC transparent plate silk printing, polycarbonate PC colorless transparent plate silk printing and plastic parts direct silk printing.
3) Plastic-bonded aluminum sheet. Plastic-bonded aluminum sheet is formed by combining processed plastics with aluminum sheet through a certain process. It has a variety of colors, soft color, delicate texture, simple and generous, stable and elegant artistic effect. This material is also widely used in instrumentation. The coloring process of plastic-bonded aluminum sheet is similar to that of engineering plastics.

8. Conclusion
The basic requirements of instrument panel modeling are composition and layout, representation of functional area, color, text, graphic symbols and signage, materials and coloring technology. Like the face of the product, its panel is the visual center of the entire product, is the core part of product modeling, it will made an important and deep impression on you. The modeling design of instrument panel has a great influence on the performance modeling and even sales of the whole product, and must be given high attention.

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