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Retraction

Retracted: Application of User Experience Gene Extraction Model Based on Industrial Design

Security and Communication Networks

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope

(2) Discrepancies in the description of the research reported

(3) Discrepancies between the availability of data and the research described

(4) Inappropriate citations

(5) Incoherent, meaningless and/or irrelevant content included in the article

(6) Manipulated or compromised peer review

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] Z. Yu, "Application of User Experience Gene Extraction Model Based on Industrial Design," *Security and Communication Networks*, vol. 2022, Article ID 7366480, 14 pages, 2022.

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Research Article

Application of User Experience Gene Extraction Model Based on Industrial Design

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Product design DNA is a new concept produced by applying the idea of genetic engineering to the field of industrial design, involving multiple knowledge fields, aiming to give products a unique shape and style image to build a brand. This paper systematically summarizes the current situation and progress of product design DNA research at home and abroad, focusing on the expression structure, application research progress, and research on key technologies. The law of DNA generation and derivation; explore the user's cognitive mechanism for product design DNA; realize the connection between product design DNA reasoning and production. The designed user experience gene extraction based on industrial design provides new ideas for product design and has strong guiding significance.

1. Introduction

China is becoming a global manufacturing base but "made in China" should not be synonymous with "imitation." China is striving to "create in China," and rapid product innovation and brand building will become the focus of Chinese enterprises in the next step. With the homogenization of technology, products no longer only meet the functional requirements [1]. How to give products a special form and style image to shape a unique brand has become one of the important works of product development. In those famous enterprises, the style of products always maintains a certain inheritance in continuous innovation such as Mercedes Benz, BMW, and Nokia. No matter how many generations of their products are updated, people can always identify them from the products of many brands. However, because product design is full of fuzziness and uncertainty, designers usually map the design intention to the new design with their own experience, intuition, and inspiration. Due to the lack of rational support, it is difficult to form a set of practical style-oriented product design methods. Industrial design is not equal to appearance design. It contains more internal factors including culture and brand, which not only maintains the continuity of product design style but also has innovation. In product innovation design, an important means is to adopt the gene design method for user experience to realize the serialization of products facing different needs or products with greater deformation ability [2].

Today's economic forms are diverse, with the emergence of new terms such as "leisure economy," "tourism economy," "silver hair economy," and "fitness economy," as well as the topic of "experience economy." With the emergence of the "experience economy," as the basis of providing economy, the attributes of products also change with the change of economic form. Product design is the product of the industrial revolution. It is the internal reflection of the times, economy, technology, and culture. The development of the "experience economy" drives the development of "experience design."

However, when it comes to the "user experience" of products, most of us only stay on the interactive interface, and even narrow it down to the "screen." We think "experience" should only be the category of interaction design, and the software is appropriate. We should know that a good product is not only based on interactive software development and design but also includes a hardware system covering many factors such as color, material, size, design psychology, and so on. Not only at home, but also abroad,

few people mention the concept of software and hardware of product design and the systematic research of such design at the same time.

DNA stores the information of parents and guides the development and functional operation of organisms through instructions. In nature, the previous generation of organisms copied their DNA into their offspring to realize inheritance, so that their traits can be maintained; at the same time, DNA will also change, and the traits of offspring will change accordingly. Due to the continuous progress and development of science and technology, various disciplines intersect and learn from each other, and there is a trend of high integration among interdisciplinary disciplines. In this context, relevant researchers have also applied the idea of gene and genetic engineering to the field of industrial design, and a new concept of "product design DNA" has emerged. Its main focus is on how to endow products with unique form and style images, so as to shape the brand under the trend of increasing homogenization of technology among manufacturers. After hundreds of years of development, the product styles of famous foreign enterprises always maintain a certain degree of inheritance and continuous innovation. Therefore, consumers can always identify them from many brand products [3].

2. State of the Art

The source of "user experience design" is the "user and man-machine interface experience." In the early design process, the development of the man-machine interface is independent of the development of the functional core and often starts at the end of the whole development process. The result is that the products developed lack "user experience" data, resulting in risky failure and almost difficult to obtain satisfactory results. Therefore, someone proposed to implement "user experience" in interface design. "Product user interface experience," as an important bridge between users and products, has not received corresponding attention. Design is often lost in "modeling" and "style," and forgets to deeply study the deep meaning between "user" and "product." "As far as consumers are concerned, the interface is a product." Paying attention to the user experience can achieve satisfactory results.

When consumers buy products, they are no longer limited to the investigation of product functions, but also gradually pay attention to whether the products can meet their own spiritual needs, as the first element of transmitting product information, product form is particularly important in the process of industrial design because product form not only affects the use function of products but also reflects the spiritual connotation of science and culture that designers want to convey. Today, with the serious homogenization of product form and its modeling technology, innovative research on product form design technology has become an important field of industrial design research. At present, the research on product form design technology at home and abroad mainly includes product gene, QFD and TRIZ, combinatorial innovation principle, fuzzy theory, grey theory, and so on. However, with the continuous cross integration of biology and industrial design, the research on product genes has become a frontier and hot topic in industrial design. Feng et al. also put forward the insufficient research on the key characteristics of gene transcription technology and the use of gene transcription technology [4]. Chen and Luo proposed that product design must extract the explicit and implicit features of product family DNA from many aspects such as syntax and semantics [5]. Lu et al. proposed the DNA reasoning method of product design based on shape grammar [6]. Yan et al. proposed the coding technology of using the set of morphological parameters as the target problem coding [7]. Gero and Kazakov studied genetic engineering and applied it to genetic algorithm genetic engineering [8]. These scholars have studied the product gene and related technology from different fields to a large extent, reflecting the related technology of product gene, and have good scientific and advanced nature.

However, in the current product design, the DNA extraction of user experience is not mature enough. This paper proposes a user gene extraction algorithm based on industrial design. By using gene extraction for users of product functions and product appearance, it provides the design of industrial products reference guidance. The overall process is shown in Figure 1 [9].

Based on the in-depth study of product genetic characteristics and morphological gene theory, the product form gene hybridization technology aims to provide new technologies for product form design and improve product form through the extraction and coding of product form genes and the study of gene hybridization algorithms, design efficiency, and design quality.

3. Methodology

3.1. Definition of Product Design DNA. Design is a creative process, and this does not mean that new products or components must appear, but should be created on the basis of existing knowledge in an effective way, and the existing design elements should be reintegrated and developed under given constraints. Most of the previous design knowledge is fragmented and scattered in various fields, and the expression method of design knowledge is mainly to classify these fragments, which often leads to the segmentation of design knowledge, isolation, limitation in their respective scope, and lack of coherence and organic connection. The concept of product design DNA appears to solve these problems.

The so-called product design, DNA refers to introducing the concepts of DNA similarity and inheritance into the internal genetic and variation characteristics of product design. In the process of product development and design, all new products are related to previous products but not exactly the same. At present, there is no standard definition of product design DNA. According to relevant materials, it can be summarized that product design DNA should have the following characteristics: (1) Just as biological DNA determines and controls the growth and development sequence and process of organisms, product design DNA should also determine the cycle, process and stage of product

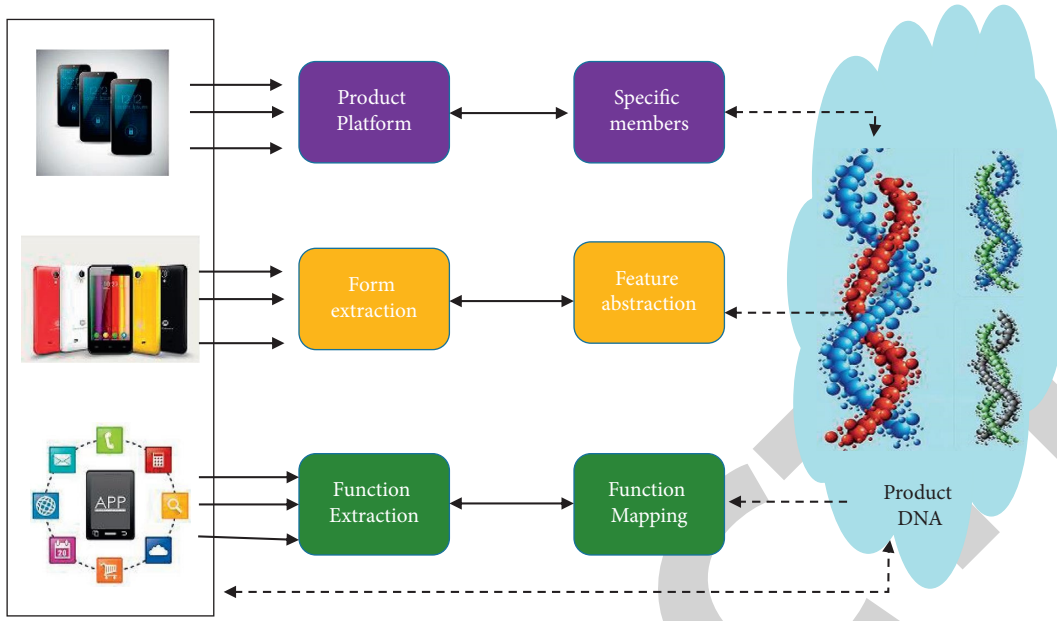

Figure 1: The user experience gene extraction based on industrial design.

design to a great extent; (2) Product design DNA should be confirmed by practice, product design information with genetic value, that is, it has the significance and value of inheritance and reference for other product design; (3) Product design DNA should be standardized product information to facilitate the management and use of product information; (4) Product design DNA is based on coding oriented and function-oriented knowledge. It can produce new product forms that meet the requirements under given constraints [10].

Product gene is the application of genetic engineering in product design. This concept was first proposed by Gero and Kazakov [8]. Feng et al. [4] and Chen and Luo [5] of Zhejiang University were the earliest researchers in China to understand product design with the concept of the gene. The early research on product genes mostly focused on the field of mechanical design, but recently it gradually shifted to the field of industrial design and increased the attention to perceptual images [11]. There are many types of research on product optimization in the evolutionary algorithms, which focus on optimization efficiency and quality, and do not pay special attention to the product design problem itself.

In a specific application, product design DNA has the following characteristics: (1) Flexible knowledge structure. Since the external conditions often change in the actual situation, the design knowledge should be able to be flexibly transformed and effectively responded to; (2) With the rapid and rapid application, product design DNA can be divided into two design knowledge domains (discussed in detail below), including several basic knowledge units such as morphological features, expert knowledge, organization and management, creativity, working principle, patented technology, operating mechanism, and value utility, these knowledge units ensure the rapid application of design knowledge under constraints; (3) Easy to read. Product design DNA can be expressed by unitary structure and graphic way, which is easy to read by users and design software [11].

3.2. Knowledge Structure of Product Design DNA. Turbon and Aronson proposed that knowledge can be divided into implicit knowledge and explicit knowledge, which are closely related to each other. According to this theory, the design knowledge in the system of product design DNA is divided into two parts: morphological knowledge domain and functional knowledge domain. There is a mapping relationship between the two domains, as shown in Figure 2.

As can be seen from Figure 2, the morphological knowledge domain includes invisible knowledge and other knowledge concepts, which are composed of morphological features, expert knowledge, organization and management, creativity, etc. Expert knowledge is an important criterion for evaluating design, which corresponds to the working principle and patent in the field of functional knowledge; organizational management represents the knowledge structure and the connection of various knowledge units, which corresponds to the operation mechanism in the functional knowledge domain; creativity refers to the creative thinking in product design, which is related to working principle, patented technology, operation mechanism, and value utility. The functional knowledge domain includes explicit knowledge such as working principles, patent technology, operation mechanism, and value utility. They also form a mapping relationship with each knowledge unit in the morphological knowledge domain. Given constraints will ultimately determine the specific mapping relationship [12].

Taking the mobile phone as an example, according to the product design DNA knowledge construction method proposed above, the knowledge structure of mobile phone design DNA is established as follows, as shown in Figure 3.

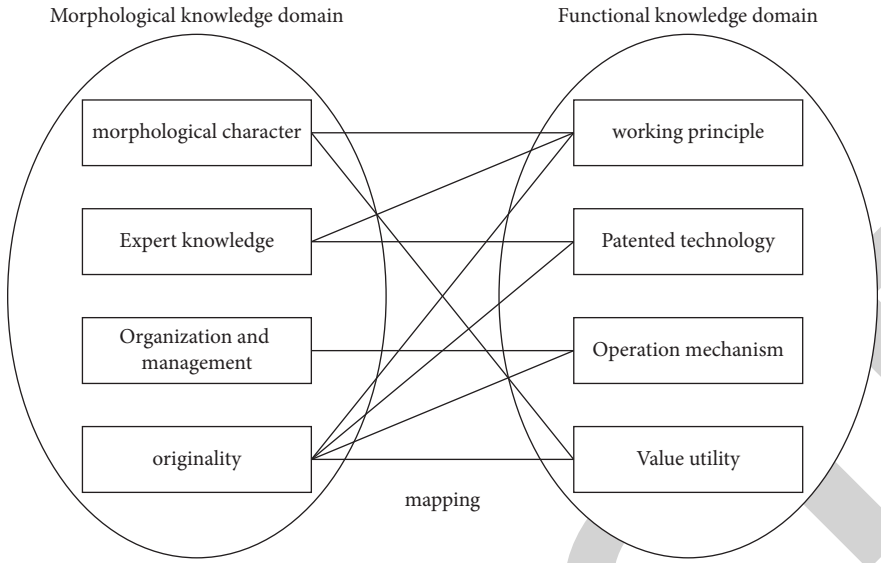

Figure 2: The two knowledge domains and their mapping relationship.

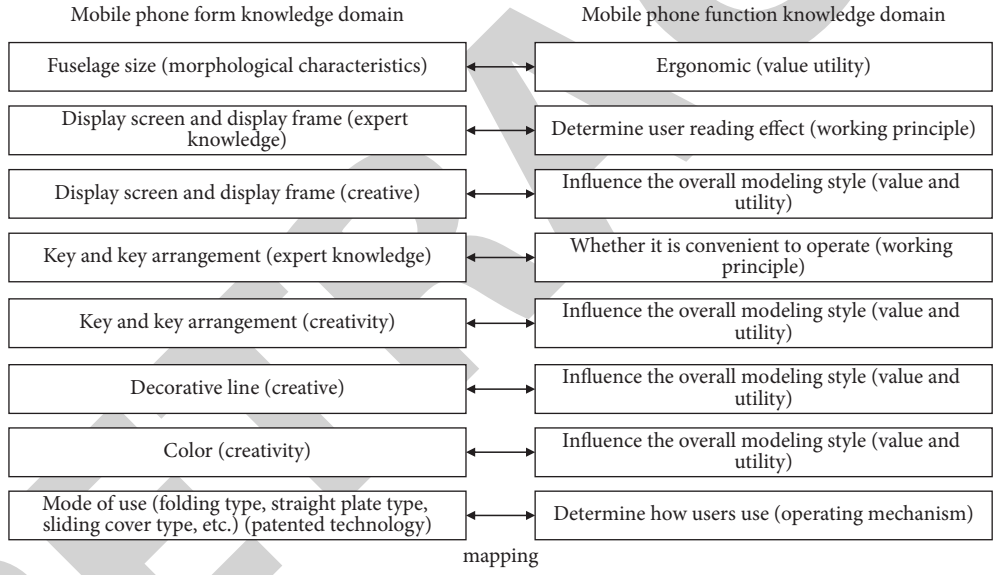

Figure 3: The knowledge structure of DNA design of the mobile phone.

3.3. Analogy between Product Design DNA and Biological DNA. Referring to the molecular model structure of biological DNA, try to establish the structural model of product design DNA. Take the mobile phone as an example, as shown in Figure 3. The product design DNA in the figure has a linear double helix structure, which consists of two "chains"—morphological knowledge domain and functional knowledge domain—and their mapping relationship, as shown in Figure 4.

When the new product design starts, the two chains of product design DNA will be spun and transcribed under the design constraints (such as cost, cycle, market division, and consumer preference) and become two knowledge systems leading the design, and product design mRNA and product design tRNA. This is just as if the DNA of an organism is transcribed into mRNA and tRNA under the action of a biological enzyme (enzm and ENA T are the enzymes in biology, and DNA is transcribed under their binding action). In biology, mRNA, that is, messenger RNA, carries genetic information and serves as a template in protein synthesis; tRNA is the transport RNA (transfer RN a), which transports the activated amino acids to the ribosome by matching itself and the mRNA template to synthesize protein. In contrast, product design mRNA refers to the knowledge space structure with mapping relation formed by rearrangement and combination of each knowledge unit in product design DNA, while product design tRNA determines the organizational relationship of each knowledge unit according to external constraints. Furthermore, product design mRNA is converted into coding, which contains the feature information of product parts; tRNA is transformed into anti coding, which can make the components form the whole

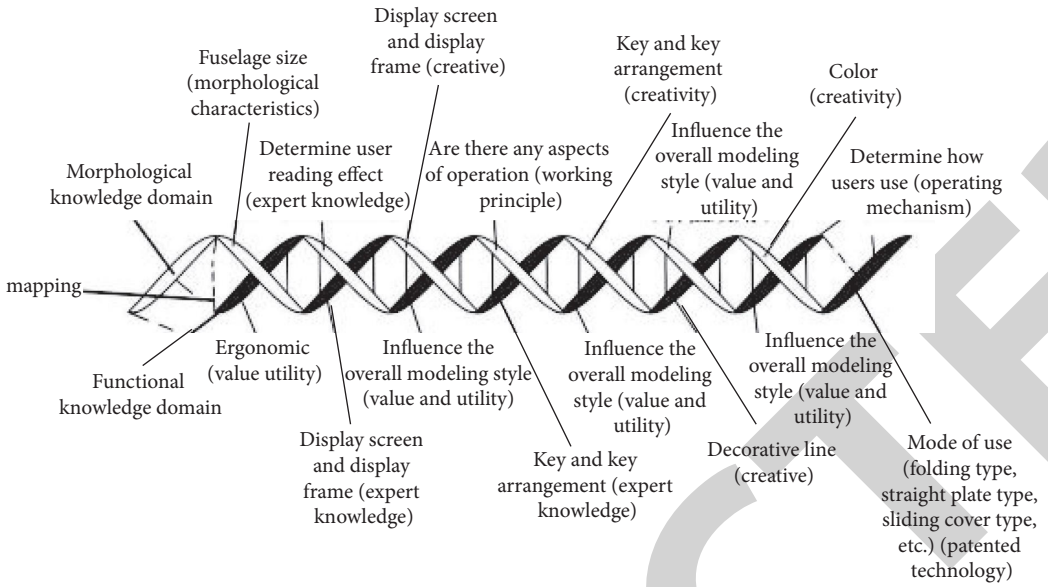

Figure 4: The structural model of mobile phone design DNA.

product characteristics under the constraints by transmitting the relationship information between the components. Heebyun gives an analogy between product design DNA and biological DNA, as shown in Figure 4.

3.4. Product Design DNA and Product Family Design DNA. In recent years, the concept of "product family design DNA" has been put forward by scholars of Zhejiang University. A product family is a group of related products based on a product platform and by adding different personality modules to meet the personalized needs of different customers. mey Er,A product platform is the foundation of a product family, and it is a reusable module set that can be shared by a series of products. Generally, it has a relatively stable structure. An effective product platform is the core of the product family and the foundation of related series products within the product family. It has the common characteristics of all products within the product family, product family design is the core content of mass customization. The similarity between DNA family and product design is studied and put forward [13]

Through comparative analysis and research, it is considered that the connotation of the two concepts of "product family design DNA" and "product design DNA" are very close. The reason is that the core of the product family is a basic product platform, so the product family is a general designation of products with a large number of the same or similar characteristics, which means that the product members in the product family are changing, but they enjoy many common characteristics, so that the products of the enterprise have common identification elements. Then, the product family design DNA can also be considered as the product design DNA of the product platform in the product family, as shown in Figure 5.

The first type is the potential relationship between similar elements in the two sub-networks of "design parameter network" and "image target network." According to the types of node parameters, there are two methods for discovering this kind of edges: Pearson correlation and Spearman correlation. The value of node parameters is a continuous variable. When the data distribution conforms to the normal distribution, the Pearson correlation between the two groups of parameters is used to calculate its correlation. This is also a common way in the process of building biological gene networks.

The specific calculation method is:

$$r = \frac{\sum (x - \overline{x})(y - \overline{y})}{\sqrt{\sum (x - \overline{x})^2}\sqrt{\sum (y - \overline{y})^2}}. \quad (1)$$

In the above formula, X and y are the values of two design elements, $\overline{x}$, $\overline{y}$ are the mean values of the two. R is the correlation coefficient between the two sets of parameters. The closer R is to 1, the higher the correlation between them. On the contrary, the closer R is to 0, the lower the correlation between them.

When the parameters in the nodes are classified as variables or the distribution does not conform to the normal distribution, and the Pearson correlation method cannot be used, Spearman correlation is generally used to calculate the correlation degree between nodes. The calculation method is as follows:

$$r = 1 - \frac{6 \sum d_t^2}{n\left(n^2 - 1\right)}, \quad (2)$$

where: n is the number of genes; Du is the order difference between two genes.

No matter that calculation method is used, a correlation value r can be obtained. Set a correlation threshold $[R]$ for it.

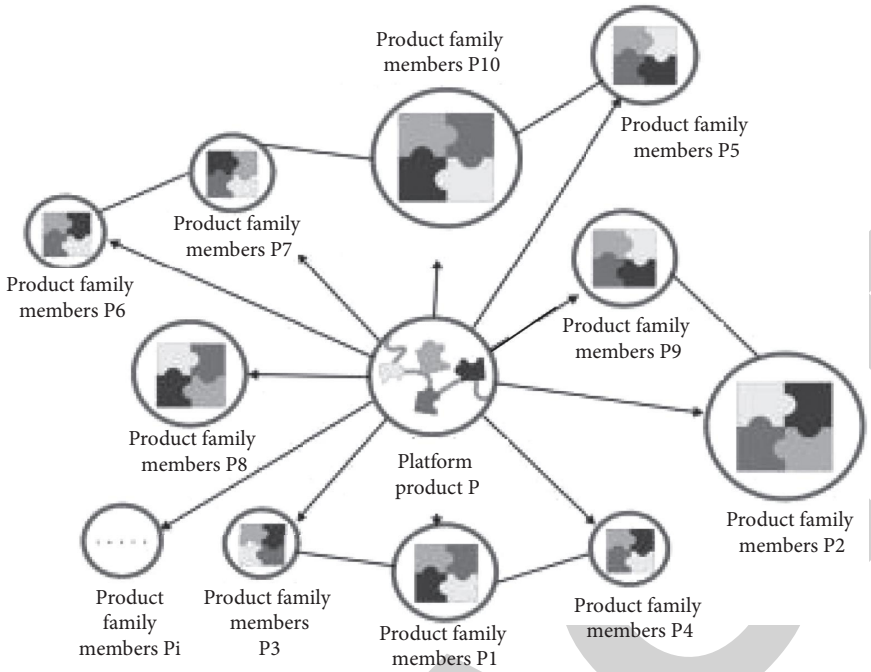

Figure 5: The product family member structure relationship.

When the correlation coefficient r exceeds this threshold, it is considered that the two nodes are associated, and a connection can be established between the two nodes.

In order to find all the edges in the sub-network of the product modeling gene network, the correlation between all nodes in the network needs to be calculated by formula. Finally, the gene network model of product modeling is established [14].

The second type is the mapping relationship between two different nodes, namely, the "design parameter subnet" and "image target subnet." This kind of edge connection can be obtained by comparing the design parameter characteristics of the vehicle models classified by each image target in the process of constructing the image target subnet with the "indirect method."

3.5. Product Gene Network Feature Recognition. Through the identification of the shape and characteristics of the product gene network, we can get the macro knowledge that can directly assist the designer in the design process. It is mainly divided into two parts:

① In the product gene network model, there are two main values associated with nodes for the identification of node characteristics:

One is the number of connections between the node and other nodes, that is, the degree of this node. It can be determined by equation (3)

The threshold R is obtained by statistics. This value represents the centrality of the node.

The second is the node variance, which is calculated as follows:

$$V = \frac{1}{m-1}\sum_{i=1}^{m}\left(x_i - \overline{x}\right)^2. \tag{3}$$

In the formula, all samples are divided into m equally large intervals according to the value definition field of this parameter. X is the number of samples at the i-th level in the parameter arrangement among all samples, and X is the average value of the number of samples at all levels of this parameter.

The above formula expresses whether the parameter distribution probability density curve of this node has a tendency, that is, the influence of the change of this node parameter on the overall evaluation can be simply described as the sensitivity of the node.

Through the calculation and statistics of "centrality" and "sensitivity" of nodes in the network, they can be divided into four categories, as seen in Table 1.

Key node parameters are related to many other nodes. At the same time, they are worthy of change and have a great impact on the product itself, which requires special attention. Although independent nodes have a great impact on products, they are not strongly related to other nodes and can be considered independently. The value of passive nodes has little impact on the overall product, but it is affected by many other nodes based on its high psychological characteristics. The value of secondary nodes is not obviously related to other nodes, and the change of value has little impact on the overall evaluation of products, so such nodes can be appropriately ignored.

Table 1: The classification of nodes in product GRN.

Node type	Centrality	Sensitivity
Key node	High	High
Independent node	Low	High
Passive node	High	Low
Secondary node	Low	Low

② For the identification of node groups, in the product gene network model, it can be observed that several nodes are associated with each other and obviously have edges with each other. It can be seen that these parameters play a common role in the expression of products. In this paper, the correlation threshold method is used to identify the node group. According to the formula, the correlation between nodes in the product gene network is a continuous variable. The setting of the threshold directly affects the presence or absence of the inner edge of the network structure, that is, under different threshold R values, the product gene network will show different density differences according to the connection strength between nodes. By adjusting the correlation threshold, we can gradually and clearly show the division of node groups in gene networks. The identification process and results of these node groups can provide designers with clear reference and auxiliary information: which elements can be considered independently, which elements need to be considered uniformly, and which elements are most firmly related.

3.6. Design Method of Emotional Interaction. Good interactive attention function, excellent interactive attention to emotion. To make the interactive design have an emotional function, it is necessary to make products have an emotional connection with people. In this way, users can have some feelings of pleasure, pleasure, and passion.

When we design a product, we need to use a variety of design elements such as modeling language, color matching, material performance, and so on. If we combine these elements in different ways, people need to invest in different emotions to understand these combinations, so the emotional interaction between the product and people will arise. In essence, interaction design is a design of user behavior. Emotional interaction can affect user behavior from the inside out. This influence is subtle. We often say that to make emotional interaction, we should treat the user as a moody person because this is in line with people's irrational nature. Emotion is something suppressed by reason. To break through reason and make emotional interaction, we need to pay more attention to users.

It must be noted that a certain emotion expressed by emotional products must consider whether it meets the needs of target users. For example, medical products should be compatible and safe, and children's toys should be interesting. It is very important that the personality of emotional products should be consistent with the personality expected by users.

Back to creating emotional interaction, there are basically the following design methods: integrate the elegantaesthetic experience into the product. Everyone has a love of beauty. Beauty can affect people's feelings through people's senses, and even affect people's behavior. A product has external formal beauty that can infect people, which can make users have the impulse to use it when they see it, and this formal beauty does not separate the logical relationship with the product function.

4. Result Analysis and Discussion

The design parameters of the product include all kinds of information in all dimensions such as color, size, and texture. To completely define a product with the parameters of each dimension, the information of each dimension needs to be rewritten to facilitate statistics and analysis, so as to build a network. Therefore, the complete gene network model of product industrial design is very complex. This paper aims to prove the existence of gene networks in complex product modeling and extract relevant knowledge, so only the dimension of shape features is selected. Product modeling gene network has been demonstrated in simple products such as water bottles. In this paper, the automobile is selected as the research carrier of modeling design gene network, because the modeling structure of the automobile is complex, involving a free-form surface and a large amount of modeling information in space. The application of the gene network model in automobile modeling has better universal significance.

4.1. Design Parameter Network of Automobile Modeling

4.1.1. Determination of Automobile Modeling Design Parameters. Automobile modeling is one of the most complex industrial design objects. Its complexity is mainly reflected in: there are many design parameters that need to be assigned in the design process, and there are many perceptual evaluation images as design objectives. Under the influence of these image objectives, there are a lot of implicit relationships between design elements only through the accumulation of long-term work experience can designers grasp these potential relationships perceptually, which leads to the industry characteristics of high entry threshold and long design cycle in the automotive industry design industry. Therefore, how to use CAD technology improves the work efficiency of the automotive design industry has always been a research hotspot. At present, most CAD technologies prefer automation, and intelligence can be grafted into this industry to replace the work of designers. This kind of solution ignores the evaluation goal with absolute certainty, which is different from mechanical products. The evaluation of automobile design results is mostly perceptual image evaluation with complexity and fuzziness. The designer's participation is stripped from the design activities to completely rely on computer technology for a design solution, which inevitably leads to the deviation between the

solution result and the expected value, and the practical value is limited. Therefore, in complex industrial design tasks such as automobile modeling design, it is difficult to completely rely on CAD technology to solve the design object. The designer's decision is still an important guarantee to control the design quality. The combination of CAD technology and designer decision-making is undoubtedly an important means to solve this problem. The specific goal of this chapter is to excavate the potential relationship between the primary and secondary structures and periods in each "design assignment parameter" and "image evaluation target" by building the genetic network model of automobile modeling, and to excavate and output relevant knowledge through the means of information visualization, To assist designers in decision-making.

The automobile design involves many free surfaces, and the number of design parameters to be assigned is huge. But no matter how complex the shape is.

The information transmission of its geometric features has no information hierarchy of points, lines, and faces.

That is, the visual effect of automobile modeling depends on the dimension relationship of each part and the shape of the feature surface.

The size of the local dimension and the shape of the feature surface depend on the shape constraints of feature curves. Automobile modeling example.

The experiment shows that three types of modeling such as area line, form line, and crown line, are proved.

Feature lines have a great influence on the car shape, and these characteristic curves are determined by the coordinates or relative position relations of key points. In other words, automobile modeling can be obtained indirectly by the dimension parameters between the key points. It can be simply considered that the process of automobile design is the process of assigning the position dimension parameters that determine the key points. So these parameters are selected as the design elements of automobile modeling in this chapter.

Based on the above ideas, this paper takes the model of Audi A6 model of 2006 as an example to extract the design elements.

Firstly, the rough a-plane features of the vehicle body are obtained by three-dimensional modeling. A total of 23 basic modeling feature curves are involved during the construction, as shown in Table 2. The shape and spatial position of these 23 modeling feature curves are determined by the spatial position relationship of 106 key points. For the whole process of automobile design, these parameters are only a small part of the design elements to be assigned in the process of design and do not contain all the modeling details. But these parameters constrain the most important body features the body and have a decisive influence on the overall style of the body shape. For the construction of the product modeling gene network, these data contain the position information of key points in the projection surface of the vehicle body modeling, which has enough complexity. This chapter will take 106 parameters as nodes to construct the network of vehicle design parameters, as seen in Table 2.

Table 2: The names of key styling lines for automobiles.

Line number	Line name
1, 2, 3	Side view top profile
4, 5	Side window boundary line
7	Wheel housing boundary line
8	Waistline
9	Front ceiling lamp line
10	Lower edge of front window
11	Lower edge of front window
12	Rear window side line
13	Side line of top wall
14	Curvature line of wheel housing
15	Hood style line
17	Along the lower A-pillar
18	Along the lower C-pillar
21	Headlamp boundary line
22	Boundary line of air inlet grille
23	Tail lamp boundary line
24	Front bumper side line
25	Rear bumper side line
27	Front lower boundary
36	Side view underbody profile

4.1.2. Design Parameter Network Modeling. After the market selection, the product will produce more appearances under the contemporary aesthetic trend.

Unified evaluation standard. Under this evaluation standard, many parameters in automobile modeling show potential connections, which are reflected in.

The relation and restriction between parameters. The network of automobile design parameters is precisely used to describe the potential correlation among various design parameters.

The model of the vehicle is an important link between the perceptual evaluation image and the design parameters of the vehicle modeling.

It is proposed to extract this connection in the actual existing brand car funds.

In the process of network construction, it is very important to select samples. The quantity and quality of samples are all important to the quality of network construction.

It has a decisive impact. In reality, all kinds of car funds, as the products tested by the market, can be regarded as conforming to the requirements.

In the previous sample of the evaluation criteria for the vehicle models, this study collected more than 300 pictures of each brand. The appearance and design style of products is affected by social, time, and cultural factors. The purpose of building a product modeling gene network is to assist the appearance design of cars in the future, so it is not suitable to choose too old cars. This paper selects cars of various brands since 2000. Considering the accuracy of statistical results, similar models of the same brand are excluded and only one is included. At the same time, the constructed automobile modeling gene network should be the summary and refinement of general vehicle design modeling knowledge in a fixed era. Considering the universality of the results, too-

personalized cars are eliminated. Finally, 146 models of 32 automobile brands were selected as the experimental samples, as seen in Tables 3 and 4.

Through the identification and extraction of relevant design parameters in these parameterized vehicle models, the 146 vehicle models can be obtained.

A total of 106 shape design parameters of this.

When the design element nodes are identified, finding the connections between nodes is the main task of gene network modeling.

The size assignment parameters in automobile modeling are continuous variables, so this paper finds the continuous variables through the Pearson correlation coefficient Connect.

By setting different correlation thresholds, a limited number of important nodes can be presented to designers.

4.1.3. Help of Design Parameter Network to Designers. Modeling design has great perceptual factors, and the role of designers (that is, to determine the value of each design element) is very important at present.

It is still irreplaceable by technical tools. Design elements are the objects directly operated by designers, so their network has a great influence on designers.

The auxiliary function is mainly reflected in alleviating the combination explosion caused by a large number of assignments and improving the efficiency of the designer's manual optimization, Instead of directly calculating the optimal value of a design element.

The basic idea of using a design parameter network to solve a combination explosion is to find out the most "important" from many design elements.

Give priority to nodes, or find closely related node groups for unified processing.

The degree and sensitivity of nodes are common indicators to measure the importance of nodes in the network.

(1) Degree of a node.

The number of nodes connected to other nodes in the complex network is expressed as the number of nodes connected to other nodes.

The number of relationships between them. When the correlation threshold $[R] = 0.2$, the five nodes with the highest degree in the automobile modeling design parameter network, as seen in Table 5.

(2) Node sensitivity.

Node sensitivity refers to the tendency of the distribution law of the value of a design element in the sample, which can be determined through the node.

The variance of the value is calculated. The smaller the variance, the more average the distribution of node values in each value range.

The smaller the tendency is, that is, the change of node value has little impact on the number of samples and is not sensitive. Otherwise, it indicates sensitivity.

Table 3: The sources of model samples.

Number	Brand	Quantity
01	Alfa Romeo	4
02	Audi	10
03	BMW	13
04	Mercedes Benz	7
05	Honda	8
06	Peugeot	3
07	Dachia	1
08	Daewoo	1
17	Lexus	4
18	Renault	3
19	Suzuki	1
20	Mazda	7
21	Martha	2
22	Muscoviti	1
23	Opel	1
24	Pontiac	3

Table 4: The model sample source 2.

Number	Brand	Quantity
09	The masses	8
10	Dalem	1
11	Fiat	2
12	Toyota	8
13	Ford	6
14	Jaguar	5
15	Larda	1
16	Rolls-Royce	2
25	Kia	1
26	Nissan	15
27	Mitsubishi	9
28	Sparus	3
29	Kodak	1
30	Modern	4
31	Chevrolet	2
32	Citroen	9

There is a big gap between the value ranges of various size parameters in automobile modeling, so the discrete coefficient is introduced here.

(Coefficient of variation) the concept eliminates the influence of value difference between parameters. The formula is:

$$C.V = \frac{\sigma}{\mu} \times 100\%, \tag{4}$$

Where C.V is the dispersion coefficient of the parameter value, and O is the standard deviation of the parameter, μ is the mean value of the parameter.

(3) Node group.

In gene networks, some nodes will form relatively independent groups based on close internal interaction, that is, they do not interact with each other.

Table 5: The nodes with the largest degree (relevance threshold $[r] = 0.2$).

Number	Design element node	Degree
1	Car windshield height Y @ Top	65
2	Front windshield width Z@Top	64
3	Distance between the midpoint of the front window and the front of the front window Y@side	61
4	X@top on side line 2	61
5	Front windshield length X@side	61

The isolated sub-network connected with other nodes is called "node group" in this paper. It is beneficial to the identification of node groups.

There is a potential connection in the analysis of genes, which needs to be unified the size of data considered.

When the correlation threshold $[R] < 0.5$, the connections between the nodes of the design parameter network are too complex for the designer to identify valid groups of nodes from them

The designer interview shows that the number of nodes in the node group is controlled at about five.

It is more suitable for comprehensive consideration. Based on this demand, the correlation threshold $[R] = 0.96$ is taken to design the nodes of the parameter network.

Through the modeling of automobile modeling design parameter network and the analysis of node degree, sensitivity and node group.

Analysis, combined with the designer's demand interview and in-depth interpretation, the following macro knowledge can be obtained from the analysis:

(1) Influence of wheel size on design.

"Wheelhouse radius @ side" is the most sensitive node, but at the same time, the centrality is not high, and it is not a central node, indicating that.

"Wheelhouse radius @ side" is an independent node. The wheel size has a great impact on the vehicle shape. But this conclusion is true.

The real reason is that the wheel size has been relatively standardized, the size change is small in any model, and the design space is small, therefore, the conclusion of "high sensitivity" will be obtained. The same high-sensitivity design elements are also reflected in other values.

Fixed size.

(2) Automobile side shape design.

The nodes at the key points of car side modeling have higher degrees, and their degrees are roughly the same.

Part of the shape has a large correlation with other aspects, and the degree of correlation is relatively unified. In terms of sensitivity, the middle and front parts of the car body.

The sensitivity of the rear is relatively high, while the front and rear are more constrained, which limits its morphological extension. For this part.

During design activities, the modeling can be focused on the middle position, and the front end and back end can be combined according to the modeling of the middle.

Assign values to other related nodes. Because the relevant nodes of the side rear end shape are more sensitive than those of the front part.

In the design process, it can be handled in the later detail trimming stage of conceptual design according to the specific situation.

(3) Car roof and window design.

It can be seen from the node degree list that the top three nodes are related to the front windshield shape of the car. And these three.

The sensitivity of each node is not high [15]. That is, the shape of the front windshield is greatly affected by other nodes, but its own variation.

During design activities, the modeling can be focused on the middle position, and the front end and back end can be combined according to the modeling of the middle.

Assign values to other related nodes. Because the relevant nodes of the side rear end shape are more sensitive than those of the front part.

In the design process, it can be handled in the later detail trimming stage of conceptual design according to the specific situation.

(4) Design of automobile item shed and window.

It can be seen from the node degree list that the top three nodes are related to the front windshield shape of the car. And these three.

The sensitivity of each node is not high. That is, the shape of the front windshield is greatly affected by other nodes, but its own variation.

However, it may not affect the design of other parts. The nodes related to the shape of the rear window are all low-degree nodes, and their values are important to the whole.

Little impact. Therefore, post-processing can be set in the design process. Comparing the node group list, you can see that node group 3 and node.

Group 5 is related to the shape of the rear windshield and luggage cover. Explain that in the shape of the top of the car, the front windshield and ceiling are.

There is a close relationship between the dimensions of the luggage compartment and the upper cover of the luggage compartment, which should be considered uniformly.

(5) Automobile hood design.

There are four highly sensitive nodes in the hood modeling nodes, which determine the length and arc path of the hood, respectively.

However, their degree is not large. It can be seen that this part of the shape has a certain degree of design freedom and is different from other parts.

It is not obvious that it can be designed independently, or even considered to be carried out in parallel with the morphological design of other parts [16].

The above analysis of the design parameter network based on automobile product gene provides a reference for designers' design activities, explicit knowledge of definite operability.

4.2. Image Target Network of Automobile Modeling

4.2.1. Determination of Image Goal of Automobile Modeling. The perceptual image of vehicle modeling evaluation is the general summary of automobile appearance in a specific era and culture.

The usual design goal of automobile modeling. Image target is generally expressed as a series of adjectives. Zhao Jianghong through questionnaire survey.

Analysis, positive and negative screening, category filtering, sentence slot judgment, and other statistical methods, summed up 30 groups of commonly used words for vehicle evaluation.

Sink**,** as shown in Table 6, Zhu Yi investigated the shape of the car, and the expert group made a study of Kansei based on perceptual engineering.

This paper optimizes and deletes the above words on the basis of the two taking these 20 pairs of image adjectives as nodes, this paper constructs the image target network of automobile modeling [17]. The main work includes two aspects: constructing an image target network, discussing the implicit relationship between image target and design parameters, and identifying image target network characteristics of collaterals.

4.2.2. Image Target Network Modeling. Due to the subtle differences in model shapes, it is difficult for the general public to clearly classify and evaluate them.

Employees engaged in relevant work for a long time are sensitive to changes and differences in product appearance. In order to increase the image evaluation.

Reliability, 22 designers who have been engaged in design for more than three years were recruited as subjects. The 22 designers were wanted It is required to evaluate 20 pairs of image adjectives for the above 146 models. In order to improve efficiency, the evaluation adopts.

Classification method. The subjects selected the appropriate image adjectives for each vehicle model to mark (up to 3), as far as possible.

Reduce the influence of image, color, angle, and other factors on the overall modeling judgment, and select the same angle and material rendering model, The image evaluation data are combined and counted, and each person matches a vehicle type with a perceptual evaluation adjective.

Take one score and get the score statistics of perceptual image, Table 6. It can be seen from the table that the car models are in two opposite words.

The scores of image targets show a considerable tendency, which indicates that designers recognize the relationship between the appearance and image style of the car.

The reliability of this table is high. The Pearson correlation coefficient between the image evaluation indexes in the table is calculated to obtain the relationship between perceptual images' relevance of the statistics entry is shown in Table 6. The node degree in the image network expresses the relevance between this adjective and other adjectives, but it is not limited to positive phase off, that is, these perceptual evaluation words have definite coincidence (positive correlation) in signifier or signifier when evaluating automobile modeling

or deviation (negative correlation). Theoretically speaking, there should be a strong negative correlation between pairs of adjectives, but in fact this is not entirely true, indicating that there are still some deviations in users' cognition of automobile modeling image, which needs to be further studied.

Nodes with large degrees can be considered to represent a strong user image tendency, so it needs to be tested in the design process.

. Taking a lower correlation threshold can sort the degree of each image node, in which the first four height sections.

The calculation method of node sensitivity is similar to the design parameter network, which expresses the influence of vehicle shape change on the image index.

The intensity of influence, or the feasibility of the image through modeling design. The five most sensitive sections There will also be a mutual influence, restraint, and integration between the image objectives of automobile modeling, which is shown in the image network.

It is now connected to a relatively independent node group. Table 6 shows the image targets when the correlation threshold is 0.47.

Through the identification of the key nodes of the image target network and the analysis of the topology, the following pairs of designs can be separated.

Useful auxiliary knowledge for personnel.

"Gorgeous-dynamic-smooth-gorgeous-high-grade-smooth-rigid" nodes constitute the largest node group in the perceptual image network, in which "smooth" is the most sensitive node and also has a high degree. It shows that the user's cognition of this perceptual evaluation is relatively

Table 6: high-frequency adjectives for car styling.

Thin-thick	Gorgeous-simple	Fluency-intermittent	Strong-soft
Strong-weak	Ordinary-personality	Full-withered	Rough-meticulous
Coordinated-misaligned	Static-dynamic	Upscale- low	Messy-neat
Conservative-open	Rational-perceptual	Rigid-smart	Exquisite-humble
Rough-smooth	Strong-weak	Elegant-showy	Generous-shy

unified, and the image target is closely related to many other targets, so enough attention should be paid to the design activities [18].

As the node with the highest degree, "gorgeous" is related to many image targets, but its sensitivity is low.

It is because designers have different perceptions of the appearance of the car when evaluating it, or it may be that it belongs to a passively affected goal Mark.

The six image targets of "low-grade-simple," "maladjusted–messy," and "strong-tough" form three pairs of relatively close node groups. It is obvious that there is a strong potential relevance in the evaluation of these adjectives, which can be used in the design.

Consider them together.

4.3. Discovery of Association between Design Parameters and Image Targets in Gene Networks. The discovery of the second kind of edge in product gene regulation network, namely, "design parameter image target," is the focus of this paper.

Another important task. The identification of such related information can clearly reflect the mapping relationship between image evaluation and design parameters, provide accurate design suggestions for designers, and transform the inefficient modeling design process into accurate "gene surgery" [19].

The discovery of such edges is obtained by constructing the image target network through "indirect method." The idea is to classify the image target first.

The design parameter network is established for the vehicle type under the condition of; then, through the characteristics of the design parameter network of the vehicle model under the classification of each image target.

Feature analysis establishes the relationship between image objectives and design parameters; finally, by comparing the design parameters associated with each image target. The similarities and differences of node sets further establish the relationship between image targets. The specific operation methods are as follows:

First, image target vehicle classification: according to the results of the evaluation experiment, the vehicle types are classified as image targets.

The reliability of the results is added to make the following provisions for the classification of vehicle models: ① if there are models in the image evaluation of mutual antonyms.

If there are votes, they will be classified as the style of more votes, and if the votes are the same, they will not be classified. ② To solidify the wind.

The first 30 models are selected according to the scores of the vehicles classified under the same perceptual evaluation.

Second, sensitivity calculation of design parameters under style.

Sensitivity is calculated. According to the definition of sensitivity, the sensitivity of the image expresses the influence of this parameter on the evaluation of the image target. In other words, the relationship between the value of nodes with higher sensitivity and the evaluation of the image target.

The closer it is, and vice versa. The sensitivity coefficients of each parameter under image target evaluation are obtained here. Third, the connection between different types of nodes is constructed: the design parameter nodes under the same image target are entered according to the sensitive value.

Row sort set a sensitivity threshold. The edge between the design parameter node and the perceptual evaluation node that exceeds the threshold value is connected [20]. Repeat the above work to complete the construction of the edge among all design parameters and image objectives. It is worth noting to ensure all the edges have similar firmness, and the edge connection should be based on the same evaluation standard, so all sensitivity threshold values need, it is the same. In order to better represent the correlation between design parameters and image targets, the sensitivity threshold q is set to 85%. Finally, the relationship between image targets is established: the design parameter nodes mapped by each image target can be regarded as a section point set writing [21]:

$$I_m = \{P_1, P_2, P_3, \ldots, P_n\}, \tag{5}$$

where: I_m is the set of design parameters under an image target, PI, P2, and PP. Design parameters for each of the sets.

The similarity between sets can be obtained by the method of the Jaccard similarity coefficient The formula is as follows:

$$I(I_m, I_n) = \frac{|I_m \cap I_n|}{|I_m \cup I_n|}, \tag{6}$$

where J (IM, in) is the Jaccard similarity coefficient between the image target set $1m$ and in.

If two nodes have high similarity, the image target corresponding to them is designed similar The effect of the parameters. It can be seen that there is a high potential correlation between the two image targets. The setting of the Jaccard similarity coefficient Threshold, the image target subnet can be obtained by building an edge between the image target nodes that exceed the threshold.

The abovementioned methods can be used to construct the image target network in addition to the construction of the image target network subnet [22].

The connection between nodes of the subnet is established to form a dichotograph network, as shown in Table 7.

Table 7: The image target and design parameter association table.

Image target	Front turning point and front end Y of the hood, style line length X under the front end
Neat	Line Length X
Exquisite	Bonnet forward pivot point and front Y
Shabby	Lateral line 2 and front end height Y
Generous	The distance between the front turning point of the hood and the front end X
Shy	Lateral line 2 and front end height

The information contained in this table is for the design work.

The auxiliary significance is very important, and it is the key point of knowledge mining. See "hood turning point and front end distance$Y$@Side. Side line 2 and front height$Y$@ Side. front and bottom style line length X@Side, side line 1, and front end height Y@Side" The four design parameters are closely related to the image objectives [23]. It can be seen that they are the design parameters that have the greatest influence on image style judgment. The key points of the design controlled by these four design parameters are the position of the body appearance, which should be paid special attention to in the design activities.

5. Conclusion

This paper presents the basic structure of the automobile gene network model and the technical method of constructing two sub-networks of design elements and image objectives. Based on the preliminary analysis of the two networks, this paper produces some relevant knowledge to assist designers to carry out design activities. The existence and stability of the gene network model are demonstrated. The existence of a gene network shows that there are potential relationships between the elements of the two subnetworks of automobile modeling. The mining and identification of these relationships, it lays a foundation for improving the design efficiency and success rate [24]. Gene networks can help transform the traditional design activities that rely on experience and perceptual judgment into targeted and accurate operation of "gene surgery."

Although the two sub-networks in this paper can be obtained through an independent modeling process, they are not in their own independent state, in fact, the mapping relationship between them can be obtained by constructing the image target network through the "indirect method." This mapping relationship helps to accurately find the design element node group that affects an image target. This paper also puts forward the identification method of this kind of association, which is the key content of further knowledge mining.

Product design DNA is a new concept produced by the application of the idea of genetic engineering in the field of industrial design, which involves many knowledge fields. It aims to give products a unique form and style image to shape the brand. This paper systematically summarizes the current situation and progress of product design DNA research at home and abroad, focusing on the expression structure, application research progress, key technologies, and the shortcomings of existing research. Finally, the hot spots and trends of product design DNA research are: revealing the generation and evolution law of product design DNA in the whole life cycle; Explore the cognitive mechanism of users for product design DNA; realize the connection between product design DNA reasoning and production links, as a new industrial design method, product design DNA draws lessons from the idea of genetic engineering, which provides a feasible path for realizing the rapid response of the design to market changes and establishing brand positioning. This paper systematically introduces the research status and latest progress of product design DNA for industrial design, points out the shortcomings of existing research, looks forward to the development trend of future research and holds that it is necessary to reveal the generation and evolution law of product design DNA in the whole life cycle, explore the cognitive mechanism of users for product design DNA, and realize the connection between product design DNA reasoning and production links, it will become the focus of future research work.

How to find a suitable carrier form, how to reduce the learning cost of users, and improve the use efficiency of users have become a difficult problems in front us. The emergence of the interaction design method points out the way forward for us. We use the old cognitive model formed in people's life experiences to recognize new product forms, strengthen the relationship between the two, and make users as handy as using old products. This paper mainly studies the application method of interactive design based on cognitive psychology in industrial design, establishes the mapping relationship between new products and old cognitive models, abstracts and summarizes the new elements in product design into the old cognitive models, and enables users to recognize and use new products naturally and efficiently through their natural matching.

In order to make a product easy to use, or even a product that users like to use, the design must be people-oriented, take the inner emotional needs of users as the central focus, and integrate the emotional factors of users into the product, so that users can obtain emotional experience results in the process of using the product. As for how to get an emotional design, the idea of interaction design provides designers with new ideas.

Method 1: integrate an elegant aesthetic experience into the product. Method 2: write the real scene, express the truth and trigger Association. Method 3: game interactive behavior.

Method 4: expand the participation of users and make users have the fun of creating. Method 5: the product should be in harmony with the use scene.

Data Availability

The labeled data set used to support the findings of this study is available from the corresponding author upon request.

Conflicts of Interest

The author declares that there are no conflicts of interest.

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