

UG8.0 in the Simple Application of Automatic Shoes-Washing Machine Design

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ABSTRACT

Based on the thinking method of reverse design, the paper expounds that UG8.0 software applies in the design process of automatic shoes-washing machine. On the basis of building the equal proportion 3D model of the traditional shoes-washing machine, innovatively design fixed organization and optimize the washing brush. Then using motion simulation checks the movement interference and optimize modeling model. After rendering model by UG8.0 and Keyshot5.0, using the engineering drawing module produce two-dimensional engineering drawing. Finally, complete the reverse design process of whole automatic shoes-washing machine.

Keywords: UG8.0, Reverse design, The design of automatic shoes-washing machine, Simulation, Keyshot5.0.

1. OVERVIEW

Traditional product design often use top-down modeling design method. In the development design process of modern manufacturing, the top-down design has been used quite widely, but many appearances of the product such as shape and size cannot be described using drawings, for example, automobiles, motorcycles, free-form surface appearance, etc. [1] Thus Reverse design is important to shorten product life cycle and greatly avoid the interference and conflict caused by the parts assembly. For the design of the new type of shoes-washing machine with reverse design ideas and methods, through the existing model data of the washing machine and traditional shoes-washing machine, make a rapid modeling. Then to innovate design in the some details of shoes-washing machine model, which can not only improve the efficiency of modeling, but also can meet the requirements of modern production design standardization, generalization and serialization. UG is the EDS software integration system with integrating CAD/CAM/CAE function, has a strong reverse design function. Using UG modeling, designers can quickly establish and improve the shape of complex products, and use the advanced rendering and visualization tools to maximize satisfies requirement of design concepts. [2]

2. THE OPTIMIZATION DESIGN OF AUTOMATIC SHOES-WASHING MACHINE

Shoes-washing machine is a kind of household electrical appliances which appeared on the market in 2008, as its name implies, is used to wash shoes, its appearance is similar to washing machine, and power source also comes shoes-washing machine mainly wash shoes by inner drum from the motor, but interior design is different. Traditional brush and the central wave wheel brush. The shoes with irregular motion in barrel, is easily injured (as shown in Figure 1).



Figure 1. The internal structure of traditional shoes-washing machine



Figure 2. The internal structure of new type shoes-washing machine

This design add the shoes bracket device and central wave wheel brush inside the shoes-washing machine, by controlling the shoes movement in the shoes-washing machine, effectively clean shoes (as shown in Figure 2).

At present, there are many kinds of mature shoes-washing equipment, although each has its different characteristics. But most of them only have a central pillar brush among them, they failed to control the movement of the shoes, and there is no guarantee to the location of the cleaning. Especially for surface of shoes with some advanced materials, this kind of shoes-washing machine will not only cause wear and tear to the material on the surface of the shoes, also can cause pollution in clean area.

In order to solve these problems, must design creatively a new shoes-washing machine. In this paper, the design is based on the traditional washing shoes machine, in which add the shoes fixed brackets. When washing shoes fixed on the bracket, we can control the movement of shoes in case of avoiding the wear and tear in washing shoes. Taking advantage of the characteristics of UG reverse design tools, build a new washing shoes machine 3D modeling, to reduce the fabric abrasion in high speed rotating. Using the built-in simulation plug-in UG Motion to complete the movement simulation, to check interference. Then importing UG parts to keyshot5.0, each part can be rendered to complete industrial design by keyshot5.0 combined with UG 8.0. The use of UG 8.0 quickly figures out the built-in engineering drawing module. Finally, use the engineering drawing module produce two-dimensional engineering drawing.

3. THE REVERSE DESIGN OF AUTOMATIC SHOES-WASHING MACHINE

3.1 The reverse design ideas

Reverse design process refers to the designer to digitize the product on the surface of the sample (data acquisition, data processing), and by using it can realize reverse 3D design to reconstruct the real 3D CAD model (surface model reconstruction), and further analysis is implemented by using CAD/CAE/CAM system including design, CNC programming, the NC machining process. By the application of reverse design in the shoes-washing machine, can shorten the development time, improve efficiency. At the same time, based on existing modification of washing machine, make the designed products more in line with the modern production conforming to standardization, generalization and

serialization, make the processing more convenient and lower manufacturing cost. [3]

3.2 Top-down design and reverse design

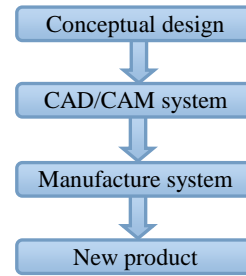


Figure 3. The original model product design process

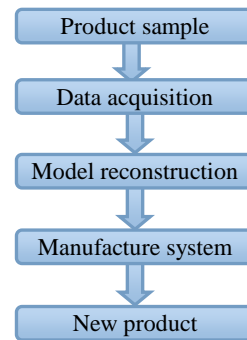


Figure 4. The reverse design process


Reverse design is usually based on the original model product design concept (The original model product design process shown in Figure 3) generated or existing products to make improvements, through direct modification、testing and analysis of the cause for the problem of model can obtain the desired results relatively, and then amended in accordance with the model or a sample to get the final three-dimensional model through a series of scanning and modeling methods. (The reverse design process shown in Figure 4) For complex products, the original model product design clearly shows its shortcomings, such as difficulty coefficient in the design process, long cycle, high cost, difficult product research and development.

In line with the modified design of traditional shoes-washing machine, the design of new type shoes-washing machine conforms to application condition of 3D reverse design. Which can modify to reduce errors caused by unreasonable structural design, and can be directly to use existing data, greatly reducing the workload.

4. THE INNOVATIVE DESIGN OF SHOES-FIXED SUPPORT AND INNER BARREL

4.1 The design of telescopic shoes-fixed support

Table 1. Shoes size

	size	35	36	37	38	39	40	41	42	43
	Length (cm)	22.5-23	23-23.5	23.5-23.7	23.7-24	24-24.5	24.5-25.5	25.5-26	26-26.5	26.5-27
	Perimeter (cm)	21	21.5	22	22.5	23	23.5	24	24.5	25

Due to object-oriented for sports lovers, in view of the special groups, we mainly design for sneakers and climbing boots as cleaning objects. According to the survey date of these kind of shoes size (table1), from 22.5 to 27 cm, we enlarge it to 20-30cm to satisfy different customers as far as possible. By virtue of automatic telescopic principle of belt buckle, we create innovatively the telescopic shoes-fixed support (as shown in the Figure 5). This fixed support is divided into inner plate and outside board, which can meet different shoes sizes by pushing and pulling inner plate.

The detailed structure design, which regards shoes bearing surface as a datum plane, build a new fixed support model inside the barrel. Then add it inner plate, outside board and spring button mechanism. One end of fixed support matches the inner barrel card slot, the other end bears the load of other parts, and stent expansion plate and outside board form sliding vice, spring button mechanism controls telescopic movement of internal plate. After that complete telescopic fixed bracket assembling into the assemble user interface

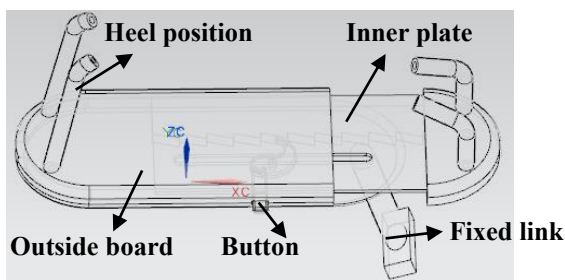


Figure 5. The fixed support assembly drawing of shoes-washing machine

4.2 The inner barrel design

Outer cylinder and power system, most of the inner barrel, which can meet the requirements of the shoes-washing parts, remain the original parts. But the wave wheel and part of the inner barrel should be transformed in accordance with the functions and ergonomics to meet size standard, mechanical principle, mechanical mechanism design standards.

First of all, the inner barrel wall side brush, because of its close to the sole, is easily polluted in the process of washing shoes, so we get rid of the traditional barrel inside wall brush; Second, to bear the clamping fixation mechanism for meeting different shoe size, we design four fixed support neck in the existing space. (Position as shown in Figure 6)

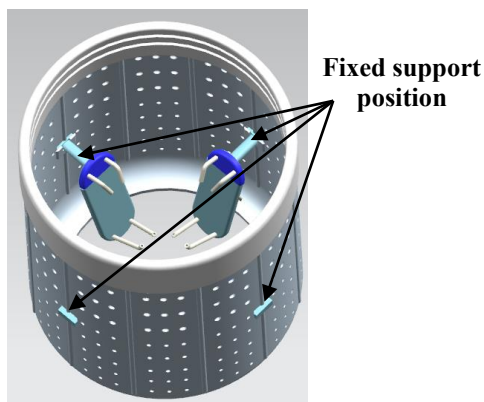


Figure 6. Fixed support position

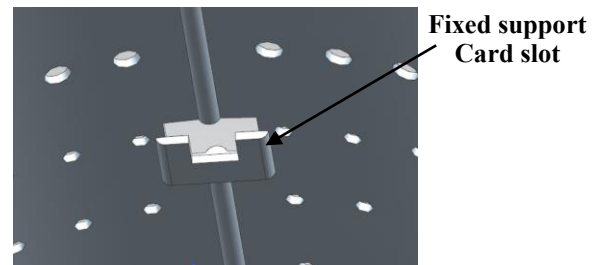


Figure 7. Fixed support card slots

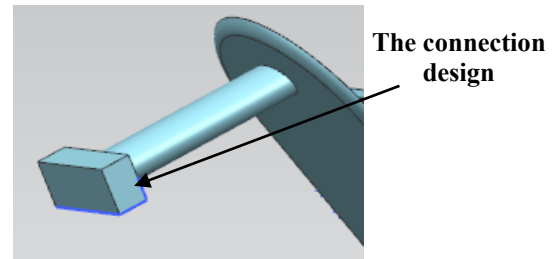


Figure 8. The connection design between fixed support and inner barrel

4.3 The connection design between fixed support and inner barrel

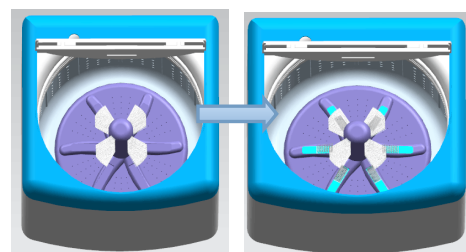
In UG8.0, click inner barrel within the existing model at suitable location create sketches, stretch outwards and make Boolean subtraction operation after mapping the sketch, to form a convex card slot (as shown in Figure 7), then create fillet surface and so on operation to complete the connection design between fixed mechanism and inner barrel. This design ensures its load-carrying capacity and inner barrel's stiffness, which also prevents the inner barrel distortion.

In the joint position of fixed mechanism, set inner barrel wall as a datum, drafting, and stretching out fixed link with suitable strength and fit dimensions (as shown in Figure 8). Similarly, according to the above method, complete four fixed bracket modeling.

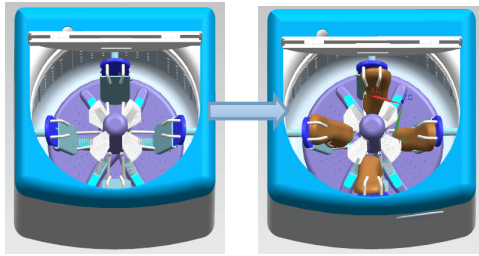
Modeling method of reverse design can ensure the size, shape of connection parts, in case that part is too large to lead to invalidation structure of inner barrel as well as too small fracture to cause low joint strength.

5. OPTIMIZATION OF AUTOMATIC SHOES-WASHING MACHINE BRUSH

5.1 Rapid modeling by existing product



A. Traditional automatic shoes-washing machine **B.** New automatic shoes-washing machine



C.Optimization of new automatic hoes-washing machine

Figure 9. Rapid modeling flowcharts

Using modeling method of reverse design, first of all should be need to improvement of the surface of the product samples including data acquisition, data processing of the digital processing, utilizing UG modeling existing wash shoes machine in equal proportion. Based on The characteristics of AutoCAD design, using UG8.0 design application and transform, combining with the characteristics of the original CAD figure design and make full use of the characteristics of UG8.0 modeling function , high efficient and accurate free surface modeling function complete shoes-washing machine 3d model of the whole building[7-8] (Model as shown in figure 9).

5.2 Optimization of adaptive brush

Adaptive refers to automatic adjusting processing methods, processing order, processing parameters, boundary conditions and constraints according to the characteristics of data processing, so that it is compatible with the statistical distribution of the data distribution characteristics, structural characteristics, in order to achieve the best results. As shown in Figure 10, Adaptive refers to the processing and analysis in the process, according to the characteristics of data processing automatically adjust processing methods, processing order, processing parameters, boundary conditions and constraints, with the statistical distribution of data processing characteristics, structural characteristics, in order to obtain the best treatment effect. As shown in figure 10, the design of the adaptive brush accord with modern appearance features of sports shoes, the soles can be more efficient clean. By UG create separate brush to matrix, and then by Boolean operation to get the shoe brush effect adapting to the type of shoes. [9]

Adaptive brush is length un-equality according to the shoes basic type to adapt to scrub on the surface of the shoes. Type material chooses generally a soft brush (PBT), to prevent wear the shoes surface when cleaning. Because the brush in the column on the surface of a spiral type configuration, its density can be increased, thus saving the material, and achieve the goal of the directional decontamination [10.11].

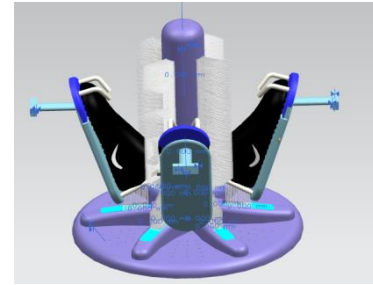
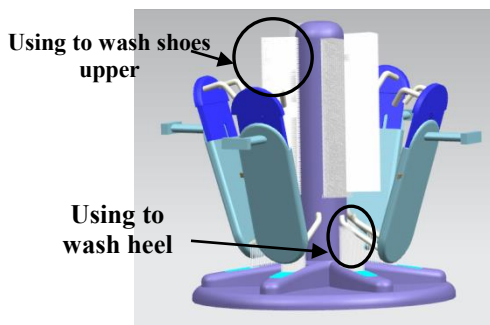


Figure 10. Adaptive brush model

6. AUTOMATIC SHOES-WASHING MACHINE MOVEMENT SIMULATION AND INDUSTRIAL DESIGN

6.1 Automatic shoes-washing machine movement simulation

After the completion of the modeling, motion simulation can check out that the constraint is correct or not, parts whether there is interference, and between each components cooperate way is reasonable or unreasonable. Before the movement simulation for each parts, we should have to make the necessary constraints, such as the outer cylinder should be fixed constraint, the wheel roller and concentric barrel should be undertaken within the constraints, this can make the model actualized, and ensure that the parts when the movement simulation movement correctly is passed on to the other parts.

This article uses the outstretching of extensible fixed bracket on Figure 5 as an example: first of all, setting the telescopic pan with the mating surface are parallel constraint and distance constraint (which value is zero), and click the movement of telescopic vice after choosing the telescopic plate. In the interface of definition, choose sliding pair and the suitable origin and vector, then switch to the driver interface to choice function and input the correct expression. You can acquire clicking decoding scheme by choosing the appropriate parameters and click ok. Then play it to watch movement simulation effect after calculating successful. If something showing decoding error criterion, you should change constraints and kinematic pair, driving conditions needed to make simulation correct.

6.2 Automatic shoes-washing machine industrial design

Keyshot is a program with interactive ray tracing and global light rendering, and can produce as real photos without the need for complex set of 3d rendering images. It can seamless dock with UG. All parts in UG can be selected and give material alone in Keyshot, don't have to be drawn, assembled or simulated. Rendering into the interface, click on the file - import, open automatic shoes-washing machine model, and select suitable material on the left material column to the corresponding parts on the right parts column, after completion of all parts material matching, click renderer, and adjust the parameters of rendering.



Figure 11. Rendering of automatic shoes-washing machine

The final rendered image is shown in Figure 11. Rendering can be used as product packaging, product promotion, product display, etc., has a strong sense of reality.

7. AUTOMATIC SHOES-WASHING MACHINE PROCESSING DRAWINGS GENERATING

In the engineering technology, the drawing expressing object's shape, size and technical requirements are according to the principle of projection and national standard. Engineering drawing is the carrier of engineering and product information, is the language of expression, communication engineering. Engineering drawing is an important technology in modern production file. In the engineering technology, engineering drawing is not only the direct production of important technical documents, but also an important of technical communication .And UG embedded engineering drawing module can project directly 3D model into two-dimensional engineering drawing (as shown in Figure 12, shown in Figure 13), This can not only avoid The product will not be able to process or produce waste because of possible errors in the drawing, but also greatly saves human resources. And engineering drawing module of UG supports common drawing software such as CAD; just put the engineering drawing to be saved as “DWG” or “DXF format, so it's convenient for multiple software revising drawings focusing on different aspects.

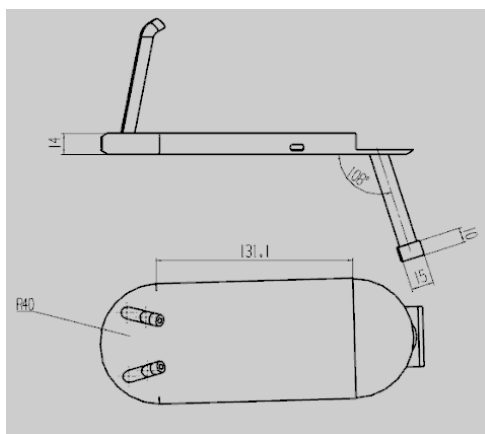


Figure 12. Fixed basket plate

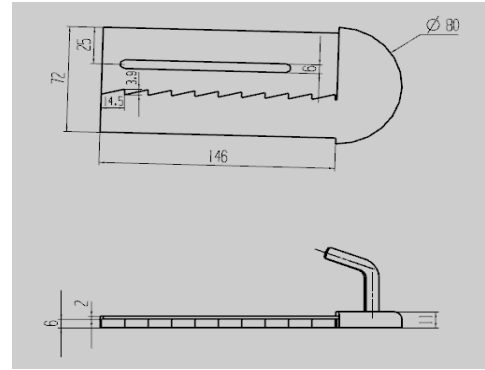


Figure 13. Fixed basket inner plate

8. CONCLUSION

UG as a mature three-dimensional software can greatly reduce the workload, improve work efficiency and finish automatic shoes-washing machine improvements by using the reverse design thinking. The simulation functions can check the error in design, and engineering drawing module can help quickly and effectively prevent the mapping error. In combination with Keyshot, it can make a realistic design drawing by rendering, and meet the needs of packaging propaganda. In this article, through case analysis of automatic shoes-washing machine innovation and optimization design, this paper expounds the important application of UG in the reverse design. In the research and development of modern design, reverse design of UG has a good application prospect, especially for some person who preliminary contact reverse engineering. The use of the existing 3 d object modeling in UG, effectively improve the efficiency of research and development. Through its built-in simulation module, rendering module and the function chart, binging greatly convenient connection of practicality to model.

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