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Research on application of computer technologies in jewelry process

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ABSTRACT: Jewelry production is a process of precious raw materials and low losses in processing. The traditional manual mode is unable to meet the needs of enterprises in reality, while the involvement of computer technology can just solve this practical problem. At present, the problem of restricting the application for computer in jewelry production is mainly a failure to find a production model that can serve the whole industry chain with the computer as the core of production. This paper designs a "synchronous and diversified" production model with "computer aided design technology" and "rapid prototyping technology" as the core, and tests with actual production cases, and achieves certain results, which are forward-looking and advanced.

Keywords: computer technology; rapid prototyping; jewelry; application

1 RESEARCH BACKGROUND

With the continuous popularization and ever-changing development of computer technology, the depth and dimensions of application for computer technology in various fields are constantly extending and expanding, jewelry production and processing industry is of no exception [1]. From the initial design and material collection, organization, two-dimensional aided design to three-dimensional aided design, analogue simulation design, display design and rendering post-processing and other aided design means in the research and development links, the computer technology gradually penetrates and develops into the rapid and precision manufacturing means in the production link. At present, in the field of jewelry production and processing, the cutting-edge technology of computer applications mainly includes simulation of three-dimensional aided design, style effect display design and high-precision rapid prototyping technology.

Compared with the traditional jewelry production and processing technology and process, the involvement of computer technology has a revolutionary significance. On the one hand, in the stage of research and development of jewelry products, the establishment and continuous improvement of the database makes the designer's research and development work quick and convenient, greatly improving work efficiency; simulated three-dimensional design and texture material performance not only reduces the link of making samples, but also shortens the cycle of research and development; dynamic effect display not only facilitates interactive exchanges with retailers, but also adds a sense of possession for end customers to choose products. On the other hand, for the jewelry production and manufacturing, especially precious metal jewelry manufacturing, today, with constantly transparent and cheap processing fees, in addition to the rapid return of funds, to improve production efficiency and reduce the losses in the processing and manufacturing links are the key factors for the manufacturers to win in competition. The involvement of computer can just greatly improve the performance of these two decisive factors, so that the manufacturers can obtain higher profits.

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2 APPLICATION STATUS OF COMPUTER TECHNOLOGY IN JEWELRY PRODUCTION AND PROCESSING

2.1 *Application status of aided design software*

Currently, there are many types of design software in the field of jewelry design [2]. The designers select different design software according to their own conditions and the required design style and effect, which is summarized as the following three types: (1)

two-dimensional aided design software of general-purpose computer (Corel draw, Auto CAD, Illustrator (AI)), (2) three-dimensional aided design software of general-purpose computer (3ds Max, Rhino, Matrix, Free Form), (3) three-dimensional aided design software of professional computer (Jewel CAD, 3Design, JCAD3 Pro, Art CAM Jewel Smith).

2.2 *Application status of rapid prototyping technology*

At present, the instruments that can be applied to actual production with the rapid prototyping technology are as follows: PROJET CPX3000 in the American 3D systems Company, which is made of wax materials, jet-printing molding by cooling and curing; PROJET HD 3000 in 3D systems Company, which is made of resin materials, jet-printing molding by curing; American Solidscpe T76; Italian laser light rapid prototyping machine, which is made of photosensitive resin materials, laser light molding by curing; Germany Envision Tec Perfactory; Israeli OBJET series of products, which are made of photosensitive resin materials, jet printing molding by laser curing. Foreign development trend is the improvement and upgrading from the following aspects: molding accuracy, molding speed, economic use of consumables, simple casting, process simplification and so on.

Rapid prototyping technology was applied in some developed countries in Europe and America at the earliest. China developed late in this field, and began to introduce it in recent years. China has not yet applied for rapid prototyping equipment used for jet printing rapid prototyping or laser curing stacking prototyping in the field of jewelry casting and other fields with a higher requirement on the degree of precision. In particular, the research on the molding materials is even a blank [3, 4]. According to incomplete statistics, there are more than 2,500 jewelry manufacturing enterprises in Shenzhen. Among them, less than 60 enterprises own the rapid prototyping equipment of jewelry, in which more than 10 enterprises belong to professional design plate making work rooms. The enterprises have a huge demand space, and this technology is a general trend for the development of jewelry industry [5, 6].

3 RESEARCH ON MODEL DESIGN PROCESS

3.1 *Traditional jewelry production and processing process*

The traditional jewelry production and processing processes are generally divided into hand-painted design drawings, making silver/stencil version, producing samples, market promotion, batch promotion and other links (Figure 1). Such a production model is bound to result in a single production process. If there is a problem in a production link, it will inevitably affect the entire production chain, not only affect the efficiency of production, but also greatly increase the cost of production, which is not expected by the enterprises.

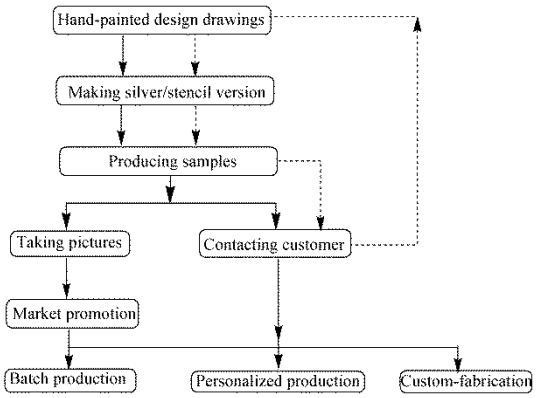

Figure 1. Traditional jewelry production process

3.2 *Model design in jewelry production and processing via computer technology*

A single traditional jewelry production and processing process and its drawbacks always trouble the enterprises. If some links in the production chain can be synchronized, the problems will be readily solved. The computer-aided design and rapid prototyping technology can just achieve such a synchronous project. The rough process is as follows: in the completion of work design, the analogue simulation technology is used for market promotion or contacting customers, and synchronized manufacturing of samples and direct batch production. If there is a need to modify the style in the process, there is only a need to modify the corresponding parameters in the database. It can not only shorten the entire operation cycle and greatly improve the efficiency, but also save a lot of resources for the enterprises.

Computer aided design and rapid prototyping technology [7-9] can make the jewelry “research and development”, “promotion”, “production” and other links realize “synchronization” and improve efficiency, and also realize “diversification” in production due to “synchronization”. The model shown in Figure 2 is a production model derived from visits to enterprises and participation in practice. Viewing from the diagram of the production and processing model, it is not difficult to see that there are two aspects in the synchronous projects realized by the production model: one is the same production section, and the other is the entire production process chain. In the same production section, the “product development section” can achieve 3 synchronous projects, namely, rapid prototyping plate making, construction of “model database”

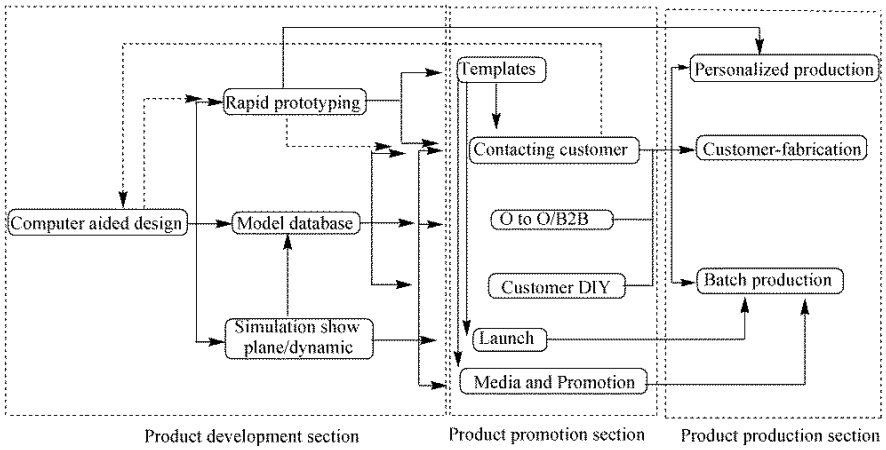

Figure 2. Model design in jewelry production and processing via computer technology

and "simulation show" plane; "product promotion section" designs six links, which are mutually independent and also connected, and achieve 9 synchronous projects; "product production section" can achieve 3 synchronous projects, while the entire production process chain can achieve 34 synchronous projects.

3.3 *Comparison with the application of new technology and traditional production process*

Efficiency is profit, while profit is the lifeline of the enterprise. Today, with the processing fee getting lower, in addition to brand awareness, product market recognition and service, the enterprises should fight for the efficiency. Compared with Figure 1 and 2, it is not difficult to know that the advantages of computer application model in the jewelry production and processing are mainly manifested in the following three aspects: 1. It can achieve a number of "synchronous projects" and "diversified production" in the jewelry production; 2. It can achieve "zero inventory" in the enterprise production, thus saving a lot of manpower, materials and financial resources; 3. The application for computer aided design and rapid prototyping technology can greatly reduce production losses and improve production efficiency. In this paper, the three-dimensional printer of American 3D system CPX 3000 (wax spraying) and the traditional manual silver version and carved wax version are compared with, and the details are shown in the table below.

4 APPLICATION PRACTICE OF COMPUTER TECHNOLOGY IN JEWELRY PRODUCTION AND PROCESSING

4.1 *Application for computer technology in jewelry development section*

4.1.1 *Application method of computer aided design technology*

Currently, the computer aided design software used in the field of jewelry design is divided into three categories: 1. Two-dimensional design software, such as Corel draw, Auto CAD; 2. Three-dimensional design software, such as Jewel CAD, Matrix, 3Design, Rhino, Art CAM; 3. Plane post-processing software, such as Photoshop. The production model developed in the development section of the project is 3D model, so the following elaboration is mainly based on the three-dimensional design software [10].

The basic idea of three-dimensional aided design modeling is mainly to first draw the two-dimensional curve (guide rail, section and contour line) of the required three-dimensional modeling, and then use the corresponding modeling tools to generate the basic three-dimensional modeling; and then edit and carry out local special effect processing according to the requirements of the product modeling; edit the corresponding material after determination of the model modeling, size, structure and level; finally, output application data for different purposes according to the needs, as shown in Figure 3.

Table 1. Comparison with the speed of traditional manual plate making and rapid prototyping plate making

Type	Completed amount of silver version in 32h	Completed amount of wax version in 32h	Rapid version (work surface: 187×165 mm, height: 25 mm)		
			Completed amount in 16h	Relative silver version / multiple	Relative wax version / multiple
Diamond ring	4	8	536	134	67
Luxury ring	2	4	160	80	40
Luxury pendant	2	4	168	84	42
Bracelet	1	2	22	22	11

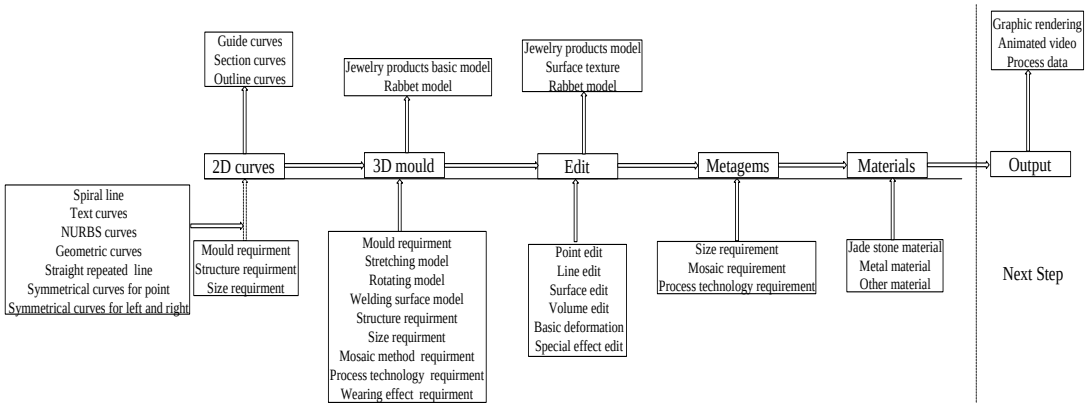

Figure 3. Main application ideas of computer aided design technology

4.1.2 *Application effect of several computer aided design software*

(1) Application and effect of Jewel CAD

Jewel CAD is currently the most popular professional design software used in China's jewelry industry, with quick and simple operation, which can meet the requirements of common commercial jewelry style modeling, effect image output and production data output. In accordance with the application methods of computer aided design of "two-dimensional curve - three-dimensional mold – edit – metagems – materials", the application method and effect of Jewel CAD are mainly shown in the flow chart of Figure 4.

(2) Application effect of Matrix

Matrix is deeply favored by a lot of jewelry designers in the industry due to its powerful modeling function, a rich gem material library and simulation rendering effect, but its occupancy is far less than that of Jewel CAD. In accordance with the application methods of computer aided design of "two-dimensional curve - three-dimensional mold – edit – metagems – materials", the application effect of Matrix is shown in Figure 5.

(3) Application and effect of 3Design

3Design is the professional software developed by Vision Numeric Company in France, which is applied to the jewelry design. Its main market is in Europe, and it is gradually developing the market of mainland China and Hong Kong, Macao and Taiwan. Due to its data parameterized design, realistic rendering effect and animation production function with a visual impact, it begins to be favored by many jewelry designers in Chinese regions. In accordance with the application methods of computer aided design of "two-dimensional curve - three-dimensional mold – edit – metagems – materials", the application effect of 3Design is shown in Figure 6.

Figure 4. Application method of Jewel CAD and modeling flowchart

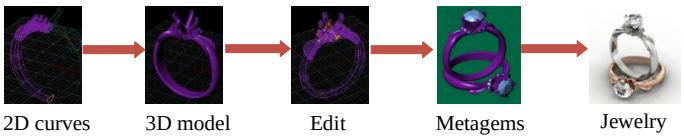

Figure 5. Application method of Matrix and modeling flowchart

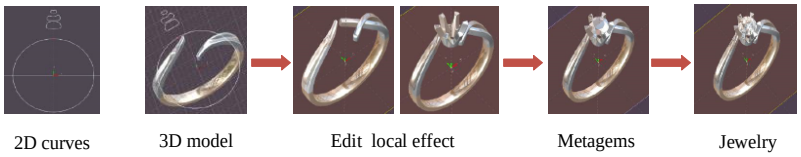

Figure 6. Application method of 3Design and modeling flowchart

4.2 *Application for computer technology in product production section*

A huge “jewelry style model database”, “style plane display rendering database”, “style interactive animation database”, “rapid prototyping plate making” and other computer technology support and “B2B model”, “O to O mode”, “customer DIY” and other flexible product promotion sales channels meet the needs of different customers, “individualized production”, “custom production” and “batch production” can be carried out. These three production models are independent and advanced.

4.3 *Application for computer technology in product promotion section*

4.3.1 *Application for computer technology in market launch*

There are many ways to launch products on the market, which are mainly the exhibition halls for their own brand, usually used for seeing products by the suppliers and distributors, or customer DIY experience; flagship stores, franchised stores, retail stores, which are facing the end consumers; jewelry fairs, which are facing potential customers around the world. There are many kinds of jewelry exhibitions around the world every year, which can be participated in according to the nature of different exhibitions.

After drawing the three-dimensional model, the jewelry research and development department selects the featured style for direct rapid prototyping plate making, and processes into samples to launch on the market to test marketing. After launching samples on the market, the improved design and depth development of products should be carried out according to the reaction situation on the market, in order to constantly upgrade and optimize the products, and make the brand effect have a virtuous circle.

4.3.2 *Application for computer technology in product propaganda and promotion*

Product propaganda and promotion media include online, offline, soft media, hard media, indoor, outdoor and many other means, but its fundamental source materials are mainly the plane rendering of the product and dynamic display, which can be made by sample shooting, or perfectly presented by the computer analogue simulation. The “plane display rendering database” and “interactive animation database” provide the convenience for propaganda and promotion that is insurmountable by the traditional manner (made by sample shooting). Jewelry holographic display instrument (jewelry shopping guide) displays by using the materials of “plane display rendering database”, and has a very good analogue simulation effect, which is currently one of popular trends of the jewelry enterprises in the propaganda and promotion. Figure 7 is the shopping guide of MY-DID co-brand in the retail store.

Figure 6. Shopping guide for the retail store

5 RESEARCH CONCLUSION

With popular application for computer technology in all walks of life, many traditional manual processing industries have gradually introduced computer technology. Jewelry processing industry is a very good case. Despite the late start, in recent years, it has a rapid development, and more and more enterprises need the support of computer technology. At present, the problem of troubling and restricting the application for computer technology in jewelry production and processing is mainly a failure to find a production model that can serve the whole industry chain with the computer technology as the core of production in this industry. This paper designs a “synchronous and diversified” production model with “computer aided design technology” and “rapid prototyping technology” as the core, and tests with actual production cases (application for the computer technology in the product development section, production section and promotion section), and finds that the production model has a strong operability, which is forward-looking and advanced, and can create values for the community and enterprises, and can be used for reference by the jewelry industry and even similar products processing and production enterprises in a period of time.

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