Analysis on the Value of 3D Printing in Jewelry Design Based on Artificial Intelligence

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Abstract. With the rapid development of Internet, big data, cloud computing and other technologies, the combination of artificial intelligence and 3D printing has a great impact on the graphic creative design, modeling, material selection, production and other links in the field of jewelry design and production, which also accords with the era characteristics of jewelry design, wear and consumption personalization, and will become an important direction of jewelry industry development in the future.

Key words: Jewelry, 3D printing, Artificial intelligence (AI)

1. Introduction
Modern and contemporary jewelry displays, expresses, and highlights more in designers and wearers inner feelings and personalized experience, not subject to the form, color, materials, wearing style and wearing parts and other constraints, few social ideology and values restrictions, unrestrained wearing concept, open wearing form, very suitable for 3D under the background of artificial intelligence era in the jewelry design and production field.

As the intelligent manufacturing era comes, the deep integration of big data, cloud computing, 3D printing and artificial intelligence means the maturity of personalized production mode. The inevitable result is the collapse of the standardized mass machine production mode in the industrialized era, and the design, production and sales of jewelry industry have undergone great changes. Through the analyzing the big data in the jewelry field, artificial intelligence carries on the deep "thinking" from the design, the material, the manufacture craft, the market consumption and so on, relies on the 3D printing to realize the intelligent digital integration to produce the individualized jewelry design product which conforms to the consumer demand

2. The Role of Artificial Intelligence in the Creative Design System of Jewelry Graphics
When the pure digital age of jewelry design draft comes, that means essence will become two basic units : 1 or 0, accompanied by the deep fusion of artificial intelligence and 3D printing. Many original designs will be carried out by the design master with the assistance of artificial intelligence. Designers are mainly responsible for jewelry transmission of emotion, artistic conception, humanistic care, the context of the times and other aspects of thinking and deliberation, as well as the selection of artificial intelligence design sketches and in-depth refinement of the design; artificial intelligence is responsible for repetitive, trivial, boring work, such as the extraction and search of massive design inspiration, including the comparison of design manuscripts, eliminate the new scheme and other contemporary designers the same or similar design, after all, artificial intelligence, big data, cloud computing can
quickly provide designers with more original ideas as a reference for original design.

Through the big data, cloud computing, we classify the jewelry design masters or enterprises in various periods, such as the geometric wind of the famous Japanese designer Pingsong Baocheng, the titanium metal series of the Belgian De Keke, and then we divide the morphology into different categories, such as natural form, geometric form, animal or character form, traditional pattern and so on. Combined with the design style of the master of jewelry design, artificial intelligence uses customer needs and inspiration sources in the database (such as natural shape profile, pattern), style features and jewelry categories.

![Figure 1. Value of Artificial Intelligence in Creative Design of Jewelry](image)

The method is automatically compiled into a number of design schemes (figure 1), in addition to the design form, color, but also the internal structure, production technology, material texture and other automatic "compilation" into compliance 3D Print the required digital documents, and then select the style to meet the needs of Party A for production proofing. For example Nervous System, who created a series of cell-like jewelry called “Cell Cycle”. Unlike the traditional design process, the design consists of a series of codes...... The advantage of directly participating in the design with parameters is that it can freely evolve a variety of designs and change a parameter to produce a new form. By analogy, hundreds of different forms can be produced in just a few days. According to this point, designers can design and mass produce different materials and types of jewelry in a short time .“Ostagram”Mini Programs in the field of painting only requires you to enter two paintings, one is style, the others composition, and the artificial intelligence system\[1\]take the first style into the second one automatically, and become to unified works. Also, Daozi Technology developed an artificial intelligence painting system-Daozi intelligent painting system. Be able to transform a landscape photographic work into an artistic image by style transfer, or ink painting. In the domain of design, Daozi artificial intelligence system also has a lot of exploration. For example, programmers have entered more than 80,000 copies of the Dao subsystem human designers designed chair images, after learning and calculation, generated more than 300,000 new chair design sketches.

In essence, innovative design is not a simple bionic, imitation, imitation shape, imitation is only a lower level of original design means or methods, and does not have dynamic growth. The understanding and understanding of artistic creation and design of the essential characteristics of artistic conception or spiritual level and soul, the care of human nature, especially the grasp of the epoch of creation, can not be completed only by the examination algorithm, which is the place that artificial intelligence can not replace. The ability of original design growth is more uncertain than science and technology-digital growth. Artificial intelligence can complete the parameters of the
design scheme according to the modern design goal of consumers, that is, original designers and artists will not be eliminated by artificial intelligence, but their design or works will be more valuable. Original design value will be pushed up, truly when creative design can be completely completed independently by 3D printing technology, the technical barrier of jewelry production is broken, and the value of original, unique jewelry design will be highlighted to the maximum extent, so that the two poles of design and technology tilt towards the only unilateral world of design. 3D printing technology just opens the door to the public, so that everyone has the aesthetic taste and design ideas into reality. From this meaning, 3D Print makes it possible for everyone to be a designer.

Although the design of artificial intelligence cannot be satisfied the top high demand, but for most people, especially the fast fashion buying group, They can spend a lower price for artificial intelligence to design a desired design and use 3D to print quickly implemented personalized jewelry. Here it is, artificial intelligence in jewelry graphics creative design value can be demonstrated.

3. The Value of Artificial Intelligence in Jewelry 3D Modeling System

Nowadays, 3D printing technology in modern jewelry design is mainly auxiliary molding or direct molding, which needs to be transformed into mathematical model-3D modeling. Jewelry industry usually use in JeweICAD, 3ds Max, MAYA, Zbrush, Rhinogold and other software for 3D modeling design. With the development of artificial intelligence technology, the process and modeling program of 3D printing modeling are more and more affected by it, such as Solidworks and AUTODESK launched Solidworks Xdesign and Dream Catcher software, which combine artificial intelligence, cloud computing and big data, it can reproduce hundreds of designs in a short time on the basis of original design; At the same time, AI carries on the magnanimity computation, analysis and comparison to the different plan, provide the best solution to designer. For designers refer it or make it be a practical scheme to Party A.

In the modeling process of jewelry design, every step of the designer's or technician's operation will be recorded and imitated by the artificial intelligence system, which can learn its modeling, technology Habits, modeling ideas, modeling intentions, and modeling goals, and then automatically generated in conformity with the 3D printer supports the STL file or the 3DP file jewelry modelling digital model scheme, and the artificial intelligence will add the support structure, the stratification processing and so on according to its depth study grasps the different material attribute and the printing way. For example, the printing principle of 3D printers is to deposit the melted wax and support wax on the aluminum platform layer by layer by nozzle. Through learning in actual production, artificial intelligence grasps the empirical characteristics of supporting points needed for multiple design models of wax with different structures and shapes. Through big data analysis, in the future printing process, Artificial intelligence can automatically provide support point scheme, automatically identify molding wax and support wax during printing, and assign tasks to different printing nozzles without manual operation.

4. Comparison between 3D printing traditional handcrafts (figure 2, 3)

![Figure 2. 3D Process of printing wax mold and hand-carved wax casting](image-url)
In the traditional jewelry industry, different materials means different manufacturing processes, such as metal materials. Traditional jewelry industry is mostly block, sheet and wire, the process used are casting, forging, chiseling, gilding, gold plating and so on. This is different from the metal powder used in "3D printing technology". Presently, metal materials 3D metal powder selective laser melting (SLM) printing jewelry are mainly gold, 925 silver, brass, titanium and other powders, the minimum particles are 30µm, 40µm, 35µm, 45µm respectively. Different power lasers are selected for bantering of different metal powders, which can be interbred directly by metal powder, or by mixing organic binder powder with the required metal powder in proportion. The mixture of two metal powders can also be sintered, with low melting point metal powder acting as binder. But no matter what kind of sintering method, artificial intelligence through deep learning, can be quickly mastered. And in the traditional jewelry industry, the use of metal materials, whether pure hand-made or hand-made + mechanical production. Its understanding of form, material cognition and production skills to learn and master, through a long time of opponents, eyes, experience training results. Such as chiseling technology, in addition to mastering the necessary chisel skills, but also have a strong artistic aesthetic ability and production experience, without many years of practice and learning understanding, it is impossible to complete such skills. And 3D print jewelry only need to provide the completed digital design, consumers put forward the required materials.

### Table 1. Comparison of traditional handicraft, industrial production and 3D printing technology

| Comparative projects | Traditional crafts | Industrial production | 3D Printing + Artificial Intelligence |
|----------------------|--------------------|-----------------------|--------------------------------------|
| Production cycle     | Uncertainty (by making product) | >30 days | Within 3Days |
|                      | The degree of difficulty is determined |                           |                                      |
| Production process   | Unspecified Level (s) | Standardization | Standardization |
| Easy to customize    | Easy | More difficult | Easy |
| Learning cycle       | >4 years | 3-4 years | Fast |
| Product quality monitoring | Uncertainty | Standardization | Standardization |

Texture, surface texture and decoration, artificial intelligence through the Internet, cloud computing quickly match its needs, the rest only need to hand over to artificial intelligence and 3D printer. Artificial intelligence by identifying digital design manuscripts, evaluating process parameters and associating with the powder database carried by 3D printers, 3 printers make their own decisions and select the appropriate process combinations (table 1).

Through the in-depth study of artificial intelligence, 3D printers can make more complex shapes and special shapes than hand-made, especially in the process of multi-layer hollowed-out form (including spherical sleeve structure, internal suspension structure, spiral active structure form etc.), linear structure form and so on. That means no matter how strange shape is, how wild ideas and
designs can be achieved by printing high precision through 3D printing, which is beyond the reach of traditional handicraft and large industrial production of machines, and 3D print can reduce the time and cost of custom jewelry. This is the gospel of personalized jewelry designers and consumers.

5. Effect of the 3D printing technology on jewelry industry in the era of AI
In the context of the era of AI, 3D printing technology is bound to have many influences on contemporary jewelry industry: the first one is design and manufacture, especially is breakthrough the traditional manual technology barrier, consumers will change from buying jewelry to buying and selling design data, because 3D printing has convenience. The traditional jewelry casting, forging, chiseling and even inlay process will be gradually eliminated, replaced, especially when the multi-material 3D printer getting mature, the 3D printer can perfectly display the designer’s scheme, and under the monitoring of artificial intelligence, the printed products are less error and loss than the traditional handicraft or machine production jewelry, at the same time, 3D printing can ensure the high quality and accuracy of the model. The artificial intelligence technology is carried on the 3D printer, machine vision can supervise the printing process. (Figure 4) For example, the identification of metal 3D printing powders through machine vision,” Researchers at Carnegie Mellon University’s School of Engineering have developed machine vision technology for metal 3D printing materials, which can automatically identify and classify different kinds of 3D printing metal powders with accuracy of more than 95%.”[3] Alternatively, screening products, such as wax printing at high temperatures, may cause local shapes to melt and deform, or produce fine cracks to print out a deformed jewelry, with 3D of artificial intelligence printers that can monitor their printed products in real time and adjust them in real time according to the output of tracking printing to control the quality of jewelry products.

Second one is industrial mass production into customized personalized jewelry on demand, under the assistance of Internet + big date and cloud computing, consumers just input personal needs, style features, production materials and processes, AI will star calculating and design a number of types of jewelry, at this time, the audience has completed its transformation from consumer to designer. This would lead to the collapse of the "economies of scale" model of maximize profits, because in the industrial age, in order to get maximize profits, it is very necessary to choose the way and means of mass production. Every time the iterative production of a product changes its appearance, it needs to re-model and open a mold, thus increasing the production cost, that is to say, the jewelry market in the industrialized era makes profits at the expense of the diversity of the product, while the cost of a 3D printing jewelry under artificial intelligence and many of its costs do not fundamentally change.

| Number of cases Quantity | 3D Print Cost | Production cost of lost wax casting |
|------------------------|--------------|----------------------------------|
| 100                    | ¥294.37      | ¥789.65                          |
| 500                    | ¥130.64      | ¥162.02                          |
The third one is the consumption mode will also be mainly experience stores, the traditional display counter sales model will become network sales, the digital age has the rapid development, effecting people no longer go to physical stores to consume and touch the real economy, and more through the network to complete consumption. Of course, the impact of 3D printing on the jewelry industry is far more than the above three points, and in a long period of time, the traditional hand-made, industrial processing and 3D printing jewelry will be parallel for a long time. With the rapid development of artificial intelligence and 3D printing technology, especially the reducing the printing costs, the market share of traditional handwork and industrial processing will be less and less.

6. Conclusion
With the rapid expansion of artificial intelligence, Internet +, big data, cloud computing and 3D printing technology, 3 printing will effectively realize the accelerated intelligent development of jewelry industry, and the rapid realization of jewelry industry 4.0. Consumers will be more and more join the design, even consumers can design and sell at the same time. In conclusion, artificial intelligence is bound to create independently or assist humans, the combination of AI and 3D printing will inevitably lead to a revolution in the jewelry industry. Personalized design and consumer market, the design before production will be the future development direction of jewelry industry.

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