Hindawi
Wireless Communications and Mobile Computing
Volume 2023, Article ID 9892873, 1 page
https://doi.org/10.1155/2023/9892873

Retraction

Retracted: Numerical Simulation and Optimization Control of Precious Metal Jewelry Process Based on VR Virtual Technology

Wireless Communications and Mobile Computing

Received 28 November 2023; Accepted 28 November 2023; Published 29 November 2023

This article has been retracted by Hindawi, as publisher, following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of systematic manipulation of the publication and peer-review process. We cannot, therefore, vouch for the reliability or integrity of this article.

Please note that this notice is intended solely to alert readers that the peer-review process of this article has been compromised.

Wiley and Hindawi regret 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 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] L. Li, "Numerical Simulation and Optimization Control of Precious Metal Jewelry Process Based on VR Virtual Technology," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 8723282, 7 pages, 2022.

Hindawi
Wireless Communications and Mobile Computing
Volume 2022, Article ID 8723282, 7 pages
https://doi.org/10.1155/2022/8723282

Research Article

Numerical Simulation and Optimization Control of Precious Metal Jewelry Process Based on VR Virtual Technology

Lu Li

Guangdong Industry Polytechnic, Guangzhou, Guangdong 510300, China

Correspondence should be addressed to Lu Li; 20152404051@m.scnu.edu.cn

Received 14 August 2022; Revised 18 September 2022; Accepted 26 September 2022; Published 8 October 2022

Academic Editor: Balakrishnan Nagaraj

In order to solve the problem that the design direction of precious metal ornaments in virtual reality environment which is complicated and most of them are operated by human, and the speed of obtaining the global optimal design result is not good, this paper proposes the numerical simulation and optimization control of precious metal ornaments process based on VR virtual technology. Through the hierarchical modeling structure design of precious metal jewelry and the coding of jewelry modeling gene, the fitness function is used to evaluate the fitness of individuals and determine the fitness of coding individuals; the evolution of jewelry modeling design scheme is supported by genetic operators. After the artificial participation conditions are met, the design scheme is evaluated manually in the virtual reality environment until a satisfactory scheme is produced. The experimental results show that under the same conditions, the design results of industrial ornaments based on genetic algorithm are 410 times less than those generated by conventional methods. *Conclusion*. It can accurately converge to the global optimal design result, which indicates that the genetic algorithm converges to the global optimal result faster and better in the industrial jewelry modeling design under the virtual reality environment.

1. Introduction

With the rapid development of social economy and the continuous improvement of the people's material living standards, precious metal jewelry has gradually been widely concerned by people. It plays an important role in meeting people's aesthetic needs, spiritual and cultural needs, and health function needs [1]. First of all, precious metals are generally bright and brilliant. In addition, they have strong extensibility and are easy to be processed into various exquisite handicrafts. By wearing these precious metal ornaments, people can effectively meet their needs for beauty and reflect the master's taste and beauty; Secondly, precious metal jewelry itself has a very profound cultural connotation. As early as the Bronze Age, people began to use precious metals to make jewelry. Precious metal jewelry was a symbol of wealth and identity at that time. At the same time, precious metal jewelry itself has rich connotations. For example, the "longevity lock" made of gold has the meaning of warding off evil, pursuing good fortune, and avoiding evil. For example, the "dragon and Phoenix Bracelet" worn in ancient marriage takes the meaning of "dragon and Phoenix presenting good fortune", which expresses the appeal of the ancient working people for a better life [2]. Finally, precious metal ornaments also have good health care functions. For example, metal silver has a good bactericidal effect and can also be used for drug testing. It can prevent bacteria from breeding, calm the five viscera, calm the mind, stop the economy, dispel evil gases, and effectively protect people's health [3].

Precious metals refer to gold, silver, platinum, palladium, rhodium, etc. Precious metals have different material performance characteristics from ordinary heavy metals. In the traditional jewelry processing industry, artisans rarely create design drafts, and more rely on oral skills and production experience to complete the processing of jewelry. When special customized jewelry is needed, it is difficult to produce suitable jewelry at one time. In this repeated deduction and production, a lot of production materials and time are wasted [4].

Therefore, what is missing when communicating with craftsmen is a transitional demonstration. The virtual reality technology can fill the gap of this technical communication

well. By using Rhino3D software, the splicing, inlay of different materials, and various structural details of the whole can be accurately produced in the virtual space, so that the refined and transformed decorative elements and ornaments can be more skillfully combined. The intuitive display facilitates the communication between peers and saves the production materials and time [5]. As a new scientific and technological achievement, virtual reproduction technology has become more and more closely integrated with all aspects of design, and has become an important technical means and component of jewelry design.

2. Literature Review

With the development of science and technology, in addition to visual display, virtual reproduction technology can also realize the docking and conversion between virtual objects and real entities through technical means such as numerical control machine tools [6]. In the virtual space, the design of ornaments can be processed and modified repeatedly, and every detail of the ornaments can be adjusted constantly, so that the ornaments can be perfected day by day through repeated deliberation [7]. Jewelry is not only an independent individual, but also has certain requirements for its functionality. Necklaces and pendants should match the matching of clothing, earrings, and headwear, and also have a modifying effect on the face and hairstyle. The handheld rosary beads and play pieces need to have a certain meaning. The designer needs to consider all aspects when creating, and the refined decorative elements should achieve an organic combination of characteristics and functions [8]. Virtual reproduction technology has run through every production stage of jewelry design under the commodity economy. As an jewelry designer, when refining and transforming the decorative elements with distinctive national characteristics, he should not only keep the creative attitude of traditional craftsmanship and excellence but also adapt to the new technologies and challenges brought by the development of science and technology. Only when we truly master the technical means suitable for the development of the discipline can we contribute our own strength to the development of jewelry design [9].

With the rapid development of science and technology, consumers have higher and higher requirements for jewelry modeling, not only focusing on the use function of jewelry but also pursuing the enjoyment of visual sense [10]. In order to respond to the rapid development of market demand, it is very necessary to use virtual reality technology to assist designers to complete jewelry modeling design. In the process of traditional ornament modeling design, it is mainly based on the function of ornaments to improve the appearance form of ornaments, including the shape design, color design, and texture design of ornaments [11]. The designer needs to first take the user's needs as the design direction, analyze the principle and performance of the jewelry by using his own design experience, and design the basic structure, function, and shape of the corresponding jewelry, which mainly depends on the designer's personal ability [12]. It is difficult to ensure the efficiency of design work and meet the requirements of rapid development and design of jewelry modeling design.

Therefore, the high parallelism and self-adaptability of genetic algorithm are used to solve the jewelry modeling design [13]. In order to better integrate the needs and preferences of users and the experience of designers, and avoid the subjective views of designers and the process of users participating in the evaluation, virtual reality, and genetic algorithm are combined. Through interactive means, manual evaluation is used to adjust, and the fitness value in genetic algorithm is replaced by manual evaluation to obtain the optimal result, which can not only reduce the workload of users but also improve the convergence speed of jewelry modeling design results.

3. Method

3.1. Application of Genetic Algorithm in Jewelry Modeling Design. Genetic algorithm can process multiple design objectives at the same time, and obtain multiple satisfactory jewelry modeling design results in one jewelry modeling design process [14]. The application of genetic algorithm in jewelry modeling design is based on evolution theory and genetic theory. It codes each individual design element in jewelry modeling, and then arranges and combines genes through selection, crossover, and mutation operators until satisfactory new individuals are generated [15]. After the evolution process meets certain conditions, it enters the manual evaluation stage for scheme adjustment. If the output result is not optimal, it enters the natural stage of computer operation to form a cycle until the optimal design scheme is generated [16]. Because the computer can search multiple objects in parallel at the same time, it can improve the design efficiency of jewelry modeling. The jewelry modeling design process based on genetic algorithm is shown in Figure 1.

3.2. Design Jewelry Modeling Gene Coding. In the operation of genetic algorithm, the floating-point coding method is used to convert the actual feasible solution variable into individual coding, which can represent more patterns in the population with a certain size [17]. In the initial population, jewelry shape, color, etc. can be expressed as specific hierarchical structure data, each functional unit corresponds to a structural feature parameter, and each chromosome contains a series of feature parameter sets [18]. The feasible solution is transformed from the solution space to the search space, and the characteristic floating-point parameters are encoded into the jewelry individual through this hierarchical structure [6]. The modeling elements of ornaments are represented by hierarchical chromosome structure, as shown in Figure 2.

The gene locus of the jewelry chromosome is the chromosome of the functional unit, the chromosome gene locus of the functional unit is the chromosome of the characteristic parameter, and the functional characteristic parameter is defined by the floating point value [19]. Set the parameter code of each jewelry modeling design element, including the name, quantity, shape characteristics, geometric size, and jewelry color of the functional unit. The data types of

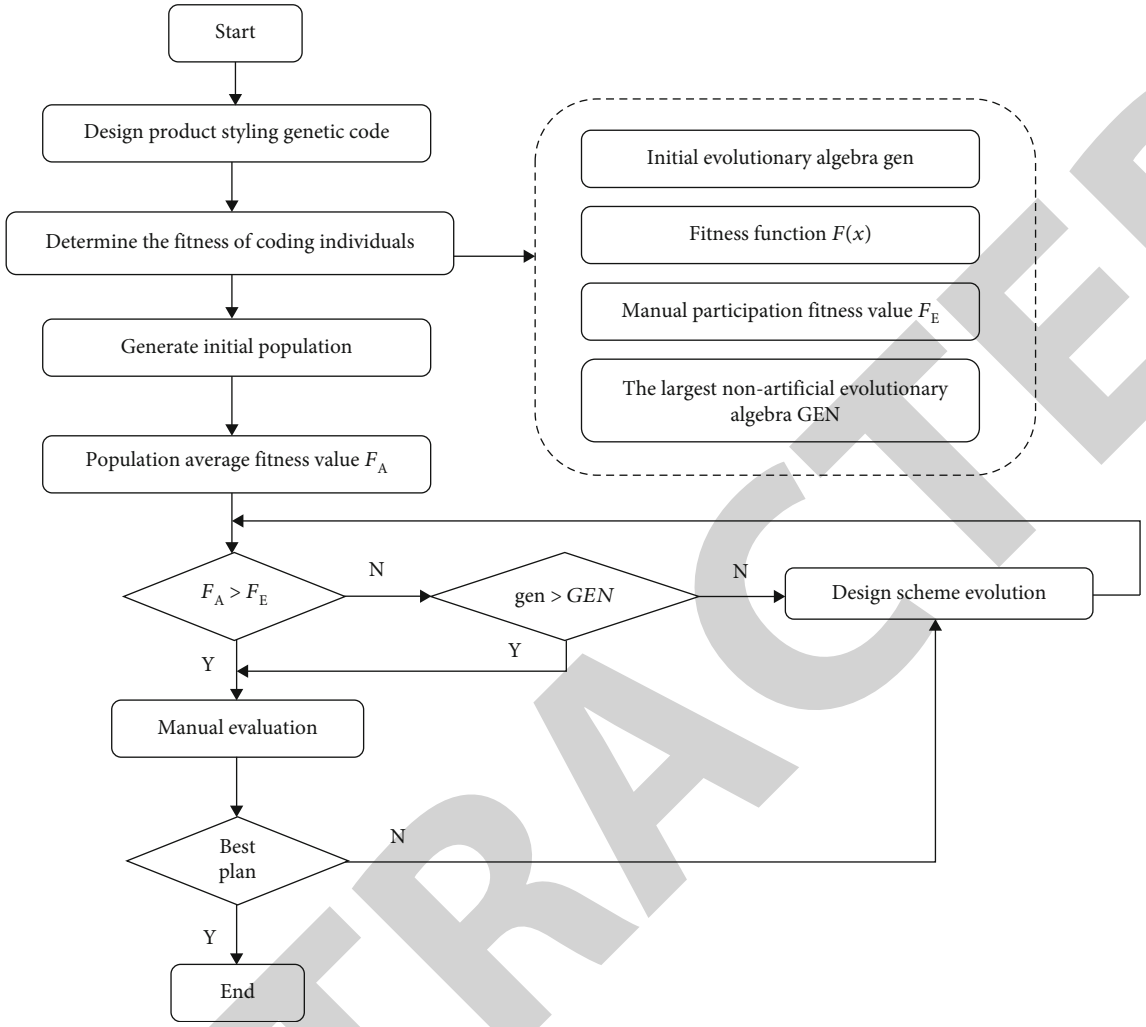

Figure 1: Jewelry modeling design process based on genetic algorithm.

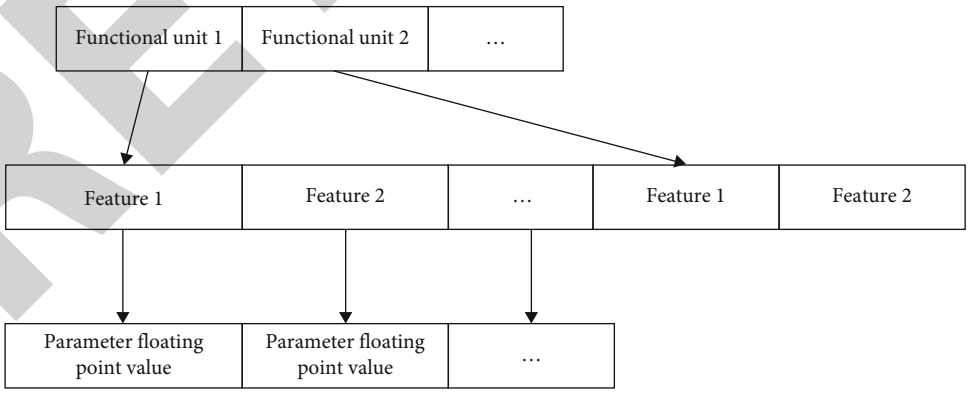

Figure 2: Chromosome structure of modeling elements of hierarchical ornaments.

coding parameters of some jewelry modeling design are shown in Table 1.

Before importing the coding parameters into the computer-aided software, the designer needs to extract the required data from the market and conceptual design, and encode the data according to the above hierarchical structure. The corresponding characteristic parameters of different ornaments are different, and this difference will affect the genetic algorithm to obtain an effective solution. Therefore, the floating-point values of the encoded data are

Table 1: Data types of coding parameters of jewelry modeling design.

Serial number:	Name	Data type
1	Name of functional unit	Character string
2	Number of modeling design elements	Integer
3	Shape features of modeling design elements	Integer
4	Geometric size of accessories	Floating point value
5	Jewelry weight	Floating point value
6	Main color of jewelry	Floating point value
7	Accessory color	Floating point value
7	Decoration color	Floating point value

forcibly mapped within the same effective range, so that each corresponding gene locus is in the range of [0, 1], and the problem of parameters in different ranges is solved.

3.3. Determination of Coding Individual Fitness. In the nonartificial evaluation stage; that is, the natural stage, the fitness function is obtained from the objective function transformation, and the fitness value of the individual is evaluated. The fitness function is expressed by

$$F(x) = \begin{cases} C_{\max} - f(x), f(x) < C_{\max,} \\ 0, f(x) \geqslant C_{\max}, \end{cases} \quad (1)$$

where: $F(x)$ is the fitness function; $f(x)$ is the objective function; $C_{\max}$ is a preset relatively large positive number to ensure that most solutions are positive. Set the population average fitness value F_{A_0}.

Jewelry modeling design is a multiobjective optimization process. The actual process includes a variety of characteristic parameters, corresponding to different states of jewelry. The morphological semantic weighting method is used to set an appropriate weight value according to the importance of design elements in the design scheme, and the user semantics is correspondingly linked with the description of jewelry features to reflect the advantages and disadvantages of design individuals in various aspects. Investigate each design element, and take the arithmetic mean value of the investigation results to obtain the manual evaluation fitness value F_E.

Randomly generate N individual strings, where n individuals are the initial population size, the initial evolution algebra is gen, and the maximum non artificial evolution algebra is Gen.

3.4. Evolution of Jewelry Modeling Design Scheme. The evolution of jewelry modeling design scheme is supported by three genetic operators. The iteration starts from the initial population. After obtaining the average fitness of the initial population, the individuals with high fitness are selected to pair up, and then the new individuals are regenerated through crossover and mutation operations in genetic operations. The process is repeated until the new population is generated. The new population generated after each generation of operation will replace the old population. Crossover operation is to randomly select two individuals in the previous generation population for crossover under the control of crossover probability P_c, and provide more genes by the individuals with higher fitness values among the two individuals. The initial mutation probabilities P_m and $P_m \in [0, 1]$ are first set in the mutation operation.After the generation of the next generation population, compare the fitness values of the optimal individuals in the two generations. When the optimal individuals in the new population are smaller than the fitness values of the optimal individuals in the old population, increase the initial mutation probability PM by 0.05, otherwise, decrease by 0.05, but always keep the mutation probability between the initial mutation probability value and 1. In order to ensure that the individual with the best fitness value is retained in the next generation population, the individual with the highest fitness value in the current population is directly substituted for the individual with the lowest fitness value generated by crossover and mutation genetic operation. At the same time, if the fitness value of the optimal individual in the previous generation population is higher than the fitness value of the optimal individual in the current population; that is, the optimal individual in the previous generation population is used to replace the individual with the lowest fitness value in the current population. When the algorithm runs to generate a new jewelry modeling design scheme and meets the conditions of manual participation, the decoding enters the stage of manual evaluation in the virtual reality environment.

3.5. Artificial Evaluation Design Scheme under Virtual Reality Environment. The artificial evaluation stage in the virtual reality environment is mainly controlled by the computer host with the help of the virtual reality technology. The algorithm content stored in the knowledge base and database is displayed in the virtual scene through the four-dimensional form, and the final design result scheme, drawing or modeling is output to the customer. The output flow of virtual reality design results is shown in Figure 3.

Whether the optimal scheme is generated is manually evaluated. Set the design jewelry evaluation target as $u = (u_1, u_2, \cdots, u_n)$, and the corresponding weights are q_i, which are expressed as $Q = (q_1, q_2, \cdots, q_n)$ by matrix, and score the jewelry evaluation targets according to

$$B = \begin{bmatrix} b_1 \\ b_2 \\ \vdots \\ b_m \end{bmatrix} = \begin{bmatrix} b_{11} & b_{12} & \cdots & b_{1n} \\ b_{21} & b_{22} & \cdots & b_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ b_{m1} & b_{m2} & \cdots & b_{mn} \end{bmatrix}. \quad (2)$$

If the user is satisfied with the scheme in the manual evaluation stage, stop the operation of the algorithm; otherwise, continue the operation in the natural stage, and eliminate the scheme that does not meet the design requirements. So far, the application of genetic algorithm

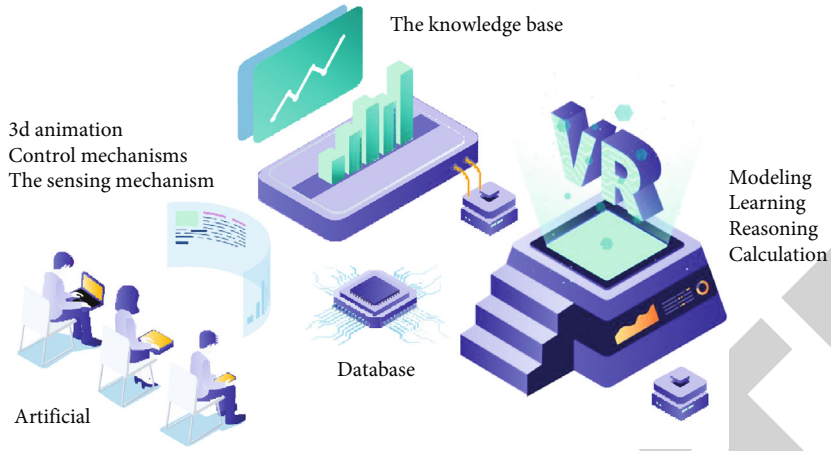

Figure 3: Output process of virtual reality design results.

Table 2: Partial operating parameters required by genetic algorithm.

Operating parameters	Parameter value	Algorithm type
Population size	9 ~ 302	
Number of iterations	9 ~ 901	
Maximum crossing probability	0.81	Optimal individual preservation strategy
Minimum crossing probability	0.06	
Maximum variation probability	1	Elite strategy
Minimum variation probability	0.06	

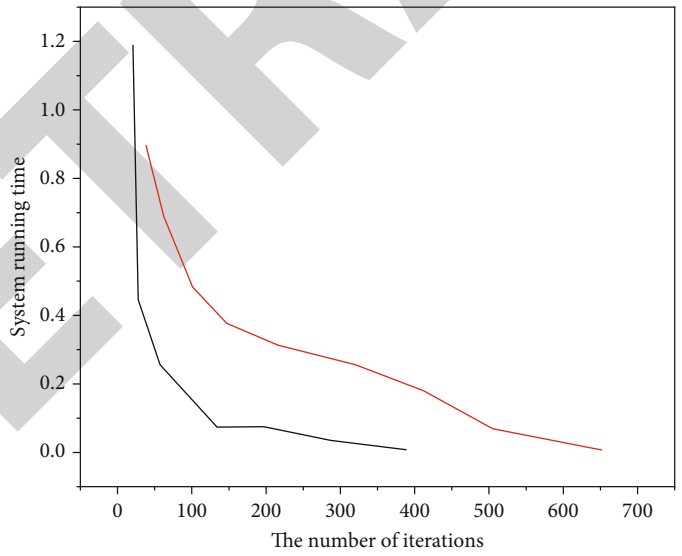

Figure 4: Convergence curve of generated design results.

in industrial jewelry modeling design under virtual reality environment has been completed.

3.6. Experiment Preparation and Operation Parameter Setting. A simulation experiment is designed to compare the convergence speed of the optimal industrial jewelry modeling design results generated by genetic algorithm in the virtual reality environment and the convergence speed of the design results generated in the conventional virtual reality environment.

The global optimization toolbox of MATLAB software is used to run the algorithm in the original modeling system. According to the designer's experience, the operating parameter values in the genetic algorithm are set in advance, including the maximum/minimum population number, the range of generations, the crossover probability, and the

mutation probability. Genetic algorithm type selection is the best preservation strategy and elite strategy. Some operating parameters required by the genetic algorithm are shown in Table 2.

4. Results and Discussion

Taking the number of iterations as the horizontal axis and the system running time as the vertical axis, the algorithm convergence curve is drawn as shown in Figure 4.

It can be seen from Figure 4 that the convergence speed of the conventional generation of the optimal precious metal jewelry modeling design results needs about 700 iterations, while the precious metal jewelry modeling design based on the genetic algorithm accurately converges to the global optimal solution after 290 iterations. Under the same conditions, the design results of industrial ornaments based on genetic algorithm are 410 times less than those generated by conventional methods. The results show that under the same conditions, the design results of precious metal ornaments based on genetic algorithm converge faster, and can converge to the global optimal solution more quickly, which improves the design efficiency.

5. Conclusion

In this paper, the numerical simulation and optimization control of precious metal jewelry process based on VR virtual technology are proposed. Combined with virtual reality and genetic algorithm technology, the artificial evaluation stage is implemented in the virtual reality environment. Users can observe the design results more intuitively and conveniently. At the same time, designers can play the positive role of subjective experience to make up for the shortcomings of conventional design methods. The evolution process of the design scheme is automatically completed by the computer, and the advantages of the genetic algorithm with strong global search ability are brought into play to approach the global optimal solution. In addition, since the artificial evaluation stage is conducted after certain conditions are met, if no artificial satisfactory results are generated, it will be transferred to the computer natural stage to continue to run. Therefore, most of the iterative process of genetic algorithm is completed automatically by the computer, which can effectively reduce the number of manual participation, reduce the workload of users, and avoid the limitation of iteration times. In addition, the manual evaluation process is carried out in the virtual reality environment, which is easy for users to operate and further reduces the workload of users. The application of genetic algorithm in the modeling design of precious metal jewelry in the virtual reality environment is completed.

Data Availability

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

Conflicts of Interest

The author declares that they have no conflicts of interest.

References

[1] M. Korium, H. Roozbahani, M. Alizadeh, S. Perepelkina, and H. Handroos, "Direct metal laser sintering of precious metals for jewelry applications: process parameter selection and microstructure analysis," *IEEE Access*, vol. 9, pp. 126530–126540, 2021.

[2] F. Burat, A. Demirağ, and M. C. Şafak, "Recovery of noble metals from floor sweeping jewelry waste by flotation-cyanide leaching," *Journal of Material Cycles and Waste Management*, vol. 22, no. 3, pp. 907–915, 2020.

[3] A. Pinheiro and J. D'Almeida, "Peach palm: pseudo-wood for sustainable jewelry design," *Materials Today: Proceedings*, vol. 33, pp. 1869–1873, 2020.

[4] M. Shi, C. Zhang, Y. Ting, and P. H. Lin, *Application of Auspicious Cultural in Metalworking Jewelry Design*, Springer, 2020.

[5] E. Nalacigl and A. F. Zyilmaz, "A research on marketing and consumer habits in Konya jewelry sector," *ISPEC International Journal of Social Sciences & Humanities*, vol. 4, no. 4, pp. 350–386, 2020.

[6] A. Atamtajani, G. N. Firdauzi, and D. Yudiarti, "Maritime biota waste as eco-jewelry materials, potentials and possibilities," *IOP Conference Series: Materials Science and Engineering*, vol. 1098, no. 5, article 052030, 2021.

[7] N. I. Pratiwi, A. Mukimin, N. Zen, and I. Septarina, "Integration of electrocoagulation, adsorption and wetland technology for jewelry industry wastewater treatment," *Separation and Purification Technology*, vol. 279, article 119690, 2021.

[8] W. Yu, "Research on innovation and development of Chinese traditional silver jewelry products under service design thinking," *Arts Studies and Criticism*, vol. 3, no. 1, pp. 1–4, 2022.

[9] K. Munpakdee, P. Ninpetch, S. Otarawanna, R. Canyook, and P. Kowitwarangkul, "Effect of feed sprue size on porosity defects in platinum 950 centrifugal investment casting via numerical modelling," *IOP Conference Series: Materials Science and Engineering*, vol. 1137, no. 1, article 012021, 2021(7pp).

[10] H. Zheng and J. Chang, "Cad method and model in teaching of creative design for jewelry," *Computer-Aided Design and Applications*, vol. 19, no. S1, pp. 47–58, 2021.

[11] C. Jin and J. Li, "Application of vr technology in jewelry display," *Mathematical Problems in Engineering*, vol. 2021, Article ID 5516156, 9 pages, 2021.

[12] M. S. Ahmad, M. Ibrahim, and M. Z. Daud, "The preservation of Malaysian identity in jewelry design through semantic differential scale in teaching and learning process," *Journal of Advanced Research in Dynamical and Control Systems*, vol. 12, no. 7, p. 626, 2020.

[13] F. Demarco, F. Bertacchini, C. Scuro, E. Bilotta, and P. Pantano, *Algorithms for jewelry industry*, Springer, 2020.

[14] N. Fedorova, "Foreing and domestic experience in protecting intellectual property right to jewelry and jewelry," *Theory and Practice of Intellectual Property*, vol. 6, pp. 31–37, 2021.

[15] E. Ramadan and Y. Wu, *A Study of Framework Development and Research of Jewelry Design, Based on Pattern Egyptian Culture (Lotus Flower) Used in Culture Product Design*, Springer, 2021.

[16] A. Atamtajani and D. Yudiarti, "Micro pave setting for the triple moon goddess jewelry set designs," *Journal of Physics Conference Series*, vol. 1517, no. 1, article 012022, 2020.

[17] B. Duan, "Analysis on the value of 3D printing in jewelry design based on artificial intelligence," *Journal of Physics: Conference Series*, vol. 1744, no. 4, article 042132, 2021.

[18] M. Negev, T. Berman, S. Goulden, S. Reicher, and M. L. Diamond, "Lead in children's jewelry: the impact of regulation," *Journal of Exposure Science & Environmental Epidemiology*, vol. 32, no. 1, pp. 10–16, 2021.

[19] A. A. Gerasimova, B. L. Kagan-Rosenzweig, and S. A. Gavritskov, "Design of modern jewelry using unconventional materials," *IOP Conference Series: Materials Science and Engineering*, vol. 1079, no. 2, article 022049, 2021.