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Penetration of Green Design Concept in Jewelry Design in the Era of Internet of Things

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Abstract: With the continuous economic development, people's living standard has been significantly improved. However, with this comes an obvious disconnect between traditional industrial design concepts and modern civilization. Therefore, an effective innovation of modern jewelry is essential. In this paper, jewelry is studied and analyzed from the perspective of Internet of Things (IoT) technology, and methods to solve its problems such as green quality and humanized design are discussed. After that, this paper studies the jewelry design system based on IoT technology and tests and analyzes the basic architecture of the system. The test results show that the memory resource data usage of the system is between 3654k-3782k. It is hoped that these research results can provide a reference basis and thought guidance for the healthy, sustainable and stable development of the economy.

1. Introduction

With the rapid development of the economy, people's demand for material life and spiritual culture continues to increase, and consumption concepts have also undergone significant changes [1-2]. The jewelry industry, as an emerging industry, has great potential, but in recent years, it has been constrained by various factors, such as rapid growth in the jewelry market and severe macroeconomic regulation, which have led to an overall downturn and urgent problems to be solved. At the same time, jewellery design personnel are not aware of product quality and cost control, and have not formed a scientific and reasonable management model and method to meet consumer needs, which to some extent hindered the development and progress of the jewelry industry.

At present, there is relatively more research in this field, but it mainly focuses on theoretical and practical aspects, and there is less analysis and exploration of the problems that exist in the marketization process. Some scholars believe that jewelry design needs to possess characteristics such as creativity, artistic sense, and innovative consciousness. Some scholars consider that the jewelry industry is one of the sunrise industries with enormous development potential, high technological content, and the ability to drive economic benefits in related industries. However, research in this field is currently relatively weak [3]. In addition, some scholars have conducted

research on traditional jewelry design concepts and published relevant articles. This mainly includes two aspects. Firstly, in order to achieve better development in the jewelry industry, it must follow the "green" path. Secondly, by effectively solving environmental and resource problems, it can achieve dual improvement in economic benefits and social value [4]. Therefore, this article conducts a systematic study on jewelry design based on the Internet of Things technology and green environmental protection concepts.

The design of jewelry is based on innovation and transformation of traditional craftsmanship, and is carried out by studying the laws and methods of modern science and technology, people's living environment, and economic concepts. This article mainly extracts relevant information and data from existing products in the current market, analyzes the problems and reasons that exist in the development process of the jewelry industry based on these data, and proposes corresponding solutions. Finally, based on the background of IoT technology and the design concept of external jewelry, some suggestions and measures are proposed to better and faster promote the pace of green economy construction in the era of great prosperity of modern Chinese art and culture.

2. Exploration of the Green Design Concept in Jewelry Design in the Era of Internet of Things

2.1 Green Design Concept

With the development and progress of society and the improvement of living standards, consumers are increasingly paying attention to environmental protection concepts such as harmonious coexistence with nature, protecting the natural ecological environment, and conserving resources. At the same time, due to the continuous innovation and updating of modern science and technology, people's demand for reducing natural resource consumption is also increasing. Therefore, green design has become one of the goals pursued by contemporary designers. Green design is guided by the concept of sustainable development, with people, the environment, and society at its core. From the initial product to the emergence of the concept of "environmental protection", green design has gradually gained attention. With the improvement of people's awareness of environmental protection and the rapid rise of economic level, a series of problems, such as excessive consumption of resources, serious soil contamination, industrial production and the discharge of a large number of sewage and waste gas, are increasing, leading to the deterioration of the ecological environment, the increase in the amount of domestic waste makes the concentration of carbon dioxide in the atmosphere rise, and so on. These problems make the living environment of human beings more and more bad. Therefore, in the design process, people must adhere to the concept of sustainable development and put people first. The purpose of green design is to achieve harmonious coexistence between humans and nature, emphasizing the systematic control of the ecological environment by analyzing environmental and human factors. Throughout the entire product production process, the concept of "sustainable development" must be followed. For consumers, they hope to reflect their use value and environmental friendliness in the items they consume, which is reflected in the "ecology" aspect. For managers, they require green design to maximize corporate benefits, optimize social benefits, and maximize environmental friendliness, in order to achieve systematic control and management of the ecological environment. Green design requires designers to put people first and consider how to meet people's increasing living needs and aesthetic taste. Through scientific and effective design methods, the goal of saving resources and protecting the ecological environment can be achieved, and corresponding measures can be taken to better utilize products and materials, thereby improving people's income level and national quality.

Throughout the entire design process, the concept of green permeates every aspect, making research on it a very important topic. Jewelry should not only meet people's material needs, but also meet the requirements of environmental protection, resource conservation, and other aspects [5-6].

From another perspective, the significance of green concepts in both economic and environmental dimensions is reflected in: on the one hand, in terms of economic value, green concepts emphasize the fundamental goal of harmonious coexistence between humans and nature and sustainable development; on the other hand, in terms of ecological benefits, it means purifying the ecological environment and decomposing the entire process into small pieces through technological means to achieve environmental protection. At the same time, measures such as waste treatment and garbage classification and collection should also be taken to protect the environment, save energy, reduce harmful substance emissions, and improve the performance of renewable recycling.

2.2 Design of Jewelry

The design of jewelry is based on the needs and purchasing power of consumers. In this process, it is necessary to fully consider the pursuit of product functionality and appearance by different consumer groups, and style selection is very important. Modern society is increasingly emphasizing brand awareness and fashion concepts, so these factors need to be taken into account in design. The selection of materials should also conform to the trend of the times and aesthetic taste, in order to attract consumers' attention and enhance their influence in the market, thereby promoting sales. The design of jewelry should be people-oriented, emphasizing humanization and creativity [7-8]. Firstly, product style positioning should be based on emotions. Secondly, factors such as consumer group, purchasing behavior, and psychological characteristics are determined based on brand concept and target audience, and integrated into the design plan. Finally, according to the requirements of the plan, a design form with reasonable element structure and in line with the requirements of human-computer interaction interface should be selected to meet consumer needs and avoid harm to the human body, making jewelry and users have a more intimate contact and interactive experience, becoming a fashion trend.

The design of jewelry is tailored to the needs and psychological characteristics of different consumers, and innovation is carried out on the basis of meeting the functional requirements. When selecting matching relationships and styling elements, it is necessary to consider whether they meet people's aesthetic standards to determine the type and price of the selected material, pay attention to the designer's creative thinking and creativity, and integrate emotions and artistic styles into the design, so as to achieve the expected results and maximize value. The design of jewelry is based on the full utilization of materials and functions required for future life, in order to meet people's higher-level needs and become a popular choice for consumers [9-10]. For designers, they should not only pursue aesthetic appearance, but also blend in with the surrounding landscape and scenes.

Figure 1 shows the cost structure of jewelry industry design. For consumers, they pay more attention to the visual enjoyment brought by jewelry design, while also generating a desire to purchase, thereby enhancing their consumption value. In modern society, with the development of the economy, the improvement of material standards, and the transformation of consumption concepts, traditional culture and ideas are gradually being replaced by modern civilization. As a fashion element appearing in the contemporary jewelry market, it is facing some problems, such as a lack of innovation in design style, being too simple, and not meeting people's needs for visual beauty, thereby affecting consumers' purchasing desire. For consumers, wearing jewelry is a sense of enjoyment and pleasure [11-12]. For the product itself, it reflects the relationship, mutual influence, and coordination between consumers and enterprises. Therefore, whether an attractive brand can attract and retain a customer base depends not only on design factors, but also on the perspective of consumers, so that jewelry can better meet their needs and create more value.

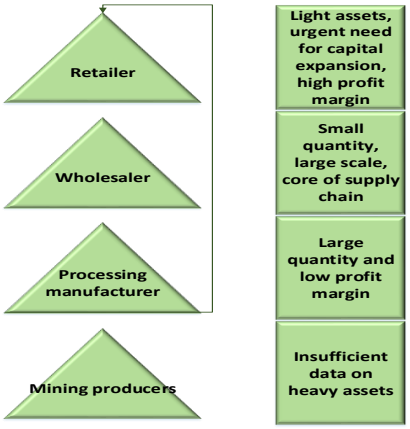

Figure 1: Cost structure of jewelry industry design

2.3 Internet of Things Technology

Through internet technology, in jewelry design, consumers can have a more comprehensive and systematic understanding of product information, thereby better utilizing the Internet of Things era for consumption. In order to improve the efficiency and quality level of the entire industry, this article should make full use of existing network resources and advanced technology, effectively integrate, comprehensively utilize, and innovate their applications. At the same time, it is also necessary to continuously improve the performance and quality of our own products, and strengthen the development trend of brand effect. Comprehensive services can be provided to jewelry designers through internet platforms, in order to achieve the goal of maximizing economic benefits for enterprises. In jewelry design based on the Internet of Things, designers can have a comprehensive understanding of the products and experience environment to better serve consumers through online platforms [13-14]. Firstly, the page mainly includes display interfaces and interactive interfaces. Secondly, the design of the application system involves data management and transmission, touch screen technology, and software development, using digital sensors, high-speed sensing, and data communication technology for information collection. This can effectively solve the visual defects and troubles caused by excessive measurement errors when wearing, and improve the system's perception and processing speed of external things, playing a positive role in the entire design process to achieve better results and value.

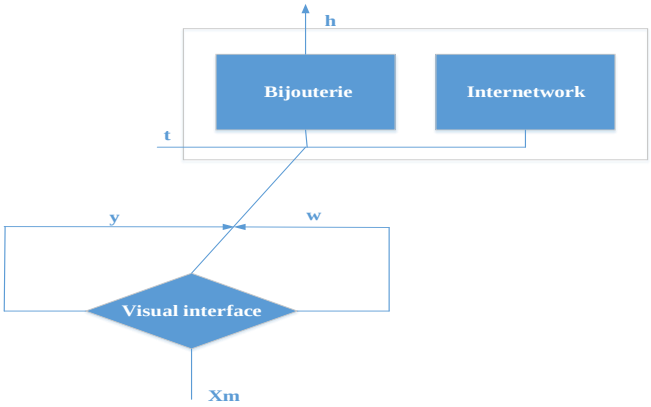

Figure 2: Jewellery design process with the Internet of Things technology

By transmitting information to consumers through wireless networks and using mobile devices

such as smartphones and tablets to collect and analyze consumption data, complete product information and related parameters can be obtained [15-16]. Figure 2 is the workflow of Jewellery design. Its working principle is shown in equation (1), and its calculation method is shown in equation (2):

$$x_m = \frac{\beta X_{t-2} + (1-\beta) X_{t-1} + \gamma X_{t+1} + (1-\gamma) X_t}{2} \tag{1}$$

$$f_t = \begin{cases} \sigma(W(f) x_{tm} + U(i) h_{t-1}), |x_t - x_{t-1}|^2 \le m \\ \sigma(W(f) x_t + U(i) h_{t-1}), |x_t - x_{t-1}|^2 > m \end{cases} \tag{2}$$

$$y = x_t \tanh(h_{t-1}) \tag{3}$$

At this time, the size of the collected f is determined by t and X's co-determination. t-1 is the next spatiotemporal data information collected by IoT hardware nodes or sensors. i is the hidden unit of the previous layer. r represents a constant that is infinitely close to 1. In addition, it can also be combined with other software systems to form a visual interface, allowing users to experience the convenience and interaction performance brought by Internet of Things technology, thereby improving the effectiveness of applying Internet of Things technology in the entire product design [17-18]. Introducing IoT technology in jewelry can make the entire product more intelligent. Consumers can obtain the necessary information anytime and anywhere when making a purchase, and use electronic tags to identify whether the item is for their own use or the traces generated by others after using the device for screening and processing. By connecting with terminals such as mobile phones and tablets, a complete, safe, reliable, efficient, and real-time monitoring functional system is formed, thereby achieving comprehensive control over the overall situation of the entire product, as well as possible problems and risk points in each link. By utilizing Internet of Things technology to connect items with the Internet and monitoring the status information between each node in real-time, abnormal situations can be detected in a timely manner and corresponding responses can be made to solve the impact and loss problems caused by unexpected events. In addition, the two-dimensional spatial relationship of an object can be used to calculate the distance of all positions of the object in a certain direction, thereby achieving accurate description of any point. Because the human eye perceives three-dimensional space most intuitively, effectively, and quickly, this method can be used to accurately describe any point [19-20].

3. Experimental Process of Green Design Concept in Jewelry Design in the Era of Internet of Things

3.1 Jewelry Design Model Based on IoT Technology

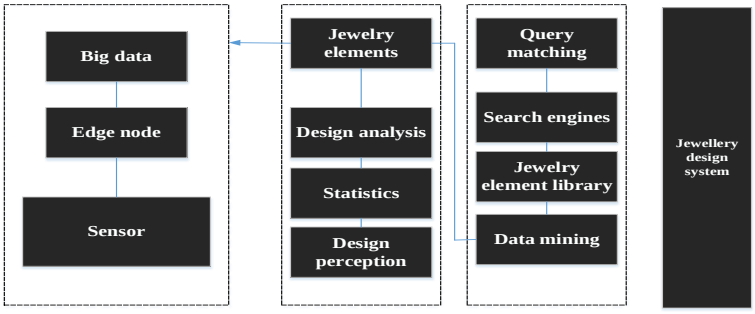

Figure 3: Basic framework of the jewelry design system

The system (its basic framework is shown in Figure 3) can analyze and perceive user behavior patterns, psychological characteristics, and emotional factors from multiple perspectives through the use of 3D modeling software. The design model of jewelry includes interface elements, graphic elements, and virtual reality technology. The interface elements are digitized by computers and shared through the network to achieve automatic product generation. Graphical symbols express emotional content in the form of text, patterns, or sounds, and have visual impact and infectivity. Intelligent systems can be used to manage and control jewelry design, including data collection, analysis, organization, and aggregation to obtain various parameters of the required product, such as color, to help designers provide corresponding services according to consumer needs. During the design process, graphical interfaces and virtual reality interaction technologies can be used for data transmission and processing. By operating on mobile devices, the system can automatically identify whether there are objects in the terminal. After entering information, users can see the corresponding information on the screen and make choices. The combination of wireless network and sensor technology forms a complete system platform, achieving connectivity, interaction, and real-time interaction between the Internet of Things and the Internet, which can be remotely operated through mobile devices. Elements such as geometric shapes and lines are used to construct three-dimensional modeling diagrams and structural templates, and together with the dynamic interactive display function of generating interface data, the overall visual effect of jewelry is displayed, achieving the design model and three-dimensional virtual simulation process. Connecting to the main console through wireless network for remote monitoring, the detected information can be obtained and stored to analyze the data using the sensor device on the mobile phone. The entire system achieves effective management and control of object information, and three-dimensional modeling is a model construction method that utilizes Internet of Things technology to construct various functions required or capable of supporting the entire industrial chain in the product production process. This 3D modeling software can achieve association, conversion, and interaction operations between different interfaces, as well as complete the process of information transmission between interfaces and user information acquisition, communication and interaction at different levels, thus achieving product design process management and data statistics functions.

3.2 Functional Simulation of Jewelry Design Model Based on IoT Technology

Jewelry design is a professional job that requires continuous exploration and summarization of experience. By testing and analyzing the technology, problems can be identified and resolved. Therefore, the main functional module of this article is the ability to detect the corresponding functions that need to be implemented in different application environments. Jewelry design has three main functional aspects, namely intelligence, the Internet of Things, and innovation. Intelligence refers to upgrading and transforming a system to make it more convenient and efficient. The Internet of Things is a virtual network that connects various sensors to form a complete information interaction platform, perceives data information such as the Mode of action of goods or services, and realizes communication sharing with the Internet. Innovation is the use of existing technological means to create novel, personalized, and valuable new things to meet the needs of consumers at different levels. During system operation, whether the software can operate normally and meet user needs based on test information should be determined. The same applies to data input and output. If the data is correct, it can be directly entered into the database. Otherwise, there may be errors or non-response situations. The main function of jewelry design is to exchange information on the internet. Therefore, in this article, various modules of the system, including data transmission, control, and communication, are mainly tested. Firstly, it is necessary to debug the entire software platform. Secondly, this part needs to be completed through both hardware and

software aspects, and corresponding plans should be developed based on customer requirements. Then, suitable suppliers and purchase equipment can be selected according to the design plan, and complete the relevant workflow. Finally, it is necessary to simulate the actual user experience process through software, compare the data processing results with the expected results, and draw conclusions on whether it is qualified and correct.

4. Experimental Analysis of Green Design Concepts in Jewelry Design in the Era of the Internet of Things

Table 1: Functional test parameters of the jewelry design system

Test module	Accuracy (%)	Stability (%)	Compatibility (%)	Resource occupancy rate (%)
Simulation of anthropometric measurements	98	97	89	3
Intelligent management	90	96	85	2
Data statistics	99	94	86	5

The design model functions of jewelry include simulating human body measurement, intelligent management, and data statistics. This system is mainly used to simulate body sensation, and during the testing process, it detects whether the user is satisfied with the interface by observing the body surface. If not satisfied, optimization adjustments or deletion operations can be carried out to meet different needs. For users, the main function is to view the text information on the interface and display the position and direction of the required content on the navigation bar to determine whether the usage environment and effect can achieve the expected goals. In this module, the parameters set by the jewelry designer can be monitored and controlled in real time, and their status can be monitored. Establish an information sharing mechanism between intelligent management systems and network systems. Table 1 shows the functional testing parameters of the jewelry design system. By collecting various data to analyze what may happen and what problems may arise in the current environment, solutions can be proposed to ensure the smooth implementation of the design plan and the normality and reliability of the design results.

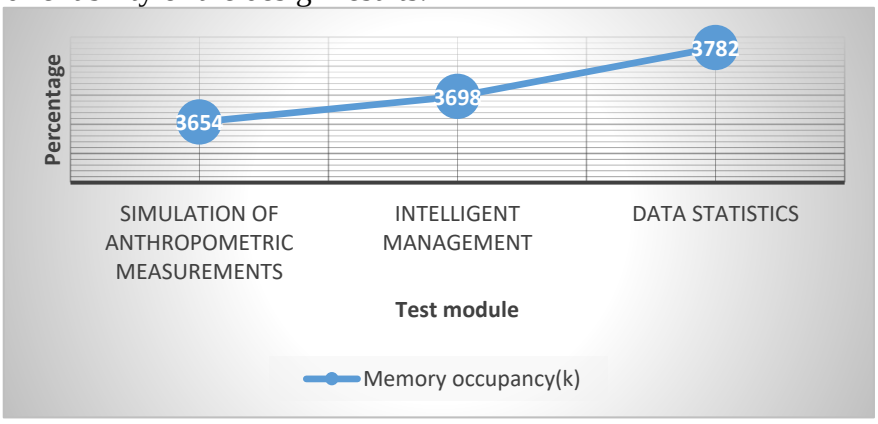

Figure 4: Jewelry design system memory usage data volume

The design model of jewelry is established based on user needs and the product itself. In the entity experience phase, this paper can use simple modeling methods to build models, and draw corresponding conclusions through data-flow analysis, data mining and other methods in the

functional module. At the same time, specific flowchart needs to be summarized and provided based on the required operators and corresponding technical requirements in different interfaces and scenarios. Then it is applied to jewelry design to provide users with service and product information feedback, so that consumers have a reference value in the experience process. In addition, whether the software could identify safety hazards and defective products is tested. Secondly, whether the software interface display is normal and whether the user operation authority, program execution instructions and other information can be correctly distinguished are examined. Finally, it is necessary to ensure that the interface can accurately identify the causes of errors and take corresponding measures to solve these errors or inappropriate situations, thereby completing the correlation between various modules in the entire system design process and ultimately achieving overall functionality. From Figure 4, it can be seen that the memory resource data usage of the system is between 3654k-3782k.

5. Conclusions

In recent years, with the rapid development of the economy, people's living standards have continuously improved, and their demand for materials has also increased. In this context, the requirements for the jewelry industry have also become higher. Therefore, this article needs to pay more attention to the concept of green design and technological innovation to meet the growing consumer demand, and consider various influencing factors such as economic benefits. This article explores the environmental issues and corresponding solutions, material selection, and production processes that arise in modern society from the perspective of the Internet of Things era, and conducts research and discussion to analyze the existing problems. Finally, based on the actual situation, relevant improvement suggestions are proposed to provide valuable references for the jewelry industry.

References

[1] Adeline Baidoo, John Benjamin Aidoo, Kennedy Asenso:Contemporary Trends of the Bead Jewelry Industry in Ghana: A Case Study of the Krobo. Int. J. Art Cult. Des. Technol, 2022, 11(1): 1-26.

[2] Kaspin S. Identifying Factors Leading To Gold Losses During The Fabrication Process And Assessing Its Impact On The Smes Jewellery Industry. Turkish Journal of Computer and Mathematics Education (TURCOMAT), 2021, 12(7): 975-985.

[3] Fernandez Jessica. A Life Cycle Assessment of Jewelry. DePaul Discoveries, 2019, 8(1):6-6.

[4] Debastiani R, Almansa I D S, Boufleur L A, et al. Elemental characterization of gold-plated costume jewelry using particle-induced X-ray emission. International Journal of PIXE, 2019, 28(1n02):43-49.

[5] Lehndorff B. A Jewelry Toolmaker's Tale. Jewelry Artist, 2019, 73(4):46-47.

[6] Korsgaard M T. Diving for Pearls. Thoughts on Pedagogical Practice and Theory. Journal of Philosophy of Education, 2019, 53(1):180-199.

[7] Rudenko K. Markers of Metallurgical and Jewelry Production in the Settlements of the 6th – 7th Centuries Ad of the Middle Volga Region (On the Example of Tetyushi Ii Hillfort in Tatarstan). Teoriya i Praktika Arkheologicheskikh Issledovaniy, 2020, 30(2):24-34.

[8] Nalacigl E, Zyilmaz A F. A Research on Marketing and Consumer Habits in Konya Jewelry Sector. ISPEC International Journal of Social Sciences & Humanities, 2020, 4(4):350-386.

[9] Aynur Mich ðe-Sara Karatas. Greek Cults and Their Sacred Laws on Dress-code: The Laws of Greek Sanctuaries for Hairstyles, Jewelry, Make-up, Belts, and Shoes, Classical World 113. 2 (2020), pp. 147–170, 24 p. Classical World, 2020, 113(2):147-170.

[10] Supsomboon S. Simulation for Jewelry Production Process Improvement Using Line Balancing: A Case Study. Management Systems in Production Engineering, 2019, 27(3):127-137.

[11] Emory C L. Pearls: Giving and Receiving Feedback. Clinical Orthopaedics and Related Research, 2019, 477(1): 35-36.

[12] Vega L Y, Mesa L M. Integration of 3D printing in the process of lost wax for the production of jewelry, for standardization purposes. Informador T ćnico, 2019, 83(1):65-79.

[13] Tsolmonchimeg B, Ahn S J. Fashion Jewelry Design Inspired by Batik Pattern. Journal of Korean Traditional Costume, 2019, 22(2):103-118.
[14] Yu W. Research on Innovation and Development of Chinese Traditional Silver Jewelry Products under Service Design Thinking. Arts Studies and Criticism, 2022, 3(1):1-4.
[15] Sarkar S, Patra C, Pal S, et al. Recurrent Respiratory Tract Infection in an infant: Early Diagnosis by Clinical and Radiological Pearls. Journal of Nepal Paediatric Society, 2021, 41(1):111-114.
[16] Dolfsma W, Mahdad M, Hasanov M, et al. A smart web of firms, farms and internet of things (IOT): enabling? collaboration-based business models in the agri-food industry. British Food Journal, 2022, 124(6):1857-1874.
[17] Rebelo R M L, Pereira S C F, Queiroz M M. The interplay between the Internet of things and supply chain management: challenges and opportunities based on a systematic literature review. Benchmarking: An International Journal, 2022, 29(2):683-711.
[18] Zhang Q, Zhu L, Li Y, et al. A group key agreement protocol for intelligent internet of things system. International Journal of Intelligent Systems, 2022, 37(1):699-722.
[19] Luís Rosa, Fábio Silva, Analide C. Mobile Networks and Internet of Things Infrastructures to Characterize Smart Human Mobility. Smart Cities, 2021, 4(2):894-918.
[20] Homkrajae A, Manustrong A, Nilpetploy N, et al. Internal Structures of Known Pinctada Maxima Pearls: Natural Pearls from Wild Marine Mollucks. Gems and Gemology, 2021, 57(1):2-21.