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Analysis of the Impact of action figure miniaturization on figure clothing design

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Abstract: *Action figurines require various materials and different joint movable models. Figurines are related to ancient religious worship, and have been endowed with new meanings throughout history, gradually evolving into popular toys, performance props and collectibles. Dressing up action figurines with realistic miniature clothing is meant to better render that character's overall image and appearance; this practice represents a design choice that has been practiced since ancient times. With the support of social productivity development, economic progress and technological innovation, the development of the action figurines industry has also ushered in changes corresponding to the times, that is, in order to cater to a broader market and to make the experience of the buyer as worthwhile as possible. As a means to achieve the above-mentioned goals, the industry has strove to focus on the mobility of the figurines, alongside the details of the sculpting and painting process. As a result, the collection of such figurines has become a more attractive matter. The original design choices, which focused on resemblance to the original and low costs, have now changed and focus more on producing exquisite, high-priced works excelling in both resemblance and form. Under this premise, in order to match the change in scale and consumer demand, the design choices regarding figurine clothing have also begun to adjust. This paper will analyze: the development of small-scale figurines and the change in their demand on the market; what kind of impact the development of figurine clothing design has received and what kind of trend it has kick-started, while providing theoretical references for related industries.*

Keywords: *action figurines; clothing design; development trend; analysis; prediction*

1. Introduction

As one of the industries that has never experienced a hiatus in history, figure production has always held its significant value at any given time. In order to meet the increasingly diverse needs of people, the figure industry has gradually modernized with the development of societal productivity, with action figures becoming an important part of popular toy collections. From a market perspective, the price, playability, and intricacy of action figures are the primary considerations. However, traditional scale figures have gradually lost room for improvement due to technological constraints on their development. Nevertheless, technological advancements have brought new vitality to modern small-scale action figures. In this context, the design of figure clothing also needs to change timely, achieving more ideal effects through improvements in materials and craftsmanship.

From an artistic perspective, figure collections have always been a part of the spiritual sustenance of human society, reflecting the psychological needs of a certain period and group of people. Studying these psychological needs can provide a better understanding of social behavior and economic development, allowing for real-time adjustments to the phased goals of relevant industries. In summary, this paper will use research methods such as literature review, experiential summaries, and surveys to analyze the impact of the trend towards smaller scales on figure clothing in terms of materials, craftsmanship, and other aspects.

2. Trends in the Modern Action Figure Industry

The development of action figures in the modern era can be traced back to the emergence of Barbie dolls in 1959. Subsequently, Hasbro's G.I. Joe series introduced the concept of action figures and toy soldiers to the historical stage. Adapting to popular aesthetic trends, various categories gradually emerged. In this chapter, a combination of literature review and survey methods will be employed to analyze the

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historical development and current status of the action figure industry. Some product feedback will be derived through experiential summaries based on practical experiences.

Currently, action figures can be broadly categorized into three types: articulated body figures, clothed action figures, and silica gel body figures.

Articulated body figures: These feature externally visible joints. Character depiction is achieved through sculpting the body itself, mostly using plastic materials and crafted through techniques like injection molding and casting. This category remains one of the predominant types of action figures. Taking the popular brand McFarlane as an example, its joint design already encompasses the latest "super-articulation" design philosophy, providing a broader range of motion compared to traditional figures. McFarlane's significance lies in its more affordable prices and relatively higher quality model sculpting, bridging the gap between toy-grade and collectible-grade figures. With advancements in production technology, the development of articulated figures may gradually break through the price threshold of collectible figures through lower-cost yet higher-quality presentation, capturing a larger market share.

Clothed action figures: Both clothed and articulated figures share articulated bodies. The key difference is that articulated figures directly sculpt characters on the body, while clothed figures add clothing to the articulated body, partially concealing joints and reducing the toy-like appearance, resulting in more vivid character depictions. This category, equally mainstream in the action figure realm, has a rich historical background. Soldiers, represented by Hasbro's G.I. Joe series, initially broke the dominance of Barbie dolls in the feminized figure market. In the development of soldier products, the scope of clothed figures expanded beyond soldiers to include creative works from films, games, animations, and even independently created DIY products. This led to the emergence of major IP brands like Hot Toys and fashion toy brands such as 3A Toys. The difference in their design philosophies, whether realistic or stylized, is united by a common emphasis on expressing the personality traits of corresponding characters through styles and color schemes.[1]

This type of action figures has matured in terms of fabric material and design in figure clothing. There is still significant room for improvement in simulating other materials such as metal and leather, making it a key focus for the future development of this category. These figures are currently mainstream at a scale of 1:6, which, technically, is the most suitable for a balance between playability and high precision. However, in reality, the emphasis on precision far outweighs playability, and most collectors of these items tend to display them in cabinets, treating them more as statues than interactive toys. In this scenario, the 1:12 market, dominated by articulated figures, has garnered attention from clothed figure manufacturers.

This interest has existed for quite some time but faced technical constraints until recent years, where it has seen rapid development. As a result, 6-inch clothed action figures that genuinely combine both playability and precision have gained an expanding market. Examples include Mezco and emerging third-party figure studios like Limtoys and Nota. It can be said that the market for small-scale clothed figures is genuinely starting to be developed due to technological advancements and rapid socio-economic growth. Entering this market early and maintaining high quality can lead to richer market resources. As the market expands, addressing past issues in small-scale precision, such as the realism of head sculpts, the texture of clothing, and accurate designs, becomes crucial.

Silica gel body figures, also known as rubberized figures, replace articulated bodies as the core of clothed figures. As the youngest category, it generally inherits the design philosophy of toy soldiers and represents a variation of articulated bodies with clothing, developed based on silicone technology. The use of more realistic skin textures and nearly completely concealed joints brings a fresh visual impact, marking a significant breakthrough in figure realism technology. However, due to the less mature development of silicone materials, these figures, while capable of achieving rich articulation, face the risk of silicone ruptures, making maintenance challenging and rendering them unsuitable for prolonged play. Additionally, silicone bodies are prone to staining, posing significant challenges in the selection and wear of clothing materials. Despite these issues, the exquisite representation of silica gel body figures has gained popularity among an increasing number of collectors.

With the trend towards smaller scales, silica gel body figure manufacturers are also entering the 6-inch silica gel body market, exemplified by companies like Tbleague and Verycool.

In summary, the development of action figures not only continues the articulated statue concept represented by 12-inch figures but also gradually shifts focus towards the playability represented by 6-inch figures. This implies that, while balancing playability, emphasis is also placed on ensuring the

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delicacy of the toy itself. The previously distinct boundaries between playability and precision are gradually blurring, and the wave of downsizing in the market for action figures is gradually gaining momentum.

3. Impact on the Figure Clothing Industry

3.1. Emerging Figure Clothing Production Technologies

The advancement of craftsmanship has a significant impact on the trend towards increasingly refined and interactive figures. To meet consumer demands, collaboration with various industries is essential, ranging from high technology to emerging fabrics, all of which are crucial components of figure clothing production technology.[2]

Figure clothing production technology can be divided into traditional and emerging techniques. Traditional techniques do not differ significantly from those used in the production of real clothing and will not be extensively discussed here. Emerging production technologies primarily revolve around 3D modeling and printing, and this section will focus on these aspects.

3.1.1. 3D Modeling Technology

3D modeling originated in the 1960s with Sketchpad, a tool allowing simple three-dimensional model creation using a light pen on a screen. Subsequently, Autodesk introduced the first version of 3ds Max in 1990, providing an outstanding platform for digital modeling and animation production. The technology explosion of 3D modeling followed, with ZBrush introducing the concept of digital sculpting in 1999. This innovation expanded the scope of 3D modeling beyond data limitations, enabling artists to reach new heights due to their new-found freedom.

3D modeling technology plays a crucial role in providing precise drawings for 3D printed molds. It also significantly reduces the time and material costs required for manual sculpting. In the realm of modern figure and figure clothing design, 3D modeling technology has become indispensable.[3]

3.1.2. 3D Printing Technology

3D printing, also known as Additive Manufacturing, is a type of rapid prototyping technology. It relies on three-dimensional data model files and uses adhesive materials such as powdered plastic or metal to construct objects through layer-by-layer stacking. Compared to traditional manufacturing techniques, 3D printing offers advantages such as large design space, high production flexibility, and minimal human labor input. Importantly, it can produce complex structures and assemblies through a single process. The technology also allows manufacturers to optimize production designs in real-time by adjusting the flexibility of the manufacturing process, reducing material waste, and achieving lean production.[4]

In the design and production of figure bodies and clothing, two main 3D printing methods are commonly employed: SLA (Stereolithography) and FDM (Fused Deposition Modeling).[5] The difference between these two printing methods lies in the requirements of their mold materials. For instance, fine resin molds may utilize photopolymerization printing (SLA) to achieve more intricate details, while FDM is used for areas that do not require high precision or for large, cost-effective sections.

Traditionally, figure clothing production involved manual sewing or carving, followed by mold replication. The introduction of 3D printing technology has significantly shortened the figure production process and greatly improved sculpting accuracy. The popularity of small-scale figures has also led to 3D-printed figure clothing becoming a new trend. For example, traditional leather materials are replaced with higher-precision SLA technology-printed wax molds, followed by silicone molding, resulting in products that rival leather in sharpness, design, material flexibility, and overall performance.

3.2. Changes in Materials and Craftsmanship Approaches

Materials and craftsmanship are two inseparable aspects in the design and production of products. Therefore, this article will address both aspects together, using different time periods as references to trace the evolution of materials and craftsmanship.

Traditional clothed figures utilized real fabrics in their design, meaning that the dolls wore clothing similar to what real people would wear. Even decorative elements were meticulously crafted to replicate the same or similar materials in proportion. This type of design was prevalent in ancient times,

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flourishing during the Renaissance, and persisting to the present day. Its essence lies in the limitations imposed by the lack of advanced production capabilities, where there were no superior solutions in terms of materials and craftsmanship. Therefore, the techniques and materials used in human clothing production were applied downward to figure design. Additionally, due to the expensive cost of figure molds, mass-produced figures often adhered to standardized proportions.[6]

This design approach continued into modern times and became synonymous with high-end customization, exemplified by the previously mentioned BJD (Ball Jointed Doll) figures, known for their elevated cost and exquisite craftsmanship.

The rapid development of the manufacturing industry in the 20th century brought about a new opportunity for figure clothing design through the use of inexpensive, mass-produced plastics. Sculpting the desired shapes and creating molds from plastic offered a faster and cost-effective alternative to traditional methods. This approach became widely adopted due to its efficiency and affordability in mass production.

In the 21st century, the widespread use of digital modeling and 3D printing has once again changed the design approach for figure clothing. Components that used to require manual sculpting can now be efficiently and affordably produced using 3D technology, allowing for greater precision and adaptability across multiple scales. Represented by 1/6 scale articulated figures, many figure clothing items have replaced traditional fabrics with 3D printed molds in plastic or metal materials.

As traditional 1/6 scale figures matured, their limitations became increasingly evident. The body of these figures struggled to achieve optimal articulation compatibility, as the figure body itself couldn't replicate the nuanced movement of human muscles and bones, especially to support diverse styles under the cover of heavy clothing. In contrast, 6-inch figures, with their smaller scale, benefited from lighter and thinner clothing materials, along with more lightweight body structures, resulting in improved articulation. With the growing purchasing power of customers, the market for exquisite small-scale figures has gained popularity. Traditional 6-inch clothed figures with relatively rough and inexpensive clothing designs have gradually been replaced by more refined products.

Previously, small-scale clothing struggled to convey the desired image due to the use of materials designed for larger-scale figures, resulting in a bulky and ill-fitting appearance. However, as the industry focus shifted and technology advanced, small-scale figure clothing began to exhibit its potential. This article highlights two representative products from the end of 2021 – Limtoys' RPD Officer and Nota Studio's Richman. These products have pushed the boundaries of the industry in terms of material and pattern handling for miniature clothing. It's challenging to imagine such intricate clothing at a 1:12 scale. This chapter will conduct a case study and summarize the design techniques and effects of these products to analyze the impact and achievements in the figure clothing industry.

Limtoys' RPD Officer utilizes thin polyester fabric combined with spandex to create a very realistic wrinkling effect. Additional polyester fabric is layered and attached to simulate pockets on the clothing. The bulletproof vest incorporates the use of Velcro, and the clothing closures are achieved with Velcro as well. Decorative elements, resembling resin-dropped buttons, are attached to the surface, avoiding the various drawbacks associated with small-scale sewing. Accessories, knee pads, and boots are produced using 3D printing with ABS, PVC, TPE, and PU materials. The meticulous craftsmanship perfectly replicates the clothing image. The design approach focuses more on replicating the form rather than functional accuracy, breaking away from the traditional pursuit of both functional and stylistic replication..

Richman also uses thin cotton fabric fused through heat pressing, and Velcro is employed instead of real buttons. The most creative aspect is the insertion of iron wire at the back of the coat, allowing for the opening and closing of the coat.

From this, we can observe that the development of the figure clothing industry will undoubtedly undergo new changes due to the miniaturization of action figures. Material selection for small-scale clothing will be more targeted, emphasizing the use of materials that best express the desired effects for different parts, rather than the traditional perfunctory approach seen in small-scale doll clothing. The design of patterns will be more precise, aligning closely with the figure itself, while overall functionality will be reasonably reduced, with a greater focus on material and pattern design. In other words, small-scale clothing will not only become more exquisite, but there will also be a greater emphasis on material research, including factors such as fit and drape. Moreover, the expression of the clothing's image will no longer be confined solely to the material and functionality but will shift towards a more creative simulation of form. Simultaneously, the limitations of clothing on the articulation of figures persist, so

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the development of miniature clothing will also devote more attention to reducing the constraints of materials on articulation.

4. Predictions for the Development Direction of Small-Scale Figure Clothing

4.1. Pursuit of Lightweight and Draping Materials

The trend towards lightweight and draping materials will continue, as these characteristics are essential for effectively showcasing the desired effects of clothing on small-scale figures. Polyester and spandex, known for their lightweight and good elasticity, may dominate the design of small-scale clothing in the future.

4.2. Simulation of Hard Materials

The representation of hard materials like leather may involve the use of simulated leather and plastics, with the incorporation of a significant amount of digital modeling and additive manufacturing technologies.

4.3. Influence of Pattern Design

Pattern design for small-scale clothing will be a predominant factor influencing the design approach. The reduction of functional complexity may provide more creative avenues for achieving a high level of clothing fidelity.

4.4. Industry Shift and Opportunities

The shift in industry focus is expected to bring about more opportunities for the small-scale figure clothing sector. Advancements in related miniature technologies may lay the groundwork for the future development of industries such as small-scale bio-inspired robots.

5. Conclusions

In conclusion, the future of small-scale figure clothing is likely to involve a continued pursuit of lightweight materials with good draping characteristics, the simulation of hard materials using technologies like 3D modeling and additive manufacturing, a focus on pattern design, and the exploration of new opportunities arising from industry shifts. This evolution is expected to contribute to the overall advancement of the miniature technology sector and may potentially impact related industries like bio-inspired robotics in the future.

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