Exploration of Character Design for the Development of The Millennium Robot Toys

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ABSTRACT

This research investigates character design principles for millennium robot toys, with a focus on the impact of aesthetics, personality, interactivity, and emotional engagement on their appeal and functionality. The study aims to provide design guidelines that enhance user experience and educational value. Employing a quantitative approach, the research measures user preferences, reactions, and perceptions of character design elements through surveys, controlled experiments, and statistical analysis.

The methodology is divided into three key components: (1) Survey-Based Research: an online survey will collect quantitative data from a diverse sample, including children (the primary users), parents, toy designers, and educators, to assess preferences for various design elements (e.g., color, shape, size, personality traits, interactivity). (2) Experimental Design: controlled experiments will be conducted using robot toy prototypes with varying design features (e.g., color, shape, personality) to evaluate user interaction and emotional engagement in a controlled environment. (3) Data Analysis: quantitative data from both the survey and experiments will be analyzed using statistical methods to identify trends and correlations between design features and user preferences. Descriptive statistics (mean, median, mode) will be used to determine the most favored design elements.

Key findings include: (1) Four super robots, including B. Gaita and D. Unicorn Gundam, were the most recognizable, receiving 43.12% and 28.44% positive ratings, respectively, demonstrating a continuous evolution in public aesthetics. Both exhibit a roughness reminiscent of toy accessories and prioritize realism in design. (2) Among survey respondents, toy accessories emerged as a primary concern, with a strong demand for innovative toy accessories, reflecting contemporary preferences for armed robots over the unarmed fighting of previous eras. (3) No significant distinction was found between darker and lighter tones; however, blended colors accounted for 40.37% of the sample, contributing to a more dynamic and diverse color palette. The design of super robots reflects a delicate balance between realism and idealism, embodying both scientific fantasy and human aspirations. These creations serve as more than just functional machines; they represent an artistic expression that inspires and captivates audiences. The evolution of robot animation has been integral to the genre's growing fanbase, with China experiencing both the proliferation of unofficial model toys and a recent shift toward officially licensed products. Despite challenges in production quality, the enduring appeal of super robots ensures their continued presence and significance in both creative and commercial realms.

Keywords: Character Design, The Millennium, Robot Model, Art Toys

Introduction

Previously the realm of science fiction, they have now become a fundamental component in contemporary families and educational environments. The transition from wind-up mechanical toys to sophisticated AI-driven robots reflects the swift progress in robotics and artificial intelligence. The worldwide toy business has adopted this change, with robot toys fulfilling dual functions: amusement and education. This article examines the evolution of robotic toys, emphasizing their transition from rudimentary devices to sophisticated systems, and their role in fostering learning, creativity, and social engagement.

Hero veneration is a deeply rooted cultural practice throughout human history, ranging from ancient mythological figures to modern military heroes. These figures have played a critical role in inspiring and motivating individuals to face significant challenges. In contemporary society, as people confront increasingly complex obstacles, such as natural disasters and social conflicts, the need for heroic figures remains strong. The Super Robot concept emerges from the historical tradition of war hero reverence and is closely linked to science fiction narratives surrounding human industrial advancement (Napier, 2005). The aim of this study is to explore and reinterpret the heroic ideals of the past century within the framework of modern cultural production. Superheroes such as Superman and Captain America, widely considered two of the most iconic figures globally, have been deliberately crafted to embody either the archetype of a war hero or the overwhelming forces of nature. Across centuries of cultural production, they have been portrayed as guardians of justice, with their depictions evoking a sense of righteousness, grandeur, and strength. In today's complex global environment, marked by a diverse array of challenges facing humanity, superheroes continue to offer individuals a sense of solace and inspiration.

Following the Industrial Revolution, humanity entered the era of steam power, giving rise to a new form of aesthetic appreciation centered on artificial artifacts. This period marked a significant shift from the veneration of nature to the veneration of human ingenuity. As a result, the visual appeal of industrial machinery has become a prominent focus in contemporary art and design. A design solution that seamlessly merges industrial aesthetics with heroic symbolism is embodied in the concept of the super robot. Robot animation emerged as a cultural phenomenon within Japan's left-wing movement, arising from the movement's limitations, which prompted individuals to channel their aspirations into artistic innovation (Craig, 2000). As a result, robot animation developed with a strong anti-authoritarian inclination. Due to its significant commercial success, the thematic elements of robot animation gradually became intertwined with traditional Japanese culture, evolving alongside advancements in technology and cultural development. Undeniably, robot animation represents a core component of the Anime industry, and its trajectory mirrors key stages of Japan's economic growth. Rooted in tangible societal realities, it has followed a distinct cycle of inception, growth, peak, and decline.

Akurasu Wiki. (2024) launched the information of main characters in the 1977 television series "Super Electromagnetic Hero Voltes V" eventually came to realize that the root cause of conflict was a corrupt, authoritarian government, leading them to take control of their own destiny. Due to its strong anti-discrimination and anti-dictatorship themes, the series was banned for a decade by the Marcos dictatorship in the Philippines, a move that later contributed to the famous Aquino uprising. This animated series holds national significance in the Philippines. In 2024, the Philippines debuted a new live-action feature film titled Super Electromagnetic Hero Voltes V-Heritage, a reimagining of the original Voltes V series, as shown in Figure 1.

Figure 1. Super Electromagnetic Hero Porugis V-Heritage

Research problems

What are the key design principles that can enhance the interactivity and user experience of millennium robot toys?

Research objectives

This research aims to explore character design principles for millennium robot toys, focusing on how aesthetics, personality, interactivity, and emotional engagement influence their appeal and functionality, while providing design guidelines to enhance user experience and value added to the toys manufacturer.

Literature review

Robot toys have existed since the early 20th century, with the first mechanical robots appearing in the 1920s and 1930s. These early toys were basic, often relying on wind-up mechanisms or simple electronics to simulate movement. One of the most iconic examples is the 1950s "Robbie the Robot" toy, based on the character from the science fiction film Forbidden Planet. These early iterations were more a novelty than an educational tool, offering a glimpse into the futuristic world of robots (Brown, 2021).

In the 1980s and 1990s, the first generation of programmable robot toys emerged. Toys like the Big Trak (1979) and LEGO Mindstorms (1998) introduced children to the basics of programming and robotics. These toys marked the beginning of a shift toward interactive, educational play, as they allowed users to engage with the underlying technology. However, the complexity of robot toys was still limited by the available technology at the time, with basic motors and sensors offering a narrow range of interaction.

Technological Advancements in Robot Toys With the 21st century came a wave of technological innovations that transformed robot toys into more interactive and intelligent systems. Key technological advancements have included:

1. Artificial Intelligence (AI) and Machine Learning

AI has had a profound impact on the capabilities of modern robot toys. The integration of machine learning allows these toys to learn from user interactions, adapt their behavior, and provide a more personalized experience (Wood, 2020). For example, Anki Cozmo (2016) and Vector (2018) are examples of toys that can recognize faces, respond to voice commands, and interact autonomously with

their environment. AI enhances the ability of toys to simulate life-like behaviors, fostering deeper engagement.

2. Natural Language Processing (NLP)

Another key advancement is the implementation of natural language processing in toys, enabling voice-based interaction. Products like Woobo (2017) and Sphero RVR (2019) allow children to communicate with their robot companions using natural speech, turning toys into conversational partners. This not only enhances the play experience but also introduces children to emerging technologies in AI-driven communication.

3. Sensor and Actuator Technologies

Modern robot toys use sophisticated sensors and actuators to interact with their surroundings. Infrared, ultrasonic, and optical sensors allow toys to detect obstacles, measure distances, and respond to environmental stimuli. The development of more sensitive and accurate sensors has facilitated the creation of robots that can exhibit complex behaviors, such as navigating obstacles or mimicking emotions. For instance, Sony Aibo (2018) employs advanced sensors to mimic the behavior of a real dog, learning from user interactions and evolving over time.

4. Connectivity and IoT Integration

The Internet of Things (IoT) has extended its reach into the realm of toys, with many modern robot toys being equipped with Wi-Fi or Bluetooth connectivity. This allows them to update their software, download new features, and connect to other devices. Toys like Sphero's BB-8 and LEGO Boost use IoT to enhance their functionality, offering new ways to play through companion apps. Connectivity also enables collaboration between toys, as seen in programmable robots that can work together to complete tasks or solve problems.

5. Educational Potential of Robot Toys Robot toys have transcended traditional play to become powerful tools for education. These toys can teach children the basics of coding, robotics, engineering, and even artificial intelligence (Chambers, 2018). Products like LEGO Mindstorms, Osmo Coding Jam, and FurReal Friends combine hands-on play with digital interaction, introducing children to critical thinking, problem-solving, and collaborative skills.

6. STEAM Learning

STEAM (Science, Technology, Engineering, Arts, and Mathematics) education is increasingly integrated into the design of robot toys. Dash and Dot by Wonder Workshop and Makeblock's mBot are popular tools for teaching children coding and robotics in a playful, accessible way (Chambers, 2018). These toys often come with programmable features, allowing children to design and control robots while developing coding skills. By encouraging experimentation, robot toys can inspire a passion for STEM fields from an early age.

7. Emotional and Social Development

Some robot toys, particularly those that simulate human or animal behavior, contribute to emotional and social development. Leka, a robotic companion for children with developmental disabilities, helps improve social skills through interactive play. Robot toys designed to foster empathy and communication, such as TOMY’s i-Sobot, are increasingly being used as therapeutic tools in healthcare settings.

Technological advancements in robot toys have revolutionized their interactivity, intelligence, and educational value. The integration of AI, machine learning, and natural language processing allows for more personalized and lifelike experiences, while sensors and IoT connectivity enhance responsiveness and adaptability. These innovations have transformed robot toys into powerful educational tools, promoting STEAM learning, coding, and robotics skills in an engaging way. Moreover, robot toys contribute to emotional and social development, particularly for children with developmental challenges, offering not only entertainment but also therapeutic benefits, this will be a main design factor. As technology continues to evolve, robot toys will likely play an even greater role in education and emotional well-being. Challenges and Future Directions Despite the numerous advancements, the

development of robot toys is not without its challenges. One significant concern is data privacy, particularly for toys that connect to the internet or store personal information. As these toys become more advanced and integrated into daily life, ensuring the safety and privacy of users, particularly children, is paramount.

Moreover, the cost of advanced robot toys remains a barrier for many families and educational institutions. While prices are decreasing as technology becomes more accessible, high-end AI-powered toys still tend to be expensive.

Looking to the future, robot toys will likely continue to evolve in line with advances in AI, machine learning, and robotics. We can expect further improvements in interactivity, autonomy, and educational content, with toys increasingly blurring the line between entertainment and learning.

Research methodology

This research will employ a quantitative approach to objectively measure user preferences, reactions, and perceptions regarding character design for millennium robot toys. The methodology will focus on gathering numerical data through surveys, controlled experiments, and statistical analysis to draw conclusions about the most effective design elements.

1. Survey-Based Research

A structured online survey will be designed to gather quantitative data from a large sample of participants, including children (the primary users), parents, toy designers, and educators. The survey will focus on assessing preferences for various character design elements such as color, shape, size, personality traits, and levels of interactivity.

Objective: To measure the preferences and expectations of users regarding key design features in millennium robot toys.

Sample Size: Approximately 200-400 respondents, stratified by age (children aged 7-14), gender, and user type (parents, toy designers, educators).

Survey Instrument: A Likert scale will be used to rate design features (e.g., 1 = Strongly Dislike, 5 = Strongly Like). Multiple-choice questions will assess design preferences, and demographic data will be collected for comparison.

Data Collection Tool: Online survey platforms (e.g., Google Forms, Qualtrics).

Example Survey Questions:

On a scale of 1-5, how important is the character's color in influencing your interest in a robot toy?

Which personality traits do you prefer in a robot toy? (Multiple options: Friendly, Serious, Playful, etc.)

How much do you value voice interaction in robot toys? (Scale: 1-5)

2. Experimental Design

Controlled experiments will be conducted to evaluate how different character design variables affect user interaction and emotional engagement with robot toys. Several robot toy prototypes with varying design features (e.g., different colors, shapes, personalities) will be developed and tested in a controlled environment.

Objective: To measure the impact of specific design elements on user engagement and satisfaction.

Sample Size: 100 participants (children aged 7-14), divided into groups based on exposure to different robot toy prototypes.

Variables:

Independent Variables: Design features (color, shape, personality, interactivity).

Dependent Variables: User engagement (time spent interacting with the toy), emotional response (measured through surveys), and satisfaction (post-experiment Likert scale rating).

Data Collection Tool: Observation and user interaction tracking (e.g., using time-tracking software to measure engagement duration), post-experiment surveys for emotional response and satisfaction.

Experimental Procedure:

Participants will be randomly assigned to interact with one of the robot toy prototypes.

Each interaction session will last for 15-20 minutes, and user engagement will be recorded.

After the session, participants will complete a brief survey rating their experience with the robot toy on aspects like enjoyment, engagement, and emotional connection (e.g., How much did you enjoy playing with the robot? Rate on a scale of 1-5).

3. Data Analysis

The quantitative data collected from the survey and experiments will be analyzed using statistical methods to identify trends, patterns, and correlations between different character design features and user preferences.

Descriptive Statistics: Mean, median, and mode will be calculated for survey responses to determine the most favored design elements.

Correlation Analysis: Pearson's correlation coefficient will be used to assess the relationship between different design features (e.g., personality traits, interactivity) and user satisfaction or engagement levels.

ANOVA (Analysis of Variance): This will be used to compare user satisfaction across different groups exposed to varying character designs, to determine which design features have the most significant impact.

Regression Analysis: To predict which design elements (e.g., color, interactivity) are most likely to lead to higher levels of user engagement and satisfaction.

Findings

Table 1. The identification of the super robot classifications

Robot Name	Percentage (%)
A. Mazinger Z	18.35%
B. GAITA	43.12%
C. Genzu GUNDAM	10.09%
D. Unicorn GUNDAM	28.44%

The four most recognizable super robots are B. Gaita and D. Unicorn Gundam, which received 43.12% and 28.44% positive ratings, respectively. It is noteworthy that both were developed in close temporal proximity, indicating a continual evolution in public aesthetics. Simultaneously, both super robots have a roughness akin to actual toy accessories and a design aesthetic that prioritizes realism.

Table 2. The identification of appealing components of the super robot

Robot Components	Percentage (%)
A. Head styling	3.67%
B. Armed Forces Used	55.05%
C. Trunk part	30.28%
D. Limb parts	11.01%

Among the responses from all polled individuals, B. Armed Force Used is toy accessories emerged as the paramount concern; specifically, the invention of innovative toy accessories that might captivate attention was deemed highly significant. The contemporary era exhibits a significantly greater demand for toy accessories, in contrast to the previous era, which was characterized by unarmed fighting.

Table 3. The identification of color scheme of the super robot

Robot Color Scheme	Percentage (%)
Plain color system, mainly consisting of any single color	12.84%
Dark color scheme, mainly black, gray, etc.	19.27%
Mix color scheme to maximize color representation	40.37%
Light color scheme, mainly blue, white, etc.	27.52%

The analysis revealed no significant distinction between darker and lighter tones. However, blended colors accounted for 40.37% of the sample, contributing to the development of a more dynamic and diverse color palette.

Conclusions and Discussion

In examining the design aesthetics of super robots, this study analyzed the key characteristics of the previous surge in robot animation and synthesized their design trends (Smith, 2017). In contrast, it also considers the artistic considerations necessary when creating visuals informed by contemporary aesthetics. This outcome supports the research objective about the essential characteristics of aesthetics, personality, interactivity, and emotional involvement. Historically, the depiction of robotic art was constrained by the traditional portrayal of justice heroes, who were often designed to resemble humans more closely than machines (Kato, 2018). These figures typically avoided the use of toy accessories, and their physiques mirrored the idealized forms of robust individuals, reminiscent of ancient Roman sculptures, with muscular builds akin to bodybuilders (Tanaka, 2020).

However, in recent years, social transformations and evolving human aesthetics have shifted public interest toward designs that reflect more authentic military forms and actions. This trend has influenced robot designs to incorporate mechanical elements, such as tanks and armored vehicles, with contemporary robots increasingly resembling military hardware. Cannons and rifles, for example, are instinctively recognized as offensive toy accessories in modern cognition, and their inclusion enhances the association of these robots with toy accessories. Key design elements that led the Development of the Millennium robot toys as are 1) GAITA: is the identification of the super robot classifications 2) The identification of appealing components of the super robot is: Armed Forces Used 3) The identification of color scheme of the super robot is: Mix color scheme to maximize color representation, as shown in Figure 5.

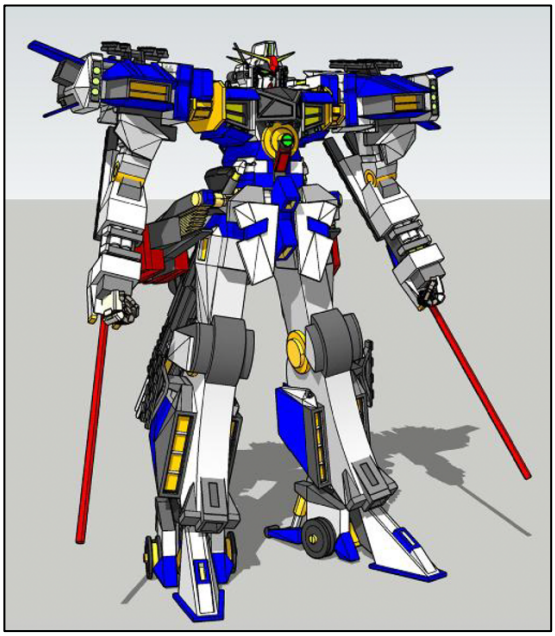

Figure 2. Robot toy prototypes

The primary consideration in the design of super robots remains the balance between realism and idealism. Super robots exist within the realm of scientific fantasy and do not conform to practical value in the real world. Instead, they represent an aesthetic and spiritual ideal that resonates with humanity's need for inspiration. Thus, their design transcends mere functionality, reflecting a fusion of fantasy and artistic expression.

Robot animation can be considered one of the earliest forms of animation, emerging during the initial phases of the medium's rebirth. Consequently, its fanbase has been steadily growing since the advent of animation. Over the past two decades in China, stagnation in international trade has contributed to the proliferation of illegally produced model toys, largely due to limited awareness of copyright issues. For many individuals, their first encounter with robots came through these unofficially produced toys. However, with increased awareness of intellectual property rights, these toys have reemerged in the Chinese market as officially licensed products. Although the manufacturing process of these models remains relatively coarse, often incorporating soft rubber components, the selection typically focuses on highly popular robots with distinctive features to cater to a broad market.

In China, a range of model markets exists, from upscale to lower-end channels. Some models are officially sanctioned, while others are produced without authorization. Unauthorized manufacturers often attempt to create their own designs, either through original concepts or by drawing inspiration from exceptional designs found online. As a result, robot model toys can be promoted through both premium and budget markets. Low-end markets often require only basic model outlines, while high-end markets demand more intricate designs, including detailed internal frameworks.

The market for robot models is further bolstered by the fact that many individuals who grew up during the golden era of robot animation in the 1990s are now entering middle age, with increased disposable income to invest in their hobbies. As a result, consumers are now more inclined to invest in products that evoke nostalgia (Puenpong, 2023), contributing to a domestic market that has grown by

more than 30% annually. Industry reports predict that by 2023, the market for model toys will surpass 9 billion yuan. This indicates that the study of robot animation and its associated merchandise holds substantial commercial potential, with both artistic and economic value, making it a promising area for further development.

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