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A Study on the Design of Children's Distance-Cognitive Interactive Toys Based on Artificial Intelligence Technology

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ABSTRACT

The current children's distance cognitive interactive toy design trigger mechanism is generally a single form, the design of more restrictions, resulting in the final result of the attractiveness of the index is small, so proposed to the children's distance cognitive interactive toys based on artificial intelligence technology design research, according to the current determination, the first user positioning and analysis of characteristics, the use of diversified ways to break the design of toys to design limitations, and set diversified children distance cognitive trigger mechanism. Based on this, the construction of artificial intelligence distance cognitive interactive toy design model, the use of visual interaction verification and user feedback repair to achieve the toy design, test results show that: from the figure can be observed, the test design toys on the children's attractiveness index can reach more than 90%. This indicates that the designed toys are more attractive and promote the children's distance cognitive interaction effect to be further improved, which is targeted and has practical application value.

Keywords: Artificial Intelligence; Children's Distance Cognition; Interactive; Toy Design; Informatization; Intelligent Control;

INTRODUCTION

Today, the rapid development of artificial intelligence technology (AI) has not only profoundly changed people's lifestyle, but also demonstrated great potential and value in education, entertainment and other fields. Among them, children's education, as an important cornerstone of social development, is gradually deeply affected by artificial intelligence technology. Especially for the cultivation of children's cognitive ability. The introduction of AI technology not only provides new tools and methods for education, but also brings revolutionary changes to the design of children's toys. Children's distance cognition is an important part of their spatial perception, which is crucial to children's growth and daily life. However, the traditional way of distance cognitive education for children is often limited to a single teaching material and teaching aids, which is difficult to stimulate children's learning interest and initiative. The traditional AR technology children's distance cognition interactive toy design proposed in reference [1] needs to fully integrate the advantages of AR technology and the characteristics of children's psychological development. Smart combination of virtual world and real environment through AR technology enables children to intuitively feel the change of distance in play; The traditional intelligent cognitive children's distance interactive toy design proposed in literature [2] uses advanced intelligent sensing technology, which can detect the distance between children and toys in real time, and help children intuitively understand the distance through acousto-optic feedback or vibration prompts. The design of toys takes full account of children's psychological characteristics and interest preferences, with rich colors and cute shapes. Through the design of various interesting games and challenging tasks, children's curiosity and desire for exploration are stimulated, so that they can naturally learn the concept of distance and develop a sense of space and direction in play; The traditional GHG monitoring children's distance cognition interactive toy design proposed in literature [3] combines the popular science knowledge of GHG emissions. By simulating the impact of emissions at different distances, children can understand the impact of greenhouse gases on the environment and learn how to maintain a safe distance to reduce potential risks. The appearance is bright in color and cute in design, aiming to attract children's attention and arouse their curiosity; The traditional AI children's distance cognition interactive toy design proposed in literature [4] captures the distance between children and toys in

real time through intelligent sensors, and shows children feedback at different distances through voice prompts or screen displays. Although this kind of design form can achieve the expected demand, the cost is too high and lacks pertinence. Therefore, developing an interactive toy for children's distance cognition based on artificial intelligence technology can not only enrich children's learning experience, but also promote children's cognition and understanding of the concept of distance more effectively through intelligent interaction. This in-depth exploration of the design of children's distance cognition interactive toys based on artificial intelligence technology. From the perspective of children's psychology and cognitive science, the psychological characteristics and cognitive laws of children in the process of distance cognition will be analyzed to provide scientific basis for toy design. Make full use of artificial intelligence technology, especially machine learning, natural language processing and other technical means to design and implement an interactive toy [5] that can intelligently recognize children's behavior and provide personalized feedback. Through intelligent interaction, the toy can track children's learning progress in real time, and adjust teaching strategies according to children's performance, so as to achieve the true sense of "teaching students in accordance with their aptitude". In addition, we also need to focus on the interactivity and fun of toys [6] . Through the design of diversified game scenes and interactive links, children's learning interest and enthusiasm for participation are stimulated. Increase the safety and ease of use of toys to ensure that children can safely and conveniently obtain learning experience during use. To inject new vitality into children's education and contribute to the healthy growth of children [7] .

1 DESIGNING CHILDREN'S DISTANCE-COGNITIVE INTERACTIVE ARTIFICIAL INTELLIGENCE TOYS

1.1 User orientation and characterization

The target users of children's distance cognitive interactive toys are mainly children between the ages of 3 and 8. Children in this age group are in the critical period of rapid physical and intellectual development, full of curiosity about the surrounding environment, like to interact with various types of toys, and enjoy learning new knowledge from the game [8] . At the same time, their parents are also important indirect users who are concerned about their children's growth and are willing to choose educational toys for their children [9] . Therefore, advanced user characterization is needed. The specific directions are shown in Figure 1.

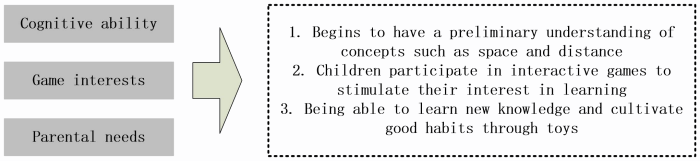

Fig. 1 Graphical representation of user profiling directions

Figure 1 shows the direction of user profiling. On this basis, the analysis is refined for each region. Cognitive ability:Children between the ages of 3 and 8 are in the golden age of cognitive development, and they are beginning to have a preliminary understanding of concepts such as space and distance [10] . However, due to age constraints, their comprehension is relatively limited and they need to learn through visual and vivid ways. Interest in games: Children in this age group like to participate in interactive games. They enjoy the fun of games and are happy to learn new knowledge through games [11] . Therefore, designing an interesting and educational toy can attract their attention and stimulate their interest in learning [12] . Parents' needs: As the guardians of their children, parents want their children to grow up healthily and happily [13] . When choosing toys, they not only pay attention to the entertainment of toys, but also emphasize their educational significance [14] . They hope that their children can learn new knowledge and cultivate good habits through toys, thus laying a solid foundation for their future growth [15] . Combined with the current measurement demand, it is necessary to combine the interaction demand and calculate the initial cognitive load value, see Equation 1.

$$V = \sum_{Y=1} \alpha Y - \sqrt{(1+T^2)} \tag{1}$$

In equation 1: V represents the initial interactive cognitive load value, the α represents the cognitive range. Y represents the number of mutual inductions. T represents the initial characteristic value. Combined with the initial interactive cognitive load value, we analyzed the depth characteristics and needs of the children, and strengthened the design of the toys from the three aspects of intuition, interactivity and education, so as to lay the basic conditions and stabilize the environment for the subsequent in-depth processing [16] .

1.2 Setting cognitive triggers for distance in diverse children

Generally speaking, the trigger mechanism of toys is mostly in a single form, which is designed by combining the characteristics of each toy. However, such a form will lead to the shortening of children's cognitive distance and the emergence of unitary cognitive impairment in the daily interaction process, which will affect the subsequent development and growth [17] . This time, we designed a diversified cognitive distance triggering mechanism for children by combining artificial intelligence

technology [18]. The content of the basic trigger targets is described in Table 1.

Table 1 Illustrative table of the content of the cognitive triggers for distance in diverse children

The triggering mechanism of diversified children's distance cognition	Content Description
Visual triggering	Real time monitoring feedback
Sound trigger	Guided by sound
Tactile trigger	Simulate a sense of distance through tactile perception
Game Trigger	Manipulate toys to "capture" virtual objects on the screen
Social triggering	Simulate activity scenarios
Environmental triggering	Multi environment switching
Emotional triggering	Emotional feedback

Table 1 mainly explains the content of distance cognition trigger mechanism of diversified children. Among them, visual trigger, sound trigger and social trigger are very important. AI technology is often used for visual triggering. Toys can be equipped with cameras to capture the distance between children and toys [19]. When children are close to or far away from the toy, the toy will feedback the change of distance through color changes, animation effects or voice prompts, so as to help children intuitively understand the concept of distance; Sound trigger is to set a sound sensor in the toy to adjust the size or pitch of the sound according to the distance between the child and the toy [20]. For example, when children approach, the voice gradually increases; When the child is away, the voice gradually decreases. This change in voice not only attracts children's attention, but also urges them to perceive distance through hearing; Social trigger is to realize social interaction between toys and children or other family members through the APP of smart devices (such as mobile phones or tablets) [21]. For example, you can set up a competition or task involving multiple people, and require family members to keep a certain distance to complete the task [22]. This social trigger mechanism can not only enhance the interaction between family members, but also enable children to practice distance cognition in real life [23].

1.3 Constructing an artificial intelligence distance cognitive interactive toy design model

From the perspective of technical realization, artificial intelligence technologies, in particular machine learning, computer vision and sensor technologies, are used to create an intelligent system capable of recognizing, calculating and providing feedback on distance information [24]. The system captures distance data between the child and the toy through sensors, then uses machine learning algorithms to analyze and process this data, and ultimately provides the child with feedback on distance information through sound, light, or other forms [25]. At this point, the interaction direction of the toy can be designed to take into account the need for distance awareness, as illustrated in Figure 2.

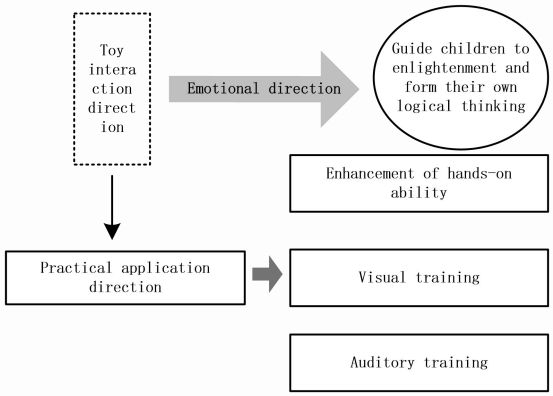

Fig. 2 Diagrammatic representation of toy interaction direction design

Figure 2 shows the design of the interactive direction of the toy. On this basis, the process requires in-depth understanding of the psychological characteristics and developmental needs of children. At this point in the design of the current model implementation, see Figure 3 for an illustration.

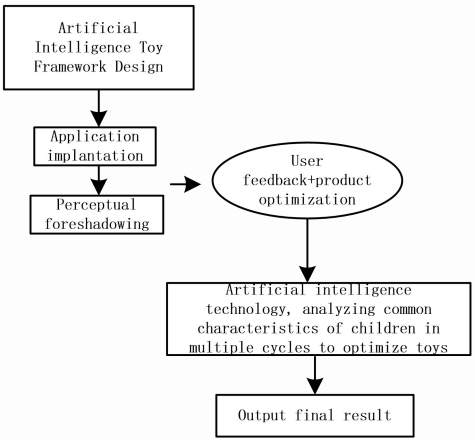

Fig. 3 Graphical representation of the artificial intelligence distance cognitive interactive toy design model link

Figure 3 mainly shows the design and practice of the artificial intelligence distance cognition interactive toy design model link. Children usually rely on direct perceptual experience when cognizing distance, therefore, the design of toys should be able to visualize the change of distance to help children form an intuitive perception of distance. In addition, the age and interests of children should be taken into account to design toys that are both cognitively appropriate and interesting. In terms of educational needs, combining distance perception with other subjects, such as math and physics, makes the toys entertaining and educational at the same time. For example, designing some game tasks that require children to solve problems by measuring distances can help children master the concept of distance and calculation methods in practice. User experience is an important part of design. We need to make sure that the toys are easy to use, safe and comfortable, so that children can feel pleasure and satisfaction in the process of using them. In addition, we can also optimize the product design through user feedback to improve the user experience. At this time, we need to combine with artificial intelligence technology to analyze the common characteristics of children in multiple cycles, and calculate the characteristic value for a certain area, see formula 2:

$$R = \varsigma^2 + \frac{W(1-X)}{Q} \tag{2}$$

In equation 2: R represents the eigenvalue, ς represents poor cognition. Q represents the number of feedbacks. W represents the perceptual region, W represents the overlapping sensory regions combined with the current measurements, the computed eigenvalues are used as a guide to construct the expression of the model, see formula 3:

$$H = \upsilon - (\sqrt{\theta} \times \sum_{V=1} \delta V + Z) \tag{3}$$

In equation 3, H represents the output of the toy design. υ represents the characteristic mean, θ represents cognitive differences. δ represents single-cycle satisfaction, δ represents the preset period. Z represents the design prediction difference. The final results were compared and analyzed with the current measurements to study the effectiveness of the application of the designed toy.

1.4 Visual interaction verification and user feedback trimming to achieve toy design

Visual interaction verification aims to ensure the effectiveness and ease of use of the design by visualizing the interaction between the toy and the child. First, we need to build a system that captures and displays real-time data about the child's interaction with the toy. This can be achieved by integrating hardware devices such as sensors and cameras, as well as analyzing and processing them using artificial intelligence techniques. In the process of visualizing the interaction verification, we need to focus on the following aspects:

(1) Data accuracy: Ensure that the system accurately captures and transmits data on child-toy interactions for subsequent analysis and evaluation.

(2) Interaction fluency: Evaluate the responsiveness and accuracy of the toy to ensure that children receive timely feedback and response during play.

(3) User experience: Observe children's expressions, movements and feedback during the use of the toys to assess the ease of use and fun of the toys.

Next, the toy is modified with user feedback based on the design and application of the toy. This is an important basis for design iteration and optimization. After collecting user feedback, we need to organize and analyze the feedback to find out the existing problems and the direction of improvement. Identify the problems and deficiencies from user feedback, such as functional defects, lack of ease of use, and so on. Conduct in-depth analysis of the problems to find out the causes of the problems, such as design flaws, technical implementation problems. Adopt iterative optimization, apply the solution to the toy design, and carry out iterative optimization until it meets the user's needs and expectations.

The combination of visual interaction verification and user feedback forms a closed-loop iterative optimization process. Through visual interaction verification, the interaction process between children and toys is more intuitively displayed, and potential problems and deficiencies are found; through user feedback modification, targeted improvement and optimization is carried out based on user feedback to improve the ease of use and fun of toys, so as to realize iterative optimization of children's distance-cognitive interactive toys design based on artificial intelligence technology and enhance user experience.

2 EXPERIMENT

This is mainly to analyze and verify the practical application effect of children's distance cognition interactive toy design based on artificial intelligence technology. Considering the authenticity and reliability of the final test results, the form of comparison is selected for analysis. The references set the traditional AR technology children's distance cognition interactive toy design The traditional intelligent cognitive children's distance interactive toy design and the designed artificial intelligence technology children's distance cognitive interactive toy design. Summarize and integrate test application data for future use. Next, set up the test environment.

2.1 Experimental preparation

Combined with artificial intelligence technology, build an interactive toy design that sets children's distance cognition. At present, we conduct research on the children's toy market in Area A, understand and analyze the children's toy store's after purchase preference and actual development trend, and collect corresponding data and information. After the relevant personnel had a certain understanding of this, they set and selected six styles of distance cognition toys as the target objects of the test, and calibrated the toys. At this time, auxiliary test indicators and parameters need to be set, as shown in Table 2:

Table 2 Distance perception toys auxiliary test indicators and parameter settings

Distance cognitive toy auxiliary testing indicators	Parameter standard value
Distance difference/m	1.5
Sensing area limit	16.24
Regional overlap ratio	3.4
Cognitive content	Environmental cognition, character cognition, distance cognition
Toy interaction section	Target recognition, independent thinking, forming opinions, interactive sharing

Table 2 mainly shows the settings of the auxiliary test indexes and parameters of the distance cognition toys. Combined with the current test environment, feature extraction is performed for each toy to realize the basic measurement mark, and then, combined with the computer vision technology in artificial intelligence technology, the current children's distance cognition environment is measured to ensure the stability and safety of the test.

2.2 Experimental process and results analysis

In the above built test environment, combined with artificial intelligence technology, the design of interactive toys for children's distance cognition is analyzed and studied. At present, the cognitive interaction distance of five toys of 1.5 m, 2 m, 2.5 m, 3.5 m and 4 m is set. Children are tested in this environment. In combination with the characteristic values of children of different ages, different action types are used to analyze the specific situation, as shown in Table 3:

Table 3 Test data and information unfolding analysis table

Child age	Cognitive distance/m	Action type
3 year	1.5	Meticulous movements
4 year	2	Meticulous movements
5 year	2.5	Rough movements
6 year	3.5	Rough movements

Under the guidance of different types of actions, for the analysis of test data and information, a number of test cycles are set, and the data formed in each cycle are summarized to determine the children's current application of toys, and to measure the attractiveness index of toys to children in various cycles, and the specific results of the test are shown in Figure 4.

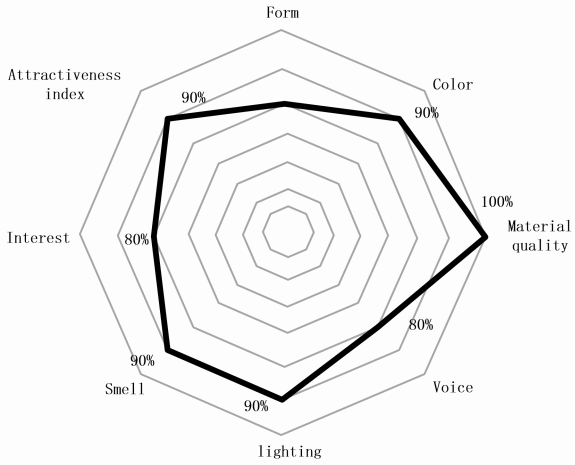

Fig. 4 Graphical representation of changes in the index of attractiveness of designed toys

Figure 4 shows the analysis of the changes in the attractiveness index of the designed toys. Combined with the current measurement of the designed toys in the actual situation, in the specific children's distance cognitive background environment, the design of the corresponding toy test background, based on the change of the attractiveness index, to lay the foundation for its practical application value and practical significance. At this time, real-time data and information are collected, and the test results are analyzed and discussed.

Based on the above settings, under different background conditions, combined with the actual application status and verification of the designed toys, the final test results are compared and analyzed, as shown in Table 4.

Table 4 Comparison and analysis table of the test results

Test cognitive distance/m	Traditional AR technology children's distance cognition interactive toy design attractiveness index/%	Traditional intelligent cognitive children distance interactive toy design attractiveness index/%	Artificial Intelligence Technology Children's Distance Cognitive Interactive Toy Design Attraction Index/%
1.5	77.45	80.16	92.35
2	70.38	79.52	94.65
2.5	65.38	84.58	97.54
3.5	76.38	79.58	93.54
4	78.22	78.55	96.54

Table 4 mainly analyzes the test results: compared with the traditional AR technology children's distance cognition interactive toy design and the traditional intelligent cognition children's distance interactive toy design, the design method of the artificial intelligence technology children's distance cognition interactive toy designed this time under the setting of more than 1.5m, 2m, 2.5m, 3.5m and 4m distance test background. Finally, the attractiveness index of toys to children can reach more than 90%. Therefore, the following discussion is carried out: the results of this design test show that the attractiveness of the designed children's toys is significantly enhanced by the above factors under different distance test conditions. The attractiveness index also shows that the designed toys further stimulate children's interest, it also has a guiding effect, promoting children's distance cognition interaction effect to be further improved, with strong pertinence and practical application value.

3 RESULTS AND DISCUSSION

In this study, a new design scheme based on artificial intelligence technology was proposed to address the problem of a single triggering mechanism in traditional children's distance cognition interactive toy design. By analyzing user positioning and characteristics, a diverse design approach was adopted, breaking the limitations of traditional toy design and setting a diverse

range of children's distance cognitive triggering mechanisms. By constructing an artificial intelligence distance cognitive interactive toy design model, visual interactive verification and user feedback modification of toys have been successfully achieved, making toy design more in line with children's actual needs and interests. In multiple distance testing backgrounds (1.5m, 2m, 2.5m, 3.5m, and 4m), the designed interactive toys showed extremely high attractiveness, with an attractiveness index of over 90%. This fully demonstrates the effectiveness and attractiveness of the toy design.

The key to the success of this study lies in the design of diverse triggering mechanisms. Traditional interactive toys for children's distance cognition often use a single triggering method, which not only limits the interactivity of the toys but also affects their attractiveness to children. Through the application of artificial intelligence technology, this research design has achieved diversified triggering mechanisms, allowing toys to flexibly adjust interaction methods based on children's different behaviors and reactions, thereby greatly enhancing the attractiveness and fun of toys. At the same time, the design fully considers the characteristics and needs of children, providing personalized interactive experiences for children of different ages, personalities, and interests through user positioning and feature analysis. This personalized design makes toys closer to children's inner world, which can better stimulate their interest and curiosity, and thereby enhance their distance cognition ability. The test results indicate that the designed interactive toy for children's distance cognition based on artificial intelligence technology has extremely high appeal in practical applications. This not only proves the effectiveness of the design, but also provides strong support for its practical production and market promotion. With the continuous development and popularization of artificial intelligence technology, this innovative and practical toy will occupy an important position in the future children's education market.

Although this study has achieved certain results, there are still many aspects worth further exploration and improvement. For example, in future research, further research can be conducted on how to utilize artificial intelligence technology to achieve more complex interaction logic and richer interaction modes; How to dynamically adjust the interaction difficulty and teaching content of toys based on children's behavioral feedback and learning progress; And how to apply this design concept to more types of children's educational toys, providing more diverse support and assistance for children's comprehensive development. Through continuous exploration and innovation, contribute more to the growth and education of children.

CONCLUSION

In conclusion, the above is the design of children's distance cognition interactive toys based on artificial intelligence technology, which not only brings innovative perspectives to the field of children's education, but also provides new possibilities for children's cognitive development. Through intelligent interaction, the toy can stimulate children's interest in the concept of distance, improve learning efficiency and make the learning process more vivid and interesting. With the continuous progress of artificial intelligence technology, this kind of interactive toys can further expand its functions and provide richer and more personalized learning experience. It is hoped that more educators, designers and developers will pay attention to this field and work together to promote the innovation and development of children's educational toys. Through continuous research and practice, children's distance cognitive interactive toys based on AI technology will play a more important role in children's growth.

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REFERENCES

[1] Gui J , Suh J .Research on Teaching Method of Children's Image Cognition Based on AR Technology[J].IoT Magazine, 2022, 4(4):197-213.

[2] Nouraldeen R M .The impact of technology readiness and use perceptions on students' adoption of artificial intelligence: the moderating role of gender[J].Development and Learning in Organizations: An International Journal, 2023, 37(3):7-10.

[3] Mauro D , Giorgio M .Artificial Intelligence GHG Monitoring for a Voluntary Carbon Certification[J].Environmental Science and Engineering:B, 2023, 12(1):1-16.

[4] Liu K , Wei Z , Zhang C ,et al.Towards Long Lifetime Battery: AI-Based Manufacturing and Management[J].Journal of Automation, 2022, 9(7):1139-1165.

[5] Huo W , Fang H , Chen X ,et al.Risk Analysis of Chemical Hazards Based on the Case of EU Children's Products Recalled and Study on the Reasonable Limitation of Harmful Element in Toys[J]. Biomedical engineering, 2022, 15(1):1-5.

[6] Qiang Y .An Intervention Study of Language Cognition and Emotional Speech Community Method for Children's Speech Disorders[J].International Journal of Mental Health Promotion, 2023, 25(5):627-637.

[7] Liu S .Research on the Intervention Program of Dance Therapy on the Joint Attention of Children with Autism[J].Journal of Higher Education Research, 2022, 3(1):56-59.

[8] Tillman K A , Walker C M .You can't change the past: Children's recognition of the causal asymmetry between past and future events[J].Child development, 2022, 93(5):1270-1283.

[9] Cheng T , Cheng N , Wang M ,et al.Toddlers' anxiety predicts their creativity at the age of five: The chain mediation effects of general cognition and mastery motivation[J].Acta Psychologica Sinica, 2022, 54(7):799-812

[10] Ismael N , Almhdawi K , Jaber A ,et al.Participation patterns in elementary school-aged children with autism spectrum disorders and their typically developing peers[J].Journal of Children's Services, 2023, 18(2):121-132.

[11] S. Roording‐Ragetlie, Spaltman M , Klip H ,et al.Working memory training in children with borderline intellectual functioning and neuropsychiatric disorders: a triple‐blind randomised controlled trial[J].Journal of Intellectual Disability Research, 2022, 66(1-2):178-194.

[12] Huo W , Chen X , Fang H ,et al.Research on the Chemical Hazard Risk of Toys Exported to EU from China Based on the Analysis of the EU "Safety Gate" Alerts Cases[J].Biomedical engineering, 2023, 16(4):53-64.

[13] Heljakka K .Toys, Comics and Transmedia Play: Tracing the connections between multidimensional storytelling and playability[J].The Journal of Popular Culture, 2022, 55(5):1144-1168.

[14] Othon C M .Capturing the Random Walk with Toys[J].The Physics Teacher, 2023, 61(2):122-123.

[15] VpelHenning.The "Inhuman" Revolution – Artificial Intelligence as the Technology of Destiny for Germany and Europe[J].Wirtschaftsdienst, 2023, 103(8):513-517.

[16] Javaid M , Haleem A , Singh R P ,et al.Artificial Intelligence Applications for Industry 4.0: A Literature-Based Study[J].Journal of Industrial Integration and Management, 2022, 07(01):83-111.

[17] Nanfeng M A , Yao X F , Wang K S .Current status and prospect of future internet-oriented wisdom manufacturing[J].SCIENTIA SINICA Technologica, 2022, 52(1):55-75.

[18] Song Xuguang Z M .What Kind of Skilled Talents Are Needed in the Age of Intelligent Manufacturing?[J].Journal of Northeastern University (Social Science), 2022, 24(1):16-24.

[19] Immersive virtual reality application for intelligent manufacturing: Applications and art design[J].Mathematical Biosciences and Engineering, 2023, 20(3):4353-4387.

[20] Zhao L , Zhu D , Shafik W ,et al.Artificial intelligence analysis in cyber domain: A review:[J].International Journal of Distributed Sensor Networks, 2022, 18(4):121-131.

[21] Luo X , Zhang Z , Tang D ,et al.A practical approach for multiagent manufacturing system based on agent computing nodes:[J].Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science, 2022, 236(4):1907-1930.

[22] Amaizu G C , Njoku J N , Lee J M ,et al.Metaverse in advanced manufacturing: Background, applications, limitations, open issues & future directions[J].ICT Express, 2024, 10(2):233-255.

[23] Petrillo A , Murino T , Piccirillo G ,et al.An IoT-based and cloud-assisted AI-driven monitoring platform for?smart manufacturing: design architecture and experimental validation[J].Journal of Manufacturing Technology Management, 2023, 34(4):507-534.

[24] Kang D , Jiajia L I , Cai S .Preschool children's sleep problem and language disorder[J].Advances in Psychological Science, 2022, 30(6):1270-1281.

[25] Y Liu,H Ji,Z Lv,et al.Design and Development of Immersive Learning Environment for Human Circulation System[J].Computer Simulation, 2023, 40(6):278-285.