

Product Design for Preventing Alzheimer's Disease in Aging Society

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Abstract: With the continuous development of society, the population of Alzheimer's disease has been rapidly increasing. The prevention of Alzheimer's disease should attract everyone's attention. In the medical aspect, there are constantly some new treatment methods and breakthroughs for Alzheimer's disease, but there are relatively few educational products on the market to prevent and slow down Alzheimer's disease. This paper is mainly about brain training products in prevention of Alzheimer's disease. In this essay, we will explore the symptom of Alzheimer's disease and the prevention of this disease. The paper adopts a variety of research methods, including literature retrieval method, case analysis method, etc. First, we consulted research papers related to Alzheimer's disease at home and abroad. At the same time, we conducted a comparative analysis of different types of educational products on shopping websites to find out the advantages and disadvantages of each product. Through these methods to provide the basis for the research and analysis of the elderly and educational products. The number of Alzheimer's patients is increasing, and the disease not only affect the life of the patient alone, but their family members also need to spare time to take care of them. Therefore, if the disease can be effectively prevented or delayed, it will be beneficial to the family. The burden will also be relatively reduced.

Keywords: Alzheimer's disease, training products, prevention

1. Introduction

The 21st century is an era of population aging. With the increasing population of elderly people all over the world, the degree of global aging is intensifying. Especially in Developed countries, they are entering an aging society earlier than developing countries [1]. Now, over 50 million people are living with dementia, and this number is set to increase to 152 million by 2050 [2]. Alzheimer's disease (AD) is the leading cause of dementia, whose clinical symptom is cognitive impairment [3]. According to the statistics of the World Health Organization, Alzheimer's disease is one of the four major diseases that threaten the health of the elderly. And it is the fifth cause of death for the elderly [4]. The symptoms of Alzheimer's disease can be divided into 3 stages: mild, moderate and severe. Since Alzheimer's disease onset gradually, its symptoms are easily mistaken as normal intelligence decline by their family members. Once the elderly suffering from Alzheimer's disease, it's irreversible. The life quality of patients and their caregivers will also reduce. Therefore, it's

particularly important to prevent elder people from getting this disease. Studies have shown that intelligence decline can be delayed through specific methods, like playing with brain training products can apparently lower the possibility of Alzheimer's disease [4]. Also, beloved music tunes help the Alzheimer patient to stimulate their brain [5].

At present, the brain training products on the market are still limited to traditional education products. For the elderly, their entertainment activities occupy the most of their daily life. However, these existing products which are relatively simple and common can be also played by children and adults. So, it's significant to form a product system which specially aimed at the prevention of Alzheimer's disease for the elderly.

The goal: to develop a brain product that can slow or prevent Alzheimer's disease. Address some research issues:

1) Realize the pathogenesis of Alzheimer's disease, so as to lay a good foundation for the design of the products.

2) Research the brain products on the market to prevent and slow Alzheimer's disease, and make sure that the product is practical.

The population of elderly people is increasing year by year, The sudden changes around them will cause problems in the psychology of the elderly. Making suitable products for AD's can not only relieve their loneliness, but also improve the living quality of the elderly.

Next, this paper will mention the formation principle and harm of Alzheimer's disease, existing products on the market to prevent and slow down Alzheimer's disease, product design concept, product features and instructions etc.

2. Product Design

There are not many products on the market aimed at preventing and slowing Alzheimer's disease. The product was designed in three ways. 1) To understand the pathogenesis of Alzheimer's disease, a certain degree of memory training and brain can slow down Alzheimer's disease in the elderly. 2) As the elderly grow older, all bodily functions decline, and the flexibility of hands and feet declines. The product can be combined with the elderly finger exercise. 3) Older people also have different problems with their eyes as they age. So, in the choice of product color need to be clear color, easy to identify.

2.1. Design Idea

With the gradual improvement of consumers' consumption power and information acquisition ability, traditional product design mode has been unable to attract consumers' attention. Only by innovating the design ideas of products can we meet the aesthetic and use needs of consumers and enhance the comprehensive competitiveness of products [6]. Alzheimer's disease has been on the human spectrum for 115 years, since the first officially recorded case was reported at a medical conference, and is one of the world's most devastating diseases [7]. With the development of the society, great progress has been made in the medical field. More and more research has been done on Alzheimer's disease. However, there are not many treatment methods in the medical field at present. Alzheimer's disease is still a thorny problem facing today's society. Since there hasn't been much progress in medicine, can we design products to prevent and slow Alzheimer's disease in our lives? There are not many products on the market aimed at preventing and slowing Alzheimer's disease. Many people think that old people are old children, still full of childlike innocence. From this point, this work came up with the idea of designing a puzzle game for the elderly. The product was designed in four ways (see Figure 1):

1) To understand the pathogenesis of Alzheimer's disease, a certain degree of memory training

and brain use in the elderly can prevent and slow down Alzheimer's disease.

2) As the elderly grow older, all bodily functions decline, and the flexibility of hands and feet declines. The product can be combined with the elderly finger exercise.

3) Older people also have different problems with their eyes as they age. So, in the choice of product color need to be clear color, easy to identify.

4) The product can detect users' finger strength when playing games and synchronously transmit it to the App to provide users with personalized services.

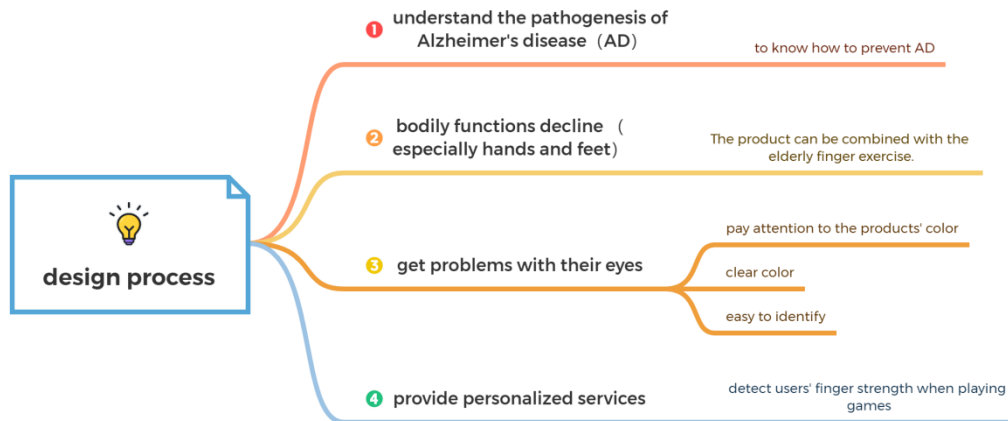


Figure 1: Design process.

2.1.1. Product Modeling Analysis

The overall shape of the product is an egg. There is a gray round button on the top right of the product, and the middle is concave. Users can turn the product on by pressing this concave point. In addition, the button is surrounded by a ring of gears, the user can choose three modes of the game by rotating this gear. The left side of the front of the product is the key area, there are four keys, keys around the light circle. The size of the keys is designed to fit ergonomically. There is a row of small round lights on the right side of the product, totaling 6. The size of the round lamp and the proportion of the size of the key is reasonable, which refers to the size design of other similar products. In addition, symmetry, as the name implies, refers to a relationship between points, lines and surfaces of a figure or object in terms of size, style and arrangement position [8]. Symmetry technique plays an important role in aesthetics and is applied in various fields. At the same time, left-right symmetry is in line with most people's aesthetic, especially many elderly people like symmetrical things. So, there is reason to believe that older people will like this product. In addition, the other side of the product increases a large range of silicone convex points, the role of these gray convex points is to increase the friction of the whole product, so that the product is easier to grasp in the process of use, to avoid the product in the process of the game hand slip or slide affect the game record.

2.1.2. Product Color Analysis

The main shape of the product is designed with quail eggs as the prototype. The main color of the product is white, and we add some gray spots as embellishment in the egg body. On the right side of the product are the power button and the raised spot area. We choose gray for the color of these two

parts, mainly to weaken the color of this part and to emphasize the main functional area. The main functional area of the product is the button area and the round lamp area. We used yellow, blue, red, and green Led lights around the keys in the same color as the small circle lights on the right. The reason why we choose bright colors is that the key area and the round lamp area make the main functional areas of our products, which must be represented by prominent colors. In addition, for the elderly with the growth of age, vision gradually weakened. A survey of 1,200 eye health surveys of urban elderly over 65 years old conducted by Guangming Helpline for the elderly showed that the most common eye diseases among the elderly are cataract, glaucoma, macular degeneration, floters and retinal detachment. [9] Choosing distinct and common colors, bright colors are conducive to the elderly can better see the light, reduce the mistakes in the game. We have three colors for this product, white, purple and blue.

2.1.3. Product Material Analysis

Product structure is divided into shell, internal support structure, circuit board. The shell has a power key, keys, round lights, convex points. In the next two years, China's ABS will enter the peak of production, the production of ABS will increase significantly, and the domestic supply gap will be made up [10]. The material of the shell is ABS, the material of the power button and the key is pc, the red light belt is selected around the key, and the small round light is made of environmentally friendly materials and small bulbs. Convex material to reduce the cost, so choose silicone. The internal support structure is also made of pc material considering the weight. The circuit board selected the most widely used pcb circuit board on the market. The material aspect of the whole product is mainly from the light weight, cost-effective, environmental protection three aspects.

2.2. Instructions

The grey round button is the power button of the product. The user can start the product by pressing the button. At the same time, a small round light comes on. After the startup is complete, the user can rotate the button to enter the mode selection. This product has three kinds of difficulty, easy, medium and hard. Users can choose according to their own situation. The user selects the mode and enters the game. There are 6 small round lights on the right side of the product. In simple mode, the first four lights are lit up in sequence with random colors. When the next light is lit, the color of the last light remains, and each light is lit up for 2 seconds. In medium mode, five lights turn on in sequence and memory time is shortened to 3 seconds. Six lights are lit in hard mode. At this time, six lights are randomly lit, and when the next light is on, the last one will be off. The interval is one second. Figure 2 showed the entirely process of how to use this product.

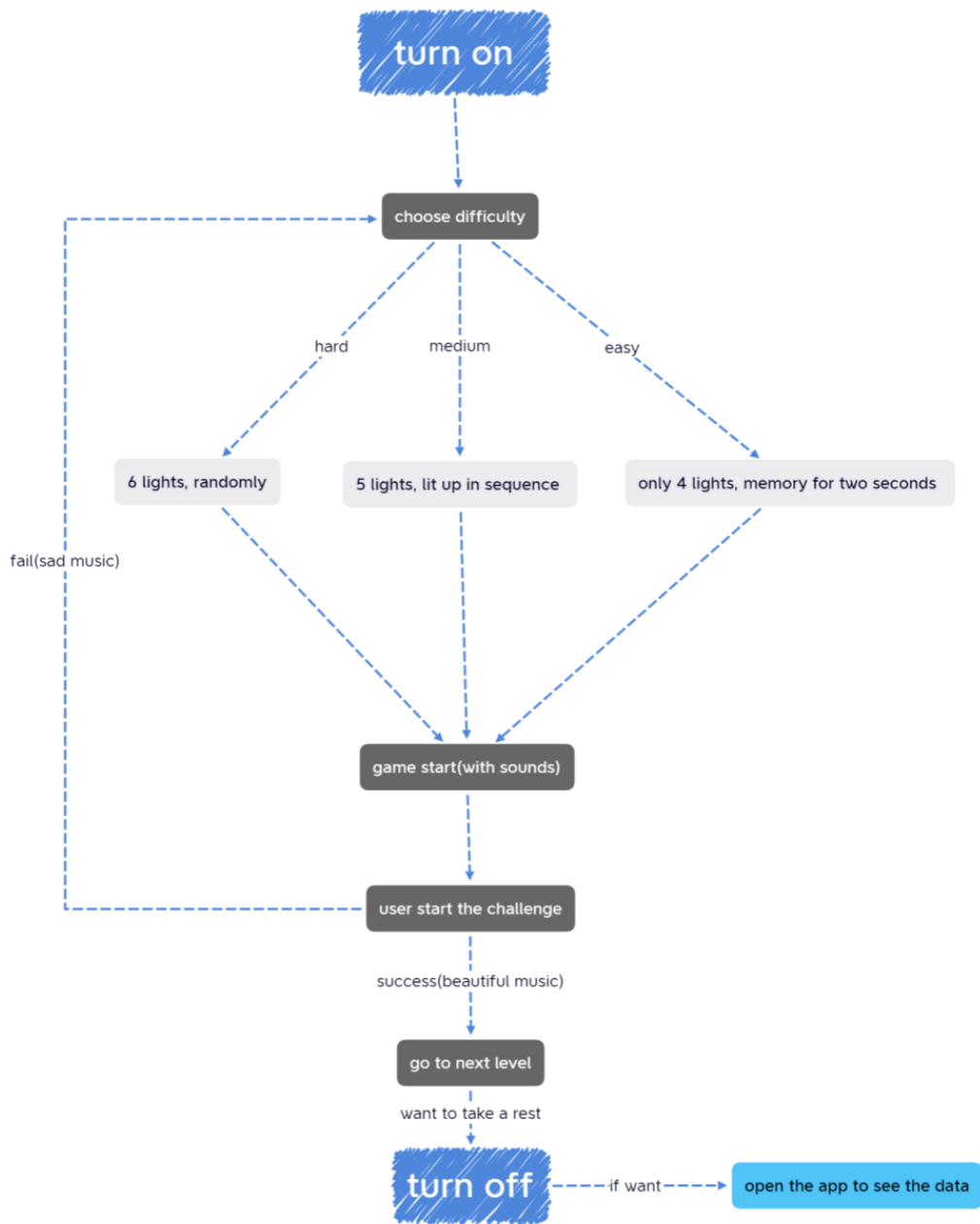


Figure 2: Process of how to use.

3. Analysis in Product

3.1. Product Size Analysis

When the product is used, it is held in the hand of the user. The size of each component of the product is determined by the auxiliary analysis of the human body size of Chinese adults (GB10000-1988), especially the length of the hand, the width of the hand and the length of the index finger. Figure 3 showed the relationship between each set of data and hands. Table 1 and table 2 showed human hand size of men and women.

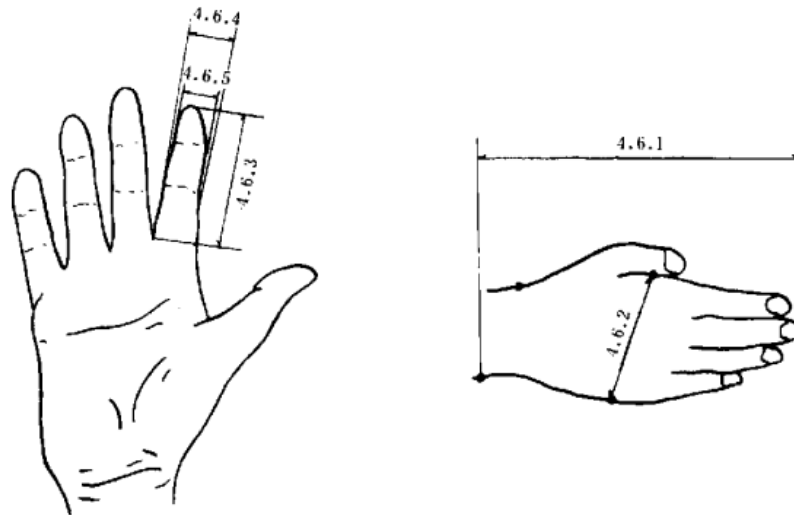


Figure 3: The relationship between each set of data and hands.

Table 1: Human hand size (man).

	18~60years old						
	1	5	10	50	90	95	99
4.6.1 hand length	164	170	173	183	193	196	202
4.6.2 hand width	73	76	77	82	89	89	91
4.6.3 index finger length	60	63	64	69	76	76	79
4.6.4 index finger carry knuckle width	17	18	18	19	21	21	21
4.6.5 index finger distal knuckle width	14	15	16	17	18	18	19

Table 2: Human hand size (woman).

	18~55years old						
	1	5	10	50	90	95	99
4.6.1 hand length	154	159	161	171	180	183	189
4.6.2 hand width	67	70	71	76	80	82	84
4.6.3 index finger length	57	60	61	66	71	72	76
4.6.4 index finger carry knuckle width	15	16	16	17	218	19	20
4.6.5 index finger distal knuckle width	13	14	14	15	16	16	17

The official data only counts up to the age of 60. The muscles of the elderly will face problems such as gradual atrophy, resulting in the hand size of most elderly people being smaller than the data in the picture. In the design process, the impact of this point should also be fully considered. It can be seen from the figure that the human body percentiles of men aged 18-60 and women aged 18-55 are generally designed to take the 95th percentile into consideration for most users. This product mainly serves the elderly and can be taken as 90th percentile. Considering the action of grasping, the height of the product is positioned at 108mm, the length is 72mm, and the width is 50mm, which is showed in Figure 4.

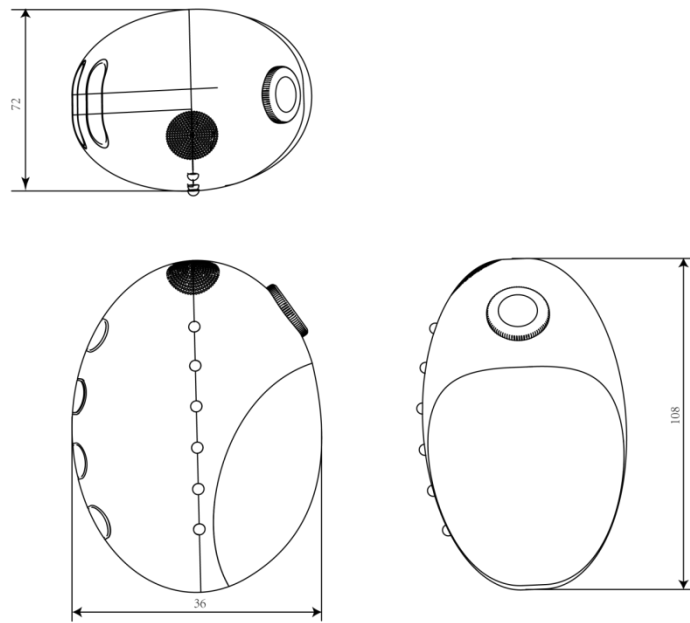


Figure 4: Three views and their dimensions.

3.2. Product Sketches

After determining the function of the toy theme, the brainstorming of the shape was carried out. At the beginning, we planned to use the shape of the ball, but considering the ergonomics, the ball is too round, and it is not convenient for the elderly to grasp. So, we changed it into oval shape. In order to fit the shape of the finger, we use the button as shown in the figure. Charging port and the interaction with mobile phone also can be seen in the sketches. Figure 5 showed the whole process creating the product.

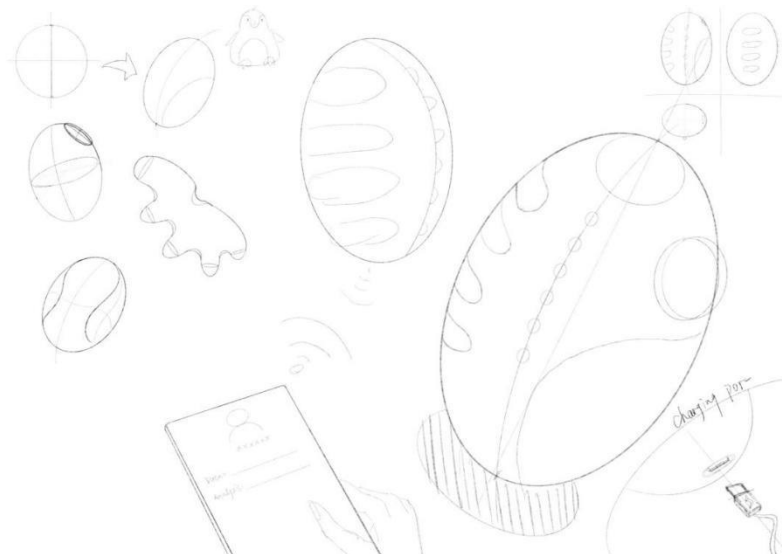


Figure 5: Sketch about the product.

3.3. Product Modeling

The whole design is finished based on Rhino. First, the approximate shape of the oval is determined by the known dimensions. Then, determining the position of the buttons, LED lights and the switch. Figure 6 showed the initial model on model show mode.

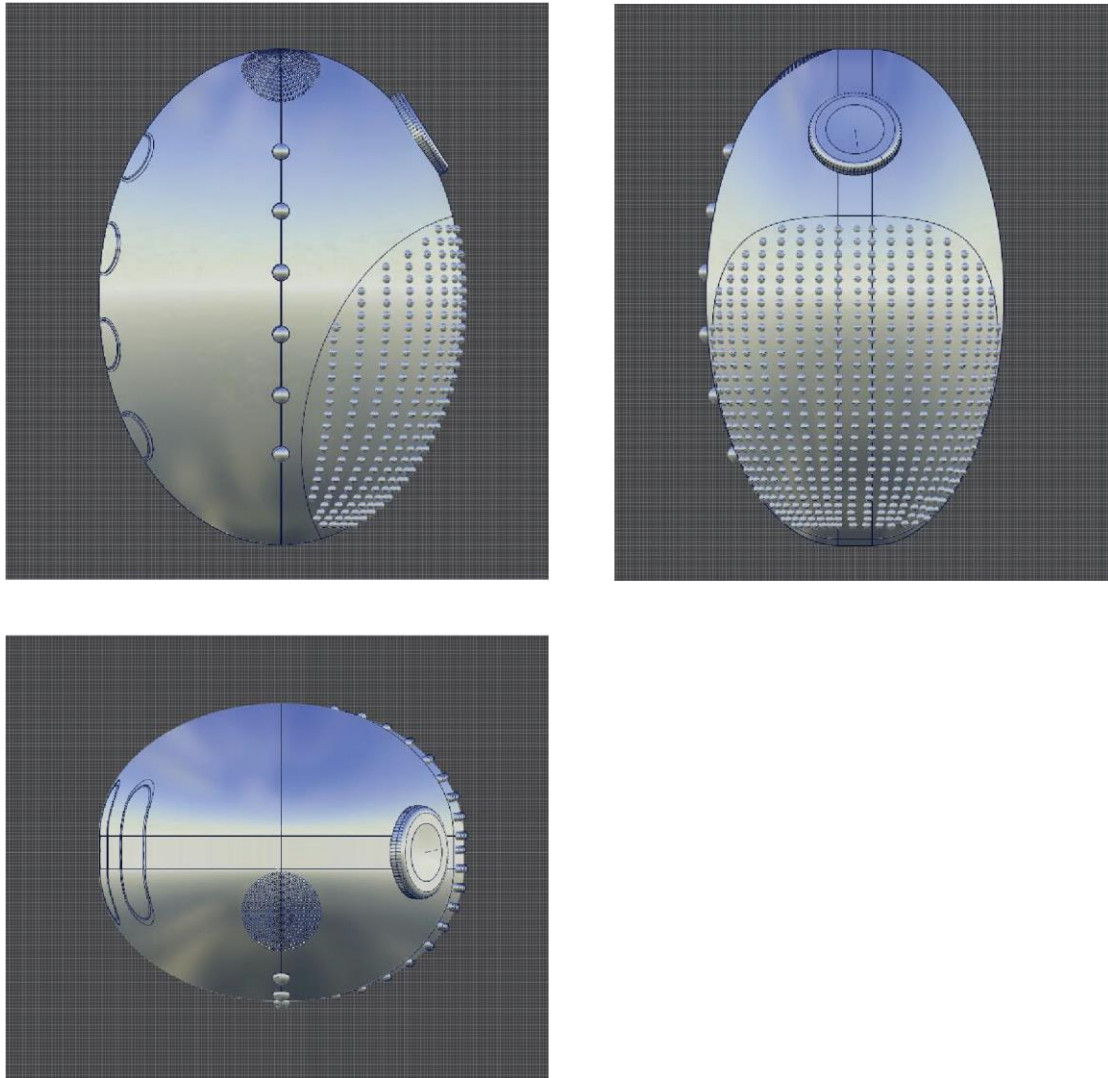


Figure 6: Initial model on modelshow mode.

3.4. Product Rendering

The model is rendered by keyshot in various aspect and scene. Figure 7 showed simple renderings in two different angles. Figure 8 is the explosion diagram which showed the internal structure and electronic component. The other two colors of the product are presented in Figure 9. And Figure 10 is the scene picture.

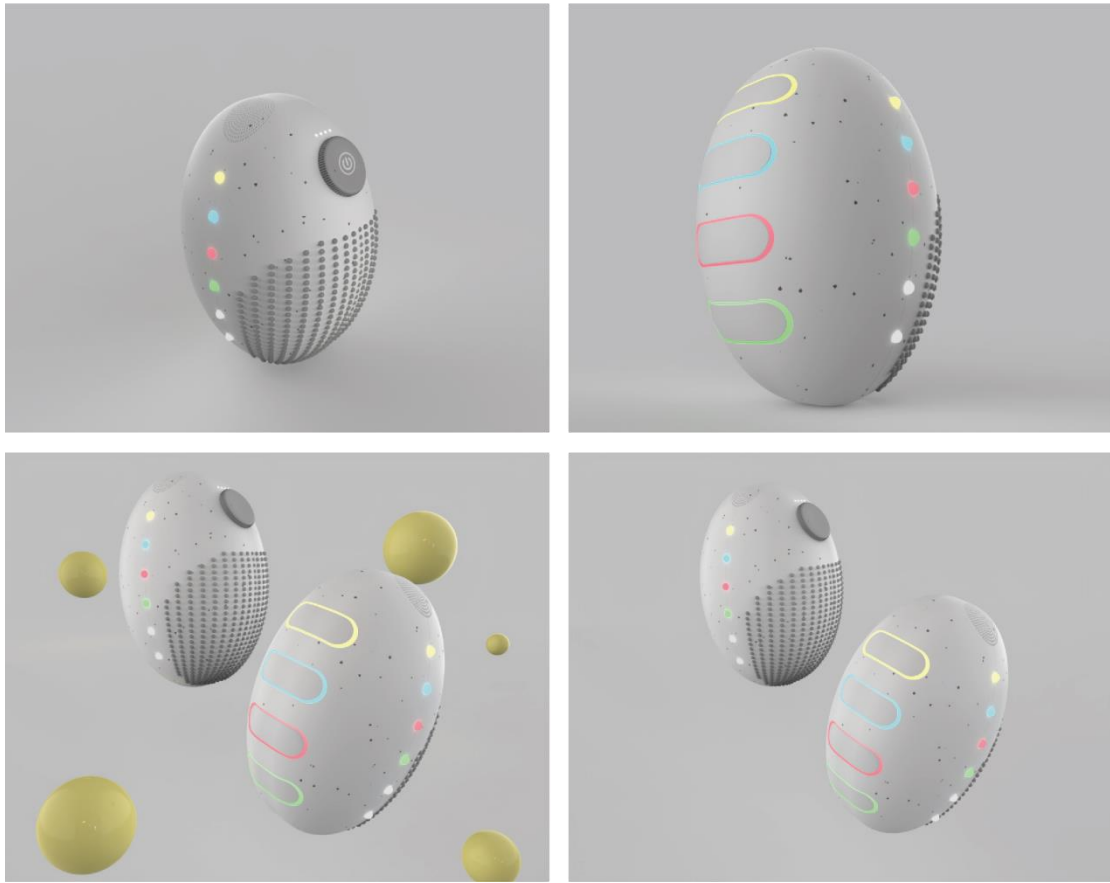


Figure 7: Simple renderings.

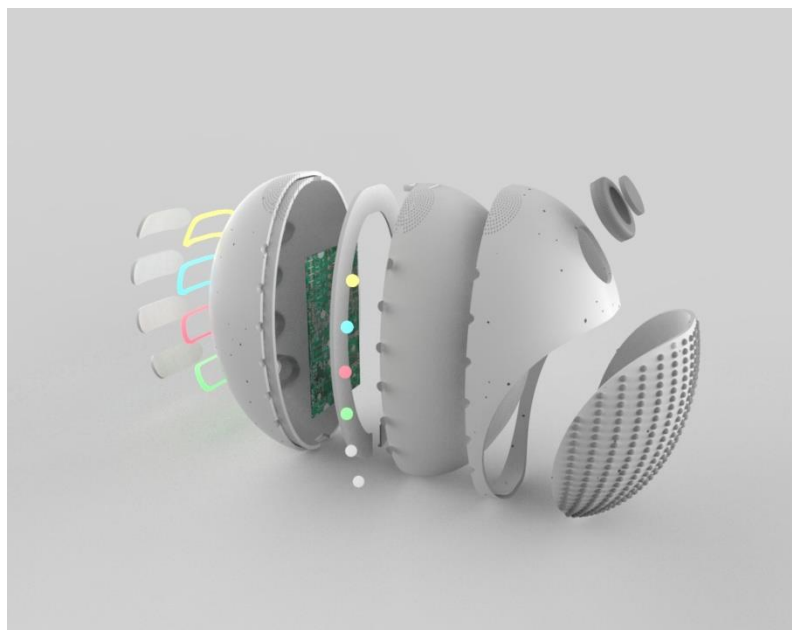


Figure 8: Explosion diagram.

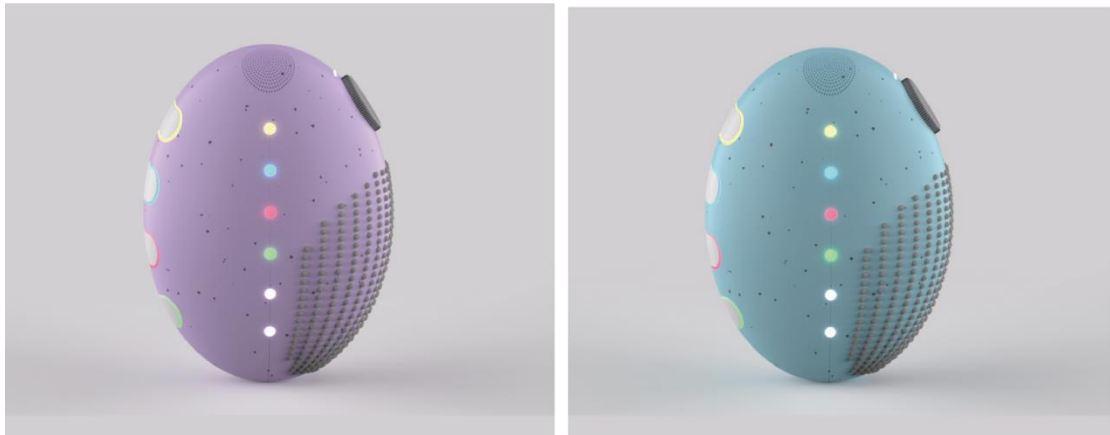


Figure 9: Other two colors.



Figure 10: Scene picture.

4. Conclusion

The impact of population aging cannot be ignored. In the face of such a phenomenon, we should actively find ways to solve and deal with the problem we faced. This article brings new ideas for future product innovation through the direction of preventing or alleviating Alzheimer's disease and has carried out bold innovations in shape and rules. Hand-held toys are small and portable which have no requirements for the environment. Memory toys can encourage the elderly to use their brains more. At the same time, the game is combined with buttons and music, and the elderly are stimulated and exercised in the three aspects of touch, hearing and vision.

This design only puts forward an innovative idea in terms of prevention, and it is still in the conceptual stage. The issues considered may not be complete. For Alzheimer's patients, there are still many innovations that can be explored in depth. The product has a certain degree of difficulty for the elderly who are already sick and can only play the role of prevention and exercise. These issues require further research and consideration.

References

- [1] Ying Gao, (2019) *Cognitive guidance and improvement of Alzheimer's disease patients based on human-computer interaction design*, *Cognitive Systems Research*, 56, 192-202.
- [2] International AsD. *World Alzheimer report 2019: attitudes to dementia*. In: *Book World Alzheimer Report 2019: Attitudes to dementia* (Editor ed.^eds.). London: Alzheimer's Disease Internationals; 2019.
- [3] Lyketsos CG, Lopez O, Jones B, Fitzpatrick AL, Breitner J, DeKosky SJJ. (2002) *Prevalence of neuropsychiatric symptoms in dementia and mild cognitive impairment: results from the cardiovascular health study*. *Jama*. 288: 1475–83.
- [4] Yi Jiahui. *Research on the Design of Educational Products for the Elderly Based on Interactivity [D]*. Beijing Institute of Technology, 2015.
- [5] M. Sudharsan, G. Thailambal, (2022) *A Recognition of Alzheimer Disease using Brain MRI Images with DPNMM through Adaptive Model*”, In *proc. 2022 Int. Conf. on Edge Computing and Applications (ICECAA)*, 952-959.
- [6] Jiang Fei, (2023) *Practical Research on Application of Material Innovation in Product Design [J]*. *Art Appreciation*. 06.
- [7] Liu Xia, (2022) *Can we cure Alzheimer's disease in the next ten years [N]* *Science and Technology Daily* 8-22.
- [8] *Analysis on the Application of Beauty of Symmetry in contemporary Architectural Space [J]* *Cultural Monthly* 2018 (08)
- [9] Huang Jian. (2012) *The important standard of healthy old people - bright eyes[J]*. *Middle-aged and elderly health care*, 06.
- [10] Chang Min. (2021) *Analysis and forecast of global ABS supply and demand [J]*. *World Petroleum Industry*, 03.