International Journal of Organizational Innovation

DESIGN OF LIFTING WASHING MACHINE

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Abstract

The washing machine is an indispensable household article in modern daily life. It has the advantages of simple operation and is convenient to use. However, when the clothes are taken out of the washing tank after washing, we need to bend over and stretch out our hands to take them out. This physical activity will pose safety and convenience issues for the elderly. This research will take the improvement of the washing machine structure as the starting point, and the improvement of the product will help the elderly in their daily home laundry work to maintain their health and reduce injuries. First, we will have a brainstorm to discuss the topic of improving the washing machine, and consult the actions and items that can be improved: 1. Take out the clothes conveniently and easily. 2. There is no need to bend over when taking out clothes. Then convert these actions or items to TRIZ 39 engineering parameters as No. 33 conveniences of use and No. 10 force, and then use a single engineering parameter innovation rule table to find out 40 innovation rules that can be improved. Through 40 innovation rules and sub-rules, the idea of washing machine improvement was suggested, and a newly patented washing machine with a lifting structure is proposed.

Keywords: Health promotion, TRIZ, New patent structure, 39 Engineering parameters

Introduction

Background

With the advancement of science and technology and the development of medicine, the life expectancy of human beings has increased every year since 1840, for example, the average life expectancy of women in England and Wales was 42 years in 1841 and increased to 82 years in 2001 (Zai Haozhi, 2014). Some experts estimate that the average life expectancy of human beings may reach 95~100 years in 2080 (Manton, 1991). According to the analysis of Taiwan's population structure, the proportion of people over 65 years old reached more than 7% in 1993, officially entering an aging society. The Ministry of the Interior announced in 2008 that the "average life expectancy" of Malaysian citizens was 74 years in 1990, 77 years in 2000, 75.46 years for men and 81.72 years for women in 2007, and 80.6 years in 2019. In the face of such an aging future, the cost of long-term care and medical expenses for the elderly will become more and more heavy, and how to maintain the health of the elderly will be an important issue.

According to the report of the Ministry of Home Affairs (2006), 91.3% of the elderly believe that the home is the most ideal place to live, and according to the survey, the most common place for accident injuries among the elderly is in the bathroom or toilet at home, followed by the living room, and falls, falls, and falls are the most common (Zhang Xiumian, 2010). As we age, the size of the human body will shrink, and the elderly are more likely to suffer from muscle atrophy caused by lack of exercise, which makes it sometimes impossible to fully lift or extend the hands, and the waist is unable to bend easily due to osteoporosis.

Research Motivation and Purpose

In daily life, washing clothes is a fixed and necessary job. However, for the elderly, when using a single-tank washing machine on the market, they may first lift the lid of the washing machine and bend down in the first step and reach into the rotating plate at the bottom of the laundry sink to take out the washed clothes, causing injury due to the action of bending down and reaching out when taking out the washed clothes.

The main objective of this study is to explore how elderly people can easily take out the laundry washed in the washing machine after their physical functions have deteriorated.

(1) To understand the characteristics and needs of the elderly when using washing machines.
(2) Analyze and discuss the structure of washing machines and the direction of improvement
(3) Design a washing machine that can assist the elderly to easily access and put away their clothes.

Research Methods

This study explores the needs of the elderly in taking out clothes while using a washing machine through brainstorming, understands the possible effects of their body movements, and searches for patented inventions related to the auxiliary functions of washing machines. Then apply the 39 engineering parameters and 40 innovation rules in the TRIZ theory to think about the design of the auxiliary functions of the washing machine, improve the product design, and finally apply for a new patent for the improved washing machine.

Literature Review

TRIZ Theory

TRIZ is a former Soviet inventor Genrich Altshuller who studied more than 400,000 patents in various countries around the world, and found that innovation is not a random and disorderly process but a systematic process, so it has developed a set of concepts and tools to solve invention problems, which can make it easy for engineers to obtain innovative thinking. The TRIZ theoretical problem-solving method can be widely applied to many engineering improvement problems (Chen Peijun, 2015). There are many innovative tools in TRIZ theory, among which the most commonly used tools include 39 Engineering Parameters (John, 1988), Table 1. Contradiction Table (Altshuller, 1988), and Table 2. 40 Inventive Principles (Altshuller, 1997), these were defined by Altshuller's analysis of hundreds of thousands of patents. Chen Jiahao (2006) discusses the advantages and disadvantages of contradiction matrices, and also compares the effects of different contradiction matrices. Hu Shuzhen (2019) used the contradiction matrix, 40 innovation rules and human factors engineering to discuss and study the design of a device to assist the elderly in putting on and taking off shoes. Lin (2016) applied the TRIZ innovation to assist in the design of a recycling device for Tetra Pak.

The contradiction matrix table is used to solve the problem of contradictory engineering features in the system,

when we want to improve a certain engineering feature, we can analyze and predict that it will cause deterioration to other engineering features, and there is a technical contradiction between these two engineering features, and the contradiction matrix table can be used to obtain 40 innovation rules to solve the problem. However, if only one engineering feature is improved, and it is not possible to predict whether it will cause the deterioration of another engineering feature, it is not possible to use the contradiction matrix to solve the problem. Liu Zhicheng and Chen Jiahao (2001) proposed the innovation law of single engineering characteristic to solve the problem of unpredictable deterioration of engineering characteristics, and the single engineering characteristic corresponding innovation law to improve the engineering characteristic problem is shown in Table 3.

Table 1. Contradiction matrix (partial)

避免惡化的參數 欲改善的參數	1.移動物件的重量	2.不動物件的重量	3.移動物件的長度	……	39 生產力
1.移動物件的重量					35,3 24,37
2.不動物件的重量					1,28 15,35
3.移動物件的長度	8,15 29,34				14,4 28,29
..					
38 自動化程度	28,26 18,35				5,12 35,26
39 生產力	35,26 24,37				

(Source: Compiled with reference to Liu Zhicheng (2003))

Table 2. 40 rules of innovation

編號	法則內容	編號	法則內容
1	分割	21	快速過
2	抽出	22	轉害處為益處
3	局部性質	23	回饋
4	不對稱	24	中間物
5	結合	25	自助
6	多面性	26	複製
7	套疊	27	便宜的替代品
8	反重力	28	更換機械系統
9	先前的反作用	29	氣體或水力結構
10	先前的作用	30	彈性殼或薄膜
11	事先的緩衝	31	多孔材料
12	等位性	32	改變顏色
13	反轉	33	同質性
14	球狀化	34	拋棄及再生零件
15	動態化	35	改變物理或化學狀態
16	部份或過度動作	36	相的變化

17	移至新次元	37	熱膨脹
18	機械振動	38	強氧化劑
19	周期性動作	39	惰性環境
20	有效動作的連續	40	複合材料

(Source: Compiled with reference to Liu Zhicheng (2003))

Table 3. Table of innovation rules corresponding to single engineering characteristics (partial)

出現次數 工程參數	A1(10 次以上)	A2(8~9 次)	B(6~7 次)	C(4~5 次)
1.移動物件的重量	35		18.28.26. 27.31.34	02.03.10.29 01.08.19.36.40
..				
10.力量	35.10 18.37	36.01	15.19.28	03.13.21
..				
33 使用方便性	01.13	02	18.28.32 34.15.25 35	16.17
..				
39 生產力	35,10 28	01		16.20.27.30.04 40.05.25.21.31 36

(Source: Compiled with reference to Liu Zhicheng (2003))

Brainstorming

Brainstorming is defined as providing solutions to specific problems through human intelligence and creative thinking. It can be used to strengthen the

ability to think about problems and stimulate creativity to come up with solutions when making designs. This method was developed by Alex Brown, the founder of the American BBDO (Batten, Bcroton, Durstine and Osborn) advertising agency. Presented by Alex F. Osbom in 1939 (Yang Jiping, 1992). The ultimate goal of brainstorming is to motivate each member of the team to generate constructive ideas and practices effectively and quickly, and to strive to cultivate better opinions or ideas through the facilitator leading the participating members. When it comes to brainstorming group discussions, there are four basic rules that must be followed:

(1) Prohibition of criticism: During the meeting, it is forbidden to comment on the opinions or ideas put forward by others to suppress them, so that everyone can express their opinions freely.

(2) Free association: You can freely associate and put forward opinions without restrictions, and often have good insights from different points of view and ideas in different fields.

(3) Pursue quantity: Try to put forward ideas or opinions, whether good or bad, and when the number of opinions is raised, effective solutions may appear.

(4) Combining and improving ideas: It is possible to synthesize other people's ideas into a more effective method, or extend other people's ideas to get a better idea.

Patent Searches

After searching the existing technology patents related to washing machine assistance, it is found that there are two patents in Taiwan, including the new patent announcement number M471470 "internal improvement of the washing tank", which are listed in Table 4 below. After analysis, the above-mentioned patents are different from the methods and improved structures adopted in this study, and the "lifting washing machine" developed in this paper is an innovative technology with the function of lifting and lowering the inner base of the laundry trough.

Design Process

In this study, the product design will be carried out according to the product design process in Figure 1, and the brainstorming session will be conducted to discuss the physical or psychological problems that the elderly will encounter when washing clothes in the washing machine at home and taking the clothes, as the requirements for the design of improved products. Then, the design requirements obtained are converted into

39 engineering parameters corresponding to the Cuizhi Innovation Rule, and whether there is a contradiction between these engineering parameters, and the contradiction matrix table is used if there is a contradictory relationship. If there is no contradictory relationship, a single engineering parameter innovation rule table is used. Then, a new type of washing machine is designed from the 40 rules of innovation and sub-rules, and a new model patent is applied for after patent search and analysis.

Brainstorming group

This study focuses on how to easily remove and wash clean clothes when using a washing machine in the home life of the elderly. First of all, consider the structure and use of a single-tank washing machine, and examine and discuss the movements that the elderly have to bear when taking out the washed clothes from the washing machine and the accidents that can occur. After the brainstorming group was enthusiastic and enthusiastically put forward their opinions, the following insights were obtained:

(1) The existing single-tank washing machine on the market has a certain capacity and depth, so when taking out the washed clothes, it is necessary to bend down and reach into the laundry tank to take out the clothes at the bottom of the tank.

(2) For the elderly, if they bend down and reach into the laundry sink to take out the clothes at the bottom of the trough, it is easy to cause discomfort and injury to the lower back, especially for those who are relatively short, and there may also be a risk of falling in.

(3) Therefore, the best way for the elderly to pick up and wash their clothes in the washing machine is not to bend down and reach into the laundry trough, so that there will be no injury to the waist and no risk of falling.

(4) The newly designed washing machine should take into account the above shortcomings and meet the following design items: 1. It should be able to take out clothes in a convenient and easy way. 2. Do not bend over when taking out clothes.

Table 4. Patent search for new patents of lifting washing machines in Taiwan

no	公告號	專利名稱
1	M471470	洗衣槽筒內部改良
2	M447392	具有衣物分類功能之洗衣機

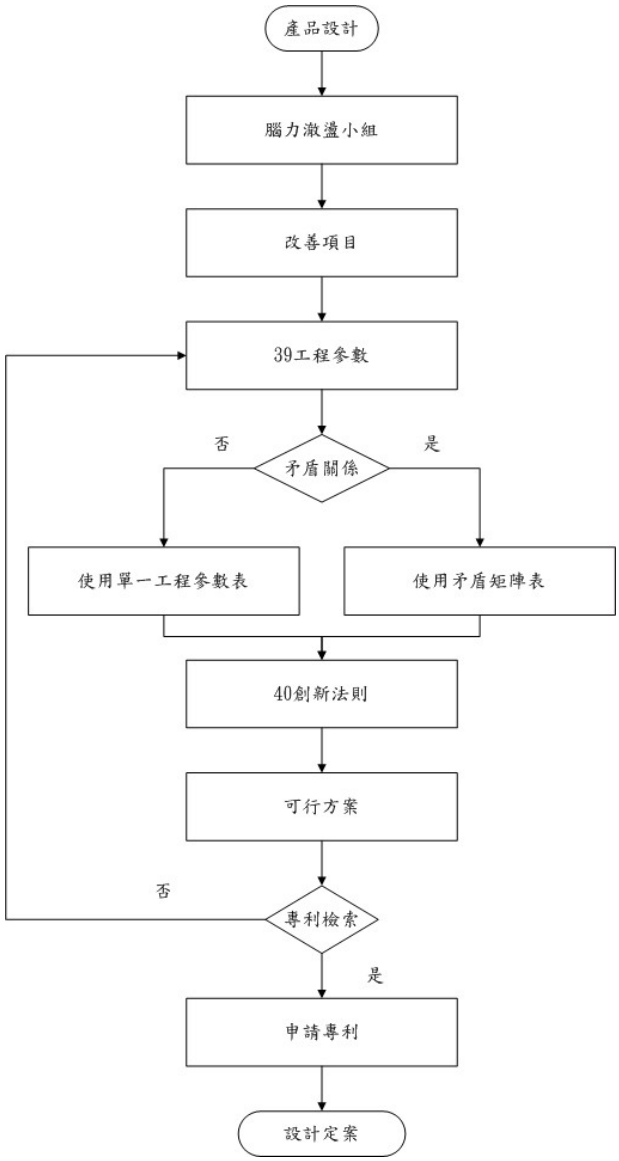

Figure 1: Product design flow chart

39. The engineering parameters and single engineering characteristics correspond to the table of innovation rules Then, the design element items obtained by the brainstorming method were converted into 39 engineering parameters of Cuizhi. By the first design requirement: to be able to take out the clothes in a convenient and easy way, the engineering parameters to be improved are number 33 ease of use. By the second design requirement: do not bend down when taking out the clothes, and the engineering parameter to be improved is the number 10 force. Because the two engineering characteristics to be improved cannot predict the engineering characteristics to be avoided from deterioration, the contradiction matrix table in Table 1 is not used in Table 1 and the single engineering feature corresponding to the innovation law table in Table 3 is used instead. From Table 3, it can be found that if you want to improve the convenience of use of engineering parameter number 33, the number 40 innovation rules appear more than 10 times, numbered 35 changes in physical or chemical state, number 10 previous effects, number 18 mechanical vibration, number 37 thermal expansion, and the number of occurrences is 8~9 times, there are number 36 phase changes, number 01 segmentation. If you want to improve the power of the engineering parameter number 10, the number 01 division and number 13 reversal of the 40 innovation rule that appear more than 10 times are numbered 01, and the number 02 is extracted if the number of occurrences is 8~9 times.

40. Principles of Innovative Invention. In the first set of 40 innovative rules obtained: the previous role of No. 10, the mechanical vibration of No. 18, the thermal expansion of No. 37, the change of phase No. 36, and the division of No. 01, the mechanical vibration of No. 18, the thermal expansion of No. 37, and the change of phase No. 36 are not applicable to this design, so the previous role of No. 10 and the division of No. 01 are considered. The second group of 40 innovative rules: number 01 division, number 13 reversal, number 02 extraction, the number 13 reversal is not applicable to this design, so number 01 division, number 02 extraction. Based on the above discussion, the 40 innovation rules that can be used for creative thinking are the previous action of number

10, the division of number 01, and the extraction of 02, so the use of these three innovation rules and sub-rules (Table 5) to guide the design of washing machines that can assist the elderly can be designed, and the lifting washing machine can be designed as shown in Figure 2. The design of its innovative invention is described as follows:

(1) Adopt the number 10 preliminary action in TRIZ 40 innovation rule: think about how to make the washing machine after washing the clothes, before the elderly can pick up the clothes, the washing machine design has a function to complete part of the actions required to take the clothes, here thinking is to complete the first step of bending action.

(2) Segmentation in TRIZ 40 innovation rule No. 01: Considering the transformation of the rotary disc at the bottom of the washing machine by sub-rules a and b, it can be divided and can be made into a combined way.

(3) Taking out in TRIZ 40 innovation rule No. 02: The rotating disc at the bottom of the washing machine washing tank is improved into a combined way by sub-rules a and b, which can be designed as a lifting function, after completing the laundry, the elderly lift the lid and press the rising button of the rotating disc, and the rotating disc rises to the height designed to facilitate the removal of clothes, as shown in Figure 3, at this time, the elderly have completed the first step of taking the clothes without bending over. Then you don't need to reach to the bottom of the laundry sink to complete the second step to get the clothes, as shown in Figure 4.

Table 5: 40 Innovation Rules and Sub-rules (Partial)

No.	The law of innovation	The law of subordination
01	Partition	a. Splits an object into separate parts. b. Fabrication of a combined object. c. Increase the degree of object segmentation.
02	Take	a. Removing (removing or separating) obstructive parts or properties from an object.

		b. Remove only the parts or attributes you need
10	Action in advance	a. Complete all or at least part of the movement beforehand b. Place objects so that they do not waste time waiting while they are moving

Figure 2: Perspective view of the design of the lifting washing machine

Figure 3: Cross-sectional view of a lifting washing machine

Figure 4: Scenario diagram

Patent Search

In order to evaluate the innovation of the lifting washing machine in this research result, the design proposal with the main integration and lifting structure characteristics will be examined for the patent examination. Finally, the design was approved by the model patent on February 8, 110, Taiwan, and the supporting information is shown in Figure 5. below.

Conclusions and Recommendations

In this study, we propose a modified lifting washing machine with a rotating disc at the bottom of the washing tank of the washing machine. The user is that after the washing machine is washed, use the lifting switch on the outside of the machine body to start each driver, each driver drives each lifting piece to rise high, the top end of each lifting piece is embedded in each groove of the base rotating disc when it is raised, and each lifting piece drives the base rotating disk and the clothes in the washing drum to rise together, and after the base rotating disk and the clothes are raised, it is convenient for the user to take out the clothes, and after the user takes the clothes, then use the lifting switch to control each lifting piece to lower down, In order to lower the base rotating disc back to its original position, it can assist the mobility of the elderly when engaged in cleaning work, and to achieve the design purpose of this study,

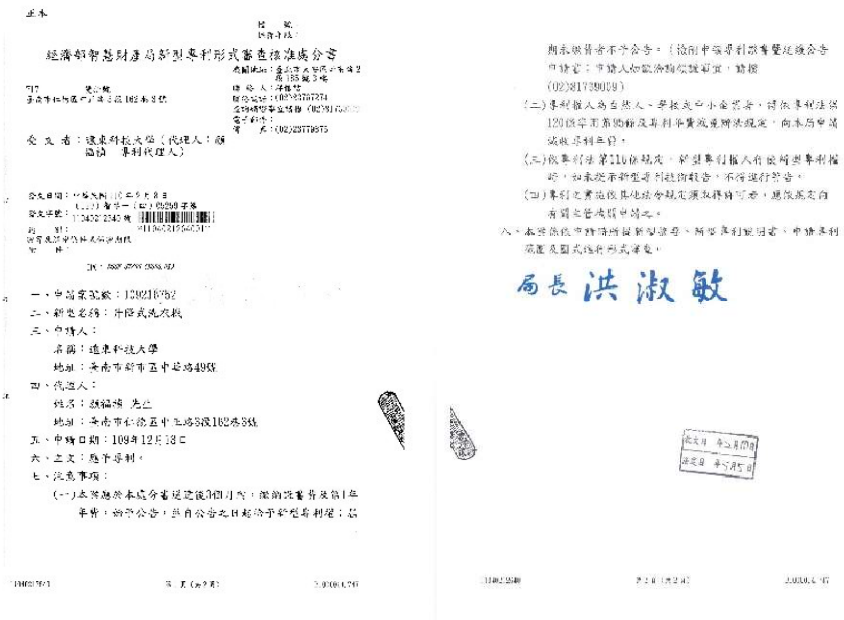

Figure 5: Scenario diagram

this design was approved by the new model patent examination on March 23, 110, Taiwan.

References

Altshuller, G. (1988). Creativity as an exact science (A. Williams, Trans.). Gordon and Breach.

Altshuller, G. (1997). 40 principles. TIC.

Chen, P. (2015). Application of TRIZ innovation principles to the research of innovative design of assistive devices (Master's thesis). Institute of Computer Application Engineering, Far Eastern University of Science and Technology.

John, T., Alla, Z., & Boris, Z. (1998). Systematic innovation: An introduction to TRIZ (Theory of Inventive Problem Solving). St. Lucie Press.

Lin, S. Y. (2016). Application of TRIZ inventive principles to innovate recycling machine. Advances in Mechanical Engineering, 8, 1–8. https://doi.org/10.1177/1687814016639826

Liu, Z., & Chen, J. (2001). A TRIZ innovative design method without

contradictory information. In The 12th National Symposium on Automation Science and Technology, Huwei Institute of Technology.

Manton, K. G., Stallard, E., & Tolley, H. D. (1991). Limits to human life expectancy: Evidence, prospects and implications. Population and Development Review, 17, 603–637. https://doi.org/10.2307/197360

Ministry of the Interior. (2006). Summary analysis of the survey results of the situation of the elderly in the Republic of China in 94.

Hu, S., & Ye, L. (2019). Research and design of applied human factors engineering and TRIZ in assisted shoe putting and taking off devices. International Journal of Systematic Innovation, 5(4), 33–39.

Yang, J., & Yang, P. (1992). Brainstorming and conferencing. Taihua Business Press.

Zai, J., Zhang, J., & Lin, J. (2014). Discussion on the trend of average life expectancy and longevity genes in China. Taiwan Medical Circle, 57(10), 15–20.

Zhang, S. M. (2010). The elderly are safe at home. Changhua Nursing, 17(2), 13–14.

Liu, Z. (2003). Research on TRIZ method improvement and green innovation design method (Doctoral dissertation). Department of Mechanical Engineering, National Cheng Kung University.