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Article

Application of Concurrent Design Strategy on the Design of Multifunction Hydrotherapy Bucket

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Abstract: With the improvement in medical quality, cold mechanical rehabilitation equipment can no longer meet the psychological needs of the physically handicapped. Therefore, design for behaviour change should be viewed as a strategy for enabling lifestyle changes as soon as possible. Although how to use equipment to assist physically disabled people in hydrotherapy rehabilitation is the primary design goal, the psychological feelings of users are also one of the focuses of this study. Besides, coupled with the large-scale spread of the Coronavirus Disease (COVID-19) in the past two years. People's living habits are also forced to change, many activities that people are used to doing outdoors are being slowly completed at home. During the epidemic, it is very dangerous and inconvenient for users who need to go to institutional rehabilitation regularly. Hence, it is urgent to change past usage habits and places. In this study, a personal multi-functional hydrotherapy bucket is designed. In addition to not having to use a public spa with other people to reduce the risk of contracting the Coronavirus Disease, it can be easily placed at home by reducing its size. According to market research, it is known that the current domestic hydrotherapy buckets on the market usually only have a single function. The large medical hydrotherapy pools are not only rare in Taiwan, but this kind of equipment also takes up a lot of space. Various factors have resulted in a relatively low market share of hydrotherapy pools compared to other rehabilitation equipment. In order to take into account, the physical and psychological needs of the physically disabled, this research focus on the design of a multi-functional but small-sized hydrotherapy bucket. Taking the convenience of entering and leaving the bucket as the starting point to improve the shortcomings of the existing products, on the other hand, because most users are inconvenient to move, safety is also the focus of the design to reduce the occurrence of accidents and injuries. This study is based on the systematic design methodology of concurrent design to obtain product design results. Firstly, conduct market research and select products from different manufacturers for analysis and comparison. Through functional analysis and sorting out the problem points, the TRIZ theory and the morphological diagram method are used to find the solution to the problem. Finally, the best design scheme is obtained by the PUGH method. Besides, construct a 3D model to present the design concept that meets the design goals. The research results are hoped to be used as a reference for designing and developing related products, thereby increasing the home's multifunctional hydrotherapy buckets' market share.

Keywords: concurrent design; morphological diagram method; PUGH method; TRIZ theory

1. Introduction

Rehabilitation is undoubtedly a difficult road for the patient with physical disabilities or limb injuries. Regularly going to institutions for rehabilitation has become routine. In general, rehabilitation equipment is usually designed with the goal of improving their health, with each new devices aimed at better treatment offering. Besides, a successful designer should understand the diverse and complex needs of people, and then design solutions and services to meet these needs [1].

However, sometimes this kind of equipment created to improving health can result in negative, even traumatic, emotional experiences in patients, for example, when operating cold rehabilitation equipment and the arduous rehabilitation process, they often feel uncomfortable. Besides, most patients don't want to be in the public eye when they are traumatized or failed in the rehabilitation process. As Kim opinions, the fundamental principle of human-centered design is premised on maintaining dignity [2]. Design for behaviour change (DfBC) should be considered at this moment, because it is viewed as an effective way to deal with some of the main problems in our society [3]. Brooker further proposed a concept of person-centered care, both healthcare professionals and administrators know that providing person-centered care is very important to patients [4]. Person-centered care should aim to create a positive social environment and enable people to experience wellbeing. Therefore, it is best practice to treat patients as individuals and thus assess and meet their individual needs. Patients are known to experience anxiety when interacting with the healthcare environment, and healthcare providers are slowly realizing that the services they provide often hard to meet the needs of their patients. In fact, if patients feel anxious during treatment or rehabilitation, it will definitely affect the quality of medical care. Anxiety must be taken seriously in the medical process today, since it has also been negatively associated with treatment, showing that anxiety can have far reaching consequences and it can undoubtedly impact quality of life in many different ways [5]. For example, it may lead to an increase in awareness and exacerbation of medical symptoms, and less effective medical decision-making. [6,7]. Mullaney also considers that it is necessary to reconsider the patient experience in healthcare, because human-centered design must look holistically at patient experience to find a new solution to mediate and prevent situational anxiety [8]. Therefore, when designing this functional physiotherapy rehabilitation equipment, the primary consideration is the user's psychological feelings. A successful product should be able to solve consumers' problems, or bring a more convenient life to the public, so designers and planners must identify problems and implement effective solutions when designing products, and strive to develop solutions that can bring consumers high-quality products with different benefits [9]. At present, most of the multi-functional rehabilitation hydrotherapy pools provided by rehabilitation institutions are large-sized products used by many people, while the personal rehabilitation hydrotherapy buckets take up little space but often have a single function. Considering that users may not be able to afford the huge cost of large-sized products and have too much space, this design case reduces the size of the multi-functional hydrotherapy bucket and modulates it for home use. In this way, the burden on the body, movement, and use of the rehabilitated person can be effectively reduced. At the same time, the developability and popularity of the product can be considered, and reduce production costs and product size as much as possible to benefit more users and perform personal rehabilitation with dignity. According to Cooper and Kleinschmidt, the key factors for the success of a product to be launched are the design of the product itself, the characteristics of the product, the production methods, and techniques aimed at producing a quality product, the implementation of collaborative production and design, and the benefits that the product brings to the user [10]. In addition, a good product should carefully evaluate every detail during the development phase. Therefore, to study the competitiveness of products, we should start from the market performance, analyze the direct factors such as cost, price and quality, and then analyze the indirect factors such as resources, materials, capital and technology, and finally find the specific reasons and ways to improve competitiveness. In this study, a concurrent design strategy was used as the main approach for the multifunctional hydrotherapy bucket, and different research methods were used to analyze and propose solutions for each problem in a clear box process, in the hope that the selected design solutions could effectively improve the problematic points of the product.

2. Background

2.1. Hydrotherapy

Lynda Huey, a Santa Monica, Calif.-based kinesiologist and sports trainer, considers that the '70s were dominated by running and the '80s by aerobics, but the '90s belong to water exercise.

"Swimming is no longer the only form of activity for the water," says Huey [11]. In fact, aquatic fitness has become popular because of the publication of "Deep Water Exercise for Health and Fitness". The author of Glenn McWaters is a former Marine combat helicopter pilot, who tried walking in water using a flotation belt while recovering from a thigh wound sustained in Vietnam. He considers that deep-water running can improve exercise efficiency, because the resistance encountered in water movement is 12 times that of air movement. "A 20-minute workout in the water is the equivalent of a 30-to 35-minute workout on land," McWaters explains [12]. Aquatic fitness was initially used in injured athletes but has since been applied to other patient users in orthopedics, rheumatology, and cardiology. This kind of program usually focuses on improving aerobic capacity, and the principles of traditional hydrotherapy are used to increase the difficulty of walking in water. Therefore, Aqua jogging has popped up, with programs covering much different aquatic fitness, such as shallow water walking, aqua-aerobic, aquasteps, aquanastics, hydrosports, hydropower, and aquadynamics. The most advantage of rehabilitation in the hydrotherapy pool is that users are not afraid of falling, and reducing the fear will help arouse their willingness to activity. Many experts in the field of rehabilitation believe that changes in the motor skills of the user can be seen when training balance in the water, and if training balance in the hydrotherapy pool is effective, the chances of successful rehabilitation on land will increase, this argument is also confirmed in clinical research [13]. In addition, "Coaches found that athletes were coming out of rehabilitation in better shape than before they were injured," says Ruth Sova, president of the Aquatic Exercise Association in Port Washington, Wis., a research organization for professionals in aquatic fitness and therapy. Hence, we can know that running in water and many other aquatic exercises trace their roots in therapy [14]. Besides, there are several advantages to be gained by using hydrotherapy: improved movement ability by increasing joint range of motion and relaxation, use of an easy and simple method to strengthen weak muscles, and movement can be performed with less force, low mechanical shock enhances cardiovascular endurance, stability, equilibrium, and adequate balance reactions can be facilitated, increase proprioceptive and exteroceptive input, reduce subjective complaints, such as shoulder pain, motivation and self-esteem can be increased, improve body image [15].

To sum up, aquatic fitness in a hydrotherapy pool can provide a pleasurable and enjoyable situation for users and can encourage them to be active, reduce the distraction of rehabilitation on dry land, and at the same time have substantial benefits for physical rehabilitation.

2.2. Lifestyle change and Design for behaviour change

Due to the large-scale spread of the Coronavirus Disease (COVID-19), many countries have created policies and legislation to reduce social interaction and curb the massive spread of this pandemic disease. Governments in most countries have imposed a blockade on all non-essential infrastructure. These rules include closing sports clubs, fitness centers, and community sports fields. Additionally, social gatherings of more than two people are banned, further limiting opportunities to exercise and exercise together. Therefore, many people have replaced organized physical activity with individual home-based workouts. Home-based workouts are definitely an easier and time-saving approach for those who already have the required equipment, home workouts are definitely an easier option for those who already have the required equipment. They can able to continue exercising without assistants and instructions in this situation, but adequate space at home is necessary [16]. From this, it can be seen that if we want to design a home-type multifunctional hydrotherapy bucket, how to reduce the storage space is also one of the key points that must be considered. Mattioli et.al. even suggest people can take online exercise classes, and use video- or app-guided aerobics training at home, because there are many workout videos available and useful that can assist people in exercising on their own [17]. Moreover, many patients have the problem about their physical and mental status, and this can cause them to be reluctant to continue with rehabilitation or exercise, for example there may be frustration, hopelessness, fatigue, and resignation from the rehabilitation process. Hence, more and more patients believe that exercising at home is necessary and beneficial for physical and mental health [18]. In addition, for patients with complex health conditions, such as stroke, has become an essential part of healthcare in Sweden and

internationally. Therefore, in recent years, there has been growing agreement that the home environment has a good effect on improving people's health [19]. Based on the above viewpoints, this study expects to design a home-use and multi-functional hydrotherapy bucket, so that patients can change their past rehabilitation habits, and then gradually recover their physical condition.

3. Conceptual Framework and Methodology

This research uses the concurrent design to solve the black box problem in design, and considers the practicality of the multi-functional hydrotherapy bucket, the storage capacity of the household type, and the safety during exercise. This research constructs a systematic, efficient, and fair design process.

3.1. Objectives tree method

The objectives tree method can effectively help designers to clarify the main objectives of the design and effectively organize consumer needs to make the design process more fluid. In addition, the ambiguity between consumers and the design team is minimized. The objectives tree method is presented in a graphical format so that the interrelationship between design goals and secondary goals is clearly presented [20].

3.2. TRIZ theory

TRIZ is a combination of the initials of the Russian word "Teoriya Resheniya Izobreatatelskikh Zadatch", proposed by Soviet engineer Altshuller in 1946. TRIZ theory stands for "Theory of Inventive Problem Solving"; its English translation is "Theory of Inventive Problem Solving". The principle that inventions should be universal and that certain principles inherent in creative inventions are usually the same or similar. Therefore, Altshuller uses these assumptions as the basis of TRIZ theory and integrates these principles. TRIZ theory compiles and summarizes 39 engineering parameters and 40 principles for solving inventive problems, and emphasizes that inventions or innovations can be made in accordance with certain procedures and steps. As a result, TRIZ theory is regarded as a comprehensive, systematic solution to the problem of the invention and the realization of technical innovation [21].

3.3. Morphological chart method

The morphological chart method is a method of analyzing and systematizing all generated concepts, and this method is based on the functional analysis method [22,23]. A new component is composed of abstract parameters built from concrete technical principles. The parameters and components are expanded and confirmed in parallel on the final morphology chart. Finally, the components are selected from each of the parameters. Finally, the components are selected from each parameter, and each component that is combined together is considered a solution to the problem.

3.4. PUGH method

The PUGH method is completed by comparing many problem options and is often used to select the best design solution. All question options have a weight that is used to compare with the datum [24,25]. If the question option is better than the datum, it is indicated by "+"; conversely, if it is worse than the datum, it is indicated by "-". If the question option is difficult to compare with the datum, it is indicated by "S". Finally, the relative scores of each option are used to obtain an optimal result.

4. Case Study

Most of the users of the multi-functional hydrotherapy bucket are physically disabled or disabled. Therefore, in addition to the free entry and exit of the bucket, it is more important to include multiple rehabilitation functions without taking up space. In this case, products of different brands on the market were selected for analysis and comparison, and their problem points were summarized






through functional analysis. The solution to the problem was found by TRIZ theory and the morphological chart method. Finally, the best design scheme was obtained by the PUGH method.

4.1. Market research

Generally speaking, market research is a good way to understand a consumer market. Through it, designers can better understand a market's needs. Therefore, this research starts with market research and current status analysis of related products by collecting data, so as to accurately understand the market demand for hydrotherapy pools and the hydrotherapy buckets in the early stage of design. The market data reference sources in this research for the preliminary work are related product web pages, books, journals, besides, field visits to merchants, special education schools, and physiotherapy rehabilitation clinics to obtain the most authentic information, in addition to grasping the functional structure of the existing hydrotherapy buckets, the main design and improvement guidelines can also be obtained from the problem points.

This study collects hydrotherapy pools and buckets launched in different countries, and then integrates them into a product comparison table (Table 1). After collecting data and compiling the results, it was found that the small or individual hydrotherapy buckets on the market do not take up space, but most of them are single-use and single-function. Except for the slightly different materials, the appearance has not changed much. The functions are mainly rehabilitation, and there are no other additional functions that can be used. The main function is to relieve physical fatigue and soreness, and there are fewer other additional functions.

Table 1. Existing product analysis and comparison table [26–30].

	<i>Pevonia</i>	<i>Ever Prosperous</i>	<i>Jengshin</i>	<i>Natural Create</i>	<i>YAHU</i>
Brand					
Type	Capsule	Immersion barrel	Upper body barrel	Running type	Lower extremity type
Feature	1.Digitally Controlled 2.NHydrotherapy, Tub Wet table, Steam, Vichy shower	Using the linear velocity of water flow and ultrasonic equivalent	Comes with four 4 brake wheels	Users can run in the bucket	Chair style with wheels
Size	L: 223.5cm W:119.4cm H: 51 129.5cm Weight: 179.6kg	L: 71cm W: 38cm H: 46cm Motor Weight: 2 kg	L: 71cm W: 38cm H: 51cm	L: 238cm W:120cm H: 51 180cm Weight: 300kg	L: 70cm W:68cm H: 123cm
Material	Acrylic resin	Stainless Steel	Stainless Steel	Acrylic resin	Stainless Steel

4.2. Design specification

In order to clearly understand the hierarchical relationship between design goals, the results of market research, product analysis and field visits are drawn into a target tree diagram with a master-slave relationship (as shown in Figure 1). Then use the TRIZ method to find out the parameters of improving features and worsening features.

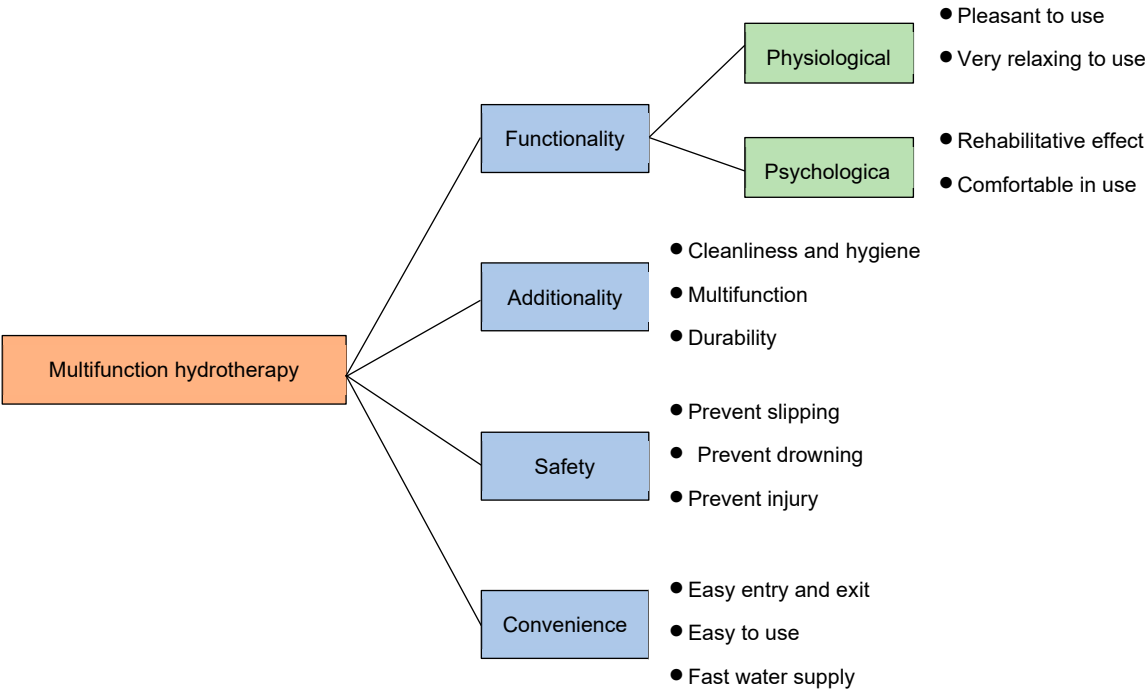
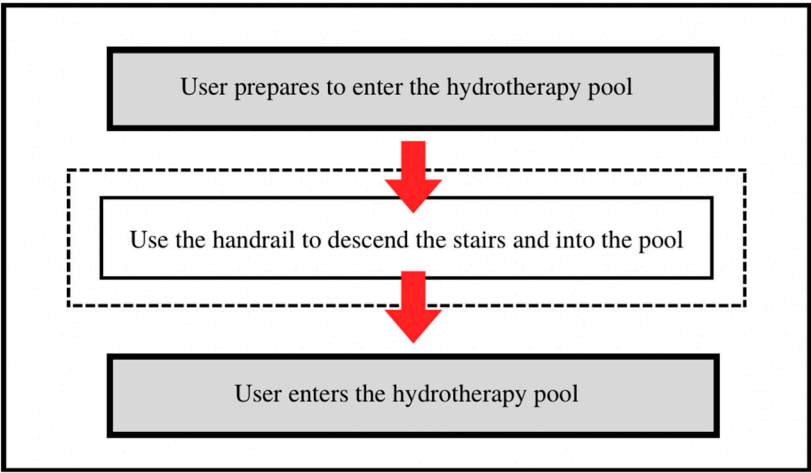
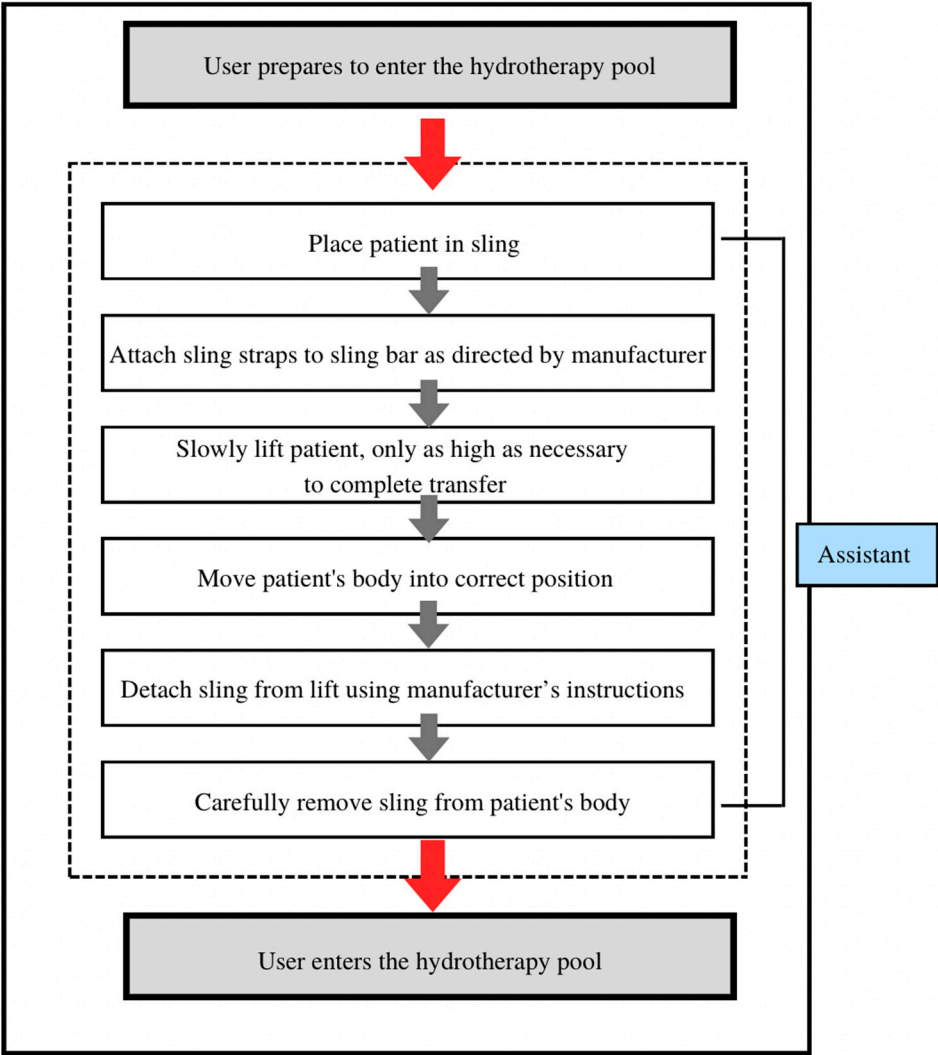


Figure 1. The total items of the objectives tree.

Generally speaking, hydrotherapy pools provided by rehabilitation institutions usually contain a variety of rehabilitation equipment. Firstly, functional analysis and use process of a large-scale hydrotherapy pool is shown in Figure 2. Figure 2A,B are different ways of entering and exiting a hydrotherapy pool, and Figure 2C is different rehabilitation exercises to carry out the process, both entering and exiting and the rehabilitation process require the assistance of a therapist to guide. Next, this study will design a multifunction hydrotherapy bucket suitable for home use after understanding each step of use. Although the hydrotherapy bucket designed in this study also requires other people to assist when moving patients or performing rehabilitation, this role does not need to be a professional nursing staff, as long as the family is careful to complete the work.



(A)



(B)

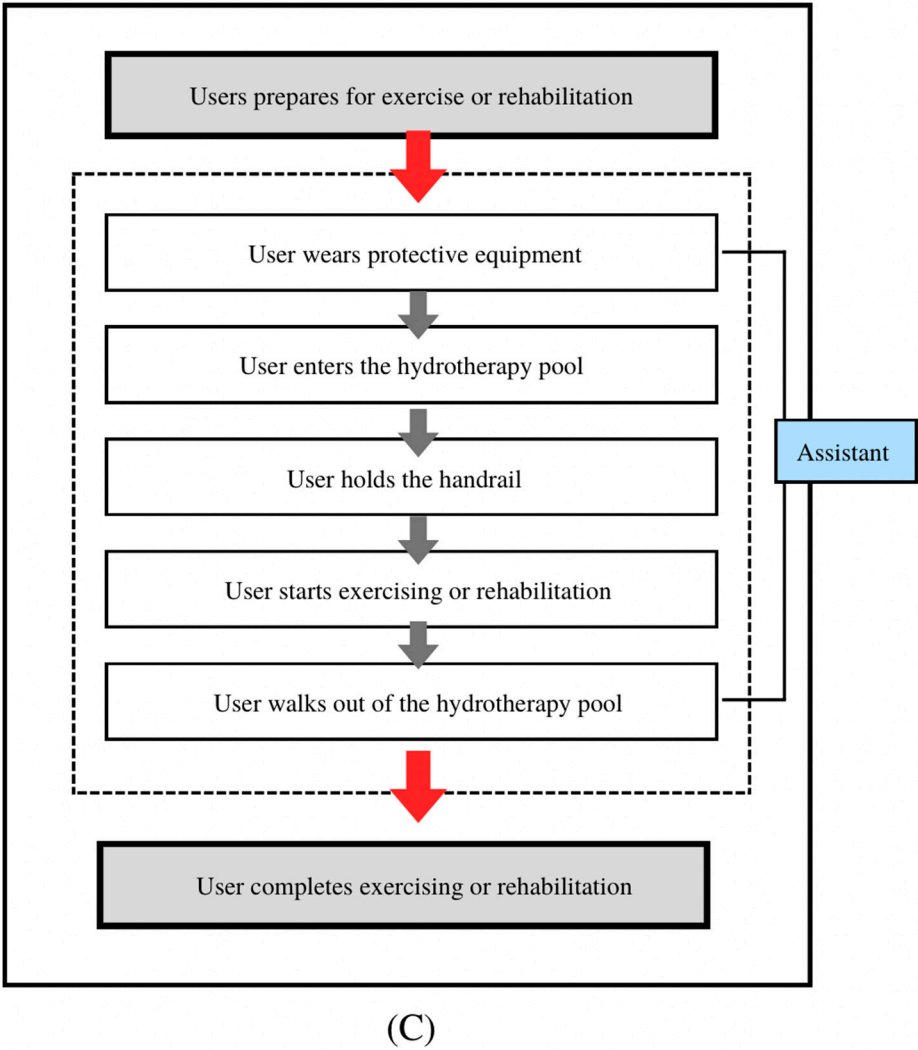


Figure 2. The function analysis and use process of a large-scale hydrotherapy pool.

Through the above methods, a set of design criteria was developed (Table 2), with D (Demand) indicating the design requirement as the "need" for essential functions and W (Wish) as the "expectation" for non-essential functions. Since most of the users who need hydrotherapy rehabilitation have physical disabilities or physical injuries, this product will consider both physical and psychological factors in terms of functionality, expecting that users can not only relieve physical pain, but also feel relaxed during the rehabilitation process. In this study, the focus was on the safety, functionality, and ease of use of the device, such as preventing slips, drowning, and injuries, which were considered as desired goals.

Table 2. Design specifications for multi-purpose hydrotherapy bucket.

Functionality		Additionality		Safety		Convenience	
Pleasant to use	W	Cleanliness and hygiene	D	Prevent slipping	D	Easy entry and exit	D
Very relaxing to use	W	Multifunction	D	Prevent drowning	D	Easy to use	D
Rehabilitative effect	D	Durability	D	Prevent injury	D	Fast water supply	W
Comfortable in use	W						

4.3. Development strategies

This product is still in the development stage, and there is still room for improvement in terms of acceptability, convenience, and ease of use, so this study uses different design strategies to improve the deficiencies.

4.4. TRIZ theory

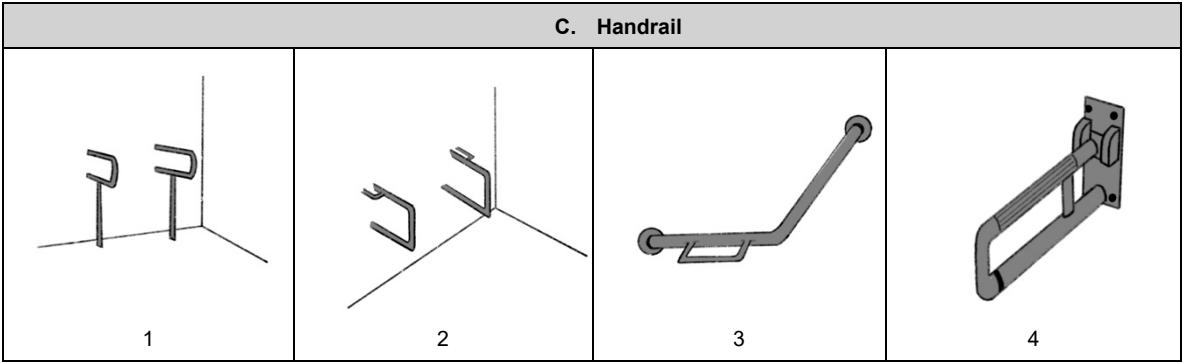
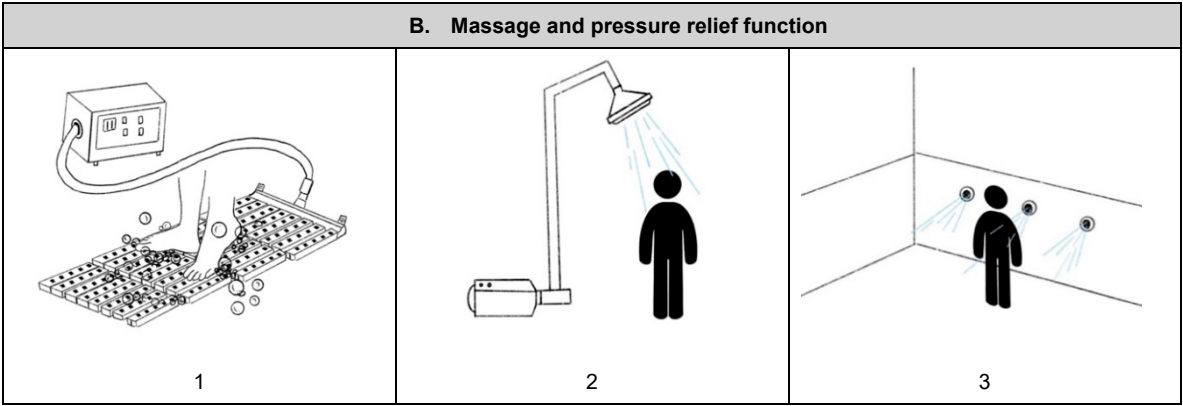
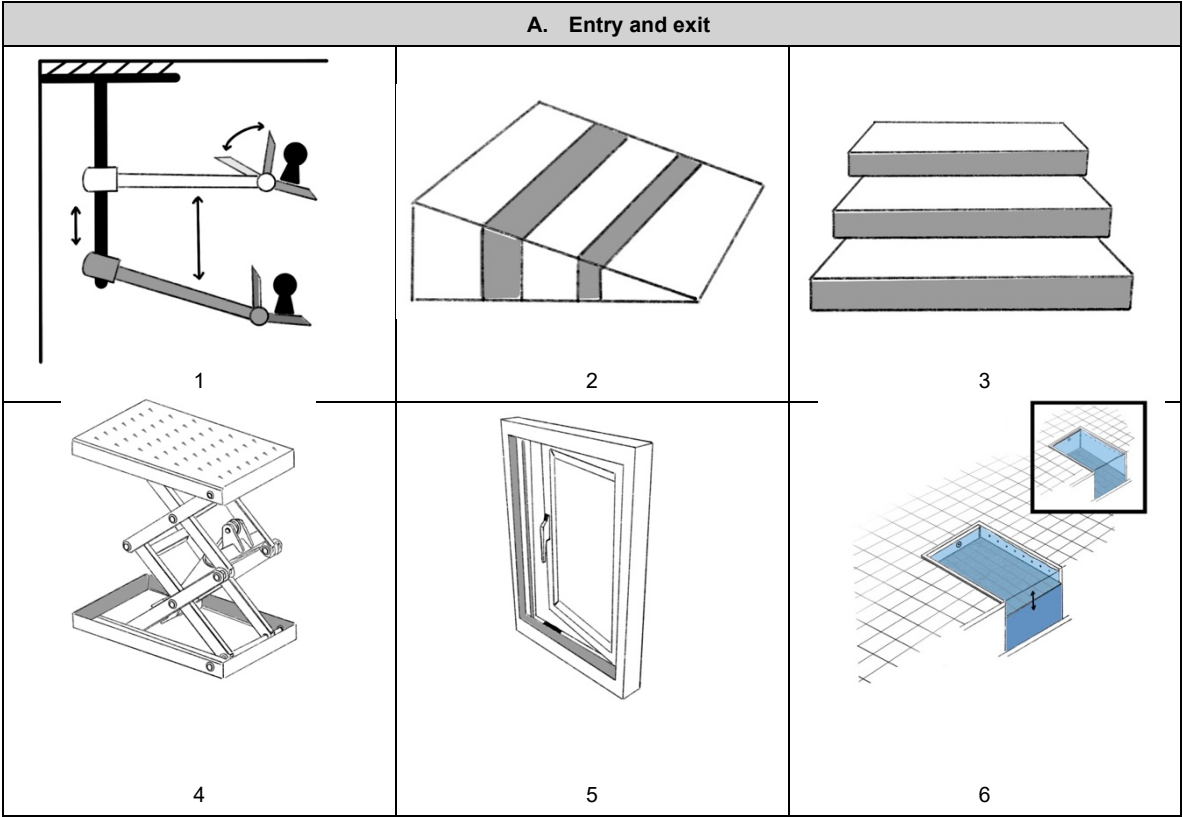
In this stage, TRIZ theory is used to explore the inadequate function of the hydrotherapy bucket and the problems accompanying its use, and the problem-solving model according to TRIZ theory and the steps are as follows.

Analysis of problem points: This research draws up design specifications through functional analysis and use process, and also analyzes 3 problems, namely (1) the size of the multi-functional hydrotherapy pool is too large, (2) the function of the hydrotherapy buckets for home use is insufficient, (3) Large hydrotherapy pools for the general public or medical use are inconvenient for people with physical disabilities to enter and exit.

TRIZ Inventive problem solving: After analyzing the problem, the improvement features were to enhance the equipment and functions with the least possible space, and to reduce the complexity of entering and leaving hydrotherapy buckets to avoid worsening features. These two features must be translated into the context of various engineering parameters of TRIZ. Then, go to the contradictions matrix and select the contradictions from the list of 39 that best fit the conflict statement. According to the TRIZ contradictions matrix, parameter 36 "Complexity of device" is introduced into the vertical axis (Feature to change) and parameter 33 "Convenience of use" is introduced into the horizontal axis (Undesired result). Finally, expand Principle 9 "Preliminary anti-action", Principle 24 "Intermediary", Principle 26 "Copying" and Principle 27 "Cheap short-living objects" and brainstorm solutions. In this case, Principles 24 "Use an intermediary carrier article or intermediary process" and "Merge one object temporarily with another (which can be easily removed)" provided helpful ideas, and this study will use these concepts to solve the problems

4.5. Component development

Generally speaking, regardless of the appearance and components of the product is always considered by many consumers as one of the purchase factors, the product set up in this study is a multi-functional hydrotherapy bucket, so users are mostly based on the function, efficacy, practicality, ease of operation, durability, price, size and other factors for purchase considerations rather than the appearance of the shape. The morphological diagram method is divided into four parts after disassembling the individual components and functions. First of all, Figure 3A shows the different ways of entering and leaving the bucket. Figure 3B is mainly for different massage and pressure relief functions. Figure 3C shows the handrails of different directions, sizes, and shapes. Figure 3D is the treadmill devices used for running or walking training.



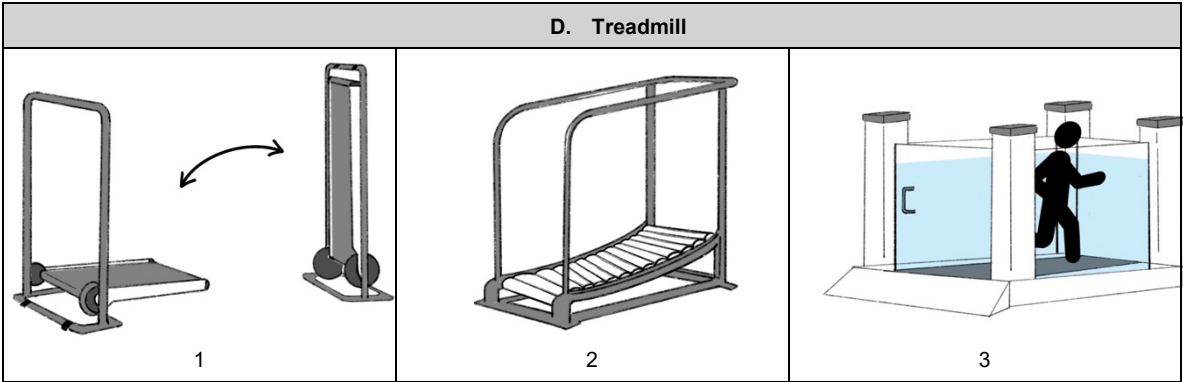


Figure 3. Morphological diagram of each component.

4.6. Concept development

In this stage, the parts disassembled after the morphological diagram are combined to produce a total of four design concepts (Table 3) generated after the initial evaluation of this study for the subsequent screening of the best solution. The four concepts are (A) single function type for single person, (B) multifunction type for single person, (C) convenience type, and (D) combination storage type.

Table 3. Four design concepts.

(A) Single function type for single person		(B) Multifunction type for single person type	
A6_B2_C3_D3		A5_B3_C1_D2	
(C) Convenience type		(D) Combination storage type	
A4_B3_C3_D2		A5_B1_C2_D1	

4.7. Concept Selection and Evaluation

In this study, there are 8 design criteria, which are 1. Does the hydrotherapy bucket take up space? 2. Is the hydrotherapy bucket economical? 3. Is the hydrotherapy bucket easy to access? 4. Is the hydrotherapy bucket easy to use? 5. Is the hydrotherapy bucket easy to assemble? 6. Is it too expensive to buy a hydrotherapy bucket? 7. Does the hydrotherapy bucket contain multiple functions? 8. Is the hydrotherapy bucket safe? Then, the weights of these eight design criteria were obtained by tabular method (as in Table 4). Finally, the four design concepts (A-D) were compared to a commercially available personal hydrotherapy bucket that was considered a DATUM for this study. This personal hydrotherapy bucket is a movable lower body hydrotherapy bucket equipment set, which not only has wheels to push it but also includes a motor. The size of this hydrotherapy bucket is 107(L) x 51(W) x 71(H) centimeters and the capacity is 68 gallons. The hydrotherapy motor is 18 cm (diameter) x 96 cm (height), with a maximum water output of 55 gallons per minute and a weight of about 21 Kg. Then, the PUGH method (Table 5) was used to evaluate the most suitable decision scheme. After screening, Concepts D received the highest score. In terms of cost, all design concepts are inferior to DATUM, but that is because DATUM is a single-function hydrotherapy bucket, so the cost must be much lower than a multi-function one. In addition, Concept D is superior to DATUM in terms of access, use, assembly, function, and even safety.

Table 4. The weight of each policy design criteria.

<i>Design Criteria</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>	<i>Design Criteria Total Score</i>	<i>Weight</i>
1		5	4	3	2	5	3	3	25	0.10
2	3		3	2	3	2	1	1	15	0.07
3	4	5		2	3	2	1	1	18	0.08
4	5	6	6		5	4	4	5	35	0.16
5	6	5	5	3		3	3	4	29	0.13
6	3	6	6	4	5		4	4	33	0.15
7	5	7	7	4	5	4		5	37	0.17
8	5	7	7	3	4	3	3		32	0.14
Total Score									224	1

Table 5. The weight of each design criteria.

<i>Design Criteria</i>		<i>Concept A</i>	<i>Concept B</i>	<i>Concept C</i>	<i>Concept D</i>	<i>Weight</i>
1		S	S	S	S	0.10
2		S	S	S	S	0.07
3		S	+	+	+	0.08
4		-	S	+	+	0.16
5		-	S	S	+	0.13
6		-	-	-	-	0.15
7		+	+	+	+	0.17
8		-	S	+	+	0.14
+ Score		0.17	0.25	0.55	0.68	
-		0.58	0.15	0.15	0.15	
Score						
Total		-0.41	0.1	0.34	0.53	
Score						

Technical drawing of the SS 1000 refrigerator, showing front, side, and top views with dimensions in millimeters.

Front View Dimensions:

- Height: 1500
- Width: 1410
- Bottom Panel Height: 608
- Bottom Panel Width: 1665
- Bottom Panel Depth: 100

Side View Dimensions:

- Height: 1275

Top View Dimensions:

- Width: 1000
- Depth: 1240
- Top Panel Width: 174.6
- Top Panel Depth: 100

Figure 5A-G show the detailed 3D drawing of each component. This product has a water-blocking door with a side anti-leakage plastic strip, so it can achieve the effect of preventing water leakage Figure 5A. The two-stage closing function can enhance the tightness of the door plate and the hydrotherapy bucket Figure 5B. Figure 5C combines the air foam cushion with the treadmill, so users can do running and walking training at the same time also has the effect of massage. Besides, this device can instantly eject small bubbles, about 10,000~15,000 times per second micro-vibration to achieve the massage effect. According to design specifications (Table 2), we can find that the safety of the patient such as prevent slipping, prevent drowning as well as prevent injury is the top priority. Hence, this design includes a monitoring system to avoid patient injury during rehabilitation. Figure 5D shows a monitor, which is operated by the therapist or family members and monitored externally, while Figure 5E shows a monitor that can be operated directly by the user from inside. Figure 5F is a schematic diagram of the treadmill and the air foam cushion that can be disassembled and stored. In addition, it can be seen from Figure 5 that the design is provided with handles everywhere, which can also increase the safety of the patient when exercising.

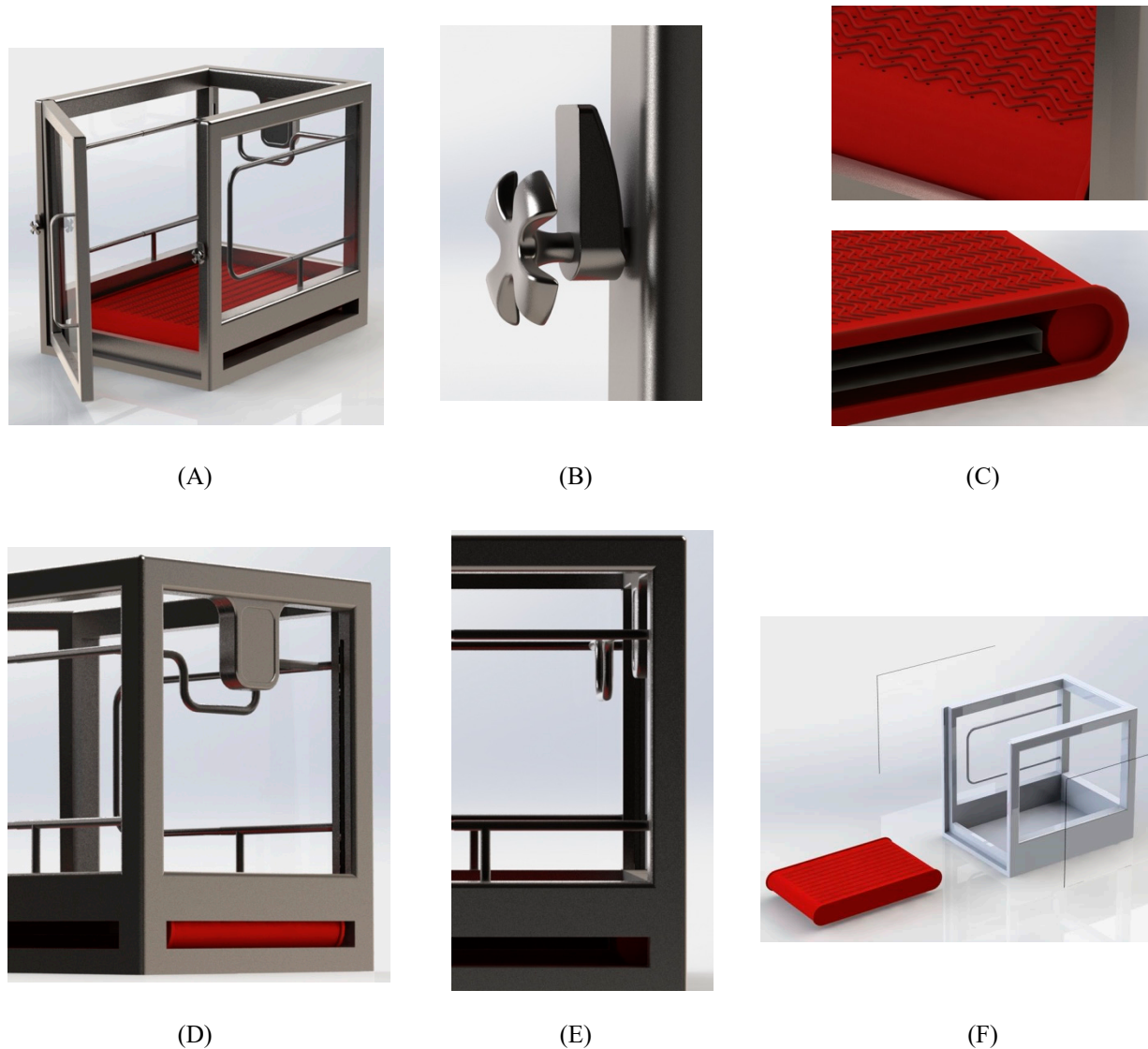


Figure 5. The detailed 3D drawing of each component.

5. Conclusion

Before the outbreak of the epidemic, most people exercised outdoors, and most of the patient with physical disabilities were rehabilitated in rehabilitation institutions. However, in recent years, the spread of the Coronavirus Disease epidemic has led to changes in people's living habits. Designers must start confronting the importance of design for behavior change. For the patient with physical disabilities, if we can improve their behavior by design, or even reduce their anxiety during treatment by design, it will definitely bring them better quality of rehabilitation by design, it will definitely bring them better quality of life. Think from a different angle, *if patients can rehabilitate in their own homes, in addition to reducing the risk of infection, they can also maintain patients' self-esteem.* Thus, in addition to behavioral change design, safety in use must also be considered. With these concepts, the concurrent design strategy is applied to the development and redesign process of the multi-functional hydrotherapy bucket. Pre-design of products with objectives tree method for decision making and design specifications. The TRIZ contradictions matrix and morphological diagram are used to find the problematic points and principles for solutions. Throughout the design process, the user experience and the PUGH method are used to select the best version of the design, and finally, the best one is presented in 3D by computer-aided design.

This study adopts a systematic design process, which can effectively save development and design time, and is also closer to the real needs of users. Overall, this design proposal uses various methodologies and data to select the best solution, and by compiling relevant data to build a user-oriented product as much as possible, but whether it can really achieve the effect of rehabilitation is still to be known after the test.

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