INNOVATIVE DESIGN FOR A FOLDABLE TROLLEY

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ABSTRACT

The innovation advance of the “Innovative Design for a Foldable Trolley” is a new way of thinking about improving the structure of the traditional foldable trolley. This new way of thinking will not only change the way to fold the supporting frames and handrail through a pivoting angle, but also easily store the support frames and the supporting plate through folding-style disassembly. The entire volume of the body can thus be effectively reduced to as little as possible in order to facilitate the best usage and storage methods. Through a mutual pivot junction with the supporting frames and handrail, we can not only change the folding angle and the folding method to form the smallest body volume in order to facilitate the way it is used and stored, but also can easily carry the trolley by pulling a handrail while on roller wheels after folding.

I. FOREWORD

General foldable trolleys can only be folded vertically, from perpendicular to horizontally flat, with the frames and the supporting plate. This simple structure movement only allows for a small increase in space, and is not...
as effective in space-saving during usage or storage. In the meantime, if the structure’s entire volume cannot be as small as possible, carrying or using a foldable trolley is troublesome and inconvenient. This research combines a human-oriented design concept with the technical theory of human-machine interaction to decrease the cognitive distance between the designer and the user, and provide an innovative design that combines disassembly folding with carrying abilities through pulling and rolling, which are very convenient for users to use, store, and carry.

II. LITERARY REVIEWS

1. Prior Art


They only can create a small amount of space by folding and overlapping the frame and the supporting plate of the trolley, which does effectively reduce the total volume of the trolley because the handrail and the frame structure connected to the bottom of the handrail still occupy a lot of space. Therefore, they are not convenient for users to store and use, which is the first shortcoming. Further, this simple structural movement only allows for a small increase in space, and is not effective in space-saving. Therefore, they are not convenient for users to carry and use, which is the second shortcoming.

2. Human-Machine Interaction

The estimation and planning of the human-machine interaction interface are two of the innovative development factors used by commercial and industrial fields. An appropriate human-machine interaction interface will make the operation of the machine quick and easy for users, which can achieve a higher usability of the machine and make it more user-friendly [7].

Creators and designers can analyze human factors, performance, and user interaction in the operation and functions of the machine being developed, after understanding the operation of the machine and the requirements of users when designing a conceptive model conforming to the anticipation of users. Finally, the cognitive difference between designers and users, and the mental self-interpretation model, can both be minimized.

3. Human-Oriented

Enterprise leadership will influence the business direction of the unit, institutes, and organizations. A product will not be in a leading position or even have partial success in the market without design. Even if the idea or function of the designer is perfect, the product should be tested by market users before become the best product. People can cognitively understand the value of this system. The concept of analyzing the current market, the creative development stage, and human-oriented technical convergence are the results of sensory perception acceptance and creative verification [8].

4. Kansei Engineering Method

Mitsuo Nagamachi proposed the term “emotion technology” [9] in 1970’s, which has similar meaning as the concept of kansei engineering widely applied nowadays. Over the past twenty years, quite a lot of studies or designs, academic and industrial as well, have been based on kansei engineering to satisfactory effect. Currently, the applications of the product design behaviors based on the Kansei engineering are important techniques [10-15]. Kansei engineering aims to search for a perfect triangular effect among man, thing and object. It can be explained as human nature’s psychological search and emotional expression. Kansei is primarily based on common feelings and perceptions. It is also a cognitive behavior of communication and thought. Through kansei we can understand people’s common feelings and behaviors.

By applying kansei engineering at the initial stage of product design, we are able to explore updated human thought and arouse the consensus between man and thing. For this reason, this article proposes an improved trolley with a volume that can be minimized for users to easily carry and use based on kansei engineering.

III. INNOVATIVE DESIGN AND RESULT

1. Innovative Design

This research provides an improved structure of a trolley, as shown in Fig. 1. The structure of the trolley
The body comprises of a supporting frame, a supporting plant, a handrail set, and two connection pieces.

The supporting frame includes two side bars and a cross-linkage. The two ends of each supporting side bar are respectively positioned with a rolling wheel. The inner side of each supporting side bar is connected to the cross linkage with a linked-movement structure, which can be spread and collapsed. The supporting plant is positioned on the spreadable supporting frame and includes a number of ligaments which can be folded in stages.

The handrail set includes two vertical supporting bars and a detachable horizontal supporting bar positioned above the vertical supporting bars. The two vertical supporting bars can be assembled with or disassembled from the horizontal supporting bar via the two supporting sleeves. The bottoms of the horizontal supporting bar are connected to the supporting frame. When disassembling the trolley, the user can collapse the cross-linkage between the two side bars to form a collapsed structure, fold the supporting plate, wrap the collapsed supporting plate, and rotate the handrail set to fit over the supporting frame, minimizing the volume.

Two connection pieces are as shown in Fig. 2, where the bottoms of the two horizontal supporting bars are pivotally connected to the bottoms of the two vertical supporting bars, respectively, at the sides near the non-steerable rolling wheel. The connection piece includes an upper connection block and a lower connection block, where the upper connection block is pivotally connected to the lower connection block. The ends of the two connection blocks are respectively positioned with a positioning pole and a corresponding positioning hole. The upper connection blocks are connected to the bottoms of the two vertical supporting bars of the handrail set, and the lower connection blocks are connected to the upper surfaces of the two supporting side bars of the supporting frame at the side
near the non-steerable rolling wheels. When the two connection blocks are rotated to overlap with each other, the positioning poles can be inserted to the positioning holes to fix the two connection blocks. Therefore, the two connection blocks can be rotated to be separated from each other, or overlap with other.

The surfaces of the two ends of each supporting side bar of the supporting frame are respectively positioned with a pair of convex bodies. The four corners of the supporting plate are also arranged with the positioning holes which can be connected with the positioning convexes. The tops of the two vertical supporting bars of the supporting frame are capped by supporting sleeves connected to the two ends of the horizontal supporting bar. The horizontal supporting bar is positioned with several positioning holes which can be connected with the positioning convexes of the supporting side bars of the supporting frame.

To sum up, the research provides a foldable trolley which can be folded to minimize its volume, and the user can carry the folded trolley by pulling and rolling when the rolling wheels positioned on one end of the supporting frame make contact with the ground, as shown in Fig. 3.

2. Detailed Description of the Embodiment

The proposed trolley comprises a supporting frame, a supporting plate, a handrail set and two connection members. When a user wants to unfold the trolley, they need to spread the cross linkage between the supporting frame, and interlock the positioning holes at the four corners of the supporting plate with the positioning convexes of the horizontal supporting bars, and insert the two ends of the horizontal supporting bar into the corresponding holes of the supporting sleeves at the tops of the vertical supporting bars of the handrail set, to form an unfolded structure using the supporting plate to load objects, as shown in the expanded view of Fig. 4.

If the user wants to fold the trolley, he needs to disassemble the horizontal supporting bar and the supporting plate, as shown in Fig. 5, and collapse the cross linkage between the two supporting side bars of the supporting frame to form a collapsed structure with a smaller volume, as shown in Fig. 6, and then interlock the positioning holes of the vertical supporting bar with a pair of the positioning convexes of one of the horizontal supporting bars (Fig. 7).

Afterward, as shown by the arrow in Fig. 8, the user needs to bend the supporting plate via the ligaments to wrap the supporting side bars of the collapsed supporting frame. Next, as shown in Fig. 9, the user needs to release the positioning poles of the connection pieces at the bottoms of the two vertical supporting bars of the handrail set to rotate the upper connection block via the pivoting part at
Fig. 6 The schematic view before the supporting plate is collapsed

Fig. 7 The schematic view after the supporting plate linkage is collapsed

Fig. 8 The schematic view after the supporting plate is folded up to wrap the supporting frame

After folded, the proposed trolley can contact the ground via the non-steerable rolling wheels disposed on one ends of the two side bars of the supporting frame. Therefore, the user can hold the handrail set at the side near to the supporting sleeves of the two vertical supporting bars to carry the folded trolley by pulling and rolling. Fig. 11 shows the schematic views of the practical situations of standing the trolley.

Fig. 9 The schematic view when folding the trolley

Fig. 10 The schematic view after the volume of the trolley is minimized

Fig. 11 The schematic view when the trolley is standing

one end. In this way, the two vertical supporting bars of the handrail set can be folded in the direction of the arrow to minimize the volume of the trolley (Fig. 10).
3. Awards and Patents

This advance in innovation won the gold medal award of the 17th Moscow International Salon of Inventions and Innovation Technologies “Archimedes” in Moscow, Russia in 2014, and obtained the Republic of China utility patent No: M479256.

IV. CONCLUSION

Based on the concept of kansei engineering, the designer develops a new foldable trolley. It is a product which not only meets human needs but also follows consumer psychology and design principle of a product. This research provides an improved structure for a foldable trolley, which allows users to rotate the handrail set to overlap the supporting frame, and fold the supporting frame and the supporting plate of the body of the trolley to minimize the total volume of the trolley for users to easily use and store. Moreover, the research also provides an improved structure for a foldable trolley, which allows users to fold the trolley, minimizing its volume and making it more convenient to carry through pulling and rolling. Thus, the innovative design of the research can effectively improve the structure of conventional foldable trolleys.

REFERENCES


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