

Small Snow Sweeper Design Based on Man-Machine Engineering

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Abstract—Based on the current development of small snow sweeper on the market, the paper takes man-machine engineering and the shortcomings and problems of current small snow sweeper as the starting point to design a small snow sweeper, which not only can make multi-function conversion, but also add more humanized design concepts, so as to become more convenient for people to use and meet different needs and environment, achieving the perfect unification of appearance and function.

Keywords—Small snow sweeper; Appearance design; humanized

With the development of society and economy, it is the inevitable trend for people to use machine to remove snow to free themselves. Therefore, the scientific designer has been exploring how to develop small snow sweeper which is safer, smaller and more reliable and convenient. There are all kinds of small snow sweepers on the market at present. Although they meet the people's need for snow removal on the function, they still have shortcomings on humanized design. Their function is simple.[1] The paper starts with humanized design, and design a small snow sweeper which can meet various needs and environments and achieve the perfect unification of appearance and function.

I. DESIGN POINT

Currently the small snow sweeper in the market only has single function, which can't meet the needs to work in different environments. The improved snow sweeper in the paper is different from other existing common small snow sweeper. It is the organic combination of humanized appearance and improved function. In addition, a small snow sweeper not only needs to have technical aesthetics, but also have emphasis on function. Technology is important to the fast developing society, at the same time humanized design is also becoming especially important. Therefore, this paper takes function and humanized design as starting point to meet the needs for products.

II. THE MAIN PROBLEM OF THE PROJECT FOR THE EXISTING PRODUCT PEOPLE RELATIONSHIP

Human factors engineering is a new and rapidly developing interdisciplinary, involving a variety of disciplines such as physiology, psychology, anatomy, management, engineering, system science, science, safety science, environmental science. It has broad application areas. Through the analysis of the using process of existing small snow sweeper and investigation of its users, the paper has concluded following problems, and takes them as the important goals of the design of multifunctional snow sweeper.

The design focuses on some problems existing in small snow sweeper in the market now, such as low security at night, single function, lack of humanized design on details, lack of flexibility. It starts with the communication between people and product, and become more humanized on the design of details, making the small snow sweeper more humanized. On the basis of coordination of overall structure and local components, it pays more attention to the reasonable layout of local components, making small snow sweeper more flexible and convenient. After ensuring its snow cleaning function, add other functions to allow small snow sweeper to have other applications other than snow weather, improving its utilization. Let the small snow sweeper to meet people's needs through these designs and play a bigger role. [3]

III. SMALL SNOW SWEEPER DESIGN POINTS

A. The overall appearance modeling conception

It's not enough for products to only have advanced function, but without the beautiful appearance, which also do not conform to people's aesthetic requirements. As a mechanical snow removal tool, small snow sweeper has become more and more important. The power device and transmission device of small snow sweeper have been fixed; we only need to design the appearance and some details. The front of the integral body is wider than the back of it. The main body of small snow sweeper uses surface streamlines appearance, which is novel, fashion, small, flexible, and reduces the resistance. It designs front and back light, and add a warning light on both sides. It is driven by the battery. There is a power display screen on the armrest. The small snow sweeper adds a tool to sprinkle salt on the back with plug connection. As shown in Fig. 1.



Fig. 1. Exterior styling

B. The idea of light

The working hour of small snow sweeper is not fixed. The lamp is particularly important when working at night. Currently the lamp of small snow sweeper in the market is generally designed at the armrest, which often cause the operator not able to see the situation nearby clearly,[5] forming potential risk. And the small snow sweeper on the market basically has no taillight. So we intend to design the angle of front light a little lower to shorten the range of the light. In this way there's lighter on the ground, which helps the operator to observe the situation on ground. Add taillight at the back, and warning light on both sides, so that vehicles in the back can see the working range of small snow sweeper clearly and improve operating security. The small snow sweeper is more reasonable and humanized in this way. As shown in Fig. 2.



Fig. 2. Automotive lighting

C. The conception of power plant and tire

Currently the small snow sweeper on the market is mainly driven by the internal combustion engine. Now the oil price is high, it's not only a waste of money but also causes pollution to the environment. The designed small snow sweeper adopts high power battery drive, which is energy saving and environmental protection, inexpensive but substantial. Its operation mode is also easier and more convenient than small snow sweeper with internal combustion engine. [6] A power display screen is designed at the armrest so that user can know the remaining power any time and avoid sudden power off.

Because small snow sweeper is running on the snowy roads, its tire must prevent slippage phenomenon, or it will

affect the operator's safety. Improve the abrasive resistance of the tire to reduce the replacing times of tires and save money. Increase the spacing of pattern block on tire, and deepen the depth of pattern to increase abrasive resistance, prolong life and get stronger road holding. As shown in Fig. 3.



Fig. 3. Idea of tire

IV. THE MAN-MACHINE ANALYSIS

With the development of science and technology in our country and opening to the outside world, people gradually realize the importance of man-machine engineering to the development of national economy.[7] Man-machine engineering is a research method of application of disciplines such as human body mechanics, body mechanics, labor physiology, labor psychology. It studies human body structure characteristic and function characteristic, provide the size, weight, surface area, specific gravity of each part of human body and the human body structure characteristic parameters of their relationship and reaching range in activity. It also provides the body function characteristic parameter of each part of human body, such as power output range, activity range, movement speed, movement frequency, gravity center shift and habits of movements. The research method of discipline ensures the optimization of overall performance of human-machine-environment system through revealing the relation of human, machine and environment. As shown in Fig. 4.(Unit: mm)

A. The dimensions

A simplest product, if the designer doesn't try their best on design, it will also bring inconvenience to consumers. Man-machine engineering is a discipline studying the relationship between human and products. It reveals the interaction of human, machine and environment to let products blend in with human and environment. Regarding the design of small snow sweeper, the dimensions of some components should take into consideration of the actual situation of operator in use, such as whether the armrest is comfortable, whether the operation is complicated. Analyze the small snow sweeper and operator as a whole, and comprehensively consider the overall coordination, aesthetics, stability, etc. [8]

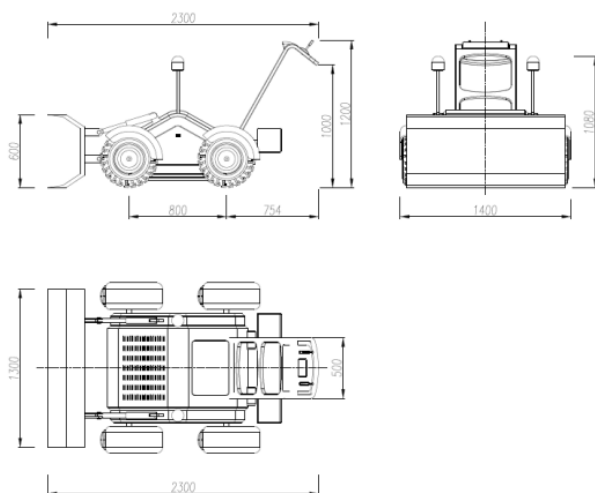


Fig. 4. Three view drawing

B. Material analysis

With the development of the times, science and technology is also in the rapid development. All kinds of synthetic materials and new materials have been found and put into the market, applied to all kinds of products. Good material can increase the life span of the product; allow them to have more beautiful appearance. The interaction of materials can also produce a feeling of harmony.

As a small snow removal construction machinery, small snow sweeper has high requirement for the material. Choose cast iron as the body material of small snow sweeper after analysis of metal material. Cast iron material has good mechanical property and casting molding process and low price, small elasticity. It has shock resistance, abrasion resistance and self-lubrication. The tire quality of small snow sweeper directly influences the operator's safety, so we choose thermoplastic elastomer (TPE) material, which has strong abrasion resistance and shock absorption performance.

C. Color analysis

Color is the most expressive and infectious factor in the design, and also the most sensitive thing to human vision. It products a series of physiological, psychological, and similar physical effect through the visual perception of people, forming rich imagination, profound meaning and symbol. When knowing a product, people always think of its shape and color. Reasonable color collocation tends to have twice the result with half the effort. When consumers buy products, the first thing that attracts the consumer is color. Good product color design not only shows the artistic quality of product, but also blends into the designer's understanding of the product and emotion. The collocation of color should be based on product function and appearance. Color aesthetic should closely integrate with the practicability of product and environment.

Currently most of the small snow sweepers on the market use red or yellow as the main body color, and match with other colors. As a small construction machinery to remove snow in the snowy day, its overall appearance uses yellow or red to form strong visual impact to warn people, avoiding unnecessary accidents. And different colors may be added on the details and some parts to increase the ornamental value of product, but it should be consistent with the overall color to give people comfortable feeling.

V. CONCLUSIONS

The design project improves the design of current existing small snow sweeper on the market through the survey of small snow sweeper. While keeping the basic skeleton and sweep function, deeply study and analyze the problems revealed in the market investigation, and take electrical drive on the design to save energy and protect environment. Change the traditional appearance, and adopt streamline appearance to reduce resistance. Add warning lights and enlarge the range of head lamp to increase its security. Change the traditional connection way to the plug connection to change different tools. Increase pattern spacing on tire to avoid slippage. Design the small snow sweeper with all these changes.

The improved design of small snow sweeper allows me to get rid of the pure state of theoretical study in the past, and apply the theoretical knowledge in practice, use my knowledge to solve existing problems in the small snow sweeper on the market currently and improve the small sweeper. It is also an examination of the knowledge I've learned in my four years of college. However, there are still some shortcomings in the design of small snow sweeper. It's not modern, scientific and convenient enough.

The design let me fully understand the design concept of people-oriented. We need to consider and solve problems and design products from the demand of consumers, letting the products meet the needs of consumers and market in a better way. With the development of science and technology, I believe that these will all be achieved, and small snow sweeper will also become more and more modern and scientific.

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