Research on Innovation Design of Art Wood Printing Machine Based on Ease of Use Theory

Peng Peng* and Ke Zhang
Industrial Design Engineering, School of Design, South China University of Technology, A5, 382 Outer Hoop East Road, Panyu District, Guangzhou, China
Email: pengpeng950917@gmail.com

Abstract. The professional traditional printing machine is an indispensable tool in the process of making woodblock prints. However, the disadvantages of high cost, low cost performance, cumbersome machine, high operability and low safety are constantly revealed in the creation of prints. The common printing machines on the market do not meet the needs of users. An art printing machine based on the theory of ease of use is proposed based on the comfort, accuracy and simplicity of printmaking. Through the method of market research, combined with in-depth analysis of the user’s real needs, the ease of use theory is used to analyze the human-machine features of the art printing machine and the feature differences of the print features. A comprehensive summary of the current status of the art printing machine, identified relevant issues, analysis of the factors affecting the ease of use of the art printing machine, and found a new design improvement program.

1. Introduction
In recent years, with the rapid development of the domestic cultural economy, the printmaking market has also had a good opportunity for advancement. The art of prints offered by art academies and comprehensive colleges across the country seems to be gradually becoming a popular discipline [1]; The development of children’s printmaking education in the Children’s Palace has gradually emerged. At the same time, the public’s understanding of printmaking has been further deepened, and the value and future development of printmaking art have also been fully affirmed [2].

2. Overview and Problems with Traditional Printing Machine Products

2.1. Analysis of the Current Situation of the Domestic Market of Art Printing Machine Products
There are very few articles on the design and research of art printing machines in domestic and foreign literatures, and most of them are about the content of print art. Only a small number of researches deal with the product appearance, materials, production process and other materials of the art printing machine will be mentioned. In general, scholars from both foreign and domestic countries have not systematically researched the art printing machine. Therefore, the design research of the art printing machine based on human-machine force analysis not only has the innovation of product design practice, but also a theoretical academic innovation attempt.

The printing machine is an indispensable tool in the process of making woodblock prints. The defects in printmaking are very noticeable. The common printing machines on the market cannot meet the needs of users. For example, the traditional art printing machine shown in figure 1 and its working principle cannot ensure that the pressure of the screw on both sides is equal when the screw on both...
sides of the press is applied to the working face. Users are paying more and more attention to the comfort, accuracy and simplicity of use. Comfort and simplicity have become research hot spots in product design and development [3].

![Figure 1. (a) Traditional commercial printing machine; (b) Working principle of the screw press.](image)

2.2. Introduction of Ease of Use Theory and Human-Machine Analysis Design Ideas

2.2.1. Theory of Ease of Use. Ease of use, in simple terms, is a more user-friendly and easy-to-use experience in the process of using the product. In order to understand the ease of use properties of art printing machines, you need to consider the target users of the machine products, the specific use environment, the specific functions of the art printing machine products and some other factors so as to come up with the specific ease of use elements of the art printing machine [4].

At present, the definition of product usability in the field of art design at home and abroad mainly has the following explanations according to different application fields: “The ease of use of products is demonstrated and affirmed when the specific users achieve specific goals in a specific environment. “Efficiency, efficiency and satisfaction”; “The ease of use of products can be translated into the ability to be easily and effectively used”; “based on the principle of barrier-free design, to help people complete tasks more quickly, efficiently and easily”.

“The ease of use of products is mainly expressed in five aspects, namely, easy to learn, efficient, easy to remember, low error, and satisfaction.” Although there are various expressions about ease of use, I believe that the core idea of ease of use is to allow users to achieve a higher degree of matching in product awareness, helping users to more easily use the product to achieve functional compliance.

2.2.2. Human Machine Analysis Design Perspective. In the study of the design of products related to the human body. The parameters of human body shape, the characteristics of human body perception, the characteristics of human body reaction, the psychological characteristics of human, especially the cognition and living habits and so on. In the interface design of the product, studying the size of the human body can solve the rationality of the user’s operation and comfort. The study of human body perception can solve the problems related to the rationality and comfort of visual perception. Starting from people’s psychological characteristics, users can efficiently complete relevant operations and receive information in the use process. Working in a healthy environment, comprehensive study of the
characteristics of the human body, can be more reasonable layout and control, so that the man-machine system to the best state.

3. Research Methods and Product Analysis

3.1. Analysis of the Human-Machine Characteristics of the Art Printing Machine Based on the Theory of Ease of Use
The user orientation of this study is the students who study college printmaking course, and the research environment is the college printmaking classroom. The research object of this paper is the engraving tool-art printing machine. The main research content includes the following four aspects:

Through the comparative analysis of different types of art printing machine, field visits, communication with users, as well as the exchange and observation of other personnel to obtain information about art printing machines. Through the investigation and analysis of the design, the unreasonable phenomena in the operation of the art printing machine are obtained and summarized. From the user’s point of view, to understand and survey the user’s demand for the ease of use of print rubbing tool design, summed up the physical and cognitive aspects of the two aspects of ease of use. In terms of cognition, the ease-of-use of art engraving and embossing machine includes clear and understandable human-computer interaction and users’ good emotional experience.

We analyze the factors influencing the ease of use of art printing machine, including man-machine size, operation gesture, user mentality and operating environment. By analyzing the psychological characteristics of users at different ages, their preferences of psychological characteristics are obtained, which will guide the positioning of subsequent product design elements. Through the analysis of the use environment of the products of the art printing machine, the matters needing attention in the positioning of the design elements are obtained [3]. Based on the above analysis, the research framework affecting the ease of use of art printing machine is obtained, and the preliminary design guiding principles of art printing machine are summarized.

In the specific product scheme design stage, from the perspective of industrial product design, combined with the above summarizes the factors that affect art printing machine product usability, it is concluded that with a product form the basic elements of the corresponding points, such as material, the color of the corresponding specific design elements analysis and positioning, through improved design to provide users with more easy to use art printing machine products [5]. The best scheme is selected through the satisfaction rating, and then the design scheme is refined and the model prototype is made.

Through the test and analysis based on the usability of the model and prototype of the art printing machine, the comparison experiment is made with the traditional art printing machine. The usability test based on the physical level adopts the subjective comfort evaluation and the objective arm fatigue index test [6]. Then the usability test based on cognitive psychological preference was conducted. Then the evaluation results are further optimized and reevaluated. Finally, the paper summarizes the whole paper and points out that the product design in ergonomics and usability need to be further studied and improved [7].

4. How Does the New Art Printing Machine Work?
Based on the defects and limitations of the traditional engraving press, the advantages of the hydraulic control system are applied to the improvement of the screw pressing device technology of the engraving press. Hydraulic controlled automatic feedback art printing machine as shown in figure 2, the hydraulic pressure device is a hydraulic pressure can be adjusted and can automatic feedback balance of simple hydraulic system, instead of the original spiral compression device controller, the installation of a hydraulic cylinder rod clamping device, at the same time compression rod as the hydraulic cylinder piston rod, and install a reset spring; The extended piston rod of the hydraulic cylinder is a hand rod with a pressure regulating spring. The hydraulic gauge is installed directly above the oil pipe for real-time monitoring of the impression force.
The operation of the hydraulic pressure device of the new artistic engraving press is faster, simpler, more convenient, and more effective than that of the traditional commercial engraving press. The specific working principle is shown in figure 3. Before embossing, according to the thickness of the drawing board and the requirements of working pressure, the pressure lever is pressed down to read the pressure value displayed in real time in the hydraulic gauge and press it to the appropriate pressure size to achieve the embossing force required by the panel.

At the time of stamping, when drawing board pattern raised on panel will follow up and push upward pressure device, through the liquid incompressibility relay feedback to the hydraulic cylinder, piston overcome pressure reset spring forces moving up, the pressure reset spring on the rebound more panel stamping force, print ink deep, bright colors, texture clear; When drawing board pattern under the concave on the panel will be down, then the corresponding hydraulic cylinder piston rod clamping down, also at the same time, the hydraulic cylinder piston under the action of pressure reset spring moves down, at this time due to loosen in pressure reset spring, rebound smaller, reducing the pressure applied to the hydraulic cylinder of liquid, and so on panel stamping force is small, the print ink shallow, shallow light color, skin texture fuzzy. After the imprinting is completed, release the pressure lever, and the piston compression device of the hydraulic cylinder is reset under the action of the reset spring, driving the module to move up, lifting the upper panel, and returning to the initial position when not working.

5. Result

5.1. Art Printing Machine Product Usability Attribute Summary
From the results of interviews and observations, we find that the ease-of-use of the printmaking machine products can be classified into the ease-of-use of the physical aspect and the ease-of-use of
the cognitive aspect, and each aspect has corresponding specific attributes. Physically on the engraving embossing machine product material itself is easy to use, physical aspects of the compressive strength, ease of use have rotates and panel will be physical ease of use as the basis of the two from the human-computer interaction interface and function realization of interface to distinguish, the human-computer interaction interface in engraving embossing machine rotation of the handle on the morphology of the product is reflected area, function realization of interface refers to print the embossing machine rubbing surface pressure parts, user usability requirements of engraving embossing machine products mainly reflected in the two parts, so physics is easy to use as the handle is easy turning and chassis and pressurization.

5.1.1. Physical Aspect of Usability Attributes

- Handle is easy to turn
  In the case of reducing the size of print-imprint lithography products, at the same time designed a more easy-to-use printing machine handle shape. Therefore, this phenomenon and demand can be summarized as the physical “handle is easy to turn”.
  - reduce and pressurize the panel
    The main function of the printing machine is to use rubbing, which determines that the product itself needs to have the property of pressurizing through the user’s operation. So users generally hope that the printing machine can provide enough pressure to be more portable and simple.

5.1.2. Cognitive Aspect of Usability Attributes

- Human-computer interaction that is clear and understandable
  In the process of operating the printing machine, good communication between the product and the user is essential, and the quality of human-computer interaction affects the user’s usability experience. The clarity and understandability of human-computer interaction is reflected in the form of the product, which specifically refers to the structural layout of the product so that users can easily understand how to operate the product, guide users to use the product correctly, and avoid uncomfortable user experience caused by users’ wrong understanding of the holding mode of the printing machine product [8].
  - Good emotional experience
    The design of a product should not only have practical functions, but also provide users with better emotional experience if it can convey product semantics more in line with users’ psychological needs through the point, line and surface of the real product [0].

6. Conclusion

In this paper, in the process of the research and design of the printing machine, the usability analysis is innovatively introduced into the design and research of the printing machine. The paper focuses on the analysis of the ease-of-use of the printing machine made of product structure and material, and redesigns a new type of art printing machine which meets the ease-of-use requirements and has a good man-machine interaction experience. It is of great significance for the innovative development of the theory and the development of the new market of the printing machine.

This subject introduces the concept of ease of use to design and study the new type of art printing machine products, and the following results are obtained:

- By using the methods of market research, preliminary interview and observation, it summarizes the problems existing in the domestic printing machine products, and analyzes and summarizes the specific needs of users for the ease of use of the printing machine.
- The factors affecting the ease-of-use of the printing machine were analyzed in a multi-dimensional way. Combined with the basic design elements of the product, the framework of the practical process of product design based on ease-of-use was summarized.
• By summarizing the demand for ease of use and analyzing the factors affecting the ease of use, the design conditions of the new type of art printing machine that satisfy the target users are finally obtained.

The target users of this project are college students, so the design of a new type of art printing machine is mainly for the college market.

Acknowledgments
Central University Project of South China University of Technology “Research on the Influence of printmaking works on individual physiological and psychological reactions indoors”; Item no.: x2sj/D2190390.

References
[1] Song Y 2015 The Study of Printmaking into Primary School art Classroom Teaching (Zhejiang Normal University) pp 1-2.
[2] Chen J 2007 China’s printmaking market to be developed Zhuzhou Teachers College Newspaper 1.
[3] Dan S 2013 Micro-interaction: Detail Design to Achieve Excellence Products (Beijing: People’s Posts and Telecommunications Press) Translated by Li S F p 2.
[4] Jiang T 2007 Cbid System Usability Study (Hunan University) pp 2-3.
[5] Su X P 2008 Printmaking Techniques (Beijing: Peking University Press) pp 2-4.
[6] Cao S S 2004 Research on Ease of Use in Industrial Design (Tsinghua University) p 3.
[7] Zhao D 2010 Analysis of the ease of use of product design purposes Popular Literature 3.
[8] Wang X M and Xu N Z 2008 Product usability design - a bridge to communicate human-machine relations Harbin Vocational and Technical Studies Journal of the Academy 4-5.
[9] Norman D A 2010 Design Psychology (Beijing: CITIC Publishing House) p 5.