

Original Article

Design and Research of an Intelligent Ironing Machine

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Abstract - As a good helper in human life, the ironing machine has the function of fast ironing clothes. Unlike the traditional hand-held hanging ironing machine and electric iron, this paper creatively proposes an intelligent ironing machine that can automatically identify the types of clothes and iron them. The machine is equipped with various sensors and controlled by Arduino single-chip microcomputer. It has intelligent ironing functions such as intelligent temperature control and timing.

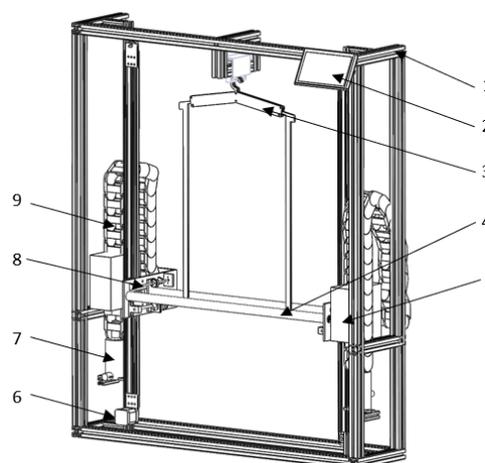
Keywords - Intelligent ironing machine, Sensors, Intelligent temperature control.

I. INTRODUCTION

There are all kinds of ironing machines on the market, but most of them can not completely free people's hands. Therefore, we propose clothes ironing device which can automatically identify and iron clothes with a pressure sensor. It has the advantages of simple structure, simple operation, and a high degree of automation. Just hang the clothes on the clothes hanger in the equipment. There are two modes: automatic mode and manual mode. If the clothes have no special requirements, as long as you select the automatic mode, the equipment can quickly complete the ironing process in a short time. If the clothes are made of special materials, you can also manually select the ironing mode to protect the clothes as much as possible. We design the device to save human resources and material resources maximally. So that the heavy workload of ironing clothes becomes easier, on the one hand, it saves a lot of time and can avoid waste. On the other hand, it increases the efficiency of ironing clothes.

II. STRUCTURAL DESIGN OF IRONING MACHINE

The ironing machine comprises a clothes hanger module and a hanging ironing module. The overall structure is relatively simple, as shown in Fig. 1.



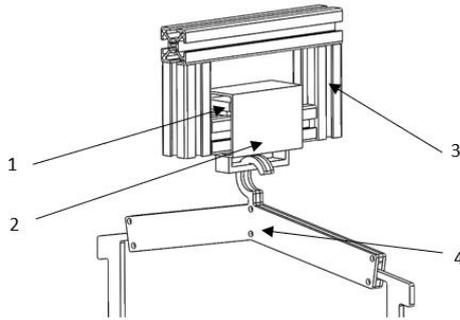
1-Aluminum profile frame 2 - display screen 3 - clothes hanger 4 - ironing rod 5 - water tank 6 - stepping motor 7 - water pump 8 - lead screw 9 - drag chain

Fig. 1 overall structure diagram of ironing machine

A. Coat Hanger Module

The structure of the ironing machine is composed of two parts. The first part is the shell of the ironing machine. The front side of the shell is equipped with an embedded display screen, a Bluetooth receiving module, and a power switch from top to bottom. A water tank is mounted on the right side to replenish water to the ironing machine. A PVC rolling shutter door is set on the front to make the ironing machine beautiful and ensure the cleanliness of clothes at the same time. A pulley block is installed at the bottom to facilitate the overall movement of the ironing machine. A 6-inch touch screen is embedded in the shell of the ironing machine, which can directly display the ironing parameters such as material, ironing time, ironing temperature, humidity, and so on. The second part is the clothing sensing module. The clothing sensing module can automatically identify the clothes after the user starts the ironing machine and independently adopt the best way to iron the clothes smoothly, which makes the perfect combination of high effect and short time, improves the intelligence of the machine, saves people's time and makes them relaxingly. This achieves the effect of one-click ironing. The coat hanger module is shown in Fig. 2.





1-pressure sensor 2-hanger fixing sleeve 3-u-shaped support
4-hanger

Fig. 2 Schematic diagram of coat hanger module structure

B. Ironing module

The ironing module consists of three parts: steam generator, belt conveyor system, and ironing mechanism. The steam generator of the first part adopts a double 1600W heating power steam generator, which produces steam rapidly and violently, which can ensure the sustainability of steam in the ironing process, improve the quality of ironing clothes, reduce the ironing time, make clothes flatter and increase the practicability of the ironing machine. The two steam generators are designed on both sides of the ironing machine. This saves the bottom space to a certain extent, reduces the height of the ironing machine, and does not impact the internal space. The synchronous belt of the second part is driven by the stepping motor, which can maximize the flexibility of the up and down movement of the ironing structure. At the same time, due to its structural advantages, the stepping motor can be perfectly hidden in the bottom plate of the ironing machine, making the ironing machine more compact and delicate. Compared with other structures, the synchronous belt has less noise and more plasticity, convenient for early model production and later use. It also speeds up the ironing speed to a certain extent, reduces the ironing time, brings convenience to life, and saves valuable time. The ironing structure of the third and core parts adopts the simplest straight plate ironing, which is simple and reliable in structure and is not easy to fail. At the same time, it can also ensure the ironing quality and enhance the user experience. The lightness of the structure enhances its mobility to shorten the ironing time and does not change the ironing quality. The ironing board is a non-contact type. The best ironing time is obtained through practice. Non-contact ironing can minimize clothing damage and mostly retain quality. Even if the time is slightly longer, its benefits outweigh the disadvantages.

III. CONTROL SYSTEM DESIGN

The hardware structure of an intelligent ironing machine includes an Arduino Uno R3 development board, 24V aircraft model battery, adjustable voltage stabilizing module, Bluetooth module, pressure sensor, temperature sensor, humidity sensor, stepping motor, water pump, etc.

Arduino Uno R3 single-chip microcomputer is selected as the main control module in terms of system control. Arduino is a very easy-to-use open-source

hardware product. The numerous control functions are realized by using advanced programming language and calling various library functions.

IV. USE THE METHOD OF AN INTELLIGENT IRONING MACHINE

After ensuring that there is water in the water tank of the ironing machine (the water level will automatically alarm if it is insufficient), the user will hang the clothes into the ironing machine and close the PVC rolling shutter door. If there are no special requirements for the ironing effect, the user can select the "auto" mode through the touch screen or app. The ironing machine will judge the ironing time and steam volume according to the basic conditions of the clothes; data is sent into the Arduino board by the detection module to complete the basic ironing operation; if users have special requirements for clothes ironing, they can select clothes material, ironing time, ironing strength (steam volume) and other operations in the touch screen or app interface, to achieve their satisfied ironing effect. After setting, the rolling shutter door will be automatically locked to prevent steam scald, the Arduino board will send the instructions for the up and down movement of the ironing rod, and the steam will be generated by the steam generator (the movement time and the amount of steam will be sent by the Arduino board together). After ironing, the ironing machine will give an alarm and unlock the PVC rolling shutter door. The user can take out the ironed clothes.

V. SUMMARY

This paper discusses the overall structure and control principle of the intelligent ironing machine in detail, demonstrates the process of ironing clothes, and shows the intelligence of the ironing machine conducted by the human-computer interactive module. With the acceleration of social rhythm, our machines can independently adopt the best way to iron clothes, perfectly combine a good effect and short time, improve the intelligence of the machine, make users more relaxing and time-saving, achieve the effect of one-click ironing, and add a trace of convenience to today's fast pace life.

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REFERENCE

- [1] Xie Bo, Research on Intelligent Control of Clothing Ironing Apparatus [D], University of Electronic Science and Technology. (2017).
- [2] Wu fan, An Exploratory Study on Ironing Temperature and Steam Volume of Different Fabrics [C], Proceedings of China Household Electrical Appliance Technology Conference, China Household Electrical Appliances Association: Journal of Electrical Appliances. 5 (2015).
- [3] Liang Shuitong, Analysis of Influencing Factors and Process of Ironing Textile Materials for Clothing [C], Proceedings of China Household Appliance Technology Conference, China Household Electrical Appliances Association: Journal of Electrical Appliances. 6 (2015).
- [4] Su Tingting, Design and Research of Portable Hairdryer and Ironing Machine [J], Tomorrow Fashion. (05) (2017) 72.
- [5] He Haiyun, Steam Hanging Ironing Machine vs. Electric Iron: Dragon and Tiger of Clothing Care Appliances [J], Electrical Appliances. (06) (2018) 72-73.

- [6] Wang Shuai, Ji Siyu, Jiao Yonghui, et al., Intelligent Drying and Ironing Machine [J], Internet of Things Technology. 9(9) (2019) 6.
- [7] Wu Guang Wang, Reliability and Efficiency Calculation for Drive System of Multi-Bush Roller Ironing Machine [J], Applied Mechanics and Materials. 3844 (2015) 741-741.
- [8] Stefano Bracco, Carlo Cravero, Dynamic Simulation of a Steam Generator for Ironing Machines [J], Energy Conversion and Management. (2014) 84.
- [9] Guangdong Shunde Highspot Technology Co. Ltd., Steam Spray Head and Steam Ironing Machine in Patent Application Approval Process (USPTO 20190360146) [J], Journal of Engineering. (2019).
- [10] Wu Guang Wang, Reliability and Efficiency Calculation for Drive System of Multi-Bush Roller Ironing Machine [J], Applied Mechanics and Materials. 3844 (2015) 741-741.
- [11] Electrolux Laundry Systems France Snc, Patent Issued for Ironing Machine (USPTO 10,563,344) [J], Journal of Engineering. (2020).
- [12] Deep Research Report on China Steam Hanging Ironing Machine Industry [J], M2 Presswire. (2013).
- [13] Dogan Kamil Hakan, Demirci Serafettin, Gunaydin Gursel, Buken Bora, Accidental Ligature Strangulation by an Ironing Machine: An Unusual Case [J], Journal of Forensic Sciences. 55(1) (2010).
- [14] V. K. Shirgin, B. V. Matseevich, O. V. Tin'kov, A. N. Chichev, Yu. F. Gartsev, S. A. Trifonov, Automated Production of Large-Dimension Articles of Complex Geometric Shape on Hydraulic Press Equipment [J], Chemical and Petroleum Engineering. 44 (2008) 7-8.
- [15] V. E. Vernikovskii, Morphological Analysis of Structural Features of Equipment for Semidry Pressing [J], Refractories. 36(10) (1996).
- [16] N. G. Ly, C. V. Le, Liu Rantong, Ironing Performance and Steam Ironing Effectiveness of Woolen Garments [C], Proceedings of the 2nd China International Wool Textile Conference, Publisher Unknown. 1 (1998) 158-160.
- [17] Zhao Lingzhu, Research on Ironing Mechanism and Process of Garment [J], Beijing Textile. (03) (1989) 33-35.
- [18] Wu Fan, DING Xuemei, WU Xiongying, LIU Huayong, Exploration and Research on Ironing Temperature and Steam Volume of Different Fabrics [C], Proceedings of the China Household Electrical Appliances Technology Conference. (2015) 665-669.
- [19] HAN Jingji, Steam Nozzle and Steam Ironing Machine Using Steam Nozzle [P], Jiangsu Province: CN1982530B. 10 (2010) 20.
- [20] Zhao Nana, FAN Jiahui, HE Yichen, DING Xuemei, Study on the Influence of Closed Box Steam Ironing Parameters on the Care Effect of Fabrics [C], Proceedings of the China Household Electrical Appliances Technical Conference. (2018) 731-737.
- [21] Cao Changjiang, LI Zhihu, ZHANG Chen, ZHANG Jian, Design and Implementation of Master-Slave Ironing Machine Control System [J], Electronic Technology. (05) (2000) 27-30.
- [22] Electrolux Steam Ironing Dryer [J], Home Appliance Science and Technology. (15) (2009) 28.
- [23] Tang Xueqin. High Temperature and High-Pressure Ironing Machine [J], Modern Marketing Chuangfu Information Edition. (02) (2005) 9.
- [24] Automatic Steam Iron Clamp Ironing Machine, Jieshen Dry Cleaning Machine Factory, Sanhe County, Hebei Province. 1 (2003) 1.
- [25] Zhang Xianshun, Ironing Mechanism for Ironing Equipment, Zhejiang New Leap Co. Ltd., Zhejiang Province. 9 (2008) 22.
- [26] Vertical Ironing Machines and Ironing Components for Vertical Ironing Machines, Suzhou Hanjingji Technology Co. Ltd., Jiangsu Province. 1 (2008) 1.