Study on The Automatic Follow Up Sunshine Intelligent Environmental Hanger

Zhihao Lu and Hongwei Han

College of Mechanical Engineering, Shanghai University of Engineering Science, Shanghai, 201620, China

Abstract

The drying speed of clothes, on the other words is the problem of daylight's receive rate, is the most concern aspect for many citizens when using the ordinary coat hanger. A intelligent rotate coat hanger is designed based on the working principle of the electromotor and the planet gear train. Firstly, some parts of the hanger and its transmission system are initially designed with the UG (Unigraphics NX) software. Secondly, combining with the working principle of the electromotor, the working principle of the intelligent rotate coat hanger is clarified in detail. Connecting the structure of planetary gear train with requirement of rotating with the sun always, the specific structure of transmission system is determined. Finally, the usage of concrete methods is provided. The smart rotate coat hanger's structure is simple and cost is lower, and has good marketing prospect and research value which greatly satisfy demand for intelligent furniture in modern life.

Keywords

Intelligent rotate coat hanger, Electromotor, Planetary gear train, UG.

1. Introduction

With the development of intelligence and wisdom city vigorously promoting, intelligent products gradually into our daily life, and brought a lot of convenience to our life. Traditional coat hanger is relatively outdated, and far cannot satisfy the demand for drying their clothes. So automatic coat hangers have been designed and researched on many literatures. Literature [1], based on single-chip technology and computer technology, according to the temperature, humidity and strength of the light to determine whether retrieve the coat hangers, and realization of the process through the motor controlled with the signals of sensors. Literature [2], a intelligent coat rack is designed based single-chip, sensor, stepping motor, which can retrieve and rotate automatically according with the fine and rainy day. Literature [3], a kind of automatic clothes-rack is design regarding the light, humidity, temperature as basis conditions, illustrating the structure of the automatic clothes-horse and control system specifically.

The current coat hanger is focused on the level of high-end intelligent control and theoretical research, however the low price and practical ones are less, such as the number of automatically rotate coat hanger followed with sunlight is much less. Because the balcony appeared in now buildings, the automatic put hangers has less practical, the automatically rotate coat hanger is worth for researching especially in the rainy humid south district because it could ensures the fastest speed to dry clothes.

The paper design a kind of intelligent coat hanger which could automatic rotating followed with the sun's rays. This paper is organized as follows: First of all, initial structural design of coat hanger, second, demonstrate the principle of work, in the end, specifically determine the transmission system and concrete application method.

2. The detail structural design of coat hanger

The smart coat hanger includes three parts: hanger body, hook and internal transmission part.

The hanger body be used to hang clothes, hook is support part of the intelligent coat hanger which can be hooked on the clothesline pole, and the internal drives located inside of the hanger which be used to bring the hanger body rotated with hook.

2.1 The design of hanger body

The hanger body is basically same with the lower part of ordinary hangers, except for the upper structure to be installed for transmission parts. Two small hooks at the bottom of the hanger body, they used to link up with small clothes, and two hollows in the more upper place ,they are mainly prevent clothes miss and hook much more reliable when hanging some larger items. The hollows are half arc shape formed with denting on straight rod part. At the top place of it, there is a small box container as the core part of smart coat hanger. To stabilize and strengthen the position of small box, stiffeners are set up on either side of it. The specific shape designed by UG software, as shown in figure 1.The inner of small box container have two axis to be install gears, and two pieces of magnets on its side wall of right and left, as is shown in figure 2.

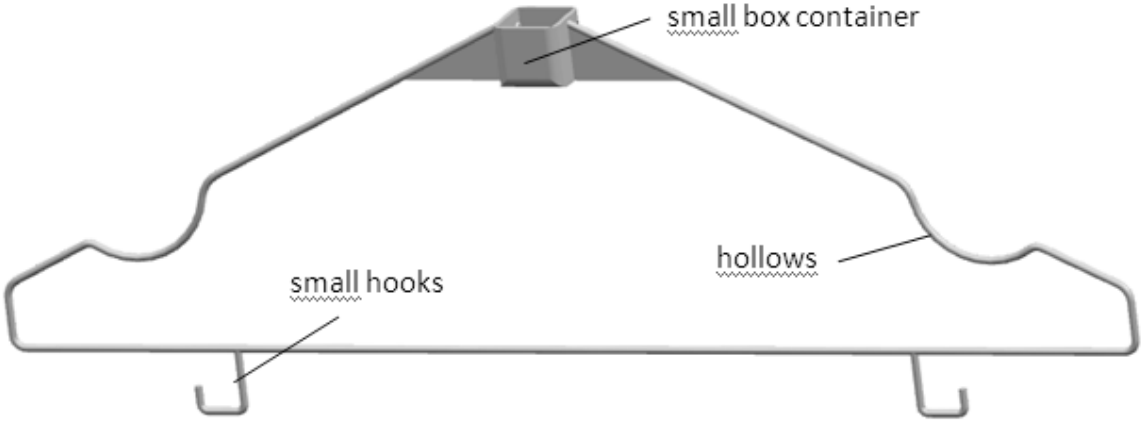

Figure 1. The hanger body

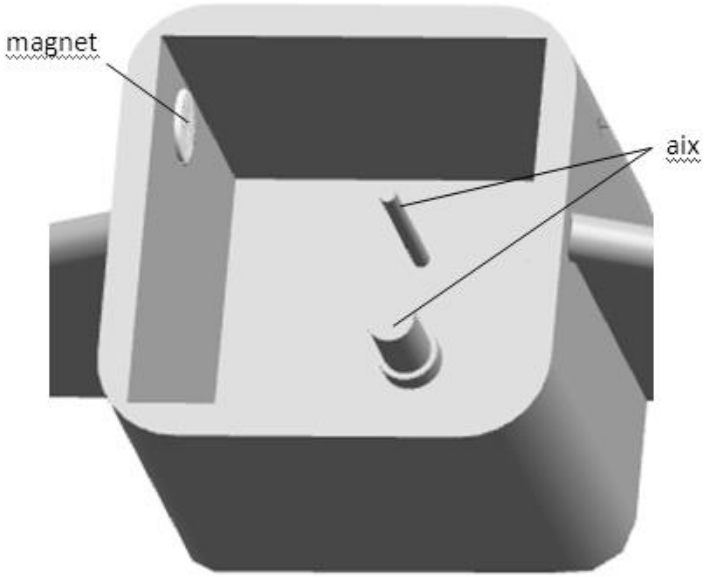

Figure 2. The inner sturcture of small box container

2.2 The design of hook

The hook is made up with two parts: straight rod section and solar panel of amorphous silicon respectively. The upper of straight rod is half arc which is used to hook clothesline pole, and the lower straight section is connected with hanger body. At the middle of it, a solar panel is designed to provide the energy for the whole system. There are many advantages about the solar panel of amorphous silicon, not only it is good for environment due to its renewable and self-sufficient in energy self-sufficient, but also it has lower cost and easier accessible for the perspective of long-term[4]. Besides it has been rapid expanded in the recent ten years and slowly became a efficient energy accepted by increasing citizens. The concrete shape as is shown in figure 3.

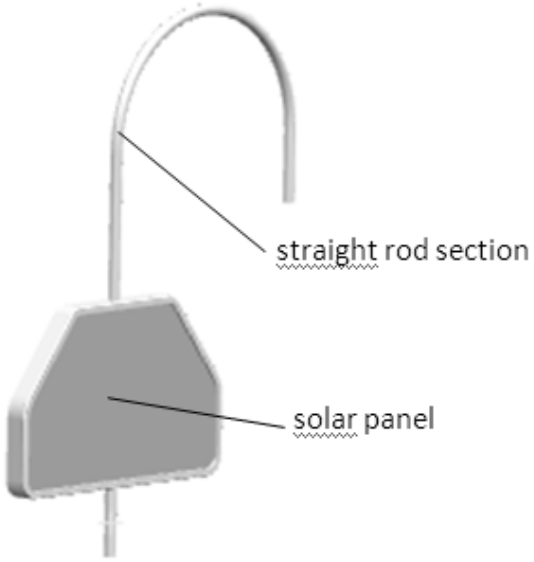

Figure 3. The hook

2.3 The design of internal transmission system

The internal transmission part is consisted of three mutually meshing gears. And accomplishment of the procession via a set of planetary gear train. There are many advantages about the planetary gear due to its compactness, light weight, heavy carrying capacity, large transmission ratio, and high-transmission efficiency [5]. The traditional planetary gear train includes three gears: planetary gear, planet carrier, sun gear respectively, the center axis of planetary gear and sun gear is same, the planet carrier turns around its geometry axis, at the same time turns around the axis of rotation of planetary wheel and sun wheel. Because internal transmission system of the coat hanger is special, the original planetary gear train is not available, and its transformation is much more proper, the different of them is the planet carrier only turns around its geometry axis. The structure diagram of transform planetary gear train can be expressed in figure 4.

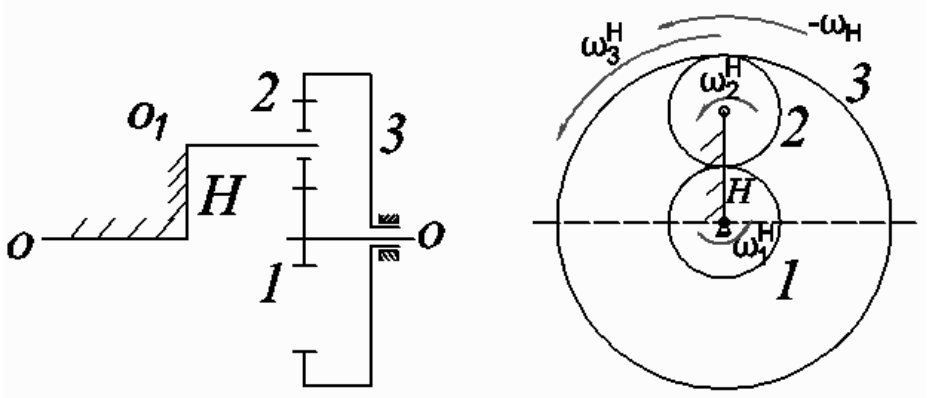

Figure 4. The structure diagram of transform planetary gear train

Where the speed of the planetary gear, planet carrier and sun gear is n_1,n_2,n_3 respectively, and the corresponding number of gear is z_1, z_2, z_3 respectively, load a public H speed to the planetary gear train which equals to planet carrier's in opposite direction. According to calculation formula of gear transmission ratio of the planetary gear train, the ratio i_{13} can be obtained as formula1.

$$i_{13}^{H} = \frac{n_1^H}{n_3^H} = \frac{n_1 - n_H}{n_3 - n_H} = (-1)^1 \frac{Z_1 Z_3}{Z_1 Z_2} = -\frac{Z_3}{Z_1} \quad (1)$$

This structure could so greatly satisfy the small output refer to the certain input that the overall volume is small enough. The result of design as is shown in figure 5.

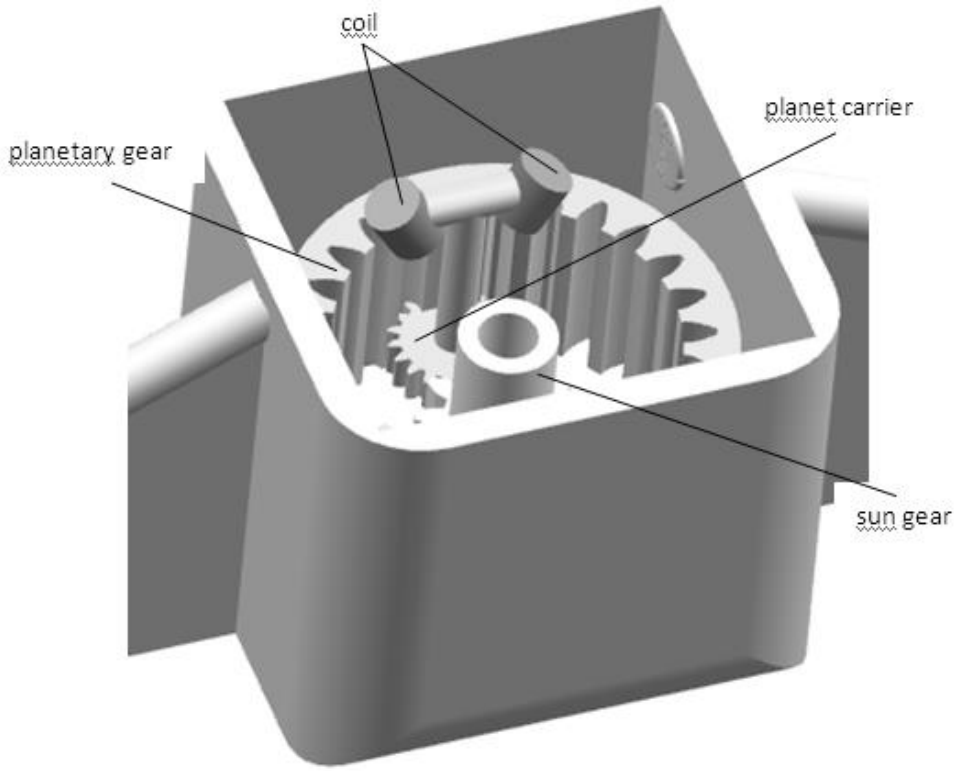

Figure 5. Internal transmission system

2.4 The general design of intelligent coat hanger

Under the environment of UG software assembly hanger body, hook and internal transmission part, the general structure schematic diagram of the intelligent hangers could be got, as shown in figure 6.

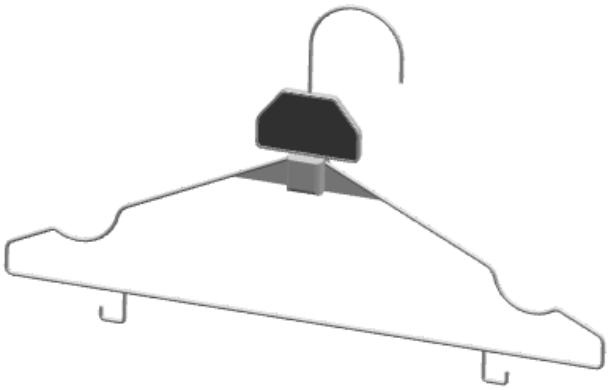

Figure 6. The general structure schematic diagram of the intelligent coat hanger

3. The work principle and implementation process of smart coat hanger

3.1 The work principle of smart coat hanger

The working principle of intelligent rotate coat hanger is similar with the working principle of the electromotor. The three elements of all motor's work is electric, magnetic, force, and ampere's law: the force of the current-carrying conductor in magnetic field is the common work principle of all kinds of motor. The most important reason of motor's work is the driving torque of the rotor rotation is in the same direction at any time which produced by electromagnetic force [6].The work schematic diagram of coat hanger as shown in figure 7.

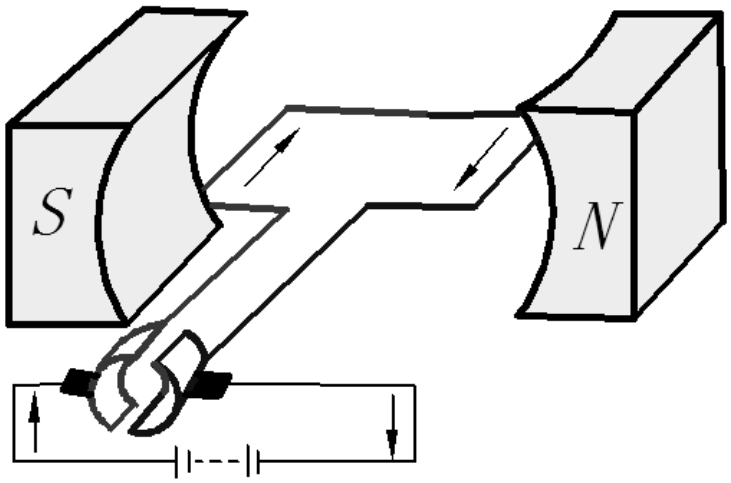

Figure 7. The work schematic diagram of coat hanger

3.2 The implementation process of smart coat hanger

In this article， the solar panel provide the electricity for the two coils, when energize the coils, under the action of the stator magnets in side wall of right and left, the coils would be get force of constant direction. Due to the forces without going through the center of the rotate axis, so they will form a constant torque, and the torque will bring continuous rotation of coat hanger. The actual output speed is determined by the ratio of planetary gear train.

Considering a day has 24 hours, as is known to all is that the earth moves around the sun, and the period of around sun is a year, rotation period of the earth is 23 hours 56 minutes, here regard it's rotation period approximate as 24 hours, so it turns 15 degrees per hour, in order to guarantee maximum daylight rate of the hanger, rotational speed of hanger is 15 degrees per hour also. In other words the coat hanger turns 1/24 circle per hour.

According to the formula 1, if the transmission ratio is 24, when the sun gear turns 1 circle per hour, the planetary gear turns 1/24 circle per hour, when the number of the sun gear teeth z3 = 16, the number of planetary gear teeth z1 = 192. The transmission system is shown as in figure 5. In this design idea, the coat hanger could rotate with sunlight always.

The concrete implementation methods: rotating the coat hanger to large area to receive the sunlight, the coat hanger could rotate with sunlight always, and the receive rate of daylight could always remain biggest of all.

4. Conclusion

The working principle of the electromotor is originally applied to the intelligent rotate coat hanger, and its transmission system is designed based on planet gear train. The designed intelligent coat hanger shows that:

1) The working principle of the motor can totally be applied to rotate coat hanger, and attained the effect of environmental intelligence with the using of amorphous silicon solar panel.

2) The use of planetary gear train not only ensures the design requirements of large transmission ratio, but also the structure design of drive system is more compact and reasonable.

3) As long as make clothes get maximum daylight rate when using the intelligent rotate coat hanger to dry clothes, the clothes time could get maximum daylight rate throughout the day, and the drying speed is greatly increased.

References

[1] Weibo Weng, Jinguang Wen. Intelligent clothes hanger[J]. China Computer & Communication. 2011(12):102-102.

[2] Qian Zhang, Xiao Sun，Hao Zhou, etc. Design of Intelligent clothes Rack Based on MCU [J]. Mechanical Engineering & Automation. 2012,12(6):152-153.

[3] Caihong Zhao, Siyuan Lu, etc. Design of Automatical Clothes Hanger Based on PLC [J]. Machinery & Electronics. 2015, (10):45-47.

[4] Stefano Ferrari, Massimo Lazzaroni, etc. Solar pane modeling through computational intelligence techniques [J]. Measurement. 2016, (93):572-580.

[5] Jin Wei, Aiqing Zhang, etc. A couping dynamics analysis method for a multistage planetary gear system [J]. Mechanism and Machine Theory. 2017, (110):27-49.

[6] Rongli zhang, zurong xie, etc. a kind of design experiments of working principle of motor [C]. The second session of the national college of electrical engineering and its automation specialty teaching reform discussion papers .2004, (4):578-581.

[7] DENG Jun, FENG Moujie.Study on automatic energy-saving and environmental protection solar energy automatic telescopic drying rack [J]. Modern Manufacturing Technology & Equipment, 2014 (3): 33-34.

[8] DU Fu-jin, LI Pei-pei, ZHANG Da-zhi, et al.Design of a concealed hanging hanger [J]. Shandong Chemical Industry, 2015, 44 (21): 103-104.

[9] Zhou Junxiao. Design of solar multi-function drying rack [J]. Electronic production, 2013 (4): 48-48.

[10] [Lu Yisheng. Molded fiber structure Long strip hanger: CN202537051U [P]. 2012.

[11] Design of Intelligent Hanger System Based on AT89C2051 Single Chip Microcomputer Garment Industry [J]. Digitized Users, 2014.

[12] Zhang Hong. Home Smart Hanger Based on Smart Home [J]. Jiangsu University, 2013.

[13] Design of Intelligent Drying Hanger for Automatic Shrinkage at Night and Night [J]. Mechanical and Electrical Product Development and Innovation, 2007, 20 (6): 79-81.

[14] YANG You-ping.Design of intelligent drying rack control system based on 89C51 [J]. Mechanical Engineering and Automation, 2011 (6): 126-128.

[15] ZHANG Xiao, SUN Xiao, ZHOU Hao, et al. Design of Intelligent Drying Hanger Based on Single Chip Microcomputer [J]. Mechanical Engineering and Automation, 2012 (6): 152-153.

[16] Weng Bosbo, Wen Jinguang. Intelligent drying racks [J]. Information and Computer: Theory, 2011 (12): 102-102.

[17] SUN Shao-xiang, ZHOU Lian-quan, ZANG Shuguang, et al.Design of intelligent drying rack system based on single chip and sensor [J]. Mechanical Engineer, 2013 (9): 85-87.

[18] LU Guang-hong, HUANG Chong-lin, CHEN Xiao-ming.Design of Intelligent Drying Hanger Based on AT89C52 [J]. Automation and Instrumentation, 2013 (2): 71-73.

[19] Hu Feng, Wu Guanmao.Design of Intelligent Drying Hanger Based on AT89C52 Single Chip Microcomputer [J]. Microcomputer and Application, 2013, 32 (12): 96-98.

[20] LIU Kai, WAN Zhong-hong, ZHANG Yu-chen. Intelligent drying rack based on GSM [J]. Electronic Design Engineering, 2014, 22 (17): 172-174.