Multifunctional Intelligent Invisible Bookcase Bed Based on Voice Control

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Abstract— *Aiming at the single intelligent and multifunctional furniture on the market, a multifunctional intelligent invisible bookcase bed based on voice control is proposed. This article has designed the structure of the bookcase bed in detail; introduced the principles of hardware control and software control. Experiments show that the bookcase bed in this book can complete the expected functions, and through voice control to achieve the intelligent control of the bookcase bed.*

Keywords— *Smart home; Multifunctional; Voice control; combined furniture; Python*

I. INTRODUCTION

With the continuous development and progress of society, more and younger people have entered the city, which has led to increasing housing tensions and higher housing prices in first-and second-tier cities. Small units are gradually favored by young people and small houses in order to create a beautiful living environment; storage has become an important issue that needs to be solved immediately. The mobility of consumer groups and the unstable lifestyle must also determine the strong demand for flexible storage. By studying the IKEA home design concept, and combining the psychology of our young people's pursuit of fashion, novelty and diversity, the creative design of small space storage homes is a subject worthy of study.

The design of a small space storage home is a reasonable layout in a small space, all practical functions are arranged in it, and the focus is on the design of the storage function. In fact, the design of a small space storage home is a very popular topic recently. In a small space, it is necessary to make the house not only practical, but also to have a reasonable storage function, and more importantly to meet the various needs of the occupants.

Therefore, the folding bed with "invisible" function has a good sales market and development prospects, but most of the folding beds on the market rely on manual and have a single function. Therefore the bookcase with multifunction integrated intelligent voice control can solve these problems well.

II. STRUCTURE DESIGN of BOOKCASE BED

A. Solution Design:

The main design purpose of the bookcase bed is not only to innovatively upgrade the traditional manual

folding bed into an electrically controlled smart bed, but also to incorporate the concept of multifunctional combination furniture into it to achieve the goal of multifunctional intelligence while also realizing the maximum use of home space. At the same time, it integrates indispensable furniture such as beds, bookcases, desks, and speakers into the home, and intelligently regulates the effects of sound, lights, light, and massage to meet people's high-quality sleep. The following is a flow chart of the research plan (Fig. 1):
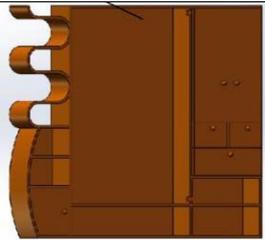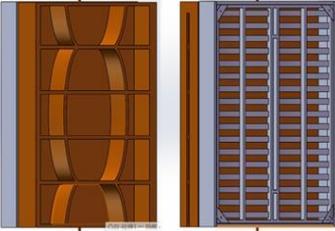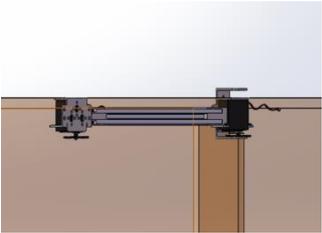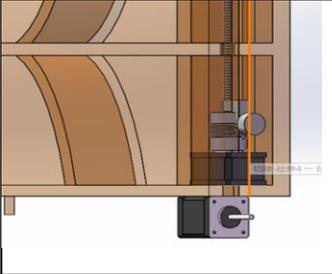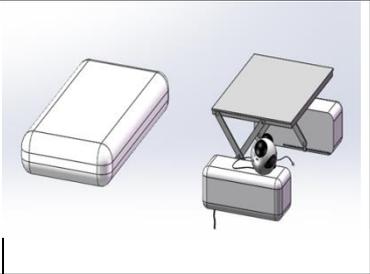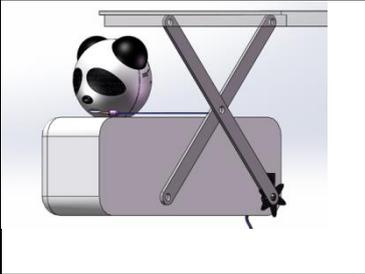

Fig. 1 Flow chart of the research plan

B. Structural design of bookcase bed:

The bookcase bed is mainly divided into six parts: fixed bookcase, mobile bookcase bed, rotary lifting traction power unit, voice control, traction device, sofa and tea table. (TABLE I)

TABLE I

MAIN BODY NOTE

Fixed bookcase	Mobile bookshelf bed	Rotating power unit
As the fixed frame of the whole device, mainly made of aluminum profile and wood.	It is divided into two parts: bookshelf and bed. It is changed by rotating power device and traction device.	Through the raspberry pie 3B control steering gear 1 and steering gear 2 rotation to drive the entire rocker rotation to achieve the control of mobile book rack bed flipping.

Pulling device	Sofa and tea table	Tea table lift device
The rotation of the 42 step motor is controlled by the raspberry pie 3B to realize the lifting of the fulcrum and the retraction of the traction rope by the winding device.	The design accords with ergonomic, the height of tea table is: 0.4m, the height of sofa is: 0.4m, the distance of sofa from coffee table is 0.5m.	Through Arduino to control the rotation of the connecting rod, using the slide rail to achieve the movement of the link constraints, to achieve the tea table rise and fall.

C. **and Bed**

1) Through

Cabinet (Fig. 2) Cabinet:

investigation and data analysis, the most popular bookshelf plus cabinet structure is adopted. The innovative design on the left breaks the square traditional square shelf style and uses curves to create a more beautiful cabinet. In the middle of the cabinet combined of bed, the square bed is perfectly" invisible" with a square design. There are two links above and below to connect it with the cabinet as a whole and the screw rods are inlaid on both sides of this cabinet. The right part of the cabinet the composition of the wardrobe, drawers and shelves makes the storage method diversified.

2) *Bed:* The bed is combined with the middle part of the cabinet, hidden on the back of the bookcase, mainly composed of a mattress.
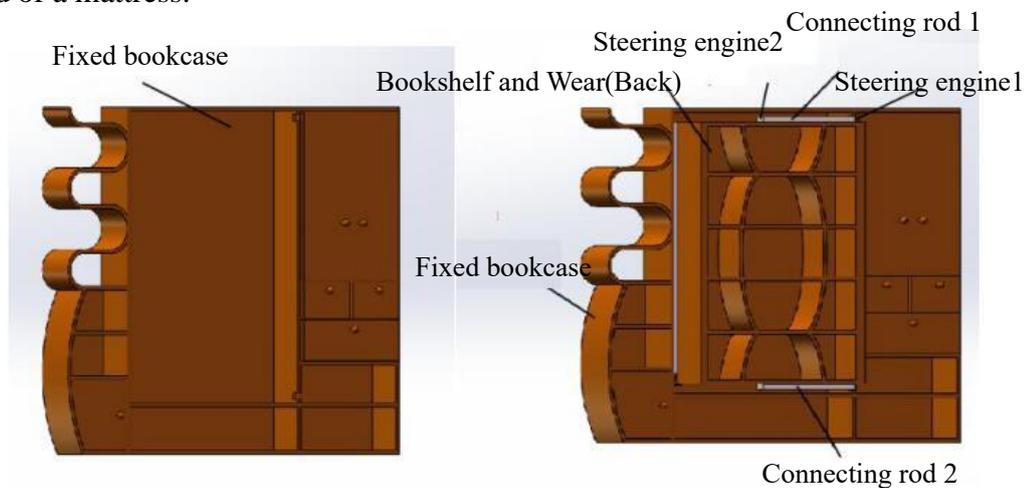

Fig. 2 Support diagram of the main body of the fixed bookcase

3) *Rotating, lifting and traction power units:* The joint part of the bed and cabinet is connected with the whole cabinet through the connecting rod, and the table top is connected with the two ends through the connecting rod of the two shear fork structure. The steering gear at both ends of the connecting rod controls the rotation of the connecting rod, and the step motor drives the wire rod rotation to make the wire rod nut move, and the rope produces tension, and the bed is put down and put up.

*4) Sofa and Desk Section:*The two ends of the desk are fixed, with the sofa and so on high. The lifting device adopts the shear fork type mechanism, and the desktop part is free to lift and drop by the connecting rod 3 driven by the steering gear 5. When the bed is put down, there is no need to clean up the original items on the book table, the book table automatically drops, the two ends of the book table support and sofa to hold the bed body firmly. As shown in Fig. 3.
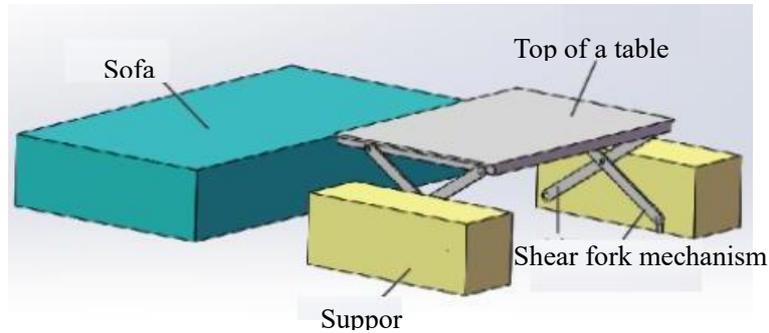

Fig. 3 Sofa and desk part structure

5) Voice control part

Speech control includes database, speech recognition server, speech synthesis server, and intelligent chat server and instruction generation server. ;

Among them, the control circuit uploads the voice audio issued by the user to the speech recognition server through the network, the speech recognition server converts the command audio to the text information, and uploads to the intelligent chat server; the intelligent chat server recognizes the corresponding command and uploads the text reply to the speech synthesis server; on the one hand, the speech synthesis server combines the text answer into the corresponding reply audio, and finally, the reply audio is played through the external speaker to realize the speech reply. On the other hand, the instruction generation server recognizes the reply text to generate the corresponding organization running command, feedback the command back to the control circuit, and start the corresponding parts by the control circuit to realize the corresponding Function. (Fig. 4)
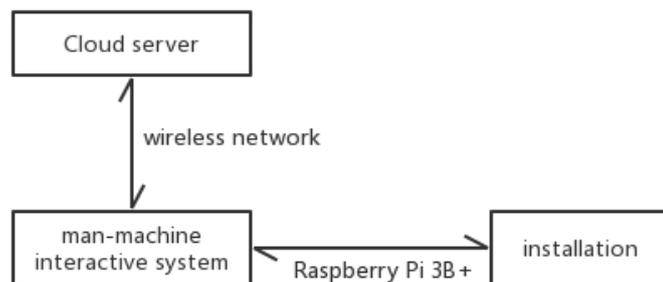

Fig. 4 Schematic diagram of voice control network

III. HARDWARE and CONTROL PRINCIPLE

The intelligent voice controlled multifunction bookcase bed with its hardware structure as shown in figure 5 and figure 6. Mainly include: raspberry pie 3B, steering gear, connecting rod, baffle, and wire rod, sound (not marked), wire rod, pulley, 42 step motor, etc.

①The rotary power device(Fig. 5) includes:

The first-stage rotary drive device is assumed by the steering gear 1 and the steering gear 2 at the junction of the connecting rod 1, connecting rod 2 and the fixed bookcase; the steering gear 1 and the steering gear 2 are controlled by the raspberry pie 3B, and then the moving bookshelf and the bed body are driven by the connecting rod 1, the connecting rod 2 and the moving bookshelf , and the steering gear 3 and 4 are assumed by the connecting rod 1, and the steering gear 4 through the pie 3B+ rotating to drive the bookshelf and bed body horizontally.
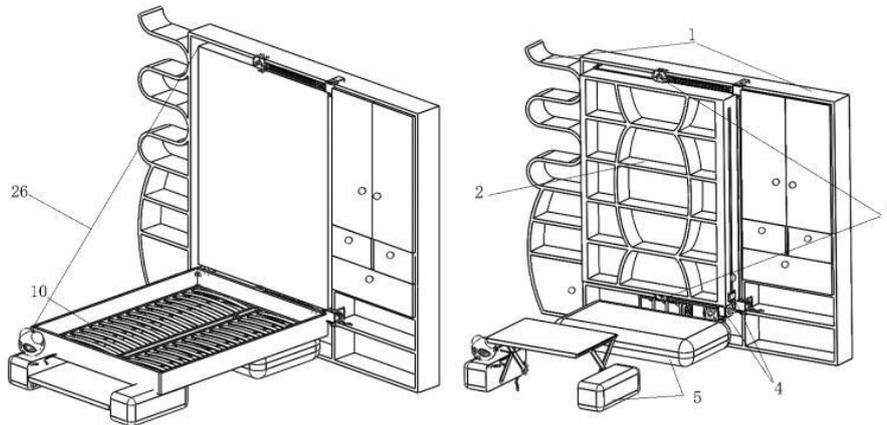

Fig. 5 Schematic diagram of lifting mechanism

②Traction devices(Fig. 6) include:

The fulcrum lifting device is composed of a fulcrum lifting device and a winding device , in which the fulcrum lifting device is a wire rod nut principle, which is located inside the side of the moving bookshelf and drives the wire rod rotation through the torque motor (Y direction), plus the limiting track on the side of the moving bookshelf, and the nut   moves the fixed pulley up and down while moving the fixed pulley up and down to achieve the fulcrum lift; the winding device is a rotating traction rope with the motor fixed at the bottom of the bookshelf. One end is connected to the distal end of the bed body, and the rise and fall of the bed body is realized with the contraction and elongation of the traction rope. Of which: connected to the wire rod through a flexible coupling through a torque motor (Y direction).
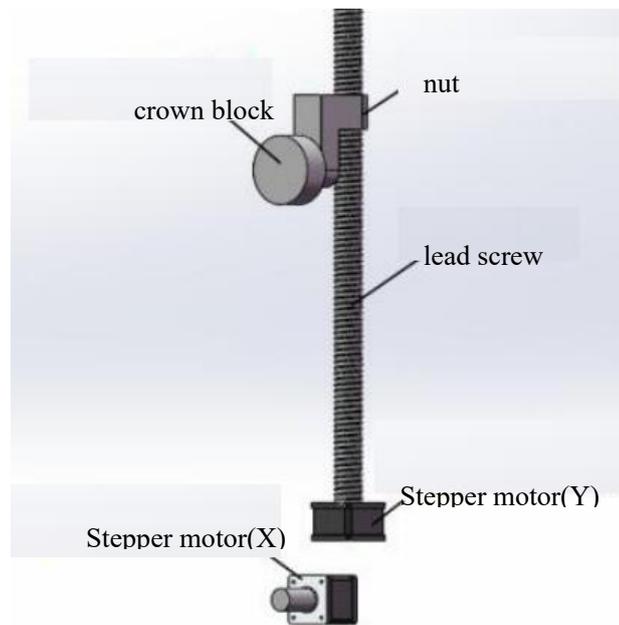
Fig. 6 Traction device (internal)

IV. EXPERIMENTAL RESULTS

The bookcase bed can be easily disassembled and assembled.

When the operator needs to put down the bed board for rest, it can wake up the human-computer interaction system by issuing the voice command of "Hello, XiaoXi ". After the human-computer interaction system wakes up, it can issue" I need to rest "to let the raspberry pie 3B recognize the voice command, after the raspberry pie 3B processing data, control the steering gear 5 rotation, complete the drop of the desktop, feedback back to the raspberry pie 3B, raspberry pie 3B re-control the steering gear 1 and steering gear 2, drive the mobile bookshelf and the bed body together horizontal to the outside 90°, after the first rotation, the raspberry pie 3B control 3 and 4 rotation of the steering gear, drive the mobile book   The frame and the bed body rotate 180° together, after the second rotation is completed, then the raspberry pie 3B controls the steering gear 1 and the steering gear 2 to reverse, driving the moving bookshelf and the bed body to rotate 90° horizontally to achieve the condition that the bed body is on the outside. At this time, the raspberry pie 3B re-controls the torque motor to turn forward, after the fulcrum rises to the highest, the torque motor is controlled, and the traction rope is extended to achieve the function of lowering the bed body, and then the fulcrum is rotated to the lowest end, the torque is rotated to the motor, and the traction rope is retracted.

When the operator needs to obtain the temperature, humidity and air quality in the room, under the premise of the voice recognition system awakening, the command of "querying the indoor environment data" is issued, and the human-computer interaction system will recognize and give back to the operator in real time.

When the operator needs to set the alarm clock, under the premise of the voice recognition system to wake up, issue the command of "the alarm clock for tomorrow XX point / the alarm clock for today XX point ", the human-computer interaction system will recognize and give back to the operator" to successfully book the alarm clock for tomorrow XX point / the alarm clock for today XX point ".

When the operator needs to play the music, under the premise of the voice recognition system to wake up, issue the command of "play music" XX ", the human-computer interaction system will recognize and play the music, need to adjust the volume size, issue "increase the volume or decrease the volume ", the human-computer interaction system will recognize and adjust the volume.

In the testing process of intelligent multifunction bookcase bed, each part can work normally and stably.

V. CONCLUSIONS

In this article, the structure of the multifunctional bookcase bed based on intelligent voice control and its control principle are introduced in detail. Through experiments, it is proved that it can switch between the two forms accurately and efficiently, and it can be reflected by voice control. This product is intelligent, and has shown stable, intelligent and efficient characteristics during the testing process

The beneficial effects of the present invention are:

(1) Different from the traditional manual folding bed, this product replaces the previous manual drive with an electric drive, saving operating steps and reducing manpower;

(2) Incorporate the concepts of multifunctional combination furniture such as light control, bookcases, wardrobes, sofas, desks, etc. to achieve the goal of multifunctional intelligence and also maximize the use of home space;

(3) Multifunctionality is realized, effectively reducing the purchase cost and time, and providing customers with a more convenient and comfortable purchase experience;

(4) The intelligent control of the effects of audio, light, light, massage, etc, and is in line with the development trend of smart home.

(5) "Yawn" alarm clock, which reminds users to seep with a yawn sound, breaking the traditional function of alarm clock.

(6) It is suitable for various small and medium- sized hotels and small family homes, has a small footprint and is multifunctional, which can give people a comfortable experience;

(7) The operation is simple and flexible, and easy to use, which is conducive to application promotion.

At present, the intelligent classification of multifunctional bookcase beds in the market belongs to the blank field. Beds and desks are indispensable furniture for people's daily life. The number of corresponding types of furniture is also increasing year by year. It is not limited to households. It has a low cost and has broad applications, research prospects, and market value.

FUNDING STATEMENT

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