Folding table using servomotor

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Abstract

The folding table must be assembled and folded.
We adopted the automation of work by using a motor, in order to reduce the work burden for such a user.

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1. Introduction

There are two types of tables. One is used indoors ⁽¹⁾ and the other is a table used outside. In the case of an indoor table, it will not be moved a lot of times in the living room. In the case of a table used outside, it is necessary to carry around and most things need to assemble.

So we focused on assembling / folding work. Currently carried tables is easily assembled and used by many people. However, most things are often used by both hands to fold and assemble. Also, large-sized tables used in camps and school sports festivals, etc. are heavy and more hard to assemble and folding. Those can be handled comfortably by most people, but people with disabilities, small children and elderly people are hard to handle.

In addition, disabled people increase year by year ⁽²⁾, the population of young people is decreasing and the number of elderly people is increasing ⁽³⁾. For that reason, I felt the necessity of convenient and items, and I decided to study the carryed table.

The basic motion of folding table is shown below.

「When prepare a table」

- ① Turn the table up sides down.
- ② Expand each leg.
- ③ Turn the table face up.

「When put away the table」

- ① Turn the table face down.
- ② Collapse each leg.
- (③ Turn the table face up.)

We described the actions such as putting the table facing upside down in ① and ③, because it is the point of the research contents.

Therefore, we developed a table that automatically assembles and folds to reduce the burden of assembly and folding work. The system of this table is assembled / folded by pressing a button. The folding table using servomotor is operated by automating the operation of ①②and③by pressing the button, to reduce the burden of the user.

2. Structure of system

2.1 Overall structure

Figures 1 and 2 show the overall structure picture and the structure of the servomotor machine, respectively.

This system consists of the body of the table and the sensor section.

As can be seen from Fig. 2, this system has servomotors and they are attached to the legs of the table. This servo motor become a joint part of the leg and is a mechanism to perform a folding motion. And a motor is used for the body of the leg and a tire is attached at the tip of the leg. This motor is for stretching and shrinking the leg. In addition, the center part of the table is a fold in folding, and servo motors are attached to this part too as shown in Fig. 2. The sensor section consists of Arduino and switch, and all movements of the table body are controlled by Arduino.

Fig. 1. Overall of the system

Fig. 2. Servomotor mechanism

2.2 Movable

Here, we explain the mechanism of the leg that moves during assembly / folding and the mechanism of the movement of the center of the table.

(a) Leg joint mechanism

In the joint part of the leg, there is a mechanism to vertically or horizontally set the legs as shown in Fig.3. This mechanism uses servomotor, and enables the legs to open and fold setting the movable area by a program.

In addition, the reason why the servo motor was used here is because positioning by angle is specialized ⁽⁴⁾.

The angle of opening and closing of legs is shown in Table 1.

As shown in Fig. 4, when the legs are folded, the angle is set to 0 degree and when the legs are opening, the angle is set to 90 degrees.

b) Center mechanism of the table

At the center of the table, a servomotor is attached to the fold, and this mechanism enables the table body to open and close.

In order to move the half of the table main body, this servo motor uses a more powerful one than the servo motor used

Table 1. Program setting

	open	close
legs	90°	0°
fold	180°	0°

Fig. 3. The joint mechanism of the leg

Fig. 4. Leg position with angle

Fig.5 Opening and closing the table by angle

at the joint part of the leg.

And as shown in Fig. 5, when the desk is folded, the angle is set to 0 degree, and when the desk is open, the angle is set to be 180 degrees.

3. Motions

I will explain the actual operation of the table.

The table is a button type. This button has two switches; a switch that starts the operation to fold the table and a switch that opens the table.

The switch that fold the table is black, and the switch that open the table is yellow.

We will look at the flow when pushing the switch that starts the operation to fold the table for the first time.

- ① Press the switch.
- ② The table board opens.

As shown in fig.6, the table opens vertically from the closed state of the board.

It takes about 7 seconds to operate it, and it aims to reduce the burden for the main body by slowly performing the operation.

At this time, the half of table is opened by the rotating shaft of the servo motor.

A series of movements are shown in fig.6, fig.7 and fig.8.

- ② Leg joints open

The joints move as shown in fig.9, fig.10 and fig.11.

Each of the four joints opens from 0° to 90° at the same time. It takes about 5 seconds to operate.

Moreover, when actually performing the operation, it turned out that it got standing off at misplace from the first position.

Next, we will look at the flow when pushing the switch that opens the table.

- ① Press switch
- ② Legs are folded.

It takes about 4 seconds to operate.

As with opening the legs, there is some displacement from the initial position when this action is taken.

As shown in fig.3, the tire is attached to the body of the leg. By attaching this tire, the body of the leg is not dragged when opening and closing the joint.

By doing this, it reduces the burden due to the friction to the body of the leg, allowing the joint to move smoothly.

- ③ The table board closes

The movement of the motion is the same as when opening it and the operation time is about 9 seconds.

Fig. 6. Table operation 1

Fig. 7. Table operation 2

Fig. 8. Table operation 3

Fig. 9. Leg operation 1

Fig. 10. Leg operation 2

Fig. 11. Leg operation 3

4. Conclusion

The folding table used in the research was a small model. As a result of the experiment, it was smoothly assembled and folded.

Also, the motor which is the body of the leg in the text was attached to adjust the height of the table. With this function, it will be the future research subjects to stand stably even on uneven ground.

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