

肢體殘障者使用翻書機之研發、評估與推廣

The Development, Evaluation, and Promotion of Page Turner for the Disabled

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Abstract

For those people who were disabled by cerebral palsy and cervical spinal cord injury, they have to rely on high technology assist due to they are crippled in motion, especially in hands, which were caused by the injury in central nervous system. The purpose of the research is to develop a automatic pager turner that will help such disabled people to complete the motions of turning pages so that to satisfy the desires of reading and learning. This system is controlled by microprocessor, which was reformed from tradition mechanical control. It is light and portable. The primary functions include:

- a) The page turner has the function of turning a page at a time by eliminating electrostatic induction which usually causes turning couple pages at a time.
- b) Besides controlled by hands, it also can be connected with other controllers such as blowing and treading to meet the needs of various patients.
- c) The page turner can be adjusted adequately according to the size of

books. In addition, it also provides function of turning pages either from left side or from right side.

Keywords : cerebral palsy, cervical spinal cord injury, page turner, rehabilitation engineering, assistive technology.

摘要

由腦性痲痺、脊髓損傷或腦血管病變所造成肢體殘障，因中樞神經受損，造成動作障礙尤其是手部功能，以致需仰賴高科技輔具。本計畫目的乃在針對上述患者，研發自動翻書機以輔助其執行翻書動作。滿足其閱讀與學習需求。本系統由微處理器控制，改良傳統機械式控制，達到輕巧、便於攜帶之便利。其初步功能包括：

- a) 達到單次只翻一頁之功能，改良因書頁靜電效應而造成一次多頁的情形。
- b) 除經由手部控制外，亦可外接多種控制器，如口吹、腳踏等控制方式，以利於不同病患操作之需求。
- c) 機構可隨書本尺寸不同調整適當的位置，另外控制方式有左、右翻閱兩種方式。

關鍵詞：腦性痲痺、頸髓損傷、翻書機、復健科技、生活輔具

Introduction

With technology innovation in medical and engineering, people pay more attention on the independent living ability of the disabled. At present, most assist instruments are imported from foreign countries. It's costly and may not meet compatriots' needs from viewpoint of Human Factor. Thus, it is of great urgency to develop assistive technology domestically.

The research applies rehabilitation science and medical engineering to develop Page Turner that solves the inconvenience caused by the difficulty in fine motor control of hands. By using the Page Turner, the disabled can use his/her mouth, hands, or feet to control the motion of turning pages.

Structure Design

The development of the pageturner were divided into three portions:

A) Machinery design

Via power supplier, 12V DC deceleration motor, turning arm, turning tappet, and rod to complete the action of turning pages.

B) System control

System control includes: 8052 single chip (AT89C52 20PC 9830 , ATMEL) , 7404 chip (HD74LS04P 7M16 , HITACHI) , relay, and transformer (transform 110V to 12V/5V)

C) Control flow

User gives instruction to control mechanism, then the 8052 single chip program drives DC motor, which propels

turner manipulator and turner tappet to lift the page. The rod keeps moving horizontally to a preset point and completes the motion of turning until turning tappet moves back and turning arm is up. The device consists of nine parts described as follows. (figure 1)

1.casting; 2. platform; 3. both sides' control buttons; 4. system reset control buttons; 5. both sides turning arms; 6. both sides turning tappets; 7.turning rod; 8. 8052 single chip program control; 9. power supplier. The details are as follows:



Figure 3 The device consists of nine parts described

1). Casting:

It is made from ABS material, the main body is 58cm in length, 69.5cm in width, 7.5cm and 17.5cm in high respectively. Besides satisfying needs for visual arts, the appearance design also satisfies the need of reading angle adjustment by users.

2). Platform:

It's made from ABS material and used to place standard sized book which sizes up 56cm × 64cm. When using it, just put the book on it and fasten.

3). Both sides control buttons:

There are two buttons with 5.5cm caliber on control panel for users to execute motions of turning from left or right side. Users can annex other control mechanism such as pedaling, blowing.

4). System reset control button:

On the panel, a round button with 5.5cm diameter is used to replace system when error occurred.

5). Both sides turning arms:

It is made from ABS material and derived by a DC motor. The shape is to imitate nature movement of human beings. Thus, there are two protuberances: one is to simulate the thumb to be a fix point for performing turning motion; the other is to simulate the motion of forefinger, as shown in figure 2.



figure 2 turning arm and turning tappet

6). Both sides turning tappets:

It is made from ABS material, a rubber pad, with better friction, is equipped on the forefront of tappet to push the page up. In addition, such design also reduces the friction effect between pages.

7). Turning rod:

It is made of an ABS rod with 25cm in length and 4mm diameter. By way of

DC motor to make it move horizontally to turn pages. The merit of ABS rod is its good flexibility so that it can be adjusted to the book to smooth the motions.

8). 8052 single chip program control --

It's controlled by 8052 single chip. 7404 chip and relay to execute actions separately control five DC motors.

9). Power supplier ---

The power supplier is used to propel voltage motor for operating to transform 110V to 12V and 5V.

The system control is shown as figure 3:

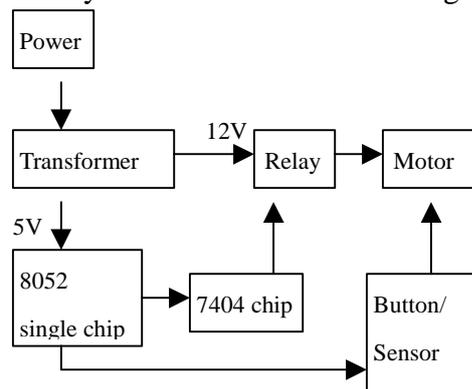


Figure 3 System control flow chart

The overall operating flow is shown as figure4:

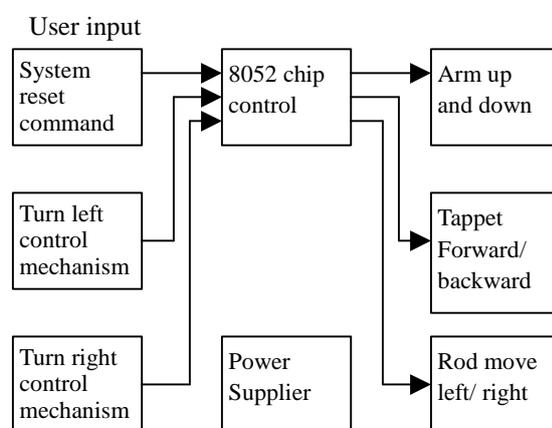


Figure 4 Operating control flow chart

Results and Discussion

Most technology assists are imported from foreign countries currently. Thus, it keeps technology assists costly. The Page Turner, developed in this project, propels DC motor via 8052 single chip. The preliminary functions include:

- i.) Controlled by microprocessor that was reformed from overseas tradition mechanical control. It is portable and can be tied with wheelchairs.
- ii.) To turn a page at a time by eliminating electrostatic induction which usually causes turning couple pages at a time.
- iii.) Besides controlled by hands, it can be connected with other controllers such as blowing and treading to meet various patients' needs.
- iv.) Be adjusted adequately according to the size of books and performs turning motion from either left or right side.

Self- Evaluation

The developed pageturner is trying to meet the desires of reading and learning of the disabled. Because of requiring the experts from medical engineering, electrical engineering, rehabilitation, and disability education fields, it is not easy to develop such technology assist domestically.

The research achieves 90% of the goal. Currently, due to the mold is produced by designer merely, the accuracy of production is worse than the one produced by machine. Therefore, the success rate of turning pages is around

70%-85%. The research lasts for 3 years, and this article only present the result in the first year. However, it will be used as the basis of clinical evaluation and promotion in the future.

The research has great contribution to technology assists development afterwards, since the Page Turner is designed especially for Asian. Also, the research is of great worth in academia and patent application that is value to juniority. The research on pageturner is an initiative to promote technology assists development and it should be continued to benefit the disabled.

Reference

1. Glass. K., & Hall, K. (1987). Occupational Therapists Views About the Use of Robotic Aids for People With Disabilities. *American Journal of Occupational Therapy*, 41, 745-747.
2. Officer, T. M. (1991) A microprocessor controlled Page Turner. *Biomedical Science Instrumentation*. 27, 141-144.
3. Hillman, M. R. (1987). A feasibility study of a robot manipulator for the disabled. *Journal of Medical Engineering & Technology*, 11(4), 160-165.
4. Kao Chi Chung, 1997, Rehabilitation technology education, research, and execution --- body assists related technology.
5. Wu Dian Wu, 1994, Developing the potential of the disabled and related policy. *Technology education quarterly journal*, 51,1-12.