

Design and Fabrication of Page Turner for Quadriplegic

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ABSTRACT

Reading books, magazines, and printed materials is an essential activity of daily living. Turning pages of a book or magazine is often cumbersome for avid readers and disabled individuals. An automatic page turner can serve as an assistive technology for people with disabilities and people with limited upper-body extremity function. The purpose of this project is to find a better new form of an automatic page turner that will help such disabled people to complete the motions of turning pages so that to satisfy the desire of reading and learning. Individuals with decreased hand functioning, as the result of diagnoses such as arthritis, cerebral palsy, and stroke often have difficulties with fine motor activities. Reading, specifically the act of page-turning, can be one such activity that is greatly affected. Assistive page turners are available commercially, but for many school systems and private families the cost of these systems is prohibitive. A low-cost page turning device has been designed, allowing a user to turn a page of printed matter by simply touching a switch with their head, hand, or other body part. So developing an automatic page turner will ultimately provide a capability to turn and hold the page using a mechanical structure for people who need to read without assistance.

Keywords: Quadriplegic, Reading, Automatic page turning, low cost

I. INTRODUCTION

Page turning is an important ancillary process of reading. It is a pervasive task that many people take for granted. The goal of this paper is to review the state-of-the-art in automatic page turners, the assistive technology for automating this mechanical process. An automatic page turner is a device that automates the mechanical elements of reading so that book pages can be turned hands-free in either direction. A suitable hand/foot pedal or breath-controlled switch can be used to activate the page turning mechanism without hindrance. Additional activation options include an eye switch, chin switch, or voice activation unit. Hands-free operation is particularly important to musicians and disabled individuals. Musicians, for example, are often hampered by the need to turn pages in a music score while their hands are occupied playing their instrument. Disabled people, facing the challenges of the physical process of page turning, require assistive technology to aid them in the basic daily function of reading books, magazines, and newspapers. In this manner, the page turner is directed toward the substitution of normal reading functions for people with disabilities. A page turner is particularly beneficial to people with limited bilateral upper extremity function caused by neurological impairment, musculoskeletal problems, and generalized weakness. Included in this population, for example, are patients who have suffered cerebrovascular accidents, spinal cord injuries, amyotrophic lateral

sclerosis (ALS), multiple sclerosis, cerebral palsy, and arthritic joint changes.

An automatic page turner serves to enhance their quality of life by improving their independence in reading, an important activity of daily living.

The vast majority of commercialization efforts in this field has targeted people with disabilities. As a result, offerings have often proven to be bulky, noisy, and expensive mechanical devices operating on conventional books and magazines. This has generally limited the use of automatic page turners to disabled individuals who place a high premium on this technology. Successful penetration in the consumer market is needed to offer economies of scale that would significantly lower cost. Only then can page turners grow beyond the disabled market to musicians and avid readers, providing them with convenient book support and hands-free page turning features. This would enable the product to find pervasive use among the disabled and elderly populations, and become convenient attachments to pianos, music stands, book stands, and exercise equipment. Its role as assistive technology in hospitals, nursing homes, and libraries is clear. Sections 2 and 3 respectively survey the mechanical and digital product offerings that address page turning for musicians.

II. METHODOLOGY

I. Finalising the Concept.

- II. Concept Development.
- III. Purchase and Details of Components.
- IV. Design and Development of PCB Board.
- V. Assembling of Components.
- VI. Testing the Prototype.

III. DESIGN DETAILS

3.1 Hardware Details

- D.C. Motor
- Microcontroller-8051
- L293D Driver controller
- Adopter

3.1.1 D.C Motor

Details

- Operating Range: 6-12 VDC
- Torque @ Stall: 278 oz-in.@12VDC
- Gear train damage can occur if stalled (locked)
- Stall Current: 1.0 Amp @ 12VDC
- No load current: 120mA
- No load speed: **45 RPM**
- Gear ratio: 100:1
- Motor size: 1.355" Dia. x 1.70"L
- Gear size: 1.45" Dia. x 1.30"L
- Shaft size: 6mm (0.236") Dia. x 0.715"L
- Weight: 0.504 lbs. (8.05 oz.)
- DC reversible motors
- Solder type terminal
- High torque construction
- Oil bearing design for long service life
- Insulation resistance: 20 MOhm
- Dielectric Strength: 250VDC



Fig 3.1: D.C. Motor

3.1.2 Microcontroller-8051

The 8051 architecture consists of these specific features:

- 8-bit CPU with Register A and B
- 16-bit program counter (PC) and data pointer (DPTR) 8 bit program status word (PSW)
- Internal ROM or EPROM
- Internal RAM 128 bytes.

In this,

- 4 Register banks, each containing 8 registers 16 bytes which may be addressed at bit level 8 bytes of general purpose data memory
- 32 input /output pins arranged as 4-8 bit ports P0-P3
- Two 16 bit timer/counters (TO-T1)
- Fully duplexed serial data receiver/transmitter (SBUF)
- Control register TMOD, TCON, SCOM, PCON, IP and IE
- Oscillator and Clock circuit

Port 1 Bit 0	1	P1.0	Vcc	40	+5V
Port 1 Bit 1	2	P1.1	(AD0)P0.0	39	Port 0 Bit 0 (Address/Data 0)
Port 1 Bit 2	3	P1.2	(AD1)P0.1	38	Port 0 Bit 1 (Address/Data 1)
Port 1 Bit 3	4	P1.3	(AD2)P0.2	37	Port 0 Bit 2 (Address/Data 2)
Port 1 Bit 4	5	P1.4	(AD3)P0.3	36	Port 0 Bit 3 (Address/Data 3)
Port 1 Bit 5	6	P1.5	(AD4)P0.4	35	Port 0 Bit 4 (Address/Data 4)
Port 1 Bit 6	7	P1.6	(AD5)P0.5	34	Port 0 Bit 5 (Address/Data 5)
Port 1 Bit 7	8	P1.7	(AD6)P0.6	33	Port 0 Bit 6 (Address/Data 6)
Reset Input	9	RST	(AD7)P0.7	32	Port 0 Bit 7 (Address/Data 7)
Port 3 Bit 0 (Receive Data)	10	P3.0(RXD)	(Vpp)/EA	31	External Enable (EPROM Programming Voltage)
Port 3 Bit 1 (XMIT Data)	11	P3.1(TXD)	(PROG)/ALE	30	Address Latch Enable (EPROM Program Pulse)
Port 3 Bit 2 (Interrupt 0)	12	P3.2(INT0)	PSEN	29	Program Store Enable
Port 3 Bit 3 (Interrupt 1)	13	P3.3(INT1)	(A15)P2.7	28	Port 2 Bit 7 (Address 15)
Port 3 Bit 4 (Timer 0 Input)	14	P3.4(T0)	(A14)P2.6	27	Port 2 Bit 6 (Address 14)
Port 3 Bit 5 (Timer 1 Input)	15	P3.5(T1)	(A13)P2.5	26	Port 2 Bit 5 (Address 13)
Port 3 Bit 6 (Write Strobe)	16	P3.6(WR)	(A12)P2.4	25	Port 2 Bit 4 (Address 12)
Port 3 Bit 7 (Read Strobe)	17	P3.7(RD)	(A11)P2.3	24	Port 2 Bit 3 (Address 11)
Crystal Input 2	18	XTAL2	(A10)P2.2	23	Port 2 Bit 2 (Address 10)
Crystal Input 1	19	XTAL1	(A9)P2.1	22	Port 2 Bit 1 (Address 9)
Ground	20	Vss	(A8)P2.0	21	Port 2 Bit 0 (Address 8)

Fig 3.2: Pin description of 8051 Microcontroller

3.1.3 L293d Quadruple Half-H Driver

Details:

- a) Wide Supply-Voltage Range: 4.5V to 36V
- b) Separate Input-Logic Supply
- c) Internal ESD Protection
- d) High-Noise-Immunity Inputs
- e) Output Current 1 A per Channel (600 mA for L293D)
- f) Peak Output Current 2 A per Channel (1.2 A for L293D)
- g) Output Clamp Diodes for Inductive Transient Suppression (L293D)

Descriptions:

The L293 and L293D devices are quadruple high-current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, DC and bipolar

stepping motors, as well as other high-current/high-voltage loads in positive-supply applications. Each output is a complete totem-pole drive circuit, with a Darlingtion transistor sink and a pseudo-Darlington source. Drivers are enabled in pairs, with drivers 1 and 2 enabled by 1,2EN and drivers 3 and 4 enabled by 3,4EN. The L293 and L293D are characterized for operation from 0°C to 70°C.

3.1.4 Adopter

Tab 1: Specifications of adapter

Current Rating	2 Amps @ 50 V RMS
Temperature	-65° to 105° C
Termination Resistance	50 mOHMs Typical
Insulation Resistance	1000 MOHMs Min.
DWV	500 VAC Min.
Module Slots Needed	1



Fig 3.3 Adopter

3.2 Software Details

8051 Development Tools Keil C51 is the industry-standard tool chain for all 8051-compatible devices, it supports classic 8051, Dallas 390, NXP MX, extended 8051 variants, and C251 devices. The µVision IDE/Debugger integrates complete device simulation, interfaces to many target debug adapters, and provides various monitor debug solutions.

MDK Version 5 Microcontroller Development Kit Keil MDK Version 5 is the latest release of our complete software development environment for a wide range of ARM, Cortex-M, and Cortex-R based microcontroller devices. MDK includes the µVision IDE/Debugger, ARM C/C++ Compiler, and essential middleware components. It's easy to learn and use.

IV. WORKING PRINCIPLE

The step by step working of device is as follows

- Activation is accomplished by depressing a single switch that commences a microprocessor-controlled sequence.

- The first step is for the clamps to disengage the book.
- Rotating wheel is used to roll in the clockwise or anticlockwise direction depending on which side we want to turn it, the wheel folds the page in a upward direction.
- The wiping arm then rotates the clockwise or anticlockwise, catches the fold of the page and turns it.
- The clamps are then placed on the either ends of the books.
- This process is repeated with the user's requirement.



Fig 4.1 Page Turner

1.1 Flowchart

Upon activating the switch the signal will be sent to the microcontroller, it carries a set of detailed sequences from the codes that was dumped into it. The controller then sends the signals to the driver circuit when helps in the proper synchronization between the motors. The subtended angle which is meant to be rotated by the motors will be stored in the programs the driver executes this program Consider the page turning to the left, motor 1 which controls the right clamber activates and the clamp disengages the book, motor 2 controlling the arm motor moves to the right and motor 3 which is attached to the wheel rolls the page up, motor 5 which controls the left clamp now disengages. The wiping arm controlled by motor 4 catches hold of this page and wipes this page to the other side. At the end of this cycle both the clamps will hold the book.

The cycle repeats for the right page turning cycle.

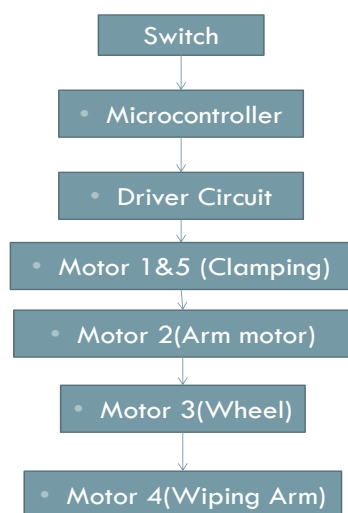


Fig 4.2 Flowchart

SL.NO	PARTICULARS	COST(INR)	QUANTITY	TOTAL(₹)
1.	D.C. SERVO MOTORS	250	5	1250
2.	MICROCONTROLLER(8051)	550	1	550
3.	DRIVERS CIRCUIT(L293D)	100	3	300
4.	SWITCHES	10	4	40
5.	WHEEL	20	1	20
6.	ARMS	20	4	80
8.	ADOPTER	100	1	100
9.	MISELLANEOUS	-	-	1000
10.	PLYWOOD PLANK	160	1	160
	TOTAL	-	-	3500

turn one single page (one complete cycle) it takes approximately 8 seconds. The response of the system can be improved by using faster processor.

VIII. FUTURE SCOPE

- It can be developed for Wireless Switches.
- It can be developed for Automatic Power On/Off function.
- It can be developed for better Accuracy and Precision control.

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V. COST ESTIMATION

Table 2: The Detail cost estimation is shown in the table

VI. ADVANTAGES AND DISADVANTAGES

Advantages:

- Ease of Use.
- It is Reliable.
- It is Robust in Operation.
- It has Multi points switching.
- It is Portable.

Disadvantages:

- Need Assistance for initial setup.
- Less Accuracy for different page thickness.
- Initial cost is high.
- Need proper Maintenance.

VII. SUMMARY AND CONCLUSION

The prototype was tested and it was observed that the accuracy of the device depends upon the page thickness. In the present prototype to [7]. <http://www.cerebralpalsy.org/what-is-cerebral-palsy/statistics/>

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ANNEXURE

THE CODING:

```
#include<reg52.h>
sbitarm_left_a=P0^0;
sbitarm_left_b=P0^1;
sbitarm_right_a=P0^2;
sbitarm_right_b=P0^3;
sbitwiping_a=P0^4;
sbitwiping_b=P0^5;
sbitwheel_a=P0^6;
sbitwheel_b=P0^7;
sbitangle_a=P1^0;
sbitangle_b=P1^1;
sbithand_L_Key =P3^0;
sbithand_R_Key =P3^1;
sbitleg_L_Key =P3^2;
sbitleg_R_Key =P3^3;
voiddelay_ms(unsigned intdelay_value);
void main()
{
    delay_ms(100);

    while(1)
    {
if((hand_L_Key==0) ||(leg_L_Key ==0))
    {
        arm_left_a=1;
        arm_left_b=0;
        delay_ms(200);
        arm_left_a=1;
        arm_left_b=1;
        angle_a=0;
        angle_b=1;
        delay_ms(200);
        angle_a=1;
        angle_b=1;
        wheel_a=0;
        wheel_b=1;
        delay_ms(300);
        angle_a=1;
        arm_right_a=1;
        arm_right_b=0;
        delay_ms(200);
        arm_right_a=1;
        arm_right_b=1;
        wiping_a=1;
        wiping_b=0;
        delay_ms(400);
        wiping_a=1;
        wiping_b=1;
        angle_a=1;
        angle_b=0;
        delay_ms(200);
        angle_a=1;
        angle_b=1;
        arm_right_a=0;
        arm_right_b=1;
        arm_left_a=1;
        arm_left_b=0;
        delay_ms(200);
        arm_right_a=1;
        arm_right_b=1;
        arm_left_a=1;
        arm_left_b=1;
    }
else if((hand_R_Key==0) ||(leg_R_Key ==0))
    {
        angle_b=1;
        arm_right_a=1;
        arm_right_b=0;
        delay_ms(200);
        arm_right_a=1;
        arm_right_b=1;
        wiping_a=1;
        wiping_b=0;
        delay_ms(400);
        wiping_a=1;
        wiping_b=1;
        angle_a=1;
        angle_b=0;
        delay_ms(200);
        angle_a=1;
        angle_b=1;
        arm_right_a=0;
        arm_right_b=1;
        arm_left_a=1;
        arm_left_b=0;
        delay_ms(200);
        arm_right_a=1;
        arm_right_b=1;
        arm_left_a=1;
        arm_left_b=1;
    }
    }
}
```

```
{
    arm_right_a=1;
    arm_right_b=0;
    delay_ms(200);
    arm_right_a=1;
    arm_right_b=1;
    angle_a=1;
    angle_b=0;
    delay_ms(200);
    angle_a=1;
    angle_b=1;
    wheel_a=1;
    wheel_b=0;
    delay_ms(300);
    angle_a=1;
    angle_b=1;
    arm_left_a=1;
    arm_left_b=0;
    delay_ms(200);
    arm_left_a=1;
    arm_left_b=1;
    wiping_a=0;
    wiping_b=1;
    delay_ms(400);
    wiping_a=1;
    wiping_b=1;
    angle_a=0;
    angle_b=1;
    delay_ms(200);
    angle_a=1;
    angle_b=1;
    arm_right_a=0;
    arm_right_b=1;
    arm_left_a=1;
    arm_left_b=0;
    delay_ms(200);
    arm_right_a=1;
    arm_right_b=1;
    arm_left_a=1;
    arm_left_b=1;
}
else
    P1=0xff;
}
}
void delay_ms(unsigned int delay_value)
{
    unsigned int x,y;
    for(x=0;x<delay_value;x++)
        for(y=0;y<1275;y++);
}
```