The Paper Crane: An assistive device for turning book pages

07 Paper Cranes: Saaya Daga[1], Ryan Mechery[2], Daniel Kaminski[3], Maya Zheng[4]

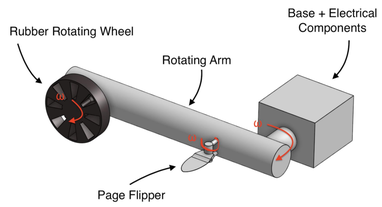
[1]CEO, [2]CTO, [3]CMO, [4]CIO

Problem Statement

People with motor disabilities have difficulty turning book pages independently, making the reading process difficult and unenjoyable.

Preliminary Designs

Design 1:



- CAD model
- Concept for movement and parts
- Page flipper attached to arm

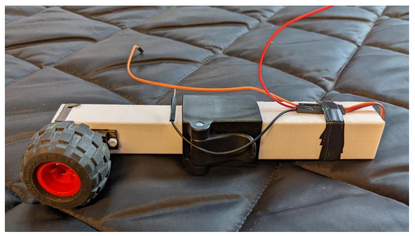
Design 2:

- Cardboard model
- Added page clamps onto base
- Page flipper attached to arm

Design 3:

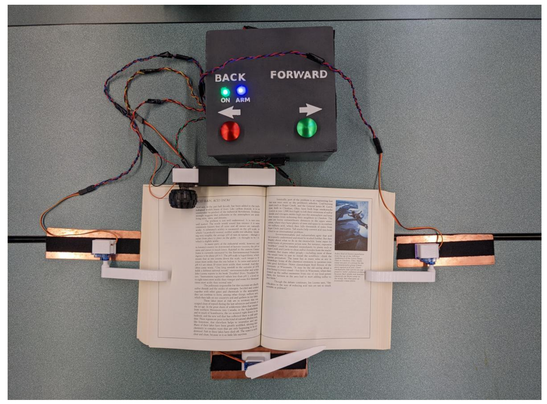
- PVC pipe model
- Wheel and arm rotate
- Page flipper moved to a separate base

Design 4:



- 3D printed body
- Adjustable size
- Flipper and clamps on separate base

Final Design and Methods



- Main parts are 3D-printed collapsible arm, plywood electrical housing box, and 3D- printed page clamps and page flipper
- Powered on Arduino UNO
- Arm rotates as needed to turn page forwards or backwards, controlled by buttons on lid
- Page flipper helps complete turn

CAD Files

Design Studies

Study #1: Delta Wheel Speed vs. Device Function

- Took pass/fail data of three different speed settings to get range for optimal speed
- A pass equated to successfully turning only one page

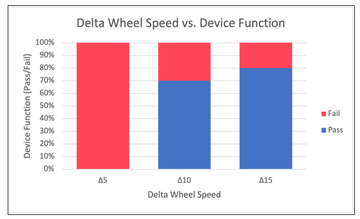


Figure 1. Delta Wheel Speed vs. Device Function. Pass/Fail data was collected to determine a range for an optimal wheel turning speed

Study #2: Wheel Spinning Duration vs. Device Function

- Took pass/fail data of three different wheel turning durations (ms) to determine a range for the optimal duration
- A pass equated to successfully turning only one page

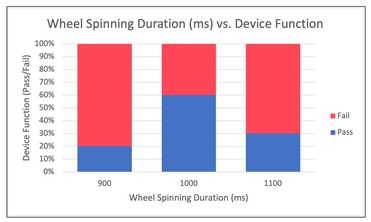


Figure 2. Wheel Spinning Duration vs. Device Function. Pass/Fail data was collected to determine a range for an optimal wheel turning duration

Study #3: Minimum Frequency vs. Device Function

- Took pass/fail data of three different minimum frequencies to determine optimal arm angle for turning pages backwards
- A pass equated to successfully turning only one page

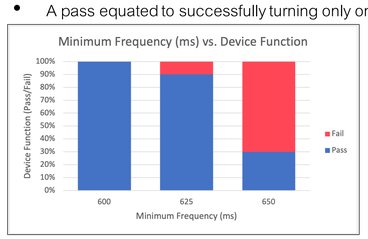


Figure 2. Maximum Frequency vs. Device Function. Pass/Fail data was collected to determine optimal angle for arm for page turning backward

Study #4: Maximum Frequency vs. Device Function

- Took pass/fail data of three different maximum frequencies to determine optimal arm angle for turning pages forwards
- A pass equated to successfully turning only one page

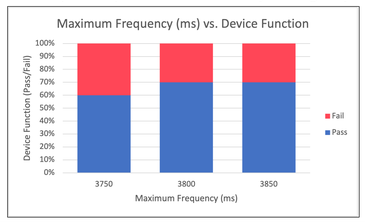


Figure 4. Minimum Frequency vs. Device Function. Pass/Fail data was collected to determine optimal angle for arm for page turning forward

Level 1 Requirements

Type	Description
Functional	Turn a page via accessible user input, I.e., press of a button.
Cost	Device costs less than $100.
Functional	Must not cause damage to the book.
Functional	Must not hurt the user.
Functional	Can turn pages both forwards and backwards.

Conclusions

- Device is functional: turns pages forwards and backwards
- Occasionally turns multiple pages
- Wheel speed settings are also highly variable depending on book size and placement – can be easily edited in code

Future Extensions

- Develop voice activated input – more accessible than buttons and allows totally hands-free reading
- Build larger mount or case for entire device to increase portability
  - Previous idea for suitcase-style design
- Refine device to turn pages more accurately – especially turning only one page at a time
- Slowly increase or decrease arm rotation angle to turn pages when there is a lot of pages on one side – manually via a dial or automatically