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Student Scholarship

Junior Design: Automatic Page Turner

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Junior Design: Automatic Page Turner

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Problem Statement

This device is intended for use by anyone who is severely disabled with minimal use of his or her extremities. It is assumed that these children can only move several fingers and may or may not be restricted to a wheelchair, powered or manual.

Objectives

The device must be able to:
- Accommodate books of different page sizes
- Hold the book steady without allowing the book to move
- Reliably turn single pages
- Go forward and backward
- Have enough available power for at least four hours of use
- Be lightweight
- Be inexpensive

It is assumed that initial setup of the book and page turner will be done by an able bodied assistant, such as a care giver or nurse, but then can be operated by the intended user.

Arduino Micro-Controller
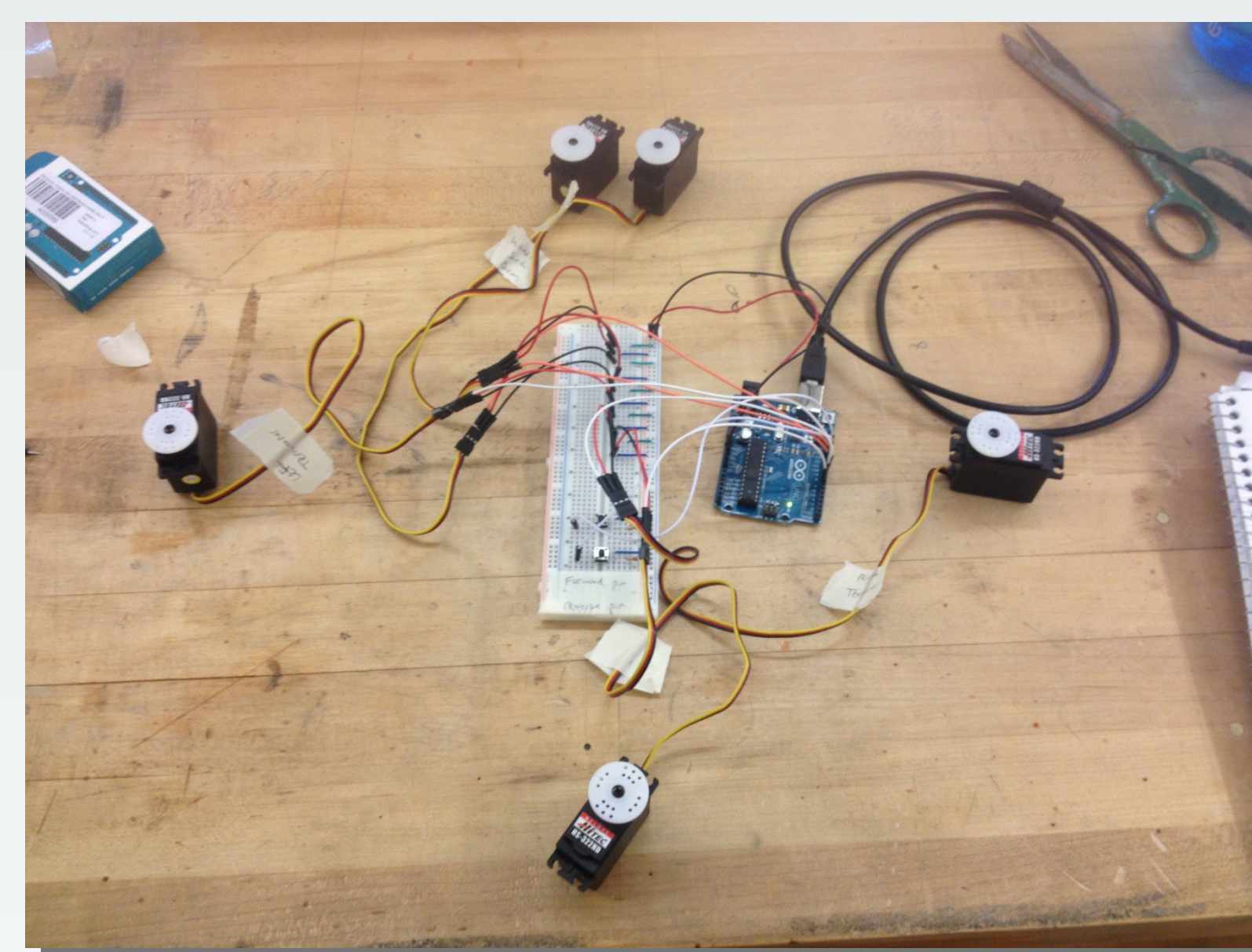
We chose a design that would use the combination of five servo motors which are all controlled by an Arduino Microcontroller. The Arduino seemed like a logical choice since it allowed for easy programmability through their custom IDE and came with a wide range of open source codes and libraries. The model we chose is the Arduino Uno. This controller has 14 digital I/O pins and delivers +5V to output devices.

Abstract

This project details the design and build process of an automatic page-turner. The primary goal of this project is to design and manufacture a product that not only has an efficient operation, but is easy to use for people with disabilities and minimal assistance. The device will consist of a mechanical structure to support the book, an electrical system to facilitate the turning of pages in both directions, and additional features to support comfort and readability, such as LED reading lights.
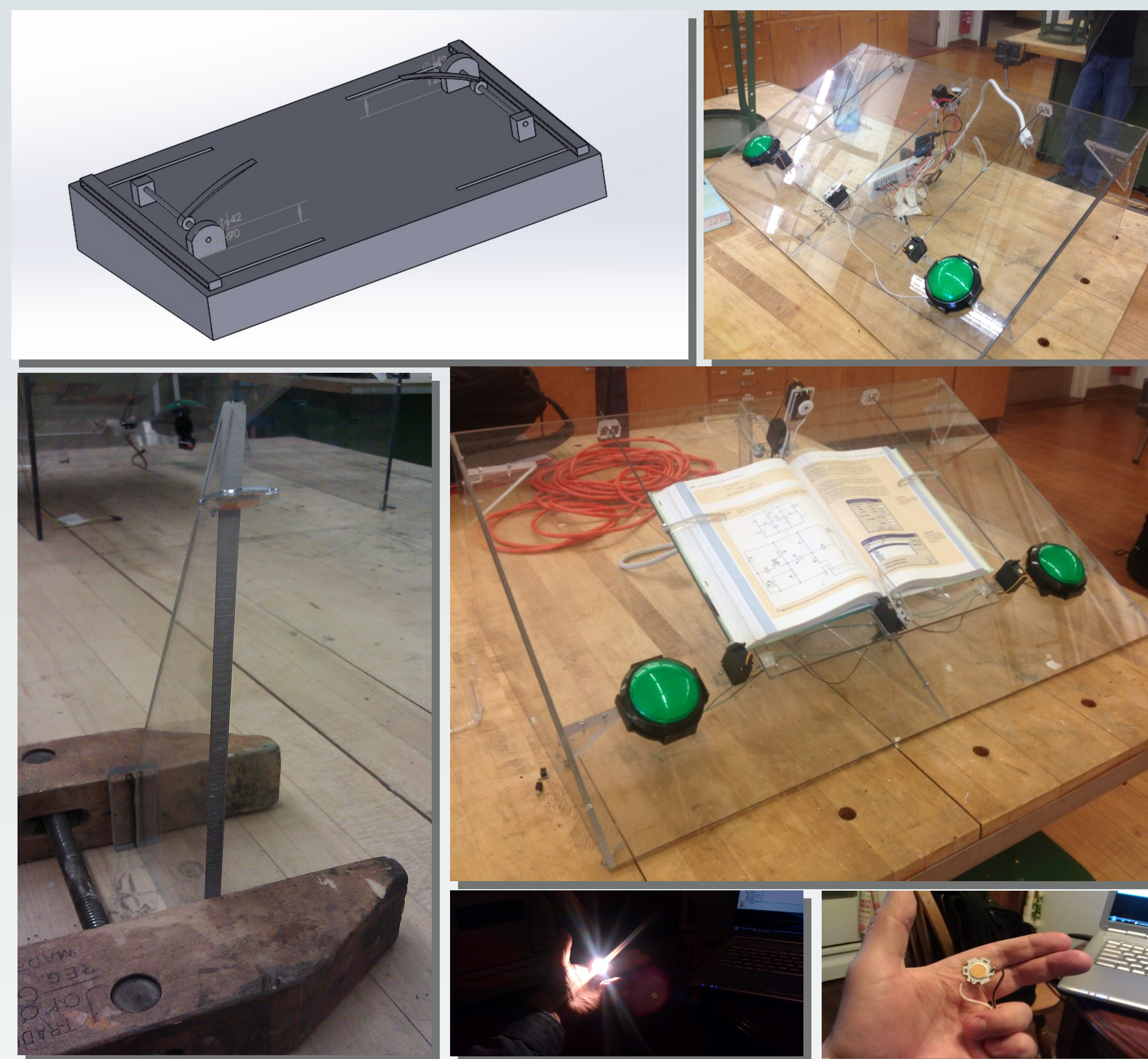
Budget

Component	Cost
Arduino Starter Kit	$ 38.79
Servo Motors	$ 69.93
Buttons and Switches	$ 5.62
Pressure Switch (x2)	$ 10.82
Wires	$ 7.90
Plexiglass	$ 108.00
EL Wire	$ 9.95
EL Inverter 12V	$ 14.95
Power Supply	$ 9.70
Power Strip	$ 10.58
100mm Buttons	$ 30.00
Adhesive Wiring Tie down	$ 23.51
Total	$ 339.75

Improvements

- Add motors to automate the re-sizing process as different book sizes are used.
- Create housing to protect user from motors and associated components.
- Add local power switch that the user can toggle on the face of the lectern.
- Add pressure switch to positioning arm to detect when the wheel has contacted the page.
- Design and manufacture mobile lectern cart for additional ease of use.

Lectern Design

For the construction of the Lectern, the group chose to use a Plexiglas surface. This would allow for lightweight yet ridged construction, it would also give the design a sleek and clean look. The actual base itself is sitting on three support bars with a 35-degree angle and held together by small machine screws, there are also a few triangular supports holding the sides and top together. The top surface was put through the Bridgeport milling machine and slots as well as small openings for the individual motors were cut out to allow all components to sit snuggly. Some of the moving parts were also constructed using the band saw and belt sander. These parts included both tension arms as well as the page flipper and the motor arm located at the twelve o'clock position. The construction took about 15 hours to complete (which includes the machining and planning).

Programming

The unit was programmed to control five servo motors. Two motors are used as page tensioning devices to keep the pages flat while the user is reading. One motor is used as a page flipping bar – which will contact the page and continue to rotate until the page flips over. The final two motors are used in tandem – one motor to position the arm that supports the page turning wheel, and the second motor to rotate the page turning wheel to 'curl' the page for the page flipping bar to rotate through.

These actions are controlled by two push buttons – one to turn the page forward, and one to turn the page backwards.

Lighting

The reading lights are two high brightness, Bridgelux Soft white ES Star Series LEDs. Each LED will output 600 lumens when driven at 18V, 350mA.

The positioning of the LEDs over the book pages is intended to provide the best page illumination, while the LEDs are tilted forward to the point where the reader is no longer looking directly into the LED lights.