Design of an Educational Robotic Exoskeleton

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Goals for the ExBow

- Make a low cost robotic exoskeleton
- Safe to use
  - Low torque
  - Avoid pinching points
  - Easy to stop
- Easy to use and replicate
- Uses parts and tools that are relatively easy to acquire
- Uses some sort of sensor to cause motion
- Accessible as an educational tool
Educational Values

- Physics
  - Torque
  - Gear Ratios
- Electronics
  - Coding with the Arduino
  - How circuits work and how to use a breadboard
- Engineering Design
  - What are different ways that this could have been designed?
Functioning ExBow
Original Design

New Design
Improvements

- Reduce cost
- Reduce the amount of printed plastic
- Make it easier to put on
- Faster and easier assembly
- Be able to change gear ratio quickly and easily
- Be able to adjust the belt tension
- Continuous loop belt
- Make a better joint
3D Printing Basics

Fused Deposition Modeling (FDM)

http://www.padtinc.com/blog/additive-mfg/rapid-prototyping-technology.animations
Found at P-D-A-T
Makerbot Replicator 2x (has dual extruders)

- Makerbot software allows you to adjust the density, or infill of the parts that you are printing. As such you are able to adjust the strength of your 3D Prints to a certain extent.
Original Design 20% Solid

180.49 grams
16 hr. 17 min.
New Design 50% Solid

153.57 grams ABS
9.08 grams Support
21 hr. 21 min.
What's in each kit:

• 7-3D Printed Parts
• 2-Aluminum Bars
• 1-Bolt
• Extra Wood Screws**
  • (To be used on gear only)
• 1-Timing Belt
• 4-Velcro Straps
• 1-USB Flash Drive

• 1-Bend Sensor Assembly
• 1-Battery Pack
• 6-AA Batteries
• 1-Wire Extension**
• 1-Servo Motor Kit
• 1-Nano-Arduino
• Small lengths of wire**
• Misc. Electronic Components**
• 1-Mini-B USB Cable
• 4-Shock Absorbers
• 1-Medium Breadboard
What’s in Each Kit:

- Two Aluminum Bars
- 7 3D Printed Parts
- 1 Bolt
- Timing Belt
Velcro Straps

Optional: 1 USB Flash Drive (to store files)

Battery Pack and AA Batteries

1 Bend Sensor Assembly

Arduino Nano

Wire-Extension Servo Motor Kit

Lengths of Wire

Mini USB Cable

Shock Absorber

Misc. Electrical Components

Medium Breadboard
The Elbow-Sandwich Joint
Step: 3
Note: It may be easier to fit the nut into the part then screw in the bolt.
Squeezing Force
The Motor Mount
T-Bar Set-up
Put in the shock absorbers

4x
Part D and motor
Slide motor into the mount

Step: 8
Slide mount onto the aluminum bar
Different iterations of the Motor Mount
Motor Mount Tension
Forces on the gear

Motor

Belt

Lip
Putting the rest together...