Multifunction Table and HANSS with Biofeedback

Team #1
Mark Galiette, Liz Hufnagel, Daniel Tichon
Client: Annalee Hughes
Introduction

- Background
- Purpose
- Current Products
- Initial Design
- New Multifunction Table and HANSS Design
  - Specifications
  - Previous Work
  - Future Work
- Budget
- Conclusion
Client Background Information

- Client: Annalee Hughes, a 10 year old suffering from Cerebral Palsy
- Cerebral Palsy is a broad classification of abnormal muscle tone, reflexes, motor skills development, and fine coordination
- Unable to stand or sit without external assistance
- Confined to a power chair for a majority of the day
Purpose of the Design Project

Goal: Design and implement two devices for each of Annalee’s specific needs

1. A multifunction table for Annalee for completion of homework, using her laptop, and reading
2. HANSS with biofeedback to position the head, stabilize the neck and shoulders, and provide positive reinforcement to client for correct positioning
Current Available Products

- Many wheelchair attachable desktops are available
- Head and neck support [Headmaster Cervical Collar]
- Combination of head, neck, shoulder support [i2i]
- Currently no biomechanical feedback devices available
Initial Device Designs

- Scissor lift with spring for table
- Separate head and neck supports
- These designs had minor flaws that led to them being redesigned
Multifunction Table: Specifications

- Adjustable height
- Adjustable tilt
- Attach to wheelchair
- Lift assisted
- Storage compartment
- Easily movable
Multifunction Table: Completed Work

- Updated to Cantilever Design
  - Able to be mounted on many chairs
  - Fully adjustable with linear actuator
  - Sturdy
  - Fits project specifications
  - Prevents binding
Completed Work Continued

- AutoCAD Drawings and Stress Analysis
  - Ensure appropriate materials and dimensions
  - Full technical drawings generated for easy fabrication
Previous Work Continued

- NEAT Marketplace
  - Bought 2 plastic wheelchair desks to be modified
- Ordered preliminary parts
  - Linear actuator
  - Switch
Multifunction Table: Future Work

• Order metal for table frame and upright support
• Strip plastic wheelchair desks and cut to size
• Fabricate frame and support for table
• Assemble linear actuator, switch, and power supply
Future Work Continued

- Assemble all parts of Multifunction Table
- Test electrical and moving parts
- Mount to wheelchair, test, and teach Annalee how to use it
HANSS: Specifications

- Must attach to power wheelchair
- Must keep the head in upright position without being too restrictive to daily activity and also be aesthetically pleasing
- Must be padded and comfortable
- Must house biofeedback components
- Must be manually adjustable for changes over time due to growth
HANSS: Completed Work

Function: Attach HANSS to current power wheelchair. Allow adjustment.

- Purchased 2 used headrests
  - First for adjustable bracket mount
  - Second for square shaft design
Completed Work Continued

Function: Support head and neck. House biofeedback equipment. Removable chin support for additional support:
- Purchased foam supply and fabric covering
- Purchased SS stock for HANSS frame
- Prototyping of chin support
HANSS: Future Work

- Adjust ball socket size of square shaft and attach to adjustable bracket
- Remove headrest
- Check compatibility on new power chair
- Alterations to shaft or adjustable bracket design
- Attach HANSS
- Field testing of completed device
Future Work Continued

- Machine SS stock to product shape
  - Neck Circumference = 14"
  - Overall width = 9"
  - Arm Length = 8.5"
- Use contact cement and foam supply to pad device
- Field testing to determine adjustments in dimensions
- Attach HANSS to bracket system
- Incorporate biofeedback and electrical housing
- Sew nylon fabric cover
- Complete chin support and sew attachment pouches into cover
- Field testing of final product and adjustments
Biofeedback System: Specifications

- Determine anatomical position of the neck and head
- Reward user with music from iPod or other music device when in the correct anatomical position
- Encourage user with tactile vibrations when anatomical position is incorrect
  - RF communication used to communicate with device worn on the wrist
Biofeedback System: Completed Work

- Purchased or located various electrical components in the BME Lab
- Completed PCB Design of the RF Receiver and RF Transmitter circuit boards
- RF Communication
  - Assembled, on a protoboard, and tested RF Receiver and Transmitter
- Batteries and Holders
  - Purchased 3V 23mm coin batteries for power
  - Ordered battery holders capable of holding 2 23mm batteries
Completed Work Continued

• Position Sensing Switches
  ▫ Series layout of three non-contact and contact switches
  ▫ If any switch is pressed, the user is considered in the correct position
  ▫ Tested using completed RF circuitry and LED lights as outputs

• Voltage Regulation
  ▫ Assembled voltage regulation circuit for both the RF Receiver and Transmitter
Biofeedback System: Future Work

- **Coin Vibrator Circuit**
  - Find a vendor and purchase coin vibrator motors
  - Integrate coin vibrators into completed circuitry
- **Audio Circuit**
  - Assemble and integrate input and output 3.5mm headphone jacks
Future Work Continued

• Perform extensive testing the completed electrical system
• Finalize design and purchase PCB boards
• Purchase or fabricate enclosures for transmitter and receiver circuits
• Integrate switches into completed HANSS
• Complete testing again of completed device
BUDGET

• Total initial budget: $1000
• Expenses Categorized by Component
  ▫ Multifunction Table: $48.62
  ▫ HANSS: $52.97
  ▫ Biofeedback: $99.14
• Total Funds Remaining: $799.27
Conclusion

- Currently in construction and fabrication phase for all components
  - Group intends to work in lab/machine shop at various dates throughout winter break
- Upcoming meetings with client for field testing of designs
- Expected product completion date: 2/29/2010
- Remaining budget: $799.27
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