Assistive Mobility Device

A National Science Foundation Engineering Design Project

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Overview

- Introduction
- Project Goals
- Current Products available
- Design
- Budget
- Conclusion
Introduction
Client Background:
• Hampton Elementary School Staff
• Intelligent 10 year-old boy seeking more independence
• Cerebral Palsy since birth
  ▪ Athetoid Quadriplegia
  ▪ Uses C400 Stander Jr. electronic wheelchair
  ▪ Dyna Vox augmentative communication device and his laptop to communicate at school
Cerebral Palsy

• All those suffering from Cerebral Palsy do share some impediment with fine motor control.
• Symptoms of this syndrome can also include problems with balance, posture, verbal articulation, involuntary movements, and sometimes mental impairment.

Athetoid Quadriplegia
• Athetoid: lack of ability to control the particular muscles in affected areas of the body
• Quadriplegia: Lack of muscle control that encompasses all four limbs and the trunk
Project Objective

To create a robotic arm that would allow the client to do the following actions independently:

- Eat
- Retrieve objects such as pens, pencils, rulers, crayons, and other classroom items
- Open doors
- Reach his backpack on the back of his wheelchair
- Open his laptop and raise the screen
Current Products Available

ARM: Assistive Robotic Manipulator

- Exact Dynamics of Netherlands created a device which assists disabled people with severe handicap to the upper limbs.
- The device mounts to an electric wheelchair and receives input from a number of devices including a keyboard, joystick, and switch.
Reacher Arm for Quadriplegics

- Created by Mississippi State University as part of the National Science Foundation Engineering Senior Design Projects for Persons with Disabilities.

- The device attaches to a wheelchair and has the capability to retrieve an object weighing up to two pounds from a variety of positions.
Arizona State University
• “Clutching and Gripping Device”
  ▪ This unique device starts out with closed prongs. In order to grasp a desired object, the client must apply pressure to the trigger, located on the handle, so that the prongs will open. When the client releases the trigger, the prongs close automatically around the object.

University of Massachusetts
• “Assistive Reach Mechanism”
  ▪ Can reach objects up to four feet away and is capable of lifting up to five pounds.
  ▪ Has the ability to pick up objects as small as a needle or as large as a can with the gripping claw.

• “The Outreach Reaching Aid”
  ▪ Increases the strength of the previous device to pick up larger objects, makes the trigger mechanism more advanced, and has a variable length of the reaching aid which ranged from 12 inches to 30 inches.
Project Design

Figure not drawn to scale
The Robotic Arm Features

- 3 joints and a stable base which will be attached to the wheelchair
- Joints at shoulder, elbow, and wrist
- The shoulder and wrist will have 360 degrees of freedom
- The elbow will be a hinge joint
- The gripping device will be connected to the wrist
- The input device will be a keypad and joystick
- Emergency stop button
The Gripper

• Capable of opposition and reposition motions

• Capable of grasping with a force of approximately 3N

• Will have removable accessories that will correspond to the client’s particular activity

• Accessories will snap in and out of the wrist.

• Accessories will include a fork, spoon, gardening tools, and a default gripper.
Joysticks and Keypads for Controlling the Arm’s Motion
• Keypad will act as the input device for this robotic arm.
• Keypad for this robotic arm will work similarly to a regular keyboard on a computer except only containing arrow keys.
• Arrow keys will be used to move up, down, and sideways in small increments
• Part of this keypad will be the key matrix.
• Keypad requires a spring with a greater constant, $k$, in order to produce more resistance to compensate for his gross movements.
**Materials**

**Base:**
- Constructed out of an aluminum-steel alloy
  - avoid bimetallic corrosion

**Arm:**
- Constructed out of pure steel
  - rust proof

**Grippers:**
- Edges made out of rubber
The budget allotted by the National Science Foundation for this project is $750.00.

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<tr>
<th>Material</th>
<th>Cost</th>
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<td>Raw Metal</td>
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<td>Electrical Motor</td>
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<td>Power Source</td>
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<td>Microcontroller chip</td>
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<td>Parallax Standard Servo</td>
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Conclusion

• The robotic arm will aid the specific needs that a fifth grader, with limited mobility, faces in the classroom

• Assist the client with the everyday hindrances caused by his lack of muscle activity

• Implement a safe, reliable, and durable device

• Create a custom built device while not exceeding the budget parameters
QUESTIONS ??