



# Arm Support System

**Client:**

**Ms. Megan Schiele**

Team Leader: Camille Duan

Communicators & BWIG: James Tang

BPAG & BSAC: Maggie Zhou

Advisor: Tracy Jane Puccinelli, PhD

# Client Information

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## Megan Schiele

- Pediatric School Occupational Therapist
- Madison Metropolitan School District



Figure 1. Typical Occupational Therapist for kids



# Problem Statement

- Designing an arm support system to help a 4-year-old girl with an SMA condition to play and pick up game pieces
- Great shoulder control but limited upper limb muscle control, and has weakness in her leg muscles



Figure 2. 4-year-old girl with elbow and wrist disabilities



# Spinal Muscular Atrophy (SMA)

- A genetic disorder characterized by weakness in muscles used for movements (skeletal muscles)
- Caused by loss of motor neurons protein SMN on chromosome 5
- Muscle weakness usually worsens with age

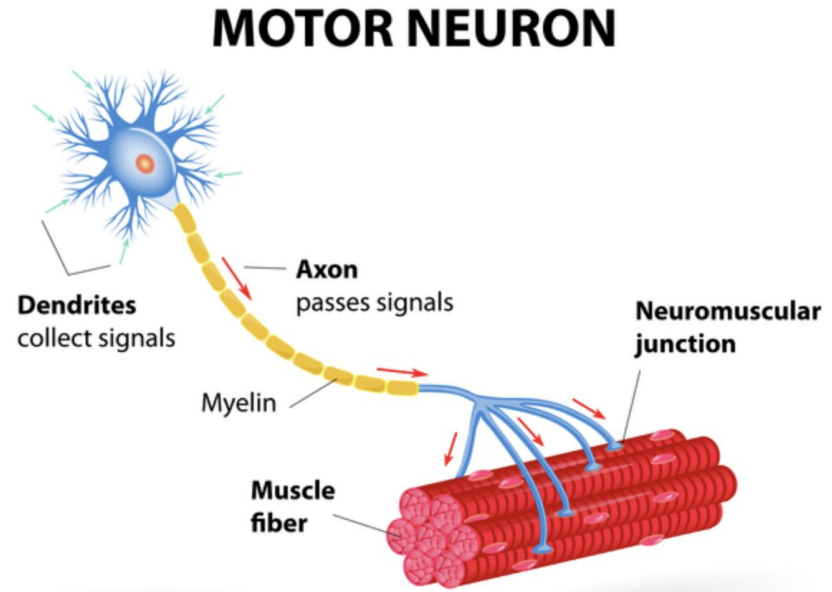


Figure 3. How Motor Neuron Controls Muscle Movement



# Spinal Muscular Atrophy



Figure 4. No.1 genetic cause of infant death



Figure 5. 1 in 50 adults in US is a carrier



Figure 6. Affects 1 in every 10k babies/year



# Competing Design



Figure 7. Arm support stabilized on a table



Figure 8. Korean Researcher Design



# Product Design Specifications

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- Client Requirements:
  - Design needs to be light ( < 10 lbs)
  - Mobile ( preferably not fixed on a table)
  - Lift her arm weight (~ 2.6 lbs)
  - Allow arm movements in all three planes
  - Under \$200 budget



# Design 1. Suspension Mobile Arm Support

- **Advantages**
  - Can be easily carried around
  - Able to adjust height
  - Lightweight and comfortable
  - Easy to fabricate
- **Disadvantage**
  - Unable to stabilize at one fixed location



Figure 9. Suspension mobile arm support design idea





# Design 2. Motor Elbow Lifting System

- **Advantages**

- With accelerometer sensor, so no extra help needed
- Simple DC motor

- **Disadvantages**

- Motor carried at the back, weight issue
- Lifting is not directional

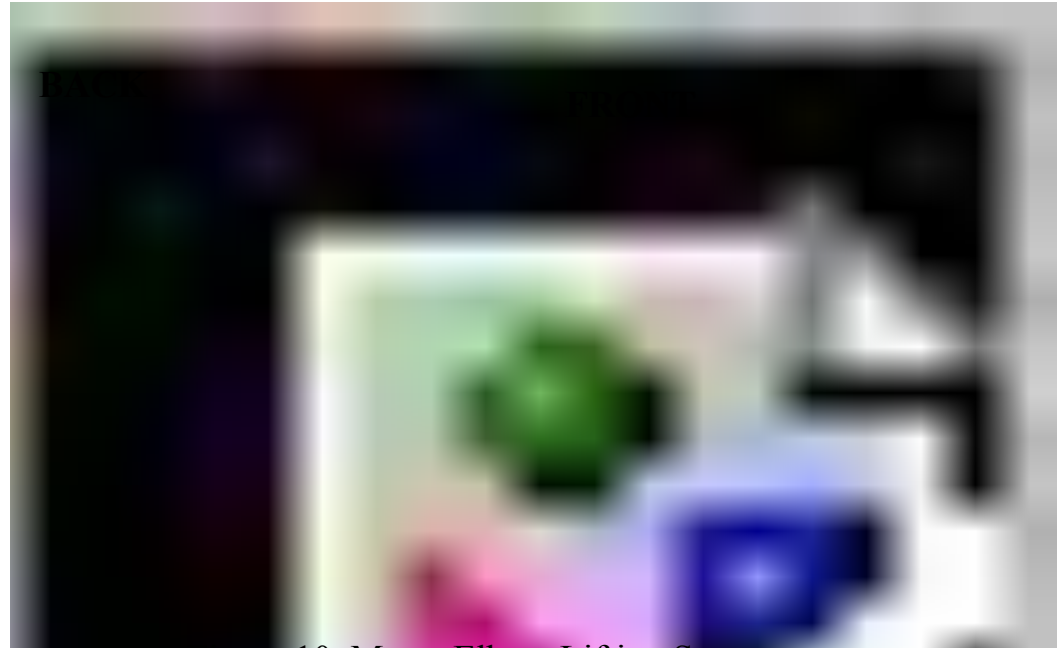


Figure 10. Motor Elbow Lifting System



# Design 3. Mind-controlled Exoskeleton


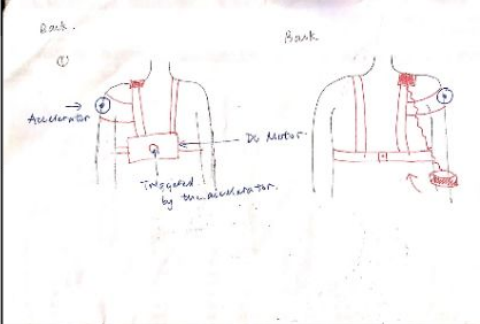

- **Advantages**
  - Brain is the controller
  - User can use their whole arm freely
  - Very powerful
- **Disadvantages**
  - Expensive (\$5000-\$10K)
  - Lack related technologies to complete the design



Figure 11. Mind-controlled exoskeleton

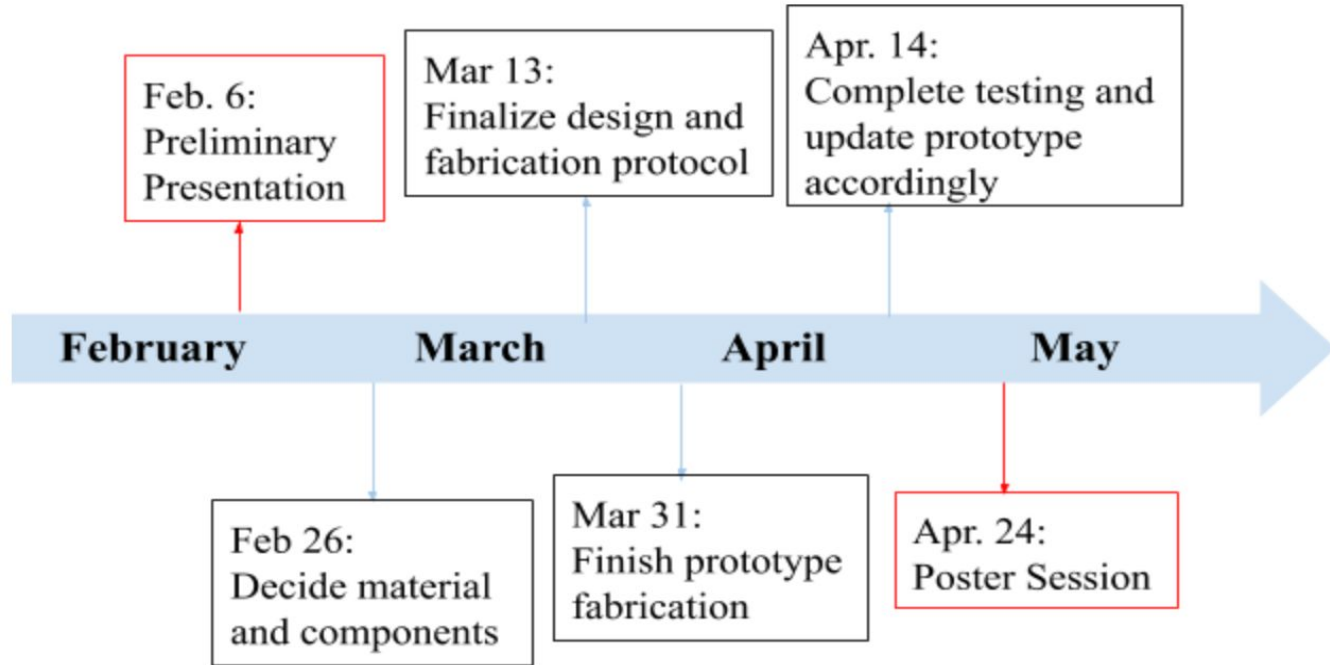


# Design Matrix

	Suspension Mobile Arm Support		Motor Elbow Lifting System		Mind-control Exoskeleton	
	 <p>→ Arm Holder</p>					
Mechanical Stability & Safety (25)	4/5	20	4/5	20	5/5	25
Patient Comfort (20)	4/5	16	5/5	20	3/5	12
Effectiveness (15)	3/5	9	4/5	12	5/5	15
Ease of Fabrication (15)	5/5	15	4/5	12	1/5	3
Cost (15)	5/5	15	4/5	12	1/5	3
Ease of Operation (10)	3/5	6	4/5	8	5/5	10
<b>Total (100)</b>	<b>81</b>		<b>84</b>		<b>68</b>	



# Future Work



# Acknowledgements

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# References

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