Dynamic Balance Device

Date: 02/8/2026 - 02/14/2026

Client: Mr. Daniel Kutschera
Advisor: Professor Monica Ohnsorg

Team:

Kat Sattel - Team Leader (sattel@wisc.edu)

Therese Kalt- Communicator (tkalt@wisc.edu)

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Problem statement: Patients that have suffered strokes have a 25-30% rate of developing spatial neglect syndrome. Symptoms of spatial neglect syndrome include loss of awareness of the body in space. Our client, Dr. Kutschera, a physical therapist, helps patients to regain strength and balance following a stroke. The client seeks to develop a device that can be used to improve visual scanning and balance training that is an update from the previous yard-stick design. The device should be mutli-functional so as to help patients with varying degrees of need and be effective in the rehabilitation treatment.

Brief status update: The team used the information learned from the client and advisor meetings to create 3 design matrices for various components of the final design. The team began initial 3D modeling.

Difficulties / advice requests: None to report

Current design: None

Materials and expenses

None to report, see table below:

Item	**Description**	**Manufac-turer**	**Mft Pt#**	**Vendor**	**Vendor Cat#**	**Date**	**#**	**Cost Each**	**Total**	**Link**
Category 1										
									$0.00	
									$0.00	
Category 2										
									$0.00	
									$0.00	
								TOTAL:	**$0.00**	

Major team goals for the next week

1. Choose final design to move forward with
2. Begin preliminary report and presentation
3. Order materials and continue creating a final CAD model

Next week's individual goals

- Kat Sattel
  - Work on preliminary report/presentation
  - Help with ordering final materials
  - Continue work on CAD models
  - Present the preliminary presentation!
- Therese Kalt
  - Work on preliminary report and presentation
  - Create CAD model of final design
- Noor Awad
  - Work on preliminary report and presentation
  - Work on modeling designs in CAD
- Freyja Heggeland
  - Work more on the preliminary report and presentation
  - Communicate with team and begin ordering materials for draft
  - Model device in CAD

Timeline

Task	Week				Week					Week				Week	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Project R&D															
Empathize	X														
Background…	X	X	X												
Prototyping															
Testings															
Deliverables															
Progress Reports	X	X	X												
Prelim presentation															
Final Poster															
Meetings															
Client		X													
Advisor	X	X	X												
Website															
Update	X	X	X												

Filled boxes = projected timeline
X = task was worked on or completed

Previous week's goals and accomplishments

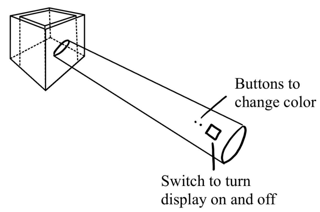
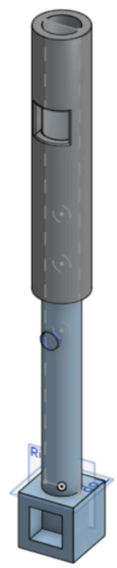
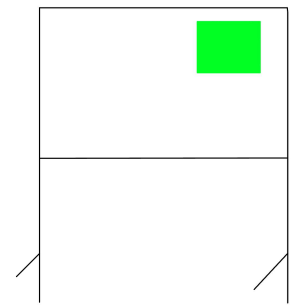
- Kat Sattel
  - Worked on materials and audio design matrices
  - Continued research on electronic components of design
  - Began preliminary CAD models
- Therese Kalt
  - Worked on design criteria and matrix
  - Sketched 2 design ideas for design matrix
- Noor Awad
  - Worked on design criteria and matrix
  - Planned work for report and presentation
  - Created design ideas for matrix
- Freyja Heggeland
  - Designed material matrix
  - Helped work on the preliminary report and presentation
  - Designed new ideas for the preliminary presentation

Activities

Name	**Date**	**Activity**	**Time (h)**	**Week Total (h)**	**Sem. Total (h)**
Kat Sattel	2/10/2026 2/11/2026 2/12/2026	- Audio research in LabArchives - Continued research - Finalized design matrices	1 1.5 2.5	5	10
Therese Kalt	2/10/2026 2/11/2026 2/12/2026	- Worked on design criteria and matrix - Sketched 2 design ideas for design matrix - Finalized design matrix	1.5 1 1.5	4	10
Noor Awad	2/12/26 2/11/26	- Design matrix - Planning/researching electronics	2 1	3	8
Freyja Heggeland	2/8/2026 2/10/2026 2/11/2026	- Material research - Starting the design matrices - Continued design matrices, design sketches	1 1 2	4	13

Design Matrices:

Design Matrix

Designs		Design 1: Fixed Length Shaft 		Design 2: Push Button Pin Shaft 		Design 3: Hands Free Board 	
Rank	Criteria	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
1	Weight (25)	4/5	20	4/5	20	5/5	20
2	Durability (25)	5/5	25	4/5	20	4/5	20
3	User Comfort (20)	4/5	16	4/5	16	3/5	12
4	Ease of Fabrication (15)	5/5	15	3/5	9	2/5	6
5	Safety (10)	5/5	10	4/5	8	4/5	8
6	Cost (5)	5/5	5	4/5	4	1/5	1
			81		77		67

Criteria

Weight (25):

Weight evaluates numerically and experimentally how heavy the final design will be perceived by the user. The product is intended to be in use while the client is physically supporting patients, so a manageable weight is a key factor in how easily this can be done. In addition, if the device is too heavy it might degrade faster or fail at attachments. Weight will be evaluated as better or worse than the previous design, which was deemed too heavy. If the device is too heavy and it hinders the client's ability to support the patient, the patient could face a safety risk. Since weight impacts comfort, durability, and safety, it is given the highest weighting of the criteria.

Durability (25):

Durability refers to the device's ability to withstand use for 8 hours a day 5 days a week. The device will be durable if it does not require frequent servicing. Durability also specifies that the attachments should be especially secure, since the previous designs have failed at the attachments. Durability can include the material strength and also the integrity of the design. If the device is not durable enough the device will be unsafe for the patient, so durability is very important for the chosen design.

User Comfort (20):

User comfort evaluates how easy it will be for the user to effectively use the final product. This includes how much the user's hand needs to extend to change the color of the light displayed at the end of the device, the grip used to hold the device for extended periods of time, and the user's confidence with using the final product for therapy. This criteria is important because this design has previously lacked comfortability for the user.

Ease of Fabrication (15):

Ease of fabrication describes the complexity of the design and evaluates how complicated the design would be to fabricate. This includes any 3D printing, machining, and circuitry. This criteria is important in order to determine if the proposed design would be able to be fabricated during the timeframe for this project and with the given resource constraints. However, this criteria is not the most important as there is only one prototype being fabricated opposed to multiple that need to be easily replicated.

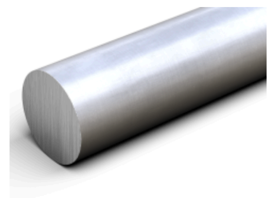
Safety (10):

Safety describes the potential risk of injury due to sharp edges, exposed circuitry, etc. in order to choose a design that reduces the risk of injury for the user. This criteria is weighted low as all of the design ideas will have the circuitry safely enclosed and include rounded edges in order to avoid harming the user.

Cost (5):

Cost evaluates the expense for fabricating each design. This criteria is weighted the lowest because all of the designs have a similar complexity and will easily remain in the budget provided. The overall cost will ultimately be determined by the material chosen which will be evaluated in the material matrix.

Material Matrix

Designs		Design 1: Carbon Fiber 		Design 2: Aluminum Alloy 		Design 3: PVC Tubing 	
Rank	Criteria	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
1	Weight (40)	5/5	40	2/5	16	3/5	24
2	Durability (30)	5/5	30	5/5	30	4/5	24
3	Ease of Fabrication (15)	1/5	3	3/5	9	5/5	15
4	Ease of Engraving (10)	2/5	4	4/5	8	4/5	8
5	Cost (5)	3/5	3	4/5	4	5/5	5
			80		67		76

Criteria

Weight (40):

Weight is ranked as the most important criteria because excessive weight was the primary concern raised by the client regarding the previous prototype. A reduction in weight is therefore critical to improving overall usability. The selected material must be as lightweight as possible while still meeting strength requirements. This will improve user comfort and reduce physical strain, particularly in a clinical setting where the device will be used repeatedly throughout the day. Additionally, lowering the weight contributes to patient safety by minimizing the risk of injury if the device is dropped or mishandled.

Durability (30):

Durability is ranked as the second most important criteria due to issues with structural failure in previous prototypes. The final design is expected to have a minimum life in service of one year with minimal maintenance. Therefore, the selected material must possess sufficient strength in order to not bend or break due to bending stresses from normal use. It should also demonstrate resistance to wear and impact from patients that can be encountered in a clinical environment. Ensuring durability will increase longevity and overall performance of the device.

Ease of fabrication (15):

Ease of fabrication is given a slightly lower weighting because the design requirements involve minimal complex manufacturing processes. The material will be purchased in tubular form, reducing the need for most fabricating techniques. Any additional fabrication such as cutting, drilling, or finishing will be carried out using tools available in the TEAMLab on campus. Although the fabrication process will be straightforward, the material should still be compatible with available tools and processes to ensure safe and accurate construction of the prototype.

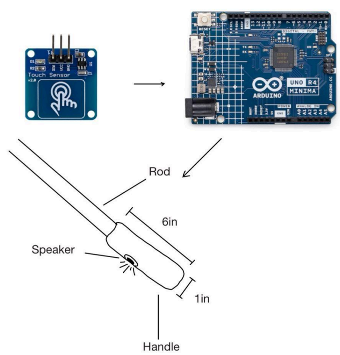
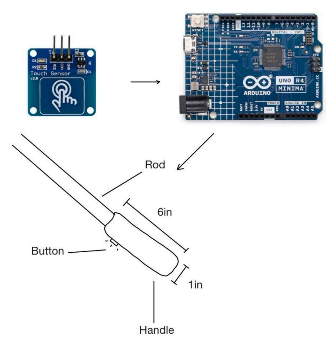
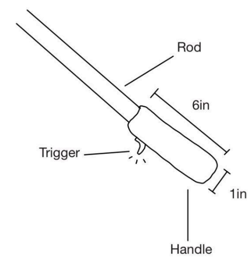
Ease of Engraving (10):

Ease of engraving evaluates how effectively measurement markings can be permanently applied to the material. The final prototype must incorporate a clear and accurate measurement system so that the client can collect reliable data during functional reach tests. The material should allow for precise engraving, etching, or marking without compromising structural integrity. While this is an important feature for usability and data accuracy, it is not weighted as highly because alternative marking methods such as vinyl decals, adhesive scales, or stenciling can be used if direct engraving is outside of the scope of this project.

Cost (5):

Cost is assigned a lower weighting because performance characteristics such as weight and durability are of greater importance for this project. As only a single prototype will be manufactured, material cost does not significantly impact the overall design. Furthermore, the client has provided a flexible budget, allowing material selection to be guided primarily by functionality rather than price constraints. However, cost is still considered to ensure responsible purchasing choices and to maintain the potential for future scalability if additional units are to be made.

Auditory Feedback Matrix

Designs		Design 1: Sensor-activated Speaker 		Design 2: Sensor-Activated Button 		Design 3: Manual Trigger 	
Rank	Criteria	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
1	Weight (35)	3/5	21	4/5	28	4/5	28
2	Ease of Use (30)	5/5	30	5/5	30	3/5	18
3	Ease of Fabrication (20)	4/5	16	2/5	8	4/5	16
4	Sound Variability (10)	5/5	10	3/5	6	3/5	6
5	Cost (5)	3/5	3	3/5	3	5/5	5
			80		75		74

Criteria:

Weight (35):

Weight is ranked as the most important criterion because excessive weight was a significant issue identified by the client in previous iterations of the device. Since the auditory feedback system is an additional feature being integrated into the existing design, it is essential that it does not increase the overall weight of the device by a large amount. The selected components must be lightweight and compact to ensure that the final prototype is lighter than previous versions.

Ease of Use (30):

Ease of use refers to the level of additional input required from the physician in order to activate or receive auditory feedback. The device should operate intuitively and integrate seamlessly into therapy sessions without requiring extra switches, buttons, or manual inputs. This ensures that the clinician can focus entirely on supporting and monitoring the patient rather than managing device controls. This criteria is weighted highly in order to prioritize patient safety and so as to not give extra work to the client.

Ease of Fabrication (20):

Ease of fabrication evaluates how complex it would be to integrate the auditory feedback system into the existing device architecture. This includes considerations such as modifying current circuitry, writing and debugging additional code, integrating new sensors or output components, such as a speaker, and producing any required 3D-printed housings or mounts.

Sound Variability (10):

Sound variability refers to the system's ability to adjust volume or tone to accommodate different patient needs. For example, patients with hearing impairments may require higher volume levels or specific frequency ranges to perceive feedback effectively, that may be too loud for other patients. Additionally, varied sounds for positive or negative feedback can potentially improve patient outcomes. Although customizable auditory feedback would enhance usability and inclusivity, it is not essential for basic device functionality. Therefore, this criteria is weighted lower than core functional considerations such as weight and ease of use.

Cost (5):

Cost is assigned the lowest weight because the project does not have strict financial constraints. The client has provided a flexible budget, allowing design decisions to prioritize performance, reliability, and usability over price. Furthermore, the potential design options are expected to fall within a similar cost range, reducing the impact of cost differences on decision-making. Therefore, cost will likely not be a determining factor.