

Knee Crutch

Date: 12/4/25

Client: Daniel Kutschera

Advisor: Randy Bartels

Team:

Violet Urdahl - Team Leader (vurdahl@wisc.edu)

Tess Fitzgerald - Communicator (tkfitzgerald@wisc.edu)

Aubrey Younker - BPAG (ayounker@wisc.edu)

Lauren Anderson - BSAC (ldanderson6@wisc.edu)

Kayla Christy - BSAC (kjchristy@wisc.edu)

Evan Koelemay - BWIG (ekoelemay@wisc.edu)

Problem Statement:

Knee crutches are an assistive device used to help non-weight-bearing patients recovering from a lower limb injury move efficiently and comfortably. Current devices available target assistance with walking, but are not suitable for ascending or descending stairs. To ensure patients can get home safely, the improved knee crutch will provide ample stability and assistance for stair climbing without the additional use of crutches. The goal is to create an improved version of an existing prototype that will provide users with sufficient mobility and stability when climbing stairs.

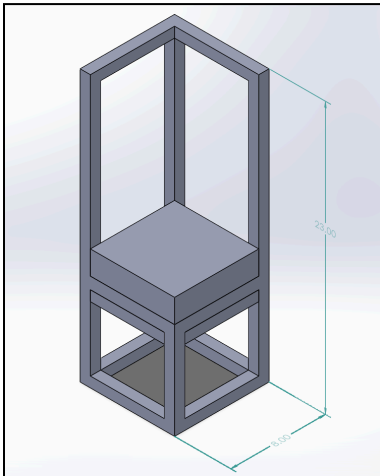
Brief Status Update:

The team was able to complete fabrication of the device and all adjustable components. Machine screws were cut down to three different sizes using a hacksaw to fit with the 1", 2", and 2.75" height-adjustable blocks. Velcro was aligned and attached to both the cushion and the blocks. Testing was then performed: static testing, dynamic testing, and survey testing. Force plate data was collected during the static and dynamic testing and used to calculate the average path length using MATLAB. This gave us quantitative stability data to perform analysis on for the final deliverables. Additionally, the team prepared for the final poster presentation by summarizing the work we've done this semester and practicing our presentation skills. This way, we can clearly and concisely describe our project to other teams, clients, and advisors.

Project Difficulties/Advice Requests:

- None

Final Design:



Materials and Expenses:

Item	Description	Manufacturer	Mft Pt#	Vendor	Vendor Cat#	Date	QTY	Cost Each	Total	Link
Category 1 - Base Materials										
4 piece Extruded Aluminum Rail Set	This set includes 4 rails that are 47.5 inches long each, and 4 sets of corner connector pieces	SkySHALO	# 335664 731 or model # 2020O BLXC4J Z2RFA O001V 0-S403	Home Depot	-	10/17/2025 and 10/24/25	1	\$43.70	\$46.10	link
10 piece Corner Connector Set	This set includes 10 extruded aluminum connectors and 20 t slot connectors and 20 screws	TOHIRA	TOHIR A1CR	Amazon	-	10/17/2025	3	\$12.99	\$38.97	link
Rubber Grip Tape	This includes one, 10 foot roll of grip tape	CATTONGUE GRIPS	B08CS3 Q3Y4	Amazon	-	11/18/2025	1	\$19.95	\$19.95	link
Category 2 - Knee Rest Materials										
PLA Stackable Blocks for Preliminary Prototype	Material used to 3D print stackable blocks for knee rest	Wendt	-	MakerSpace	-	11/5/2025	2	\$8.38, \$4.78	\$13.25	
PLA Stackable Blocks for Final Prototype	Material used to 3D print stackable blocks for knee rest	Wendt	-	MakerSpace	-	11/11/2025, 11/21/2025, 12/1/2025	3	\$6.37, \$10.76, \$14.62	\$31.75	
Memory Foam	Material for knee	Coaseb	B0CY7	Amazon	-	11/11/2025	1	\$19.36	\$19.36	link

Cushion	to directly rest on, custom size foam		C1YV4			25				
Velcro Strips	8 pack of black 1x2 in strips of velcro to attach cushion	UPwoktem	B0D1KJ P8GQ	Amazon	-	11/11/2025, 11/17/2025	2	\$13.99	\$27.98	link
Long Bolts with Washers and Lock Washers	8 pairs of long bolts, lock washers, and washers	BNUOK	B0DM1 PF9F7	Amazon	-	11/7/2025	1	\$9.99	\$9.99	link
synthetic fabric	piece of synthetic fabric used to wrap cushion component	Wendt	-	-	-	11/21/2025	1	available to us	\$0.00	
10-32 x 4" Flathead Machine Screws	15 threaded 4' flathead machine screws	Hard-to-Find Fastener	B008R YVV7C	Amazon	-	11/29/2025	1	\$10.25	\$10.81	link
1/8" Allen Wrench	1/8" Allen Wrench	Eklind Tool	000375 165160 84	Amazon	-	11/29/2025	1	\$3.29	\$3.47	link
10-32 x 1 1/4" Machine Screw	threaded 1 1/4" machine screws	TEAMlab	-	ECB Shop	-	11/11/2025	3	available to us	\$0.00	
Category 3 - Handle Materials										
Aluminum T-slot Handles for Preliminary Prototype	Set of 4, 7.5 inch aluminum handles compatible with t-slotted aluminum	Uxcell Store	a24091 800ux1 295	Amazon	-	10/24/2025	1	\$27.59	\$27.59	link
Aluminum T-slot Handles for Final Prototype	Set of 4, 4.7 inch aluminum handles compatible with t-slotted aluminum	Uxcell Store	a24091 800ux1 286	Amazon	-	11/17/2025	1	\$20.42	\$20.42	link
Grip Tape	Pack of 10 small rolls of multicolor grip tape for handle comfort	ORBEIN	griptape	Amazon	-	10/24/2025	1	\$9.99	\$9.99	link
Stainless Steel Button Screws	4 button screws and 4 washers	TEAMlab	-	ECB Shop	-	11/14/2025	4	\$1.48 (total)	\$1.48	

(10-32)										
								TOTAL:	\$281.11	

Team Goals for Upcoming Week:

- Wrap up all loose ends of testing and final deliverables
- Prepare the prototype and all additional parts to give to the client

Individual Goals for Upcoming Week:

- Tess Fitzgerald
 - Present final prototype and findings
 - Complete feedback fruits
 - Finish final report
- Aubrianna Younker
 - Share our project with the advisor, client, and peers
 - Give final feedback to peers and reflect on my constructive feedback
 - Complete and review final deliverables
 - Send all costs and receipts to the client for the refund process
- Lauren Anderson
 - Practice and present the final prototype to advisor, client, and peers
 - Finalize the final report
 - Complete the feedback fruits
- Violet Urdahl
 - Present final prototype to advisor and client
 - Finalize final report
 - Submit all final deliverables
- Kayla Christy
 - Complete and submit final deliverables
 - Share project with advisor, client, and peers
 - Give and receive feedback with peers
 - Complete feedback fruits for my group
- Evan Koelemay
 - Complete final deliverables
 - Give feedback to teammates
 - Present the final poster

Timeline

Task	September	October	November	December
------	-----------	---------	----------	----------

	5	12	19	26	3	10	17	24	31	7	14	21	28	5	10
Deliverables															
Progress Reports		X	X	X	X	X	X	X	X	X	X	X	X	X	
PDS Draft			X												
Design Matrix				X											
Preliminary Presentations					X										
Preliminary Lab Notebook						X									
Preliminary Report						X									
Preliminary Evaluations						X									
Show and Tell									X						
Final Poster Presentation														X	
Final Lab Notebook															
Final Report															
Final Evaluations															
Meetings															
Team	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Client	X			X		X				X					
Advisor			X		X		X	X		X	X				
Website															
Update	X	X	X	X	X	X	X	X	X	X	X	X		X	

Previous week's goals and accomplishments:

- Tess Fitzgerald
 - Completed final poster
 - Met with team to organize and create timeline for rest of semester
 - Conducted survey testing
 - Performed force plate testing
 - Printed final height knee rest block
- Aubrianna Younker
 - Cut machine screws down to size in the TEAMlab
 - Conducted static, dynamic, and survey testing
 - Analyzed and graphed test results from the survey testing in MATLAB
 - Finalized and completed the BPAG expense sheet
 - Reviewed and printed the final poster
- Lauren Anderson
 - Helped sew the final cushion for the knee crutch
 - Created survey for in person testing

- Participated in force plate testing
- Completed the final poster
- Violet Urdahl
 - Added velcro to blocks and adjusted the height of the device
 - Conducted survey and force plate testing
 - Analyzed test results in MATLAB and evaluated design implications
 - Completed final poster
- Evan Koelemay
 - Met with team to plan out final deliverables
 - Completed final poster
 - Worked on final report
- Kayla Christy
 - Completed final poster
 - Worked on final report
 - Cut down screws to size for 3D printed blocks
 - Finished connecting parts on our prototype with our correct screws
 - Joined team meeting to discuss final deliverables

Activities

Name	Date	Activity	Time (h)	Week Total (h)	Sem. Total (h)
Violet Urdahl	12/3/25	Added velcro to blocks, completed testing, analyzed results, and completed final poster	8	8	35.5
Aubrianna Younker	12/3/25	Cut screws, performed testing, analyzed survey results, final poster, and expense sheet	8	8	37hrs
Tess Fitzgerald	12/4/25	Preformed testing, printed knee rest block, completed final poster	8	8	35h
Lauren Anderson	12/3/25	Sewed final cushion, participated in testing, worked on the poster, starting working on the final report	8	8	30h
Evan Koelemay	12/4/25	Team meeting, work on poster/report	5	5	30.5hrs
Kayla Christy	12/3/25	Cut screws, final poster and final report	9	9	36h
Whole Team	12/1/25	Met to finalize poster presentation, fabrication, and testing	3	3	26hrs
Whole Team + Advisor	11/21/25	Final meeting with advisor to share	1	1	

Meeting		fabrication results and testing plans			
---------	--	---------------------------------------	--	--	--