

## **Knee Crutch**

**Date:** 11/13/25

**Client:** Daniel Kutschera

**Advisor:** Randy Bartels

### **Team:**

Violet Urdahl - Team Leader ([vurdahl@wisc.edu](mailto:vurdahl@wisc.edu))

Tess Fitzgerald - Communicator ([tkfitzgerald@wisc.edu](mailto:tkfitzgerald@wisc.edu))

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### **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:**

This week, the team was able to make good forward progress on fabrication. We met with the design consultants, and they helped us work out specifics about our last steps of fabrication.

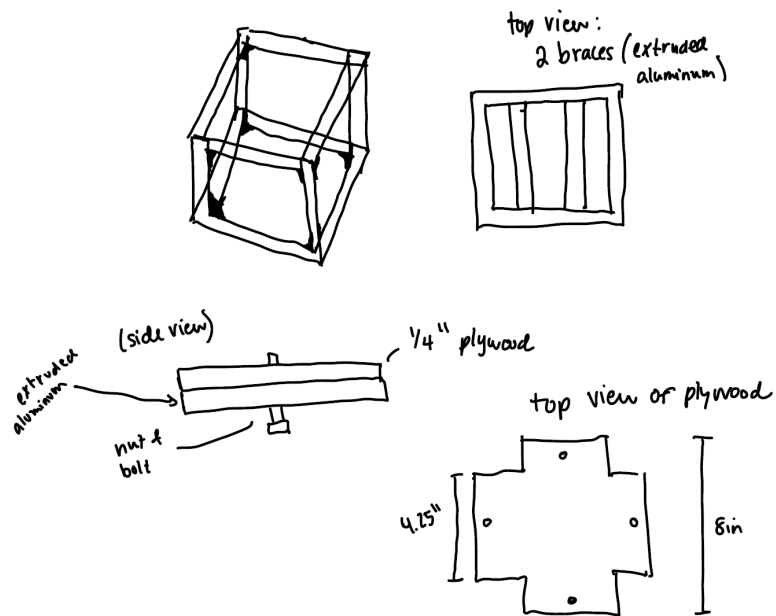
They led us to an easier fabrication method for attachment of the knee rest adjustable components to the base. Instead of drilling into the extruded aluminum, we are going to fasten the adjustable blocks to a small bolt that slides in the t slot. This will decrease the potential of damaging the aluminum frame. Also with this change, we are no longer including the plywood foundation, and instead we printed another adjustability block. The overall design idea remains unchanged, just different fabrication methods. The final round of materials was ordered:

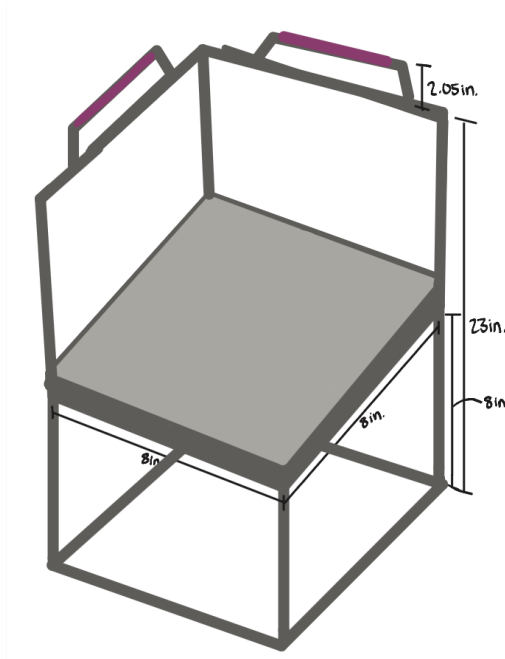
high-density foam and velcro for the knee rest. Fabrication should be concluded early this next week, so we can begin implementing our testing. Lastly this week, we were able to meet with our client again about a possible hospital visit for testing, poster presentation and updates on the device.

### **Project Difficulties/Advice Requests:**

- Finding bolts that have a head large enough to secure the handles, but a bottom width small enough to fit in a T-slot fastener.

### Current Design:





### Materials and Expenses:

- See table below:

| Item                                  | Description                              | Manufacturer | Date                 | #                                  | Cost Each | Total   | Link                 |
|---------------------------------------|------------------------------------------|--------------|----------------------|------------------------------------|-----------|---------|----------------------|
| PLA                                   | 3D printing material for knee support    | Makerspace   | Purchased on 11/5/25 | Pair of blocks                     | \$18.33   | \$24.70 | N/A                  |
| Extruded Aluminum Set with Connectors | Material for legs and knee support frame | Home Depot   | Purchased on 10/10   | 1 set of 4 rods and connector sets | \$43.70   | \$43.70 | <a href="#">link</a> |
| Memory foam cushion                   | Material for knee to rest directly on    | Amazon       | Purchased on 11/11   | 1 piece of custom size foam        | \$19.36   | \$19.36 | <a href="#">link</a> |
| Rubber base                           | Material for non-slip bottom base        | Amazon       | Have not purchased   | N/A                                | N/A       | \$0.00  |                      |

|                                                  |                                                                     |        |                              |                                |               |                          |                      |
|--------------------------------------------------|---------------------------------------------------------------------|--------|------------------------------|--------------------------------|---------------|--------------------------|----------------------|
| Additional Connectors for Extruded Aluminum rods | Set of 10 extruded aluminum rod connectors                          | Amazon | Purchased on 10/10 and 10/24 | 3 set of 10 connectors         | \$12.99       | \$37.97                  | <a href="#">link</a> |
| Aluminum T-slot Handles                          | Set of 4, 7.5in aluminum handles compatible with t-slotted aluminum | Amazon | Purchased on 10/24           | 1 set of 4 handles             | \$27.59       | \$27.59                  | <a href="#">link</a> |
| Grip Tape                                        | Pack of 10 small rolls of multicolor grip tape                      | Amazon | Purchased on 10/24           | 1 pack of 10 rolls             | \$9.99        | \$9.99                   | <a href="#">link</a> |
| Velcro strips                                    | 8 pack of black 1x2 inch strips                                     | Amazon | Purchased on 11/11           | 1 pack of 8 pieces             | \$13.70       | \$13.70                  |                      |
| Long bolts                                       | 8 sets of long bolts, lock washers, and washers                     | amazon | Purchased on 11/7            | 1 pack of 8 sets of long bolts | \$9.99        | \$9.99                   | <a href="#">link</a> |
|                                                  |                                                                     |        |                              |                                | <b>TOTAL:</b> | <b>\$186.70 with Tax</b> |                      |

### Team Goals for Upcoming Week:

- Complete all fabrication including the base, knee rest and handle
- Start the stability comparison testing between the previous prototype and ours
- Be in contact with our client and schedule the hospital visit there

### Individual Goals for Upcoming Week:

- Tess Fitzgerald
  - Finish fabrication of base and knee rest
  - Attach cushion to knee rest and handles to base
  - Write out a finalized protocol
  - Create a test survey
- Aubrianna Younker

- Cut, assemble aluminum rods, and attach handles for the top component
- Attach completed handle component to the base
- Continue filling in the gaps in my labarchive notebook
- Lauren Anderson
  - Finish fabrication of the cushion: attach the velcro components and ensure a professional finish
  - Finalize fabrication as a team and ensure the base is supportive of weight
  - Update lab archives with the fabrication changes from the design consultation
- Violet Urdahl
  - Create SolidWorks design of prototype for final deliverables.
  - Finalize testing protocol
  - Finish fabrication of entire prototype
- Kayla Christy
  - Attend the BSAC meeting
  - Work on fabricating the handle component of the prototype
  - Update lab archives with changes in the prototype
  - Do more research on patents
- Evan Koelemay
  - Finalize the last design components and make any last adjustments to the base
  - Figure out what to get for the rubber base component and add that

## 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 |    |    |    |          |    |
| 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 |           |    |    |    |         |    |    |    |          |   |    |    |    |          |    |
| Final Lab Notebook        |           |    |    |    |         |    |    |    |          |   |    |    |    |          |    |
| Final Report              |           |    |    |    |         |    |    |    |          |   |    |    |    |          |    |
| Final Evaluations         |           |    |    |    |         |    |    |    |          |   |    |    |    |          |    |
| Meetings                  |           |    |    |    |         |    |    |    |          |   |    |    |    |          |    |

|         |   |   |   |   |   |   |   |   |   |   |  |  |  |  |  |
|---------|---|---|---|---|---|---|---|---|---|---|--|--|--|--|--|
| Team    | X | X | X | X | X | X | X | X | X | X |  |  |  |  |  |
| Client  | X |   |   | X |   | X |   |   |   | X |  |  |  |  |  |
| Advisor |   |   | X |   | X |   | X | X |   | X |  |  |  |  |  |
| Website |   |   |   |   |   |   |   |   |   |   |  |  |  |  |  |
| Update  | X | X | X | X | X | X | X | X | X | X |  |  |  |  |  |

### Previous week's goals and accomplishments:

- Tess Fitzgerald
  - Went to design consultation and altered mechanism for attaching knee rest to base
  - Redesigned knee rest on SolidWorks and 3D printed at Makerspace
  - Communicated with client and discussed testing plans/hospital visit
- Aubrianna Younker
  - Placed order for the remaining material for the knee rest component
  - Updated the BPAG budget spreadsheet and purchase receipts
  - Completed group portions of the progress report
  - Consulted the client about reimbursement plans
- Lauren Anderson
  - Attended the design consultation meeting to discuss the easiest way to attach components
  - Attended the BSAC meeting and took notes
  - Assisted in finalizing what knee cushion to move forward with and order material as a team
- Violet Urdahl
  - Cut and assembled strut and additional base frame components
  - Finalized design and ordered materials
  - Met with client and received feedback
- Evan Koelemay
  - Added support beam to the base component
  - Cut more aluminum to be used for the base frame
- Kayla Christy
  - Updated the sketch of our prototype
  - Attended the design consultation meeting
  - Research on patents
  - Worked on fabrication for the handle component of our prototype

### Activities

| Name                         | Date       | Activity                                                                 | Time (h) | Week Total (h) | Sem. Total (h) |
|------------------------------|------------|--------------------------------------------------------------------------|----------|----------------|----------------|
| Violet Urdahl                | 11/7/25    | Cut and assembled extra base components                                  | 2        | 2              | 22.5           |
| Aubrianna Younker            | 11/12/25   | Material ordering, expense book keeping, group progress report           | 3hrs     | 3hrs           | 24.5hrs        |
| Tess Fitzgerald              | 11/13/2025 | Design consultation, SolidWorks fabrication, 3D printing, client meeting | 3.5hr    | 3.5hr          | 23h            |
| Lauren Anderson              | 11/13/25   | Design consultation, BSAC meeting, material ordering                     | 2.5      | 2              | 22h            |
| Evan Koelemay                | 11/13/25   | Further base fabrication/planning                                        | 2        | 2              | 20.5hrs        |
| Kayla Christy                | 11/13/25   | Updated sketch, design consultation meeting, research patents            | 2        | 2              | 21h            |
| Whole Team                   | 11/10      | Fabrication plans                                                        | 1.5      | 1.5            | 21hrs          |
| Whole Team + Advisor Meeting | 11/7       | Updates, advice, fabrication plans                                       | 1        | 1              |                |