P14006
Bath Tub Lift MSD II

Amos Baptiste
Jeremy Czeczulin
Andrew Hughes
Richard Prilenski

Introductions

Name	Major/Role
Amos Baptiste	Industrial & Systems Engineer/Team Leader
Jeremy Czeczulin	Mechanical Engineer
Andrew Hughes	Mechanical Engineer
Richard Prilenski	Mechanical Engineer

Agenda

- Action Items from Last Meeting
- Components Ordered
- System Demo
  - Actuator Test
  - Light Duty Slide Test
  - Seat Test
  - Suction Cup Test
  - Actuator Case Test
- Weight of the Device
- Problem Tracking
- Budget
- Schedule
- Action Items

Action Items From Last Meeting

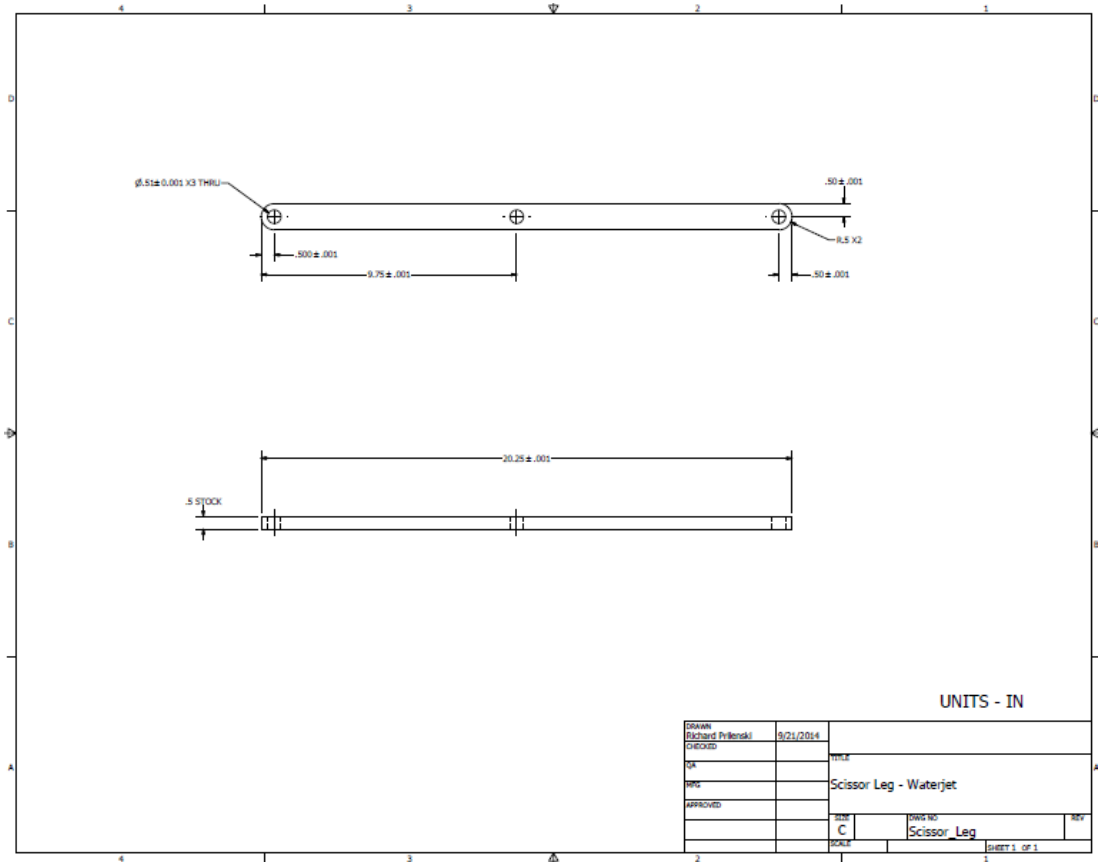
Action Item	Team Member	Promise Date
Purchase Ziploc Vacuum Space Bag	Amos	9/23/2014
Test Ziploc Vacuum Space Bag with Actuator	Team	9/27/2014
Order Seat	Jeremy & Andrew	9/23/2014
Order Swivel with locking pins	Jeremy & Andrew	9/23/2014
Update Schedule	Amos	9/30/2014
Update Budget	Amos	9/30/2014
Update Problem Tracking	Amos	9/30/2014
Develop outline draft for assembly instructior	Amos	10/2/2014
Meet with Theresa	Team	9/30/2014
Order scissor legs to be made	Richard	10/2/2014
Order Clevis	Richard	10/2/2014
Test Sunction Cups	Team	Within 1 week of delievery
Search for rollers	Andrew/Jeremy	10/2/2014
Contact metal mfg companies	Richard	10/2/2014
Update Edge	Amos	9/27/2014

Components Ordered

Light Duty Seat Slide with Stainless Steel Swivel

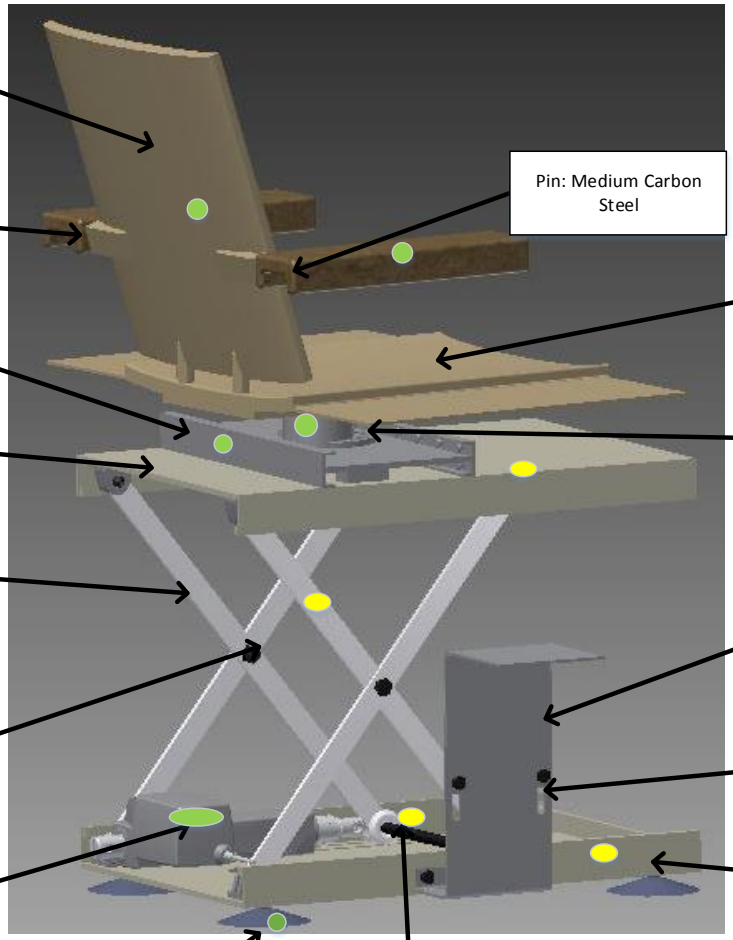
Commodore Seat (LLPE)

Manufacture Components



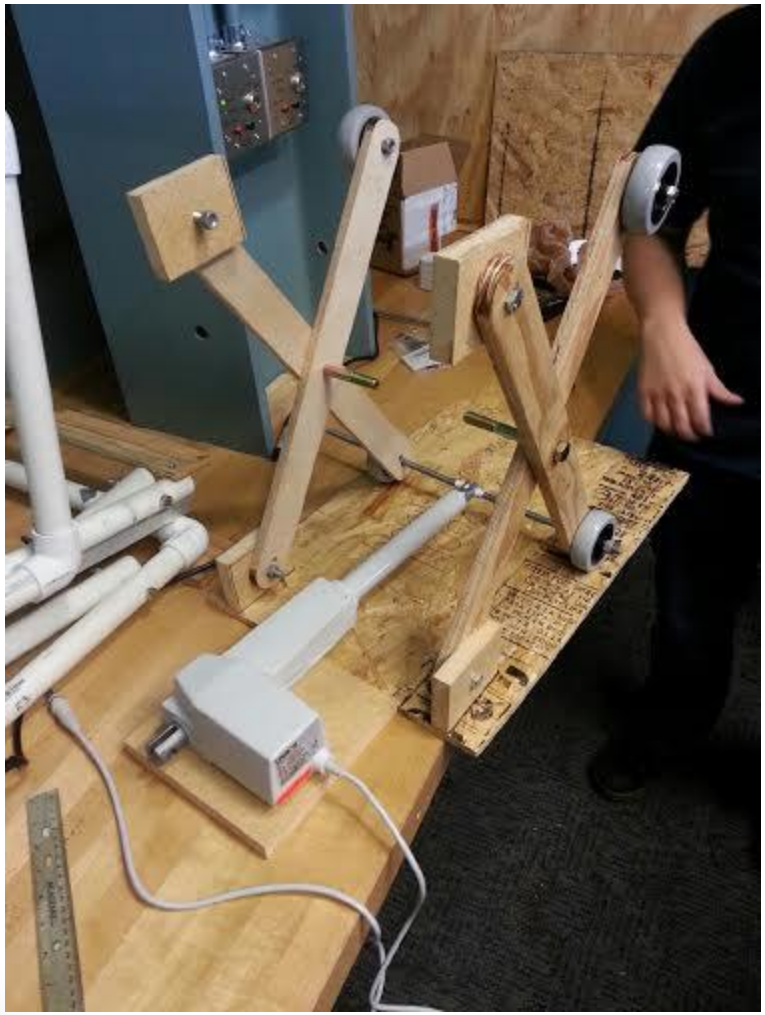
Drawing of the scissor legs to be manufactured.

Materials


Acrylic Plastic Optical Grade
Color: Beige
Acrylic Plastic Optical Grade
A36 Hot Rolled
Rollers: Steel
A36 Hot Rolled
A36 Hot Rolled
Medium Carbon Steel
LA 31 Actuator
Color: Black
Industrial Suction Cups
Medium Carbon Steel
Pin: Medium Carbon Steel
Waterproof memory foam padding
A36 Hot Rolled
Acrylic Optical Grade
Acrylic Plastic Optical Grade
Acrylic Plastic Optical Grade

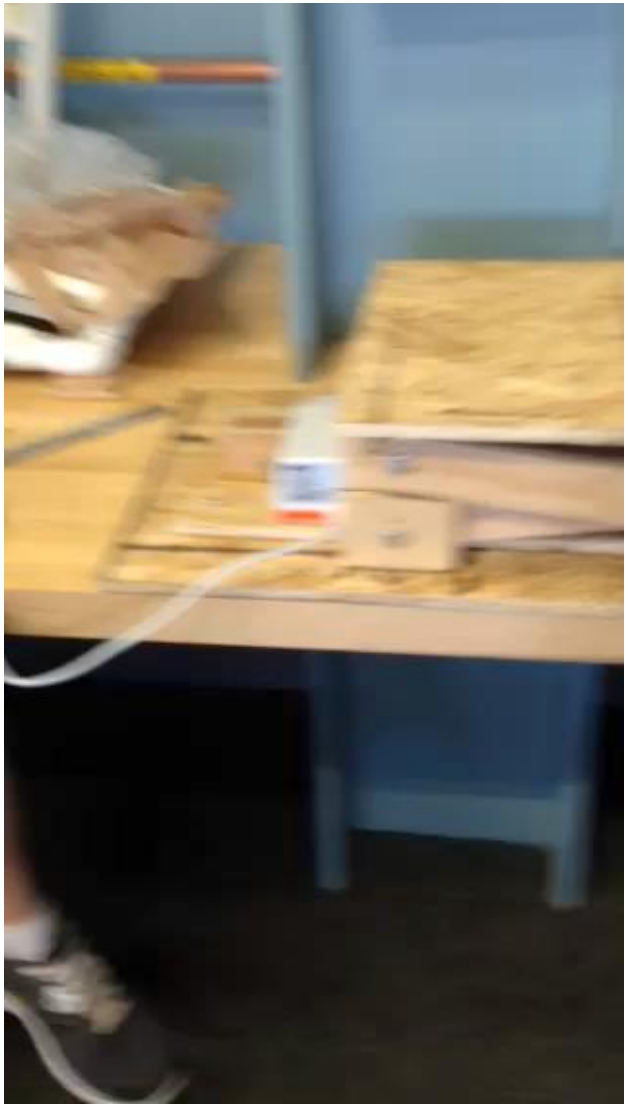
Wood Demo

Wood Demo



Wood Demo Iteration # 1

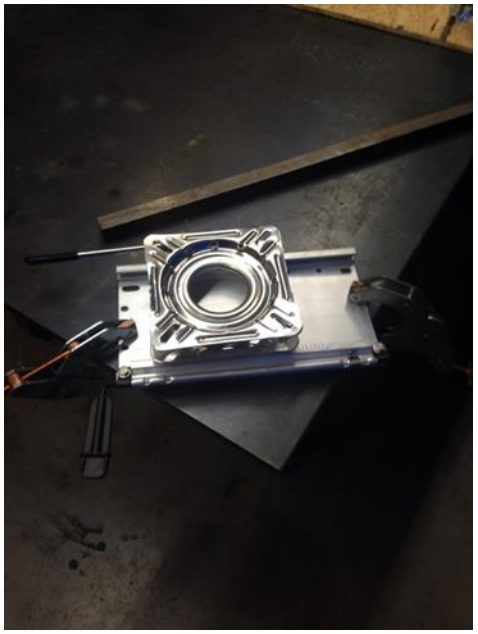
Wood Demo Iteration #2



What We Learned

- The wood demo cannot handle weight around 50 lbs.
- Need a strong dowel for the model
- Need a track system for the wheels under the seat base in order to stay in place
- Legs need to be precise in assembly and production in order for the seat to be leveled when raised
- Proof of concept

Light Duty Seat Slide Test

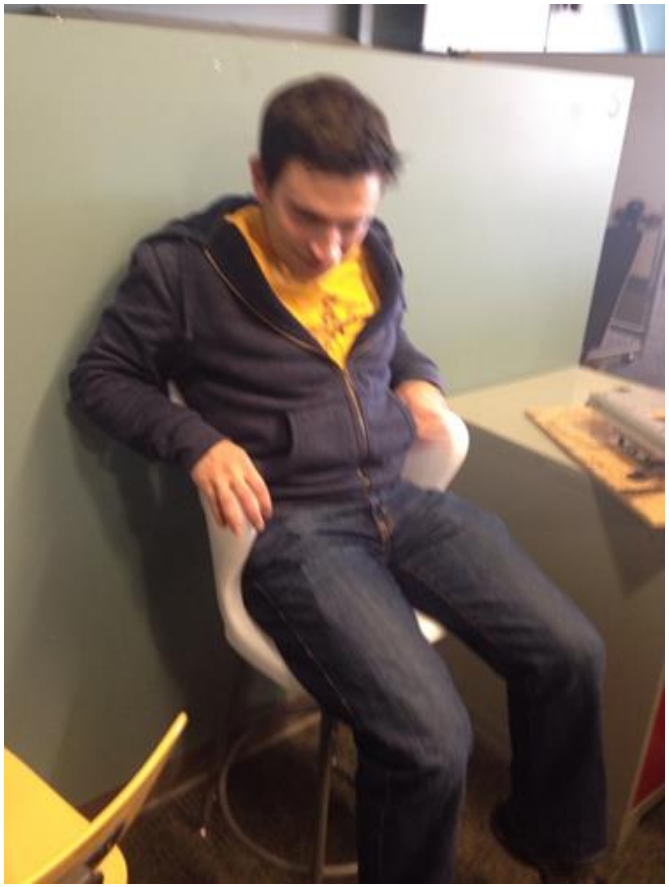


The sliding mechanism was brought to the Brinkman Lab where it was clamped to a steel table to see how much leverage is needed to rotate the swivel.

Light Duty Seat Slide Test

The sliding mechanism was then mounted on to the top base of the wood demo to test sliding and rotating with the chair.

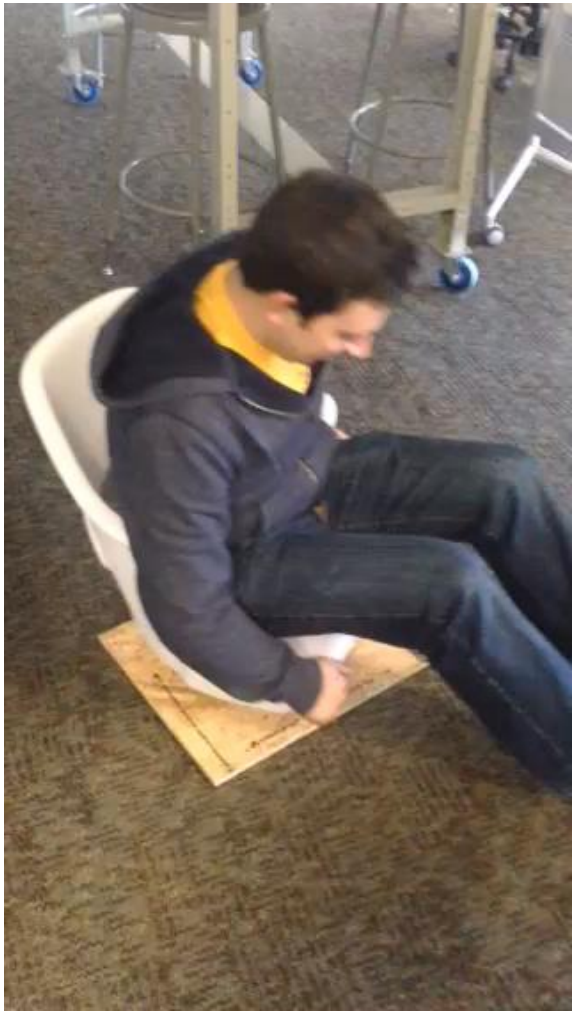
Seat Test



The chair was tested by having one of the team members sit on the chair to see for comfort and size. In addition, seeing how the chair dealt with water. As a result the chair was able to drain water out with the hole provided.

Ergonomics: The seat fit the target percentile and the arms rest are in the correct position to support Theresa when she sitting down and when she need to transfer from her wheel chair to the device.

Seat and Slide Demo

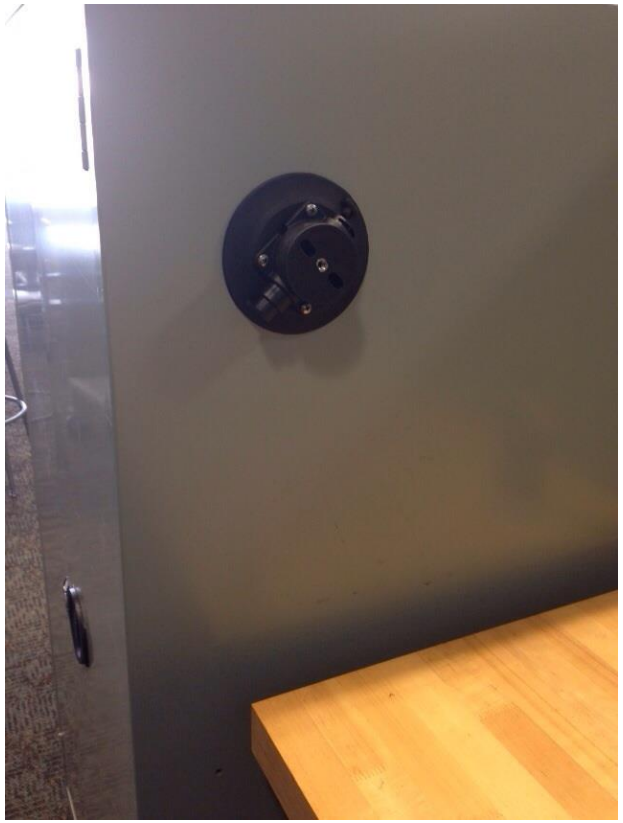


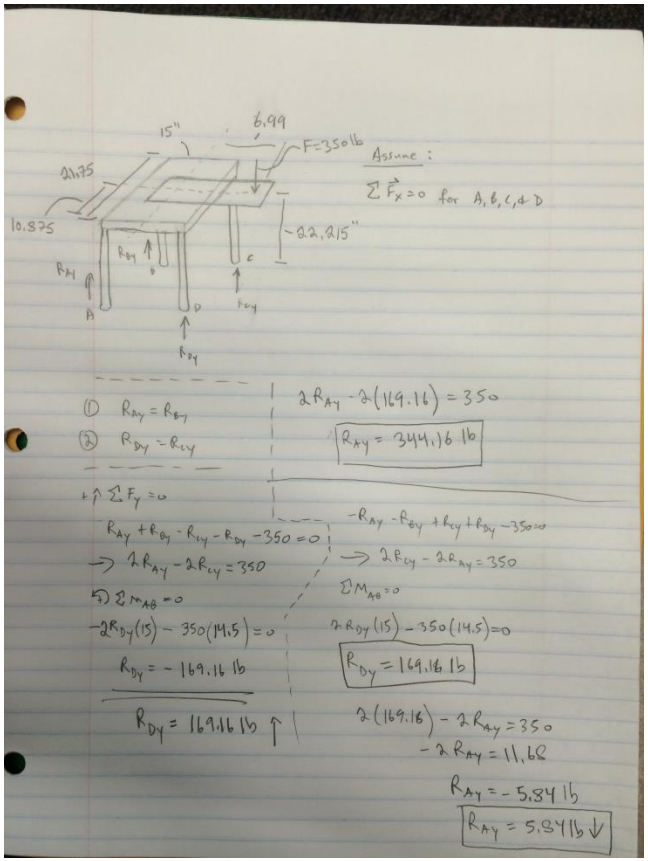
Seat and Slide Demo

Test: Group member sat on the seat and slide with weight holding down the board. Slide forward and back as well as rotating was tested.

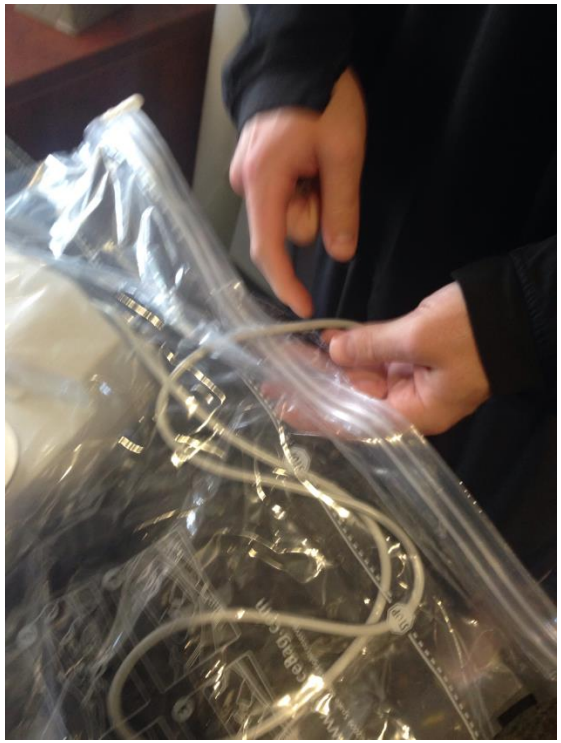
Results: The mechanism supports both functions. Sliding is easy for the user but rotating is relatively difficult. The lever needs to be held out to rotate so that it will not lock.

Suction Cup Test





Actuator Case Test



Actuator Case

Looking into bellows as a new solution and tying them off with hose clamps.

Weight of Device

Previous Weight of Product

Updated Weight of Product as of 10/11/14

ID	Part/Component	Weight (lb)
1	Actuator	5.8
2	Control Box	1
3	Control Box Remote	0.7
4	Battery	6.2
5	Slider	5.5
6	Seat	7.2
7	Seat Screws	0.1
8	Slider Mount Screws	0.2
9	Charger with Cable	1.5
10	4 Suction Cups	6.8
11	Mounting Brackets	1.3
12	4 Wheels	0.8
13	Top Base	
14	Bottom Base	
15	Rollers	
16	Scissors Legs	
17	Clevis	
18	Bellows	
19	Misc. Hardware	
20	Dowel	
21	Actuator Cover	

Total Weight	37.1
Weight of Device	27.1

Competitions

- NCEES Engineering Award
  - **Description:** ABET-accredited programs from all academic disciplines may submit collaborative projects that demonstrate a meaningful partnership between professional practice and education.
  - **Deadline:** March 15, 2015
- IEEE Engineering in Medicine and Biology Society Undergraduate Student Design Competition
  - **Description:** Involves designing and building an original device or product no currently offered on the market that applies engineering principles and technology to problems in medicine and biology.
    - Existing product modifications are acceptable
  - **Deadline:** June 1 (annually)

Problem Tracking

Problem Number	Identifying & Selecting Problem PSP 1	Analyzing Problem PSP 2	Generating Potential Solutions PSP 3	Selecting & Planning Solution PSP 4	Implementing Solution PSP 5	Evaluating Solution PSP 6
	R1	R2	R3	Y4	Y5	G6
1	Height of the chair	Actuator extends out too much the chain will surpass the required height.	Code the actuator to stop at a certain point instead of when it is fully extended			
2	Actuator failing to operate	Actuator not waterproof	•Cover the actuator with the bag. •Create and use accordion design to cover actuator. •Apply a lubricant to make the actuator waterproof.	Cover the actuator with a bag to make it waterproof.	Vacuum sealed Ziploc bag which can cover the actuator and try with demo.	Ziploc bag doesn't hold seal once a hole is placed for wiring. Bellows are now in consideration and will be tied off with a hose clamp.
3	Can't tell if the battery is charging	Depending on position/eye level with battery you can tell if it is charging.	•Mount the charger eye level to the user. •Attach a plastic piece in from of the LED light to increase the brightness.	Mount the charger eye level to the user during the time of customer visit.	While meeting with customer slightly test by attaching the charger to the wall and see where the it may be positioned.	
4	Actuator won't start	Battery is dead due to user negligence.	• Have the battery making a sound when it is low on battery. •Have the battery not operate if it is low on battery for user safety.	Have the battery not operate if it is low on battery for user safety		

Problem Tracking

Problem Number	Identifying & Selecting Problem PSP 1	Analyzing Problem PSP 2	Generating Potential Solutions PSP 3	Selecting & Planning Solution PSP 4	Implementing Solution PSP 5	Evaluating Solution PSP 6
	R1	R2	R3	Y4	Y5	G6
5	Weight of the battery	User has limited strength/arm capabilities	•Have the charging station and battery not above the users shoulders. •Place the battery and charging station where is can be installed while sitting. •Have someone help user charge the battery once a month.	Amos look into ergonomics of the weight of the battery	Have user have someone that could help once every 2 weeks to help with charging the battery	
6	Mounting bracket won't install correctly	Mounting bracket is bent	•Bend the mounting bracket back at the Brinkman Lab. •Contact Linak and have a new one sent.	Bend the mounting bracket at the Brinkman Lab.	Have the mounting bracket be bent back by the Brinkman lab and ensure it is straight.	
7	Device secured to the tub	Exceed load capacity or unleveled surface on the tub.	•Get industrial suction cups. • Side arm attachment to help prevent tipping of the bathtub lift.	Get vacuum powered suction cups from Seersuckers	Testing suction cups forces by calculation and with demo	From calculation the suction cups do very well and can withstand a load from a 350 lb person
8	Device legs buckling while raising the user up	Material and surface area of the beam	•Check previous drawings and calculations from stress analysis. •Assign new material property and conduct a stress test.	Richard run stress calculation and confirms material and suface area	Increase size of legs to 0.4" A36 Hot Rolled Steel	Device Legs buckling reduced and has a safety factor of 2.427 which is in the 2-4 range
9	Device legs buckling while raising the user up	Material and surface area of the beam	•Check previous drawings and calculations from stress analysis. •Assign new material property and conduct a stress test.	Richard run stress calculation and confirms material and suface area	Increase size of legs to 0.4" A36 Hot Rolled Steel	Device Legs buckling reduced and has a safety factor of 2.427 which is in the 2-4 range

Problem Tracking

Problem Number	Identifying & Selecting Problem PSP 1	Analyzing Problem PSP 2	Generating Potential Solutions PSP 3	Selecting & Planning Solution PSP 4	Implementing Solution PSP 5	Evaluating Solution PSP 6
	R1	R2	R3	Y4	Y5	G6
10	Force to rotate the light duty swivel	Bearing in the turn table is tight	•Apply lubricant on the bearing to make it easier to rotate	Apply a water based lubricant on the bearing to make it rotate easier. A sample lubricant was found in the suction cup shipment that was meant for bearings and is waterproof.		
11	Suction cups not coming after order	Sales representative not available and white suction cups sold out	•Find a new vendor •Track down sales representative or call Sea suckers	Team get in contact with Sea sucker and Chris from MSD office	Contacted both Chris and Sea sucker sale representative.	The suction came in. Delay in order due to sale representative being out for the week we wanted to place order.
12	Finding bellows for our needs	Customizable bellows have to be bought in bulk	•Call and see if instead of a bulk order a single order can be placed for the school			

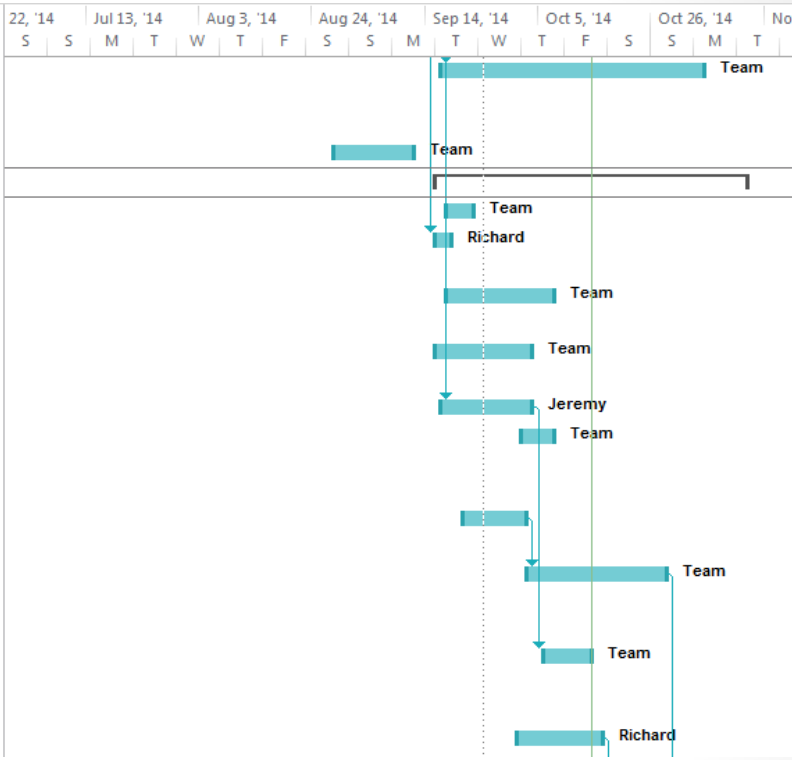
Budget

Budget	$1,500	
Material Purchased	**Cost**	**Amount Left**
Turn Table	$ 86.44	$1,414
Electrical Linear Acutator	$ 193.95	$1,220
Rechargeable Battery	$ 63.96	$1,156
Electric Control Box	$ 107.51	$1,048
Battery Charger	$ 157.37	$891
Remote Handset	$ 84.05	$807
Control Box Mounting	$ 9.76	$797
Charger Bracket	$ 11.59	$785
Main Cable	$ 15.77	$770
4 1/2" SeaSucker	$ 191.96	$578
Light Duty Seat Slide with Stainless Steel Swivel	$ 98.76	$479
Seat	$ 74.00	$405
Ziploc Space Bag	$ 13.39	$391
Platform Base	$ 50.00	$341
Home Depot Demo Purchase #1	$ 67.66	$274
Home Depot Demo Purchase #2	$ 43.78	$230
Shipping for Swivel and Seat	$ 25.00	$205

Schedule

GANTT CHART

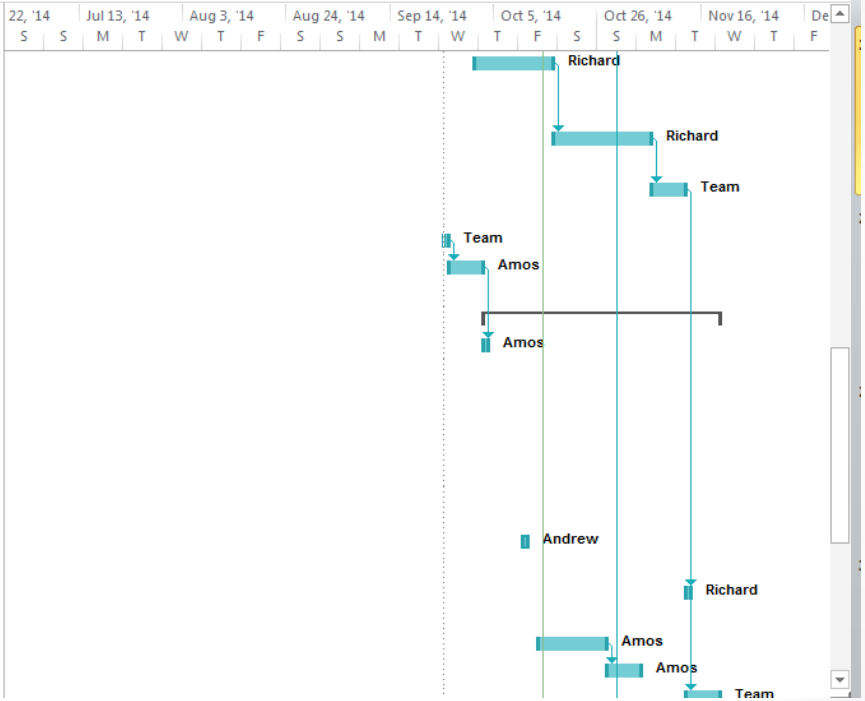
	Task Name	Duration	Start	Finish	Prede	Resource Names
7	Develop ideas for waterproof housing on actuator	35 days	Wed 9/17/14	Tue 11/4/14	6	Team
8	Build wood demo	11 days	Thu 8/28/14	Thu 9/11/14		Team
9	**Phase II**	**42 days**	**Tue 9/16/14**	**Wed 11/12/14**		
10	Test Turn Table	3 days	Thu 9/18/14	Mon 9/22/14		Team
11	Determine weight of product	3 days	Tue 9/16/14	Thu 9/18/14	3	Richard
12	Build & Test Lever with turn table	14 days	Thu 9/18/14	Tue 10/7/14		Team
13	Build & Test Acutator housing	14 days	Tue 9/16/14	Fri 10/3/14		Team
14	Test suction cups	13 days	Wed 9/17/14	Fri 10/3/14	5	Jeremy
15	Troubleshooting at the system integration level	4 days	Thu 10/2/14	Tue 10/7/14		Team
16	Build and Test Chair with Arm rest	2 wks	Sun 9/21/14	Thu 10/2/14		
17	Purchase and test Rollers on to the base of the chair	3.6 wks	Fri 10/3/14	Tue 10/28/14	16	Team
18	Build & Test base of bath tub lift with suction cups	7 days	Mon 10/6/14	Tue 10/14/14	14	Team
19	Order stock parts for	12 days	Wed 10/1/14	Thu 10/16/14		Richard



Schedule

GANTT CHART

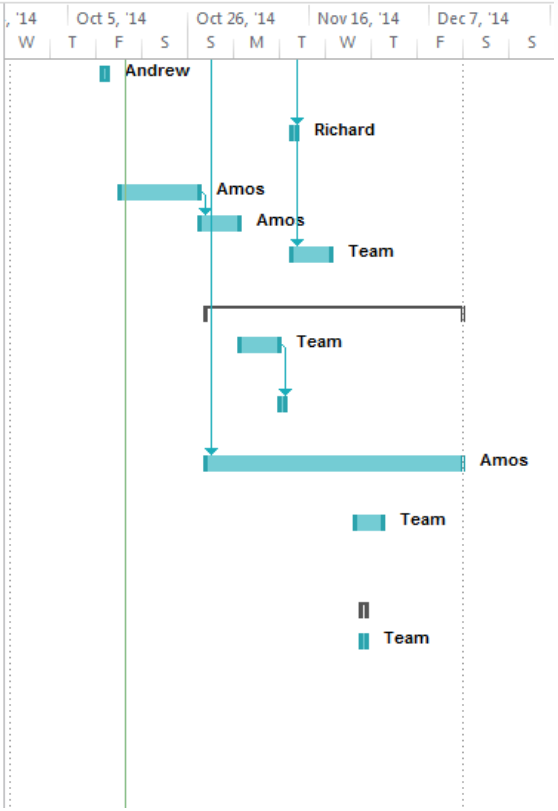
	Task Name	Duration	Start	Finish	Prede	Resource Names
19	Order stock parts for the base and legs to machine	12 days	Wed 10/1/14	Thu 10/16/14		Richard
20	Build & Test Legs of the Bath Tub Lift	14 days	Fri 10/17/14	Wed 11/5/14	19	Richard
21	Purchase & Test wheels with Legs	1 wk	Thu 11/6/14	Wed 11/12/14	20	Team
22	Phase II Review	1 day	Thu 9/25/14	Thu 9/25/14		Team
23	Meeting with Theresa with updates	1 wk	Fri 9/26/14	Thu 10/2/14	22	Amos
24	**Phase III**	**34 days**	**Fri 10/3/14**	**Wed 11/19/14**		
25	Identify external conference/competiti to submit paper, complete paper outline and identify who will be writing (or who has written) each section.	1 day	Fri 10/3/14	Fri 10/3/14	23	Amos
26	Determine new weight of product	1 day	Sat 10/11/14	Sat 10/11/14		Andrew
27	Determine new weight of product	1 day	Thu 11/13/14	Thu 11/13/14	21	Richard
28	Prepare paper	2 wks	Tue 10/14/14	Mon 10/27/14		Amos
29	Prepare poster	1 wk	Tue 10/28/14	Mon 11/3/14	28	Amos



Schedule

GANTT CHART

	Task Name	Duration	Start	Finish	Prede	Resource Names
26	Determine new weight of product	1 day	Sat 10/11/14	Sat 10/11/14		Andrew
27	Determine new weight of product	1 day	Thu 11/13/14	Thu 11/13/14	21	Richard
28	Prepare paper	2 wks	Tue 10/14/14	Mon 10/27/14		Amos
29	Prepare poster	1 wk	Tue 10/28/14	Mon 11/3/14	28	Amos
30	Complete demo of bathtub lift	5 days	Thu 11/13/14	Wed 11/19/14	21	Team
31	**Phase IV**	**33 days**	**Wed 10/29/14**	**Fri 12/12/14**		
32	Full Integrated demo with Customer	1 wk	Tue 11/4/14	Mon 11/10/14		Team
33	Troubleshooting demo	1 day	Tue 11/11/14	Tue 11/11/14	32	
34	Instruction on how to build demo	33 days	Wed 10/29/14	Fri 12/12/14	17	Amos
35	Update all BOM , schematics, and final hardware	1 wk	Mon 11/24/14	Fri 11/28/14		Team
36	**Phase V**	**1 day**	**Tue 11/25/14**	**Tue 11/25/14**		
37	Submit paper	1 day	Tue 11/25/14	Tue 11/25/14		Team



Action Items

Action Item	Team Member	Promise Date
Order stock parts for base and legs	Richard	10/17/2014
Order rollers and housings for them	Jeremy	10/21/2014
Order/purchase bellow with hose clamps	Andrew/Jeremy	10/21/2014
Machine legs and base	Richard	11/5/2014
Final assembly of device	Team	11/13/2014
Apply lubricant to bearing for easy movement	Andrew	10/21/2014
Apply to competitions	Amos	11/25/2014
Prepare Paper	Amos	11/25/2014
Prepare assembly instructions	Amos	11/20/2014
Order and machine dowel	Jeremy/Richard	10/21/2014
Test rollers	Jeremy/Andrew	11/5/2014
Test Legs and base	Andrew/Richard	11/5/2014
Test dowel	Jeremy/Richard	11/5/2014

Team Reflection

- **Team dynamics:** We are able to communicate well and address conflicts throughout the project
- **Logistics:** Meeting are scheduled 2-3 weeks with action items to work on prior to meeting
- **Project Planning:** Schedule had to be adjusted. Was a little disorganized from how thing were actually executed especially with lead time.
- **BOM:** Some issues with lead times and parts being tracked but are resolved. Issues with getting rollers and bellows currently. Have another team member find parts instead of having one person responisble.
- **Testing:** Owners for test are established and test are conducted and recorded. Findings from test are considered and adjustments are made.
- **Demos:** Participation from all members on demo for all the iterations taken.
- **Hand off to Customer:** Design for Maintenance. Currently working on instruction manual and maintenance to keep the device working properly.
- **Technical Paper:** Paper outline completed up to results since the final demo is not complete with all test.

Questions