

Ship Off the Old Blocks 2017: Results

Bharti School of Engineering
Laurentian University
Sudbury, Ontario, Canada

Winter 2017

Prototype results

Group	Performance						Cost		Total Score
	CUBE	CYL (sm)	RECT	CYL (lg)	TOTAL	Score	\$	Score	
1-01	5	5	5	5	20	100%	\$4.93	99.1%	99.7%
1-02	5	5	5	5	20	100%	\$11.49	97.6%	99.3%
1-03	3	3	3	3	12	80%	\$4.85	99.2%	85.7%
1-04	5	5	5	5	20	100%	\$3.08	99.6%	99.9%
1-05	0	0	0	0	0	50%	\$52.50	87.9%	61.4%
1-06	2	2	1	2	7	67.5%	\$23.06	94.9%	75.7%
1-07	0	0	0	0	0	50%	\$89.03	79.2%	58.8%
1-08	5	2	3	0	10	75%	\$67.67	84.3%	77.8%
1-09	5	5	3	2	15	87.5%	\$1.30	100%	91.2%
1-10	0	0	1	0	1	52.5%	\$108.06	74.7%	59.2%
2-01	2	2	2	2	8	70%	\$212.64	50%	64%
2-02	3	3	3	3	12	80%	\$21.84	95.1%	84.5%
2-03	2	3	2	3	10	75%	\$15.16	96.7%	81.5%
2-04	0	0	2	0	2	55%	\$46.08	89.4%	65.3%
2-05	3	2	3	3	11	77.5%	\$16.81	96.3%	83.1%
2-06	2	2	2	0	6	65%	\$84.49	80.3%	69.6%
2-07	2	1	2	0	5	62.5%	\$51.94	88%	70.2%
2-08	2	2	1	2	7	67.5%	\$6.20	98.8%	76.9%
2-09	0	3	0	3	6	65%	\$31.38	92.9%	73.4%

Final testing results

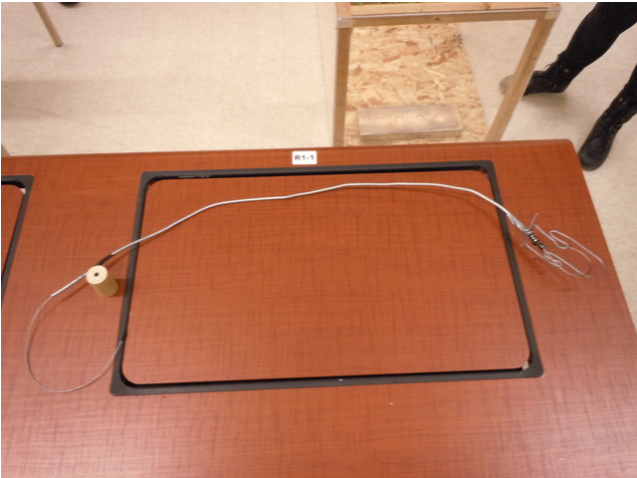
Group	Performance						Cost		Total Score
	CUBE	CYL (sm)	RECT	CYL (lg)	TOTAL	Score	\$	Score	
1-01	5	5	5	5	20	100%	\$4.41	99.8%	100%
1-02	5	5	5	5	20	100%	\$7.63	99.7%	99.9%
1-03	3	3	2	2	10	50%	\$3.17	99.9%	65%
1-04	5	5	5	5	20	100%	\$3.15	99.9%	100%
1-05	2	5	3	2	12	60%	\$38.37	55.4%	58.6%
1-06	3	3	3	3	12	60%	\$22.84	92.4%	69.7%
1-07	2	2	3	2	9	45%	\$9.84	99.4%	61.3%
1-08		5	5	5	15	75%	\$33.47	70.7%	73.7%
1-09 [†]	5	5	5	5	20	100%	\$1.25	99.9%	90%
1-10	5	5	5	5	20	100%	\$8.21	99.6%	99.9%
2-01	3	3	3	2	11	55%	\$114.85	0%	38.5%
2-02	5	3	3	5	16	80%	\$40.87	47.1%	70.1%
2-03	5	5	5	5	20	100%	\$3.44	99.9%	100%
2-04		2	2		4	20%	\$59.88	4.9%	15.5%
2-05	3	3	1	3	10	50%	\$13.17	98.7%	64.6%
2-06	2	2	2	2	8	40%	\$33.54	70.5%	49.1%
2-07	2		5	5	12	60%	\$45.52	32.3%	51.7%
2-08*	5	5	5	5	20	100%	\$5.29	99.8%	89.9%
2-09 [†]	3	3	1	1	8	40%	\$17.40	97%	51.4%
2-10 [†]	2	2	2	2	8	40%		0%	25.2%

*Penalty for being in contact with blocks at end of test (-10%).

[†]Penalty for late cost analysis sheet (-10%).

Group 1-01

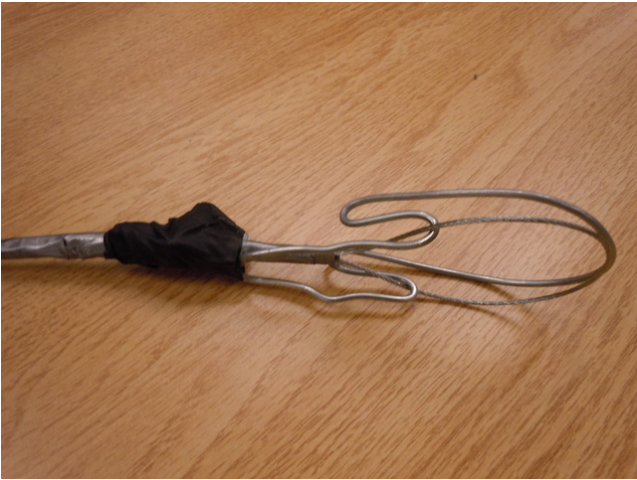
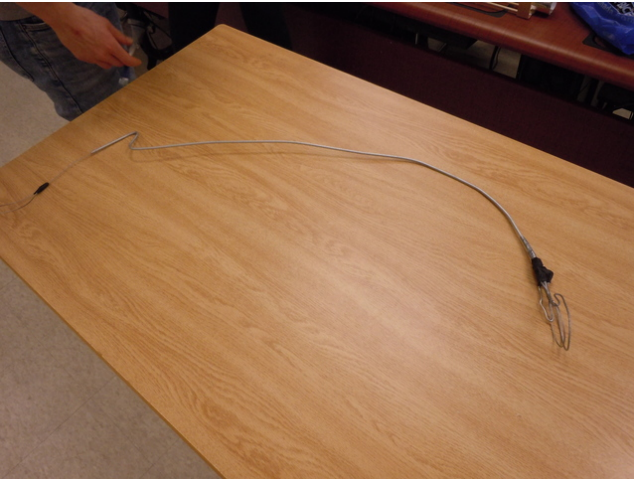
Prototype



Watch video of the device in action: <https://youtu.be/serChsab8gk?t=20s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
Roll of 25 ft. Zinc Plated 3/16" Brake Line Tubing	\$19.00	4 ft of brake line used	16%	\$3.04
TIE DOWN Pre-Cut Galvanized Aircraft Cable - Length: 50' Size: 1/16"	\$12.15	5 ft of cable used	10%	\$1.22
Madison Mill Round Material Poplar Dowel	\$5.99	2.5" of 48" used as handle	5.21%	\$0.31
The Hillman Group 14-Gauge Galvanized Wire	\$8.99	2 ft of wire used	2%	\$0.18
The Hillman Group 16-Gauge Dark Annealed Picture Hanging Wire	\$11.29	1 ft of wire used	1%	\$0.11
Cantech 48mm x 55m Multi-Purpose Duct Tape	\$7.99	0.5 m used	0.91%	\$0.07
			TOTAL	\$4.93

Final design

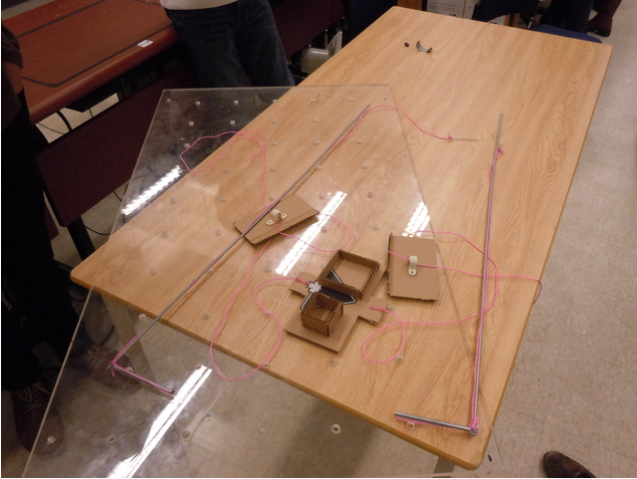
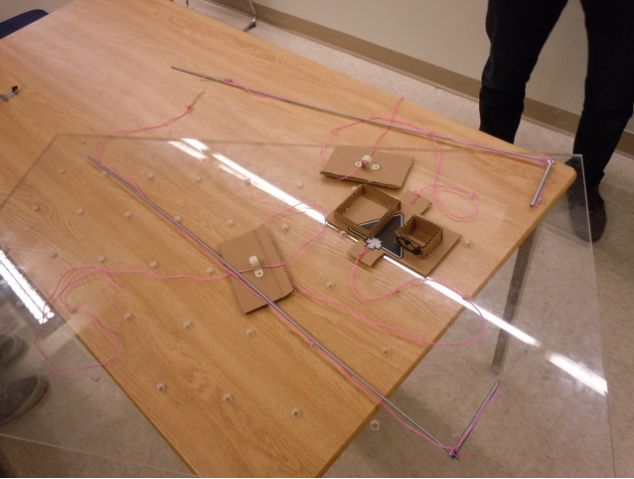


Watch video of the device in action: <https://youtu.be/ja5zt7ebGbk?t=21s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
Roll of 25 ft. Zinc Plated 3/16" Brake Line Tubing	\$19.00	44 inches of brake line used	14.7%	\$2.79
TIE DOWN Pre-Cut Galvanized Aircraft Cable - Length: 50' Size: 1/16"	\$12.15	6 ft of cable used	12%	\$1.46
The Hillman Group 14-Gauge Galvanized Wire	\$8.99	1 ft of wire used	1%	\$0.09
Cantech 48mm x 55m Multi-Purpose Duct Tape	\$7.99	0.5 m used	0.91%	\$0.07
			TOTAL	\$4.41

Group 1-02

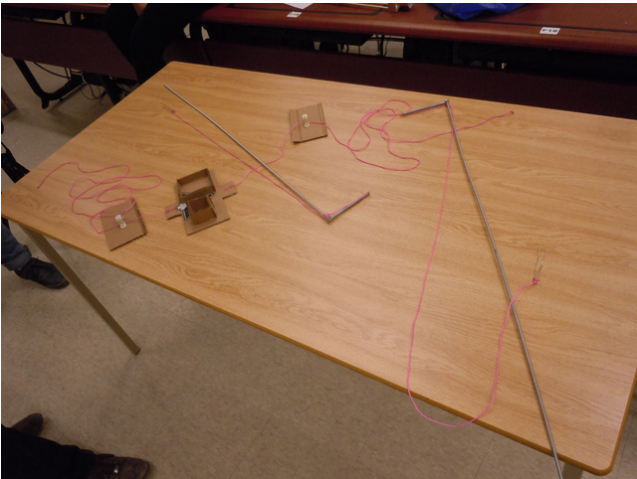
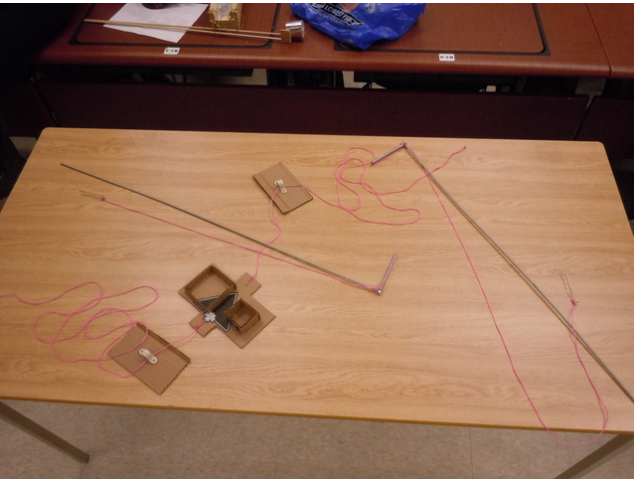
Prototype



Watch video of the device in action: <https://youtu.be/serChsab8gk?t=32s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
The Hillman Group 543019 Utility extension spring #S-1 13/32 in. Zinc Wood Screen Door Spring [NOT .CA]	\$4.29	Used in full. (Cut in half to make the two parts)	100%	\$4.29
The Hillman Group Zinc-Plated Steel Standard (SAE) Threaded Rod - 880989, 3/16-in x 36-in	\$1.97	Used 2	200%	\$3.94
Mastercraft Hot-Melt Glue Sticks (Product #054-0157-0) (6 pack)	\$1.19	Used 2	200%	\$2.38
Hillman Hex Nuts, Zinc, 60-pk (Product #161-0660-4) (10-24")	\$2.99	Used 1/2 of a glue stick. Out of 6	8.33%	\$0.25
Canadian Tire Moving Box (Product #067-6043-4)	\$5.49	Used 2 of 60 nuts.	3.33%	\$0.18
Pipe Straps (Product #063-0077)	\$1.69	We could make 9 more parts with the cardboard.	10%	\$0.17
Cotton Household Twine	\$2.49	Used 2 of 30 parts.	6.67%	\$0.17
Staples #1 Size Paper Clips, Non-skid, 10 x 100/Pack	\$3.29	Used 15ft of 450ft.	3.33%	\$0.11
	\$3.89	Used 2 of 1000 paperclips.	2%	\$0.01
			TOTAL	\$11.49

Final design

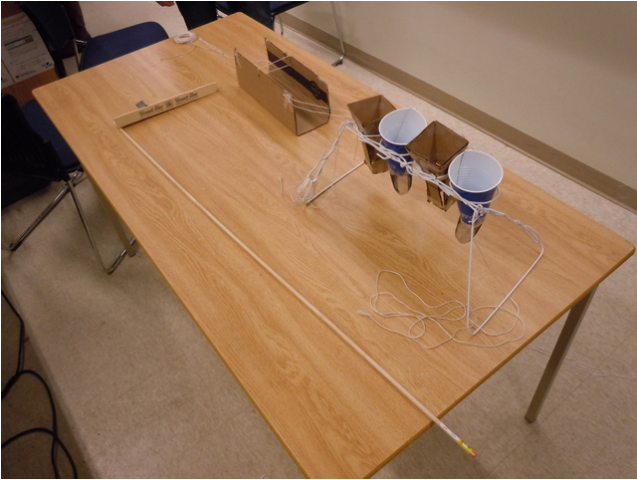
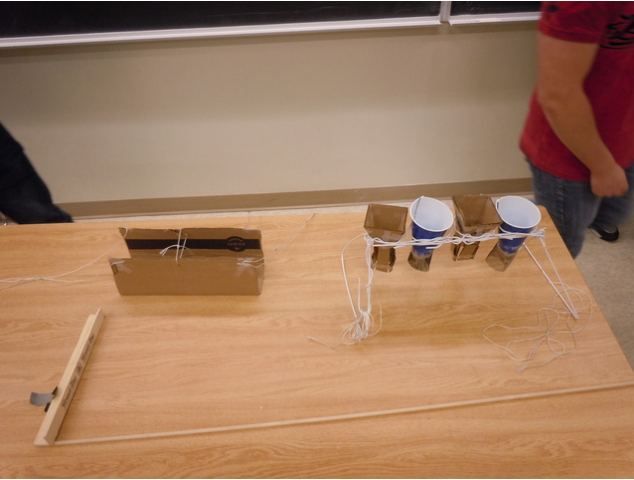


Watch video of the device in action: <https://youtu.be/ja5zt7ebGbk?t=25s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
The Hillman Group 543019 Utility extension spring #S-1	\$4.29	Used in full. (Cut in half to make the two parts)	100%	\$4.29
The Hillman Group Zinc-Plated Steel Standard (SAE) Threaded Rod - 880989, 3/16-in x 36-in	\$1.19	Used in full.	200%	\$2.38
Mastercraft Hot-Melt Glue Sticks (Product #054-0157-0) (25 pack)	\$7.99	Used 1/2 of a glue stick. Out of 25	4%	\$0.32
Hillman Hex Nuts, Zinc, 60-pk (Product #161-0660-4) (10-24")	\$5.49	Used 2 of 60 nuts.	3.33%	\$0.18
Canadian Tire Moving Box (Product #067-6043-4)	\$1.69	We could make 9 more parts with the cardboard.	10%	\$0.17
Pipe Straps (Product #063-0077)	\$2.49	Used 2 of 30 parts.	6.67%	\$0.17
Cotton Household Twine	\$3.29	Used 15ft of 450ft.	3.33%	\$0.11
Staples #1 Size Paper Clips, Non-skid, 10 x 100/Pack	\$3.89	Used 2 of 1000 paperclips.	2%	\$0.01
			TOTAL	\$7.63

Group 1-03

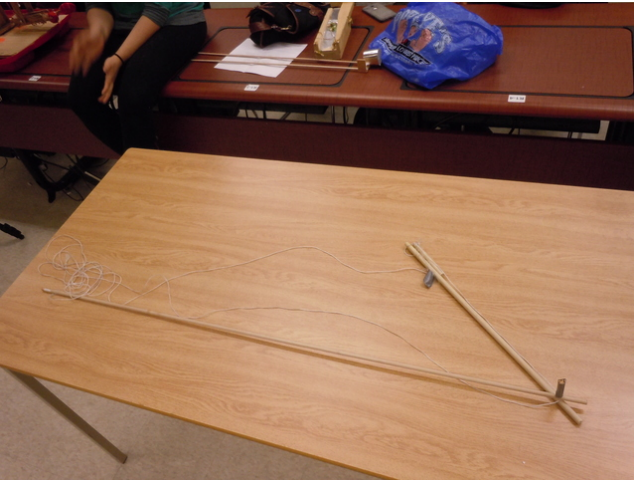
Prototype



Watch video of the device in action: <https://youtu.be/serChsab8gk?t=48s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
10 Pack White Wire Clothes Hangers	\$3.59	Used 4 of 10 pack. Could make 2.	40%	\$1.44
5/16" x 4' Hardwood Dowel	\$1.29		100%	\$1.29
SMALL CORRUGATED PADS 12 x 12"	\$400.00	Used 2 of order of 1000. Can make 500 from 1 order of 1000.	2%	\$0.78
#18 x 1,050 ft White Utility Twine	\$9.99	Used 56 of 1050 ft. Can make 18 devices.	5.33%	\$0.53
Perfect Stix 12" Wooden Paint Paddle Stirrer Sticks Length (Pack of 100)	\$22.67	Used 2 of 100 pack. Could make 50.	2%	\$0.45
24" Grey Fibreglass Window Screen	\$0.99	Used 50 in ² of 288in ² . Can make 5 devices	17.36%	\$0.17
Great Value 16 Oz. Red Party Cup	\$3.98	Used 2 of 50 cups. Can make 25 from 1 package.	4%	\$0.16
5 Star 19mmx33m Invisible Tape	\$0.98	Used 1m of 33m. Can make 33.	3.03%	\$0.03
			TOTAL	\$4.85

Final design

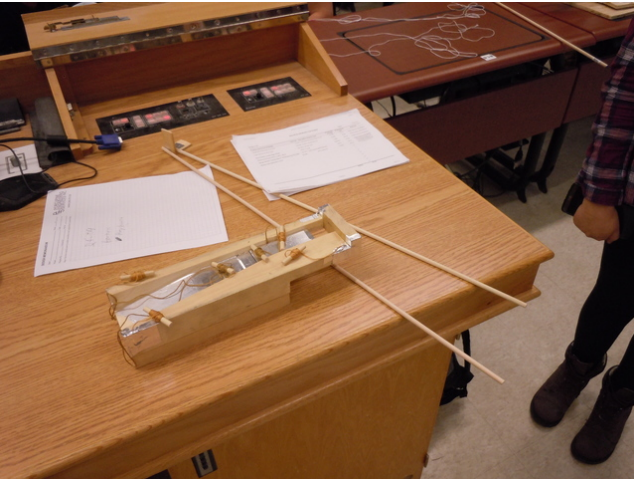


Watch video of the device in action: <https://youtu.be/ja5zt7ebGbk?t=37s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
5/16" x 4' Hardwood Dowel	\$1.29	Whole dowel used.	100%	\$1.29
7/16" x 4' Hardwood Dowel	\$2.19	Used half of one dowel. Could make 2 with one dowel.	50%	\$1.09
#18 x 1,050 ft White Utility Twine	\$9.99	Used 56ft of 1050 ft. Can make 18 devices.	5.33%	\$0.53
4" Long General Purpose Glue Stick	\$0.25	Used half a stick of glue. Could make 2 devices with one	50%	\$0.12
125 Pack 2" x 12 Ga. Common Nails	\$4.49	Used 2 nails out of 125. Could make 62 devices with one pack of nails	1.6%	\$0.07
48mm x 10M Poly Duct Tape	\$2.19	Used 0.15 m of the 10 meter roll of tape. Could make 666 devices with one roll.	1.5%	\$0.03
50 Pack 2" Paper Clips	\$1.19	Used 1 paper clip of the pack of 50. Could make 50 with one pack of paper clips	2%	\$0.02
			TOTAL	\$3.17

Group 1-04

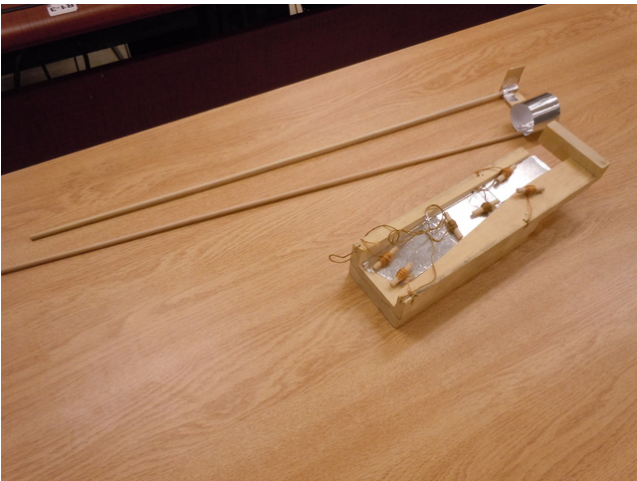
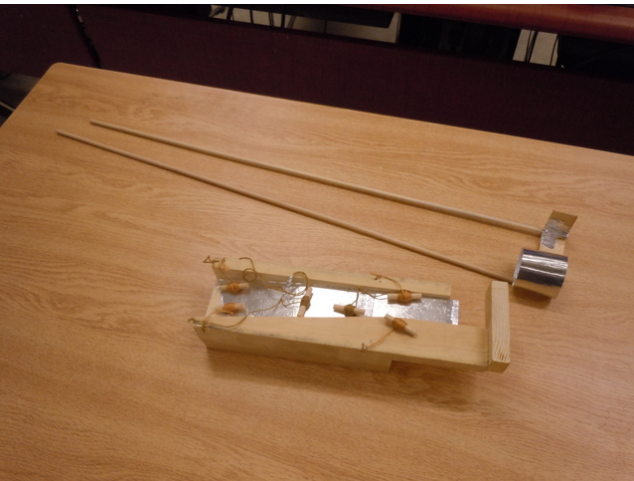
Prototype



Watch video of the device in action: <https://youtu.be/serChsab8gk?t=1m0s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
Hardwood Dowel 1/4 In. x 48 In. Blue	\$0.91	2 used	200%	\$1.82
2x4x8 SPF Dimension Lumber	\$2.95	2 feet of 8 feet total; 4 devices per	25%	\$0.74
Design Works Zenbroidery Rainbow Color Embellishment Pack, Set of 36	\$9.44	7 yards used of (36*10yards)	1.94%	\$0.18
Razor Blades Single edge 100pk	\$12.98	1 of 100 used	1%	\$0.13
Mastercraft Carpenter's Glue	\$25.00	20ml used of 4l	5%	\$0.12
Logix Aluminum Foil Tape	\$19.98	1.5 feet used of 342 feet	0.44%	\$0.09
			TOTAL	\$3.08

Final design

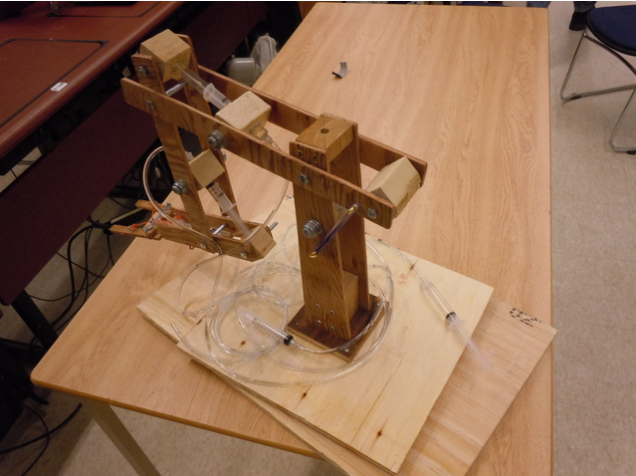
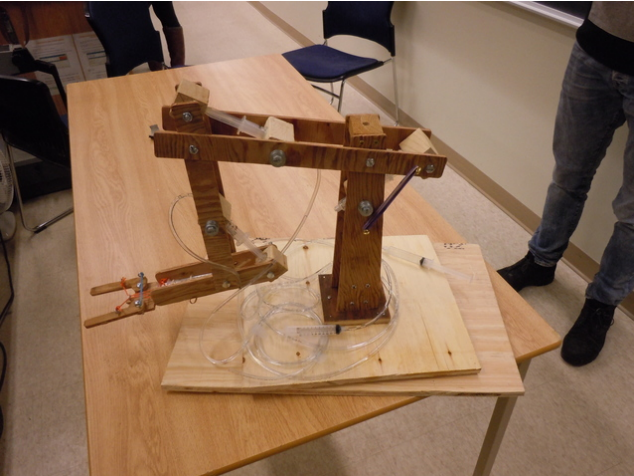


Watch video of the device in action: <https://youtu.be/ja5zt7ebGbk?t=45s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
Hardwood Dowel 1/4 In. x 48 In. Blue	\$0.91	2 used	200%	\$1.82
2x4x8 SPF Dimension Lumber	\$2.95	2 feet of 8 feet total; 4 devices per	25%	\$0.74
Design Works Zenbroidery Rainbow Color Embellishment Pack, Set of 36	\$9.44	7 yards used of (36*10yards)	1.94%	\$0.18
Razor Blades Single edge 100pk	\$12.98	1 of 100 used	1%	\$0.13
Mastercraft Carpenter's Glue	\$24.99	20ml used of 4l	5%	\$0.12
Logix Aluminum Foil Tape	\$19.98	1.5 feet used of 342 feet	0.44%	\$0.09
Danielson Removable Split Shot Sinkers, 40-pc	\$1.99	1 used of 40	2.5%	\$0.05
2 Inch Brad Nails (1000 Pack)	\$6.29	2 used of 1000	2%	\$0.01
			TOTAL	\$3.15

Group 1-05

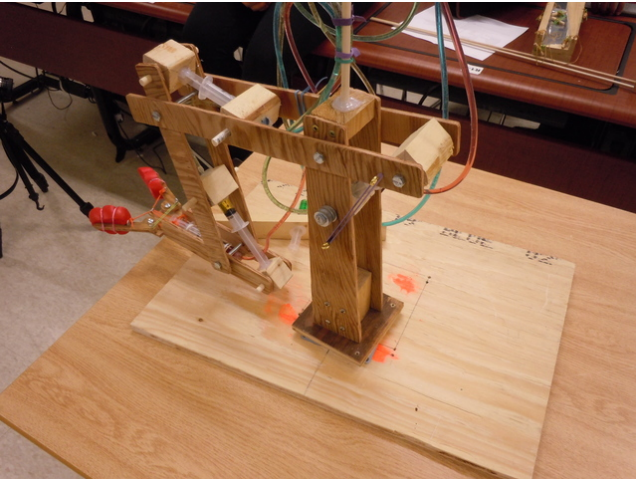
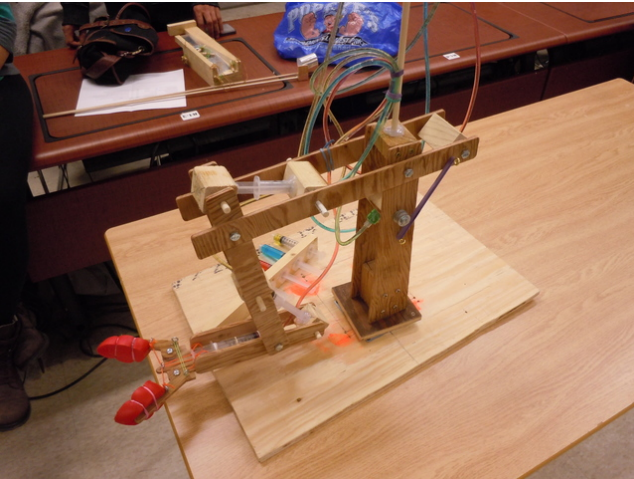
Prototype



Watch video of the device in action: <https://youtu.be/serChsab8gk?t=1m16s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
Shepherd Hardware 9547 Shepherd 4” Lazy Susan Turntable	\$11.86	4” x 4”	100%	\$11.86
The Hillman Group 16-Count 1/4”x5/8” Zinc Plated Standard Flat Washers	\$3.79	diam=1/4” (Used: 32)	200%	\$7.58
1/4” x 4ft x 8ft Pine Sanded	\$29.99	24”x24”x1/2”	25%	\$7.50
Vinyl Tubing 25’ Roll	\$8.25	L=17’, 1/8”diam; 17’ required	68%	\$5.61
10CC Syringes - 5/pkg	\$3.00	8 Syringes Used	180%	\$5.40
1/2” x 4ft x 8ft Standard Spruce	\$24.62	24”x24”x1/4”	20%	\$4.92
The Hillman Group #8 Zinc-Plated Flat-Head Square Wood Screws (L=0.5in) (Pack of 10)	\$2.59	1/2” L (Used: 15)	150%	\$3.88
The Hillman Group #8 Zinc-Plated Hex Washer-Head Slotted Standard Sheet Metal Screws (Pack of 8)	\$2.59	3/4”L; Used 6	75%	\$1.94
The Hillman group 1/4”-13 Zine Plated Hex-Head	\$0.25	Hex Bolt diam.=1/4”, Length=1 1/4”, used 7	700%	\$1.75
The Hillman Group 1/4”-20 Zinc Plated Standard	\$0.15	Hex Nut diam.=1/4”, used 7	700%	\$1.05
Hardwood Dowl 1/4 in x 48 in Blue	\$0.91	diam.=1/4”, Used: Length=24”	50%	\$0.46
Top Choice 2 x 2 x 8 ft SPF Furring Strip	\$3.09	Used: 2”x 2” x Used: 12”	12.5%	\$0.39
100ct Mini Glue Sticks	\$11.47	Gluegun glue (1 Stick used)	1%	\$0.11
Staples Economy Rubber Bands, Size #24	\$1.51	Regular plastic band (4 used)	2%	\$0.03
420’ Cotton Twine 1 Piece	\$4.48	Woven Nylon: Approx. 12” used	0.24%	\$0.01
			TOTAL	\$52.50

Final design

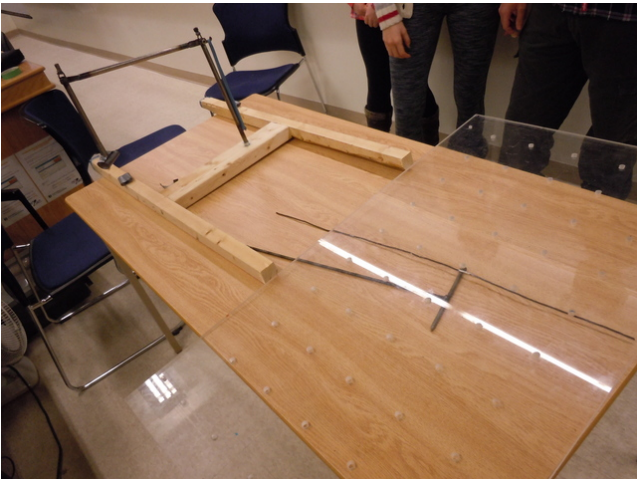
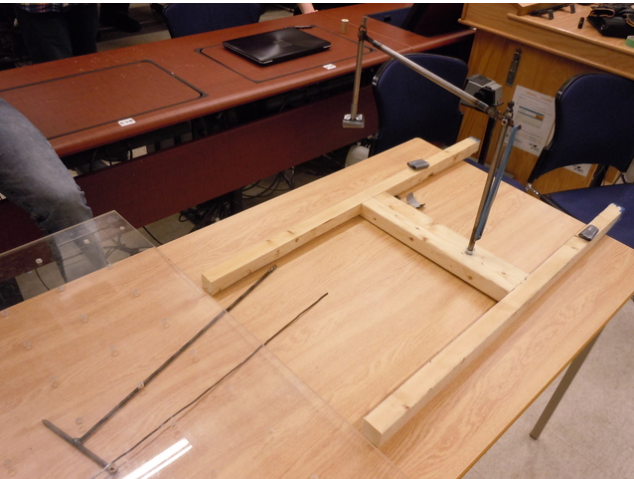


Watch video of the device in action: <https://youtu.be/ja5zt7ebGbk?t=55s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
Mintcraft JC-L01-3L Lazy Susan Turntable 4”	\$9.27	4”x 4”	100%	\$9.27
AraucoPly 1/4” x 4ft x 8ft Pine Sanded	\$29.99	24”x24”x1/4”	25%	\$7.50
1/2” x 4ft x 8ft Standard Spruce	\$24.62	24”x24”x1/2”	20%	\$4.92
The Hillman Group 280056 1/4-Inch Flat Washer, 100-Pack	\$8.02	diam=1/4” (Used: 50)	50%	\$4.01
Greenhealth Syringe 10cc Luer Lock W/o Needle 25/pk By Greenals	\$11.89	8 Syringes Used	32%	\$3.80
ATP Vinyl-Flex PVC Food Grade Plastic Tubing, Clear, 1/8” ID x 1/4” OD, 100 feet Length	\$13.10	L=17’, 1/8”diam; 17’ required	17%	\$2.23
Stress Toy, Kingfansion Apple Cream Scented Slow Rising Toy Cell Phone Charms Pendant Strap Small	\$1.24	Stress ball (Cut and attached to claw)	100%	\$1.24
The Hillman group 1/4”-13 Zine Plated Hex-Head	\$0.25	Hex Bolt diam.=1/4”, Length=1 1/4”, used 4	400%	\$1.00
Fixture Displays 100 PK Screw Philips #8 Wood Screw 1/2” 16028-100PK	\$4.67	1/2” L (Used: 20)	20%	\$0.93
100ct Mini Glue Sticks	\$11.47	Gluegun glue (8 Stick used)	8%	\$0.92
Top Choice 2 x 2 x 8 ft SPF Furring Strip	\$3.09	Used: 2”x 2” x 8’ Used: 23.5”	24.48%	\$0.76
The Hillman Group #8 Zinc-Plated Hex Washer-Head Slotted Standard Sheet Metal Screws (Pack of 8)	\$2.59	3/4”L; Used 2	25%	\$0.65
The Hillman Group 180400 Grade 8 Hex Nut, 1/4-Inch by 20-Inch, 100-Pack	\$10.98	Hex Nut diam.=1/4”, used 4	4%	\$0.44
XtremepwoerUS 347 PCS PC MM Nut Bolt Screw Washer Assortment Kit	\$14.95	Used: 2 x (1/8”diam. X 1.25”L) Bolts, and 2 x (1/8” diam.) nuts	1.15%	\$0.17
Waddell Manufacturing 6304U 1/4” x 36” Hardwood Dowel, (100 Pack)	\$14.90	diam.=1/4”, Used: Length=35”	0.97%	\$0.14
Staples Economy Rubber Bands, Size #24	\$1.51	Regular plastic band (18 used)	9%	\$0.14
Screw - SODIAL (R) 100pcs Small Tiny Mini Eye Pins Eyepins Hooks Eyelets Screw Threaded silver/gold/copper 8x3.5mm for jewelry	\$2.08	Mini Eye Hook Screws, used 4	4%	\$0.08
Garden Plus 8-in Twist Ties (100-Pack)	\$3.99	Twist ties (Securing claw cylinder); used 2	2%	\$0.08
Wilton Gel Food Color Set	\$7.82	Includes 4 bottles, used approximately 4 drops from each bottle	1%	\$0.08
420’ Cotton Twine 1 Piece	\$4.48	Woven Nylon: Approx. 12” used	0.24%	\$0.01
			TOTAL	\$38.37

Group 1-06

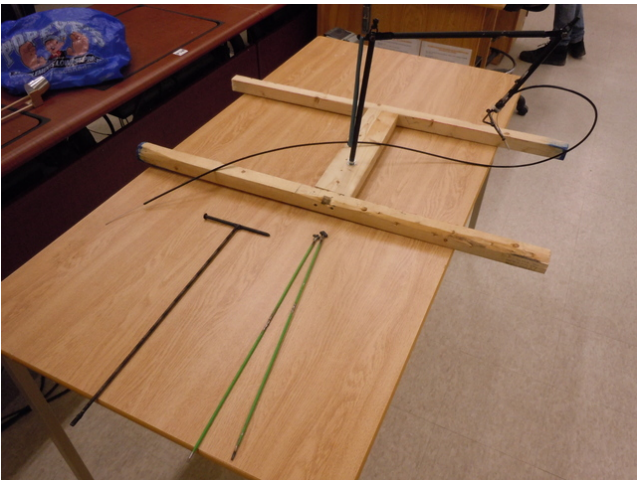
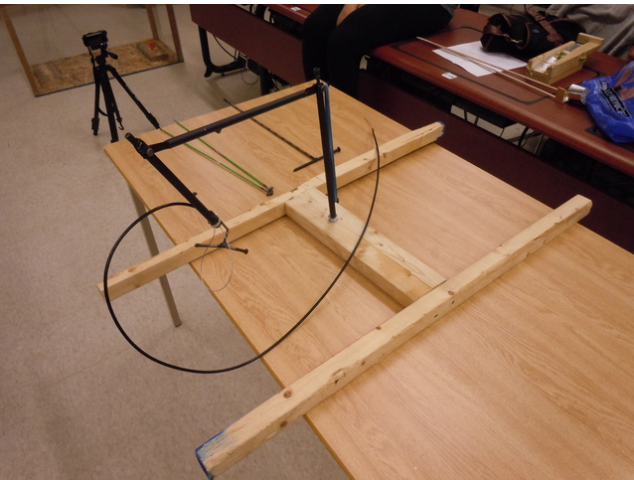
Prototype



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Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
The Hillman Group 3-ft x 1/2-in Hot-RoILED Weldable Steel Plain Tube - 11748, 3-ft x 3/4-in	\$10.99	Used for body of machine	86%	\$9.45
1/4X36 Cold Rolled Round Rod	\$4.98	Used for body of machine	66%	\$3.29
2x2x8 Framing Lumber	\$2.49	Used for the base of the machine	95.8%	\$2.39
2" x 48" Plain Steel Flat Bar	\$17.49	Used for arm of machine	12%	\$2.10
3/8"-16 x 3" #8 Zinc Plated Coarse Hex Bolt	\$1.79	Used to fasten components	100%	\$1.79
Red Tomato Cage, 42-in	\$5.99	Used for decending claw portion of arm	16.67%	\$1.00
1/4 - 20 Hex Coupling Nut	\$0.88	Used to tilt the arm	100%	\$0.88
5 Pack 3/8" Galvanized Flat Washers	\$1.29	Used to distribute the load of the nut evenly over the surface	60%	\$0.77
5 Pack 5/16-24 x 5/16" Steel Hex Key Set Screws	\$3.19	Used to pivot the machine	20%	\$0.64
100 Pack 1/4" x 1-1/4" Zinc Plated Round Stove Bolts, with Nut	\$13.99	Used to fasten components	2%	\$0.28
3/8"-16 #5 Zinc Plated Coarse Hex Nut	\$0.25	Used to fasten components	100%	\$0.25
Kamset Rubber Bands - 3OZ - Assorted Colors	\$1.97	Used to return the arm to position one	6%	\$0.12
90 Pack 4" x 6 Ga. Common Nails	\$10.99	Used to attach needed objects	1%	\$0.11
			TOTAL	\$23.06

Final design



Watch video of the device in action: <https://youtu.be/ja5zt7ebGbK?t=1m8s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
The Hillman Group 3-ft x 1/2-in Hot-RoILED Weldable Steel Plain Tube - 11748, 3-ft x 3/4-in	\$10.99	Used for body of machine	86%	\$9.45
Supercycle Rear Bike Brake Cable and Casing (5.75 ft)	\$6.99	Used to grab the blocks	52.2%	\$3.65
1/4X36 Cold Rolled Round Rod	\$4.98	Used for body of machine	66%	\$3.29
2x2x8 Framing Lumber	\$2.49	Used for the base of the machine	95.8%	\$2.39
Red Tomato Cage, 42-in	\$5.99	Used for decending claw portion of arm	16.67%	\$1.00
Hillman Group Aluminum Metal Flat Bar (8ft by 1/2 in)	\$9.59	Used for arm of machine	8.5%	\$0.82
5 Pack 5/16-24 x 5/16" Steel Hex Key Set Screws	\$3.19	Used to pivot the machine	20%	\$0.64
150 Box 3/8" x 8" Galvanized Hex Lag Screws	\$169.99	Used to fasten components	3%	\$0.51
100 Pack 1/4" x 1-1/4" Zinc Plated Round Stove Bolts, with Nut	\$13.99	Used to fasten components	3%	\$0.42
The Hillman Group 830506 Stainless Steel 3/8-Inch Flat Washer, 100-Pack	\$18.04	Used to distribute the load of the nut evenly over the surface	2%	\$0.36
Kamset Rubber Bands - 3OZ - Assorted Colors	\$1.97	Used to return the arm to position one	6%	\$0.12
90 Pack 4" x 6 Ga. Common Nails	\$10.99	Used to attach needed objects	1%	\$0.11
Everbilt 3/8 in-16 tpi Galvanized Hex Nut (100-Piece per box)	\$9.57	Used to fasten components	1%	\$0.10
			TOTAL	\$22.84

Group 1-07

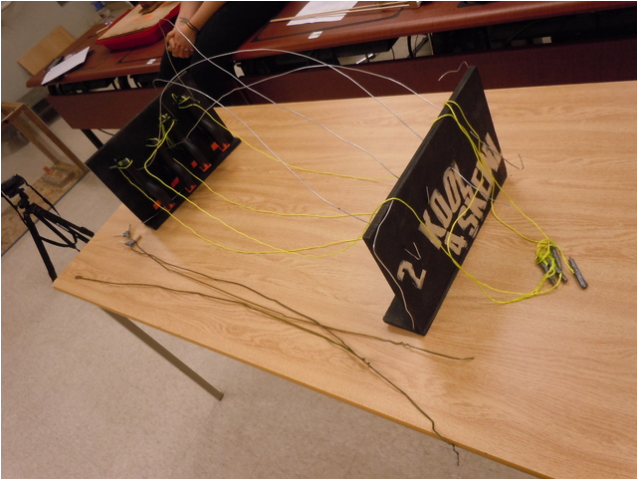
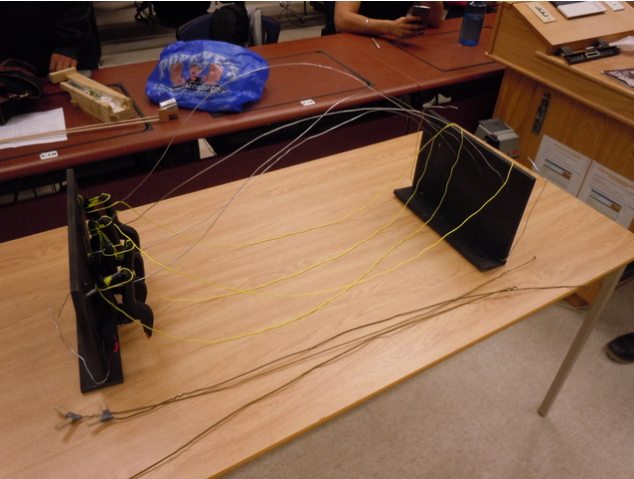
Prototype



Watch video of the device in action: <https://youtu.be/serChsab8gk?t=1m33s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
Black decker 12V Nicad Drill/driver	\$49.98	used as a motor to spin dowel	100%	\$49.98
Staples Mailing/Storage Tube, 2-1/2" x 24", White	\$3.05	5 mail tubes were used to crate the main slide tracks	500%	\$15.25
Ice Invasion Ice Hockey Puck	\$0.74	12 pucks, the pucks are cut out and used as grips to lift up the blocks	1200%	\$8.88
BOX MOVING/STORAGE 18X18X16IN [NOT .CA]	\$3.26	2 Kraft boxes used as the main body	200%	\$6.52
Paper clips Gold Jumbo	\$3.52		100%	\$3.52
Geo Construction Paper, 50 Sheets, Assorted Colours	\$2.98	used to line the inner slide of the tube	85%	\$2.53
Staples Premium Duct Tape, 48mm x 55m	\$4.94	Used to assemble the body of the design	25%	\$1.24
Elmers Washable School Glue - 225mL	\$2.47	to glue constrution paper to the mailing tube	45%	\$1.11
			TOTAL	\$89.03

Final design

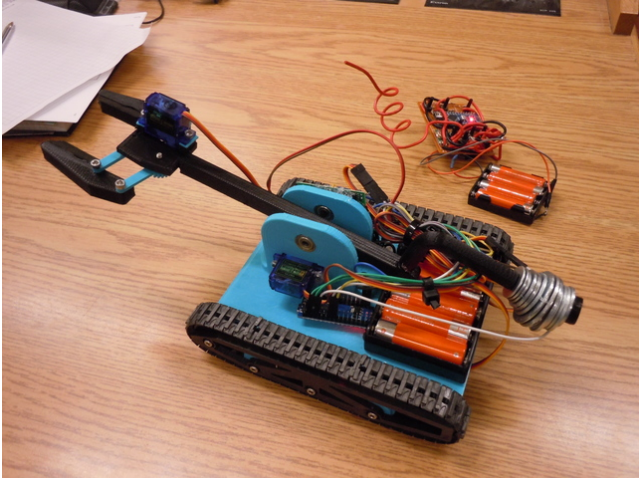


Watch video of the device in action: <https://youtu.be/ja5zt7ebGbK?t=1m20s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
G1S Plywood 1/2 Inches X 24 Inches X 24 Inches	\$9.20	cut in to peicecs to create the body/supports fot the zipline (340.5/576)in ² was used	59.11%	\$5.44
Galv. Wire-Steel Coiled 14G X 15M	\$5.98	Used for the zip line track (5/15)m was used	33.33%	\$1.99
HDX 22PCS Spring Clamp Set	\$9.98	used to grip and move blocks, 4/22 pcs were used	18.18%	\$1.81
18x225 Feet TWISTED MASON LINE NEON YELLOW	\$4.74	used to open and close spring clamps and also used to pull clamps across the box (16.40/225)ft was used	7.28%	\$0.35
Duct tape	\$4.94	Used to tape together the string	5%	\$0.25
			TOTAL	\$9.84

Group 1-08

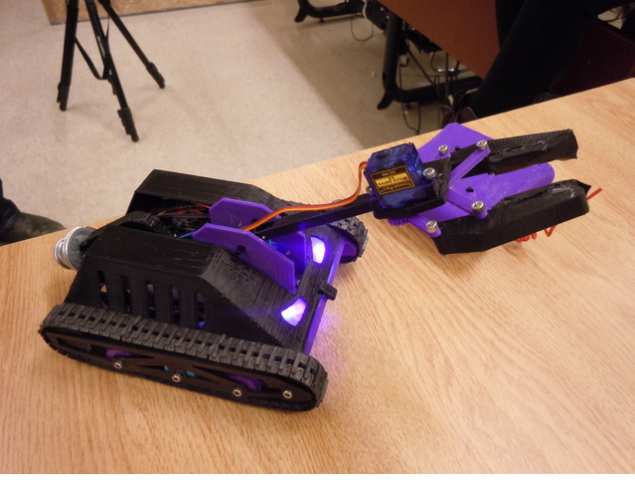
Prototype



Watch video of the device in action: <https://youtu.be/serChsab8gk?t=1m36s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
RioRand 5PCS x SG90 Micro 9g Servo For RC Airplane Car Boat Genuine	\$16.99	Servo motors to allow for robot to move	80%	\$13.59
Gikfun USB Nano V3.0 ATmega328 CH340G 5V 16M Micro-controller board For Arduino (Pack of 3pcs) EK1620*3	\$18.98	Arduino nano micro-controllers in order to control servos and process wireless signals	67%	\$12.72
Tamiya Track and Wheel Set	\$9.32	Track is used to provide sufficient grip with the surfaces it will be subjected to	100%	\$9.32
433MHz RF Link Transmitter Receiver Module Kit for Arduino	\$5.99	RX/TX Combonation in order to wireless control robot	100%	\$5.99
3D Solutech 1.75mm ABS 3D Printer Filament Teal Blue 2.2 LBS (1.0KG) - MADE IN USA	\$24.95	PLA used to make all teal 3D printed parts on robot and remote. Calculation of the portion used is based off of the weight of the printed parts; which is 143.41g total	14.3%	\$3.57
6xAA Battery Holder with Power Jack	\$3.49	Holds the AA batteries used to power the robot	100%	\$3.49
1.75mm Black PLA 3D Printer Filament - 1kg Spool (2.2 lbs) - Dimensional Accuracy +/- 0.03mm	\$27.95	PLA used to make all black 3D printed parts on robot and remote. Calculation of the portion used is based off of the weight of the printed parts; which is 120.55g total	12.1%	\$3.38
COLEMETER Solderless Breadboard Bread Board 400 Tie Points Contacts	\$2.94	Breadboard rail is used to easily connect varrious items to the power supply	100%	\$2.94
M3 Socket Head Cap Screw Kit - 180 Piece - Stainless Steel	\$19.00	M3 fastners used to hold frame together	13.9%	\$2.64
AmazonBasics AA Performance Alkaline Batteries (48-Pack)	\$15.99	AA batteries used to power robot	12.5%	\$2.00
Elego 120pcs Multicolored Dupont Wire	\$14.86	Provides a quick and easy way to connect servo motors to arduino and power supply	11.67%	\$1.73
AmazonBasics AAA Performance Alkaline Batteries (36-Pack)	\$12.99	AAA batteries used to power remote	11.1%	\$1.44
C&C Products 10pcs4x13x5mm Miniature Metal Sealed Metric Radial Ball Bearing 624-ZZ	\$6.57	Allows the robot arm to pivot smoothly	20%	\$1.31
E-Projects 100EP51410K0 10k Ohm Resistors, 1/4 W, 5% (Pack of 100)	\$15.04	Current limiting resistors in order to protect aduino nano	8%	\$1.20
Ocr 15PCS PCB Board Universal Double Sided Prototyping Breadboard Panel 4x6cm	\$14.99	Prototyping board for remote controller circuit	6.67%	\$1.00
Ocr TM10Value 180PCS Tactile Push Button Switch Micro Momentary Tact Assortment Kit	\$15.99	Buttons to control the robots movements	4.44%	\$0.71
Performance Tool W5216 350 pc Lock & Flat Washer Assortment	\$10.33		3.71%	\$0.38
Ajax Scientific PVC Solid Wire Hook-Up, 22AWG, 30m Length, Red	\$12.50	Wire used as positive wire on transmitter circuit	1.02%	\$0.13
Ajax Scientific PVC Solid Wire Hook-Up, 22Awg, 30m Length, Black	\$11.20	Wire used as negative wire on transmitter circuit	1.02%	\$0.11
			TOTAL	\$67.67

Final design

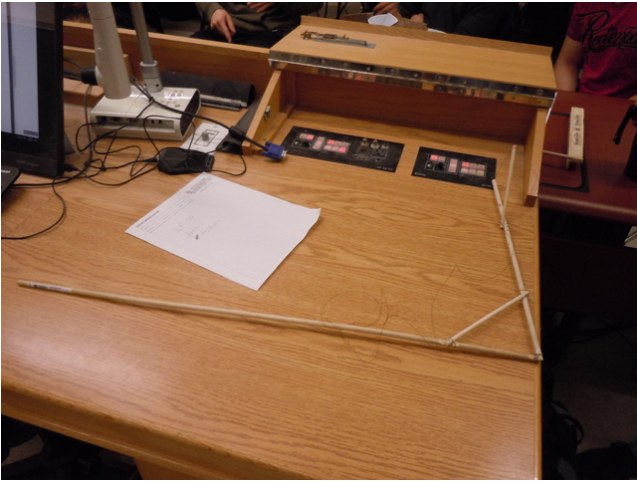


Watch video of the device in action: <https://youtu.be/ja5zt7ebGbk?t=1m36s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
Tamiya Track and Wheel Set	\$9.32	Tamiya 70100 Track & Wheel Set (japan import)	100%	\$9.32
9G SG90 Micro Servo motor RC Robot Helicopter Airplane Control Car Boat	\$1.89	Servo motors to allow for robot to move	400%	\$7.56
Mini USB Nano V3.0 Atmega328p-au Micro-controller Board Arduino-compatible	\$2.59	Arduino nano micro-controllers in order to control servos and process wireless signals	200%	\$5.18
3D Solutech 1.75mm ABS 3D Printer Filament Teal Blue 2.2 LBS (1.0KG) - MADE IN USA	\$24.95	PLA used to make all teal 3D printed parts on robot and remote. Calculation of the portion used is based off of the weight of the printed parts; which is 71.64g total	7.16%	\$1.79
AA Alkaline Battery 48 Pack	\$11.68	AA batteries used to power robot	12.5%	\$1.46
AmazonBasics AAA Performance Alkaline Batteries (36-Pack)	\$12.99	AAA batteries used to power remote	11.1%	\$1.44
Haobase 120pcs Multicolored 40pin Male to Female, 40pin Male to Male, 40pin Female to Female Breadboard Jumper Wires Ribbon Cables Kit	\$10.99	Provides a quick and easy way to connect servo motors to arduino and power supply	11.67%	\$1.28
3D Solutech 1.75mm PLA 3D Printer Filament Real Black 2.2 LBS (1.0KG) - MADE IN USA	\$24.95	PLA used to make all black 3D printed parts on robot and remote. Calculation of the portion used is based off of the weight of the printed parts; which is 46.59g total	4.66%	\$1.16
Receiver Module Kit & WL RF Transmitter MX-FS-03 433Mhz for Arduino/ARM Wireless	\$0.99	RX/TX Combonation in order to wireless control robot	100%	\$0.99
CNBTR Silver M3 Metric thread Hex Socket Head Cap Screw Bolts Pack of 100	\$3.24	M3 fastners used to hold frame together (23PCS)	23%	\$0.75
TPU - 1.75mm - Blue	\$44.00	Felxible TPU filament for tracks	1.46%	\$0.64
SODIAL(R) 5 x 1.5V AA Battery Slot Holder Case Box Wire Black	\$2.09	Holds the AA batteries used to power the robot	20%	\$0.42
SODIAL(R) Classical 10pcs Solder Finished Prototype PCB For Circuit Board Breadboard BI4U	\$3.58	Prototyping board for remote controller circuit	10%	\$0.36
BQLZR SF-1 Bronze Bushing Bearing 8mm x10mm x10mm Bush Motor Sleeve Pack Of 10	\$3.05	Allows the robot arm to pivot smoothly	10%	\$0.30
Performance Tool W5216 350 pc Lock & Flat Washer Assortment	\$11.00		2.29%	\$0.25
100 Pcs 6x6x4.5mm Panel PCB Momentary Tactile Tact Push Button Switch 4 Pin DIP	\$2.26	Buttons to control the robots movements	8%	\$0.18
Ajax Scientific PVC Solid Wire Hook-Up, 22AWG, 30m Length, Red	\$12.50	Wire used as positive wire on transmitter circuit	1.02%	\$0.13
Ajax Scientific PVC Solid Wire Hook-Up, 22Awg, 30m Length, Black	\$11.24	Wire used as negative wire on transmitter circuit	1.02%	\$0.11
docooler 1280pcs 64 Values 1 ohm - 10M ohm 1/4W Metal Film Resistors Assortment Kit Set	\$13.99	Current limiting resistors in order to protect aduino nano	0.62%	\$0.09
100 5mm Red Green Blue Yellow White LED Light Bulb Lamp	\$3.00	Violet LED Lights	2%	\$0.06
			TOTAL	\$33.47

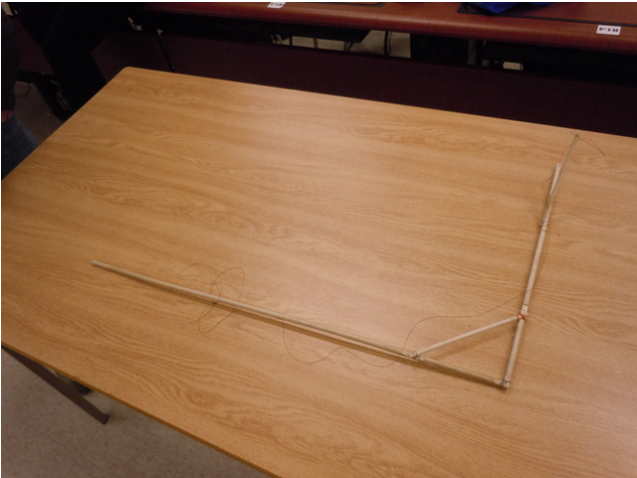
Group 1-09

Prototype



Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
Hardwood Dowel 5/16 In. x 48 In. Yellow	\$1.02	5/16" Dowel	100%	\$1.02
Hardwood Dowel 1/4 In. x 48 In. Blue	\$0.91	1/4" Dowel	27.08%	\$0.25
Staples # Size Paper Clips, Smooth, 10 x 100/Pack	\$4.99	Paper clips	4%	\$0.02
South Bend M1410-X Mono Fishing Line 650 Yards	\$3.99	Fishing Line	0.28%	\$0.01
			TOTAL	\$1.30

Final design

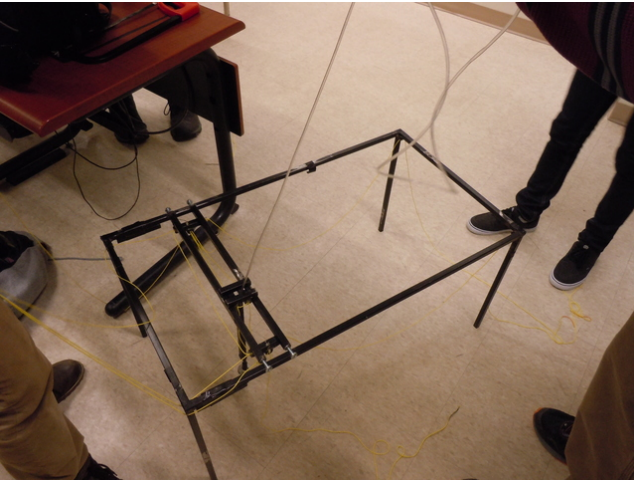


Watch video of the device in action: <https://youtu.be/ja5zt7ebGbK?t=1m44s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
Hardwood Dowel 5/16 In. x 48 In. Yellow	\$1.02	5/16" Dowel	95.83%	\$0.98
Hardwood Dowel 1/4 In. x 48 In. Blue	\$0.91	1/4" Dowel	27.08%	\$0.25
Staples # Size Paper Clips, Smooth, 10 x 100/Pack	\$4.99	Paper clips	4%	\$0.02
South Bend M1410-X Mono Fishing Line 650 Yards	\$3.99	Fishing Line	0.28%	\$0.01
			TOTAL	\$1.25

Group 1-10

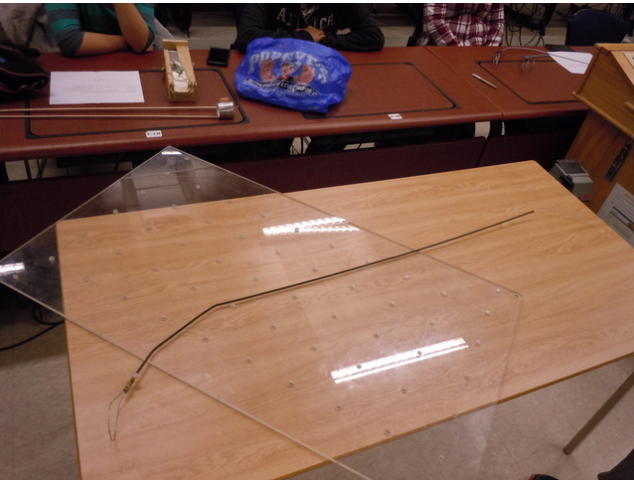
Prototype



Watch video of the device in action: <https://youtu.be/serChsab8gk?t=2m1s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
ABN Vacuum Pump/Brake Bled Kit for Automotive	\$39.82	only needed the pump	100%	\$39.82
The Hillman Group 11385 Aluminum Trim Channel, 8-ft L x 3/4-in W x 5/8-in H	\$16.89	used 2 sets of 8 ft	2%	\$33.78
Learn To Brew LLC Food Grade Vinyl Tubing - 10 feet 5/16 ID - 7/16 OD	\$29.04	4 ft out of 10 ft used	4%	\$11.62
Belanger Extension Tube Fitting 45'x5/32" Diamond Braided	\$4.99	2 used to adjust tube size	200%	\$9.98
Rope 1 Piece	\$3.98	completely used	100%	\$3.98
Dr. Brown's Standard Level 2 Silicone Nipples- 2 pk	\$3.97	completely used	100%	\$3.97
Hillman Metric Pan Head Phillips Machine Screws	\$0.79	4 rollers used	400%	\$3.16
Hillman Class 8 Metric Flat Washers	\$0.89	completely used	100%	\$0.89
Electronics-Salon 100PCS 3mm Black Nylon Round Spacer, OD 7mm, ID 3.2mm, Not Threaded, for M3 Screws, Plastic.	\$11.98	only 6 out of a pack of 100 used	0.06%	\$0.72
Duck Tape Max - Black, 48 mm. x 41 m.	\$10.97	small segment of roll used	0.01%	\$0.12
Vaseline 100 percent pure triple purified petroleum jelly	\$2.50	extremely small amount used	0.01%	\$0.03
			TOTAL	\$108.06

Final design

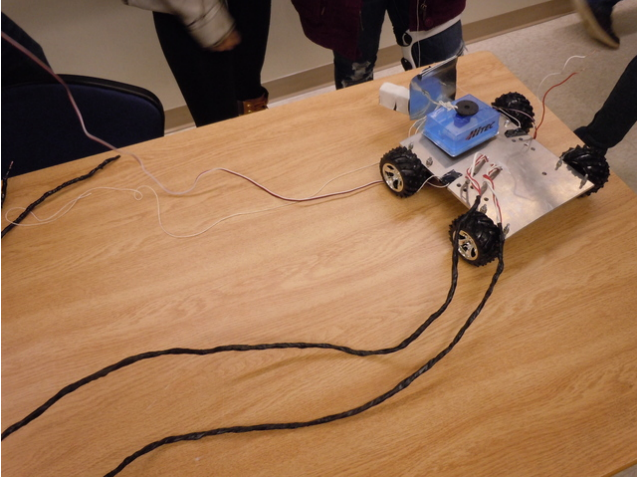
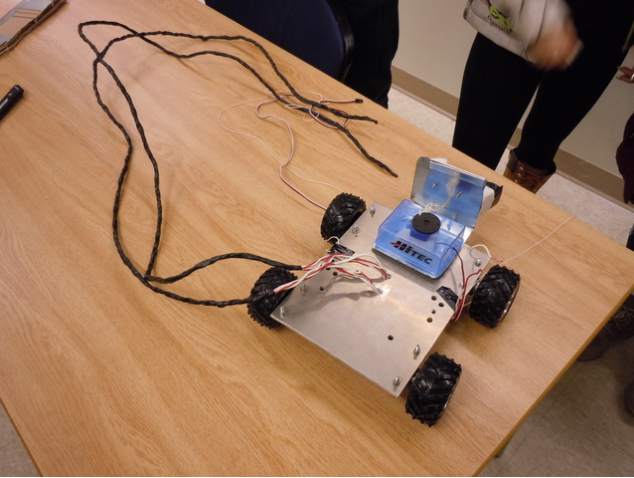


Watch video of the device in action: <https://youtu.be/ja5zt7ebGbK?t=1m52s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
Metal Round Tube Mira Lustre 1/2 In. x 1/2 In. x 8 Ft.	\$11.76	only used 4 ft	50%	\$5.88
CAMPBELL Galvanized Steel Wire Rope, 7x19 Strand Core, 3/16-Inch Bare OD, 250-Foot Length, 840-Pound Breaking Strength	\$99.00	only use 5 ft	2%	\$1.98
8" Plastic Cable Zip Ties 100-Pack (Black)	\$5.90	Only 6 used	6%	\$0.35
			TOTAL	\$8.21

Group 2-01

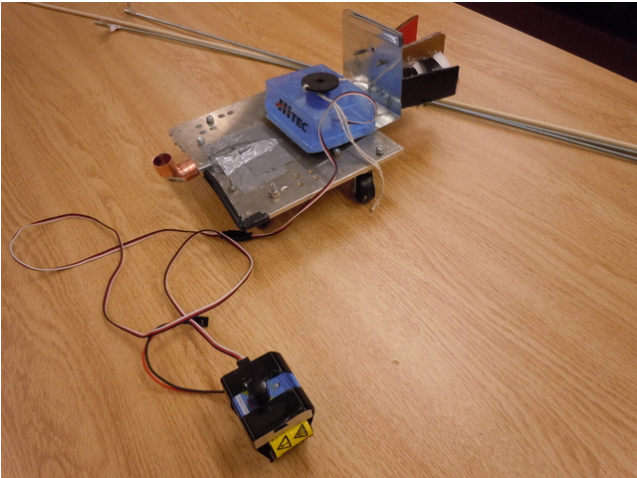
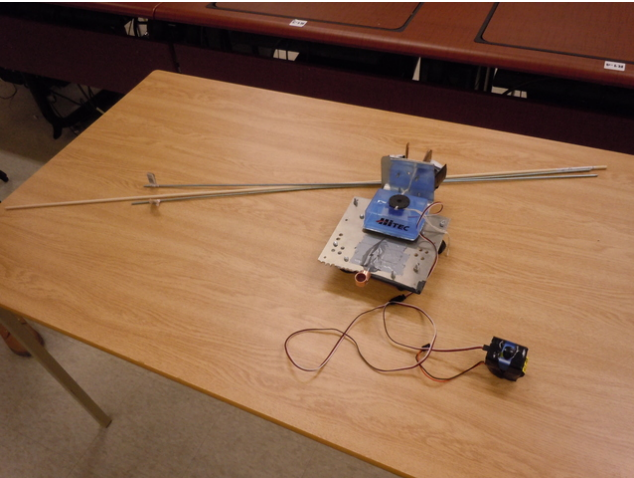
Prototype



Watch video of the device in action: <https://youtu.be/serChsab8gk?t=2m15s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
DIDC1193 Torque 370 Motor 35T w/Connector	\$15.99		400%	\$63.96
TRA2065 Servo, sub-micro, waterproof	\$42.99		100%	\$42.99
ON/OFF/ON Toggle Switch	\$6.99		300%	\$20.97
BBSERVOTESTER SERVO TESTER	\$19.99		100%	\$19.99
BBFU36 36" 900MM 60/0.08	\$14.99	servo tester wire extension	100%	\$14.99
Hillman Metric Lock Nut Nylon Inserts	\$1.29		1000%	\$12.90
Hillman Pan Head Phillips Machine Screws	\$0.99		1000%	\$9.90
BQLZR Durable 5 Spoke White Wheel Rim & Tyre Tires White+Black for RC 1:10 Drift Car & On Road Car Pack Of 4	\$9.56		100%	\$9.56
Romex SIMpull NMD90 14-2 75M, White	\$59.00	could make 25 devices, wire	12%	\$7.08
8X24X.025 Aluminum Sheet Metal	\$13.28	could build 2 devices	50%	\$6.64
3-in Black Heat Shrink Tubing, 1/4 to 1/8-in	\$3.99	could use it for 2 devices	50%	\$2.00
2 Hole Rigid Strap 3/4 In. - Bag of 8	\$1.87	could use it for 2 devices, brackets for motors	50%	\$0.94
1/2" Screws with Modified Truss Head, Box of 100	\$4.59	could use it for 16 devices	6.25%	\$0.29
30ct FULL SIZE GLUE STICKS	\$7.47	could use it for 30 devices	3.33%	\$0.25
Soft Foam Cushioning	\$3.97	could use it for 36 devices	2.78%	\$0.11
Renfrew Black Hockey Tape	\$2.98		1%	\$0.03
Moving Box, 16-in	\$1.99	used 2 strips of 3" x 0.5"	1%	\$0.02
Vinyl Electrical Tape, General Purpose, 19-mm x 18-m	\$0.99		2%	\$0.02
Blueline Multipurpose Medium Jute	\$1.99	used 2' of 210', string	0.95%	\$0.02
			TOTAL	\$212.64

Final design

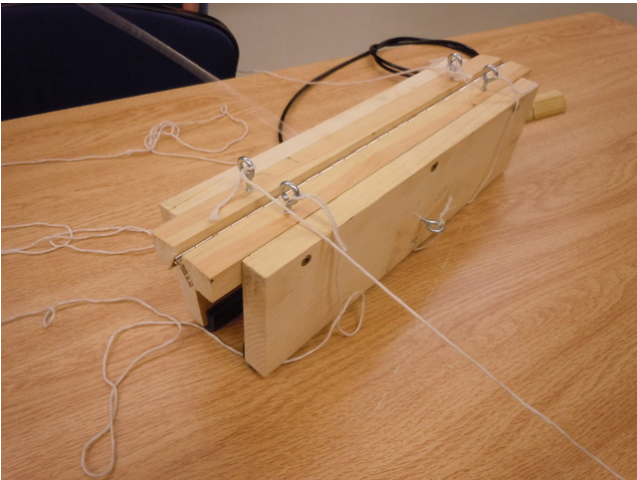
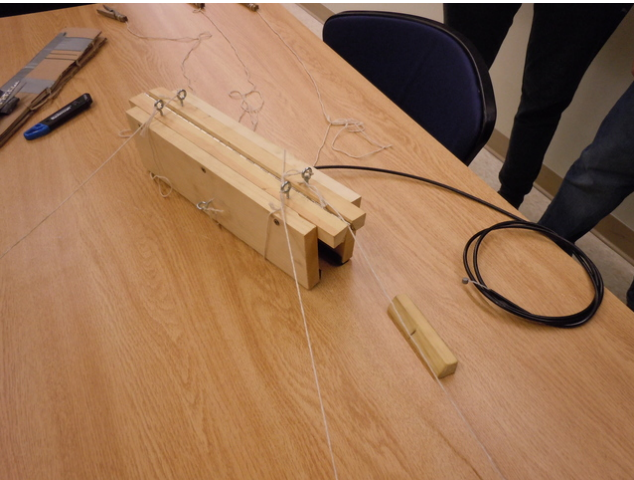


Watch video of the device in action: <https://youtu.be/ja5zt7ebGbk?t=1m59s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
TRA2065 Servo, sub-micro, waterproof	\$42.99	Servo	100%	\$42.99
BBSERVOTESTER SERVO TESTER	\$19.99	Servo Controller	100%	\$19.99
BBFU36 36" 900MM 60/0.08	\$14.99	Servo Controller Wire Extension	100%	\$14.99
Hillman Metric Lock Nut Nylon Inserts	\$1.29	Nuts for the bolts	800%	\$10.32
1-1/4" General Duty Rigid Casters	\$1.95	Wheels - Used 4	400%	\$7.80
Hillman Pan Head Phillips Machine Screws	\$0.99	Screws	600%	\$5.94
Papc10-24Uni-Rod Stl P 36"	\$2.18	Metal Rods - Used 2 rods and 4" out of a third (could make 9 devices out of the third rod)	211.11%	\$4.60
8X24X.025 Aluminum Sheet Metal	\$13.28	Sheet Metal - Could build 3 devices	33.33%	\$4.43
Premium 9 inch X11 inch Sanding Sheets Fine-150 grit 3 pack	\$4.27	Sandpaper - Used 1 sheet out of 3 (could make 3 devices)	33.33%	\$1.42
Fitting Copper 90 Degree Elbow 1/2 Inch Copper To Copper	\$0.78	90 Degree Elbow	100%	\$0.78
30ct FULL SIZE GLUE STICKS	\$7.47	Glue Sticks - Used 3 glue sticks out of 30 (could make 10 devices)	10%	\$0.75
1/2" Screws with Modified Truss Head, Box of 100	\$4.59	Bolts - Used 8 out of 100 (could use it for 12 devices)	8.33%	\$0.38
Staples Push Pins, Assorted, 100/Pack	\$2.52	Pins - Used 10 out of 100 (could make 10 devices)	10%	\$0.25
Soft Foam Cushioning	\$3.97	Foam - Used 2 strips of 2" x 1" out of 12" x 12" x 2" (could use it for 36 devices)	2.78%	\$0.11
Vinyl Electrical Tape, General Purpose, 19-mm x 18-m	\$0.99	Used 1 meters out of 18 (could make 18 devices)	5.56%	\$0.06
Blueline Multipurpose Medium Jute	\$1.99	String - Used 1 meter out of 64 (could make 64 devices)	1.56%	\$0.03
Moving Box, 16-in	\$1.99	Cardboard - Used used 2 strips of 2" x 2" (could make 192 devices)	0.52%	\$0.01
			TOTAL	\$114.85

Group 2-02

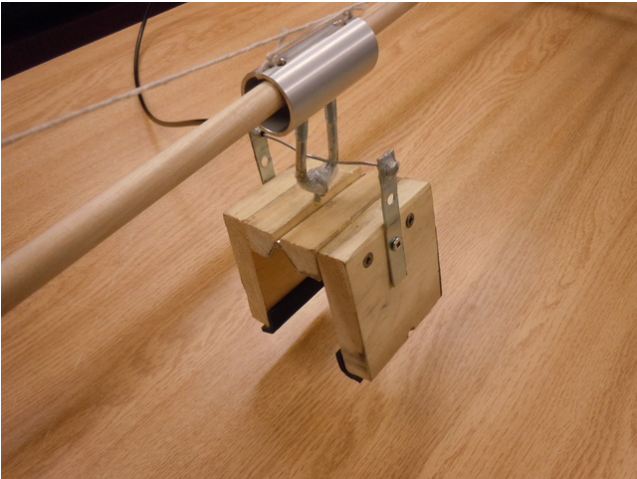
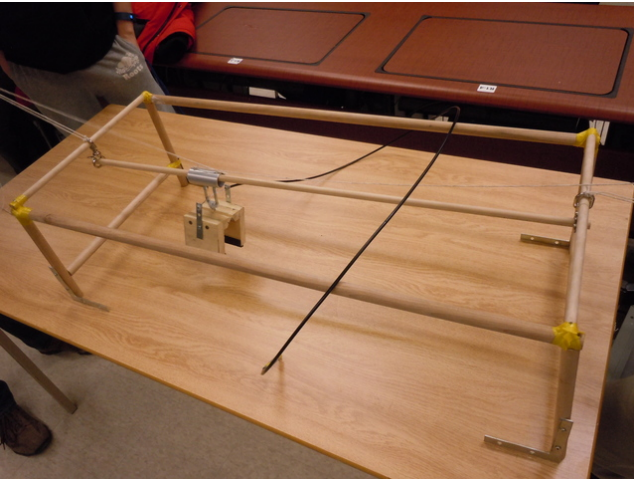
Prototype



Watch video of the device in action: <https://youtu.be/serChsab8gk?t=2m30s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
Pine Shop Shelving #1 3/4 Inch 12 Inch x 36 Inch	\$11.91		100%	\$11.91
Supercycle Rear Bike Brake Cable and Casing	\$6.99		100%	\$6.99
1/2 Inch Zinc Small Screw Eye 12pk	\$1.60	could make 2	50%	\$0.80
Open Cell Foam Tape, 3/8-in x 16-ft	\$4.99	could make 8 with this foam tape	14%	\$0.70
Blueline Kitchen Twine	\$3.39	could make 5	18%	\$0.61
10 Pack 1/2" Copper Plated Pipe Straps, with Nail	\$3.99	couble make 10	10%	\$0.40
Clothes Pin, 50-pk	\$2.49	could make 8	12%	\$0.30
95 Pack Flathead Wood Screws, Assorted Sizes	\$1.00	could make 8	12.6%	\$0.13
Tuck Tape Outdoor Repair Tape	\$7.99	couble make 1000	1%	\$0.01
			TOTAL	\$21.84

Final design

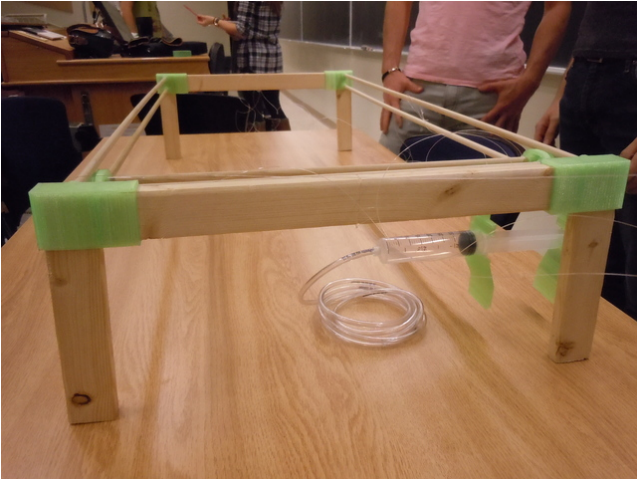
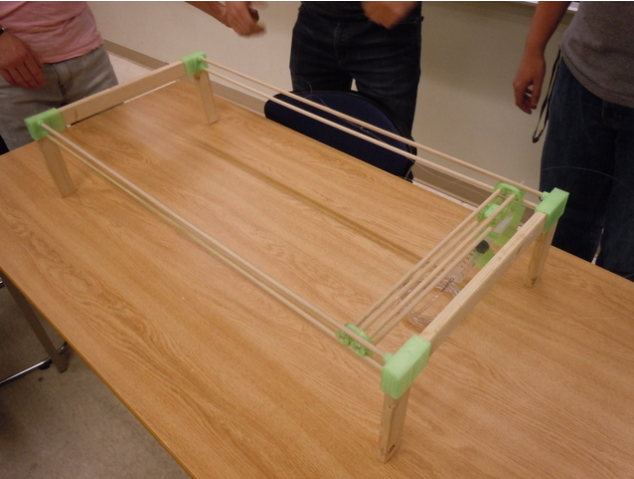


Watch video of the device in action: <https://youtu.be/ja5zt7ebGbK?t=2m13s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
3/4" x 4' Hardwood Dowel	\$3.49	make 1	280%	\$9.77
2-1/2" Nickel Scissor Snap	\$3.69	make 1	200%	\$7.38
Supercycle Rear Bike Brake Cable and Casing	\$6.99	make 1	100%	\$6.99
1/4" x 3/4" x 2-1/2" Zinc #112 U Bolt, with Plate and Nut	\$3.49	make 1	100%	\$3.49
1/2" x 4' Hardwood Dowel	\$2.39	make 1	139%	\$3.32
Pine Shop Shelving #1 3/4 Inch 12 Inch x 36 Inch	\$11.91	make 4	25%	\$2.98
4 Pack 3" Zinc Flat Corner Plates	\$2.99	could make 1	75%	\$2.24
1X3 Round Aluminum Tubing	\$14.48	could make 12	8.33%	\$1.21
10 Pack 1/2" Copper Plated Pipe Straps, with Nail	\$3.99	couble make 5	20%	\$0.80
4 Pack 2-1/2" Zinc rust Resistant Flat Corner Plates	\$2.99	could make 4	25%	\$0.75
Blueline Kitchen Twine	\$3.39	could make 5	18%	\$0.61
7mil x 3/4" x 60' CSA Approved PVC Yellow Electrical Tape	\$1.19	could make 3	26%	\$0.31
Clothes Pin, 50-pk	\$2.49	could make 8	12%	\$0.30
95 Pack Flathead Wood Screws, Assorted Sizes	\$1.00	could make 3	26.3%	\$0.26
Mini Glue Sticks	\$5.27	could make 30	3.33%	\$0.18
Open Cell Foam Tape, 3/8-in x 16-ft	\$4.99	could make 32 with this foam tape	3.1%	\$0.15
1/2 Inch Zinc Small Screw Eye 12pk	\$1.60	could make 12	8.3%	\$0.13
			TOTAL	\$40.87

Group 2-03

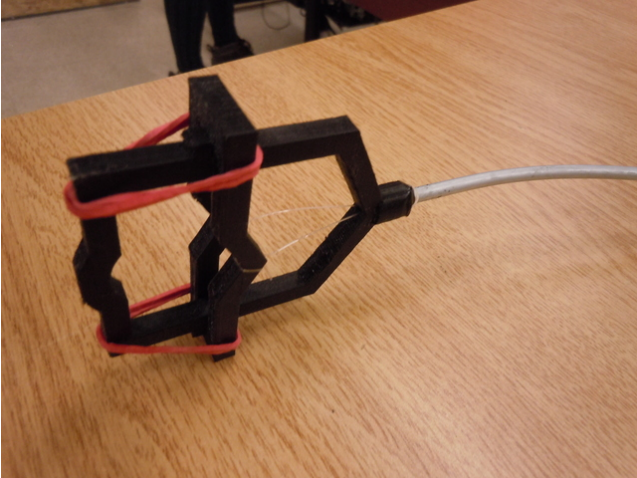
Prototype



Watch video of the device in action: <https://youtu.be/serChsab8gk?t=2m58s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
Madison Mill Round Wood Poplar Dowel 0.3125 in dia X 48 in (Lowe's Item 19379)	\$1.29	Need several dowels to complete	434.38%	\$5.60
1.75mm Trans Green PLA 3D Printer Filament - 1kg Spool (2.2 lbs) - Dimensional Accuracy +/- 0.03mm	\$28.95	Portion of filament used from spool	14.65%	\$4.24
TUBING 1/4X.170 10' CLEAR [NOT .CA]	\$4.19	can make two lenghts from whole tube	50%	\$2.10
35 ml luer lock disposable syringes pk/3 [NOT .CA]	\$2.69	Needed two out of the three	66.66%	\$1.79
Top Choice 1 x 2 x 8-ft SPF Strapping	\$1.66	Used most of one length, can still use rest for another unit	75%	\$1.25
Sufix Pro Select Fishing Line	\$8.99	Can make many from whole spool	2%	\$0.18
			TOTAL	\$15.16

Final design

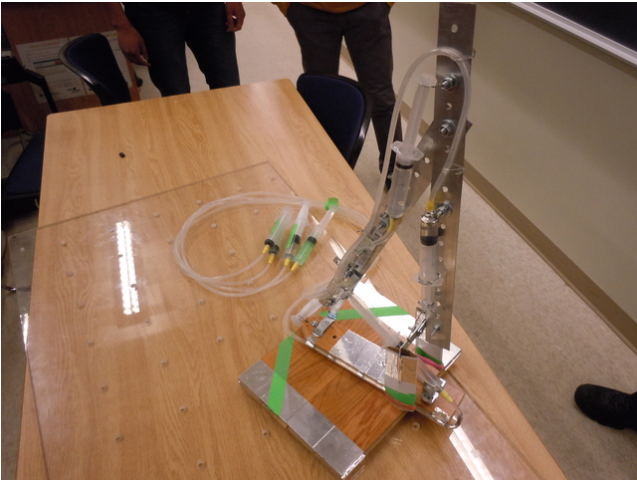
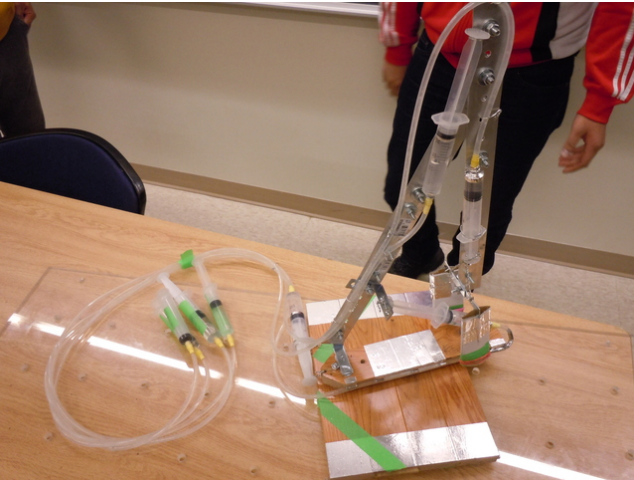


Watch video of the device in action: <https://youtu.be/ja5zt7ebGbk?t=2m21s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
Roll of 25 ft. Zinc Plated 3/16" Brake Line Tubing	\$19.00	Used 4 ft out of the 25 ft length	16%	\$3.04
1.75mm Black PLA 3D Printer Filament - 1kg Spool (2.2 lbs) - Dimensional Accuracy +/- 0.03mm	\$27.95	Used 11.81 g out of the 1 kg spool	1.18%	\$0.33
Sufix Pro Select Fishing Line	\$8.99	Used 3.33 yards of the 840 yard spool	4%	\$0.04
Alliance Sterling Advantage Rubber Band Size No.32 (3 x 1/8-Inch), 1 Pound Box (Approximately 700 Bands Per Pound) - 26325	\$10.95	Used 3 bands out of approx 700	0.28%	\$0.03
			TOTAL	\$3.44

Group 2-04

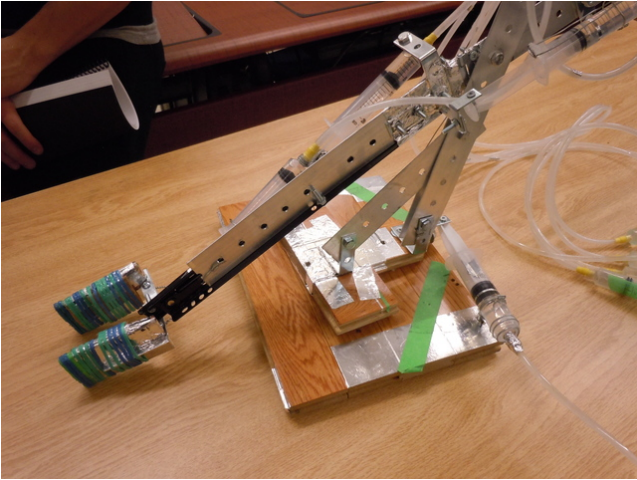
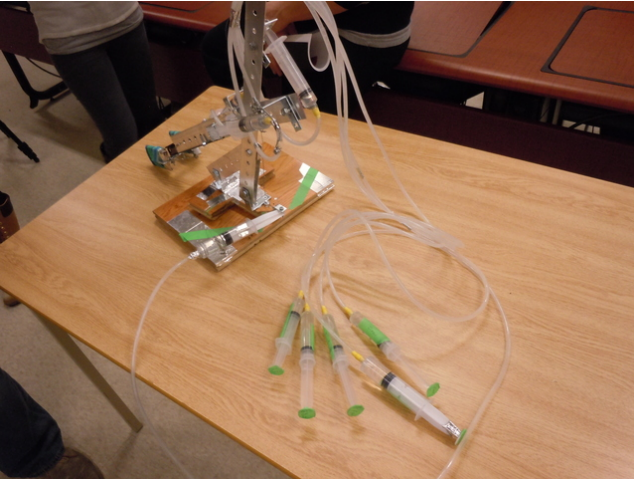
Prototype



Watch video of the device in action: <https://youtu.be/serChsab8gk?t=3m12s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
Party Shooters Syringe Shots 6ct	\$7.99	8 Syringe for hydraulic actions	133%	\$10.63
Watts Clear Pre-Cut Vinyl Tubing	\$4.49	Tubing for fluid transfer	200%	\$8.98
Steelworks Aluminum Sheet	\$7.99	Frame, 4 ft.	100%	\$7.99
Raymore Oak Butterscotch 3/4-inch Thick x 2 1/4-inch W Hardwood Flooring (18.25 sq. ft. / case)	\$112.97	Base, 1 sq. ft.	5.4%	\$6.10
Hillman Flat Washers, Hot Dipped Galvanized	\$0.14	26 fasteners	2600%	\$3.64
Hillman Finish Hex Nut, Zinc, 1/4"-20	\$0.14	13 fasteners	1300%	\$1.82
Hardware Essentials Corner Brace, Zinc-Plated	\$0.59	3 mounting brackets	300%	\$1.77
Hillman Hex Bolts, Zinc, Assorted	\$0.25	7, fasteners	700%	\$1.75
6X1/2 Ss Flat Hd Socket Metal Screw	\$0.28	4 fasteners	400%	\$1.12
2 Inch Zinc Flat Corner Brace 4pk	\$1.98	2 for Claw mounts	50%	\$0.99
Plumbshop Teflon Tape	\$1.99	sealing hydraulic connections	25%	\$0.50
1/4X1/2 18.8 Ss Hex Hd Capscrew	\$0.42	1 pivot screw	100%	\$0.42
Stainless Steel Wire	\$4.99	Utility wire	5%	\$0.25
Air Duct Aluminum Foil Tape	\$12.98	tape	1%	\$0.13
TOTAL				\$46.08

Final design

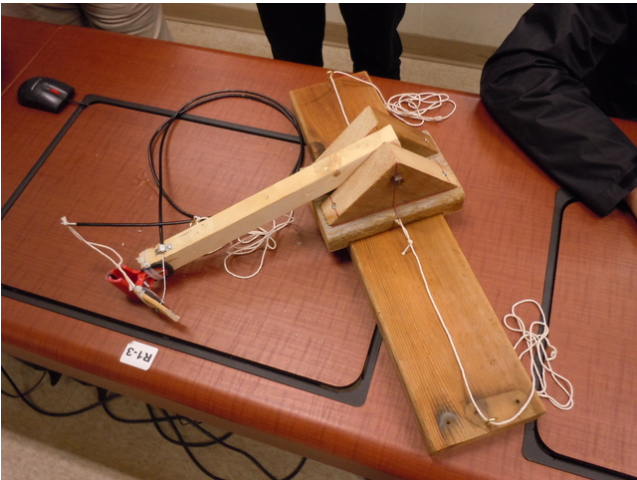
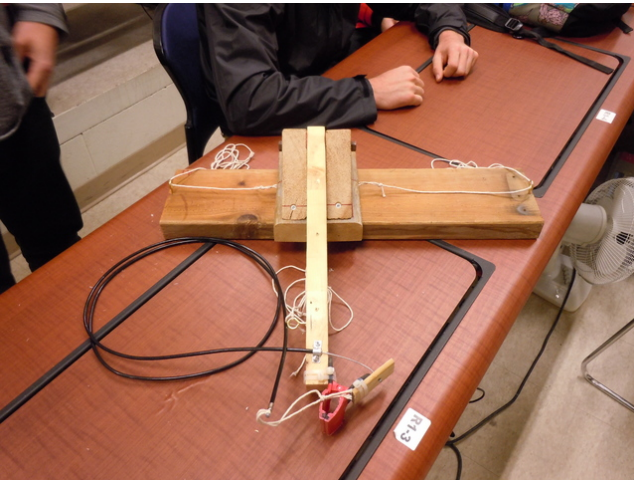


Watch video of the device in action: <https://youtu.be/ja5zt7ebGbk?t=2m26s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
Party Shooters Syringe Shots 6ct	\$7.99	10 Syringes for hydraulic motion	166%	\$13.26
Steelworks Aluminum Sheet	\$7.99	5 ft. for frame	120%	\$9.59
Watts Clear Pre-Cut Vinyl Tubing	\$4.49	20 ft., Tubing for fluid transfer	200%	\$8.98
Raymore Oak Butterscotch 3/4-inch Thick x 2 1/4-inch W Hardwood Flooring (18.25 sq. ft. / case)	\$112.97	1 sq. ft. for base	5.4%	\$6.10
Euro standard slide 300mm / 12 In.	\$4.84	For arm slide	100%	\$4.84
Hillman Hex Bolts, Zinc, Assorted	\$0.25	Used 18	1800%	\$4.50
Hardware Essentials Corner Brace, Zinc-Plated	\$0.59	6 mounting brackets	600%	\$3.54
Hillman Finish Hex Nut, Zinc, 1/4"-20	\$0.14	Used 20	2000%	\$2.80
Cantech Foil Tape	\$6.99	3 ft.	25%	\$1.75
Hillman Flat Washers, Hot Dipped Galvanized	\$0.14	Used 10	1000%	\$1.40
6X1/2 Ss Flat Hd Socket Metal Screw	\$0.28	Used 4	400%	\$1.12
2 Inch Zinc Flat Corner Brace 4pk	\$1.98	2 mounting brackets for claw	50%	\$0.99
Stainless Steel Wire	\$4.99	1 meter, Utility wire	9.61%	\$0.48
1/4X1/2 18.8 Ss Hex Hd Capscrew	\$0.42	1 pivot screw	100%	\$0.42
Staples Economy Rubber Bands, Assorted Size and Colour	\$1.51	For claw grip	5%	\$0.08
Plumbshop Teflon Tape	\$0.79	2ft. For sealing tubing	5%	\$0.04
TOTAL				\$59.88

Group 2-05

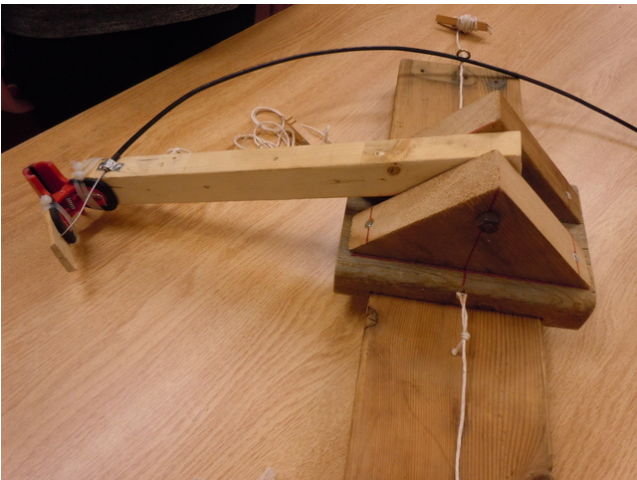
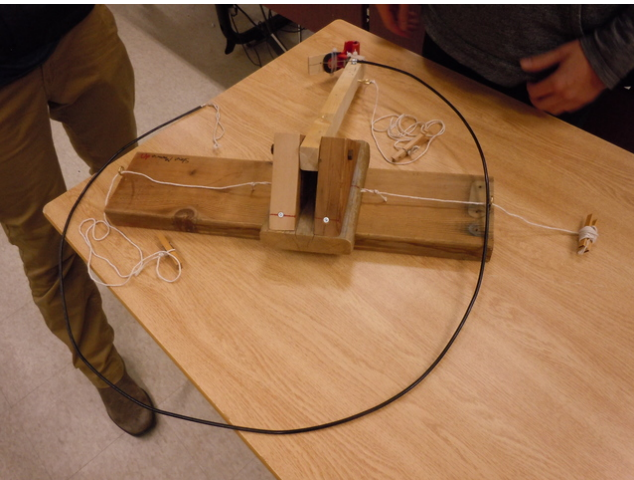
Prototype



Watch video of the device in action: <https://youtu.be/serChsab8gk?t=3m20s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
Supercycle Rear Bike Brake Cable and Casing	\$6.99	Used to close claw	100%	\$6.99
Top Choice 2 x 6 Kiln-Dried SPF Lumber	\$4.90	The base and "train" 96" version. Could make 2 deisng from the one piece	50%	\$2.45
Farberware Bag Clips, 4 Pieces 3/8" x 4" #5 Zinc Plated Coarse Hex Bolt	\$8.99	Used as claw, the red one	25%	\$2.25
2"x2"-42" WRC Baluster S4S Bevelled Both Ends	\$1.69	Used for the arm to rotate about	100%	\$1.69
16 Pack Brass Large Screw Eyes	\$2.69	Used for the arm, could make 2 arms per piece	50%	\$1.34
Marr 20 Piece 7.5 in. Cable Ties	\$3.69	used 3/16 to guide the twine upwards	19%	\$0.70
IDEAL 1/4-in UV Protected Cable Clamp (18-Pack)	\$2.99	Used only 4/20	20%	\$0.60
100 Pack #8 x 1-1/2" Zinc Plated Round Head Socket Wood Screws	\$4.29	clamp to hold break line down. Used 2/18	9%	\$0.39
Blueline Multipurpose Medium Jute	\$5.99	Used 4/100	4%	\$0.24
	\$1.99	"Twine" to move arm and body	8.1%	\$0.16
			TOTAL	\$16.81

Final design

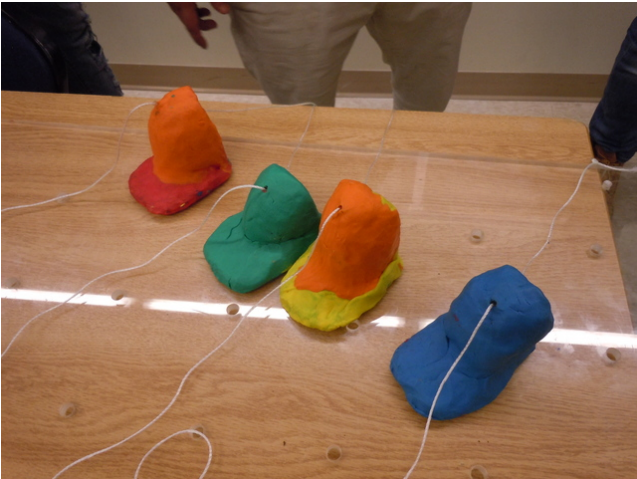
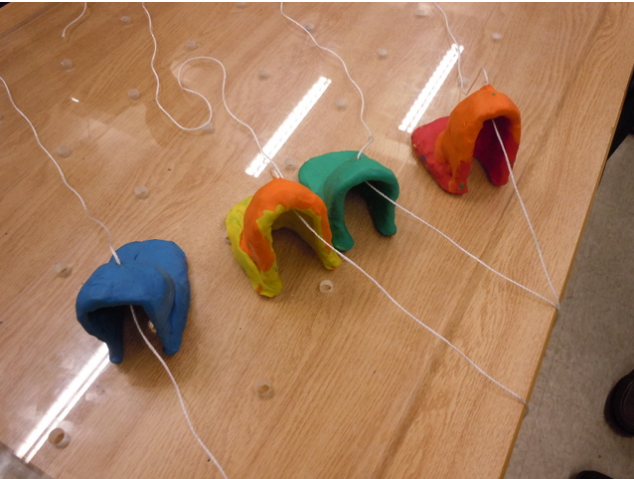


Watch video of the device in action: <https://youtu.be/ja5zt7ebGbk?t=2m35s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
Clarks 5095 Rear Galvanized Brake Cable	\$3.51	Used to close claw	100%	\$3.51
Top Choice 2 x 6 Kiln-Dried SPF Lumber	\$4.90	The base and "train" 96" version. Could make two designs from the one piece	50%	\$2.45
Farberware Bag Clips, 4 Pieces 3/8" x 4" #5 Zinc Plated Coarse Hex Bolt	\$8.99	Used as claw, the red one	25%	\$2.25
2"x2"-42" WRC Baluster S4S Bevelled Both Ends	\$1.69	Used for the arm to rotate about	100%	\$1.69
16 Pack Brass Large Screw Eyes	\$2.69	Used for the arm, could make two arms per piece	50%	\$1.34
IDEAL 1/4-in UV Protected Cable Clamp (18-Pack)	\$3.69	used 3/16 to guide the twine upwards	19%	\$0.70
100 Pack #8 x 1-1/2" Zinc Plated Round Head Socket Wood Screws	\$4.29	clamp to hold break line down. Used 2/18	9%	\$0.39
8" Plastic Cable Zip Ties 100-Pack (Black)	\$5.99	Used 4/100	4%	\$0.24
Loew-Cornell Woodsies Tiny Spring Clothespins, 1-Inch, Natural, 50-Pack	\$5.90	Used only 4/20	4%	\$0.24
Blueline Multipurpose Medium Jute	\$2.46	used 4/50 clothes pins to help hold string up	8%	\$0.20
	\$1.99	"Twine" to move arm and body	8.1%	\$0.16
			TOTAL	\$13.17

Group 2-06

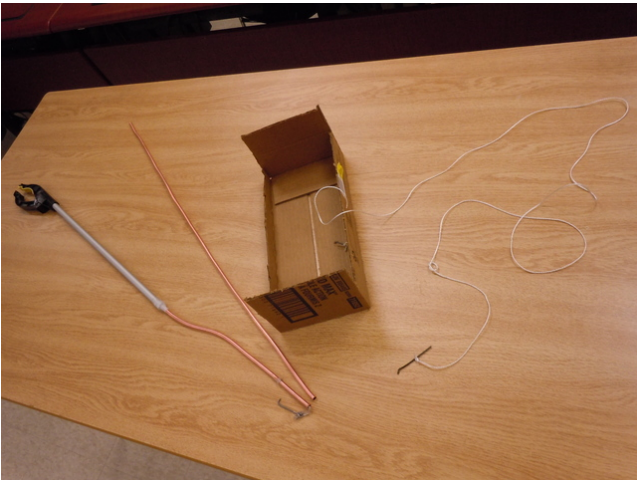
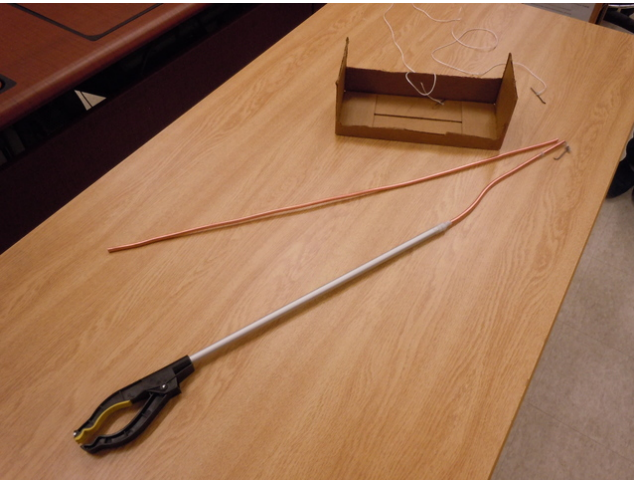
Prototype



Watch video of the device in action: <https://youtu.be/serChsab8gk?t=3m39s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
Black & Decker 18V NiCad Cordless Drill/Driver, 3/8-in	\$79.99		100%	\$79.99
2 - Crayola Modelling Clay, Assorted Colours, 453g	\$3.12	we used one and 1/4	125%	\$3.90
Blueline Masonline 76m	\$5.39	we took 8 m to make four ropes	10.53%	\$0.57
Scotch Magic Tape with Dispenser, 12 mm x 32.9 m	\$3.74	we used 33 cm	1%	\$0.04
			TOTAL	\$84.49

Final design

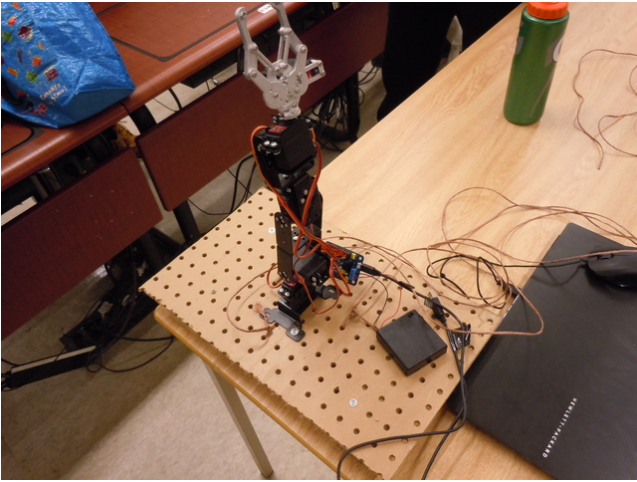
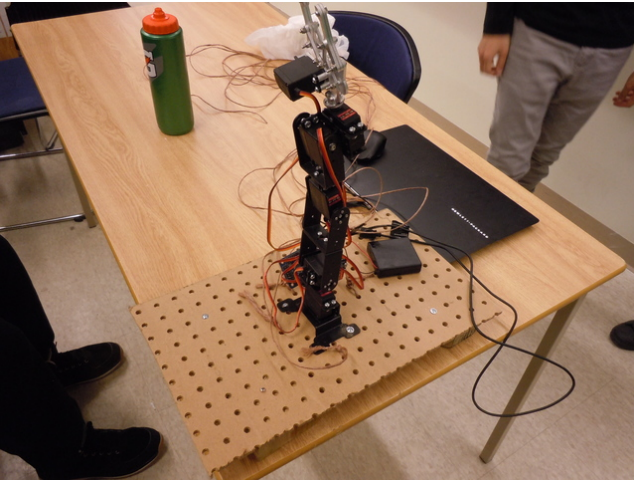


Watch video of the device in action: <https://youtu.be/ja5zt7ebGbk?t=2m42s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
Nifty Nabber	\$21.98	we used the arm to pick up the object	100%	\$21.98
Southwire5 Metre NMD90 Copper Wire Electrical Cable, Yellow, 12-2	\$23.99	we bought 2m only	40%	\$9.60
Canadian Tire Moving Box	\$1.69		100%	\$1.69
Scotch Double-Stick Tape	\$3.99		5%	\$0.20
Blueline Masonline 76m	\$5.39	we used one and 1 m	1.32%	\$0.07
			TOTAL	\$33.54

Group 2-07

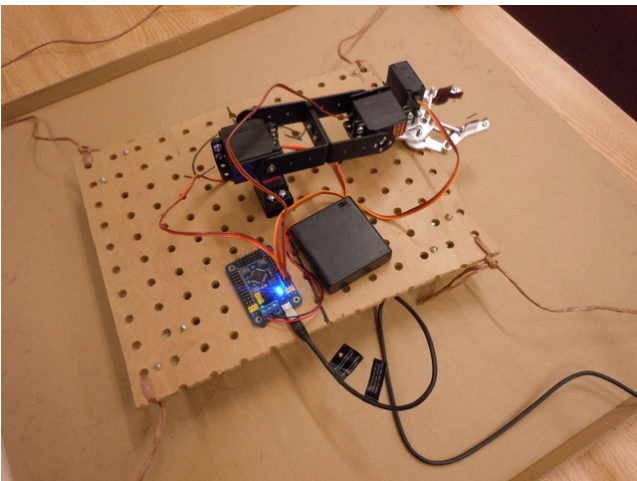
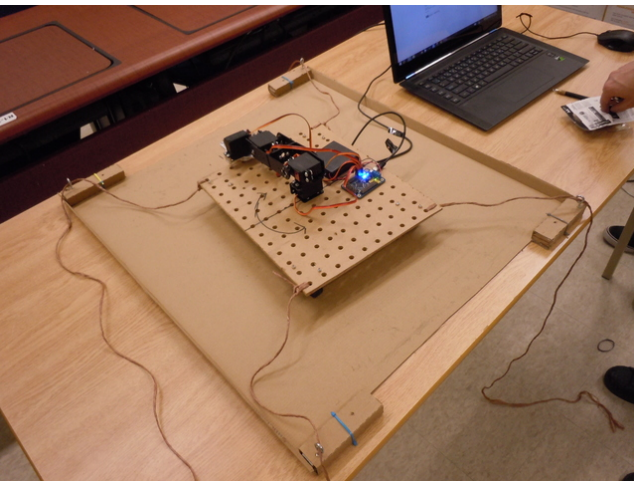
Prototype



Watch video of the device in action: <https://youtu.be/serChsab8gk?t=3m55s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
RioRand 5PCS x SG90 Micro 9g Servo For RC Airplane Car Boat Genuine	\$16.99	motors	100%	\$16.99
Click Down Arduino Pan and Tilt Mount Servo Bracket/holder Stand for Robot Clamp Claw Joint	\$2.83	*5	500%	\$14.15
Stepper Motor Drive Controller Board Module L298N Dual H Bridge DC	\$6.87	control board	100%	\$6.87
XT-XINTE 1 Set Robot Servo Spare Parts: Metal U holder + Round Servo Mount Bracket	\$3.77	*1.5	150%	\$5.66
1/8 Inch 2 Feet x 4 Feet White Hardboard Handy Panel	\$4.63	half	50%	\$2.31
Black Plastic Storage Case 4 x 1.5V AA Battery Holder w Wire Leads	\$2.27	battery holder	100%	\$2.27
1 x 6 x 5' Treated Wood Fence Board	\$2.27	wood base	100%	\$2.27
AmazonBasics AA Performance Alkaline Batteries (48-Pack)	\$16.99	4/48 batteries	8.33%	\$1.42
			TOTAL	\$51.94

Final design

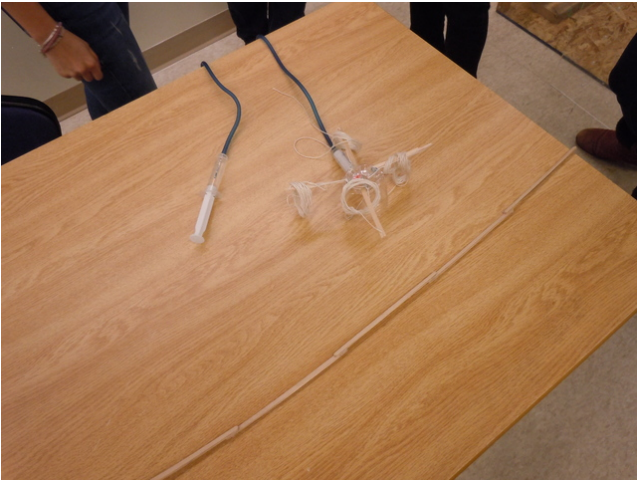
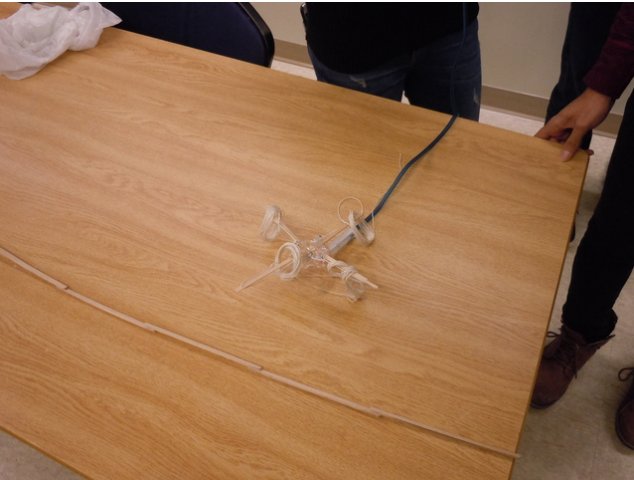


Watch video of the device in action: <https://youtu.be/ja5zt7ebGbK?t=2m50s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
RioRand 5PCS x SG90 Micro 9g Servo For RC Airplane Car Boat Genuine	\$16.99	Used 4 out of 5 motors	80%	\$13.59
Aluminum Multifunction Servo Bracket Steering Head Robot Manipulator for MG995 L	\$2.36	3 tilt mounts were used	300%	\$7.08
Stepper Motor Drive Controller Board Module L298N Dual H Bridge DC	\$6.87	One control board were used	100%	\$6.87
12 pcs Rubber Swivel Caster Wheels Rubber Base W Bearings Hot Sale!! 2 inch	\$18.32	Used all 4out of 12 wheels	33.33%	\$6.11
Stainless Steel Tiles	\$14.66	Used only 1/5 of the whole tile	20%	\$2.93
F03711 Robot servo spare parts: Metal U holder + round servo mount Bracket	\$2.72	One set were used	100%	\$2.72
1 x 6 x 5' Treated Wood Fence Board	\$2.27	Used the whole Wood board	100%	\$2.27
Black Plastic Storage Case 4 x 1.5V AA Battery Holder w Wire Leads	\$2.26	One battery holder were used	100%	\$2.26
AmazonBasics AA Performance Alkaline Batteries (48-Pack)	\$16.99	Used only 4 out of the 48 battery pack	8.33%	\$1.42
Aspire Set of 48 Kraft Paper Gift Boxes, 4" x 6-1/4" x 2-1/2" Candy Box with Clear Plastic Window-Square-1 Set	\$13.22	Used only 1 out of the 48	2.08%	\$0.28
			TOTAL	\$45.52

Group 2-08

Prototype



Watch video of the device in action: <https://youtu.be/serChsab8gk?t=4m14s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
Marina Airline Tubing, 3M	\$2.98		100%	\$2.98
6 Pcs Reusable Plastic 10ml Syringe Slip Tip for Refilling Ink Cartridge Oil DIY	\$7.99	Used 2 of 6 syringes	33.33%	\$2.66
Soft Foam Ear Plugs with case, 8 ear plugs	\$3.28	Used .5 of 8 earplugs	6.25%	\$0.20
Great Value 24pk Spring Water	\$2.97	Used 1 of 24 bottles	4.17%	\$0.12
Mini Eyes Pins Peg Tail Hooks Eyelets Hanging Hooks	\$3.46	Used 6 of 200 hooks	3%	\$0.10
Eyelets Screw Set of 200				
Wooden Stir Sticks, 10,000/Case	\$63.99	Used 14 of 10 000 sticks	0.14%	\$0.09
Cotton Household Twine	\$3.29	Used roughly 5 ft of 450 ft of twine	1.11%	\$0.04
			TOTAL	\$6.20

Final design

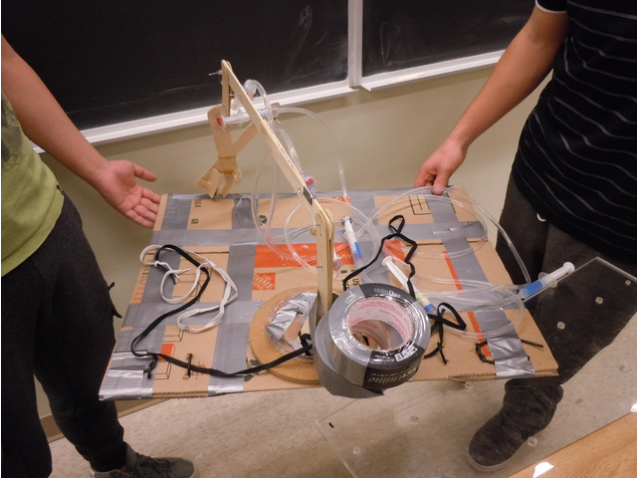
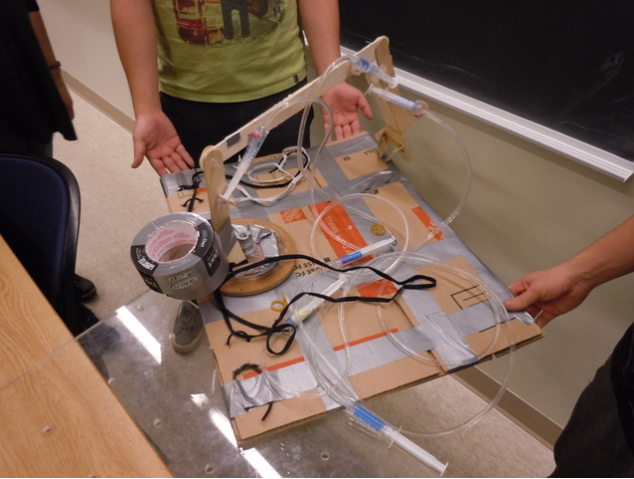


Watch video of the device in action: <https://youtu.be/ja5zt7ebGbK?t=3m07s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
Mainstays 2-Pack Tong Set	\$5.00	Used 1 tong	50%	\$2.50
Scotch Mailing Box	\$1.47	Used the whol box	100%	\$1.47
100ct Mini Glue Sticks	\$11.47	used 6 sticks	6%	\$0.69
Select Natural Bamboo Stakes, 15-pk	\$2.99	Used 2 sticks	13.33%	\$0.40
225' Yellow Mason Line Twisted 1 Piece	\$4.98	Used roughly 7 ft	3.11%	\$0.15
Great Value Aluminum Foil Roll	\$3.98	Used roughly 2 ft	2%	\$0.08
			TOTAL	\$5.29

Group 2-09

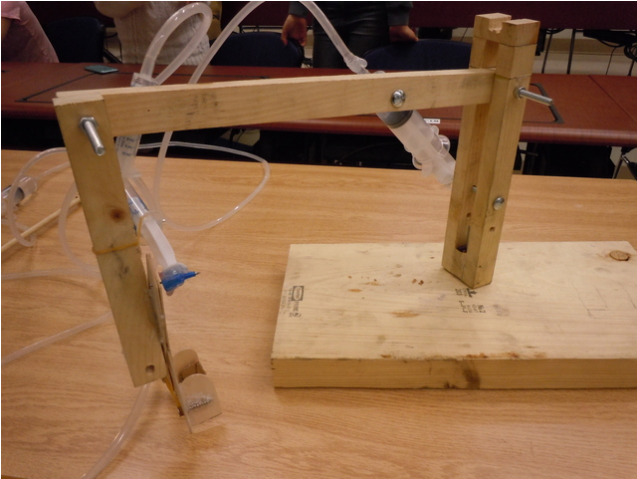
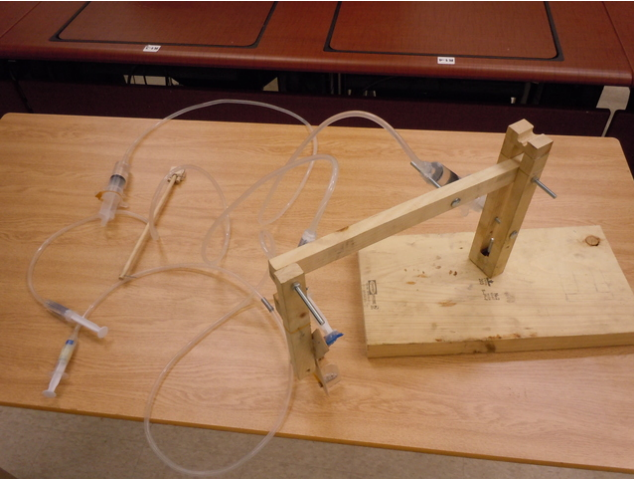
Prototype



Watch video of the device in action: <https://youtu.be/serChsab8gk?t=4m36s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
All Purpose Strength Duck Tape, 48 mm. x 18.2 m.	\$4.97	Duck Tape	200%	\$9.94
Mainstays 7.87” Cork Trivet	\$4.97	Medium Circular cork board tray	100%	\$4.97
Grreat Choice Airline Tubing	\$8.99	used 10 of 25ft	40%	\$3.60
Moneysworth & Best Jazz Oxford Dress Lace	\$2.97	shoe lace	100%	\$2.97
Heavy Duty Small Box 16 Inch x 12 Inch x 12 Inch	\$3.33	Cardboard box	75%	\$2.50
Woodsies Jumbo Craft Sticks, 6”, 300-Pack	\$3.46	40/75 craft sticks	53.33%	\$1.85
Mini Glue Sticks (30)	\$5.27	Adhesive used to glue pieces together	30%	\$1.58
Mainstays 4-Pack Cork Coasters 8-32X1 1/2 Ss Oval Phillips Mach Screw	\$5.97	Small circular cork board tray	25%	\$1.49
Great Value 7” Foam Plate	\$0.58	Screw	200%	\$1.16
Kamset Rubber Bands - 3OZ - Natural Color	\$2.63	Plastic plates	25%	\$0.66
#8 Vinyl Screw Protector	\$1.97	Elastic bands	15%	\$0.30
Steel Satin Pins	\$0.29	Screw protector	100%	\$0.29
	\$2.67	14 of 450 pins	3.11%	\$0.08
			TOTAL	\$31.38

Final design

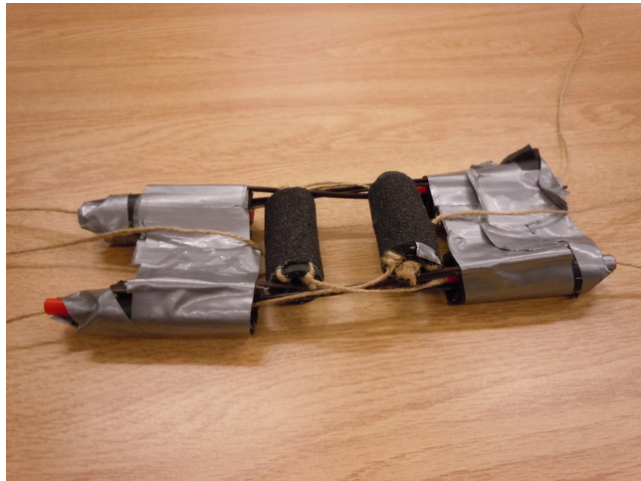
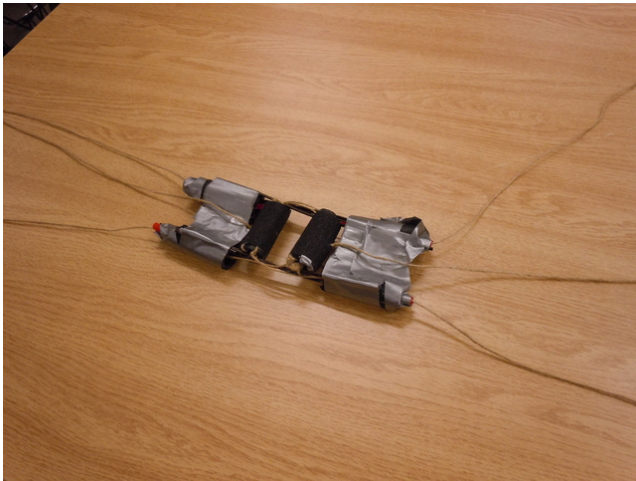


Watch video of the device in action: <https://youtu.be/ja5zt7ebGbk?t=3m19s>

Product Description	Full Cost	Parts Used	Proportion of Total	Proportional Cost
BD Biocoat syringes, non-sterile clean, 30 mL Luer-Lok tip, 25/PK	\$43.36	2 larger syringes (came with caps that we turned into washers to attach sryinge to nails with)	8%	\$3.47
1/2 x 5 GR2 Carriage Bolt HDG	\$2.65	Center pivoting bolt	100%	\$2.65
Marina Airline Tubing, 3M	\$2.98	Used to connect syringes to control syringes	80%	\$2.38
1/4x4 Carriage Bolt GR2 Unc	\$0.59	Arm joint bolts/ main syringe anchor	400%	\$2.36
2x8x10 SPF Dimension Lumber	\$10.84	Acted as base plate	20%	\$2.17
BD Biocoat syringes, non-sterile clean, 10 mL Slip-Tip, 50/PK	\$32.89	4 smaller syringes (came with caps that we turned into washers to attach sryinge to nails with)	4%	\$1.32
1X4X8 MILLSTEAD SPF SDRY	\$2.26	Is what the arm is comprised of	40%	\$0.90
Mini Glue Sticks	\$5.27	Used to attached syringes and claw	15%	\$0.79
1/4-20 Fin Hex Nuts GR5 Unc	\$0.12	Bolts for the half inch screws around the arm	400%	\$0.48
1” (17Ga) Bright Finish Nail 150 Grames	\$3.98	Nails used to anchor syringes to arm and claw	10%	\$0.40
Chenille Craft Natural Jumbo Wood Craft Sticks, 500 Pieces	\$36.90	Used for claw and for manual turning arm dowel	4%	\$0.15
10 X 1 1/4 Backer-On Screws 600Pc	\$39.99	Used to support the claws teeth	3%	\$0.12
Kamset Rubber Bands - 3OZ - Assorted Colors	\$1.97	Used to help claw close. Aaslo to keep syringe from moving	5%	\$0.10
Elmer’s Dowel Rods, 16 Pieces	\$1.97	Used for manual turning arm	5%	\$0.10
Small Moving Box	\$1.22	Padding used in the claws teeth	1%	\$0.01
			TOTAL	\$17.40

Group 2-10

Final design



Watch video of the device in action: <https://youtu.be/ja5zt7ebGbk?t=3m35s>