



# Discover Bot



# Members

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# Project Goal

**To develop a single-user prototype of the telerobotic master/slave setup and validate function and durability**

# Specifications

- Required
  - Safety
  - Durability
  - Accessibility
  - Intuitive
  - Serviceability
  - Camera
  - Size
- Preferred
  - 3D Vision
  - Haptic Feedback

# Project Learning

# Current Status

- Parts ordered
  - Waiting on delivery
- Parts being printed
- Project Learning
  - Looking into control schemes
    - Leap Motion
    - Master/Slave

# Robot Arms

- Variety of available kits online (\$300+)
  - RobotShop
  - AliExpress
- Open source designs - two significant options
  - BCN3D Moveo
    - 5 DoF
    - 3D Printed
    - Barebones design documentation
  - THOR
    - 7 DoF
    - 3D Printed
    - Extensive design documentation



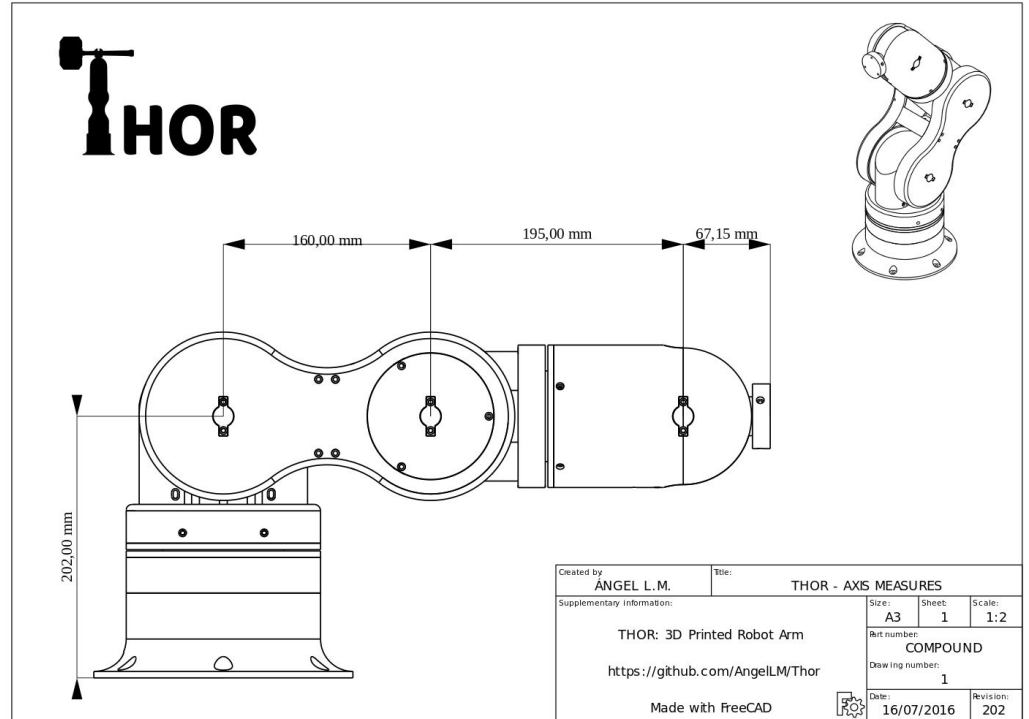
# THOR - Open Source Robot Arm



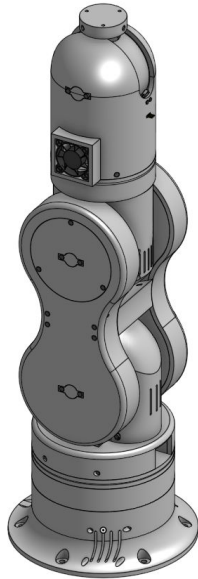


# THOR - Open Source Robot Arm

- 7 DoF arm (6 axis + gripper)
- ~1.4 ft (422 mm) horizontal reach
- Open source hardware and software
- 3D Printable for rapid prototyping

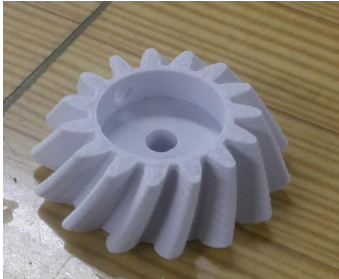
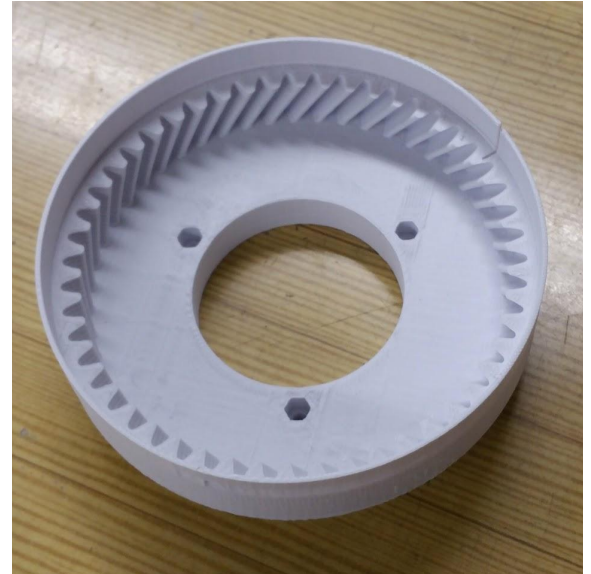
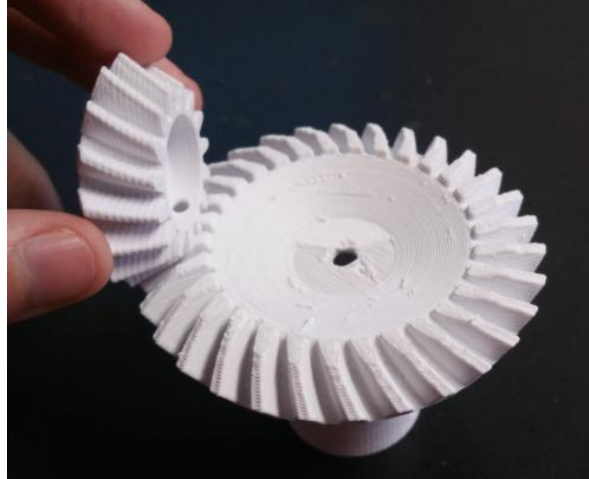
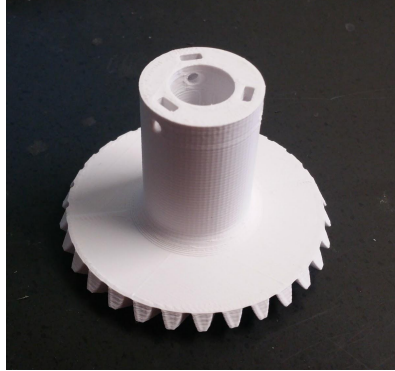


# THOR - Open Source Robot Arm



- Current objective is to recreate the arm as designed
  - Order parts - motors, electronics, etc
  - Print parts - 3D printed body
  - Recreate CAD assembly
  - Build
- Write software for real-time control
- Use to test control methods
- Adjust design to our requirements

# THOR - Printed Parts



# Controllers

- Current two implementations are Leap Motion and Master/Slave controller setup
- Leap Motion
  - Virtual Reality controller
  - Hands free controller
  - Users seem to enjoy hands free aspect
  - Issues with responsiveness and range
  - Might lack some intuitiveness
  - No haptic feedback



# Controllers Continued

- Ultrahaptics
  - Uses a grid of ultrasonic speakers to direct sound waves
  - Allows for the sense of touch in air
  - Works with Leap Motion
  - Meeting setup with company



# Controllers Continued

- Master/Slave controller
  - Second arm shaped device used for controller
  - More intuitive than Leap Motion
  - Could more easily implement haptic feedback using this controller
  - Not as durable and safe as Leap Motion
  - Great example of what a finished product could look like in the video from TeleroboticsCAR



# 3D Vision

- Issue of depth perception arises when streaming video from arm's view with regular camera
- Available options for stereoscopic shutter and polarized 3D but all have high price points
- Possibility of using two webcams to create 3D stream
- Options for creating stereoscopic anaglyphic 3D using two video streams, but not shutter or polarized 3D
- Still researching this issue



*Minoru Stereoscopic  
Anaglyphic 3D Webcam*

# Project Management



# Schedule

- This Semester
  - Finish 3D Printing THOR arm
  - Begin assembly of THOR arm
  - Begin modeling a master controller
- Next Semester
  - Finish THOR arm
  - Finish control system (either LEAP, or master)
  - Redesign arm to fit specifications
  - Test design safety and durability
  - Begin prototyping 3D vision

# Budget

Budget	Total	5000			
		total from site	order one	order two	shipping
Parts	stepper online	136.9	103.59		33.31
	amazon	191.66	89.97	101.69	0
	robot digg	60.26	46.26		14
	Ali	32.23	18.17	10.42	3.64
	mouser	8.58	0.59		7.99
	Pololu	43.55	39.6		3.95
	Seed	26.3	4.9		21.4
	control system	1500			
	parts for final bot	1000			
Travel	van	126			
	gas	182			
	food	480			
	hotel	390	1 night		
Unallotted funds		822.52			

# Ordered Parts

Stepper Motors							
#	Type	Length	n	from	purchased	here?	cost
1	Nema 17	40mm	39.22 N.cm	stepper online			\$9.98
3	Nema 17	34mm	121.2 N.cm	stepper online			\$24.51
3	Nema 17	34mm	21.57 N.cm	stepper online			\$6.69
Belts							
#	Type	Length	Shops				
2	GT2 Closed Belt	208mm (104 teeth)	<a href="#">RobotDigg</a>	robotdigg			\$0.28
1	GT2 Open Belt	2m	RobotDigg, RepRap World	robotdigg			\$9.00
Pulleys							
#	Type	Number of Teeth	Shops				
3	GT2 Pulley	20	<a href="#">RobotDigg</a>	robotdigg			\$1.60
2	GT2 Pulley	40	<a href="#">RobotDigg</a>	robotdigg			\$2.20
Bearings							
#	Type	Shops					
1	16014zz	Thingiverse (3D printed), Createc3D					
11	625ZZ Bearing	<a href="#">RobotDigg</a>		robotdigg			\$2.50
2	MFR4ZZ Bearing			amazon	x		\$11.89

Rods								
#	Length (mm)	Diameter (mm)						
2	14	4						
1	14,5	5						
1	32	5						
1	102	5						
1	128	5						
Bolts								
#	Size	Length (mm)						
2	M3	10						
6	M3	6						
46	M3	8						
1	M3	10						
15	M3	12						
9	M3	16						
4	M3	18						
8	M3	25						
8	M3	28						
8	M3	30						
13	M3	40						
8	M3	46						
1	M5	18						
Nuts								
#	Size							
2	M2							
90	M3							
1	M5							
Electronics								
#	Part	Description						

# Ordered Parts Cont.

1	Arduino Mega	-		amazon	x	here	
1	Micro Endstop	-					
7	Fans	40 x 40 x 10mm (stepper motor cooling)		amazon	x	here	6.98
Control PCB V2 (current version)							
#	Part	Reference	Description				
1	PCB	-	-				
8	A4988 Stepper Motor Driver	-	-		pololu		
				aliexpress	out of stock!!		1.7
8	100uF Capacitor	C1, C2, C3, C4, C5, C6, C7, C8	16V SMD	aliexpress	x		1.85
8	100kΩ Resistor	R9, R10, R11, R12, R13, R14, R15, R16	SMD 1206	aliexpress	x		0.57
8	10kΩ Resistor	R1, R2, R3, R4, R5, R6, R7, R8	SMD 1206	aliexpress	x		0.98
3	620Ω Resistor	RLED1, RLED2, RLED3	SMD 1206	aliexpress	x		1.58
3	LED	DLED1, DLED2, DLED3	SMD 1206	aliexpress	x		1.33
1	1N4004 Diode	D1	THT	aliexpress	x		0.97

1	MF-R700 Fuse	F1	THT	mouser	x		0.59
169	Male Pins	PM, PS, PT, PA, PDIG	THT	aliexpress	x		0.35
2	PCB Terminal Block	POWERPIN1, SW1	1x2 THT	aliexpress	x		0.94
128	Female Pins	U1, U2, U3, U4, U5, U6, U7, U8	-	aliexpress	x		1.03
24	Jumpers	-	-	aliexpress	x		1.2
2	Fan	-	40mm	aliexpress	x		1.23
1	Bus Wire 2x36	-	Optional				
Commercial Opto-Sensors (current version)							
#	Part	Description	Shops				
4	Optical Endstop	-	<a href="#">AliExpress</a>	aliexpress	x		0.66
filament							
	ASB white with cartridge			amazon	x	here	49.99
	ABS white				x	here	29.99
	PLA black				x	here	29.99
	PLA green				x	here	29.99

