ME 327: Design and Control of Haptic Systems
Spring 2020

Interactive Session 13: Hapkit Assembly, part 1

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Questions from prerecorded video?

Reminders:

Assignment 6 due Thursday

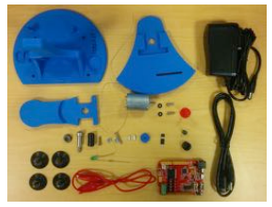
Quiz 2: 60 minutes, this Friday (May 22)

Office Hours/Q&A with Allison until 10 am.
Question queue (see tab with today's date):
https://tinyurl.com/HapticsAllison

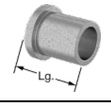
Hapkit Assembly

Have your tools and parts ready

Hapkit Parts List
Spring 2020 Hapkit 3.0

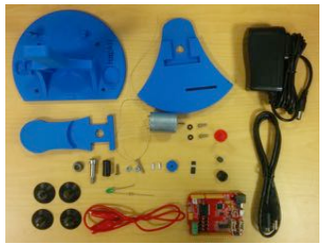


In order to make your Hapkit, you will need to gather (or make) all the parts shown in the table below and (as a group) in the picture at right. The total cost of the Hapkit ranges in price from $50 to $100, depending where the parts are sourced, shipping costs, and resources at hand. We provide online resources for purchasing most parts, although in many cases you can substitute with parts found at your local hardware store. (Many parts purchased online can only be found in bulk, but you may be able to buy parts individually at a local store.) If you are new to building mechatronic devices, we suggest that you purchase the specifically recommended items as much as possible.

Component	Photo (not to scale)	Quantity	How to get this part	Approximate cost per Hapkit
3D printed base		1	These parts are 3D printed using the files available at the Hapkit website: http://hapkit.stanford.edu/build.html. See the 3D printing tips in the Assembly document for more information. We have successfully built these parts using a commercially available consumer-grade 3D printer, the Makerbot Replicator. In Spring 2020, these parts were printed by 3D Hubs (https://www.3dhubs.com)	Cost of PLA (thermoplastic used in the Makerbot) to print all these parts is approximately $10 if you make it yourself. The cost to have these printed at 3D Hubs was about $17. The total weight of plastic used is about 100 grams.
3D printed sector pulley		1		
3D printed handle		1		
3D printed tightening washer		1		
3D printed drive wheel/magnet holder		1		
Neoprene tubing, 1/4" inner diameter, 3/8" outer diameter, cut to slightly less than 3/4" length		1	McMaster-Carr (http://www.mcmaster.com) sells in packs of 10, 25 and 50 ft: part number 51075K27	$9.60 for a *10'-long* tube ($0.96 per foot), not including shipping. Can also find at hardware store for ~$2/foot.
Bearing: SAE 863 bronze flanged-sleeve bearing, 1/4" shaft dia., 3/8" outer dia., 1/2" length, 1/2" flange outer dia.		1	McMaster-Carr (http://www.mcmaster.com): part number 2938T3	$0.88 for one bearing, not including shipping
Stainless Steel Thread-Locking Shoulder Screw, 1/4" Diameter x 5/8" Long Shoulder, 10-24 Thread	 Smooth shoulder length is longer than shown	1	McMaster-Carr (http://www.mcmaster.com): Part number 90311A144	$6.75 for one screw, not including shopping
Shaft collar: set screw shaft collar for 1/4" diameter rod, black-oxide steel		1	McMaster-Carr (http://www.mcmaster.com): part number 9414T6	$0.98 for one shaft collar, not including shipping

Have the assembly document at hand

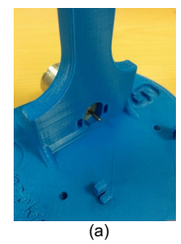
Hapkit Assembly Instructions
Spring 2020 Hapkit 3.0



1. **Obtain the Hapkit components.** Consult the parts list provided, and contact CAs for the parts you don't already have on hand.

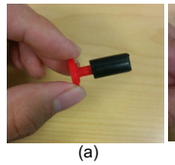
2. **Use a 3-D printer to create the 3-D printed parts.** The base, the sector pulley, the Drive Wheel and the Octagon. The STL files for the parts are available on the Hapkit website. The CAD files for these parts are also available in case you want to customize them. We recommend that you experiment and customize your handle.

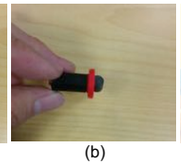
3. **Attach the motor to the base.** (a) Place the motor in the base by pushing the motor shaft through the hole as shown below. (b) Use two 4-40 screws with length 3/8" (*not* the longer screws!) with washers on either side of the motor to secure the motor in place. The height of the motor/screws in the slots doesn't matter much; the slots just make it easier to place the screws. It is easiest to get the second screw in if you don't tighten the first screw all the way. Once both screws have purchase, then tighten them.

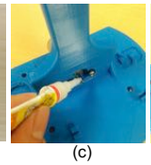

(a)

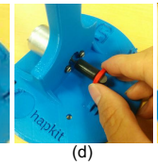

(b)

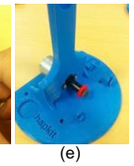
4. **Assemble the motor and drive wheel.** (a) Insert the 3D-printed drive wheel into the neoprene tube. If your drive wheel is loose within the neoprene, you can use superglue here. (This isn't necessary for most parts, but it may happen due to the tolerance of the 3D-printed parts.) (b) Then place superglue into the magnet holder end of the 3D-printed drive wheel, and insert the magnet. Let dry. When the motor shaft rotates, the cylinder-shaped magnet should rotate about an axis perpendicular to the cylindrical axis of the magnet (c) Apply a small amount of superglue on the motor shaft (d) and then slip the drive wheel over the motor shaft. (d) Let dry for a few minutes.


(a)


(b)


(c)


(d)


(e)

