HANDi-Hand Assembly Manual

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Introduction

The HANDi Hand is an open-source robotic platform specifically designed for machine learning research in prosthetic control. The inexpensive and easily modifiable hardware allows versatility for research studies, and the suite of sensors provides valuable information for machine learning and prosthetics research.

The open-source release provides all solid-modelling files, .stl files, Arduino code, and assembly instruction required to construct a fully functional HANDi Hand, and should also give the maker enough flexibility to make alterations to the design as necessary to suit their own needs. Both left and right hand versions are available. To contact the original designers, or to receive support for your build, please visit BLINCdev.ca.

This assembly manual outlines all the information required to print and source parts, and assemble the HANDi Hand as currently designed. The hand takes an estimated 30 hours to build.

The HANDi Hand was originally released in August 2017, as published in MEC '17

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Glossary of Terms

Digits: The digits are referred to by standard numbering, beginning with the thumb as D1 as shown in Figure 1.

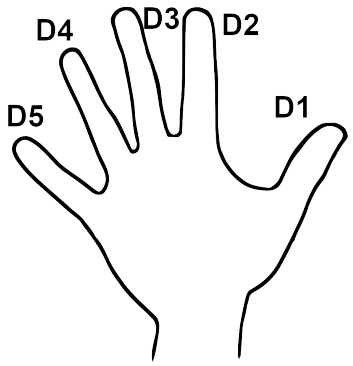

FIGURE 1: Numbering scheme used for finger naming.

Joints: The joints are named in accordance with Figure 2. The names are constructed first with a digit indicator (i.e. D2) followed by a joint indicator D, I or P, indicating distal, intermediate, or proximal respectively. Potentiometers are named for the joints that they measure. The digit D0 refers to thumb rotation.

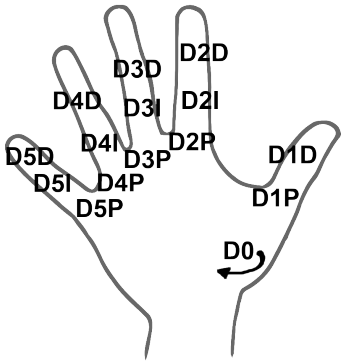

FIGURE 2: Numbering scheme used for joint naming.

Finger Parts: Each phalanx of the finger is made up of multiple parts. The part names are contrived according to the following convention:

1. Phalanx indicator. PP = Proximal Phalanx, IP = Intermediate Phalanx, DP = Distal Phalanx, MC = Metacarpal
2. Part position indicator. P = Proximal, D = Distal
3. Position modifier. There are sometimes multiple parts in the same location that must be differentiated by their function (pivot, main, lock, tip, etc).
4. Handedness indicator. R = Right Hand, L = Left Hand

An example part name would be **IP-P Pivot R**, for the proximal portion of the intermediate phalanx corresponding to the pivot, for the right-hand version of the HANDi Hand.

1 Required Materials

1.1 3D Printed Parts

The 3D printed parts are designed to be printed in PLA without support material and without rafts, except where indicated. Parts are designed for the print tolerance of a MakerBot Replicator 2. Some filing may be necessary to ensure a smooth running fit between parts.

All files required for 3D printing can be accessed via BLINCdev.ca. The suggested print specifications for each part are found in Table 1.1. The table lists all of the part sets that must be printed for a complete hand. In the event that a particular component is needed, the individual STL files can be found on BLINCdev.ca in addition to the grouped parts in Table 1.1.

TABLE 1.1: 3D Printed Parts Specifications

Part Name	**Print Specifications**	**Estimated Print Time**	**Est. Material Weight**
Dorsal Palm	0.2mm layer, 30% infill, print with raft	6h 0m	64 g
Ventral Palm	0.2 mm layer, 10% infill	1h 55m	22 g
Thumb Screw Cap	0.2 mm layer, 10% infill	0h 15m	2 g
D2 Full Finger	0.2 mm layer, 10% infill	1h 10m	9 g
D3 Full Finger	0.2 mm layer, 10% infill	1h 10m	9 g
D4 Full Finger	0.2 mm layer, 10% infill	1h 10m	9 g
D5 Full Finger	0.2 mm layer, 10% infill	1h 10m	9 g
Full Thumb	0.2 mm layer, 10% infill	2h 30m	25 g
Breadboard	0.1 mm layer, 10% infill	0h 25m	3 g
Connector Hub	0.2 mm layer, 10% infill	0h 15m	3 g
Pot Activator Set of 15	0.1 mm layer, 10% infill	0h 10m	1 g
Pot Placeholder Set of 6	0.2 mm layer, 10% infill	0h 10m	2 g
Servo Spool Full Set	0.1 mm layer, 10% infill	0h 25m	4 g
Servo Spur Gear	0.1 mm layer, 10% infill	0h 5m	1 g
TOTAL:	-	16h 50m	163 g

1.2 Off-The-Shelf Parts

The table below contains all the off-the-shelf parts required for building a complete HANDi Hand. Additional ordering information is provided in Appendix A.

TABLE 1.2: Off-the-Shelf Parts Specifications.

Item	**Part Number**	**QTY**
SENSORS AND ELECTRONICS		
Rotary position sensor	MuRata SV03A103AEA01R00	9
Force sensitive resistor	Interlink Electronics 34-00004	5
Arduino Mega	Arduino A000067	1
AC / DC 5V 2.5A wall adapter	Qualtek QAWA-18-5-US01	2
DC barrel jack adapter (female)	Sparkfun PRT-10288	1
10 kΩ, 1/8W through-hole resistor	Stackpole Electronics CF18JT10K0	5
12-position header pin (long)	Sullins Connector PREC012SACN-RC	2
12-position header pin (short)	Sullins Connector PREC012SAAN-RC	6
12-position female socket	Sullins Connector PPTC121LFBN-RC	2
3-position female socket	Sullins Connector PPPC031LFBN-RC	13
Heat shrink tubing, assorted	Sparkfun PRT-09353	1
Analog RC servo motor	Dymond D47	6
USB Webcam	Microsoft LifeCam HD-3000	1
End of Table		

1.3 Tools

A Commercial Off-The-Shelf Parts Information

This appendix contains detailed ordering information for the off-the-shelf parts used in the HANDi Hand. Links to specific vendors are supplied for convenience only; no affiliation between BLINCdev and the vendors exists or implies. Cost information is provided to give the builder an estimate of the cost of the project, and is accurate as of August 2020.