BLIMB - BLUETOOTH LIMB

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Blimb is a robot arm that is controlled with a custom android application via bluetooth. The 20 cm long arm has three servo-controlled joints and a servo-controlled clamp, thus being able to approach and grab small objects weighing up to 100 g. There is a sensor in the clamp to detect a grabbed object.

There are several steps to this project, in which you'll need the following tools and techniques:

- 3D printing

- Laser cutting

- PCB milling

- Soldering

The robot is open source excluding the andoid app since it uses a commercial bluetooth plugin. So feel free to customize the robot to your liking.

<https://www.assetstore.unity3d.com/en/#!/content/16467>

Blimb creation guide

PUTTING IT ALL TOGETHER

First of all, you’ll need to choose one from the two different case options: The laser cut, plywood case (A) or the 3D-printed case (B). You can find the case files from <https://github.com/mitjakarki/Blimb/blob/master/mechanics>

CASE OPTION A (wooden)

<https://github.com/mitjakarki/Blimb/blob/master/mechanics/frame_v02_wooden.pdf>

Cut and carve out of 4mm plywood with a laser cutter. Then glue the parts together on the finger joints. Glue the two rectangles (the lid parts) together so that the smaller part is in the middle of the bigger one. The smaller part is to hold the lid in place. If you like, you can use screws to fasten the lid more securely to the case.

CASE OPTION B (3D printed+wooden)

This case consists of a 3D printed hull and two wooden lids (top, bottom). Printing the object requires support material capability from the printer. Use a laser cutter to cut out the top and bottom parts. Files:

<https://github.com/mitjakarki/Blimb/blob/master/mechanics/frame_v10_3dprinted.stl>

<https://github.com/mitjakarki/Blimb/blob/master/mechanics/lids.pdf>

Print the body from Nylon, PLA or ABS. We used Nylon with 0.25 mm layer thickness.

Glue the top lid on using hot glue, super glue, contact adhesive or whatever you’ll think will hold. Attach your Arduino UNO to the inside of the bottom lid with a couple of screws so that the usb connector aligns with the case’s hole.

ARM AND CLAMP

The arm and the clamp are constructed of five laser cut plywood parts.

<https://github.com/mitjakarki/Blimb/blob/master/mechanics/blimb-arm%26clamp-v10.pdf>

Cut out the parts from 4mm plywood. Assemble the arm according to the pictures. Carefully align the servo angles when gluing the parts together, since they cannot be changed later easily. First, insert one of the big servos in the top lid slot and use some glue to fasten it to place. In every connection, you’ll need to use the servo horns and fittings included with the servos. The connection between the planar servo and the shoulder servo can be made with (hot) glue. Attach the shoulder servo to the upper arm part with glue and a small screw from the servo bag. Slide a small servo in the upper arm slot and fasten it with a zip tie and glue. Fasten the arm part to the arm servo again with glue and a screw. Then attach the second small servo for the clamp on the end of the arm using glue and a zip tie. Assemble the clamp part according to the pictures and glue it on the clamp servo.

Get the clamp rubber parts from <https://github.com/mitjakarki/Blimb/blob/master/mechanics/clamp_rubber2.stl>

and print three of them. We used 0.3 mm layer thickness.

Or if you have no access to ninjaflex filament cut similar pieces from a rubbery material with scissors or a knife. Then attach the pieces to the stationary clamp insides with super glue. Hot glue does not bond well with ninjaflex! Instead of glue, use a single screw when attaching the rubber on the moving part of the clamp so that the rubber has more flex and the micro switch can be pressed.

THE WIRING

You will need some extension wires for connecting the servos to the pcb shield. The lengths should be from 10 to 30 centimeters, longest being the ones for the clamp servo. You also need two long (~50cm) wires for the clamp micro switch. Solder pin headers to the wire ends that go to servos or the pcb. Cover the soldered areas with heat shrink tubing to make solid connectors.

For connecting the wires to the pcb, the correct pin order can be examined from the Arduino program code and the marking on the Arduino module. By default, the servo control pins on the shield pcb are aligned next to their Arduino mapped pins. Note that it does not matter which way you connect + and - pins of the micro switch.

PCB SHIELD

This section needs some extra caution. Making the pcb shield requires creating drill files in fabmodules.org using the drill specific settings. To start, inspect three board layout images in attached folder “unscaled\_shield\_images”. Now follow these steps to create drill files:

Get the files from <https://github.com/mitjakarki/Blimb/tree/master/blimb_shield/v1.0>

1. Open the Blimb\_shield\_cuts.png in fabmodules.org
2. input format (png)
3. select output format according to your drill brand
4. select process: PCB outline
5. select your drill model from the drop-down list
6. config the cut depth to match the thickness of the PCB board you are using
7. change the tool diameter value from default value to 0.65mm and press calculate
8. inspect that all the wanted lines and holes are marked for drilling with blue. If not, try adjusting the tool diameter a bit and press calculate, repeating until everything looks okay
9. press save to save the drilling file
10. Repeat steps 1-9 for two remaining files, but select “PCB traces” in section 4!

It is presumed in this guide that you already possess the knowledge on how to operate the drill. Run the created files with the drill in the following order: traces, text layer, outline&holes. Inspect the drilled PCB for short-circuits or other mishaps.

Next, solder the components on the board. Refer to the attached image for component placement. Then check the connections with multimeter.

PROGRAMMING

The Arduino C program for the device is in attached files (Blimb\_source.ino). Open the file in Arduino IDE and upload to your UNO.

For the mobile app, copy the attached Blimb\_v1\_0.apk file into a bluetooth capable Android device and install by opening it from the device.

Parts and materials

Frame and mechanics:

Item Description Amount

4mm plywood 0.5 \* 0.5m

ABS or PLA 3D printing filament 60 cm³ (estimate)

Ninjaflex 3D printing filament (optional) 10 cm³ (estimate)

M3\*20mm screw 2

M3 nut 6

Wood glue some

Screw ~2\*10 mm Usually bundled with servos ~10

Electronics:

Item Description Amount

Arduino UNO 1

USB A Female to USB B male cable 1

USB power supply 5 V, >1.5A 1

1.4 kg micro servo HK15178 2

4.3 kg servo HK15138 2

Bluetooth module HC-05 1

Micro switch 13\*5\*6.5 mm 1

Multistranded wire ~0.5 mm² A metre or two

Pin headers male and female ~40 pins

Electrolytic capacitor 470 uF 2

Resistor 1 kOhm, SMD, 1206 1

Resistor 2.2 kOhm, SMD, 1206 1

Solder

Flux (optional)

Tools

Tool What we used

3D printer Leapfrog Creatr, Stratasys Fortus 380

Laser cutter capable of cutting plywood Epilog Fusion 75 W

Milling machine Roland SRM-20

Android smartphone or tablet with bluetooth SGS3, Oppo N1

Soldering station

Wire cutters and such electrical tools