



(<https://inmoov.fr/>)

## 头部 i2

从图库 (<https://inmoov.fr/inmoov-stl-parts-viewer/?bodyparts=i2Head>) 下载 STL 文件。

在打印所有部件之前，您应该打印一份校准器 (CALIBRATOR) (<https://inmoov.fr/wp-content/uploads/2019/01/Calibrator.stl>)，以检查部件是否能够拼合。如果您在拼合这些部件时遇到困难，可以调整切片软件的水平扩展设置来解决这个问题。此设置可能因切片机和打印机而异，但用户报告称，将其设置为 -0.15 是一个不错的起点。

模具尺寸很大，需要很大的打印面积。在开始构建打印头之前，请检查它是否适合您的打印机。标准的220x220毫米打印床尺寸就足够了。我打印的模具厚度为0.4毫米，因为之后会在所有表面涂抹底漆填料。我使用的是Upol UHS高强度底漆S 2021 G/I及其快速固化剂S 2021/I。您可以使用装在喷雾罐中的底漆填料，进行测试，看看硅胶是否与您找到的底漆反应良好。

硅胶参考号为 Smooth-On Ecoflex 00-10。一片皮肤大约需要 500/600 克。你可以用油漆或颜料给硅胶上色。你也可以添加植绒，让它有皮肤般的质感。因为皮肤颜色很浅，而且略微透明，所以只需添加少量即可。主要添加白色，然后是一些红色和一点点黄色。

铸造前必须使用脱模剂，例如蜡喷剂。型号：Alchemie R5。

- 1 PCA9685 (adafruit 16通道)
- 15 个伺服器 JX PDI 1109MG (避免使用廉价的 SG90，它们不会持续很长时间)
- 2个伺服器 JX PDI 6221MG
- 28块钕磁铁，10x1.5mm
- 1 或 2 个微型摄像头 (选择带自动对焦的 type2)  
[https://fr.aliexpress.com/item/1005004200917640.html?](https://fr.aliexpress.com/item/1005004200917640.html?spm=a2g0o.order_list.order_list_main.76.40465e5b637U38&gatewayAdapt=glo2fra)  
[spm=a2g0o.order\\_list.order\\_list\\_main.76.40465e5b637U38&gatewayAdapt=glo2fra](https://fr.aliexpress.com/item/1005004200917640.html?spm=a2g0o.order_list.order_list_main.76.40465e5b637U38&gatewayAdapt=glo2fra)  
[https://fr.aliexpress.com/item/1005004200917640.html?](https://fr.aliexpress.com/item/1005004200917640.html?spm=a2g0o.order_list.order_list_main.76.40465e5b637U38&gatewayAdapt=glo2fra)  
[spm=a2g0o.order\\_list.order\\_list\\_main.76.40465e5b637U38&gatewayAdapt=glo2fra](https://fr.aliexpress.com/item/1005004200917640.html?spm=a2g0o.order_list.order_list_main.76.40465e5b637U38&gatewayAdapt=glo2fra)
- 6 x M3 六角螺母
- 6 x M3 x 14mm 沉头螺钉
- 6 x 0.8 x 6mm 长自攻螺钉
- 4 x 十字槽头 4g x 6.5mm 自攻沉头螺钉
- 2 x M3 x 20mm 长螺丝





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- 1x 脸颊拉拔器
- 1x EarLock (添加支持)
- 1x 眉毛支撑
- 1x 眉毛
- 1x 左面部固定器
- 1x 右脸部固定器
- 1x 头部支撑
- 1x 头部
- 1x 齿轮架
- 1x 颞铰链
- 1x JawPiston (添加支撑)
- 1x 下颌支撑
- 1x 下颌
- 1x LowBack (兼容原装头)
- 1x MainGear (兼容原装头)
- 1x 上唇
- 1 个环 (兼容原装头)
- 1x ServoGear (兼容原装头)
- 1x SkullServoFix
- 1x 牙齿托架
- 1x TopBackskull (与原装头部兼容)
- 1x 顶牙
- 1x 头骨前部
- 1x Topskull (与原装头部兼容)
- 1x 伺服适配器 (仅当您使用比 HS805BB 更小的伺服器来旋转头部时)
- 1x servoHornAdapter (仅当您使用比 HS805BB 更小的伺服器来旋转头部时)

以 30% 的填充率、2 毫米的壁厚进行打印，检查需要支撑的部分。

以下是模具所需的零件清单和打印数量，选择“公”或“母”：

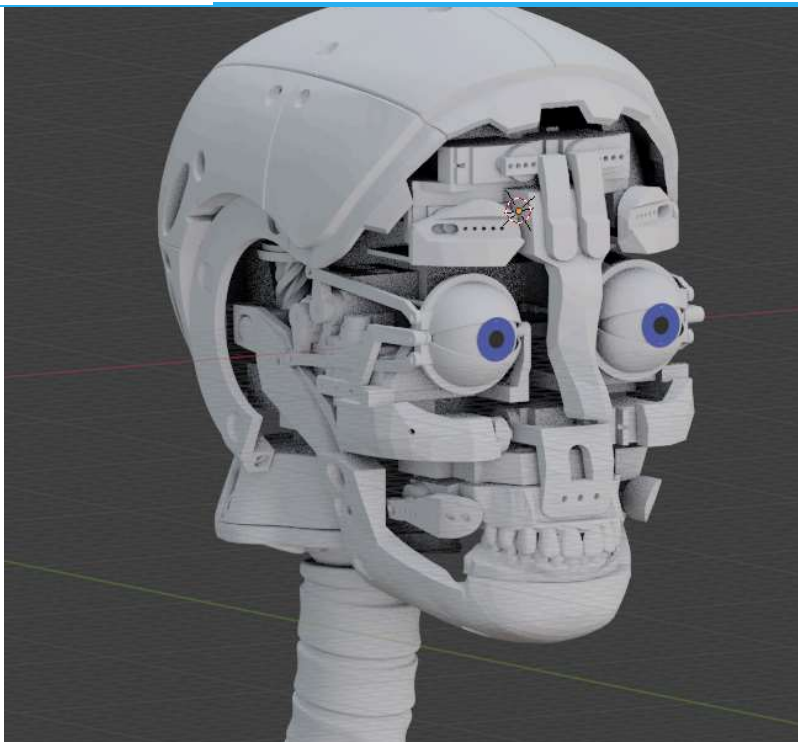
- 1x 内中模
- 1x 内侧模具
- 1x OuterBottomMoldFemale (添加支撑)
- 1x OuterBottomMoldMale (添加支撑)
- 1x OuterTopMoldFemale (添加支撑)
- 1x OuterTopMoldMale (添加支撑)



以 15% 的填充率、壁厚 2 毫米进行打印，检查需要支撑的部分。

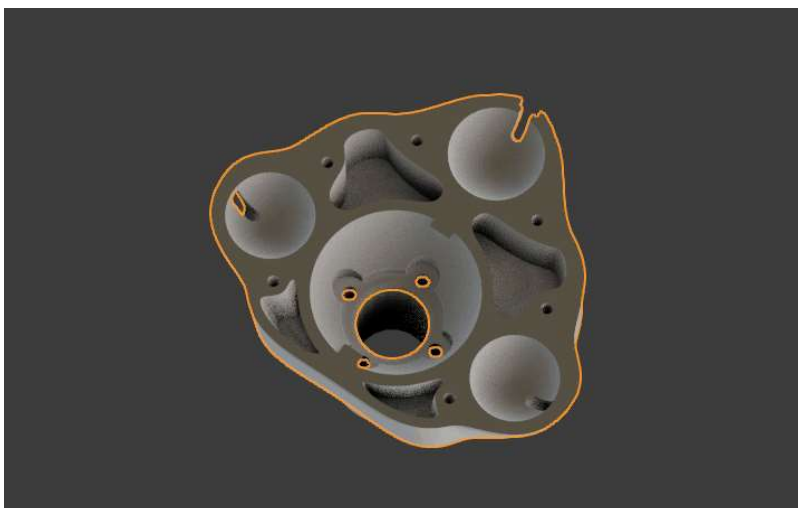


(<https://inmoov.fr/>)



([https://inmoov.fr/head\\_0new/](https://inmoov.fr/head_0new/))

使用 4 颗螺丝（3mmx16mm）将 MainGear 和 NeckPlateHigh 组装在一起。



(<https://inmoov.fr/i2head/animation1-2/#main>)



(<https://inmoov.fr/>)



([https://inmoov.fr/i2head/head\\_31/#main](https://inmoov.fr/i2head/head_31/#main))

在顶部添加 ServoGear。

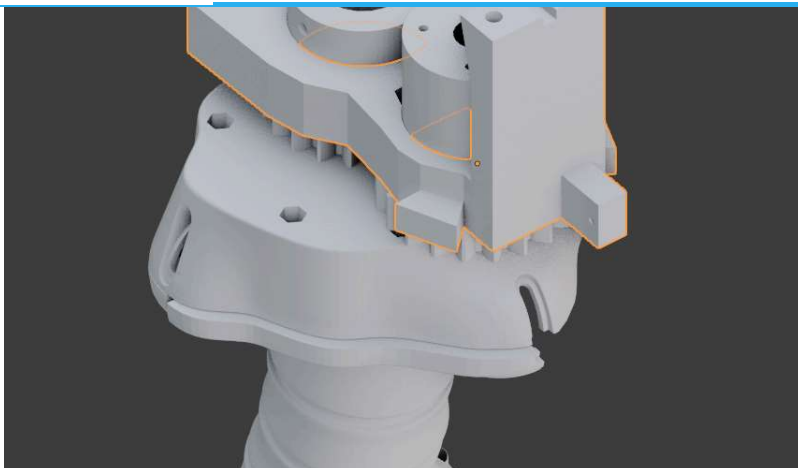


([https://inmoov.fr/i2head/head\\_30/#main](https://inmoov.fr/i2head/head_30/#main))

滑过 GearHolder，确保它可以在两个方向上自由旋转。

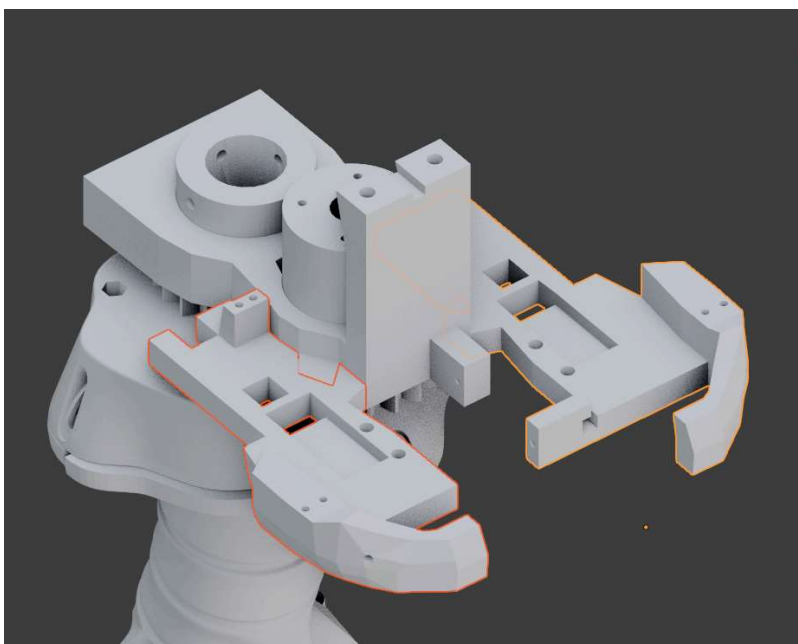


(<https://inmoov.fr/>)



([https://inmoov.fr/i2head/head\\_29/#main](https://inmoov.fr/i2head/head_29/#main))

将 GearHolder、FaceHolderRight 和 FaceHolderLeft 粘合在一起。

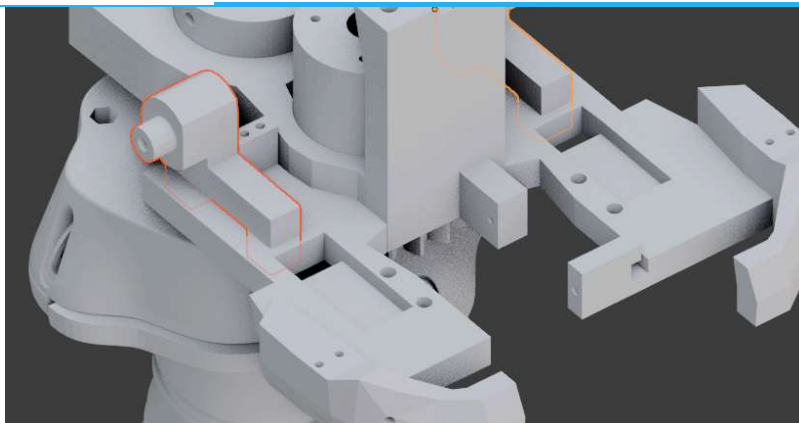


([https://inmoov.fr/i2head/head\\_28/#main](https://inmoov.fr/i2head/head_28/#main))

将两个 JawHinge 压入。如果太松，可以用胶水粘住。



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([https://inmoov.fr/i2head/head\\_27/#main](https://inmoov.fr/i2head/head_27/#main))

使用 4 个螺丝（3mmx16mm）安装 TeethTopHolder。

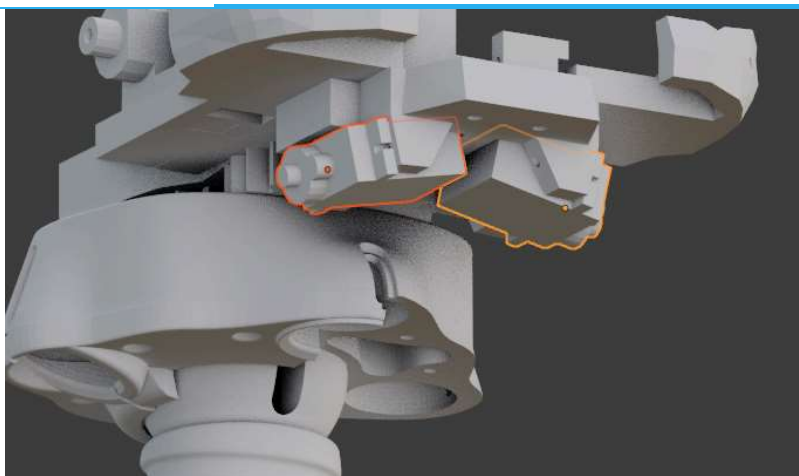


([https://inmoov.fr/i2head/head\\_26/#main](https://inmoov.fr/i2head/head_26/#main))

设置两个带有喇叭的伺服器，并确保它们在软件中预设为 90°。（静止位置）

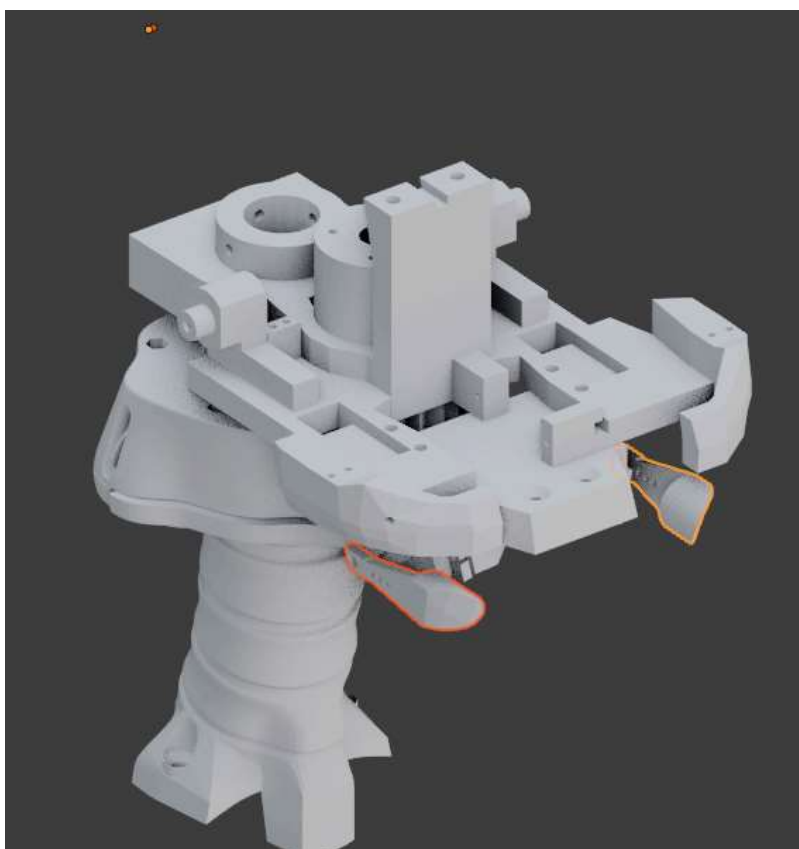


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([https://inmoov.fr/i2head/head\\_25/#main](https://inmoov.fr/i2head/head_25/#main))

将两个 CheekPuller 固定到伺服喇叭上。



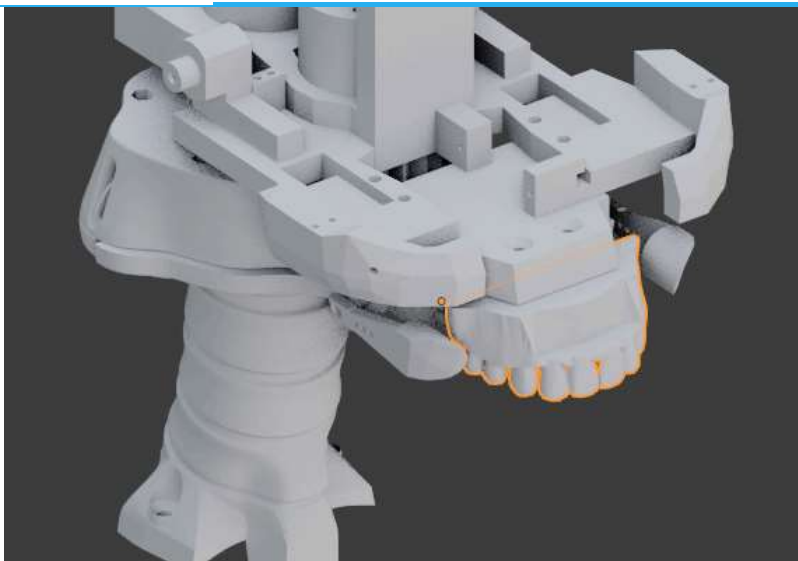
([https://inmoov.fr/i2head/head\\_24/#main](https://inmoov.fr/i2head/head_24/#main))

用两颗螺丝（3mmx20mm）组装 TopTeeth。



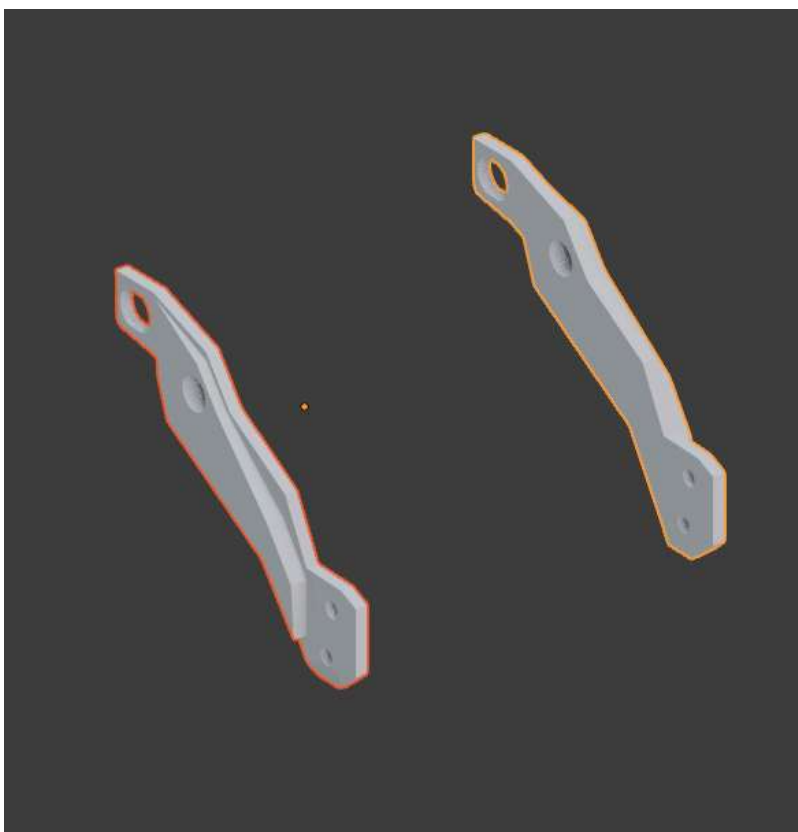


(<https://inmoov.fr/>)



([https://inmoov.fr/i2head/head\\_23/#main](https://inmoov.fr/i2head/head_23/#main))

获得两个 JawSupport。



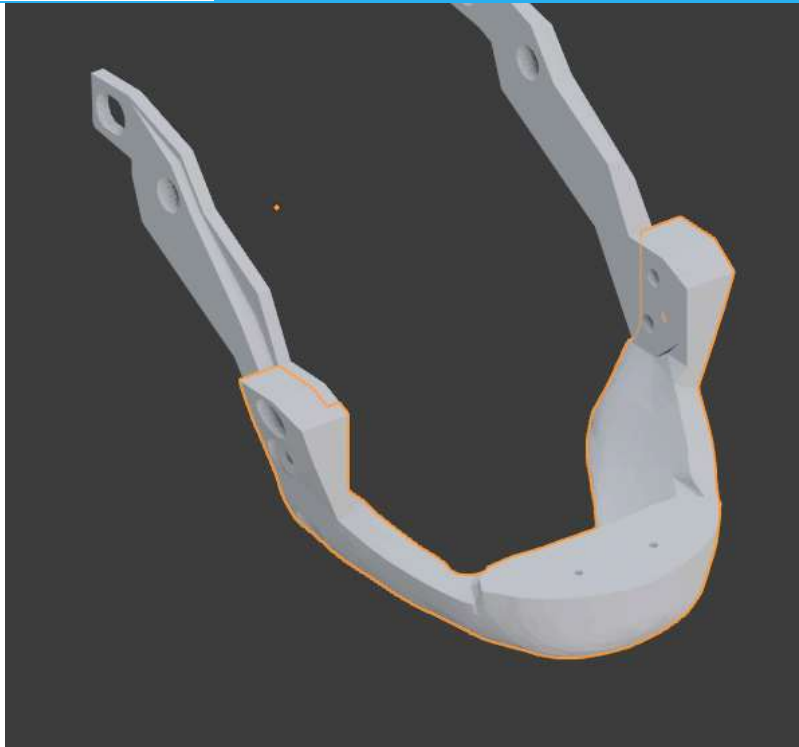
([https://inmoov.fr/i2head/head\\_21/#main](https://inmoov.fr/i2head/head_21/#main))

用 4 个螺丝（3mmx10mm + 螺栓）固定钳口，或者将各个部件粘在一起。



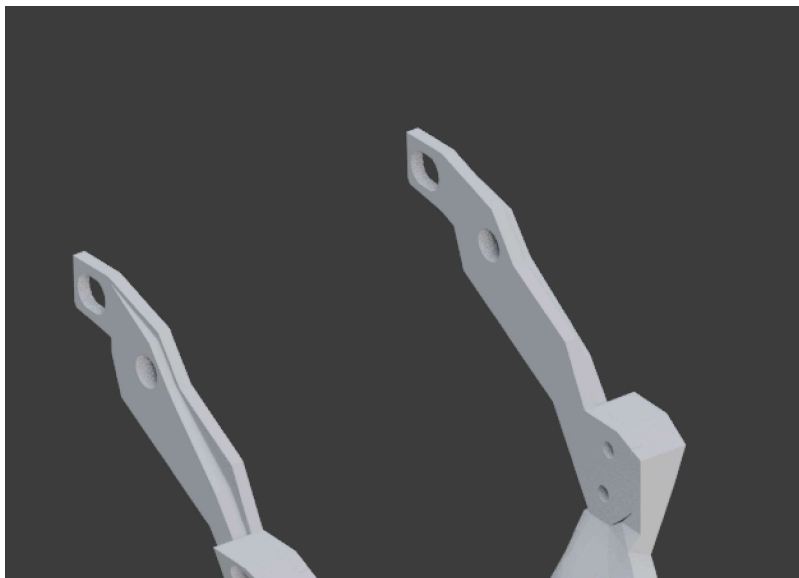


(<https://inmoov.fr/>)



([https://inmoov.fr/i2head/head\\_20/#main](https://inmoov.fr/i2head/head_20/#main))

用 2 颗螺丝将 BottomTeeth 固定到 Jaw 上。(3mmx16mm)



([https://inmoov.fr/i2head/head\\_19/#main](https://inmoov.fr/i2head/head_19/#main))



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(<https://inmoov.fr/>)

([https://inmoov.fr/i2head/head\\_22/#main](https://inmoov.fr/i2head/head_22/#main))

使用两颗螺丝添加 LowBack。(3mmx16mm)



([https://inmoov.fr/i2head/head\\_18/#main](https://inmoov.fr/i2head/head_18/#main))

按下环，确保孔与 MainGear 的孔对齐。只需从侧面安装 2 颗螺丝即可。(3 毫米 x 16 毫米)





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(<https://inmoov.fr/>)

([https://inmoov.fr/i2head/head\\_17/#main](https://inmoov.fr/i2head/head_17/#main))

如果您使用的是 HS805BB 伺服电机，请在软件中将喇叭预设设为 90%。在喇叭和伺服齿轮之间添加 2 个螺丝（小木螺钉）。

([https://inmoov.fr/i2head/head\\_16/#main](https://inmoov.fr/i2head/head_16/#main))

如果您使用的是小型舵机（JX PDI 6221MG 180°），请在软件中将舵角预设设为 90%。您需要使用 ServoAdapter 和 ServoHorn Adapter 进行组装。在舵角和 ServoGear 之间添加 2 颗螺丝（小木螺钉）。





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(<https://inmoov.fr/>)

([https://inmoov.fr/i2head/head\\_16bis/#main](https://inmoov.fr/i2head/head_16bis/#main))

按下 SkullServoFix。使用 4 颗螺丝（木螺丝）将 SkullServoFix、舵机和 GearHolder 固定在一起。

([https://inmoov.fr/i2head/head\\_15/#main](https://inmoov.fr/i2head/head_15/#main))

将喇叭安装到伺服器（JX PDI 6221MG 180°）上，并在软件中将其预设为 90°。用 4 颗螺丝（小型伺服螺丝）固定 JawPiston。将 JawPiston 插入 NoSupport。当伺服器需要通过软件旋转时，它需要能够打开和闭合下巴。





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([https://inmoov.fr/i2head/head\\_14/#main](https://inmoov.fr/i2head/head_14/#main))

如下图所示，用两颗螺丝（小螺丝）安装一个舵机。确保在软件中将舵机预设为 90°，并安装好喇叭。

([https://inmoov.fr/i2head/head\\_13/#main](https://inmoov.fr/i2head/head_13/#main))

用 2 个螺丝（小伺服螺丝）将其固定到喇叭上唇上。





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([https://inmoov.fr/i2head/head\\_12/#main](https://inmoov.fr/i2head/head_12/#main))

添加左眼组件。并用4个螺丝（小木螺丝）固定。

([https://inmoov.fr/i2head/head\\_11/#main](https://inmoov.fr/i2head/head_11/#main))

安装右侧眼罩组件，并用 4 颗螺丝（小木螺钉）固定。眼罩组件上方留出空间，可用 2 颗小螺丝安装摄像头驱动板。确保摄像头线缆穿过眼罩和驱动板之间，确保眼罩可以自由移动。





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(<https://inmoov.fr/>)

([https://inmoov.fr/i2head/IMG\\_1041/#main](https://inmoov.fr/i2head/IMG_1041/#main))

([https://inmoov.fr/i2head/head\\_10/#main](https://inmoov.fr/i2head/head_10/#main))

使用 2 个螺丝 (3mmx16mm) 添加 ForHeadSupport。







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(<https://inmoov.fr/>)

([https://inmoov.fr/i2head/head\\_9/#main](https://inmoov.fr/i2head/head_9/#main))

使用胶水或 4 个螺丝将 EyeBrowSupport 与 ForHeadSupport 一起安装。

([https://inmoov.fr/i2head/head\\_8/#main](https://inmoov.fr/i2head/head_8/#main))

用螺丝（小号伺服螺丝）安装眉毛的两个伺服器。确保在软件中将伺服器预设为 90°，并安装好喇叭。





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(<https://inmoov.fr/>)

([https://inmoov.fr/i2head/head\\_7/#main](https://inmoov.fr/i2head/head_7/#main))

用 2 个螺丝将每个眉毛固定到喇叭上。(小伺服螺丝)

([https://inmoov.fr/i2head/head\\_6/#main](https://inmoov.fr/i2head/head_6/#main))

将舵机和螺丝安装到 ForHeadSupport 上。确保在软件中将舵机预设为 90°，并安装好喇叭。





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(<https://inmoov.fr/>)

([https://inmoov.fr/i2head/head\\_5/#main](https://inmoov.fr/i2head/head_5/#main))

Fix each ForHead to the horns with respectively 2 screws. (small servo screws)

([https://inmoov.fr/i2head/head\\_4/#main](https://inmoov.fr/i2head/head_4/#main))

At this point, you might want to install and mount the PCA9685 board with it's support, and the two mini breakout Nervoboards. (eye mouth)





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(<https://inmoov.fr/>)

([https://inmoov.fr/i2head/head\\_32.png/#main](https://inmoov.fr/i2head/head_32.png/#main))

(<https://inmoov.fr/i2head/image1/#main>)

You can start connecting the servo pins according to this excel sheet: Pin number connection  
(<https://inmoov.fr/wp-content/uploads/2015/06/default-hardware-map8.png>)

The PCA9685 is directly connected to the i2C pins on the left Nervoboard. Use the 5V pin as shown bellow. Respect the polarity and pin numbers. You can power the PCA9685 servo connector with one of the power source XT60. I used the same ribbon cables for the pin connections as for the mini breakout boards and used some 12 gauge wires for the power





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(<https://inmoov.fr/>)

([https://inmoov.fr/i2head/PCA9685\\_ArduinoMega4/#main](https://inmoov.fr/i2head/PCA9685_ArduinoMega4/#main))

(<https://inmoov.fr/i2head/image2/#main>)

Mount the 2 TopBackSkull respectively with 2 screws (3mmx16mm). It is best to add bolts on the inner side of TopBackSkull. I heat up the bolts with a small flame and press it with pliers into the bolt cavity, making sure it cannot fall out. ^



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([https://inmoov.fr/i2head/head\\_3/#main](https://inmoov.fr/i2head/head_3/#main))

Same process for TopSkull. The 2 top screws are (4mmx20mm)

([https://inmoov.fr/i2head/head\\_2/#main](https://inmoov.fr/i2head/head_2/#main))

Same process for TopSkullFront.





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([https://inmoov.fr/i2head/head\\_1/#main](https://inmoov.fr/i2head/head_1/#main))

Same process for TopSkullFront.

([https://inmoov.fr/i2head/head\\_0bis/#main](https://inmoov.fr/i2head/head_0bis/#main))

Add EarLock on both sides respectively with a screw (3mmx16mm).







(<https://inmoov.fr/>)

([https://inmoov.fr/i2head/head\\_0/#main](https://inmoov.fr/i2head/head_0/#main))

Note that the i2Eyes are synced to the original eyeX and eyeY.

Also the i2Eyelids are synced to the original eyelids servos.

This will probably change in the future, but for now it allows to use standard gestures to operate the i2Eyes and i2Eyelids.

Here is the listed names for the new servos:

## the eyes

i01\_head\_eyeLeftUD

i01\_head\_eyeLeftLR

i01\_head\_eyeRightUD

i01\_head\_eyeRightLR

## the eyelids

i01\_head\_eyelidLeftUpper

i01\_head\_eyelidLeftLower

i01\_head\_eyelidRightUpper

i01\_head\_eyelidRightLower

## the eyebrows

i01\_head\_eyebrowRight

i01\_head\_eyebrowLeft





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## the upper lip  
(https://inmoov.fr)  
i01_head_upperLip
```

```
## the for head  
i01_head_forheadRight  
i01_head_forheadLeft
```

## i2Head molds tutorial:

I printed mine at 0.4mm and used an old BFB 3D printer, this is the reason my mold looks awful, but then I applied sprayed car filler plus some sanding and finished with a clean car filler spray. Even if your prints looks clean, you should use car filler. Silicone is so thin, it can pass through the surfaces of your prints. As a result you wouldn't have enough of 500/600Gr of silicone.

It is mandatory to use a release agent such as wax spray prior casting.

The three inner molds should not be glued or attached to each other, otherwise you will not be able to release the skin and inner molds from the outer molds.

The purpose of the angled middle inner mold is to be able to slide out easier once the silicone is cured.





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Use car filler to fill the gap between the two parts. This separation line should not be visible afterwards. I used heavy grain sand paper to do this.

If your mold is clean you can use grain 400. I had to go first with grain 80->sprayed car filler->grain 150->sprayed car filler->grain 400->sprayed a last layer of car filler from far to create a grainy skin effect.





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I use polyurethane car filler Primer from Upol, but most users won't have a compressor with air gun, so using car filler in spray can is another option.





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This is the finished mold with the skin grain effect sprayed from about 60 cm distance. The filler is kind of dry when it reaches the surface of the mold but still adheres.

Spray also with car filler the inner molds, this is mandatory to help for de-molding and mainly avoids any silicone to go through your printed parts.





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(<https://inmoov.fr/>)

The purpose of the angled middle inner mold is to be able to slide out easier once the silicone is cured, and to press down the two side inner molds. It is mandatory to use a release agent such as wax spray prior casting. Spray with the release agent all surfaces of the molds.

You can use clamps and a piece of wood to keep the three parts aligned. You can also add two bolts on the edges the middle inner mold. At this point it is important to seal the mold, otherwise the silicone will leak. You can use hot glue gun or kinder doe to make the seal. Do not use hot glue or kinder doe on the top edges of the molds, as we need the air bubbles to be able to escape from these seams.





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(<https://inmoov.fr/>)

This is the recipient, where you are going to pour the silicone. Any gaps in your prints and the silicone will go in there. You can see on this picture, the print is very clean but there is very tiny gaps around the holes. The silicone will infiltrate through these if you haven't sealed them all.

Prepare your silicone mix according to your reseller specifications. I recommend the Smooth-On Ecoflex 00-10 silicone because it is a super soft silicone which also has a low viscosity, this is good for what we need. You have a 30 minutes pot life to mix and pour the silicone. When pouring into the mold recipient, keep pouring all the time. And keep your silicone all the way to the top of the recipient like in the below picture. Otherwise bubbles might form in the tubes and would get drained down into the skin.







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(<https://inmoov.fr/>)

When the silicone reaches the little ear vents, it means it's full. But keep making sure the recipient stays full to the top. The silicone is infiltrating the gaps between the inner molds, so level of the silicone might still go down.

Let the silicone cure overnight. Then you can remove the hot glue sealant with alcohol, it should come off rather easily.





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(<https://inmoov.fr/>)

You can pull out the silicone from the recipient and cut with scissors the silicone in the tubes. To release the inner molds and silicone, I used my air compressor, it really helps to separate the silicone from the molds. You can blow the air through the ear vents, in the recipient holes and all sides where you estimate it might help to separate the skin from the molds. In case it really, really, really doesn't come out, you can remove the 5 bolts and separate the two outer molds.





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Once the skin is removed, you can use some baby powder (talc) on the skin surface to remove the tackiness. Cut all exceeding seams of silicone with a exacto knife or scissors. Scissors tend to make dents and might not do clean edges. It is best to lay the skin on a paper towel and cut precisely with the exacto knife.





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Using some small amounts of silicone or SilPoxy, we are going to fix the skin to the moving parts. We are going to start with the eyelids which require a special method using double side tape and stretchy vinyl. The nose, cheek bones and upperLip can be attached with some Velcro strips glued to the skin and to the printed parts. The rest of the moving parts are somehow anchored with silicone filled in the small cavities and glued to the skin. These method will allows us to remove the skin if necessary and to re-attach it again without having to glue again.

Apply and align by the edge of the eyelids small strips of double side tape. Make sure it glues really well. For a definitive fix, use Sil-Poxy or Dow Corning 732 glue.





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I used vinyl that has a clothe side and the other side is kind of plastic. When gluing the vinyl strips avoid putting silicone on the plastic side. If the vinyl doesn't glue well to the double side tape, there is probably some silicone residue which should be clean up with a bit of acetone or some silicone remover.

Glue to the inside of the skin with SilPoxy or Dow Corning 732, along the edge of the eyelids, small strips of vinyl (glue the clothe side of the vinyl). Make sure it is well aligned. Do not make large strips because we want to keep the skin very stretchy. You can also see the Velcro strip glued with Silpoxy (or Dow Corning 732) for the upperLip.





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Applying the silicone in the small cavities to create anchors.

Here you can see, I used Velcro strips, which doesn't work well when the moving part are rotating, such as the eyeBrows, cheekPuller, forHeads. It also adds a 2mm thickness, which can change the face structure, this is the reason I don't use it every where.





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Now we apply some SilPoxy ( or Dow Corning 732) on all the anchors and we mount the skin in place, making sure all parts are nicely aligned. Let the silicone cure before trying to move some servos.

Glue the magnets with epoxy (two components glue) in the printed cavities of your printed head structure. Make sure to have the same polarity for all magnets in the printed parts.







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(<https://inmoov.fr/>)

([https://inmoov.fr/headi2/attachment/img\\_1809/](https://inmoov.fr/headi2/attachment/img_1809/))






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(<https://inmoov.fr/>)

(<https://inmoov.fr/headi2/attachment/magnet1/>)

(<https://inmoov.fr/headi2/attachment/magnet2/>)

At this stage you can start testing the facial expressions in Myrobotlab and see how fun this is  on the robot.

Start the adafruit 16 channel (pca9685) into InMoov UI under the controllers section.



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(<https://inmoov.fr/>)

if your i01.left controller is already started, the pca9685 auto attach to the controller.

要访问 i2Head UI，请点击底部按钮。然后，您需要启动每个头部舵机，选择 pca9685，并在向下滚动中定义正确的引脚。完成后，您需要根据舵机的最大范围编辑限制并修改输出限制。以下是用于测试基本表情的语音命令：

([https://inmoov.fr/?attachment\\_id=17469#main](https://inmoov.fr/?attachment_id=17469#main))





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- 中性的
- 生气的
- 眨眼
- 厌恶
- 害怕
- 快乐的
- 微笑
- 伤心
- 叹
- 对不起
- 可疑的
- 思维





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选择类别



## 近期文章

- 📄 眼睛i2 (<https://inmoov.fr/eyes-i2/>)
- 📄 InMoov 的 i2Head (<https://inmoov.fr/i2head-for-inmoov/>)
- 📄 (无标题) (<https://inmoov.fr/14554-2/>)
- 📄 Tech'inn Vitré 2020 (<https://inmoov.fr/techinn-vitre-2020/>)
- 📄 杜比奥扎·科莱克蒂夫 (<https://inmoov.fr/dubioza-kolektiv/>)

## 最近评论

- 💬 EMRE关于如何启动 MyRobotLab (<https://inmoov.fr/how-to-start-myrobotlab/#comment-17730>)
- 💬 wang关于Nervo Board 教程 (<https://inmoov.fr/nervo-board-tutorial/#comment-17723>)
- 💬 Solène手指入门套件 (<https://inmoov.fr/product/finger-starter-kit/#comment-17694>)
- 💬 Didier在Nervo 开发板 + 组件上 (<https://inmoov.fr/product/nervo-board-components/#comment-17691>)
- 💬 手指启动器 (<https://inmoov.fr/finger-starter/#comment-17687>)上的失误 (<https://inmoov.fr/finger-starter/#comment-17687>)

## 新闻稿



(<https://www.inmoov.fr/on-the-net/>)

