Homunculize Me!

They always ask *how* you're feeling, but never *where* you're feeling…

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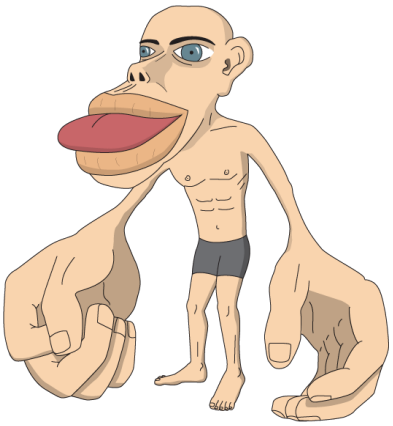
The sensory homunculus is a visualization of the human body where each body part is sized relative to the "sensory resolution" of the body part. This means that the parts of our body where we can precisely locate sources of tactile stimulation are very large. A common depiction of the sensory homunculus is visualized below.



Source: https://brainmapper.org/

We intend to build a tool that can turn a picture of any human person into a homunculized version of themselves. They will still look vaguely human, but all of their body parts will be sized up relative to their sensory resolution. If successful, we will create homunculized versions of images of Joe Biden, Tom Cruise, Rohan Mathur, Beyonce, and other notable historical figures.

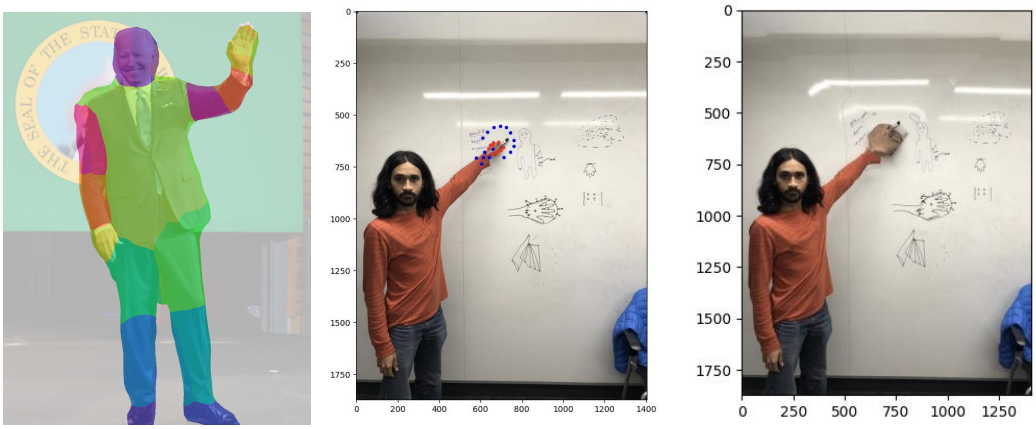
To our knowledge and extensive research, no one has ever attempted to homunculize any real, preexisting individuals, much less Joe Biden. Our approach involves automatically warping the geometry of your average Joe Biden into that of the homunculus.

1. The first step is to **segment** each of the Joe body parts using the bodypix neural network. The proportional size of each body part has been collected by psychologists and we will be referring to the mapping Brain Mapper (depicted in the link), which gives us a numerical sensory resolution r_i for each body segment *i.*
2. To identify the geometry of Joe, we **detect key points**. We'll run edge detection on the segmentation of the human, retaining evenly spaced points along the edges by sampling.
3. Next we need to **generate** the **homunculus geometry**. The gradient vector $\boldsymbol{v}$ (consisting of the gradient along the *x*- and *y*-axes) at point (x, y) is orthogonal to the segment edge (x, y) lies on. Using $\boldsymbol{v}$ we can construct the destination geometry, in which (x, y) corresponds to $(x, y) + r_i \boldsymbol{v}$ where i corresponds to the body part segment (x, y) lies in. The *r*'s in between segments should be interpolated (using a function like sigmoid) to

facilitate a smooth change. Points on the border between any segments should be invariant.

4. The face is a special case because the resolution varies more, so we'll employ the keypoint communities network to identify the facial key points *(x, y)*. We retrieve the gradients we calculated earlier for these key points and move the points differently.
5. Given our two geometries, we **warp** from the original geometry to the destination.

Proofs of concept: we segmented Biden using bodypix and made Rohan's hand larger using the manually selected points.



We'll measure success based on whether the details in the magnified body parts are preserved, and whether Joe Biden is in the likeness of the homunculus. We have the segmentation working. We'll spend the first week morphing the body (steps 2-3), and the second week morphing the face (steps 4-5).