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ENSC474 – SFU – Spring 2017

Assignment 9

Part1: Non-rigid Transformation

- I found transformation of a non-smiling selfie into a smiling one and vice versa using non-rigid transformation formulas. I also plotted the vector field of the displacement u(x).

- Non-rigid transformation allows local changes so it only transforms some smaller part of the image and has the following formula:

$$Q(x) = x + u(x)$$

- U(x), the displacement vector is different for each x and is proportional to the landmarks on the image as well as its distance to the landmarks. Therefore, u(x) is defined as follows:

$$u(x) = \sum_{i=1}^{N} \alpha_i(x).(q_i - p_i)$$

- Where ai (x) is weight at point x to give to the landmark i.
  - When x is close to pi, ai(x) should be large and,
  - When x is far from pi, ai(x) should be small.

- ai(x) can be defined as :

$$\alpha_i(x) = e^{\frac{-\|x-p_i\|^2}{2\sigma^2}}$$

Non-rigid Transformation

- For this assignment I took two selfies of myself one with a smile and one without a smile. Then I transformed my no smiling face to a smiling face and vice versa.
- I started with picking 3 landmarks and adjusted sigma to get a smooth result.

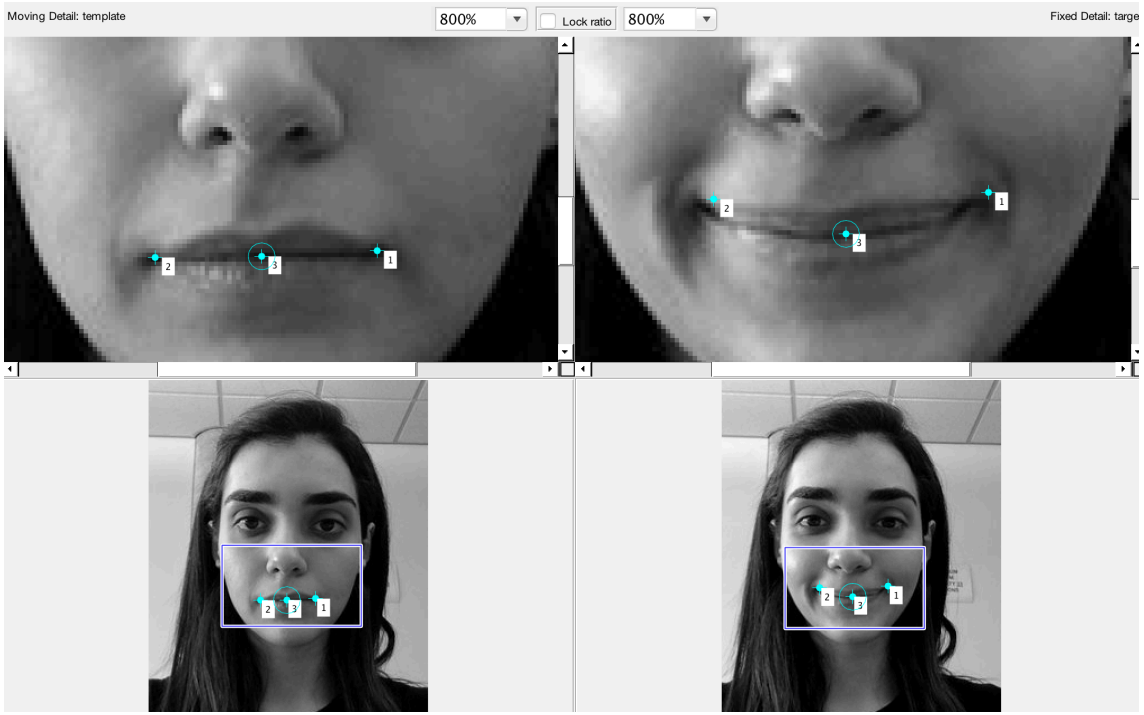

Figure1: Landmarks to transform no smile to smile

Non-rigid Transformation

- As can be seen in the following images, 3 landmarks weren't enough to result in a smooth smile. Therefore, I decided to use 5 landmarks to make the smile look better.

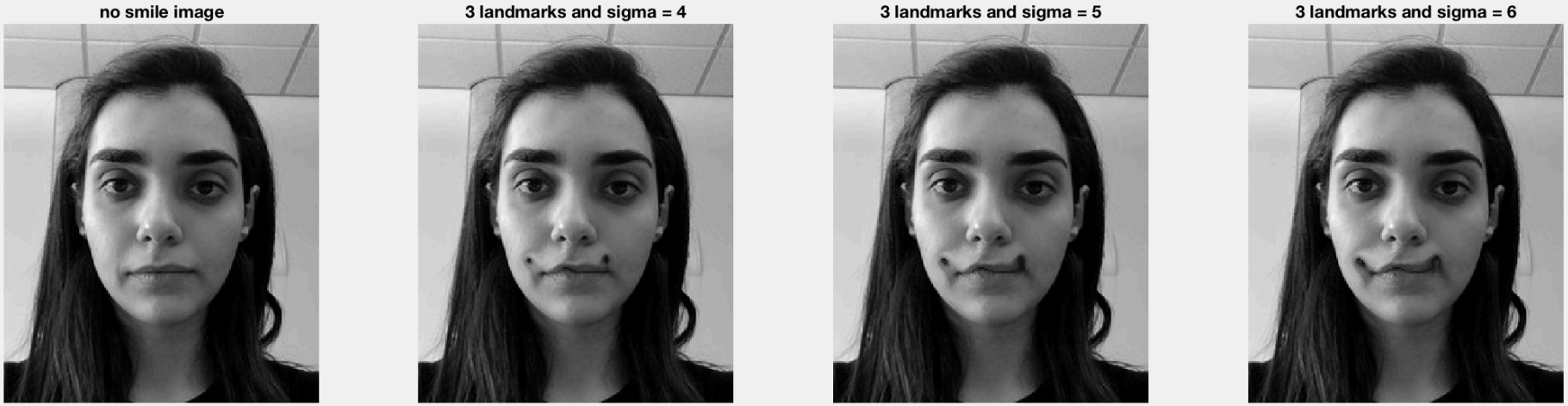

Figure2: Smile with 3 landmarks

Non-rigid Transformation

- The following landmarks were used to draw a smile.

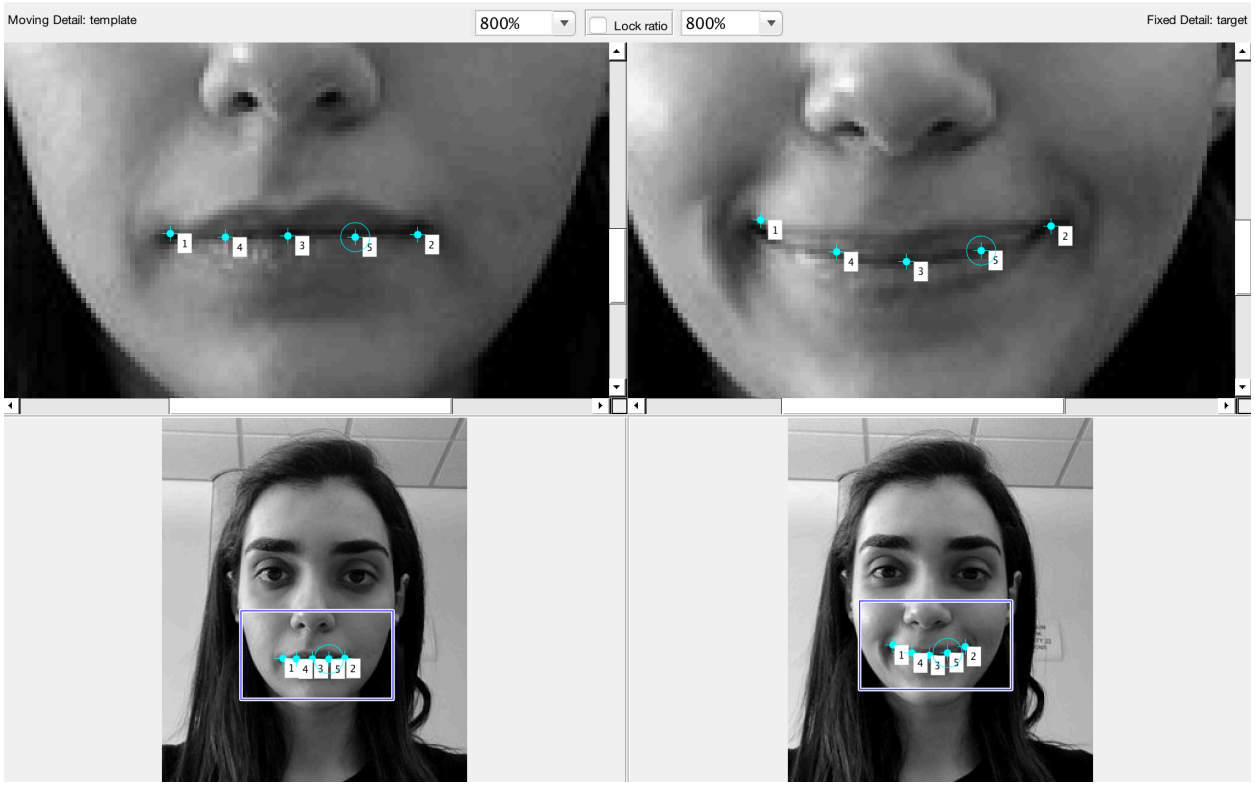

Figure3: Landmarks to transform no smile to smile

Non-rigid Transformation

- As we can see the smile with 5 landmarks and sigma = 7, looks like a smooth smile

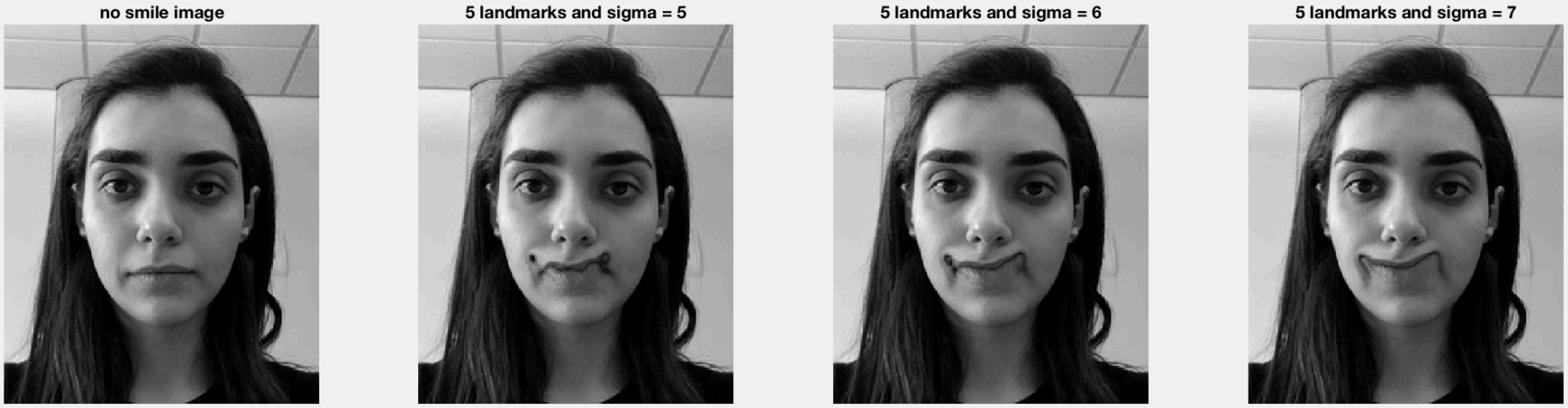

Figure4: Smile with 5 landmarks

- I then switched my template points (pi) with my target points (qi) to turn my smiling face into no smile. The results are shown on the next slide.

Non-rigid Transformation

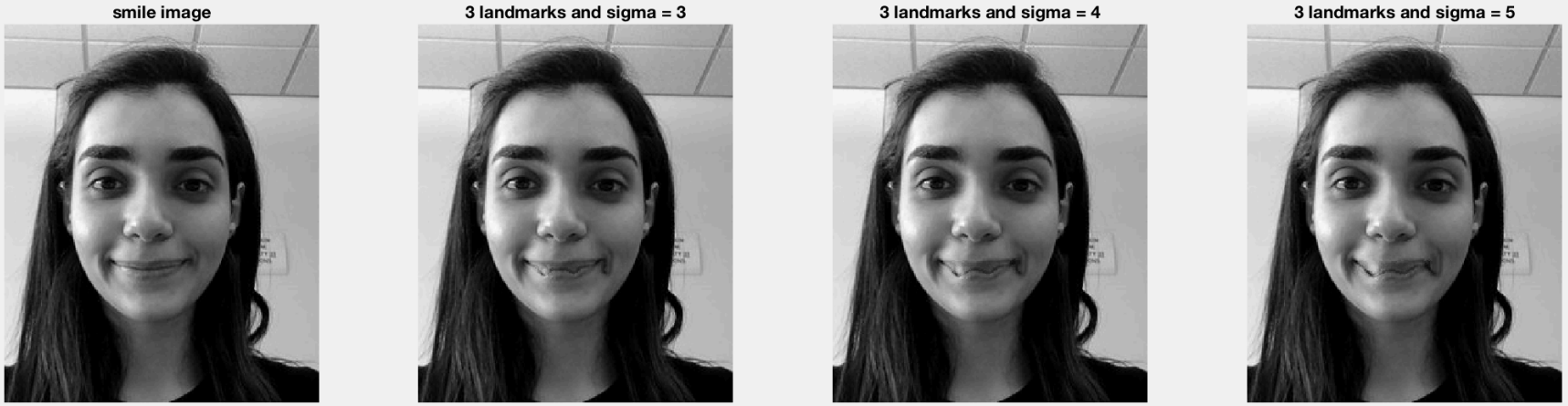

Figure5: No Smile with 3 landmarks

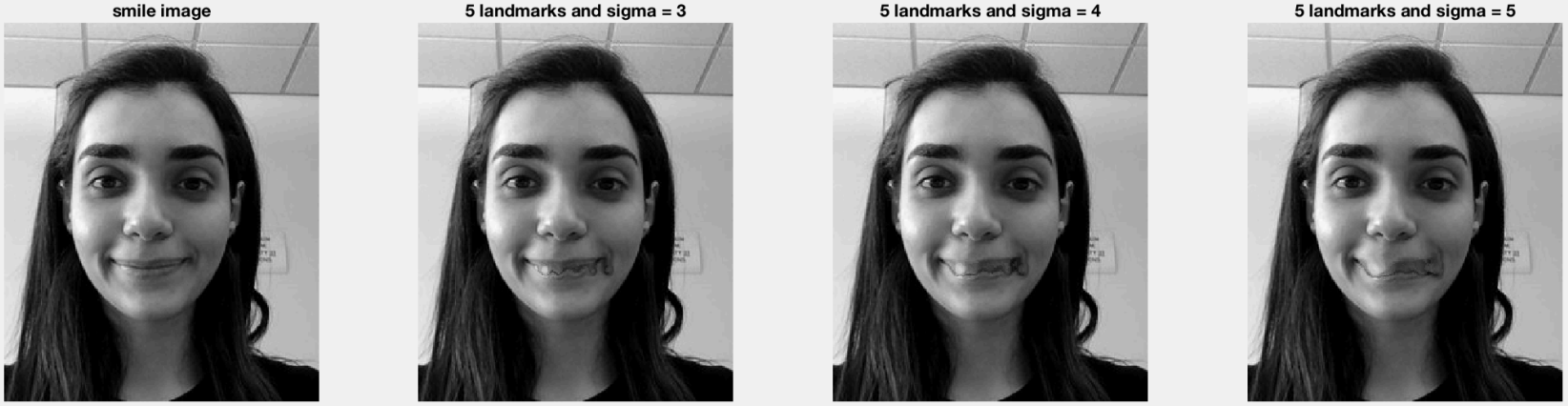

Figure6: No Smile with 5 landmarks

Non-rigid Transformation

- The Vector Field of the previous transformations were plotted using the Quiver function.
- The plots are shown below. As we can see only points local to the landmarks are moving and all other points are still.

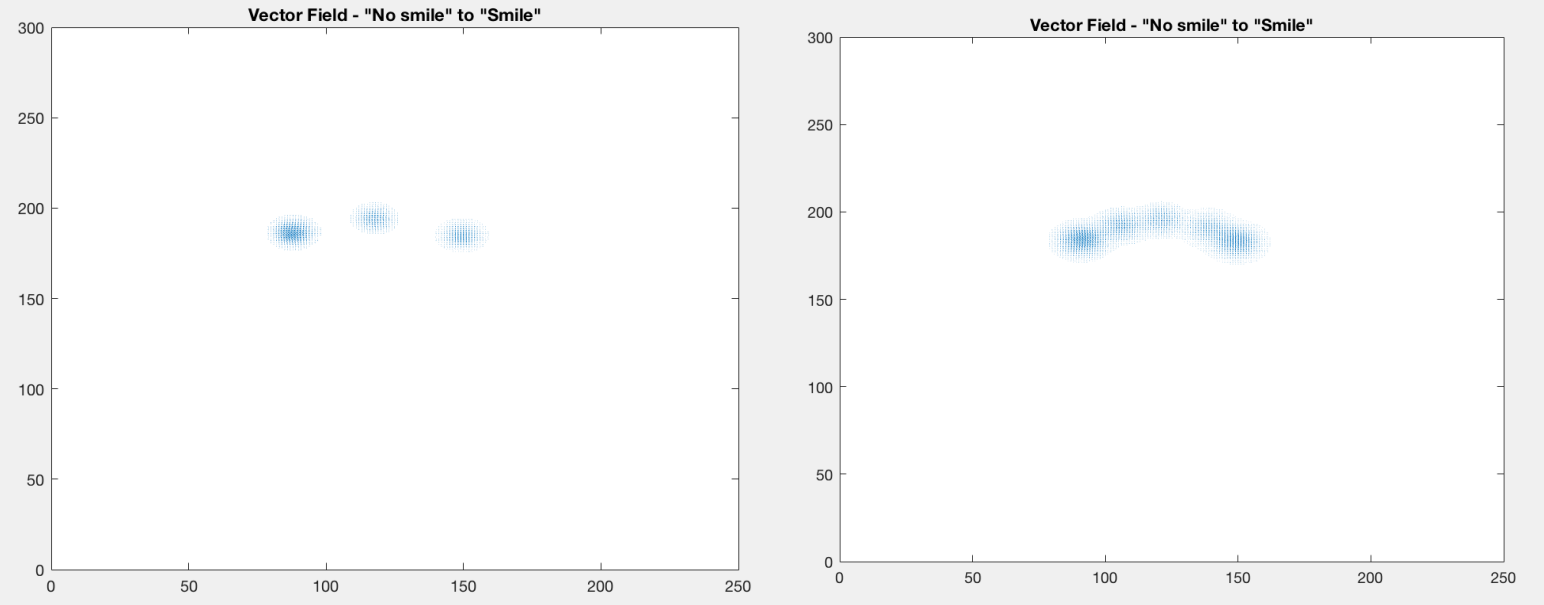

Figure7: Vector field of no smile to smile with 3 and 5 landmarks

Part2

- Next, I placed landmarks in the template so that the non-rigid transformation created from these generated a motion that is physically not possible. I decided to swirl my mouth for this part with sigma = 6.

- Following is the result of the above transformation.

Figure8: Swirling my mouth

Part3: Animation

- I decided to move my nose for this part and make an animation. I chose sigma to be 6 and the number of steps (T) to be 5.

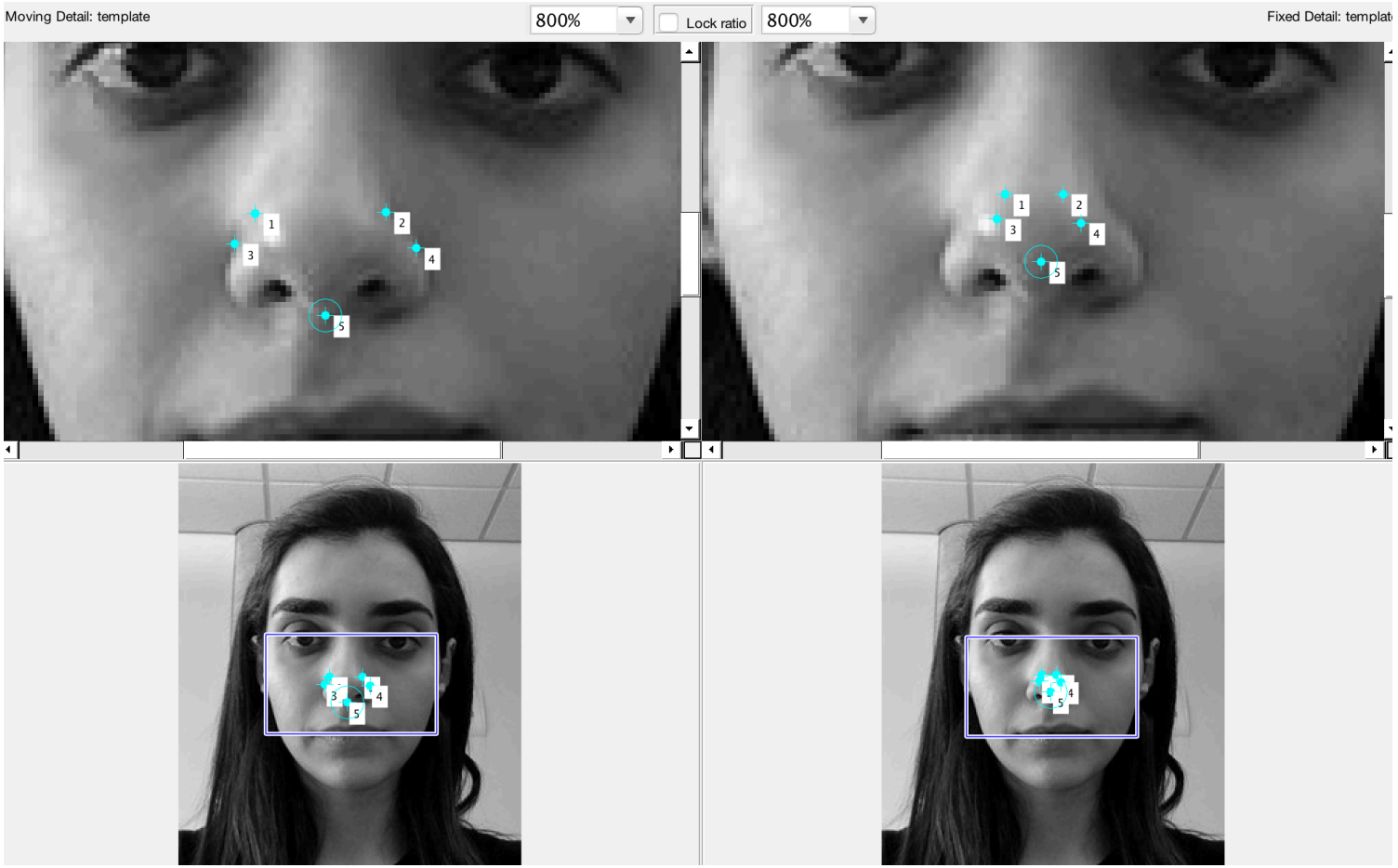

Figure9: Landmarks to move my nose

Part3: Animation

- I then created a Gif file of this movement.

Figure10:Moving my nose in 5 steps