Face Tracking using Kinect

Objectives:
To find critical facial features which uniquely define the human face.

Questions:

- Which features make human faces different from one another?
- How do we numerically determine these features based on the pixels on a facial image?
- How do we determine the most important and unique features on different faces?

Preparation:

- Download “Kinect Tools.zip” to your desktop, then right click and select extract all from the menu.
- If the Kinect for Windows SDK is not installed, download and run the “KinectSDK-v1.8-Setup.exe” and perform the default Installation. This will install the drivers and libraries for Kinect camera.
- Set up the Kinect camera in a location that provides sufficient space for capturing face images. For best results, the Kinect front should be at the same level as the user’s nose.

Procedure:
In this lab students will work with Kinect to obtain the (x, y) coordinates of different features on their face and will save them in a file for further analyses. The Face Tracking Visualization program provides the (x, y) coordinates of facial features. In total, 121 points on the face will be registered by the Kinect as shown in Figure (1). The program will take pictures of the user’s face for further studies using an image processing tool such as ImageJ.

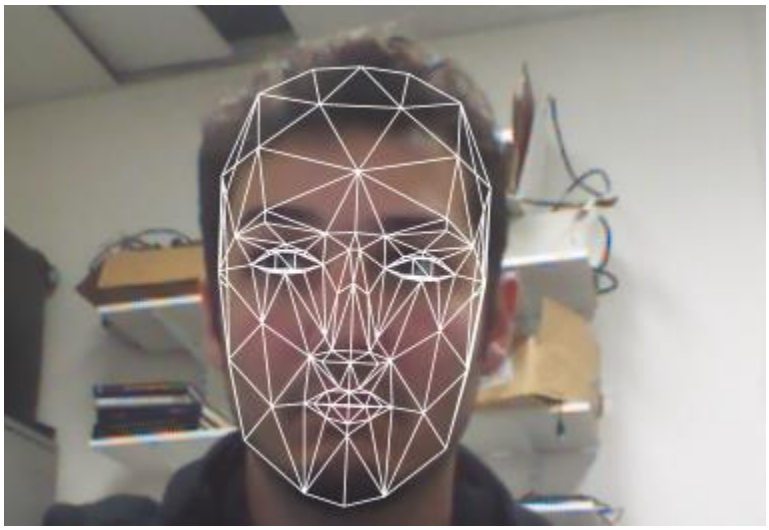


Figure 1-Tracked Points [1]

Every member of the team will stand in front of the Kinect and will perform these steps individually:

- Open the “FaceLab” program in the “Kinect Tools” folder that is located on the computer’s Desktop.
- Enter your name in the text box that says “Enter Name Here.”

- Keep your face about 3 Feet away and directly facing the Kinect to obtain the best image. As Figure 2 shows, the capturing window will appear once the program is correctly running and the face is registered by the Kinect.
- To capture an image, say “freeze” when your face is at the most suitable position directly facing the Kinect camera.

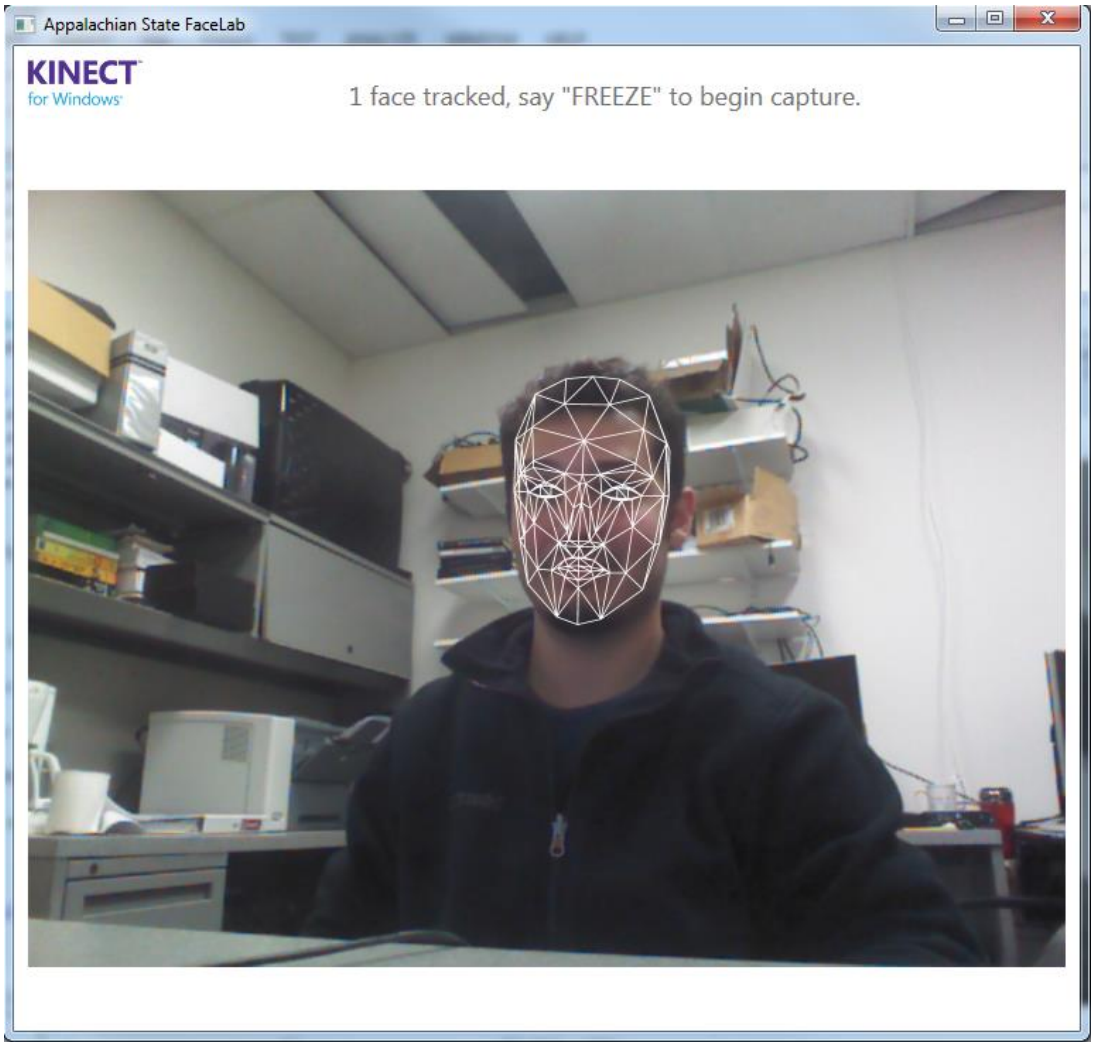


Figure 2-Capturing window

- When the word freeze is registered by the software, a countdown will begin, when it finishes the picture of your face and point coordinates will be saved in the “Images” folder in the ”Kinect Tools” folder where the FaceLab program is located.
- To view the collected (x, y) coordinates of the 121 points, go to the “Images” folder in the ”Kinect Tools” folder to find the text file with the name you entered in the text box. This file contains the 121 x and y coordinates.
- Repeat these steps for all members in your team as needed.

Develop a Strategy

To analyze the face, you will try to find critical features that are unique for each member of the group. Try to avoid using measures of the face that might change when your expression changes or your mouth or eyes close. You need to have discussions with your teammates to determine which features are best for recognizing faces. It is best that you draw and mark on the given face shown on Figure 1 to come up with an approach that is acceptable by all the team members.

Visualizing the 121 points in 3D

After developing an approach, open the "FacePlot" program in the "Kinect Tools" folder and click on points of interest to display their point number as shown in Figure 3. The model can be rotated if you click and drag. Be sure to record point numbers along with the part of the face they correspond to. For example, if your team decided that the height of the head was important to analyze you would select the top point of the face in the "FacePlot" program write down that it is point 0, and then select the bottom point of the face and record that it is point 10.

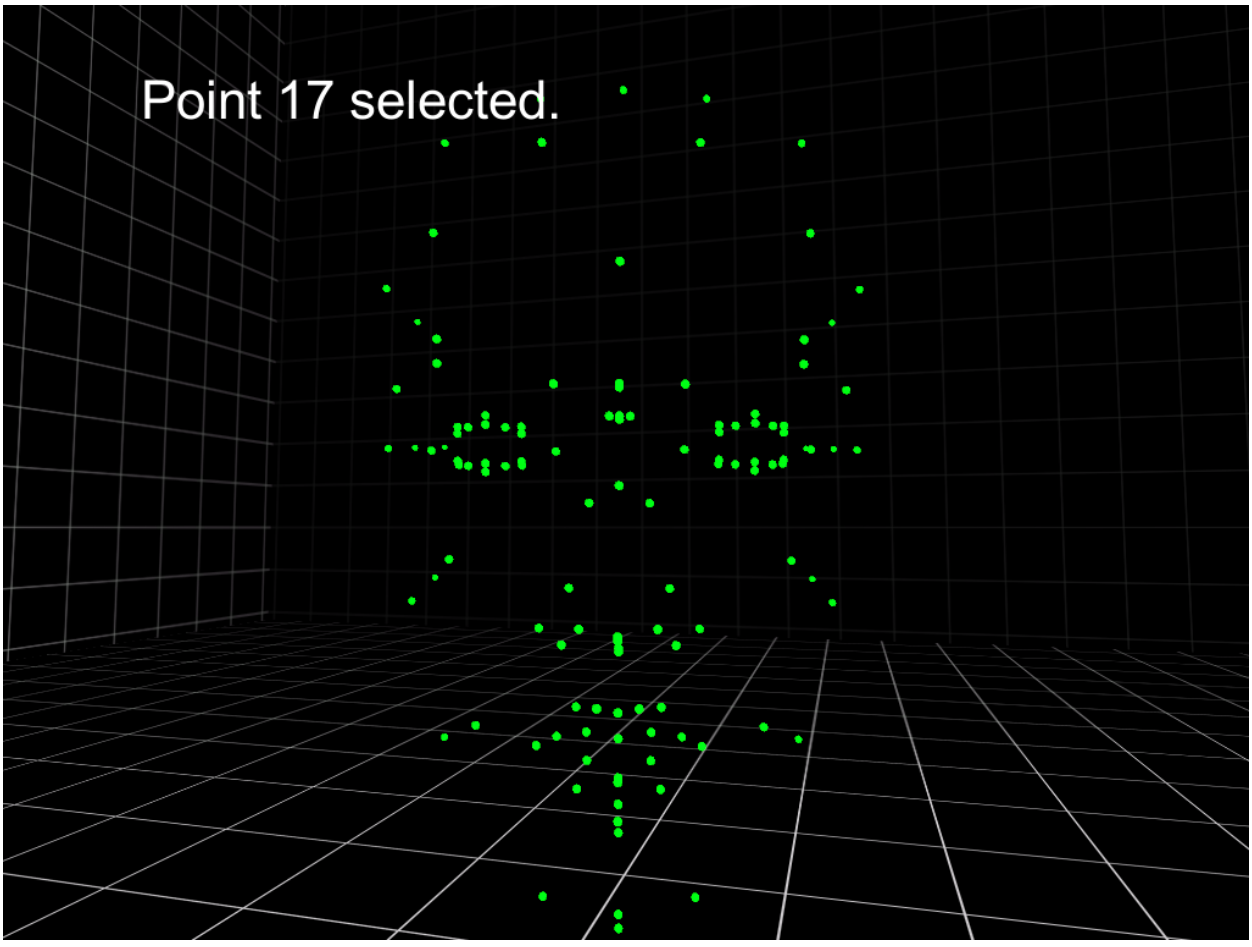


Figure 3-Analyze coordinates

Once you know the point numbers that correspond to the important features of the face go to the csv file to get the coordinates and calculate the distances between the multiple pairs of points that your team chose. The distance formula is shown below in figure 4.

$$\sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$$

Figure 4 – Distance formula

You can calculate the distances either on paper or in Excel using formulas. After you have calculated the distances it is important to understand the distances will vary based on how far away your face is from the Kinect when the points were captured. To deal with this variance you can create proportions between the distances you calculated by dividing them against each other. For example, dividing the distance between the eyes and the width of the face will give you a proportion that will be the same for a person regardless of how far their face was from the Kinect when the points were captured.

To illustrate the usefulness of using proportions, the object in figure 5 is captured at two different distances. The apparent lengths of the sides change but the proportions between the sides stay the same.

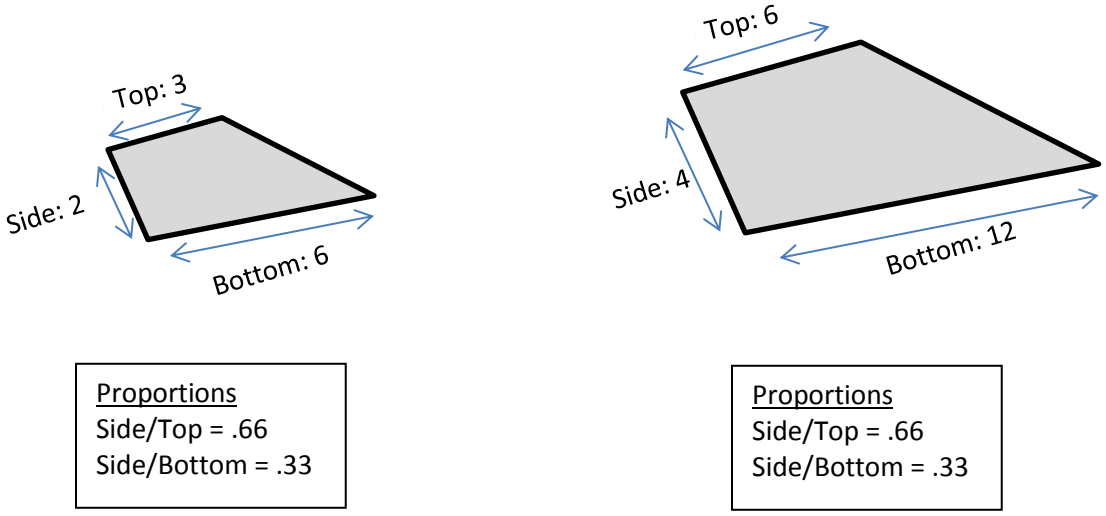


Figure 5 - Proportions vs. Distances

After you have calculated your proportions, compare them with other members of the group .

To test your approach, you can ask some new members to participate in the experiment and determine how well your parameters are able to identify different participants.

Figure 5 shows an example of some of the important facial features your group may want to consider.

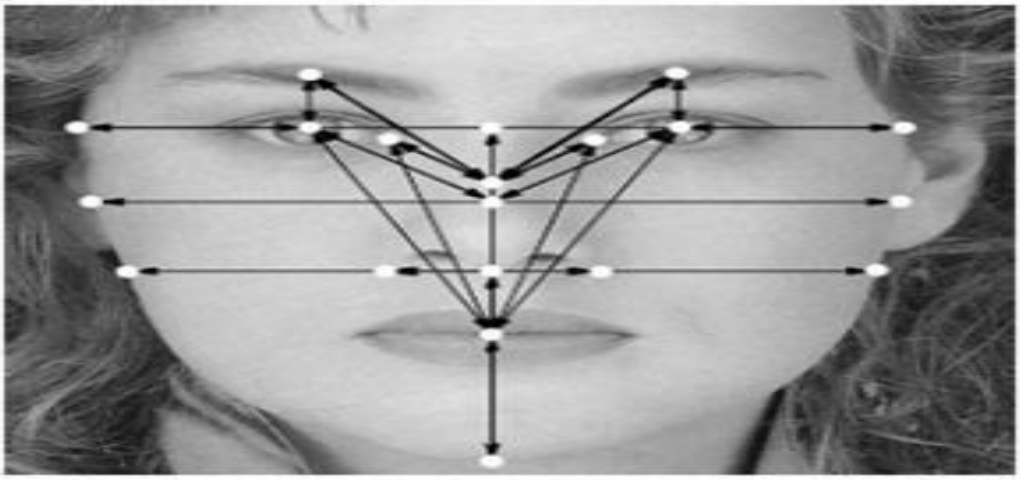
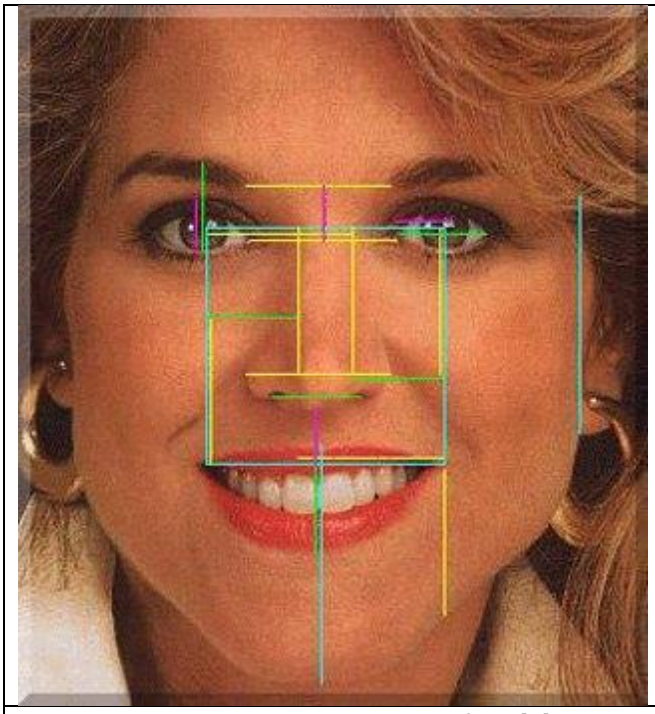
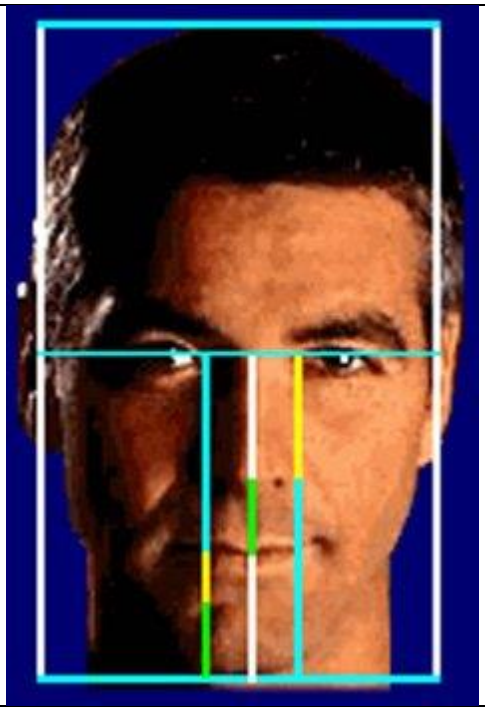


Figure 5-Facial feature [2]

You can investigate the Divine Proportion on human face [3].



Divine Proportion on human face [3]



The human face is based entirely on Phi [3]

Documentation: You will work with write a short report to present your findings.

Reference Material:

[1] Microsoft Kinect SDK website (http://msdn.microsoft.com/en-us/library/jj130970.aspx)
[2] Biometric technology research (http://inhardfocus.com/inhardfocus/2008/12/9/why-so-serious.html)
[3] http://milan.milanovic.org/math/english/body/