Facial Analyzer for Rhinoplasty Surgery (Option 9)

Priscilla Carbo, Marvin Cazeau, Jared Curtis, Maree Kelly and Alessandra Oo

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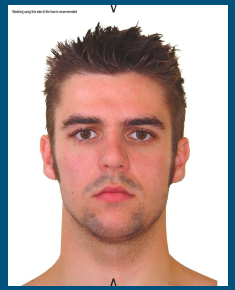
Introduction

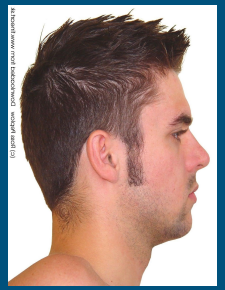
Main goals for this sprint:

- Using FaceGen Modeller to grow the dataset
- Clustering of faces based on landmarks

3D Facial Modeling

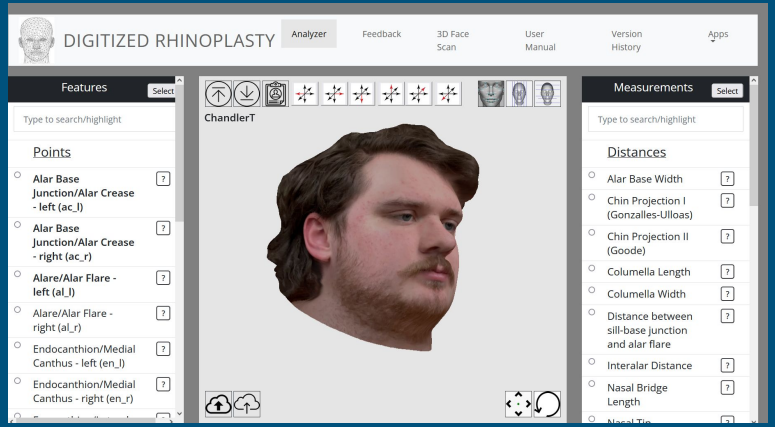
- Main purpose was to grow our database
  - Through FaceGen Modeller Software
  - Constraints with FaceGen:
    - A 3 JPGs are required
      - 2 profile and 1 front face

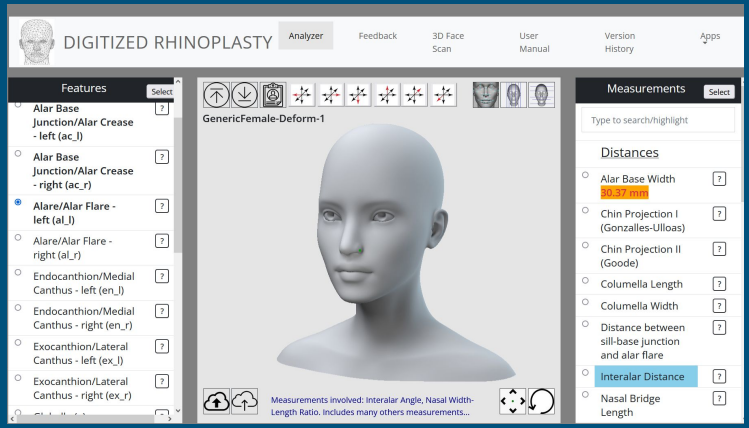




Database: Scanned faces

- 96 scanned faces using Bellus3D (iOS application, discontinued)
- Synthetic faces
- 3D faces generated by FaceGen Modeller with 2D images





Database: Digitized Rhinoplasty

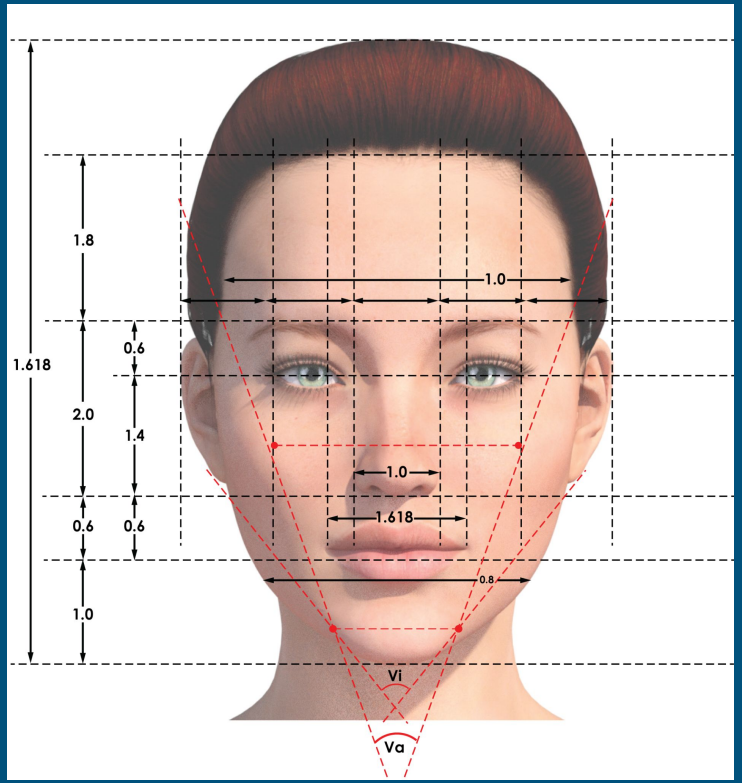
- Using Digitized Rhinoplasty website to point the landmarks manually
- Pointing the landmarks that are the most important (highlighted green)
- There are currently 14 significant landmarks

Facial Landmark	Frequency in Important Measurements	Frequency of Studies in Literature
Alar Base Junction/Alar Crease - left/right (ac)	3	9
Alar Rim's Highest Point - left/right (armax)	1	0
Alare/Alar Flare - left/right (al)	1	8
Cheilion - left/right (ch)	0	19
Columellar Break Point (cb)	4	0
Columellar Rim - left/right (cmin)	1	0
Crista Philtri - left/right (cph)	0	4
Endocanthion/Medial Canthus - left/right (en)	2	15
Exocanthion/Lateral Canthus - left/right (ex)	1	22
Glabella (g)	4	2
Labiale Inferius (li)	0	12
Labiale Superius (ls)	3	12
Lateral helix of ear - left/right (la)	1	0
Maxillofrontale - left/right (ma)	1	0
Menton/Gnathion (me)	2	4
Nasal Parenthesis - left/right (np)	1	0
Nasion/Radix (n)	6	15
Pogonion (pg)	0	6
Pronasale/Tip (prn)	9	24
Pupil - left/right (p)	0	4
Stomion (sto)	1	7
Subalare - left/right (sbal)	1	3
Sublabiale/Mentolabial Sulcus (sl)	0	4
Subnasale (sn), Subnasale - left/right	7	13
Supratip Break Point (s)	1	0
Tip Defining Point - left/right (td)	2	0
Tragion - left/right (t)	0	1
Trichion (tr)	2	0
Zygion - left/right (zy)	1	1

Table 1: Facial landmarks usage frequency in measurements important for rhinoplasty and facial landmarks studied in the literature for detection based on their geometric properties on 3D face scans.

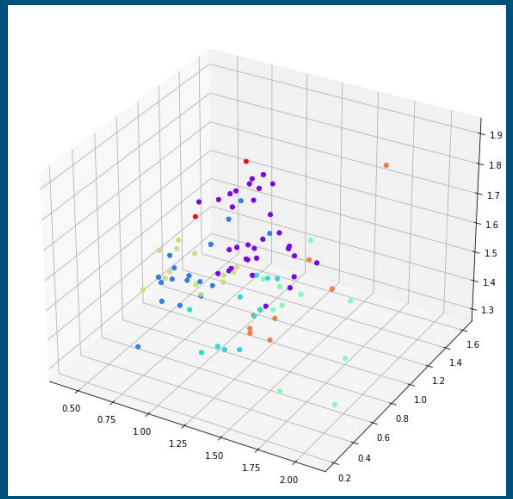
Face Clusters

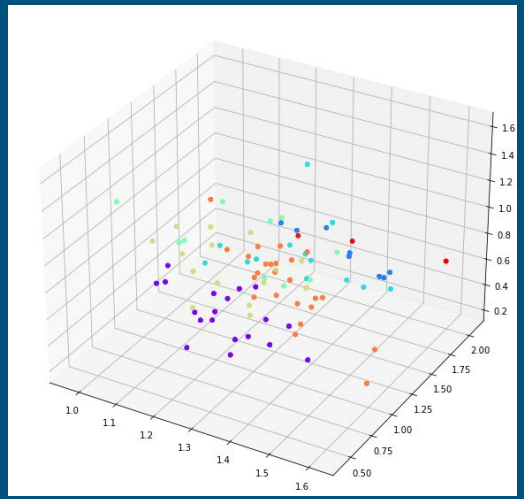
- Use database to sort patients by facial structure.
- Compares key ratios of the patient's faces.
  - i.e. distance between eyes/distance between lips
- Provide multiple sets of clusters.



Face Clusters - New Algorithms

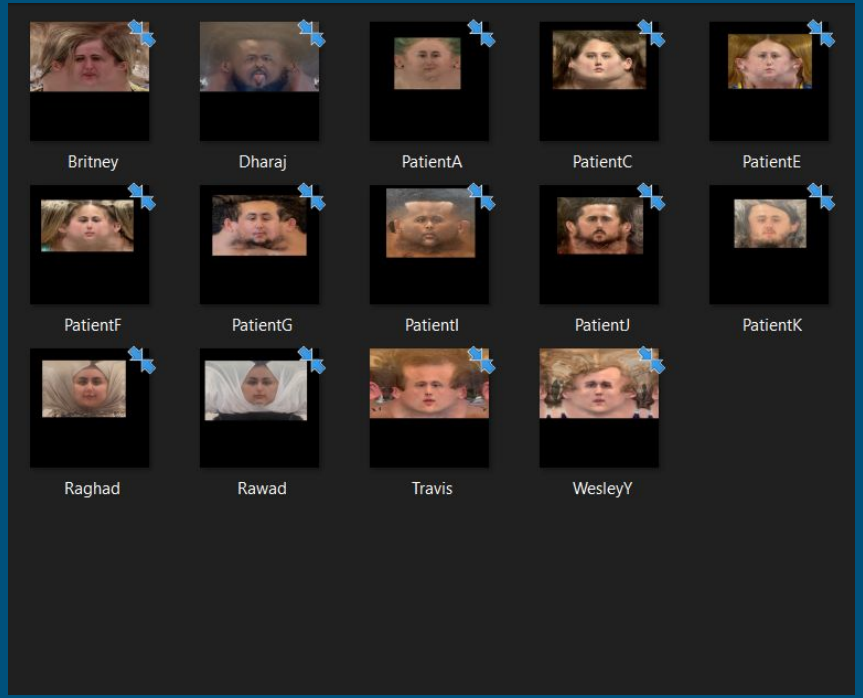
- Implemented 5 new clustering algorithms in addition to K-means
  - Affinity Propagation
  - BIRCH (Balanced Iterative Reducing and Clustering using Hierarchies)
  - Agglomerative Clustering
  - Spectral Clustering
  - Gaussian Mixture Model





Face Clusters - Additional Changes

- Removed 2 outlier patients
  - Caused the algorithms to make clusters with only 1 patient
- Plan to optimize each algorithm
  - Editing built-in settings
- Plan to perform data analysis
  - Compare which clustering algorithm can best fit the data.



Lessons Learned

- Able to create and refine more faces for database
  - We were able to make the synthetic faces using the GAN model
  - These were then used to select the significant points in the digitized rhinoplasty website

Project Timeline

- Accomplishments
  - Able to create 3D models using JPGs through FaceGen
  - Using Digitized Rhinoplasty on new 3D models
  - Generated face clusters

- Future Goals
  - Create more 3D models to build database more
  - Compare and contrast clustering algorithms
  - Implementing algorithm to generate new nose points

Questions?

Thank you!