(Notional) Artworks for GA2023

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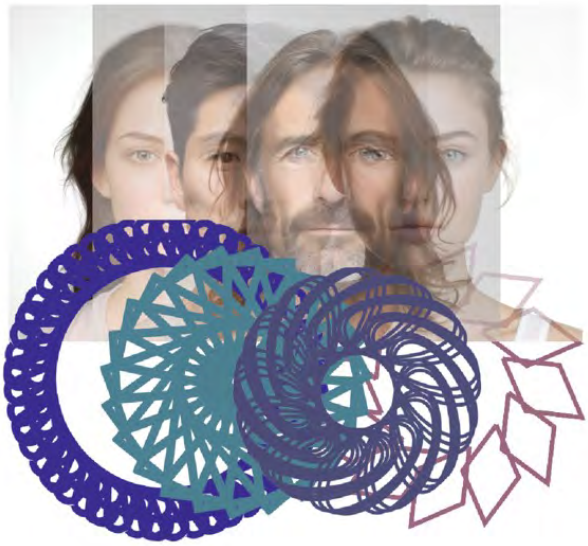


Abstract

Everyone is unique, especially their face. Even twins have more or less different faces. Faces are the most critical way for people to remember each other in their daily lives, so a face can be regarded as a unique ID of a person.

Notional aims to generate a unique pattern by collecting facial data of a person, such as face length and forehead width, to show that each person is unique. The final pattern can even be used as a form of identity in the context of the metaverse.

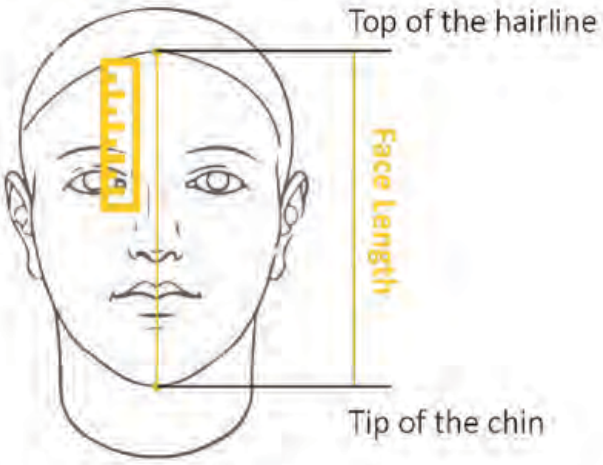
Statement of Work

Notional mainly uses human facial features as reference data to generate exclusive patterns corresponding to human faces. Taking the recognised basic face shape as the starting point, map the data into the corresponding range so that the primary geometric figure corresponding to the face shape can be transformed and copied logically to obtain the final 2D figure. Since faces will not be 100% the same as any others, everyone's graphics are unique and can be regarded as the user's exclusive graphics and used on other occasions.

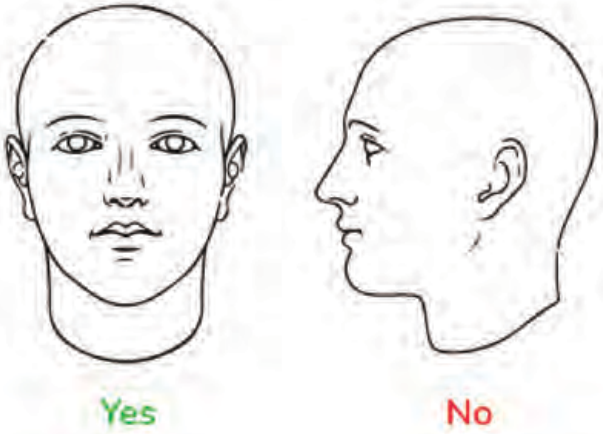
Initial Measurement & Input Processing

Grooming: Firstly, ensure the forehead is exposed as much as possible, and ornaments such as glasses and earrings should be removed to prevent the occlusion of the face from leading to recognition errors.

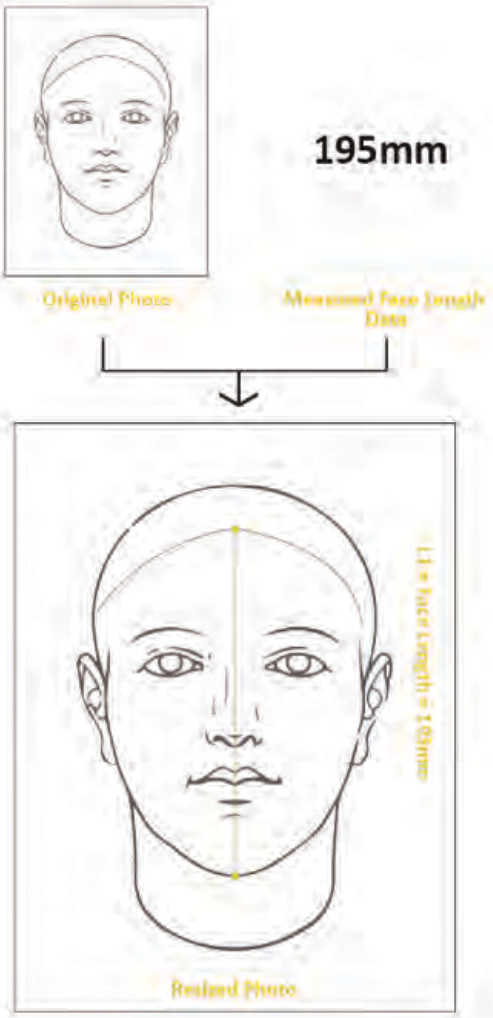
Measure Face Length:
Use measurement tools such as a soft ruler to determine the length of the face. The face length should start from the top of the hairline to the tip of the chin.



Take a photo: Then take a picture of the face from the front rather than other angles.



Resize the photo: When the face length is measured, the photo should be scaled to the same size as the reality to get almost exact facial feature data. The rest of the face data can be taken directly from the photo rather than measured individually in the real world.



Key Measurement

Length1(L1): Face length (px)

Starting point: The top of the hairline

Ending point: The tip of the chin

Length2(L2): Face Width (px)

Starting point: The left side of the cheekbone line

Ending point: The right side of the cheekbone line

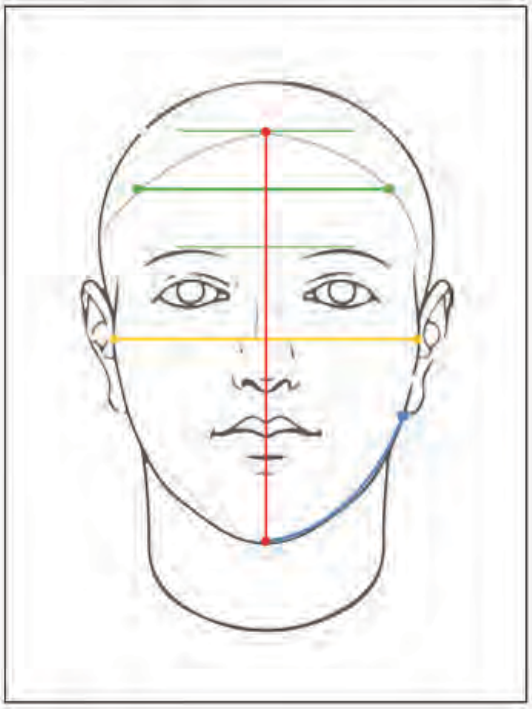
Length3(L3): Forehead Width (px)

Refer to the horizontal line passing the top of the eyebrow and the top of the hairline, take the middle point, then make a horizontal line.

Length4(L4): Jawline Width (px)

Starting point: The tip of the chin

Ending point: The root of the ear



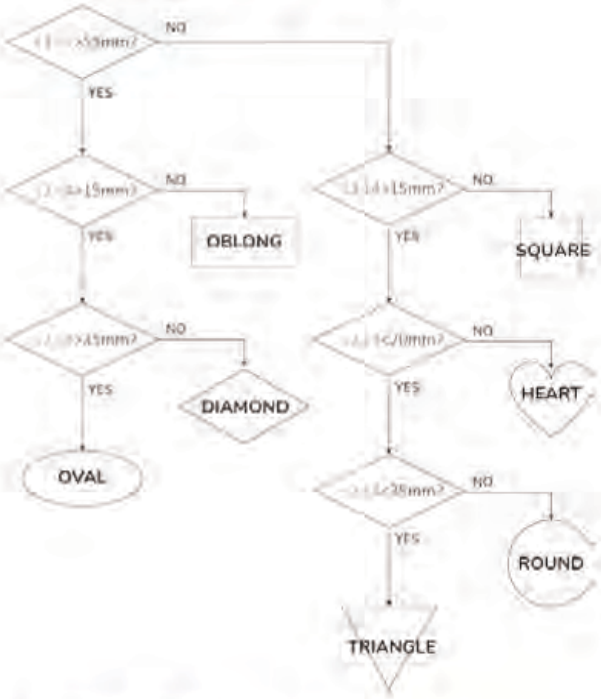
Caution:

In the demonstration prototype, these measurements are all from the resized photo, which means the unit is px(which is more universal in the digital area), and the variable "resize factor" controls the transition from px to mm, which is:

resizeFactor = measure data in real life(mm) / measure data from the resized photo(px)

Basic Shapes Definition

We classified face shapes by comparing the sizes of four key measurements so that each face could find its corresponding basic geometry.



The Basic References are from: https://www.omnicalculator.com/health/face-shape

Shapes Transition

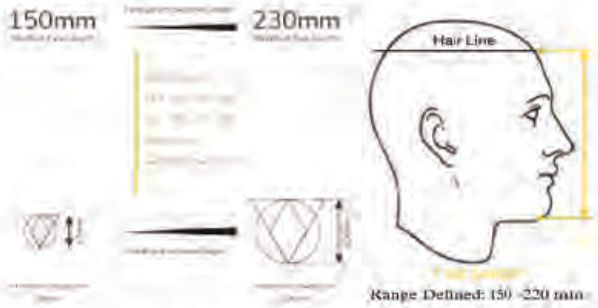
After obtaining the basic shape of the face, the primary process to get to the final pattern is to logically rotate and duplicate according to other facial data as a controlling variable and then map the average range of the facial data into the range of shape data.

Since the photo is adjusted to the size, data can be easily obtained from any other face part. The following table shows the total list of the transition of the basic shape and its depending control variable, and its detail will be shown in the next part.

Transition Steps	Reference Data
Shape Size	Face Length
Rotation Center X axis offset	Mouth Width
Rotation Center Y axis offset	Mouth Height
Rotation Number	Outercanthal Width
Rotation Angle	Intercanthal Width
Stroke Size	Nasal Width
Stroke Color -R	Left Eye Width
Stroke Color -G	Right Eye Width
Stroke Color -B	Pupillary Distance

Step1: Shape Size

Face Length is variable, which is the vertical distance from the tip of the chin to the midpoint of the hairline. It will depend on how big the user's basic shape is. The longer the Face length the user has, the bigger the shape is.



Equation: **Shape Size = Face Length * 0.625 - 43.75**

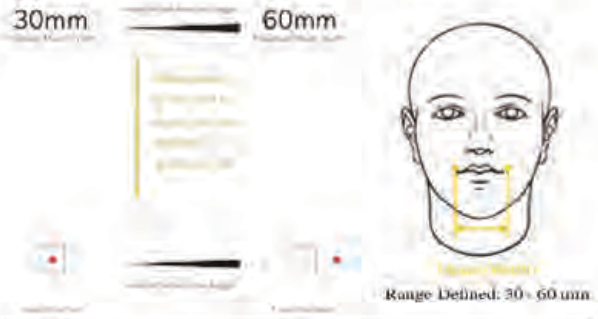
(Example: Face Length is 150mm)

Shape Size = Face Length * 0.625 - 43.75 =150*0.625-43.75 = 50mm

The Range of the Face Length is sourced from: https://en.wikipedia.org/wiki/Human_head

Step2: Rotation Centre X-axis offset

Mouth Width starts from the left side of the mouth to the right side of the mouth; take the horizontal data for the x-axis offset of the centre point. The longer the mouthwidth user has, the more deviation the shape moves from the x-axis.



Equation: **X-Axis Offset = Mouth Width * (10/3) - 100**

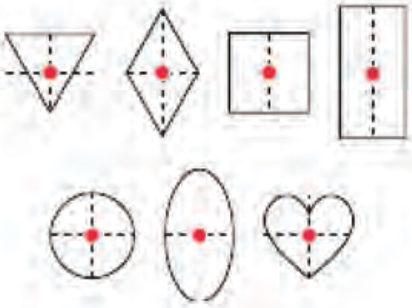
(Example: Mouth Width is 30mm)

X-Axis Offset = Mouth Width * (10/3) – 100 = 30 * (10/3) – 100 = 0

The Range of the Mouth Width is sourced from https://www.facebase.org/facial_norms/summary/#labfiswidth

(Definition: Shape Center Point Determination Rules)

Take the midpoint of both the horizontal line and the vertical line. The crossing point of the two-centre line is the initial rotation center point.



Step3: Rotation Centre Y-axis offset

Mouth height starts from the top of the lips to the bottom of the lips; take the vertical data for the y-axis offset of the centre point. The longer the mouth height user has, the more deviation the shape moves from the y-axis.

Equation: **Y-Axis Offset = Mouth Height * 6.25 - 37.5**

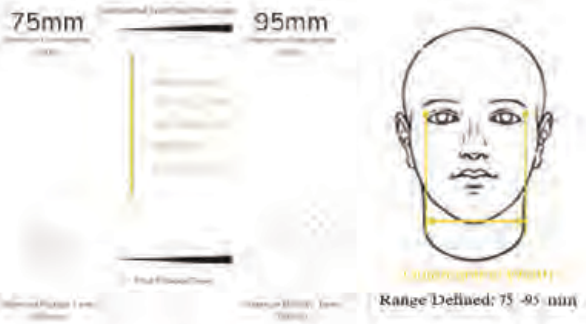
(Example: Mouth Height is 10mm)

Y-Axis Offset = Mouth Height*6.25-37.5 = 10*6.25-37.5 = 25mm

The Range of the Mouth Height is sourced from https://www.facebase.org/facial_norms/summary/#upvermheight

Step4: Rotation Number

Outer canthal Width starts from the left side of the left eye to the right side of the right eye; take the horizontal data. The longer the outer canthal width the user has, the more the shape will duplicate.



Equation: **Rotation Times = Outercanthal Width * 2 - 114**

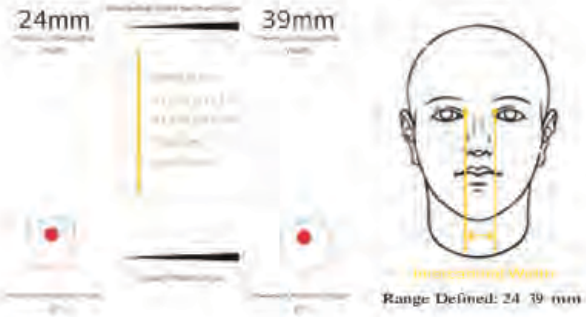
(Example: Outercanthal Width is 90mm)

Rotation Times = Outercanthal Width*2-114 = 66Times

The Range of the Outercanthal Width is sourced from: https://www.facebase.org/facial_norms/summary/#outcanthwidth

Step5: Rotation Angle

Intercanthal Width starts from the right side of the left eye to the left side of the right eye, taking the horizontal data. The longer the intercanthal width the user has, the bigger the angle shape will rotate.



Equation: **Angle = Intercanthal Width * (4/3) - 22**

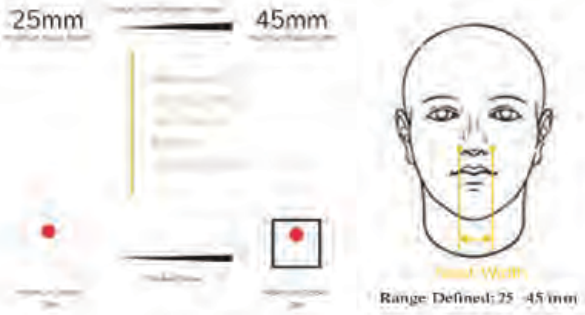
(Example: Intercanthal Width is 30mm)

Angle = Intercanthal Width * (4/3) – 22=30* (4/3)-22 = 18°

The Range of the Intercanthal Width is sourced from https://www.facebase.org/facial_norms/summary/#incanthwidth

Step6: Stroke Size

Nasal Width starts from the nose's left wing to the nose's right wing, taking the horizontal data. The longer the nasal width the user has, the thicker the shape will be.



Equation: **Stroke = Nasal Width * 0.125 - 2.625**

(Example: Nasal Width is 30mm)

Stroke = Nasal Width * 0.125 - 2.625 = 30*0.125-2.625 = 1.125pt

The Range of the Nasal Width is sourced from https://www.facebase.org/facial_norms/summary/#nasalwidth

(Special Case: Data out of range)

Since the Settings of the range are set according to the average human face size, there is a minimal probability that something will go out of range. To account for this concept, excess data is added to the stroke as additional data.

In any of the previous steps, data which is less than the minimum of the range is counted as:

EXTRA STROKE = (The difference from the range minimum) / Range Size

In a similar way, in any of the previous steps, data which is more than the maximum of the range is counted as:

EXTRA STROKE = (The difference from the range maximum) / Range Size

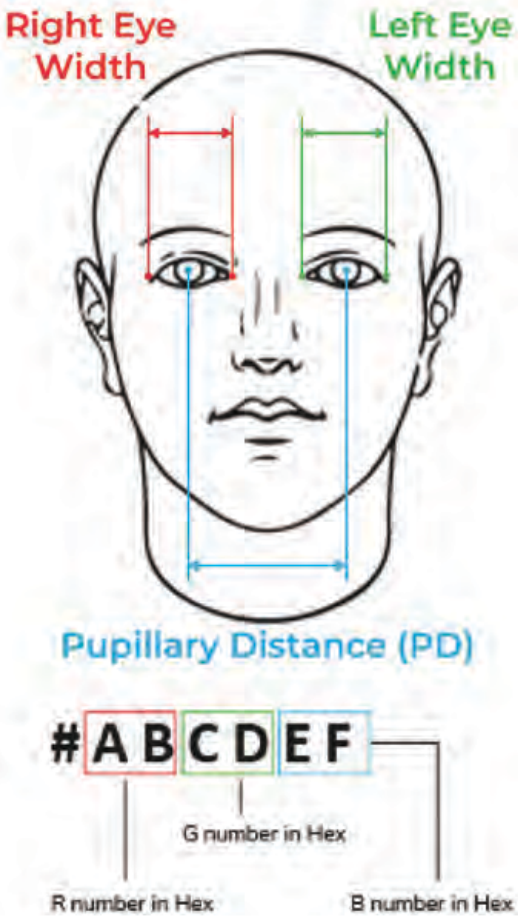
Thus, the final formula of the stroke is:

*BASE STROKE = y = 0.125x-2.625 = Nasal Width * 0.125 - 2.625*

FINAL STROKE = BASE STROKE + EXTRA STROKE

Step7: Stroke Colour

Measure left-eye Width, right-eye width and pupillary distance to form 3 hex numbers, then find the corresponding RGB colour according to these three values.



Equation:

R Value = Left eye width * 25.5 - 586.5

G Value = Right eye width * 25.5 - 586.5

B Value = Pupillary Distance * 8.5 – 425

(Example: left eye Width is 30mm, right eye width is 28mm and pupillary distance is 80mm)

R Value = Left eye width * 25.5 - 586.5=30*25.5-586.5 = 178.5

G Value = Right eye width * 25.5 - 586.5=28*25.5-586.5 = 127.5

B Value = Pupillary Distance * 8.5 – 425=80*8.5-425=255

Thus, the RGB value is (178,127,255)

The final stroke colour:

The Range of 3 Variable is sourced from:
https://www.facebase.org/facial_norms/summary/#palpfislength_r

https://www.facebase.org/facial_norms/summary/#palpfislength_l

Examples: