

Recognition of Human Face using Mandible-Ramus-Nasal Bone

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Summary

This is an application design model of identifying, verifying and validating the face biometrics towards recognizing the relation of a shot, sequential time series data. This application is initially applied for controlled boundaries of face biometric like 10x10 or 15x15 pattern pixels or defined segments. The object considered for pattern recognition is face, and this face recognition is performed through the slope of nose and gonial-angle, though the face image is observed in any of their expressions or illuminations. The gonial angle may be greater than or lesser than 125° and also it may be of any position. Further the relation between the mandible and corresponding ramus, it's head are also considered as the factors of face recognition.

Key words:

Gonial-Angle, Mandible, Ramus, Piriform-aperture, Zygomatic bone.

1. Introduction

In existing face recognition method, it is being considered as parametric values of face, their gradient energy, left and right side appearance of face, juvenile history of a person, general shape of faces, geometrical properties of face, nasal cavity and piriform aperture of different cadavers. As a sample explanation why it is independent of expression and illumination is, a composite image and the asymmetry would have to be very great / different in the following figure 1.



Figure:1 Before an individual could not be recognized it is General face-Biometric sources

This image shows middle column as original face, left column shows composite of two left sides' image and right column shows the composite of two right sides' image of the same faces.

Broca is considered by many (Fedosyutkin & Nainys, 1993) to be the first researcher to study the relationship between the structure of skull and the overlying soft tissues that define appearance and it was observed that it has great individual variations in soft tissue thickness from one person to the next. At the turn of the century criminalists drew the attention of anatomist to the result of research into the correlation between the structures of the soft tissue formation of the nose with the configuration of the piriform aperture. This led to the state of research into the comparison of faces with skull structure and many different often grossly discordant hypotheses arose. 2. General face shape

The shape of the upper head is described by (Fedosyutkin & Nainys, 1993) using four terms: rounded, square, oval and triangular. These shapes are determined by the transverse/inclined arc (vault) of the cranium which is described as semisphere, pentagonoid, oval and rectangular respectively as 1,2,3,4 in the figure 2 and the slope of the soft tissue form of the nose of about a single person will not be different over the period of time and it is proved as invariant.

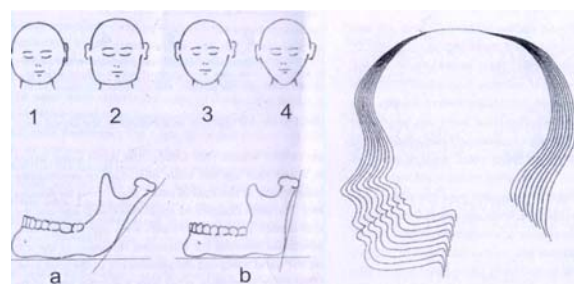


Figure:2 Juvenile historical growth of a Head

The shape of the lower part of the face repeats the contour of the mandible and, if the gonial angle is over 125° and the coronoid process is high then the lowest part of the face is likely to be a narrow variant such as oval or triangular. If the gonial angle is less than 125° and there is

a wide low coronoid process then the face shape is likely to be a wide variant such as rounded or triangular. Fedosyutkin & Nainys, 1993 also claimed that the hairline could be seen microscopically as the transition of the smooth surface of the forehead bone into small rough tubercles. Some studies (Gerasimov 1971) suggested that when the cheek bones are flat, the zygomatic muscle is located on the more frontal surface of the zygomatic bone and when the cheek bones are strongly profiled, the zygomatic muscles are located mainly on the lateral surface of zygomatic bone. Thus the shape of the face through only the semisphere, pentagonoid, oval, rectangular identification is not enough to distinguish one from the other using obtuse and acute gonial angles as shown below.

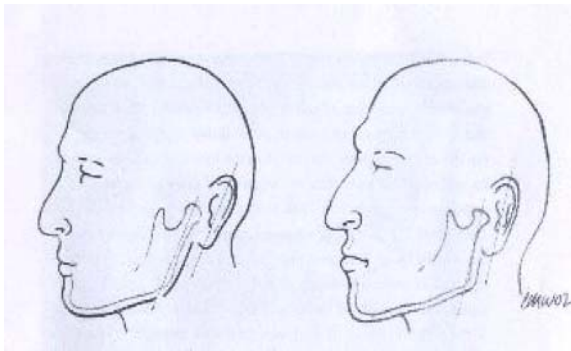


Figure:3 Appearance of Gonial and Mandible

So we need the nose as the majority of early facial anthropological research and is centered around the nasal form (Tandler 1909). It stressed the importance of nose in facial reconstruction but did not believe that the configuration of the nasal tissue was correlated to the contour of the bone at the root of the nose.

According to the authors (His 1895, Birkner 1907 and Virchow 1912) studied the correlation of prominence of the nasal spine and nose protrusion and found variation in tissue thickness based on the facial origin as in the Figure:4.

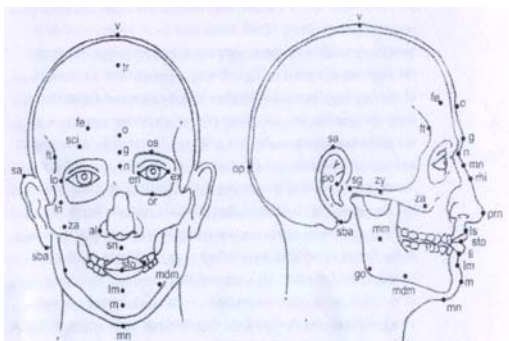


Figure:4 Important marks of Human Face and Head

The study of the relation between the external nose and the bony nose and nasal cartilages (Schultz 1918) in 8 white cadavers and 23 black cadavers found that the height of the external nose (distance between the nasal and sub nasal points (n, prn) are distinct.

n - nasian – the mid line point of the nasal root, identical to the bony landmark.

prn - pronasale – the most protruding point at the tip of the nose

An explanation of nasal bones alone does not suffice for a reconstruction and it is really pointless but the following information may be considered to fine tune the result. The height of the external nose (length) corresponded to the nasion-subspinal distance on the skull. Shultz also found that in adults subnasal point lay below the subspinal point (1.4 mm Whites and 1.6 mm in Blacks) but at birth the subnasal point was found to lie above the sub spinal point, etc Thus, this study illustrates to our proposal that it should be only the increasing line vector from time to time.

According to these explanations the fact that the new borns nostrils lie above the floor of the nasal cavity, while in the adults they lie below, Schultz found that the breadth of the nose was always greater than the piriform aperture by an average of 10 mm in Whites and 15 mm in Blacks. Other studies of the nose of African Blacks, Chinese, Indians and Sunda islanders (Virchow 1912) found the similar relationship 13 mm American Blacks, 15 mm Chinese, 13.5 mm Indians and 12.5 mm in Sunda islanders.

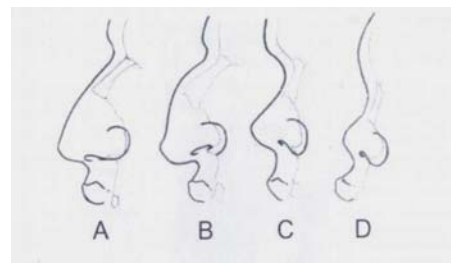


Figure 5: Soft tissue nasal forms

Thus considering mid nasal point (ns) is the mid point of the nasal bones and this point is not an effective body mark on comparing Blacks, Chinese, Indians etc., and by considering n, prn as a straight line and the angle of the nasal spine determines the angle of columella illustrated by Richard Neave as in the Figure 6.

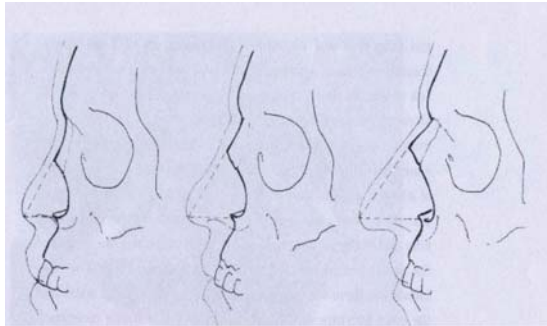


Figure 6: Relations of piriform-aperture and softtissue nasal

3. Proposed method

A mathematical model is proposed for recognizing faces. Available data are, the lines between the points n & prn, n & sg, prn & sg, o & sg, o & n, o & prn, mn & go, and the gonial angle q .

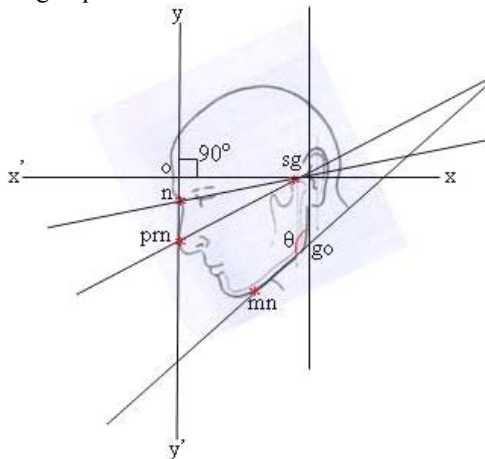


Figure 7 proposed model of this paper

n-nasion- is the point in the middle where the nasal bone and the frontal bone intersect. (The midline point of the nasal root, identical to the bony landmark) Prn-pronasal- the most protruding point at the tip of nose. Sg-supraglenoid- the point anterior to the tragus at the root of the zygoma. Also known as the pretragal point or the root of the zygoma. o- origin- is the point of intersection where the X and Y axis intersect. mn-menton- the lowest medial landmark beneath the chin. Also known as the bony gnathion. go-gonion- the most lateral point on the mandibular angle, close to the bony gonion. (gonion is the point at the centre of mandibular angle) q - theta -gonial angle.

4. Normalization

The object of given sample face biometric is moved and fixed in XY plane, where n and prn points lie on the Y

axis and the point sg lie on the X axis. And we fix this given sample as above shown in figure 7, and it can be considered irrespective of its size for analyzing the same.

As the angle at x,y axes intersection for any quadrant is 90°, we can calculate the length of the points between o and sg, o and prn, prn and sg for a right angle triangle as shown in the Figure 6. Subsequently the length of the points between o and n, n and sg can also be found. Thus, these two sets of relative and valid points and their gonial angle θ (greater than or lesser than 1250) can be analyzed to determine the given sample is positive or not, and in addition to that the length of the points between mn and go, can also be considered for the same purpose. But the vector length of the points between mn and go varies with age. Hence we can identify, validate or verify any human face biometric at any of its angle and size.

Determinations of this model of recognition (for relative point comparison)

$$osg2 + on2 = nsg2$$

$$osg2 + oprn2 = prnsg2$$

$$mngo = \text{constant (in length)}$$

$$\theta = \text{constant (gonial angle of mandible left / right)}$$

Conclusions

A different approach for face recognition is presented considering the factors such as the slope of the soft tissue nose and the angle of gonial and position(s) – (obtuse and acute). This above said model of examining the face, is completely a new approach. It has a number of features in face recognition (i) A grouped variety of certain nasal length face samples can be considered for identification or verification purpose, subsequently (ii) the relation of respective nasal length with gonial angle can also be considered for identifying the samples available at templates (iii) the illumination regions between the nasal length and the gonial angle segment can be analyzed for face recognition (iv) this application model can also be used even if the face is sensed for various positions of the angle gonial picturized (v) No factor can reorder the length of the nose of a face and the points n, prn can never be changed at any cost for a shot or video data/template. (vi) This is a standard model for both symmetry and asymmetry faces, since the comparing factors (nose length/slope and the positions of angle gonial) are taken either by left side or by right side of an unusual asymmetry face. (vii) The same comparison is quite effective though it is stored in different illumination/perspective, projection/gradient, energy/projections (viii) This recognition model can be adopted for the raw gonial bone / skull with or without the correction of soft tissue thickness statistics of any cadavers also. (ix) The distance

between nasion(n) and supraglenoid(sg) – [the point anterior to the tragus at the root of zygoma also known as the tretragal point or the root of the zygoma] is always standard for a specific face and could be different between left side and right side of a face.

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