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(54) Title: IMAGE ANALYSIS FOR DETERMINING CHARACTERISTICS OF ANIMAL AND HUMANS

Facial Descriptor Name: Degree of Facial Inflection

Anatomical Region of Face: AR01_FacialProfile

General Description:

Describes the degree of structural concavity/convexity of the *True Line of the Face*. Differentiate between a concave "dished", convex "roman", or straight bone structure.

Mathematical Proof:

$$\overline{AB} = \sqrt{(B_x - A_x)^2 + (B_y - A_y)^2}$$

$$\overline{AC} = \sqrt{((C_x - A_x)^2 + (C_y - A_y)^2)}$$

$$\overline{BC} = \sqrt{(C_x - B_x)^2 + (C_y - B_y)^2}$$

finds distance values for all sides of triangle

$$\theta = \cos^{-1} \left(\frac{\overline{BC}^2 - \overline{AB}^2 - \overline{AC}^2}{-2 \times \overline{AB} \times \overline{AC}} \right)$$

finds the angle for $\angle BAC$, denoted here as θ

$$d = \sin(\theta) \times \overline{AC}$$

finds the height of triangle $\triangle ABC$, the distance of facial inflection

$$M_{AB} = \frac{(A_x + B_x)}{(A_x - B_x)}$$

finds the slope of line $\overline{AB}$

$$Q_x = \left(\frac{C_x - A_x}{M_{AB}} \right) + A_x$$

finds the x-coordinate of point Q, intersected by line $\overline{AB}$ and its horizontal bisector inclusive of point C

$$\alpha = Q_x - C_x$$

finds a value for which α is either positive or negative, indicating respectively either convexity or concavity by the location of point C relative to the position of point Q on the Profile Line of the face

$$\sigma = \frac{\alpha}{|\alpha|}$$

finds σ , here defined of the Constant of Concavity with magnitude 1 indicating direction of inflection via sign (+/-)

$$DefI^{\circ} = \sigma \times \left(\frac{d}{\overline{AB}} \right)$$

finds the **Degree of Facial Inflection**, here defined as the degree of perpendicular deviation of the Upper Profile of the skull from the *True Line of the Face* relative to the overall length of the face.



Fig. 1A

(57) Abstract: Systems and methods are disclosed for predicting one or more characteristics of an animal by applying computational methods to image(s) of the animal to generate one or more metrics indicative of the characteristics. Embodiments determine predictors of characteristics by creating a sample library of animals of a particular type, determining facial descriptor measurements for each animal, determining relationships between facial descriptor measurements and additional library data, and selecting predictors from these relationships. Other embodiments predict characteristics of animals not in the library and, optionally, categorize animals for particular discipline, training, management, care, etc. based on the characteristics. Other embodiments predict characteristics and determine strategies for group(s) of animals using predicted characteristics of individual animals. Embodiments are broadly applicable to domesticated animals including dogs, cats, cattle, oxen, llamas, sheep, goats, camels, geese, horses, chickens, turkeys, and pigs. Other embodiments predict certain characteristics of humans, including certain cognitive or developmental disorders.



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