Preprocessing the FG-NET Aging Database using MATLAB

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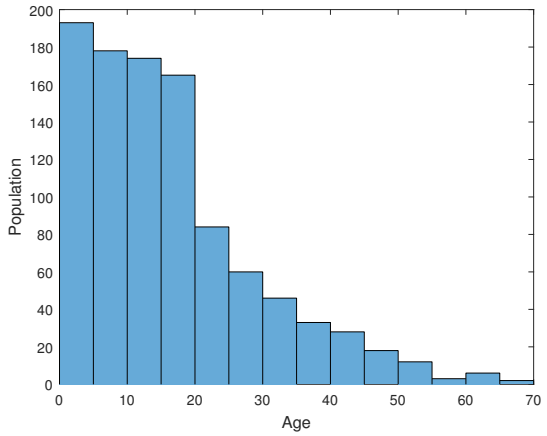
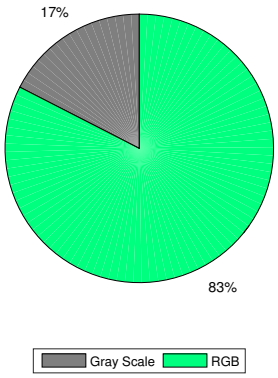
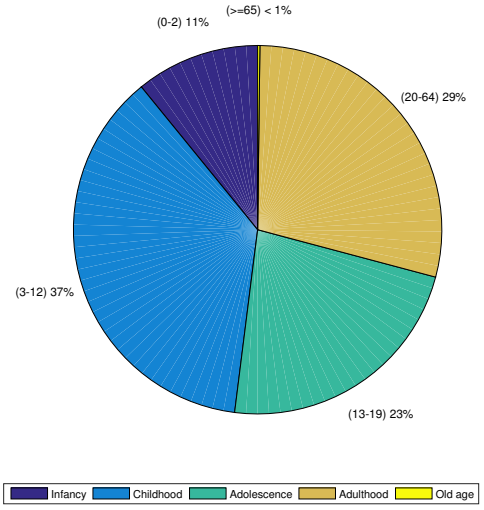
The Face and Gesture Recognition Research Network (FG-NET) aging database contains 1002 face images of 82 individuals with age ranging between newborns to 69 years old [1]. The 72% (730) of the images are newborns to 20 years old. In Figure 1 the images have been separated based on the human growth curve. From the 1002 images, the 175 are grayscale, while the remaining 827 images are red, green, and blue (RGB) images. Each image in the dataset (apart from one) is annotated with 68 landmark points located at key positions.



(a) Age histogram



(b) Percentage of RGB images

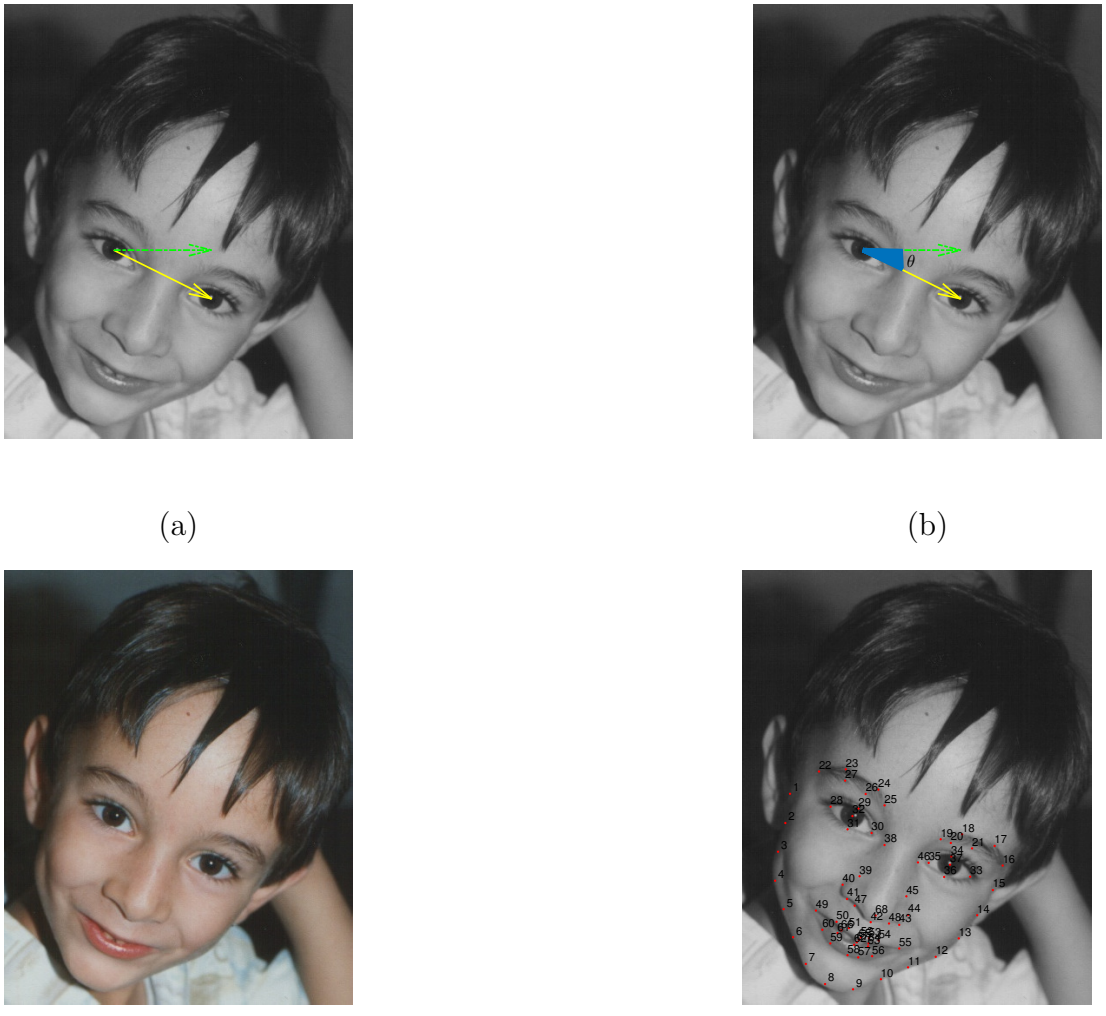


(c) Age separation

Figure 1: (a) Age histogram, (b) number of grayscale and RGB images in the FG-NET aging database and (c) age separation based on the human growth curve

The data preprocessing is a very critical step in machine learning applications and especially, deep learning. It allows the deep structure to detect or extract meaningful features.

In other words it prevent the algorithm to produce misleading results based on the given input.



(a) (b)

(c) (d)

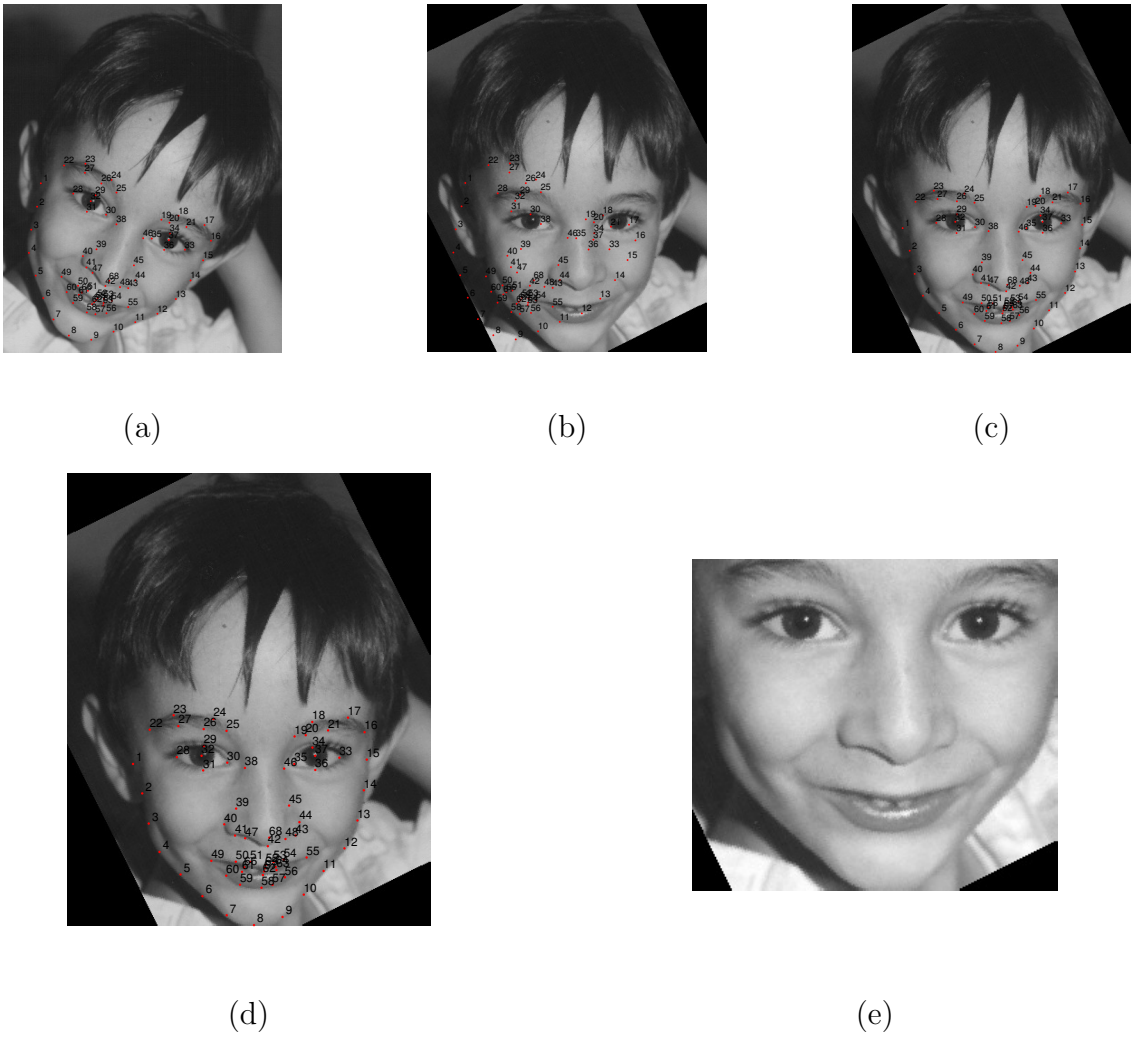
Figure 2: (a) Eyes direction from left to right eye. (b) The angle, θ, is computed using the inverse tangent. (c-d) Example of an image which is converted to grayscale. The 68 landmarks of the image are presented.

The proposed preprocessing contains the grayscale normalization, face alignment, cropping and resize. Specifically, for each image the landmarks are extracted and stored. The name of each image also contains the age of the given face, which has been extracted too. Initially, if it is needed, each image is converted to a grayscale (Figure 2). This is computed with the *rgb2gray* MATLAB's function. The face alignment is achieved based on the location of the eyes (the landmarks numbers 32 and 37 are used for all images). The direction of the vector which connects the two eyes (from the left to the right) is computed by subtracting x-axis and y-axis of the location of the two landmarks. Specifically, if (x_l, y_l) and (x_r, y_r) are the landmarks of the left and right eye respectively, the rotation angle, θ, for the face alignment is computed with the inverse tangent:

$$\theta = tan^{-1}(\frac{y_r - y_l}{x_r - x_l}) \tag{1}$$

The rotation angle is computed and the *imrotate* function is used to rotate the image and perform the face alignment. The rotation is done with anticlockwise direction. After the

image rotation it is needed to move the landmarks to the correct positions, as the following step is to use the correct position of the landmarks to perform the cropping of the image. (this is illustrated using an example in Figure 3). The computation of the new position of the landmarks is achieved through the rotation matrix. The rotation matrix requires the central point of the rotation [2]. The MATLAB's "imrotate" function uses the center of the image as the central point. Prior to the cropping procedure, the images are normalized between 0 and 1. The landmarks number 1, 4, 8 and 23 are used to perform the cropping of the image. Finally, the image is resized to $\mathbf{R}^{\mathbf{50\times 50}}$. In Figure 4 examples of the preprocessed images are provided. The same task without the landmarks would require more advanced methodologies (e.g. eye localisation algorithm).



(a) (b) (c)

(d) (e)

Figure 3: (a) Grayscale image with the 68 landmarks. (b) Rotated image, the landmarks are not changed yet. (c) The new position of the landmarks are computed based on the rotation matrix. (d) Rotated image and (e) cropped image.

(a) Initial (b) Preprocessed

Figure 4: A sample of (a) the initial and (b) the preprocessed images.

References

[1] G. Panis, A. Lanitis , N. Tsapatsoulis and T.F.Cootes, *An Overview of Research on Facial Aging using the FG-NET Aging Database*, 2004.

[2] S.E. Bekhouche, A. Ouafi, A. Taleb-Ahmed, A. Hadid, A. Benlamoudi, *Facial age estimation using BSIF and LBP*, 2014.