Nose Detection in the Human Face

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ABSTRACT

Face detection and face features extraction looks very excited, as it’s used in many applications such Facial recognition systems, Biometrics and Human computer interface etc. So it requires face detection process to success these applications.

The principle behind detecting the face feature is used to measure the respiration rate in the future as the nose represents the important region in the human face for breathing.

The methods are developed as well as the Image processing techniques. They were both used to enhance the images, remove unwanted noise and segmented the ROI.

Thresholding, Morphological as well as banalization process were investigated to achieve the aim of the suggested method. Using a skin-color segmentation and image processing techniques to detect the human face as elliptic area. Several
techniques were applied to identify the nose [the region of interest (ROI)] in the elliptic area. Edge detection to the elliptic area of the human face was applied. The investigation for looking for the longest vertical line in the elliptical area was achieved. This vertical line represents the center of the nose region (ROI).

Detect the nose as a rectangle region was also investigated and then determined this region (ROI) in the human face.

Segmenting the ROI was considered an important task in this method based on detecting the human face as well as extracting the facial features.

Further work is in progress to enhance the algorithm so that it can be used to detect the mouth and eyes regions.

*Keywords*: Region of interest, imaging processing, facial features.
المنطقة الهامة في الوجه الإنساني للتنفس. يتم تطوير أساليب وكذلك تقنيات معالجة الصور حيث تم استخدام كلاهما في تحسين الصور، وإزالة الضوضاء غير المرغوب فيها وكذلك تجزئة منطقة الاهتمام باستخدام تقنيات حد العتبة و المورفولوجية وتحويل الصوره إلى ROI. وقد تم التحقق من استخدامهما لتحقيق الطريقة المقترحة باستخدام تجزئة الجلد. لونا وتقنيات معالجة الصور للكشف عن الوجه الإنساني كمنطقة بيضوية الشكل. عدة تقنيات تم تطبيقها داخل المنطقة البيضوية للوجه البشري وبعدها تم التحقق من منطقة الانف بالبحث عن اطول خط عمودي داخل الوجه البيضوي هذا الخط سيمثل منطقة ROI. يتم كشف المنطقة المستطيلة كمنطقة الانف داخل الوجه البيضوي حيث تقسيم منطقة الاهتمام كان يعتبر مهمة هامة في هذه الطريقة تقوم على كشف الوجه البشري وكذلك استخراج ملامح الوجه. مزيد من العمل جار لتحسين الخوارزمية بحيث يمكن استخداها للكشف عن مناطق أخرى من الوجه كالفم والعينين.

Introduction

The face feature extraction plays an important role in many applications such as identity authentication, access control, measuring breathing and video surveillance, etc [1].

Therefore it is very important to consider using a reliable face detection to reduce errors occurring in those applications [2].

The fixed physical features of human beings that never change through one’s life are regarded as instrument to identify any identity. For this reasons the face features recognition considered not very easy, one of them is humans are complicated creatures
they vary from one in many different ways such as age, gender, age etc.

The main aim of face feature extraction is extracting and detecting features such as the nose, eyes and mouth [3,6].

Human face has changeable structures that cannot easily be detected or recognized. This fact makes a computer aided recognition or detection system very complex [7].

Brunelli and Poggio [8] suggested detecting the human face based on a template-based approach; by selecting four templates for each person, to contain the eyes, nose, mouth and whole face while another suggestion for face detection was proposed by Rowley et al. [9] modified a method to detect a face region by using a neural network.

Another modification was proposed by Wong et al., [10] for detecting human face and feature extraction based on locating the face region and facial features based on the characteristics of eye regions.

The suggested method for detecting and extracting the human face as elliptical area was investigated. Image processing techniques were used to detect and extract the nose as a rectangle region and it was recognized as the longest vertical line inside the elliptical area.
Methodology
The recorded images were processed off-line using the Matlab image processing toolbox. Average low pass filter of size 3 by 3 was used to reduce unwanted noise. The Sobel edge detection scheme [4] was used to identify the boundary of the subjects, heads in the thresholded images. The Sobel masks were:

\[
G_x = \begin{bmatrix}
-1 & -2 & -1 \\
0 & 0 & 0 \\
1 & 2 & 2 \\
\end{bmatrix}, \quad G_y = \begin{bmatrix}
-1 & 0 & 1 \\
-2 & 0 & 2 \\
-1 & 0 & 1 \\
\end{bmatrix}
\]

Since the image enhance by average low pass filter of size 3 by 3. The images were thresholded to separate the human head from the image background.

This step consider as important steps in the human face detection process. The efficiency of the color segmentation of a human face depends on the color face that is selected.

This operation was performed by detecting the facial color distribution. The color value of the image background was relatively lower than the color value of a subject’s head. A suitable threshold value for RGB was 100, and therefore this operation was performed as,
Where \( f(x,y) \) and \( g(x,y) \) represent image pixels prior and after the Thresholding operation respectively.

Banalization the threshold image, then the Sobel edge detection scheme was used to identify the boundary of the subjects’ heads in the thresholded Banalization images, as shown in Fig.1

![Fig. 1. shows the application of the threshold and edge detection techeneques on the filtered image.](image)

In order to select the image area covered by the subject’s face, an ellipse was automatically superimposed on the filtered images by the developed software [4]. The location and size of the ellipse were determined as follows:
• The highest (xmax) and lowest (xmin) pixels’ locations of the head boundary in the vertical direction were identified and the centre between these two locations (x0) was determined.
• Centred at x0, the head boundary points in the horizontal direction was identified, providing ymin and ymax. Then, the centre (y0) between ymin and ymax was calculated. The diagonals of the ellipse (i.e. 2a and 2b) were determined, where a and b were calculated from x0, and y0 to xmin and ymin respectively.
• The position of the ellipse on the filtered images was then determined by the software using the ellipse equation,

\[
\frac{(x_i - x_0)^2}{a^2} + \frac{(y_i - y_0)^2}{b^2} = 1
\]

Fig.2. shows the position of the ellipse on an original image.
Then, the extraction human face as elliptical area from the original image was achieved as shown in Fig.3.

![Extract the human face as elliptical area](image)

Fig. 3. **Extract the human face as elliptical area**

Initially, Threshold the elliptical region of the human face as shown in Fig.4

![thresholding the elliptical area of the human face](image)

Fig. 4. **thresholding the elliptical area of the human face**
then, scanned the ellipse area to identify the nose region. Detecting the nose based on tracking the longest vertical line in the image. This line refers to the center of the nose as well as the tip of the noise. A rectangle (ROI) was placed on the identified region in such a way that it covered the nose based on location of the longest line as shown in Fig.5.

![The location of the nose as a rectangle area](image)

Fig. 5. The ROI: the position of the nose (ROI) as rectangle region on the human face

**Results and Discussion**

Fig.6 shows the successful of tracking method to detect the human face as elliptical area as well as detect the human nose in the elliptical area as rectangle region.
Fig. 6. The successful of tracking method to detect the human face as elliptical area as well as the nose (ROI) as rectangle region on the human face

Conclusions

The main essence of this study was to detect the human face as well as the nose. The role of Image processing techniques to detect the human face as ellipse shape was investigated. Enhancement, Thresholding and segmentation were used to extract human face as elliptical area from the background. Image processing techniques was used to detect the human nose as a rectangle region. Extracted the nose region was
achieved by tracked the longest vertical line in the elliptical area which represent the nose region.

The processing was off-line due to the extent of image processing involved.

Further work on optimizing the image and signal processing will enable measurements to take place in real time. There were further issues with signal detection during the head movements.

Use this algorithm to detect the facial features such as eyes, ears as well as mouth regions. Using this tracking method to measure the respiration rate for the human body. Further improvements are currently being sought to deal with these limitations.

References


