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Pose Invariant Face Recognition using Facial Index Measurement

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1. INTRODUCTION

Facial recognition finds many application in modern world where a lot of faces are captured due to proliferation of CCTV cameras. Face recognition involves examining the unique shape and positioning of the facial features i.e. landmarks. These are the peaks and valleys that make up the different facial features. These landmarks are also called as nodal points. Some of the important landmarks are; Glabella, Endocanthion and exocanthion, Vertex, trichion, nasion, alare, sub-nasale, labiale superious and labiale inferious, stomion, gnathion, cheilion and zygion. The data for landmarks on digital image of an individual's face and the facial indices can be compared for identification. However due to variability of these ratios due to change of pose can make the identification task challenging.

Forensic facial identification refers to the process of examination and comparison of two face images and to interpret if they are of same subject or not. Photogrammetric analysis is an important facial identification method that is used when other identification features are not available due to low resolution pictures and is based on spatial measurements of facial features as well as distances and angles between facial landmarks.

In today's scenario, in the field of forensic, the quality of images available is generally low. The reason behind this is that the images of a crime scene are recorded using CCTV and these images have low resolution due to which most of the time depicted faces are not frontal and difficult to identifies the face and photogrammetric analysis gains importance.

2. MATERIALS AND METHODOLOGY

For the purpose of facial recognition, facial features or landmarks were identified. The biometric landmarks of the face were (i) vertex, (ii) trichion, (iii) glabella, (iv) nasion, (v) endocanthion, (vi) exocanthion, (vii) alare, (viii) subnasal, (ix) labiale superior (x) stomion (xi) labiale inferior (xii) gnathion (xiii) cheilon and (xiv) zygion. From these landmarks 12 facial indices were used for facial analysis. These were forehead size index, facial index, intercanthial index, nasal index, nasofacial index, naso-face width index, nose-face width index, lip index, vertical mouth height index, upper lip thickness index, lower lip thickness index, mouth width index and chin size index [1]. Facial photographs of 5 male volunteers were taken.

Photographs were taken with mobile camera (Samsung C7 Pro), at angles about straight, 45 and 90 degree to the subject's position to the left and right. A set of five measurements resulted and two other sets at similar angles but from a line below the horizontal and vertical were obtained (to simulate low camera angle and high camera angle). Subjects were allowed to sit on a chair with constant pose but camera angle was changed. Therefore, total 15 photographs of each person were taken from different angles. Photographs were taken at the distance of about 2 meters.

The photographs were saved as JPEG files and a MATLAB code was used to mark the landmarks. The code automatically calculated the 12 facial indices and the results were saved to a csv file. WEKA [3] software was used to perform logistic regression using 10 fold cross validation and true positives and false positives were identified.

3. RESULTS AND DISCUSSION

Out of the 75 total faces 68 were correctly identified and only 7 were misidentified. Thus the true positive rate was 91% and the false positive rate was only 2.3%. The ROC area that is a measure of how good the classification is was 0.986 and this corresponds to an excellent classification. Table 1 shows the results from the Weka software.

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Correctly Classified Instances	68	90.7 %
Incorrectly Classified Instances	7	9.3 %
Root mean squared error	0.1847	
Root relative squared error	46.0 %	
Total Number of Instances	75	

Table 1. Stratified cross-validation summary

TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC	PRC	Class
0.933	0.017	0.933	0.933	0.933	0.917	0.994	0.983	Subject1
0.867	0.017	0.929	0.867	0.897	0.873	0.990	0.960	Subject2
0.867	0.017	0.929	0.867	0.897	0.873	0.977	0.936	Subject3
0.867	0.050	0.813	0.867	0.839	0.797	0.971	0.904	Subject4
1.000	0.017	0.938	1.000	0.968	0.960	0.999	0.996	Subject5
0.907	0.023	0.908	0.907	0.907	0.884	0.986	0.956	Weighted Average

Table 2. Detailed Accuracy By Class

a	**b**	**c**	**d**	**E**	**Classified as**
14	1	0	0	0	**a = Subject 1**
1	13	0	1	0	**b = Subject 2**
0	0	13	2	0	**c = Subject 3**
0	0	1	13	1	**d = Subject 4**
0	0	0	0	14	**e = Subject 5**

Table 3. Confusion Matrix

4. CONCLUSIONS

This paper shows the effectiveness of the technique of measurement and comparison of facial indices. The faces can be identified well even with changes in pose. There is a need of further studies to include a larger dataset and using other statistical measures

REFERENCES

[1] Roelofse M M, Steyn M., and Becker P J, Photo identification: Facial metrical and morphological features in South African males, Forensic Science International, 177 (20008) 168-175.
[2] Stephan C N, Caple J M, Guyomarch P and Claes P, An overview of the latest developments in facial imaging, Forensic science Research, 4:1, 2019, 10-28.
[3] Kleinberg K F, Variation in proportion indices and angles between selected facial landmarks with rotation in the Frankfort plane, Med. Sci. Law, 2007, Vol 47, No. 2, 107-116.
[4] Moreton R and Morley J, Investigation into the use of photoanthropometry in facial image comparison, Forensic Science International, 212 (2011), 231-237.