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RESEARCH ARTICLE

Age Grouping with Central Local Binary Pattern Value Flooding Matrix based Shape Patterns

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Abstract- In this paper a novel method based on facial skin aging features is proposed to classify the human face images into two age groups. The facial skin aging features are extracted as shape patterns on Central Local Binary Pattern Value Flooding Matrix (CPFM). The shape patterns Lower Triangular Matrix Pattern (LTMP), Upper Triangular Matrix Pattern (UTMP) and Tri-Diagonal Matrix Pattern (TDMP) on CLBPVFM of facial images are calculated and these features are used for age grouping. This framework is trained and tested with FG-Net aging database has shown considerable improvement in the grouping of adult and child groups.

Keywords: Age classification, Central Local Binary Pattern Value Flooding Matrix, LTMPC, UTMPC.

1. INTRODUCTION

Face based age classification is an important research area in computer vision applications like forensic and criminal investigations, the determination of retirement age, military age, access to web services with age criteria and supervision of minors. The Age estimation with texture feature [1, 2], contour features and texture features separately [3, 4]. An extraction of skin feature for automatic skin aging estimation [5]. Age classification methods are categorized into three categories [6]. They are an anthropometric model [3,7], aging pattern subspace[8], and age regression[9-12] categories. Recently facial emotion algorithms based on spectral features in ECG signals [13], LBP models [14] are developed. Recently various methods for age classification and age grouping are developed by Vijaya Kumar et. al.[15], Jangala Sasi Kiran et. al.[16] and Chandra Sekhar Reddy et. al.[17]. In this paper focusing on the grouping of facial images into two classes, child and adult. The present paper considers the LBP of the facial image and central lbp value based texel are determined, and then classification method is proposed on this with shape patterns. The rest of the paper is organized as follows. In section2, proposed methodology discussed, Experimental investigations are given in section3 and conclusion is drawn in section4.

2. METHODOLOGY

In this method LBP of the facial image is computed and central lbp value based texel are determined, and then shape patterns are evaluated, is explained in the following sections.

Step -1: Color image to Gray Image conversion

The original colour image is converted into a grey level image using RGB color quantization method.

Step-2: Local Binary Pattern

The LBP is computed on the image for obtaining local neighborhood information of pixels [18]. The computation of LBP with an example is illustrated in figure1. A 3×3 neighborhood consists of a set of nine elements, P = $\{p_c, p_0, p_1, \ldots, p_7\}$, where p_c represents the gray level value of the central pixel and p_i $(0 \le i \le 7)$ represent the gray level values of neighbor pixels. Each 3×3 neighborhood then can be characterized by a set of binary values b_i $(0 \le i \le 7)$ as given in equation1.

$$b_i = \begin{cases} 0 & \Delta p_i \ge 0 \\ 1 & \Delta p_i < 0 \end{cases} \tag{1}$$

where $\Delta p_i = p_i - p_c$.

For each 3×3 neighborhood, a unique LBP is derived from the equation2.

$$LBP_{P,R} = \sum_{i=0}^{i=7} b_i \times 2^i \tag{2}$$

Every pixel in an image generates an LBP code. A single LBP code represents local micro texture information around a pixel by an integer code in between 0 and 255.

p_0	p_1	p_2		b_0	b_1	b_2		2^0	2^1	2^2		
p_3	p_c	p_4	→	b_7		b_3	X	2^7		2^3	→	LBP
p_5	p_6	p_7		b_6	b_5	b_4		2^6	2^5	2^4		

95	50	76		1	0	1		1	2	4		
54	64	64	→	0		1	X	128		8	→	45
49	89	43		0	1	0		64	32	16		

Fig. 1: Computation of LBP.

Step-3: Computing Central Local Binary Pattern Value Flooding Matrix (CLBPVFM)

The central local binary pattern value flooding forms a group of LBP values which have the LBP value as the central LBP over the 3x3 neighborhood. In the 3x3 neighborhood, for all the neighbors which have the same LBP value as the center pixel, then these values are kept unchanged otherwise, it is set to zero. The 3x3 block obtained from this process is called a central lbp value flooding. The CLBPVFM is computed over the whole image is described as follows.

(1) Central lbp value floodings I1(x,y), I2(x,y), I3(x,y) and I4(x,y) are computed starting from position (1,1), (1,2), (2,1) and (2,2) respectively with 3x3 block from left-to-right and top-to-bottom throughout LBP image I(m,n) with a step-length of three along both horizontal and vertical directions.

(2) The final Central Local Binary Pattern Value Flooding Matrix, denoted by CLBPVFM (x,y) is computed using equation 3.

CLBPVFM (x,y) = p (3)

Where p is avg (or) avg_g

avg= (I1(x,y) +I2(x,y)+ I3(x,y)+ I4(x,y)) /r , r is the number of non-zero intensity values .

avg_g = a value which is just greater than avg and equal to one of four intensity values I1(x,y), I2(x,y), I3(x,y) and I4(x,y) at position (x,y).

An example of central pixel flooding matrix detection is shown in Fig.2.

8	7	8
8	8	4
5	8	9

(a) 3x3 block with gray values

8	0	8
8	8	0
0	8	0

(b) Central lbp value flood

5	5	7	9	2	3	8
4	6	9	1	8	8	8
3	3	6	1	3	4	4
8	5	5	3	1	6	4
5	8	9	5	1	4	4
4	8	9	9	5	4	6
8	9	5	3	5	4	4

(c) 7x7 Image block

0	0	0	0	0	0	0
0	6	0	0	8	8	0
0	0	6	0	0	0	0
8	0	0	0	1	0	0
0	8	0	0	1	0	0
0	8	0	0	0	0	0
0	0	0	0	0	0	0

(d) I1(x,y)

0	0	0	9	0	0	8
0	0	9	0	8	8	8
0	0	0	0	0	0	0
0	0	0	0	1	0	4
0	0	9	0	1	4	4
0	0	9	9	0	4	0
0	0	0	0	0	0	0

(e) I2(x,y)

0	0	0	0	0	0	0
0	0	0	0	0	0	0
3	3	0	0	3	0	0
0	0	0	3	0	0	0
0	8	0	5	0	0	0
0	8	0	0	5	0	0
8	0	0	0	5	0	0

(f) I3(x,y)

0	0	0	0	0	0	0
0	6	0	0	0	0	0
0	0	6	0	0	4	4
0	0	0	0	0	0	4
0	0	9	0	0	4	4
0	0	9	9	0	4	0
0	0	0	0	0	4	4

(g) I4(x,y)

0	0	0	9	0	0	8
0	6	9	0	8	8	0
3	3	6	0	0	4	4
8	0	0	3	1	0	4
0	8	9	5	1	4	4
0	8	9	9	5	4	0
8	0	0	0	5	4	4

(h) Central Local Binary Pattern Value Flooding Matrix

Fig.2. Detection of Central pixel flood matrix

Step 4: Evaluation of Matrix Shape Patterns

The shape patterns on 3x3 block are defined as follows. In lower triangular matrix pattern, nonzero elements occur on principal diagonal and below this diagonal. In upper triangular matrix pattern, nonzero elements occur on principal diagonal and above this diagonal. In tri diagonal matrix pattern, nonzero elements occur on principal diagonal, below and above this diagonal. These patterns are shown in Fig.3. The count of these shape patterns are computed on CLBPVFM.

N	0	0
N	N	0
N	N	N

N	N	N
0	N	N
0	0	N

N	N	0
N	N	N
0	N	N

(a) (b) (c)

Fig 3: a) Lower Triangular Matrix Pattern (LTMP) b) Upper Triangular Matrix Pattern (UTMP)

c) Tri Diagonal Matrix Pattern(TDMP) , where N is a nonzero element

3. RESULTS AND DISCUSSIONS

The proposed method established a database of the 1002 face images collected from FG-NET database and other 600 images collected from the scanned photographs and sample of these images are shown in Fig.4. In this method, images are classified into two groups as a child (upto 18 years) and adult (above 18 years) based on count of shape patterns. The count of each shape patterns i.e. LTMPC, UTMPC, and TDMPC on CLBPVFM are evaluated on facial images and the results for a sample of 20 images is listed out in table1.

From the table1 it is observed that LTMPC and UTMPC are dominant patterns and TDMPC patterns are not dominant patterns as these are zero for age varying images. So LTMPC and UTMPC can be considered for age classification. The algorithm1 is proposed to classify images adult and child groups.

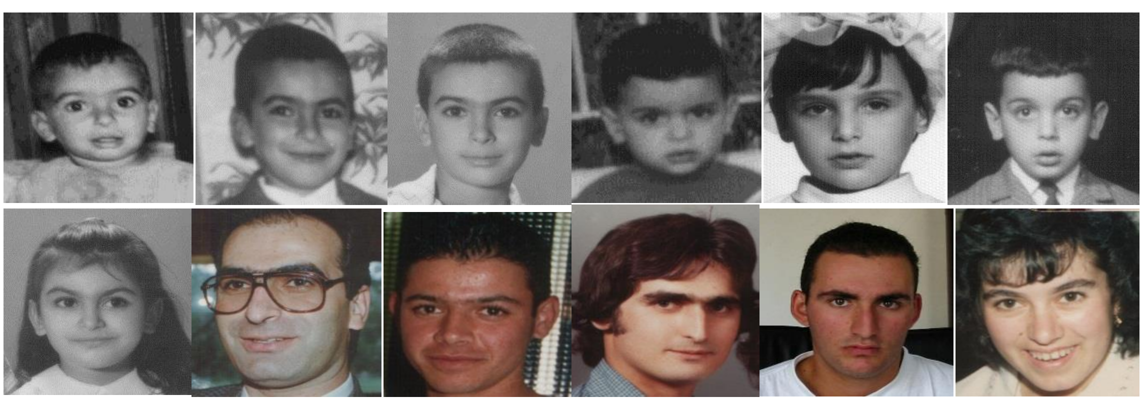

Fig 4: Sample images from FG-NET Database

Table 1. The count of LTMP, UTMP, TDMP patterns

IMAGE	LTMPC	UTMPC	TDMPC
001A33	22524	22495	0
002A36	12777	12852	0
007A22	12895	12867	0
007A45	9424	9490	0
008A35	12641	12426	0
011A40	26134	26210	0
013A25	17809	17757	0
013A34	18214	18066	0
016A19	18351	18421	0
025A22	16898	16934	0
025A39	23695	23719	0
027A20	18364	18402	0
027A41	16901	16851	0
029A29	12895	12905	0
029A31	14342	14138	0
030A26	17015	16969	0
035A21	20847	20824	0
036A20	14747	14837	0
037A19	16834	16739	0
001A05	10096	10033	0
001A08	13559	13538	0
001A14	7685	7550	0

Algorithm 1: Age classification using count of LTMP, UTMP, TDMP on CPFM

Let LTMPC, UTMPC, and TDMPC be count of LTMP, UTMP and TDMP patterns

Begin

If (((LTMPC>17044)&&(LTMPC<7288))&&((UTMPC>17055)&&(UTMPC<7249)))

{

Write('Child Image');

}

Else

{

Write('Adult Image');

}

End

The algorithm1 classified the FG-Net facial images into two groups with 97.2% correct classification rate. The proposed method for age grouping is compared with the existing methods, Age classification with shape features on lbp based texton by P Chandra Sekhar Reddy et.al.[19] and Child and adulthood classification with geometrical features by Chandra Mohan et.al.[20]. The comparison table for proposed and existing methods with the percentage of classification rate is listed in table2. The results indicate that the proposed scheme outperforms with other methods.

Table 2: Comparison of the proposed LUTM patterns on CLBPVFM with other methods.

S.no	Authors	Name of the method	% of Classification Rate	Category of age classification
1	Proposed method	LUTM patterns on - CLBPVFM	97.2	Child and Adulthood
2	P Chandra Sekhar Reddy et.al.[19]	Shape features on IT-LBP	95	Child and Adulthood
4	Chandra Mohan et.al.[20]	Geometrical features for Child and Adulthood Classification	94.5	Child and Adulthood

4. CONCLUSION

The present paper evaluated shape patterns on a 3x3 mask using CLBPVFM. The age changing in images is identified with count of LTMP, UTMP. This is a new method for identifying variation of skin wrinkles in facial images of age varying people with shape patterns. So classification algorithm uses only these two shape pattern features. The percentage of classification rate is 97.2% and this is good classification rate from table2. The proposed method for age classification is easy to implement and also efficient compared to other schemes. The CLBPVFM with new shape patterns can be extended in future work.

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