

# Age Classification with Co-Occurrence Features on LBP Based Texton Matrix

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**ABSTRACT:** Age classification from facial images is increasingly receiving attention in computer vision applications. To address this classification problem, the present paper proposes a method, computes the local binary pattern on the image and Texton matrix on this LBP image is represented and then Co-occurrence features are evaluated. The age varying of persons is observed with these features. The proposed method is experimented on facial image datasets FG-Net and other scanned images. The experimental results indicate that proposed method outperforms with other existing methods.

**KEYWORDS:** Age classification, LBP, Texton, Co-occurrence features

## I. INTRODUCTION

A human facial image comprises information, and it can be used in various applications like face recognition, age group classification, gender recognition, and facial expression classification. As an important attribute of face, age classification has attracted much attention in computer vision applications like Human Computer Interaction, electronic customer relationship management, surveillance monitoring and so on. Various age group classification methods are implemented to classify facial images. Wen-Bing Horng, Cheng-Ping Lee and Chun-Wen Chen et al. [1] considered four age groups for classification, including babies, young adults, middle-aged adults, and old adults. Kwon et al. [2] implemented age classification on facial images based on cranio-facial development theory and skin wrinkle analysis in which only three age-groups babies, young adults, and senior adults. Classification into two age groups i.e. babies and adults [3], two age groups 20-39 and 40-49 [4]. In addition to this classification of facial images based on sex [4, 5] are also implemented. Age classification implemented by reducing the image dimensionality and classified the human age into five categories [6]. Various age classification methods based on LBP are also proposed [7, 8, 9]. The present paper attempted to classify the age groups into two categories based on Co-occurrence features extracted on integrated LBP and Texton of the facial image. The present paper is organized as follows. The section II presents the proposed methodology, section III covers results and discussions and conclusion is drawn in section IV.

## II. METHODOLOGY

In this proposed method the color image is converted to gray image, on this image the Local Binary Pattern (LBP) is computed and then Texton matrix is formed and Co-occurrence matrix features are evaluated for age classification. This method is explained in the following sub sections in detail.

### Step-1: Local Binary Pattern

The LBP is computed on the image for obtaining local neighborhood information of pixels [10]. The computation of LBP is illustrated in figure 1. A 3×3 neighborhood consists of a set of nine elements,  $P = \{p_c, p_0, p_1, \dots, p_7\}$ , where  $p_c$  represents the gray level value of the central pixel and  $p_i$  ( $0 \leq i \leq 7$ ) represent the gray level values of neighbor pixels. Each 3×3 neighborhood then can be characterized by a set of binary values  $b_i$  ( $0 \leq i \leq 7$ ) as given in equation 1. For each 3×3 neighborhood, a unique LBP is derived from the equation 2.

$$b_i = \begin{cases} 0 & \Delta p_i < 0 \\ 1 & \Delta p_i \geq 0 \end{cases} \quad \text{Where } \Delta p_i = p_i - p_c \quad (1)$$
$$LBP_{P,R} = \sum_{i=0}^{i=7} b_i \times 2^i \quad (2)$$

For each pixel in the image LBP code is generated. A single LBP code represents, locally how neighborhood pixels are varying with reference to central pixel by an integer code in between 0 and 255.

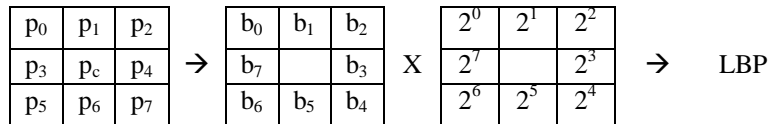


Fig. 2: Computation of LBP.

**Step-2: Texton detection**

The term ‘‘texton’’ is conceptually proposed by Julesz [11]. Textons are defined which are having a close relationship with image features and local distribution. Textons are considered as texture primitives which are located with certain placement rules. The textons are defined as a set of blobs or emergent patterns or shape features sharing a common property all over the image [11, 12]. The four types of textons on a 2x2 grid as shown in figure 3. In figure 3 the four pixels of a 2x2 grid are denoted as V<sub>1</sub>, V<sub>2</sub>, V<sub>3</sub> and V<sub>4</sub>. If two pixels are highlighted in gray color of same value, the grid will form a binary 1 texton otherwise a binary 0 texton. The four texton types used in the proposed method are denoted as T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> respectively as shown in figure 3. The process of texton detection is illustrated in figure 4.

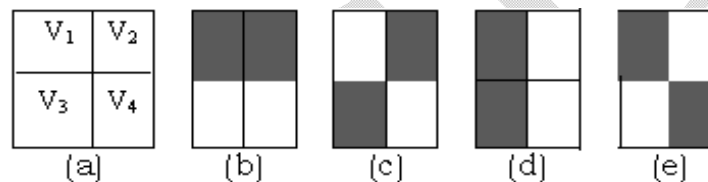


Fig. 3: Four special types of Textons: (a) 2x2 grid (b) T<sub>1</sub> (c) T<sub>2</sub> (d) T<sub>3</sub> and (e) T<sub>4</sub>

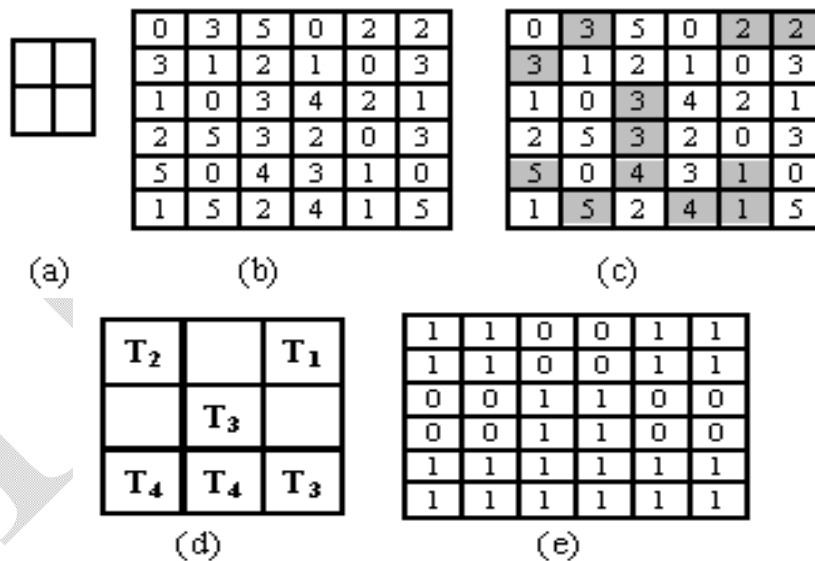


Fig. 4: Illustration of the Texton detection process: (a) 2x2 grid (b) Original facial image (c) & (d) Texton location and Texton types (e) Texton image of the face.

**Step 3: Evaluation of Co-occurrence Features on LBP based TextonMatrix (LBPTM)**

Grey level co-occurrence matrices (GLCM) introduced by Haralick attempt to describe texture by statistically sampling how certain grey levels occur in relation to other grey levels [13]. The present method evaluates the feature set contrast, correlation, energy, and, local homogeneity on reduced local information LBPTM. These features are computed using the equations 3 to 6 on LBPTM in four directions 0°, 45°, 90° and 135° age classification.

$$\text{contrast} = \sum_{i,j=0}^{N-1} -\ln(P_{ij})P_{ij} \quad (3) \quad \text{Energy} = \sum_{i,j=0}^{N-1} -\ln(P_{ij})^2 \quad (4)$$

$$\text{Local Homogeneity} = \sum_{i,j=0}^{N-1} \frac{P_{ij}}{1 + (i-j)^2} \quad (5) \quad \text{Correlation} = \sum_{i,j=0}^{N-1} P_{ij} \frac{(i-\mu)(j-\mu)}{\sigma^2} \quad (6)$$

**II. RESULTS AND DISCUSSIONS**

The proposed method LBPTM with Co-occurrence features is applied for the classification of human faces into adult and child groups. This method established a database of the 1002 face images collected from FG-NET database and other 600 images collected from the scanned photographs. Sample images are shown in figure 5.



Fig. 5: Sample images from FG-NET Database

The Co-occurrence features contrast, correlation, energy and homogeneity are extracted on LBP based TextonMatrix of considered database images. Tables 1, 2, 3 and 4 represent the derived four features in four directions with 0° 45°, 90° and 135° orientation of LBPTM on 5 facial images. The average of these features in four directions are shown in Table 5 for ten images. The average of Co-occurrence features in four directions are used as feature vector for age classification. Algorithm1 is proposed with this feature vector on LBPTM. This algorithm is tested on considered facial image data base and has shown 96% successful classification rate.

Table 1: Co-occurrence Features on LBPTM 0° of facial images.

S.no	Image name	Contrast	Correlation	Energy	Homogeneity
1	001a02	7.3834	0.5707	0.5210	0.8682
2	002A05	8.3390	0.6473	0.3763	0.8511
3	002A12	7.9694	0.6186	0.4374	0.8577
4	007A22	9.4064	0.5708	0.3976	0.8320
5	001A33	9.9538	0.5701	0.3656	0.8223

Table 2: Co-occurrence Features on LBPTM 45° of facial images.

S.no	Image name	Contrast	Correlation	Energy	Homogeneity
1	001a02	11.3494	0.3393	0.4714	0.7973
2	002A05	12.8595	0.4560	0.3240	0.7704
3	002A12	12.2408	0.4146	0.3859	0.7814
4	007A22	14.2566	0.3499	0.3461	0.7454
5	001A33	15.1867	0.3442	0.3135	0.7288

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Table 3: Co-occurrence Features onLBPTM 90° of facial images.

S.no	Image name	Contrast	Correlation	Energy	Homogeneity
1	001a02	7.0883	0.5870	0.5260	0.8734
2	002A05	8.3365	0.6473	0.3765	0.8511
3	002A12	7.9101	0.6219	0.4377	0.8587
4	007A22	8.9080	0.5935	0.4040	0.8409
5	001A33	9.5601	0.5872	0.3704	0.8293

Table 4: Co-occurrence Featureson LBPTM 135° of facial images.

S.no	Image name	Contrast	Correlation	Energy	Homogeneity
1	001a02	11.3052	0.3419	0.4719	0.7981
2	002A05	12.8971	0.4544	0.3237	0.7697
3	002A12	12.2107	0.4160	0.3862	0.7820
4	007A22	14.2147	0.3518	0.3465	0.7462
5	001A33	15.2177	0.3429	0.3133	0.7283

Table 5: Average of Co-occurrence Featureson LBPTM 0-135° of facial images.

S.no	Image name	Avg_Contrast	Avg_Correlation	Avg_Energy	Avg_Homogeneity
1	001a02	9.2816	0.4597	0.4976	0.8343
2	002A03	11.2696	0.4761	0.3863	0.7988
3	002A05	10.6080	0.5512	0.3501	0.8106
4	002A07	11.3036	0.4833	0.3784	0.7981
5	002A12	10.0828	0.5178	0.4118	0.8200
6	008A03	10.6409	0.4483	0.4387	0.8100
7	011A02	8.0588	0.4559	0.5616	0.8561
8	001A33	12.4796	0.4611	0.3407	0.7772
9	007A22	11.6964	0.4665	0.3736	0.7911
10	007A45	13.5123	0.4484	0.3038	0.7587

**Algorithm1:**Classification algorithm with Avg\_Contrast, Avg\_Energy, and Avg\_Homogeneity features.

**Begin**

```
If((Avg_Contrast >8.0588 && Avg_Contrast <11.2696) && (Avg_Energy >0.3501 && Avg_Energy <0.5616) &&
(Avg_Homogeneity <0.7988 && Avg_Homogeneity >0.8561))
```

```
{
Write ('Child Image');
}
```

```
Else
```

```
{
Write ('Adult Image');
}
```

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}

**End**

The proposed algorithm classified the Image database into two groups adult and child with 96% correct classification rate. This method for age classification is compared with other existing methods. Age classification with shape features on lbp based texton by P. Chandra Sekhar Reddy et al. [9]. Child and adulthood classification with geometrical features by Chandra Mohan et al. [14] and other age classification methods Young H.Kwon et al. [2], Tsuneo Kanno et al. [15] and Wen-Bing Horng Cheng et.al. [1]. In Table 6, the percentage of classification of proposed method and other existing methods are shown.

Table 6: Comparison of the proposed method with other methods.

S.no	Authors	Name of the method	% of Classification Rate	Category of age classification
1	Proposed method	LBPTM with Co-occurrence features	96	Child and Adulthood
2	P. Chandra Sekhar Reddy et.al.[9]	Shape features on IT-LBP	95	Child and Adulthood
4	Chandra Mohan et.al.[14]	Child and Adulthood Classification based on Geometrical Features	94.5	Child and Adulthood
3	Young H. Kwon et.al.[2]	Age classification from facial images	78	Babies, adults, and Senior adults.
4	Tsuneo Kanno et al.[15]	Classification of age group based on facial images of young males by using neural networks	80	Only young males are age groups considered for classifications are 12,15,18 and 22 years
5	Wen-Bing Horng Cheng et.al.[1]	Classification of age groups based on facial features	90.52	Babies, young adults, middle-aged adults, and old adults

## IV.CONCLUSION

The present paper considers LBP of facial images and then textural information is computed as textons. Co-occurrence features on this LBP based Texton matrix are evaluated. The age variation i.e. wrinkles on facial image is identified with these features. The proposed classification algorithm classified with 96% classification rate. This method is easy to implement and also efficient compared to other schemes. Integrated LBP and Textons with other textural properties can be extended in future work.

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