HUMAN AGE ESTIMATION

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ABSTRACT

Estimating the age is used for identifying the age based on thresholding classification using global and local features for surveillance monitoring and finding the lost children. Several problems will be considered for identifying the age such as gender classification, facial expression and selection of age progression which causes error in selecting the features in the image for identifying the age correctly. In this work, the effects of gender and facial expression on age estimation using thresholding method are investigated. Our work follows three ways for measuring the Features. First, the accuracies of age estimation using a single-level local binary pattern (LBP) and a multilevel LBP (MLBP) are compared. Second, we compare the accuracies of age estimation using global features extracted by MLBP, local features extracted by Gabor filtering, and third the combination of the two methods and compare the results of feature extraction with three different methods are compared and analyzed

Keyword: *Global and Local Features, Gabor Filter, LBP, MLBP*

1. INTRODUCTION

Human faces, as important visual cues, convey a significant amount of nonverbal information to facilitate the real-world human-to-human communication. As a result, the modern intelligent systems are expected to have the capability to accurately recognize and interpret human faces in real time. Facial attributes, such as identity, age, gender, expression, and ethnic origin, play a crucial role in real facial image analysis applications including multimedia communication, human computer interaction (HCI), and security [1]. Although automatic image-based age estimation is an important technique involved in many real world applications, it is still a challenging problem to estimate human ages from face images. The aging process is determined by not only the person's gene but also many external factors, such as health, living location, and living style. Males and females may also age differently.

2. LITERATURE SURVEY

Another approach to age estimation is non-AAM- based methods. Choi et al. used the high frequency components of selected skin regions for age estimation [2]. In this study, the high frequency components are measured by using high-pass filters, such as a Sobel filter, image differences between an original and its smoothed images, an ideal high-pass filter (IHPF), a Gaussian high-pass filter (GHPF), and wavelet transforms. The work in [1] used the local binary pattern (LBP) operator to extract age features from skin regions of a face. Although these approaches can be used for age estimation, they still have limitations. The estimation performance of the work in [2] is strongly dependent on the method of choosing skin regions (where the frequency components are extracted), which are determined by the facial feature points. The performance enhancement of the work in [1] is limited by the use of a single-level LBP operator. To overcome this problem, the work in [3] proposed an age estimation method based on a multilevel LBP (MLBP) and support vector regression (SVR). However, they did not consider the local features for age estimation.

Based on human perception, we can see that there are some differences between men and women in terms of producing facial age features. For example, an adult man can have a beard and rough skin surface, whereas

a woman does not have a beard and tends to have smoother ski compared to a man. This suggests that gender can have effects on age estimation. In previous studies, gender is recognized by voice, 3D body shape, or face image. In different ways, they show that gender recognition accuracy is affected by age.

Most of previous researches did not consider the effect of facial expression and gender on the age estimation system. Considering the limitations of previous research, we propose a new age estimation method. In addition, the effects of gender and facial expression on age estimation are investigated. The accuracies of age estimation using LBP and MLBP are compared, and MLBP shows better performance as the extractor of texture features globally. In addition, we compare the accuracies of age estimation using global features extracted by MLBP, local features extracted by Gabor filtering, and the combination of the two methods. Results showed that the third approach is superior. In addition, the accuracies of age estimation with and without pre-classification of facial expression and gender are compared. We implemented an enhanced age estimator compared to that of [3], and the novelties of our research (as shown in Abstract) are different from those in [3].

3. DESIGN METHODOLOGY

An overview of our age estimation system, which considers the effects of gender and/or facial expression, is depicted in Figure 1. For the preprocessing step, the face and eye positions are first detected from the input image using adaptive boosting (AdaBoost) method [3, 4]. Then, our system conducts in-plane rotation to align the face based on the detected positions of the two eyes [3].

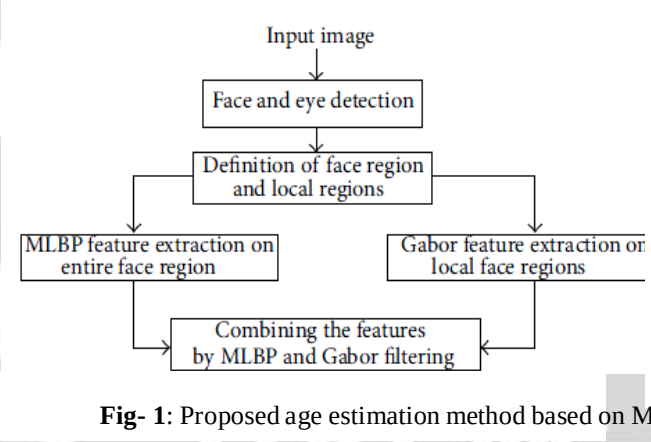

Fig- 1: Proposed age estimation method based on MLBP, Gabor

As shown in Fig 1, to consider the effects of gender or facial expression on age estimation, pre-classification of gender/facial expression is conducted before age estimation. The gender or facial expression pre-classification procedure allows us to deal with each gender (male and female) and facial expression (neutral, happy, surprised, and the like) separately for age estimation. In our research, the automatic gender and facial expression recognition algorithm is not implemented but is left for future work. For the initial research, we divide the experimental data manually according to gender and facial expression to measure the effects of gender or facial expression on age estimation. In our experiments, we compared the accuracies of age estimation without pre-classification of gender and facial expression, with pre-classification of gender, and with pre-classification of facial expression

3.1 Face Detection and In-Plane Rotation Compensation:

Typically, an input facial image contains both the facial and background regions. Therefore, the first step of the age estimation system is to localize the facial region in The input image. There have been many previous studies of face detection [5,7], and we use the AdaBoost method [3,4]. With AdaBoost, the facial region and the positions of the eyes could be detected efficiently by constructing a strong facial classifier from several weak facial classifiers. In the actual system, there typically exists an in-plane face rotation in the captured image, which degrades the performance of the age estimation system.

3.2 Age Estimation Based on MLBP, Gabor Filter

There have been many previous studies of local texture analysis [1]. In previous researches, the LBP has been successfully used for facial expression recognition, age estimation, and pattern recognition. However, those studies used only the single level for LBP instead of multilevel for LBP [7, 1]. Therefore, in our proposed method, the MLBP is used to create stronger descriptor for age estimation.

Along with global features extracted using MLBP, the proposed method also extracts local features for age estimation. The wrinkle feature is a very important feature appearing locally on the human face [7,9]. Therefore, in our method, the wrinkle feature is used as a local feature for enhancing the age estimation result. For this purpose, we use Gabor filtering [7].

3.3 Global Feature Extraction Using MLBP

LBP is a powerful method for describing image texture by thresholding the surrounding pixels with a center pixel [7, 1,3]. The LBP method has been widely used in many researches such as age estimation [7,1,3], gender recognition, finger vein recognition, facial expression recognition, and face recognition. The main advantage of LBP method is that it offers the texture descriptor robustness to the variations of illumination and rotation. Besides, the fast processing can be done by LBP method.

4. RESULTS

To measure the accuracy of our age estimation system, we chose the mean absolute error (MAE), widely used in previous research and shown in. It can be inferred that the smaller MAE value indicates better age estimation performance. To measure the performance of our age estimation system, we performed 2-fold cross-validation. In each experiment we randomly divide the entire database into two parts: learning and testing databases. The PAL aging database has been widely used for age estimation in previous researches.

However, this database does not provide the identity information. Instead, only the information face, gender, age, and facial expression is associated with the name of image. Without the identity information, it is very difficult to separate the dataset into two parts containing different individuals. Therefore, we randomly divided the database into learning and testing twice in order to perform the experiments based on 2-fold cross-validation. All the parameters with kernels are trained with the learning database, and the MAE is measured with the testing database. In the second trial, the learning and testing databases are again determined randomly, and the procedure is repeated. From this procedure, two MAEs are obtained, with the average value of the two MAEs the final MAE. The final MAE. For the first experiment, we compared the accuracies of our age estimation system based on single-level LBP and MLBP. For the experiments, the LBP accuracies with various R values (in the range of 1 to 5) and P values (8, 12, and 16) were compared. As shown in Figure 3.4, the extracted texture features by LBP operator are different according to various values of and. In order to obtain the optimal values of and (with which, the MAE of age estimation is minimized), we performed the experiments with the various values of and. In addition, we compared the accuracies of using a rectangular or square shape for each subblock, according to the various numbers of subblocks.

As shown in Table 1, the MLBP-based method outperforms the LBP based method, and we used the MLBP based method for our age estimation system. In the next experiment, we compared the MAEs using only MLBP, only Gabor filtering, and the proposed method combining the two. In addition, we compared the MAE using the proposed method to that obtained in previous researches. In Table 2, the method using only MLBP with square block division is from. The extracted LBP feature vectors can be different according to the shapes of each subblock, which can affect the accuracy of age estimation. So, we measured the MAEs according to the shapes of each subblock.

The rectangular block means that the height and width of the subblock are different whereas the squared one indicates that the height and width of the sub block are the same. As shown in Table 2, the accuracy using the proposed method is higher than that in the other cases and in previous research.

Table 1: Comparisons of MAEs of MLBP method to those of single- level LBP method (unit: years old)

Database and shape of subblock	Single-level LBP	MLBP
Testing database 1		
Rectangular block division	6.981	6.351
Squared block division	7.125	6.536
Testing database 2		
Rectangular block division	7.531	7.322
Squared block division	7.345	6.625
Average MAE		
Rectangular block division	7.256	6.837
Squared block division [13]	7.235	**6.581**

Table 2: The comparison of MAE using MLBP,only Gabor filtering , and proposed method combining the two methods (unit:years old)

Whole PAL database	Using only MLBP	Using only Gabor filtering	Proposed method
Testing database 1			
Rectangular block division	6.351	11.774	6.247
Squared block division	6.536		6.513
Testing database 2			
Rectangular block division	7.322	12.042	7.176
Squared block division	6.625		6.542
Average MAE			
Rectangular block division	6.837	11.908	6.712
Squared block division	6.581		**6.528**
Previous research [9]		8.44	
Previous research [13]		6.581	

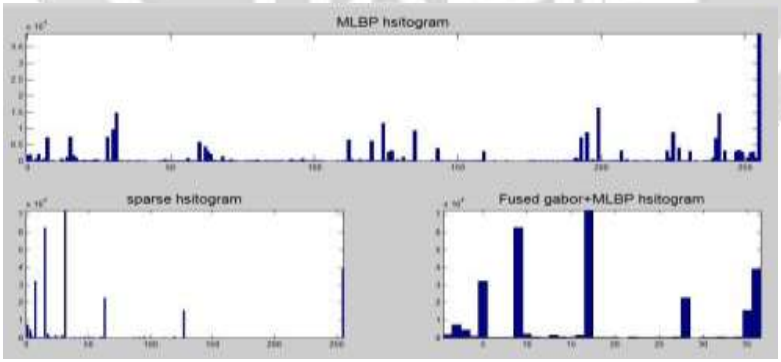

Fig 3- Above shows the various histograms for the proposed human age estimation methods

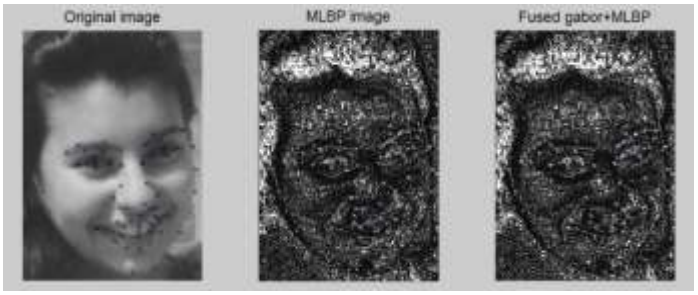

Fig 4- Above shows the original image, MLBP image and the fused gabor + MLBP image

5. CONCLUSION

In this paper, we proposed a new age estimation method based on a combination of MLBP, Gabor filtering. The experimental results showed that the proposed age estimation method outperforms previous methods by producing a better estimation result. Using the proposed age estimation method, we investigated the effects of gender and facial expression on estimation performance. We confirmed that gender and facial expression affect age estimation only if the system can be trained adequately with a large number of images. In future work, we plan to enhance the age estimation performance of our method using the scheme of assigning adaptive weights to MLBP features of each sub block based on neural networks or fuzzy systems. In addition, other effects of race, image resolution, and focusing condition on the performance of age estimation will be studied.

6. REFERENCES (Font-11, Bold)

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