Age estimation using facial images

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Abstract - **In recent years, automatic facial age estimation has gained popularity due to its numerous applications. Age estimation has already found its application in cigarette vending machine, age specific shopping, Age-specific access control , law enforcement and in many other areas. However, age estimation accuracy is sensitive to the dataset used for training the model. Nevertheless, age estimation using facial images is often hindered by physical factors like illumination, face orientation, blurriness in image, lack of training samples and several other personalized and temporal reasons. Also, Data preprocessing plays a vital role for getting accurate results. We have preprocessed our data so as to label images as per age groups, remove outliers, separate out images with size less than 50x50 and eliminate images where in face cannot be detected. Having done that, we used Local binary patterns (LBP) for feature extraction. LBP is Illumination invariant i.e. even if we increase illumination, matrix values will increase relatively and will not the result much. Further, for feature classification we have used neural networks.**

Keywords— Facial age estimation, Haar cascading, Local binary patterns (LBP), Machine learning, Neural networks

I. INTRODUCTION

Human faces convey a significant amount of nonverbal information to facilitate the real-world human-to-human communication. As a result, modern technology has found several interesting applications relating to human face. Facial attributes, such as identity, age, gender, expression ,play a crucial role in facial image analysis applications.The basic goal of an age estimation algorithm is to map an image of a person's face into an estimate of their age.

For face detection we have used Haae cascading. Object Detection using Haar feature-based cascade classifiers is an effective object detection method proposed by Paul Viola and Michael Jones in their paper, "Rapid Object Detection using a Boosted Cascade of Simple Features" in 2001. The haar cascade approach has several advantages:

1) To handle the large databases haar cascade classifier is the best detector in terms of speed and reliability.

2) Even the image is affected by illumination, face detection results are more accurate using haar cascade classifier.

3) There is no restriction on wearing glasses.

For feature extraction we have used Local Binary patterns (LBP). Advantages of LBP are :

1. High discriminative power
2. Computational simplicity
3. Invariance to grayscale changes and
4. Good performance.

We have used LBP Features extracted using LBP are used for classification using neural networks.

Our contributions are summarised as follows:

1. We have made an attempt to estimate age using facial images.
2. As dataset plays a vital role in age estimation, we have tried to refine our data as much as we could. We started by labeling the images properly with proper age groups, removed outliers, separated out images with size less than 50x50 and eliminated images where in face cannot be detected. Having done that we could achieve a fine dataset reduced to 6,000+ images from initial 10,000+ images.
3. We have deployed Haar cascading for face detection. As mentioned above, Haar cascading has several advantages in terms of speed, reliability and accuracy and so we have used Haar for face detection.
4. We used LBP for feature extraction, which is known as one of the best performing features for describing the texture of images, is well suited for classification of facial images. The major motivation for using LBP feature extraction was that, it is illumination invariant.
5. For classifying features into various age groups, we have used Neural networks.

II. LITERATURE REVIEW

The earliest work on age estimation can be traced back to Kwon and Lobo [1].They categorised images into babies, young adults and senior adults, by the use of facial anthropometric features. Thereafter, various researchers extended the idea of using facial geometric features [2–4]. However, people have since realised that anthropometric features only encode the face shape. One of the earliest works

that took into account both shape and texture information of the face is that of Lanitis et al. [5], features extracted via AAMs, were regressed with ages using a quadratic model. Subspace-learning techniques have also been utilised in the literature, these include PCA, NPP (neighbourhood-preserving projections), locality preserving projection (LPP) and orthogonal LPP [6]. In the last decade, biologically inspired features (BIF) have been the most widely used feature extraction. Besides the problem of real age estimation, researchers now study apparent age estimation, which is aimed at answering the question of how old does a person look like in a given picture.

Many traditional methods manually extract features from facial images and use supervised learning methods such as SVM. In this approach, Ahonen et al.[7] have shown that the local binary pattern (LBP) feature, which is known as one of the best performing features for describing the texture of images, is well suited for classification of facial images. With this feature, supervised learning methods such as nearest neighbourhood (NN)[8] and SVM[9] have been combined for face recognition. In addition, there has been a study utilizing the LBP feature for age estimation[7].

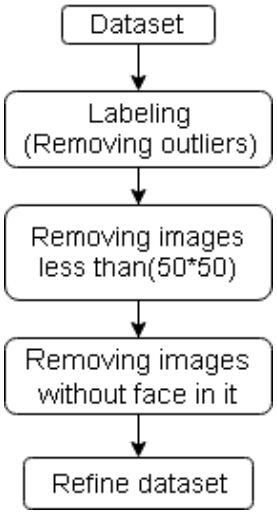
III. ALGORITHM

Step 1 : We have considered a data set of imdb images consisting of almost 10,000 images which are labelled

Challenges :

1. Few Images with multiple people in same image
2. Too small images
3. Uneven sized images
4. Different face position, orientation, illumination

Step 2: Performed preprocessing on the data set both manually and computationally, we reject images with less than 50 X 50 images also we consider images with the front facing and and ignore the completely side faced images , we reject the images which are blurred and we ultimately make a dataset of images considering of 3 classes.



Step 3 : Now we used haar cascading for Frontal Face detection from the image and it is resized in 150x150 size.

Step 4 : For feature extraction of the Frontal Face we used LBP (Local Binary Pattern), It gives a feature vector.

$$LBP_{R,P} = \sum_{p=0}^{P-1} s(g_p - g_C).2^p$$

Where,

p=0 neighborhood pixels

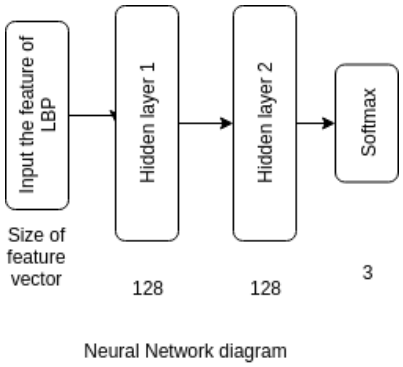
gp in each block is thresholded by its center pixel value gc

p → sampling points (e.g., p = 0, 1, …, 7 for a 3x3 cell, where P = 8)

R → radius (for 3x3 cell, it is 1).

Coordinates of "gc"is (0,0) and of "gp" is (x + Rcos(2π p/P), y − Rsin(2π p/P))

Step 5 : Feature vector are then classified by the Neural Network. Below is the Neural Network design



Neural Network diagram

IV. IMPORTANT RESULTS AND DISCUSSIONS

Data collection :

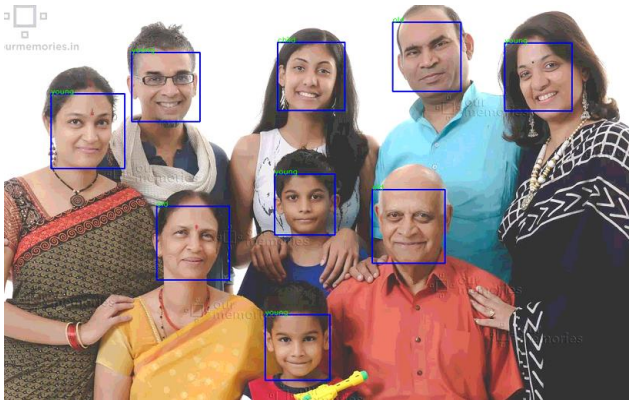
There are few famous databases for age estimation like - FG-NET, MORPH, and PCSO. These databases being paid ones, we couldn't access them. So we used data set available from : https://data.vision.ee.ethz.ch/cvl/rrothe/imdb-wiki/

Data preprocessing :

1. *Labeling of images as per Age*: Firstly, we labeled the images properly as per the age and stored them into respective folders (a folder was created for each age to store images belonging to those). We wrote a python code to split images.
2. *Select images*: We discarded images with size less than 50X50 using python coding.
3. *Face detection:* To discard images where in face cannot be detected, we carried out face detection of images and removed images where in it cannot be detected.

4. *Landmark detection:* To further refine data for better processing, we facial landmarking and discarded images where in it didn't work.

R (radius)	P (sampling points)	Length of feature vector	Training Loss	Training Accuracy
2	8	18	0.0543	0.9816
2	16	34	0.0696	0.9757
3	24	74	0.0978	0.9625



V. DISCUSSIONS

During this face recognition assignment we faced a few challenges.
The key ones are :

1. Improper data : The data we had was not proper as the image size of all samples were not equal. Some consisted of only face while some images were beyond face .
2. Data training : We had a problem while training the data due to improper data. Then we normalized data (divided eigen values by 100) and were able to train it.
3. Few images weren't labelled properly which at times created trouble.

VI. CONCLUSIONS

In this study of age estimation and classification from facial images, a 10,000 image data set was available ,we performed preprocessing of the data and transformed the data set suitable for training, then haar cascading was done in order to crop the facial region. Local binary pattern was applied in order to extract features from the facial region,which was further passed as parameters for training into the artificial neural networks which helped us to estimate the age and classify it into 3 categories viz. Child, Young and Adult. As per the training and testing of the model the accuracy obtained is 70% till now. Futher this accuracy can be improved with the increase in back propagation for in the neural nets also the increase in the number of features can benefit the accuracy.

VII. REFERENCES

[1] Kwon, Y.H., Lobo, V.: 'Age classification from facial images'. Proc. IEEE Conf. Computer Vision and Pattern Recognition (CVPR-94), 1994, pp. 762– 767

[2] Ramanathan, N., Chellappa, R.: 'Modeling age progression in young faces'. 2006 IEEE Computer Society Conf. on Computer Vision and Pattern Recognition, 2006, vol. 1, pp. 387–394

[3] Shen, C.T., Huang, F., Lu, W.H., et al.: '3D Age Progression Prediction in Children's Faces with a Small Exemplar-Image Set', Journal of Information Science and Engineering, 2014, 30, (4), pp. 1131–1148

[4] Gunay, A., Nabiyev, V.V.: 'Automatic detection of anthropometric features from facial images'. 2007 IEEE 15th Signal Processing and Communications Applications, 2007, pp. 1–4

[5] Lanitis, A., Taylor, C., Cootes, T.: 'Toward automatic simulation of aging effects on face images', IEEE Trans. Pattern Anal. Mach. Intell., 2002, 24, (4), pp. 442–455

[6] Fu, Y., Xu, Y., Huang, T.S.: 'Estimating human age by manifold analysis of face pictures and regression on aging features'. 2007 IEEE Int. Conf. on Multimedia and Expo, 2007, pp. 1383–1386

[7] Ahonen, Timo, Abdenour Hadid, and Matti Pietikainen. "Face description with local binary patterns: Application to face recognition." IEEE Transactions on Pattern Analysis and Machine Intelligence 28.12 (2006): 2037-2041.

[8]Ahonen, Timo, Abdenour Hadid, and Matti Pietik¨ainen. "Face recognition with local binary patterns." European Conference on Computer Vision. Springer, Berlin Heidelberg, 2004.

[9] Bartlett, Marian Stewart, et al. "Recognizing facial expression: Machine learning and application to spontaneous behavior." IEEE Computer Society Conference on Computer Vision and Pattern Recognition, 2005 (CVPR 2005). Vol. 2. IEEE, 2005.