Chapter 2

Literature Review

A literature review is a type of review article. A literature review is a type of review article. A literature review is a scholarly paper, which includes the current knowledge including substantive findings, as well as theoretical and methodological contributions to a particular topic. Literature reviews are secondary sources and do not report new or original experimental work. Most often associated with academic-oriented literature, such reviews are found in academic journals and are not to be confused with book reviews that may also appear in the same publication. Literature reviews are a basis for research in nearly every academic field. A narrow-scope literature review may be included as a part of a peer-reviewed journal article presenting new research, serving to situate the current study within the body of the relevant literature and to provide context for the reader.

An extensive review of the research undertaken in the domain related to face recognition along with the gender classification and facial age estimation from the face image.Every technical and IEEE papers have their own features which elaborate about particular technique with a certain methodology. It contains both advantages and drawbacks.

Reference Papers:

In paper [1] computer vision and pattern recognition systems play an important role in our lives by means of automated face detection, face and gesture recognition, and estimation of gender and age. This paper addresses the problem of gender classification using frontal facial images. Have developed gender classifiers with performance superior to existing gender classifiers. Experimented on 500 images (250 females and 250 males) randomly withdrawn from the FERET facial database.

Independent Component Analysis (ICA) is used to represent each image as a feature vector in a low dimensional subspace. Different classifiers are studied in this lower dimensional space. Our experimental results show the superior performance of our approach to the existing gender classifiers. Got a 96% accuracy using Support Vector Machine (SVM) in ICA space.

In paper [2] the problem of automatically recognizing human faces from frontal views with varying expression and illumination, as well as occlusion and disguise. It cast the recognition problem as one of classifying among multiple linear regression models and argue that new theory from sparse signal representation offers the key to addressing this problem. Based on a sparse representation computed by ‘1-minimization, we propose a general classification algorithm for (image-based) object recognitionThe theory of sparse representation helps predict how much occlusion the recognition algorithm can handle and how to choose the training images to maximize robustness to occlusion. We conduct extensive experiments on publicly available databases to verify the efficacy of the proposed algorithm and corroborate the above claims.

In paper [3], a fast and efficient gender and age estimation system based on facial images is developed. There are many methods have been proposed in the literature for the age estimation and gender classification. However, all of them have still disadvantage such as not complete reflection about face structure, face texture. This technique applies to both face alignment and recognition and significantly improves three aspects. First, we introduce shape description for face model. Second, the feature extraction phase, two geometric features are evaluated as the ratios of the distances between eyes, noses, and mouths. Finally, we classified the gender and age based on the association of two methods: geometric feature based method and Principal Component Analysis (PCA) method for improving the efficiency of facial feature extraction stage. The face database contains the 13 individual groups. Within a given database, all weight vectors of the persons within the same age group are averaged together. A range of an age estimation result is 15 to 70 years old, and divided into 13 classes with 5 years old range. Experimental results show that better gender classification and age estimation.

In paper [4] automatic face identification and verification from facial images attain good accuracy with large sets of training data while face attribute recognition from facial images still remain challengeable. We propose a methodology for automatic age and gender classification based on feature extraction from facial images, namely, primary and secondary features. Our methodology includes three main iterations: Preprocessing, Feature extraction and Classification. Our solution is able to classify images in different lighting conditions and different illumination conditions. Classification is done using

Artificial Neural Networks according to the different shape and texture variations of wrinkles on face images.

In paper [5] in order to improve shortage of Local Binary Pattern (LBP) algorithm in the field of facial feature extraction, this paper uses Local Directional Pattern (LDP) algorithm to extract the facial features about age estimation and gender classification. Because gradient information is more stable than gray information, LDP algorithm is not affected easily by noise. After preprocessing images, we use block strategy to represent facial features more fully. And then, we extract features of each block with LDP algorithm, storing the LDP histogram Finally, we obtain age and gender identification results by Support Vector Machine (SVM). Experimental results on FG-NET face database show that this method has a good effect on age estimation and gender classification.

In paper [6], over the recent years, a great deal of effort has been made to age estimation & gender recognization from face images. It has been reported that age can be accurately estimated under controlled environment such as frontal faces, no expression, and static lighting conditions. However, it is not straightforward to achieve the same accuracy level in real-world environment because of considerable variations in camera settings, facial poses, and illumination conditions. In this paper, we apply a recently-proposed machine learning technique called covariate shift adaptation to alleviating lighting condition change between laboratory and practical environment. Through real-world age estimation experiments, we demonstrate the usefulness of our proposed method.

In paper [7], Recognition of the most facial variations, such as identity, age and gender has been extensively studied. This paper concerns with providing a methodology to estimate age group and gender using face features. This process involves four stages: Pre-processing, Face Normalization, Feature Extraction and Classification. The geometric features of facial images like wrinkle geography, face angle, left eye to right eye distance, eye to nose distance, eye to chin distance and eye to lip distance are calculated. Based on the texture and shape information age classification is done. Age ranges are classified dynamically depending on number of groups using SVM classifier algorithm. This paper can be used for predicting future faces, classifying gender, and expression detection from facial images.

In paper [8] it concerns the estimation of facial attributes—namely, age and gender—from images of faces acquired in challenging, in the wild conditions. This problem has received far less attention than the related problem of face recognition, and in particular, has not enjoyed the same dramatic improvement in capabilities demonstrated by contemporary face recognition systems. Here, this problem is addressed by making the following contributions. First, in answer to one of the key problems of age estimation research—absence of data—a unique data set of face images, labelled for age and gender is offered, acquired by smart-phones and other mobile devices, and uploaded without manual filtering to online image repositories. The images in this collection are more challenging than those offered by other face-photo benchmarks. Second, a dropout-support vector machine approach is described used by this system for face attribute estimation, in order to avoid overfitting. Inorder to make classification of age using kNN more easy, texture features are extracted. Finally, a robust face alignment technique is presented, which explicitly considers the uncertainties of facial feature detectors.

In paper [9], data mining today is being used widely in diverse areas. For example: fraudulent systems, recommender systems, disease prediction, and numerous other applications. One such application is exploited in this article. This paper presents an approach to detect gender of a person through frontal facial image, using techniques of data mining and Delaunay triangulation. Gender prediction can prove to be a very useful technique in HCI (Human Computer Interaction) Systems. Classification, being a very power technique in data mining to group categorical data, is used here to classify a gender as either male, or female. Various classification algorithms such as Functional Trees, AdaBoost, J48, and few others are used to gauge the maximum accuracy. The model used in this paper is robust and attains accuracy level of 93.8283% along with relative scale invariance. Details of the prediction model and results are reported herein.

In paper[10] automatically predicting age group and gender from face images acquired in unconstrained conditions is an important and challenging task in many real-world applications. Nevertheless, the conventional methods with manually-designed features on in-the-wild benchmarks are unsatisfactory because of incompetency to tackle large variations in unconstrained images. This difficulty is alleviated to some degree through convolutional neural networks (CNN) for its powerful feature representation. In this paper, we propose a new CNN-based method for age group and gender estimation

leveraging residual networks of residual networks (RoR), which exhibits better optimization ability for age group and gender classification the another CNN architecture. Our experiments illustrate the effectiveness of RoR method for age and gender estimation in the wild, where it achieves better performance than other CNN methods. Finally, the RoR-152+IMDB-WIKI-101 with two mechanisms achieves new state-of-the-art results on Adience benchmark.

In paper [11] with the deep learning in different areas of success,beyond the other methods,set off a new wave of neural network development.The concept of deep learning originated from the artificial neural network,in essence,refers to a class of neural networks with deep structure of the effective training methods. As a powerful technology to realize artificial intelligence, deep learning has been widely used in handwriting digital recognition, dimension simplification, speech recognition, image comprehension, machine translation, protein structure prediction and emotion recognition. In this paper, we focus on the research hotspots of face recognition based on depth learning in the field of biometrics, combined with the relevant theory and methods of depth learning, face recognition technology, along the order of depth learning, based on the depth of learning face recognition, face recognition application to start research.

In paper [12] facial features are considered one of the important personal traits. This can be used in many applications, such as face recognition and age estimation. The value of these applications lies in several areas, such as security applications, law enforcement applications, and attendance systems. In addition, they are particularly useful in the finding of lost children. Present applications have achieved a high level of accuracy. However, a number of limitations, such as sunglasses, facial hair, aging, and illumination remain. This paper provides an up-to-date survey of face recognition and age estimation research. There are a number of objectives behind this survey research. Firstly, this paper aims to provide an up-to-date review of the existing literature and approaches, which are used facial recognition and age estimation. Secondly, the study aims to outline research challenges and forward recommendations for future research in the field of face detection and age estimation techniques.

Ref. No	Title of the paper	Author name	Techniques used
1	Gender Identification Using Frontal Facial Images	Amit Jain, Jeffrey Huang, and Shiaofen Fang	Cosine classifier, Linear Discriminant classifier(LDA), Support Vector Machine(SVM)
2	Robust Face Recognition via Sparse Representation	John Wright, Allen Y. Yang, Arvind Ganesh	Sparse feature selection method
3	Gender and age estimation based on facial images	Hlaing Htake Khaung TIN	Principle component analysis(PCA)
4	Facial Image Classification Based on Age and Gender	Thakshila R.Kalansuriya, Anuja T. Dharmaratne	Artificial Neural Network(ANN) classifier for age, LBP for gender classification
5	Age Estimation and Gender Classification of facial images based on local directional pattern	Min Hu, Yoana Zheng, Fuji Ren, He Jiang	Support Vector Machine(SVM) classifier, Local Directional Pattern(LDP)
6	Gender Recognization & Age Prediction	Mr. Raghvendra, Prof.Sandeep Sahu	covariate shift adaptation
7	Age Group Estimation and Gender Recognition Using Face Features	Prajakta A. Mélange, Dr. G. S. Sable	LBP, Matlab, SVM

8	Texture-based estimation of age and gender from wild conditions	Aswathy Unnikrishnan, Ajesh F, Dr. Jubilant J Kizhaketotam	Support Vector Machine (SVM), KNN
9	Gender Detection using Machine Learning Techniques and Delaunay Triangulation	Sarthak Gupta	data mining and Delaunay triangulation.
10	Age Group and Gender Estimation in the Wild With Deep RoR Architecture	Ke Zhang	RoR(residual networks of residual networks) architecture, IMDB-WIKI-101
11	Research on Face Recognition Based on Deep Learning	Xia Han, Qingdong Du	CNN, Linear encoder
12	Face Recognition and Age Estimation Implications of Changes in Facial Features: A Critical Review Study	Rasha Atallah, Amirrudin Kasim, Maizatul Akmar Ismail, Sherin Abdelrahman, Saber Zerdoumi	Support Vector Machine(SVM), Deep Convolutional Neural Network(CNN) model, Support Vector Regression (SVR)