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Identification of Gender from Facial Features

Prof. Khemutai Tighare, Prof. Rahul Bhandekar, Rashmi Kannake
M. Tech Department of Computer Science and Engineering, Wainganga College of Engineering and Management, Nagpur, Maharashtra, India

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ABSTRACT

Increasing population and changing lifestyle become a more confusing task for detecting gender from facial images. To solve such a fragile problem several handy approaches are readily available in computer vision. Although, very few of these approaches achieve good accuracy. The features like lightning, illumination, noise, ethnicity, and various facial expression hamper the correctness of the images. Keeping these things in mind, we propose our research work on the identification of gender from facial features. The major component of face recognition is to develop a machine learning model which will classify the images this can be done by haar-cascade-classifier. To train the model with images more accurately we would perform few image processing concepts for the data to perform data analysis and preprocessing for structuring our data. This can be done by OpenCV. After that, we have used PCA (Principle Comprehend Analysis) to compute Eigenvalues and for the optimal components, we will get the class name from the knowledge base and confidence score from the SVM-based face recognition model. In our project work, we get good accuracy.

Keywords: OpenCV, Principle Comprehend Analysis, Haar-Cascade-Classifier, Facial Features, Indentification Feature, Gender Identification

I. INTRODUCTION

The process of gender detection from facial features has become a difficult task nowadays. This research work become helpful in areas such as surveillance system, criminology, security, field of psychology and biometric authentication. A person's can be identified through his/her facial features like eyes, lips, nose, etc. although, these things can be identified by a human beings easily but not by machines without any intelligence. still, the world is becoming more machine dependent nowadays. so, it has become an important topic in the field of image processing and computer vision. Demand of face detection is increasing tremendously because of reliability in security and authentication process. Focusing on this problem, our aim is to develop a system which detects all the faces from a scene and performs the gender identification process on the faces from the scene. In order to detect gender we have focused on PCA, Haar-cascade-classifier and SVM based face recognition model.

II. RELATED WORK

Initial approaches to gender classifification involved using classififiers like linear discriminant classififier, cosine classififier, Support Vector Machines and Independent Component Analysis on images from the FERET facial database which includes 250 female images and 25 male images. Jain et al.[1] in 2005 fifirst used the cosine classififier to calculate the distance across two features stretched out on a hyper-sphere surface. SVM classifier was trained which speculate a hyper-plane separating the appropriate male and appropriate female features. The accuracy was best obtained around 96% in ICA Space.

Glomb et al.[2] has performed research work on gender classification using the SEXNET Network on a face data of 90 images. The researchers extracts charactristics from the entire face instead of extracting features from few facial points.Due to this he was able to achieve an accuracy of 91.9%.

Roope Raisamo and Erno Makinen[3] experimented gender classifification on automatically detected and aligned faces.There were four methods of automatic alignment and four methods to classify gender that were applied on the IMM dataset as well as the FERET dataset. Facial images were re-scale before or after they were oriented. There wasn't any significant contribution of Automatic Face Alignment Methods in improvement of classifification rate and the best accuracy actually lie on the image re-scaling. Input images of 36 x 36 pixel size passed through SVM classififier gives the best accuracy.

Tejas et al.[4] experimented gender classifification problem using discriminant functions over a dataset of 8112 images using techniques like PCA, LDA and SubClass Discriminant Analysis with images having contrast over illuminations, expressions, mirror pose and ethnicity. PCA test better than PCA integrate with LDA, PCA integrate with SVM and PCA combined with SDA. The research led to the conclusion that Linear Discriminant Functions are capable of descent generalization over a limited number of training samples and principle components and helped achieve a greater accuracy.

Samarasena Buchala et al.[5] performed with facial image properties such as age, gender and ethnicity. The author used PCA to conceal these properties and was able to classify them very well. He also observed that only the first few components of PCA were need to be encode the properties and to actually capture a major part

of the data variance. These few things also played a vital role in gender classifification. He also developed a comprehensive and feature based classifification of Faces. There were many algorithms like PCA, CCA,etc that were solicit on different parts of the face viz. eyes, mouth and full face. The PCA when compared to other methods gave 87.5% accuracy.

M. Nazir et al. [6] used the DCT Technique(Discrete Cosine Transformation). Euclidean distances were calculated to reveal the closest neighbours over the SUMS frontal images data-set. The accuracy obtained was 99.3% which was better than SVM where the ratio of train and test images were kept 50 to 50 for KNN Classififier.

Ziyi Xu et al. [7] fused global features and local features using hybrid techniques. they preprocessed the images using face normalization through the geometric alignment and gray level normalization. Adaboost algorithm was used to take out global features whereas AAM was used for basic features.

Ravi and Willson [8] performed conversion on RGB to a YCbCr image color space via an algorithm that detects the skin and facial images. To obtain facial features from RGB Images, they were alter into gray scale images. They offer an idea that face detection acts as a pre processing step for classifification and hence they combined the face detection with facial features and gender classifification for better accuracy. They have used SVM as a classififier where in features like mouth, eyes and lips are recognize on conversion of color images to gray scale images

whereas the area of skin is reconize on conversion of RGB to gray scale images.

Motivation

According to a research: "High level Feature-based" method uses a set of invidious facial features such as nose, distance between eyes, mouth, eye brow, etc. which are extracted from facial features as classification attributes. Even though this method mostly works well, it requires images in a controlled situation with proper lighting, good details and so forth which is its biggest limitation. Most of the real life images are not captured in a way suitable for this method. It also fails to work in situations where human eyes are not clearly visible, such as, an image of a male person who has prominent female attributes in his face or vice versa. Our primary motivation for this thesis has been to eliminate this limitation. This has been acknowledged by using PCA (Principle Comprehant Analysis) and SVM (support Vector Machine) method which, irrelevant of the quality of the image, would correctly assume the gender of the people in the picture.

III. Proposed work

Gender classifification can be treated as a binary class classifification problem. The Model that has been proposed aims to use implant vectors as features to predict the gender using various Machine Learning Models. The experiments in this proposed work have been carried out using Python Programming Language with the aid of the OpenCV and sklearn library using Jupyter Notebook as the simulation environment. These Embedding vectors are generated by
passing Facial Images through a pre-tained Facenet Model. Our proposed work is divided into three steps. First, faces from the inputed images are detected and cropped out. Second, the facial implant for each face are then calculated by passing it through a neural network. Third, treating these implants as feature vectors, these vectors are passed through various Machine Learning Models to predict gender. A brief architecture of all these stages are given below.

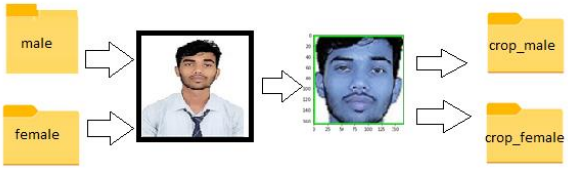

Fig.1-cropping the image

Preprocessing

Pre-processing involves cropping out faces from the first images, in order that there's no anomaly while calculating the embedding vector for those particular faces. This is done by finding the bounding boxes of all faces by applying through Face Detection Algorithms like haar-cascade-lassifier. , it is applied over each of the existing dataset's images and a new dataset is created that contains all these cropped images of faces.With Preprocessing,the noise interfering in the prediction of Facial Embeddings are eliminated.
The above diagram shows the data preprocessing method where the image is taken as an input from the dataset , in next step we have to convert that image into grayscale to image the purpose of converting our image into grayscale is to improve redablity of our image. Basically grayscale image is a two diamentional array which consist of all the parts of information that we require for our image processing.once our image get converted into the grayscale we need to apply it on Haar-Cascade-Classifier that will detect our object i.e. image that will help us to train our classifier. In order to crop our face we have to select the face area so, that we have to draw the rectangle on our image with the

help of both the x and y axis and with the help of widh and height of the image.

Feature Extraction

Feature extraction is a kind of the dimensionality reduction process, in which, an initial set of the raw data is divided and reduced to more manageable groups. In our extraction process we have Used PCA (principle Comprehant Analysis) to find out eigen faces. PCA may be a popular dimensionality reduction technique utilized in Machine Learning applications. PCA condenses information from an outsized set of variables into fewer variables by applying some kind of transformation onto them. The transformation is applied in such how that linearly correlated variables get transformed into uncorrelated variables. Correlation tells us that there's a redundancy of data and if this redundancy are often reduced, then information are often compressed. For example, if there are two variables within the variable set which are highly correlated, then, we aren't gaining any extra information by retaining both the variables because one are often nearly expressed because the linear combination of the opposite . In such cases, PCA convey the difference of the second variable onto the first variable by translation and rotation of original axes and projecting data onto new axes. The direction of projection is decided using eigenvalues and eigenvectors. So, the first few modified features (termed as Principal Components) are rich in information, whereas the last features contain mostly noise with negligible information in them. This transferability allows us to retain the first few principal components, thus reducing the amount of variables significantly with minimal loss of data . Practically, a picture can be a matrix of pixels whose brightness shows the reflectance of surface features within that pixel. The reflectivity value ranges from 0 to 255 for an 8-bit integer image. So the pixels with zero reflectivity would seem as black, pixels with value 255 appear as pure white and pixels with value in-between appear during a gray tone. The image pixel representation is show below,

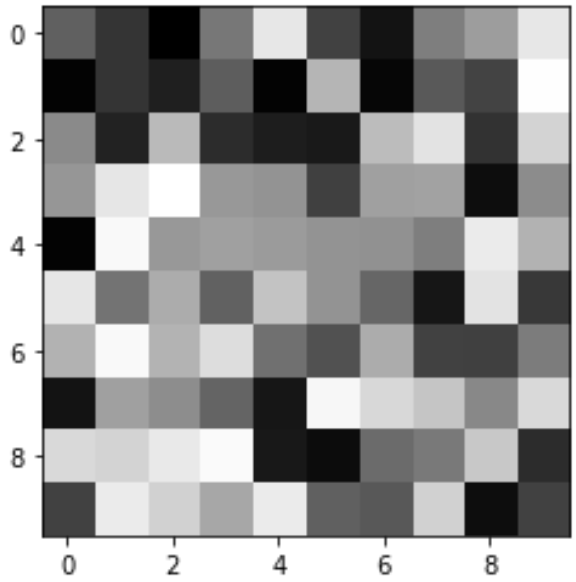

Fig.2- image pixel representation

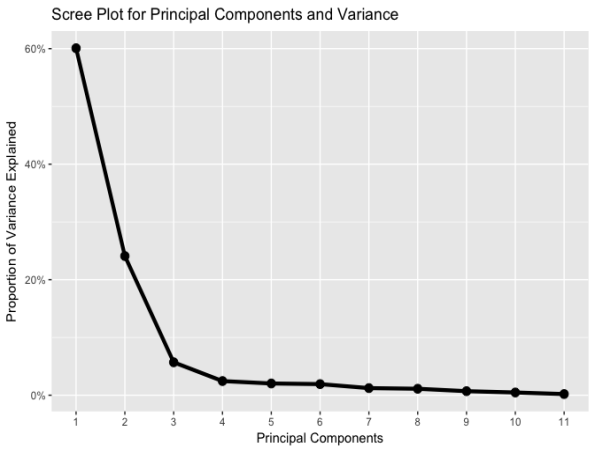

Fig.3-Explained varience ratio

Predicting gender probabilities by applying machine learning models

The last phase involves training of Machine Learning Models to classify gender on the idea of the respective facial embeddings generated for every face. To train our machine learning model we have used Support Vector Machine (SVM). SVM is one of the best Known machine learning model . the advantage of using SVM is that its not used probability and at

the same time it will work on Eigen images. after the model will be train the model evolution take place to test our model. The techniques used for model evaluation are confusion matrix,classification report which consist of recall, precision and accuracy of the model. Next we used kappa score based on the kappa score we can understand the app select that model or not.at next we will use ROC and AUC but for that we require probability. To overcome this drawback we have to set Probability=True in our model evolution step.

Challenges

One of the main challenges for classifying gender using facial images is that the effect of the posture of the person, illumination and ground noise . While neural networks are ready to learn representations, they're subject to certain spatial conditions of the input images. With the assistance of preprocessing, the proposed approach is in a position to form all input images uniform. This helps in reliable execution of the Machine Learning Methods.

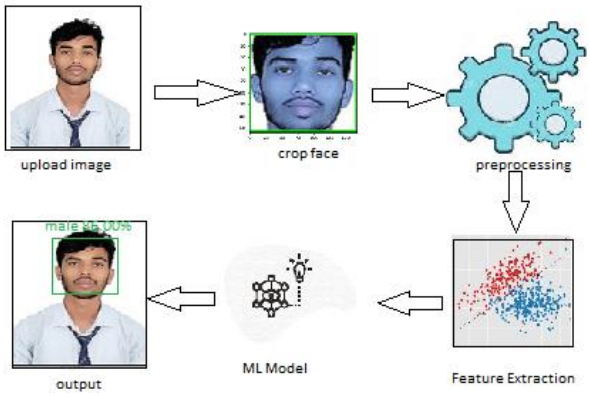

Fig.4- proposed model

IV. RESULT AND CONCLUSION

In this paper, A study of identification of gender using facial features has been done. The proposed method performs consistently well across facial images of different gender . This method is also robust and can be used to scale facial features of person from public places. The figure below shows the gender of the person with confidence score as a result. The confidence score of the image varies from image to image.

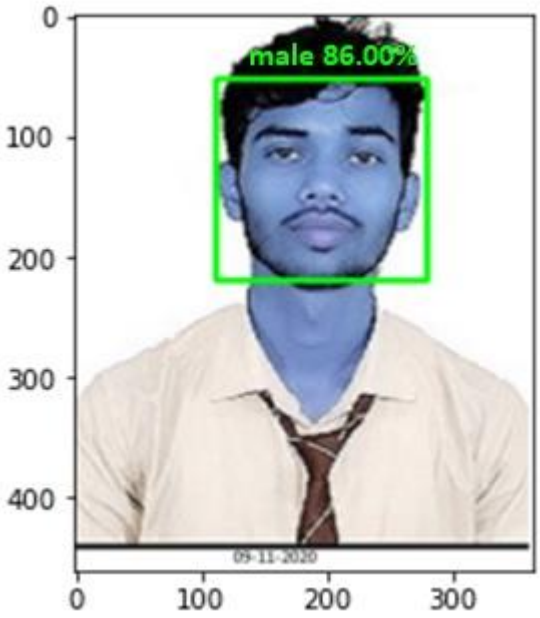

Fig.5-Output Image

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