Detailed Study on Gender Detection Using Frontal Face

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Abstract— Automatic gender detection through facial features has become a critical component in the new domain of computer human observation. Automatic gender detection has numerous applications in the area of recommender systems, focused advertising, surveillance, biometric and other security systems nowadays. A gender detection system can be implemented in the gender specific areas like woman compartments, gender detection can be used in temples and customized advertisement and in robotics field also. By analyzing the face we can get a lot of information such as, emotions, expressions, skin color, beard, mustache, etc. can be extracted. In recent literature, detection of gender by using facial features is done by many methods such as Gabor wavelets, artificial neural networks and support vector machine, Adaboost, KNN, CNN. This work presents the comparative study of various approaches that are used in gender detection system and their accuracy have been compared.

Indexed Terms-- Machine learning, Gender classification, CNN

I. INTRODUCTION

Gender detection is an important feature in this digital era. It is an important demographic attribute of human being. Gender Detecting system can be used at many gender-restricted places, like in female compartment in trains, temples, gender-specific advertisement, etc. Gender detection can be used with other application as well, such as facial recognition, age detection, Human-computer interaction, in Robots. The gender classification is to classify the gender of a person using his/her image [1]. This task is very easy for humans, but not so easy for computers to identify the identity or gender of a person. The field of the face recognition has been explored by the many researchers. But in the field of gender classification only few works are reported. Generally, gender recognition approaches work in three modes: feature extraction, classifier learning, and recognition task with the help of trained classifier. In feature extraction, the module decreases the data by measuring specific "features" or "properties" of the training face images that helps to identify the gender. After collecting the features, it is stored in the database. In between the testing phase, features of the test face from the images are extracted and these extracted features are used by the classifier to classify the image with the help of the dataset which is created during the training time and makes the final decision/result. Some of the classification methods already proposed for gender detection. They have their own method to detect the gender. SVM is one the model to detect the gender. Adaboost is proposed for gender detection by mixing up multiple algorithms. And one is Adaboost+SVM [5]. We have one more method which is K-NN. It is also a classification method to detect the gender. SVM+K-NN also proposed earlier to detect the gender of a person with some self-prepared image data. They all are achieved high accuracy during the testing phase, but still in this growing era we need to put some more efforts to gain very high accuracy to detect every possible image correctly. So, CNN comes into the pictures, with the help of convolutional neural network we achieved a very high accuracy even the training dataset is less [4].

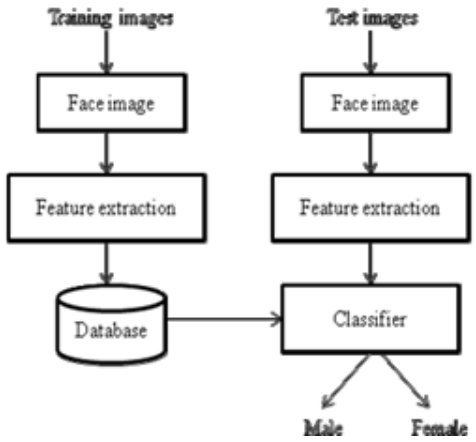

ILLUSTRATION 1: FLOW OF GENDER DETECTION

A. Convolution Neural Network

Artificial Intelligence has been stated as an enormous increase in connecting the gap between the talents of humans being and the machines. Researchers and lovers alike, work on several elements of the sector to make amazing things take place. One of many such areas is the area of CV (Computer Vision) [24].

The schedule for this discipline is to activate machines to view the arena as human beings do, understand it in a comparable way or even use the expertise for a huge number of changes including image & motion picture popularity, Image Analysis & Media Recreation, Classification, Recommendation Systems, and so on. The betterment in CV with DL have been built and perfected with time, in general over one specific algorithm — a Convolutional Neural Network.

Convolutional Neural Network (ConvNet/CNN) referred as Deep Learning algo. Which could take an enter image, assign importance to various factors/gadgets within the image and be able to differentiate one from the opposite [23]. The pre-processing required in a ConvNet is an awful lot decrease in evaluation to other category algorithms. While in crucial techniques filters are manually-engineered, with sufficient education, ConvNets have the capability to learn/teach those filters/traits [19].

The main goal of the Convolution instruction is to extract/fetch the high-stage features together with edges, from the input pictures. (ConvNets) did not restrained to simplest one Convolutional Layer. Conventionally, the basic ConvLayer is responsible for fetching the Low-Level functions inclusive of edges, gradient orientation, color, and many others. With the help of added layers, the structure/schema adapts to the High-Level functions as nicely, giving us a community which has the healthful understanding of pictures inside the dataset, just like how we'd [24].

There are two type of result to the operation — one in which the convolved method that reduced in dimensionality compared to the input, and the opposite wherein the dimensionality is both accelerated or stays the identical. How we can get this, by making use of Valid Padding in case of the former, or Same Padding inside the case of the latter.

If we increase the 5x5x1 picture right into a 6x6x1 picture and then observe the 3x3x1 kernel over it, we discover that the convolved model turns out to be of dimensions 5x5x1. Hence the name — Same Padding.

On the other side, if we do the same task without padding, we're provided with a model which has dimensions of the Kernel 3x3x1 itself is a Valid Padding.

- Pooling layers

Similar to the Convo Layers, the layer is accountable for decreasing the spatial size of the Convolved Feature. It is to lower the computational energy required to process the statistics via dimensionality reduction. Furthermore, it's miles useful for extracting dominant capabilities which can be rotational and positional invariant, as a result preserving the technique of efficiently training of the version [23].

There are kinds of Pooling: (Max Pooling) and (Average Pooling). Max Pooling returns the max val from the a part of the picture protected with the aid of way of the Kernel. On the opposite facet, Average Pooling returns the not unusual of all the values from the portion of the photograph protected with the aid of the Kernel.

B. Support Vector Machine

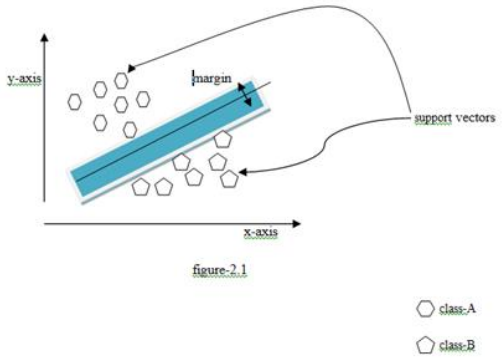

Illustration 2: Graphical representation of SVM

Support Vectors

Support vectors are the information/data points, which might be closest to the hyperplane. These points will outline the separating line higher with the aid of finding margins. These factors are extra relevant to the development of the classifier model [21].

Hyperplane

A hyperplane is choice aircraft that dissociate between a set of objects having exceptional magnificence connection.

Margin

A margin is an opening among the 2 lines on the closest magnificence factors. This can be calculated because the perpendicular distance from the road to different support vectors or nearby points. If the margin is bigger in b/w the instructions, then it's far considered a good margin, a smaller margin is a terrible margin [6].

How does SVM work?

The main objective is to isolate the given dataset in the best possible way. The distance among the either nearest points is called the margin. The main thing is to select a hyperplane with the most probable margin among aid vectors inside the given dataset [21].

II. RELATED WORK

Gender recognition is an essential project in the present technological world with the aid of applications/methods along with commercial profiling, monitoring application, surveillance purposes, and human-computer interaction. Gender recognition also can be used as a filtering mechanism to enhance performance of face classification each in phrases of faster and accuracy.

So far, many gender detection methods have been proposed by different researchers. [IEEE, 2014] Devadethan et. al [2] they proposed a system in which on the very first, face site detected with the aid by detecting the eye area. After detecting the face region other characteristic points including nose, corners of eyes, corners of lips and so forth are extracted. At first eye pairs are obtained by way of locating and verifying feasible eye areas. After detecting the eyes side area, the gape/space between the eyes was used to locate a possible face candidate. Next, the face is divided into special regions and facial capabilities are extracted from the corresponding areas.They have achieved 80% overall accuracy on the I. Ullah et. al [3] they have checked (WLD) for gender recognition. It is a texture descriptor and it performs better than other descriptors but it is holistic because its very constructive. Spatial Weber's Local Descriptor descriptor has 3 parameters. Through a very large range of experiments completed on FERET database, they have report the excellent combination of those parameters and that their proposed spatial WLD descriptor with most effective classifier offers a lot higher accuracy i.e. 99.08% with lesser algorithmic complexity than brand new gender reputation processes. Shan Sung et. Al [4] in this they have update the convolution method with cross-correlation method, consequently reducing the computational power. The n/w is educated the usage of a 2d-order backpropagation gaining knowledge of set of rules with fortify global learning rates. Performance of test of the proposed CNN solution is tested on publicly available face images dataset of SUMS and AT&T. They have gained classification accuracies of 98.75% and 99.38% on the sums and at&t databases, respectively. The neural networks is capable of system and classify a 32 × 32 pixel face photo in much less than 0.27 ms, which corresponds to a very excessive throughput of over 3700 images per 2nd. Training converges inside much less than 20 epochs. Caifeng Shan et. Al [5] they have used Local Binary Pattern to extract the feature from the face, and they have used AdaBoost to select the discriminative LBP features. They achieved the performance upto 94.81% by applying SVM. Campilho et. Al [6] they proposed a technique for gender detection from faces by means of fusing the results of SVM classifiers. Each classifier is being trained with the different styles of functions, specifically HOG (form), LBP (texture) and starting pixel values. For the latter capabilities they used an SVM classifier with a linear core and for the two former ones they have used SVMs with static intersection kernels/core. They came to a decision via apply fusion, that is the three classifiers who got the best result. They reveal the effectiveness of their method on a brand new dataset that they extracted from FERET. They have acquired an accuracy of 92.6 percentage, which outperforms the industrial merchandise face. Jain et. Al [7] They proposed a

system in which the testbed includes 500 pics (250 girl and 250 adult boys) those picked up from the FERET facial database. ICA is used to symbolize every picture as a characteristic vector in a low dimensional part. A classifier based on Linear Discriminate Analysis (LDA) is used on this decrease dimensional subspace. Our experimental consequences display a giant improvement in gender category accuracy and they attained an accuracy of 99.3 percentage. Wolfshaar et. Al [8] this paper described us that, they have discovered the relevancy of deep convo neural n/w on gender recognition by means of fine-tuning a pretrained neural n/w. They have explored the performance of dropout SVM via training them on the deep capabilities of the pretrained n/w along with deep methods of the fine-tuned community. They evaluated our techniques at the coloration FERET data collection and the currently built Adience facts series. There file cross-validated overall performance costs on every dataset. They further discover the generalization competencies of our method by means of doing cross dataset tests. It is tested that their fine-tuning technique exhibits ultra-modern performance on each dataset. They achieved 97.3% accuracy by applying CNN + Fine tuning + oversampling. In this, they have used a supervised machine learning method V. K Verma et. Al [9] They have used 3 various classifiers, the method as SVM, NN, and adoboosting. They have trained complete classifiers via the same dataset and similar functions. They have analysed a differential study to look at the performance of different classifiers and which classifier is the perfect main dataset over face images. They achieved 97.6%. accuracy from gender detection system model. Afifi et. Al [10] if we look into this paper, they have recommend a new method inspired by way of the conduct of people in gender classification. Rather of handling the face pic as a sole function, they depend on the aggregate of isolated facial components and a contingent function which they named the foggy face. Then, they used those related features to train the deep CNN accompanied by an AdaBoost-based fusion to deduce the very last gender mode. They examine their method on four difficult datasets to illustrate its efficacy in accomplishing better on-par accuracy with every methods that are proposed till now. In addition, they present a fully new face dataset that reinforce the challenges of occluded faces and illumination adjustments, which they believed to be much-needed for gender detection to explore.

III. RESULT AND CONCLUSION

By comparing many of the gender detection model we get to know that using only facial feature we can get a lot of information and with the help of computer vision and Machine learning the accuracy we get to see is too good. Different researcher used different algorithm and feature extraction model but LDA feature extraction got highest accuracy 99.3 % among all other algorithms and feature extraction But many algorithms has some disadvantages too, like slow process and need of greater dataset.

Furture scope in the field of this gender detection is that in india, upto now we have only two gender classes one is male and one is female but now a days in india transgender is receiving equal rights in term of every condition, So we can have a detection system what will classify the transgender also.

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