ORIGINAL RESEARCH PAPER

Engineering

A SURVEY ON PROCESSING HUMAN FACE AND FACTORS INVOLVED IN AGING

KEY WORDS: deep learning, neural network, fiducial points, machine learning

A. Deepa Assistant professor, Chandigarh Engineering College Mohali, Punjab, India

ABSTRACT

This paper discusses about identifying the face from any given input image. There is plethora of methods in recognizing the face from the image. The system has been used in multiple areas such as security purpose, control for access, smart devices, smart security controllers, ezones etc. The security needs has to be satisfied by the system, so the use of deep neural network is improved with the inclusion of conditional networking. In this paper, the use of deep learning and machine learning is studied. The features which are used for identifying the face and age of the face are discussed with the variations of face with respect to age progression.

I. INTRODUCTION

This paper discusses a model which can endorse a face by considering the extracted features from the facial image. The identification is done by recognizing the eyes from the face image and including the facial measures in it. The system for facial recognition identifies a face by finding a similar face from the database [6-10]. This is used in many systems which obey the facial recognition concepts or face matching concept. Deep learning is especially well-suited to identification applications such as face recognition, text translation, voice recognition, and advanced driver assistance systems, including, lane classification and traffic sign recognition A deep neural network combines multiple nonlinear processing layers, using simple elements operating in parallel and inspired by biological nervous systems. It consists of an input layer, several hidden layers, and an output layer. The layers are interconnected via nodes, or neurons, with each hidden layer using the output of the previous layer as its input. Using the results from the classifier, the age is categorized and the image is verified whether present in the database or not.

A neural network is a type of networking where the functionality is similar to the brain of the human where matching and identification of the patterns is done using the numerical database. To avail the use of any type of input data such as image, text, audio or video, the data is stored in the form of vector values. A neural network consists of multiple layers with multiple nodes. Based on the type of pattern in which the deep network learns to train, the similar type of input data is given to the node and accordingly the weight age is fixed. This weight age determines the importance of the input data in producing the final result. The total of input data is calculated and based on the threshold value the output for that particular node is determined. The input is mapped to the corresponding output by function of activation. The idea of the deep network is to approximate the function 'f'. The function f of the classifier is obtained by $y = f(x)$, which corresponds to the values of input with output. While the deep network identifies the parameter a, the approximation is given by the function, $y = f(x,a)$. In this paper the deep learning is used to recognize the face as well to estimate the age of the person.

II. EXISTING METHOD

Recognition of the face and identification of the age of the person seems to be very challenging task[1-6]. The performance optimization with the achievement of precision and/or number of features considered is the concerns in this task. The input, analysis and categorization are all equally considered in performing the analysis of the recognition and estimation of age[7-11]. From the total input, the face image alone is cropped. The filters are applied to normalize the image so as to obtain fine details and to maintain accuracy of the result. The visage technology is mostly used to solve the task.

III. PROPOSED METHOD

In this method, from the input image the face alone is cropped. The face is normalized and the features are extracted from it. From the extracted features, the analysis is done to match the image from the dataset and to estimate the age of the person. With a set of images where each image contains one of four different categories of object, deep learning recognizes the object from the image. The concern is the images should be trained. The information retrieved as output from one layer is given as input to the other layer. The information is send to different layers with appropriate processing. With the increase in layer the efficiency is increased as well the complexity. A convolution neural network (CNN, or ConvNet) is one of the most popular algorithms for deep learning with images and video. Like other neural networks, a CNN is composed of an input layer, an output layer, and many hidden layers in between. With the inclusion of conditional layering added to the existing system, the results obtained are better.

Here the model uses the process of deep learning. The process without deep learning which uses the machine learning method requires multiple features and several classifiers are used to extract the desired output. In machine learning as discussed in Table.1, the requirement of data is minimal and relatively high accuracy is obtained. The consideration of multiple features and classifiers are used and the accuracy is limited in machine learning. This when compared with deep learning, the usage of features and classifiers are done automatically and larger data is used for classification. Though the process is little complex, the accuracy rate obtained is higher.

TABLE I. COMPARISON OF MACHINE LEARNING AND DEEP LEARNING

Machine Learning	Deep Learning
Minimum data, Maximum accuracy	Large data for large accuracy
Fast modelling	Computationally complex
Multiple features and classifiers are required	Learns features and classifies automatically
Limitation in accuracy	Fine accuracy can be obtained

From Fig.1. it is clear with the processing of machine learning and deep learning. The In machine learning the segmented image is taken as input and features are extracted from it. Using support vector machine, the classification of output is obtained. In deep learning method, the features are extracted from the input image which is digitized to get values in terms of pixel values. Deep learning is done on the extracted features and the classified output is provided. The simplicity in machine learning and fine accuracy in deep learning are the preferences that the algorithm requires to provide.

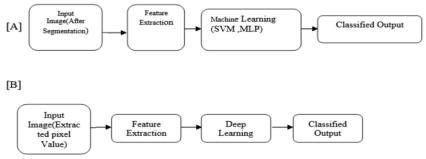

Fig. 1.A]Machine Learning B] Deep Learning

In this method, deep learning is used and the estimation of age is obtained both in images inclosing makeup and those which are devoid of makeup effect. On viewing the differences in the faces in Fig.2, the feature values remain same in the faces which has the makeup effect and without makeup effect. Since the algorithm uses both feature values as well the dimensions and the angle value of the face, the estimated output is found to be accurate. In Fig.2, the column images include the makeup effect and the images in the second column are free from makeup effect. Among the 43 features, only 35 are found to be same and the other features are different in values. But when the angle value is measured, the value is found to be same. The shape measures are also same. Hence the resultant value is found to be accurate.

Fig. 2. Images showing the difference in face with and without makeup effect

A. Main Feature Detection Layers

These layers perform one of three types of operations on the data: convolution, pooling, or rectified linear unit (ReLU). Convolution puts the input images through a set of convolutional filters, each of which activates certain features from the images. Pooling simplifies the output by performing nonlinear down sampling, reducing the number of parameters that the network needs to learn about. Rectified linear unit (ReLU) allows for faster and more effective training by mapping negative values to zero and maintaining positive values. These three operations are repeated over tens or hundreds of layers, with each layer learning to detect different features. After feature detection, the architecture of a CNN shifts to classification. The next-to-last layer is a fully connected layer (FC) that outputs a vector of K dimensions where K is the number of classes that the network will be able to predict[13-15]. This vector contains the probabilities for each class of any image being classified. The final layer of the CNN architecture uses a softmax function to provide the classification output. AlexNet is used to classify the objects in any image. This can be achieved by using the neural networking concept in the proposed model.

B. Algorithm:

The algorithm proposed in this recognition system is first to crop the face from the input image. From the face, the 43 fiducial features are identified as in Fig.3. Then using haar cascade method the feature values are extracted. The values are stored in the database. When input testing image is given, on basis of the data values the face in the image can be matched. The deep network provides the classified output. The classification is done based on the result of three layers. In the first layer, the fiducial values are concentrated. The 43 values provide the gradient and texture values in those landmarks. These extracted values provide better accuracy of the fine details of the face. From these values the recognition of the face is made easier. The second layer is based on the angle value of the face. The angle is obtained by joining the midpoint of the eyes with the lip midpoint. The value of angle determines to which group of age the person belongs to. There are 5 different angle values such as less than 45 degrees, 45-50, 50-55, 55-60, and above. Based on these values the age of the person is determined as less than 18 years, 19-25 years, 25 to 35 years, 36-45 years and above. The third layer gives the value of the shape features. When the shape feature value matches with the trained set values, the age group in the trained set is taken into consideration. The shape is a major factor in matching the age. The shape provides variation in measures in different age. As in Fig. the differences are visibly identified. The deep network is trained with epoch 50 and the drop outs of each layer are taken as 0.2. From the output of each layer, the age of the person is identified and the matching or recognition of the face is also done. The softmax function is used to obtain the final output. In matching the image from the database or to the database, the coordinates are identified from the various positions The coordinate points to be considered are one point in the top of the face where the details of highing of forehead, baldness are seen. Three points in the forehead, the four points in each of the eyebrow are considered where the visibility of fine lines commences. Four points from the eye are considered which covers the eye and eye corner details. Three points for eye corners lower side of eye portions are taken from both the sides. Five points around nose portions are taken and five points around lip and cheek portions are taken for both the sides of the face. The chin point value is also taken into consideration. The image is taken from the input source such as any standard camera or still image obtained from the video capture. The image of 30x30 pixel value is considered for standard analysis. The shape of the face is analyzed in the third layer where the measures provide the age group to which the particular face belongs to. The differences in the shape appear due to the fact that facial bones which are tender in baby face seems to become harder and after 45 years the bones start to lose volume, contributing to the appearance of aging. On considering the faces of young women and elder one, the changes in features are visible in the 43 fiducial points.

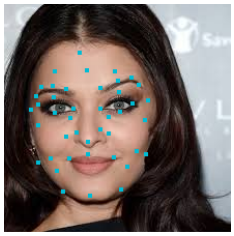

Fig. 3. Features extracted from 43 fiducial points

On observing the differences in Fig.4, which comprises the image of the person belonging to age 20 and 40 respectively. It is very clear the change in face externally is due to the internal reason. The bones of the elder person depicts the larger socket and the alignment of the lower jaw bone is dropped and the angle of the brow is reduced. This shape difference makes the age difference visible in the faces in different age group.

Fig. 4. Shape differences in face of person belonging to different age group

The estimation of age from the images where it is found difficult due to makeup effects can also be done with a higher accuracy. This is achieved because the estimation is done based on the results of three different layers of learning which takes the input from fiducial values, angular classification and shape measures. So even with inclusion of makeup effects, the estimated age is found to be accurate. For normal perception the age of the person in both the columns seems to be younger. On considering the exact values the resultant age is found to be different. This is due to the presence of fine lines and patches on the 43 fiducial points which are taken into consideration. When all the fiducial points are considered, the estimation becomes even better. The angular classification gives variance in an age group which belongs to a wider range. The shape differences give the classification based on the various age groups and what value of age category the face belongs to. On seeing the face shape as in Fig.5, the age

difference make variation in the face shape variation. The face shape changes with the increase in age.

Fig.5. Face shape variation with respect to aging

The shape of the face can be noticed to be changing with respect to the progression of age. The shape changes in the lower jaw portions in a higher rate. The chin which is found to be pointed or narrow in young age seems to be widened from the age of 35 and this width keeps increasing till the age of 65 and then the width is saturated. The drowning of the cheeks is higher after this age. So when we consider the shape of the face, there are many variations noticed.

IV. CONCLUSION

As discussed in the paper, the algorithm is used to recognize the face from the image by matching with the face in the dataset. The recognition is done for all images and it is found that the matching is found in the images of same person with and without makeup. The paper discussed the various methods in recognizing the face and what are the various changes in human faces with and without makeup as well the various fiducial points to be considered.

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