International Journal Of Engineering Research And Development
e-ISSN: 2278-067X, p-ISSN: 2278-800X, www.ijerd.com
Volume 13, Issue 11 (November 2017), PP. 43-49

Estimation of Age Group using Histogram of Oriented gradients and Neural Network

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ABSTRACT:
Requirement of Project: Face images are being increasingly used as additional means of authentication in applications of high security zone. But with age progression the facial features changes and the **database needs to be updated regularly which is a tedious task.** So we need to address the issue of facial aging and come up with a mechanism that identifies a person in spite of aging. In my project, effective age group estimation using face features like texture and shape from human face image are proposed[2]. For better performance, the geometric features of facial image like wrinkle geography, face angle, left 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 using KNN & SVM algorithm (Best algorithm according to many research paper during my research)."
Proposed System: "In this report, few classification and feature extraction techniques used for age group classification. In this report first we attempt to combining two type of face features using haar features extraction (Wrinkle features and Geometrical Features) also used viola Jones for face detection. Age estimation based on the graphical model structure is proposed. Three popular features, PCA (Principal Component analysis), HOG and Haarfeatures, are exploited in our work, and three different graphical model structures considering spatial information and hidden topics are proposed and implemented. The experimental results showed that our model performs classification techniques like SVM (support vector machine), KNN and Neural network and the comparisons between features extraction algorithm and classification techniques in order to obtain best output. features are also presented and discussed. Until now, the model we proposed hasn't been well-tuned, and we'll try to improve it for the future works." Research in those areas has been conducted for more than 30 years. "Traditionally, face recognition uses for identification of documents such as land registration, passports, driver's licenses, and recognition of a human in a security area. [22]

Date of Submission: 30-10-2017 Date of acceptance: 09-11-2017

I. GENERAL INTRODUCTION

Most of the facial variants such as identity, expression, emotions and gender have been widely studied, in the case of research of recognition. Automatic age estimation is one such area that has been rarely explored by the researchers. With the evolution of a human, the features of the face keep on changing with age. This project is providing a new combine approach of feature selection for age group classification algorithms. Further this process is further classified into three main stages: first one is Pre-processing, second is Feature Extraction (Haar feature extraction), and the last stage is classification. For feature extraction phase we used two techniques 1) Wrinkle features and 2) Geometrical features for the face pattern recognition [11]. We know that Wrinkle features are well enough to differentiate between the adult and senior, Geometrical features is good to create difference between child and adult/senior. That is why we used a combine technique of wrinkle and geometrical so that they can solve each other problems and provide the best output. These two approaches are defined below:

1.1.1) Geometrical features

This include face angle, left eye to right eye distance, eyeball, eye to nose distance, eye to chin distance and eye to lip distance that is further calculated by making use of the best feature selection algorithm

1.1.2) Wrinkle features

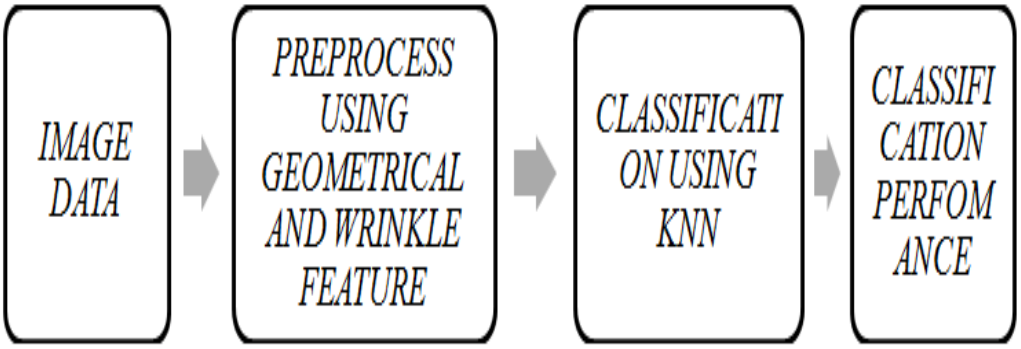
Age classification based on the texture and shape information is done by using suggested hybrid algorithm which includes Fuzzy logic and Neural Network. Depending on a number of groups age ranges are then classified dynamically using hybridization algorithms individually.

In our research, most facial features like identity, expression, emotions and gender has been majorly focused. Automatic age estimation is one area that has been rarely explored till date. As age increases, the

feature of the face keeps on changing. This project provides a comparison study of classification techniques (SVM, KNN algorithm) and these falls under the category of the best classification algorithms. Entire process is divided into three stages: Pre-processing, Feature Extraction (Haar feature extraction) [75], classification (above mentioned algorithm). Machine learning phase uses different classification algorithm approach in order to provide the best solution for pattern recognition. That is why we are using one hybrid technique of wrinkle and geometrical by which they can solve each other problems and provide the best results. Here we make use of two important features of the face which are responsible for age identification. Personal identification and verification has evolved as an active area of research these days. As biometric characteristics of the individual are unique person to person, biometric authentication techniques have a great advantage over traditional authentication techniques. Recognition of face is one of the widely used biometric methods which are used to identify individuals by their face features. Face, voice, fingerprint, iris, ear, retina are the most commonly used for authentication purpose. Research in those areas has been conducted for more than 30 years. Face recognition is beneficial for identification of documents such as for land registration, passports, driver's licenses, and recognition of a human in a security area [84]. Face images are highly used as additional means of authentication in applications having high security zone. But with increase in age the facial features also keep on changes and the database needs to be updated regularly which is one very tedious task. Hence we need to address this issue of facial aging and come up with a solution that identifies a person without any age limits. In this thesis, effective age group estimation using face features like texture and shape from human face image is proposed. For getting efficient results, the geometric features of the facial image like wrinkle geography, face angle, left to right eye distance, eye to nose distance, eye to chin distance and eye to lip distance are calculated [90]. Based on the texture and shape information, age classification is done by making use of classification algorithms

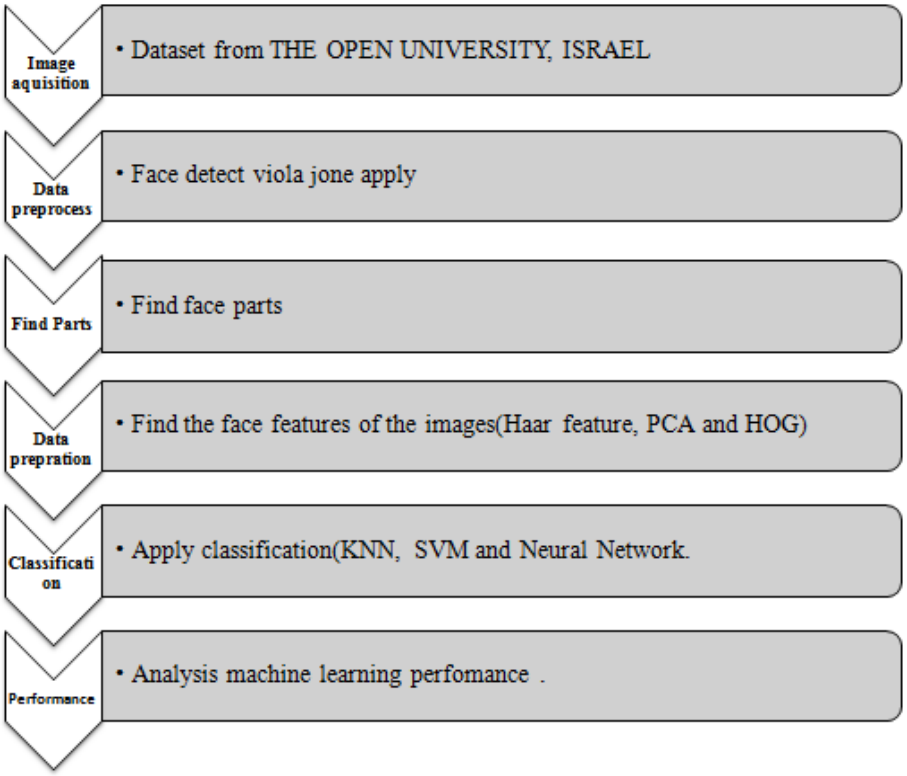
II. EXISTING SYSTEM

As we already discussed in literature survey age group classification is one of the research topics from last few years. Many research already done research on the age group classification with different algorithms (Surf algorithm, PCA and LDA etc.) and different classification techniques were used. In the age group classification the most difficult part is to identify the different pattern of the faces[78]. Many authors have tried and failed. As per our research many researchers failed to observe the exact pattern of different age group. Pattern recognition, having two critical task one features extraction and another is classification. Researcher tried to work hard on the machine learning algorithm and many of them is ignore features extraction improvisation. As the result they cannot obtain good output, but all the literature author work excellent on classification algorithm which include (Neural network, KNN, SVM and Fuzzy logic)[65].

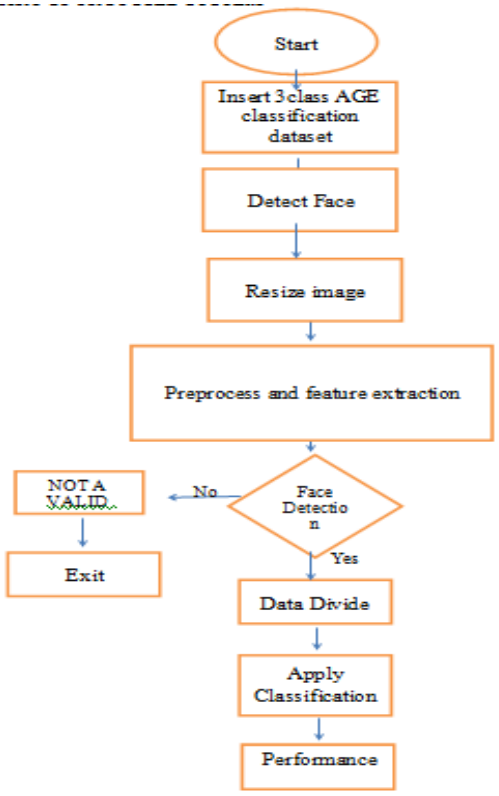


Block diagram of proposed work

3.3 Flow Chart Of Age Classification
The brief description of each block is described below:



FLOW CHART OF PROPOSED SYSTEM



2.1 Feature Extraction

One of the main key issue of any characterization frameworks is to locate an arrangement of reliable features as the basis for classification. In general these features cam be categorized into two categories. These are wrinkle features and geometric features. Let us discuss each one of them in detail[59].

Yes

2.2 Wrinkle Features

One of the most important property of wrinkle features is that it determines the age of a person. Estimation of feature F5 can be done as follows :

F5= (sum of pixels in forehead region / number of pixels in forehead region) + (sum of pixels in left eyelid region / number of pixels in left eyelid region) + (sum of pixels in right eyelid region / number of pixels in right eyelid region) + (sum of pixels in left eye corner region / number of pixels in left eye corner region) + (sum of pixels in right eye corner region / number of pixels in right eye corner region).

F5 can be estimated by making use of the grid features of face image that is completely dependent on the wrinkle geography in face image.

For the estimation of F5 features, a few steps have to be followed as discussed below:

As the age keeps on increasing, wrinkles on face turn out to be clearer. Aged individuals regularly have clear wrinkles on the face in the following areas as mentioned below :

a) The forehead has horizontal furrows.
b) The eye corners have crow's feet.
c) The cheeks have clear cheekbones, sickle molded pouches, and profound lines between the cheeks and the upper lips.

Since there are evident changes in wrinkle intensities and even some form clear lines, thus in this Project we make use of Sobel edge magnitudes, approximating gradient magnitudes in order to judge the level of wrinkles[15]. The Sobel edge magnitude is larger, if the pixel belongs to wrinkles. The reason behind the larger magnitude is that the difference of gray levels is self-evident. From this perspective, a pixel is named as a wrinkle pixel if its sobel edge size is bigger than some limit. Figure 7 (a) and (c) demonstrate a youthful grown up and an old grown up[69].

2.3 Geometrical Features

As indicated by the investigations of facial representation and emotional cosmetics, there occurs a lot of change in the facial features as the age keeps on increasing. In this phase, global features in combination with the grid features are extracted from the face images. The global features include the distance between two eye balls, chin to eye, nose tip to eye and eye to lip[76].

By making use of four distance values, there occurs calculation of four features namely F1, F2, F3 and F4 as mentioned below:

F1 = (distance from left to right eye ball) / (distance from eye to nose).
F2 = (distance from left to right eye ball) / (distance from eye to lip).
F3 = (distance from eye to nose) / (distance from eye to chin).
F4 = (distance from eye to nose) / (distance from eye to lip).

It is clear that new born babies have a number of wrinkles on their faces. The head bone structure in new born ones is not fully grown. Moreover the ration of primary features is highly different from those in other life spans. Hence we can conclude that it is more reliable to use geometric features as compared to wrinkle features when it is to be judged that whether an image is a baby or not[82].

In case of infants, the head is near a circle. The distance between two eyes is almost equal to the distance from eyes to mouth. As the head bone grows, the head becomes oval shaped and accordingly there occurs a sudden increase in the distance from the eyes to the mouth. Above and beyond the ratio between baby's eyes and noses is equal to the distance between noses and mouths which in turn are almost equal to one while as in case of adults it is larger than 1[88].

Classification (Knn Algorithms)

3.3.1 KNN Classification: The k-nearest neighbor algorithm is a classification algorithm which classifies an object on the basis of where the majority of the neighbor belongs to [76]. To choose the number of neighbors is optional and it depends on the users. If k is equal to 1 then it is classified [10] as a class of neighbor is nearest. Normally the object is classified on the basis of labels of its k nearest neighbors by finding out the majority vote. If k is 1, the object is classified as the class of the object which is nearest to it. When there are two classes, it is considered that k must be an odd integer. However, there can still be times when k is an odd integer while performing multiclass classification. After converting each image to a vector image of fixed-length having real numbers, we will then use the most common distance function for KNN that is Euclidean distance [85].

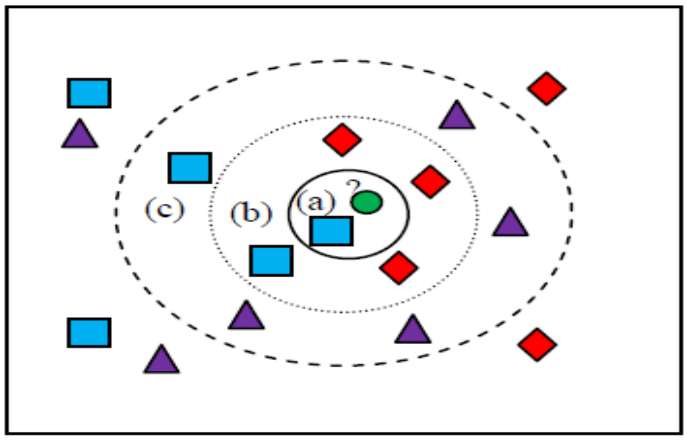


Fig 3.8 :KNN classification. At the query point of the circle depending on the k value of 1, 5, or 10, the query point can be a rectangle at (a), a diamond at (b), and a triangle at (c).

The KNN is classifies an object where the majority of the neighbor belongs to. The choice of the number of neighbors is discretionary and up to the choice of the users. If k is 1 then it is classified [10] whichever class of neighbor is nearest[13].
result = knnclassify(Sample, Training, Group, k)

3.2 Histogram of Oriented Gradients(HoG):

The next step is to extract the features of the hand gesture. This system uses the HoG descriptor (Histogram oriented gradient) to present the hand shape. HoG descriptor counts the number of times a gradient orientation occurs in a localized are of the image[22]. It uses a histogram of intensity gradient to depict the shape of the object. This technique is resilient under change of shadow and illumination. Due to this, it's a popular method for hand gesture detection[43]. The implementation method of the HoG algorithm descriptor is given as follows. Firstly, the cells are divided into smallest possible regions of an image. These regions are called **cells.** For each of these cells, a histogram of of gradient orientations or edge orientations is computed. Each cell is separated and discreted into corresponding angular bins in accordance with its gradient orientation. The weighted gradient of each cell is contributed to its respective angular bin. The adjacent cell with same gradient orientation are grouped together and these spatial regions are known as **blocks[57].** These groupings into blocks is the basis for histograms' normalization. The normalized group represents the block histogram which in turn represent the descriptor [21].

3.3) Principal Component Analysis(PCA)

PCA is one of the best available statistical methods available that is used for image compression and gesture recognition. The basic ideology behind the PCA algorithm is the reduction of the dimensionality of an image and also maintaining maximum variance. The features which remain then are the ones relevant for recognition[59]. Whenever there is 2-dimensional data, then due to the presence of more than 2 variables, the visualization of of the relationships becomes complex. PCA reduces the dimensionality of the data such that the two actual variables are reduced to less number of new one dimensional variables which are called Principal Components. This is done by using a single variable for a group of variables. The principal components are a linear representation of the actual variables[64]. These principal components can also be represented in the form of vectors called Eigen Vectors. The Eigen Vectors collectively create a feature space known as Eigen space which is calculated by the eigen vectors of a co-variance matrix derived from a hand gesture set. Each input gesture image corresponds to eigen vectors which represents the feature vector of the image[79].

3.4 SVM (Support Vector Machine)

SVM Classification: A support vector machine (SVM) is a non probabilistic linear binary classifier, which can analyze input data and predict which of the two classes it belong to. It works by building a hyper plane separating the two classes which is of higher dimension. A good separation is obtained by a hyper plane that is very far from any data point of each class [11], since further the separation of the data, better the performance[64].

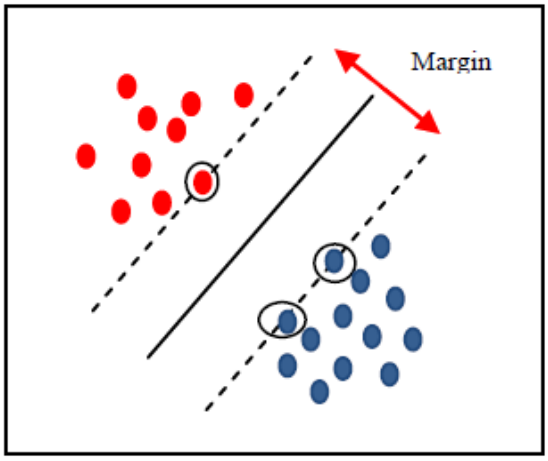


Fig 3.6.4: Shows the formation of hyperplane and also the how the image is classified between red and blue using SVM.

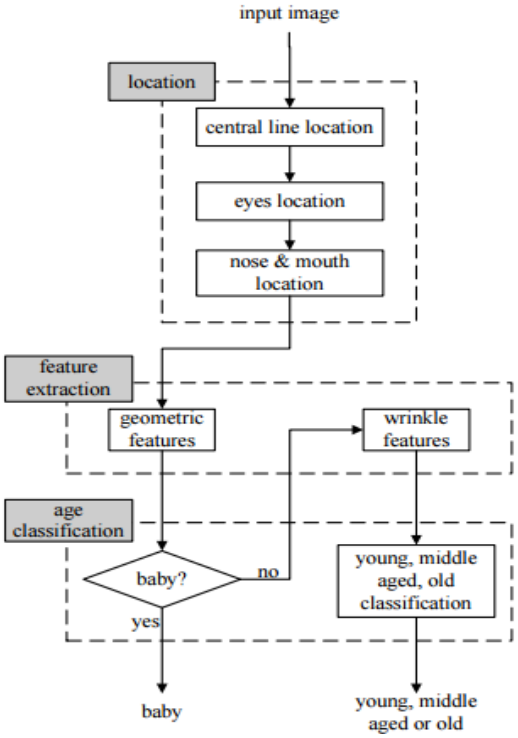


Fig. 3.6.4(B) Overall flow diagram of project

III. CONCLUSION

This thesis thoroughly explains a novel method for the age group classification. Proposed technique based on wrinkle and geometrical features provides a robust method that identifies the age group of individuals from a set of different images capturing various aged faces. From these images features are then extracted such as distances between various face elements, analysis of wrinkle geography and then calculation are performed for finding out face angles. The results are then compared at the end to find the best way to calculate age ranges for the face images present in the database. Based on the observed results, images are further classified into 3 groups on the basis of SVM and KNN algorithm. It is normally observed that wrinkle geography feature i.e., F5 provides better results to predict human age range in comparison to other features. Hence we can conclude that wrinkle geography analysis is one good approach to estimate human age range for an individual. For better eye and eyeball detection, images should be captured without spectacles. Viola Jone algorithm focuses on the front face that is why the image needs to be a straight frontal face. As we are working on the individual face age group identification so for that purpose image should contain single human face only. This thesis has shown results with 76% accuracy for two age group, 64% accuracy for three age group. As the numbers of group are

increased for classification the accuracy of classification is decreased. There is a strong possibility for further extension of the work which includes extracting more feature points that can improve accuracy of age group classification. By introducing more features the age range can also be further enhanced.

Future Scope

The future work is to add more category in the field of age group recognition classes to the given system. Also since the proposed system is limited to classify only for front images, so modeling 3-D face using various cameras to increase the efficiency of the proposed facial age recognition system can be used for future work. We can also implement face age detection by using fuzzy logic and genetic algorithm.

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*Arpit Kumar Sharma. "Estimation of Age Group using Histogram of Oriented gradients and Neural Network." International Journal Of Engineering Research And Development , vol. 13, no. 11, 2017, pp. 43–49.