FACE VERIFICATION AND AGE CLASSIFICATION USING AAM AND ASM

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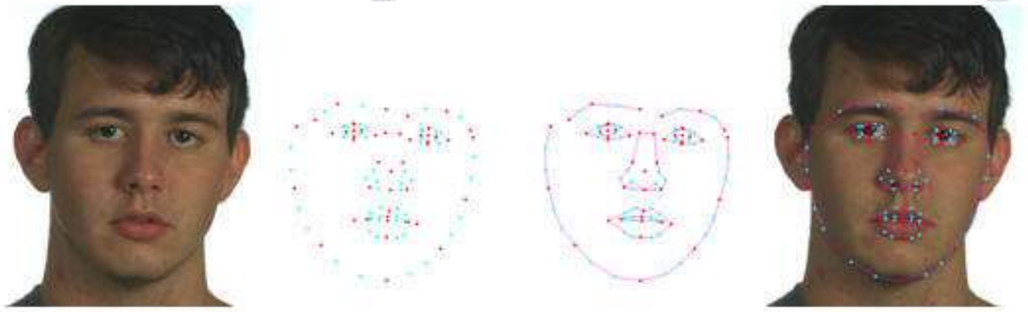
Abstract : Accurate Face recognition is a challenging task and usually accomplished in three phases consisting of face detection, feature extraction, and expression classification. Precise and strong location of trait point is a complicated and difficult issue in face recognition. Cootes proposed a Multi Resolution Active Shape Models (ASM) algorithm, which could extract specified shape accurately and efficiently. Furthermore, as the improvement of ASM, Active Appearance Models algorithm (AAM) is proposed to extracts both shape and texture of specified object simultaneously. In this paper we give more details about how the both AAM and ASM may be used to classify human age.

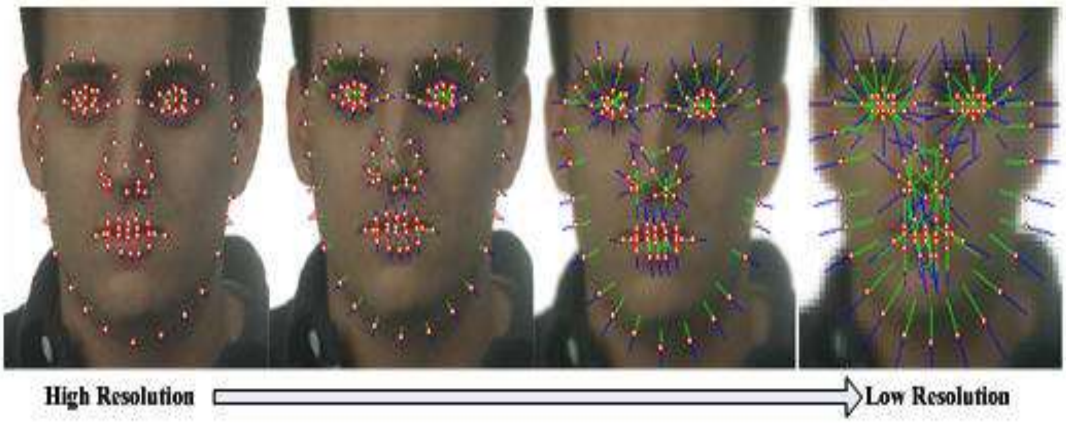
I. Introduction to ASM AND AAM

Active Shape Model (ASM)

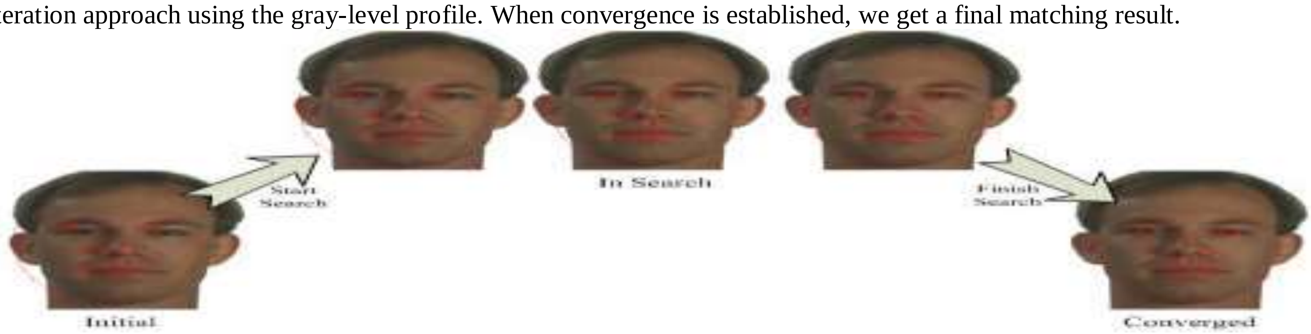
Active Shape Model (ASM) is a model-based methods, which makes use of a prior model of what is expected in the image, and typically attempt to find the best match position between the model and the data in a new image. One can make measurements whether the target is actually presented after matching the model. In face recognition application, we collect training images, represent all shapes with a set of landmarks, to form a Point Distribution Model (PDM) respectively.



After landmarks alignment and Principal Component Analysis, we construct gray-level profile for each landmark in all multi-resolution versions of a training image.

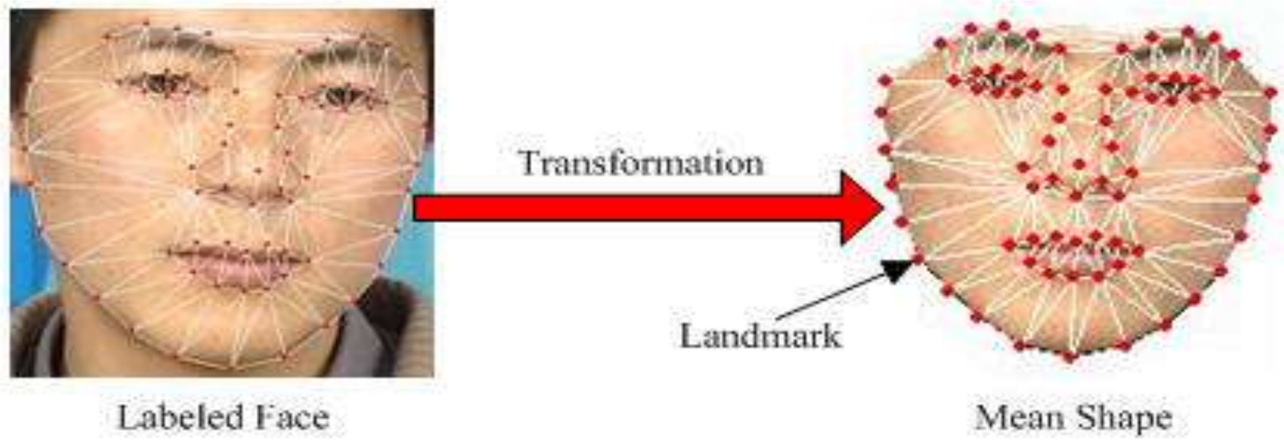


In search procedure, we give the model's position an initial estimate. Then it can compute the suggested movements through an iteration approach using the gray-level profile. When convergence is established, we get a final matching result.

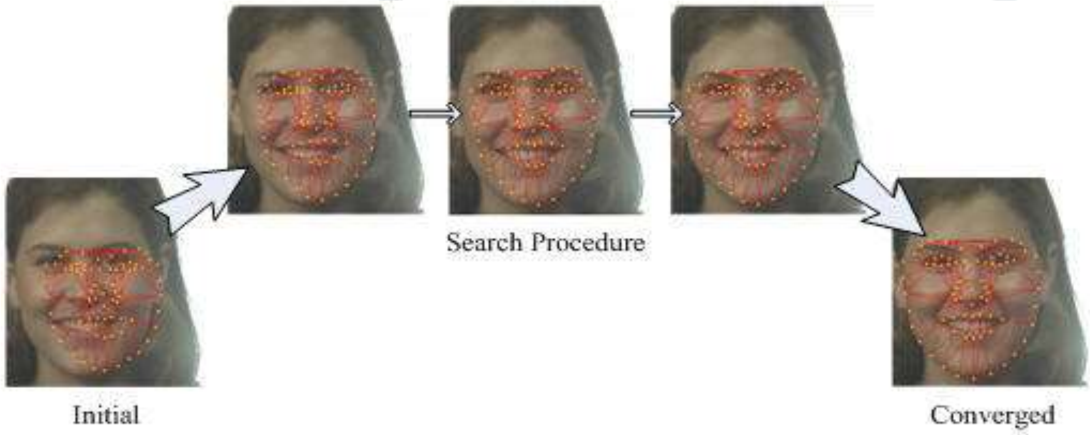


ACTIVE APPEARANCE MODEL

In face recognition application, accurate face alignment has determinative effect. Active Appearance Model (AAM) is one of the most studied methods for accurate locating objects. When applying Active Appearance Model, firstly we collect enough face images with various shapes as training set. Then we use a set of points to annotate face shape, so face shape can be represented by the coordinates of these landmarks. After a series of transformation such as Principal Component Analysis, the mean shape of all the faces can be obtained to construct shape model for face alignment.

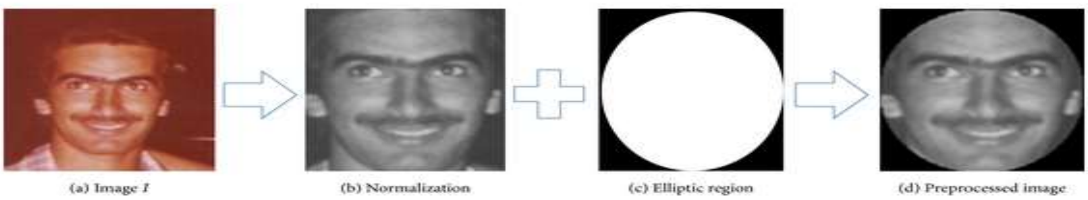


After a series of transformation such as Principal Component Analysis, the mean shape of all the faces can be obtained to construct shape model for face alignment.
Given a new face image, we estimate the model's initial position, compute the suggested movements, then we can get a good face alignment result.



MODELLING FACE APPEARANCE USING AAM

Given an AAM image pair by using the active appearance model, the gradient orientations pyramid is used to build the feature vector, this may be combined with a SVM classifier for the face verification. $L2$ norm and gradient orientation may be used with the same SVM-based framework. Firstly 68 feature points are used to establish the shape model; then they are normalized using shape model to eliminate the effect of other factors, and after the normalizing, PCA is used on the images is used in the next feature extraction process. The final AAM image is obtained. By using the AAM, the impact of the age variation can be reduced in face verification. In the process of the AAM, the face pose has been corrected; and the effect of the posture has been nearly eliminated. The differences among different people are reduced by normalizing the shape model. By normalizing the shape model, the texture models almost ignore the shape information, and the only texture information is mainly used in the feature extraction process. The texture feature is more useful than shape feature in face verification across age progression.
SVM Support Vector machines may be used for classification of the image as intrapersonal pairs and the other for extrapersonal pairs. For verification tasks, two popular critical criteria used are, the correct rejection rate (CRR) and the correct acceptance rate (CAR): where "accept" indicates that the input image pair are from the same subject and "reject" indicates the opposite, the equal error rate (EER), defined as the error rate when a solution has the same CAR and CRR, is frequently used to measure verification performance. The lower the EER, the better the performance.SVM along with AAM plus GOP is a promising approach.



The appearance changes of human faces are very different in children than in adults. The SVM+diff is more suitable for the face images in datasets like FGNET ,while on MORPH database; the faces separated by four years are easier than those separated by more than four years and less than four years. Because the age gaps of each subject are lesser, when the age gap is big enough, the task becomes easy as the age gap is four, and the results on MORPH database are irregular[2].

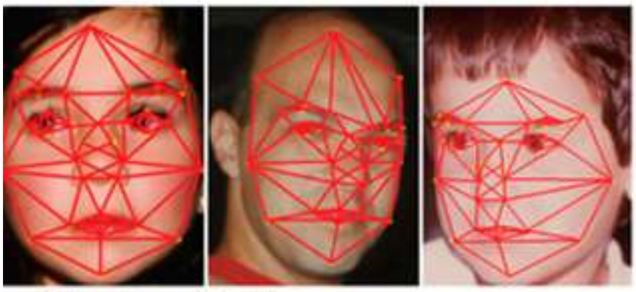
MODELLING FACE APPEARANCE USING ASM

Another approach uses An Active Shape Model (ASM) generated on the face using three-sided polygon meshes and perpendicular bisection of a triangle; feature extraction and Sequential Forward Selection (SFS) is used to select the most ideal set of features; and (6) finally, the Convolution Neural Network (CNN) model is used to classify according to age in the correct age group.

At first, the face is detected using the YCbCr color segmentation model. Second, 35 landmarks are plotted on the face using a connected components and ridge contour method. An Active Shape Model (ASM) is generated over the face using two approaches, namely, three-sided polygon mesh and perpendicular bisection of triangle. Feature extraction is achieved using two techniques, namely, image representation and aging patterns. The Sequential Forward Selection (SFS) technique is used before classification to select the ideal features for classification. Finally, CNN is used to achieve accurate age group classification.

YCbCr color segmentation is not affected by any variation of illumination in the *Y* (luma) factor. The description of the skin representation is based on two components: *Cb*(blue difference) and *Cr* (red difference) of the chrominance components. Other color segmentation models like HSV and RGB are not appropriate for skin detection. In RGB color segmentation models, the skin color region varies in all three channels.

Each individual's skin color is unique. To get the full coverage of skin pixels, the RGB image is converted to YCbCr color segmentation model. This can provide exact coverage of skin pixels and easily distinguish between skin and non-skin pixels without being affected by illumination levels.



Active Shape Model

To plot the landmarks on eyebrows, eyes and lips, the image is first converted to a binary image . A certain range is allotted to obtain the maximum connected face region. The above-mentioned facial features and the landmarks are localized on those features using the blob edge plotting technique. For the nose, the ridge contour method is used to mark the nose with the 7 landmarks, landmark localization points ranging from 1 to 35 are obtained. An Active Shape Model (ASM) is generated on the face using the 35 landmark points. The generation of ASM which are three sided polygon meshes and the perpendicular bisector of a triangle is used to determine the age of an individual. Given the image of a face and corresponding landmark localization points, a multivariate model of shape variation can be generated from the points by using polygon meshes and perpendicular bisectors of triangles. Basically, the shape of an Active Shape Model changes across age changes and this fact can be used to accurately classify individuals into age groups. Facial dimensions are taken by measuring the distance between the facial features and angles of inclination. The shortest distance between the landmark points is measured using the Euclidean distance.

CNN provides higher classification accuracies than other deep learning methods due to its ability to extract and learn image-based features. CNN also uses a small amount of bias and weights to achieve high classification accuracy.

AGE CLASSIFICATION

The problem of age classification includes face image interpretation tasks in which the execution phase includes the method of face detection, locating characteristics of face, formulation of feature vectors and age classification. According to the age estimation system applicability, the classification result can be an estimate of the exact age of a person or the age group of an individual or even a binary result indicating whether the age of a subject is within a certain age range. Facial age estimation is divided into two groups. The first group is from infancy to adulthood when most changes occur; the second stage is from the teenage to old age where skin color, texture and elasticity changes are most likely to occur. Various age estimation methods have been investigated. Recently, age estimation using multiple faces has been carried out by researchers. In this research article, we discuss age classification using single and multi-face datasets.

The features are extracted using LBP, active appearance model, and HOG. Age groups are categorized into three classes: child, adult and senior. For classification K-Nearest Neighbors, Support Vector Machine and Gradient Boosting Tree models are used. The system is evaluated on an FG-Net aging database and it achieved an accuracy rate of 82%. Principal Component Analysis (PCA) may be used to predict the age. The system may be classified into age classes ranging from 10 to 60 years old. PCA and geometric features were used to extract the features. The Euclidean distance between two points for feature extraction which may vary between distant images and close-up image may give varying results.

CONCLUSION

In this paper the application of AAM, ASM techniques for face verification, and age classification is discussed. Active Shape Model (ASM) is compared with other Active Appearance Models (AAM). The models are compared on the basis of landmark points, shape of the model and mean absolute error (MAE), ASM Active Shape Model (ASM) provides lower MAE than other well-known models.SVM along with AAM plus GOP is a promising approach that gives lower EER, and better performance.

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