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Effective Aging Approximation for Adult People Using Morphing Technique

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Abstract: Age progression results considerable change in the look of human countenances has recently gained attention from the computer vision. Because of numerous ways of life elements, it is hard to decisively anticipate how people may look with propelling years or what they looked like with "withdrawing" years. Automatic age variation methods and techniques useful to capture wanted fugitives, finding missing children, updating employee databases, enhance powerful visual effect in film, television, gaming field. Currently there are many different methods available for age variation like: Craniofacial Growth Model, Anthropometric Model, Image Morphing, Image Based Surface Detail Transfer (IBSDT), Aging function (AGES), Gaussian Mixture Model (GMM) etc. Each method has its own advantages, purpose and limitations. The main goal of our dissertation work is to enhance the effect of age variation for adult people doing facial shape changes and including specific texture information like fine line, wrinkles in age modelling process.

Keywords: Age progression, Age Variation Methods, Anthropometric Model, Ages, Image Morphing, Ibsdt, Gmm.

I. INTRODUCTION

Image processing is a technique to perform a few operations on a picture, keeping in mind the end goal to get an upgraded image or to concentrate some valuable data from it. It is a kind of signal processing in which information is a image and result might be image or qualities/highlights connected with that image. These days, image processing is among quickly developing advancements. It frames center exploration zone inside building and software engineering teaches as well. Image processing essentially incorporates the accompanying three stages:

- Importing the image via image acquisition tools;
- Analysing and manipulating the image;
- Output in which result can be altered image or report that is based on image analysis.

“I often get e-mails inquiring about software into which one can put a photograph and have it automatically turned into an age-progressed portrait. There is no such software.”[1].

There has been growing interest in automatic age progression which is useful in law enforcement and forensic investigation, missing individual, multimedia, security, capture of wanted fugitives and updating employee databases.

[1]D’Lynn Waldron is an author, artist and photographer. She is a classically trained artist who has also studied physical anthropology which allows her to do a forensic analysis of the structure of a face and understand how age changes it. As a scientist, she helped develop the computer technology used in publishing, the graphic arts, and the movies. Digital age progression is one of the many services she offers. We personally communicated with her.

Human Facial Aging can be sorted into two fundamental stages as developmental stage and grown-up stage. A technique for the developmental stage (age from 0 to 18) aging is being proposed in [3]. Grown-up stage can be further named grown-up essential stage (age from 19 to 50) and grown-up auxiliary stage (age 50 upwards). A system for the grown-up essential stage maturing is being proposed in [4]. We have to concentrate on confronts shape changes and facial texture data in elderly aging movement utilizing different methods for age variation. Most specialists utilized FGNET as a part of [5] and MORPH in [6] databases for model development and testing purposes.

A. Objective

With the progression of time the face of the individual may have changed and there ought to be a component to uncover the individual's identity. With a specific end goal to make this procedure simple, we should figure and choose concerning how he/she will look like at this point. To address this issue this thesis displays a method for adequately integrating a facial image with the aging impacts.

Objective is creating programming that consequently re-enacts age changes on a facial image. User gives an input image of the subject and a target age, and after that another image of the subject is produced to mirror the user's given target age.

B. Motivation

Various real-life applications could benefit from an automated aging system like ours. The following examples demonstrate some uses of the aging software.

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1. Capture Wanted Fugitives:
The most common usage for such a system would be to assist in the capture of wanted fugitives, [7]. Often, suspects who are wanted for crimes and have not been located, and the only available photographs are outdated. This system would be useful to predict what their current or future portraits would look like.

2. Finding Missing Children:
A special case of this application would be to predict the current facial appearance of persons missing for several years. According to the NISMART-2 research [8], an estimated 797,500 children were reported missing from home in the year 1999. The National Center for Missing and Exploited Children [9] offers age progression and facial reconstruction services which take up to 7 days to produce. With the enormous number of missing children, automated software to produce the age progressed portraits would be practical and useful.

3. Updating Employee Database:
Numerous companies have employee records with photographs of the employees stored in their database. After a certain number of years, the employees have to update their photographs to match their current appearance. Automatic software such as ours might eliminate the need for this, by automatically aging the entire database of employees [10].

II. LITERATURE SURVEY

There are a large number of algorithms are available for age progression. Comparison between these algorithms is shown in Table 1, Correct Identification Rate and Mean Absolute Error (MAE) is used for comparison. MAE is defined as average absolute error between estimated and chronological age [20]. The lowest the MAE the more accurate the algorithm is. Most commonly used database also used in this comparison is FG-NET database and MORPH database. Algorithms by Correct Identification Rate and MAE can be seen in Table 1.

TABLE 1 Comparison of different techniques

Title, Author, Publication	**Method used**	**Result**
Title: Age Progression for Elderly People Using Image Morphing[13] **Authors:** L. L. Gayani Kumari, and Anuja Dharmaratne **Publication:** IEEE, 2011	Anthropometry Model + Image Morphing	Correct Identification Rate = 60%
Title: Matching Facial Images Using Aging Related Morphing Changes[15] **Authors:** Udeni Jayasinghe & Anuja Dharrnarathne **Publication:** World Academy of Science Engineering & Technology, 2009	Anthropometry Model + Warping Algorithm	Correct Identification Rate = 54%
Title: Image Based Surface Detail Transfer[23] **Authors:** Y. Shan, Z. Liu and Z. Zhang **Publication:** Hawaii, Dec 2011	IBSDT	NA
Title: Learning from Facial Aging Patterns for Automatic Age Estimation[16] **Authors:** X. Geng, Z.-H. Zhou, Y. Zhang, G. Li, and H. Dai **Publication:** IEEE, 2006	AGES	Mean Absolute Error = 6.77%
Title: Automatic Age Estimation Based on Facial Aging Patterns [17] **Authors:** X. Geng, Z.-H. Zhou, Y. Zhang, G. Li, and H. Dai **Publication:** IEEE, 2007	Modified AGES	Mean Absolute Error = 6.22%
Title: Age Invariant Face Recognition Using Graph Matching[18] **Authors:** Gayathri Mahalingam & Chandra Kambhamettu **Publication:** IEEE, 2010	Graph and Gaussian Mixture Model (GMM)	Error Rate = 29.2%
Title: Modelling Age Progression in Young Faces[11] **Authors:** Narayanan Ramanathan, Rama Chellappa **Publication:** IEEE, 2006	Craniofacial growth model	Correct Identification Rate = 58%

III. PROBLEM DEFINITION

From the literature survey it can be conclude that for modeling age automatically image morphing method is more appropriate than other methods. Authors of paper used morphing method for change in facial shape, but not added texture information like fine lines, wrinkles. So, it can be said that by adding texture information we can get approximate aged face image at the given target age. So, I have decided to implement this facial change using feature based morphing technique and add texture variation using Image Based Surface Detail Transfer (IBSDT) method.

IV. PROPOSED METHODOLOGY

Process of proposed methodology for age progression is illustrated in Fig 1. :

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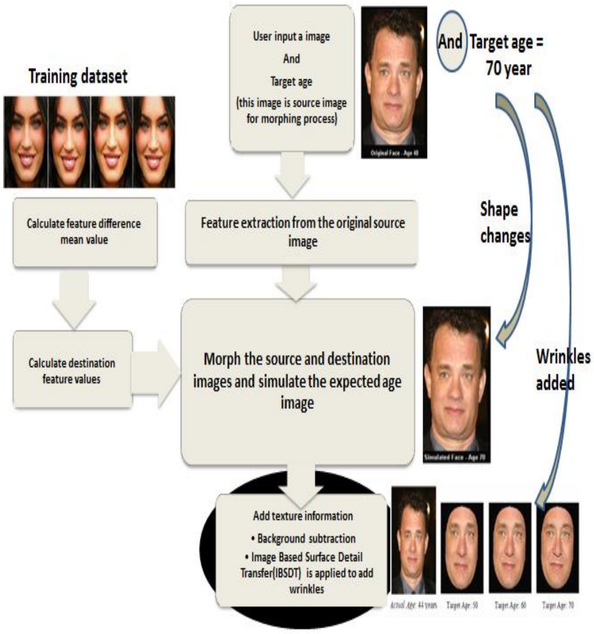

Fig 1. Proposed methodology

There are several steps for the above process:
A. Feature extraction from the input image
First user input one image which he/she want to covert at targeted age. Then User gives one target age. After that, user needs to select the above mentioned 5 features and store values of those feature points in one data file manually.

B. Compute mean values by taking feature difference
First they compute the difference for the 5 features for every image in the test dataset and for every age bunch.
Then they compute the mean value difference for the 5 features and for every image in test dataset.

C. Calculate destination feature values
Using mean value difference of the 5 features, new values for the facial feature according to the target age has been computed or extracted from the data file.

D. Morphing is done between the source and destination images and reproduce the expected age image
Here, authors used feature based warping algorithm [14]. Working of this algorithm is as follow:

1 .Distortion of a Single Image:
For warp an image, there are 2 ways:

- Forward mapping, look over the source image pixel by pixel, and duplicates them to the suitable spot in the destination image.
- Reverse mapping, look over the destination image pixel by pixel, and duplicates them to the suitable spot in the source image.

Here, we used reverse mapping. The most essential component of reverse mapping is that each pixel in the destination image inspires set to something suitable, while in forward mapping case, a few pixels in the destination won't get painted, and would need to be added.

2. Single Line Pair Transformation:
A couple of lines (one characterized in respect to the source image, the other characterized in respect to the destination image) characterizes a mapping from one image to the next. (In this, pixel co-ordinates determined by BOLD UPPERCASE ITALICS, lines are determined by sets of pixel co-ordinates, scalars specified by intense lowercase italics, and prepared variables (X', u') are qualities characterized in respect to the source image. We utilize the term line to mean a coordinated line portion.)

A couple of relating lines in the source and destination images characterizes a co-ordinate mapping from the destination image pixel coordinate X to the source image pixel coordinate X' such that for a line PQ in the destination image and P'Q' in the source image.

The worth u is the position along the line, and v is the distance from the line. The quality u goes from 0 to 1 as the pixel moves from P to Q, and is under 0 or more prominent than 1 outside that range. The worth for v is the opposite separation in pixels from the line. In the event that there is only single line pair, the transformation of the image continues as takes after:

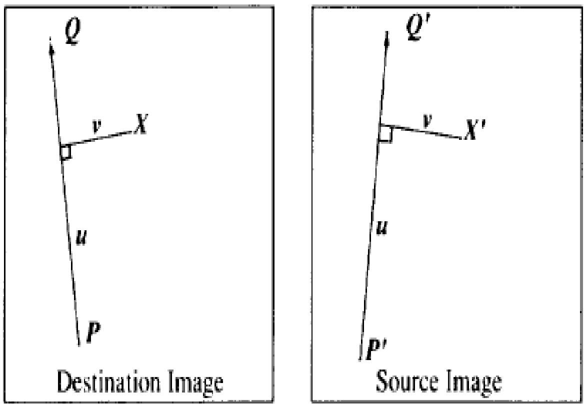

Fig 2. Single Line Pair Transformation

For every pixel X for the destination image find the corresponding U, V find the X’ in the source image for that U,V destinationimage(X) = sourceImage(X’)

In Fig 2., X' is the area to test the source image for the pixel at X in the destination image. The area is at a distance v (the distance from the line to the pixel in the source image) from the line P'Q' and at an extent u along that line.

3. Morphing Between Two Images:
A morph operation blends between two images, I1 and I2 (where, I1 is source image and I2 is destination image). To do this, we characterize relating lines in I1 and I2. Every middle casing I of the transformation is characterized by making another arrangement of line fragments by adding the lines from their positions in I1 to the positions in I2.

Interpolation can be done in 3 ways:
1. Affine interpolation for triangle

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2. Bilinear interpolation for quadrangle
3. Bicubic interpolation.

Here we applied Bicubic interpolation.

E. Add Texture Variations

Author's introduces a system which known as image-based surface detail transfer (IBSDT) exchanges geometric points of interest between the images of two surfaces without knowing their 3D data. One important utilization of IBSDT is aging impact combination. Geometrically, older individuals have more bumps on their facial skin surface than a youngster. In the event that we exchange the bumps from an old individual's skin surface to a youngster's face, the youngster's face gets to be uneven/ bumpy and looks like older person's face.

When we adjust the pictures, we can run a Gaussian filter with a user determined σ to acquire aged face. Naturally, the σ of the Gaussian filter controls how much geometrical smoothing we perform on the surface of given image. So the σ decides the exchanged surface points of interest's scale. A little σ permits exchange of fine geometrical points of interest; an expansive σ permits just substantial scale geometrical distortions.

V. IMPLEMENTATION

In this section feature parameters and implementation is described:

A. Feature Parameter

Feature parameters used are listed below:

1. Height of the forehead
2. Height of the chin
3. Width of the left cheek
4. Width of the right cheek
5. Width of the lip line

B. Implementation

Step 1: User input image and target age:

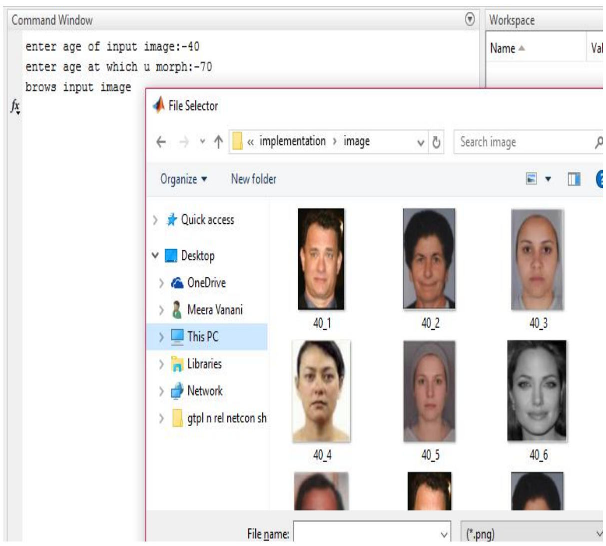

Fig 3 Output of user input image and target age

Step 2: Feature extraction from the original source image:

Fig 4. Output of feature extraction

image	Ax	Ay	Bx	By	Cx	Cy	Dx	Dy	E
40_1	32	58	67	56	125	58	146	56	
40_2	49	58	77	59	136	55	156	55	
40_3	14	57	59	56	127	57	152	56	
40_4	11	51	50	54	114	54	140	55	
40_6	18	56	64	58	136	60	159	60	
40_7	29	57	69	56	129	58	151	58	
50_1	27	60	67	58	123	58	145	56	
50_2	46	56	79	58	137	55	160	56	
50_3	13	58	57	58	125	59	152	61	
50_4	12	50	52	52	115	54	137	55	
50_6	17	58	65	60	137	61	163	61	
50_7	12	51	63	46	131	46	157	48	

Fig 5. Values of extracted features

Step 3: Calculate feature difference mean value:

Feature	Forehead	Chin	Left cheek	Right cheek	Lip line
x diff	35	21	0	1	7
y diff	2	2	28	30	0
x diff	28	20	2	4	5
y diff	1	0	27	25	0

Fig 6. Output of feature difference value

Age 40-50					
Feature	Forehead	Chin	Left cheek	Right cheek	Lip line
x mean diff	33	20	2	3	9
y mean diff	1	1	25	27	0
Age 50-60					
Feature	Forehead	Chin	Left cheek	Right cheek	Lip line
x mean diff	37	21	2	4	9
y mean diff	2	1	25	23	0

Fig 7. Output of feature mean difference values

Step 4: Calculate destination feature values:

Feature	Forehead	Chin	Left cheek	Right cheek	Lip line
x diff	37	21	2	4	9
y diff	2	1	25	23	0

Fig 8. Output of destination feature values

Step 5: A. Morphing is done between the source and destination images and reproduce the expected age image:

Fig 9 Simulated face images at age of 50, 60, 70

Step 6: Add texture information:

Fig 10 Output after adding wrinkles

VI. RESULT

Performance evaluation parameter is in terms of similarity measurements which are:

A. Euclidean distance
The Euclidean distance or Euclidean metric is the "ordinary" (i.e. straight-line) distance between two points in Euclidean space [27]. For pixel p and q, with coordinates(x, y), and (s, t), respectively, $d_e(p, q)$ is Euclidean distance between p and q is defined as[28],

$$d_e(p,\ q) = \sqrt{(x-s)^2 + (y-t)^2} \ldots \text{(Eqn 1)}$$

B. City block distance
The city block distance is path between the pixels based on a 4-connected neighbourhood [26]. In city-block space you can only move along one dimension of the space at a time. By analogy, in a city of rectangular blocks, you can't cut diagonally through a block, but must walk along either of the two dimensions of the block [25]. For pixel p and q, with coordinates(x, y), and (s, t), respectively, $d_4(p, q)$ is City block distance between p and q is defined as[28],

$$d_4(p,q) = |x-s| + |y-t| \ \ldots \text{(Eqn 2)}$$

By using these evaluation parameters dissimilarity between the simulated face image and original face image is calculated. Here, for calculate the similarity and understanding purpose the Euclidean distance and city block distance values are subtracted from 100. Figure 11 and Figure 12 shows the evaluation parameters values before and after adding wrinkles.

	ECD	**CDI**
Image at **age 70**	78.8441%	64.7416%

Fig 11. Output of evaluation parameter values before adding wrinkles

	ECD	**CDI**
Image at **age 70**	85.6264%	76.5661%

Fig 12. Output of evaluation parameter values after adding wrinkles

VII. CONCLUSION AND FUTURE WORK

Feature based morphing method is applied on given input face image for simulate the face image at the target age which gives face shape changed image. Now as we know wrinkle information is very important feature for generating aged face. So for that purpose Image Based Surface detail Transfer (IBSDT) method is used to add texture information on output of morphing process to generate appropriate aged face. And parameter evaluation values give the similarity between the original image of that age and simulated image.

The next step of the research is to extend the same application by considering more feature parameters like Height of the face, The length of the cornea, Palpebral pouches, Slough of the eyelids, Elongation and rotation of the nose, Lateral pouches of the face etc. and also by adding hair and eye line color changes with age progression.

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