Modifying Face Image for Ageing Marks using Specialized Filter

Fayas Asharindavida
College of Computers and IT
Taif University,KSA
Email: fayas.a [AT] tu.edu.sa

Abstract— **Ageing process is a non reversible process, causing human face characteristics to change over time. Human face is the first way of attraction and ageing marks are most visible on the face. Image processing area has developed vastly that it can be used to enhance a human face image without any manual intervention. Here we propose a novel method to detect the ageing marks from the face images and remove it automatically without any manual operation. After the age marks removal the face image looks as if the age is reduced to five years or ten years based on the density of the ageing marks. We focus on the areas around the eyes, forehead and the cheek area. These areas are found by Active Shape Modeling and the operations are done using various methods and specialized filters including edge preserved smoothing filters. The beauty of the algorithm is that it works in real time and gives the results quickly.**

Keywords-- face enhancement; ageing marks; filters

I. INTRODUCTION

Digital world is advanced in such a way that the images taken by a camera can be modified to any extent. These modified images can be displayed through printers and displays. Facial images are the most modified images because it is the first attraction of a person. Everybody wants their facial images to be good and so that others would admire it. At the same time facial skin is the most affected area during ageing, exposure etc. It might become dark, creates small marks in the surface such as wrinkles, blemishes, pimples, etc. Even though it is possible to reduce the ageing marks or blemishes to an extent from the faces physically but it is not so easy and fast.

But the facial images which contain the ageing marks and blemishes are easy to modify using sophisticated algorithms available [1][2]. Various image processing operations can be done on the facial images to achieve the modification to the required level. This process is often called as digital beautification of the facial image and currently it is easy effective by the emergence of high speed hardware devices and various image processing algorithms.

Here in our work we effectively reduce the ageing marks such as wrinkles and blemishes in the facial images. Wrinkles are the most prominent ageing marks which will appear on the face as age goes. The density of the wrinkle can be used to judge the skin age of a person. If the skin is not maintained well and is not health conscious, the skin will look old and might contain wrinkles even the person is not that much old. Everybody in this case will love to see their faces without wrinkles or clean faces.

Our work will effectively find out the areas containing age marks and clears it or reduces it based on its density. The proposed algorithm will effectively detect the affected area on the face especially around the eyes and forehead. This area segmentation is done using a method called active shape modeling [3]. After detecting the age marks, various image processing operations are carried out and filtered using edge preserved smoothing filters that uses the method of weighted least square framework. This method works in real time so that the result can be viewed quickly. The application is very helpful for those who want to see their faces without wrinkles and blemishes which make them happy and create health conscious to keep their skin healthy.

II. EXTRACTING HUMAN FACE FROM IMAGE

Face has to be extracted from the image which contains other areas and background. This task is achieved using various methods such as using haar classifiers, adaboost learning [4][5], etc. Once the face area is detected from the image, we need to detect the areas where wrinkles and blemishes are most commonly seen. From the studies of health science and cosmetic area it is confirmed that it occurs

commonly on outside edges of the eyes, under the eyes and forehead [6]. Extraction of these areas is done using the landmarks points provided by a mathematical model called as Active Shape Models.

III. ACTIVE SHAPE MODELS

Active shape models are an advanced method similar to contours, actives contours or snakes. ASM was initially proposed by Tim Cootes and Chris Taylor [3] in 1995 and modified later to overcome many of its limitations such as computational complexity [7] and convergence issues. ASM are statistical models of the shape objects which will iteratively deform to fit to the training shape. Shapes which are labeled with points are given to training using the point distribution model and are controlled by shape model. The aim of the ASM algorithm is to match the model trained to a given new image. In short ASM represents a parametric deformable model where a statistical model of the global shape from the training set is constructed.

Active shape model is aimed to automatically locate the landmark points which define the shape models. When considering the face models, the landmark points required consists of the points which lie on the shape boundaries of facial features such as eyes, lips, nose, mouth and eyebrows. ASM works based on the mean face shape determined from training stage whose position and size are aligned using a global face detector. The algorithm searches for landmarks from the means face image and does the two step procedure till convergence. First procedure will propose a new shape by modifying the existing points of the landmarks with considering the neighbors of the current point. And then based on the landmark's model descriptor which was generated during the training, new location for the landmark is formed by adjusting its position with the neighbor. Then in the second procedure, the new shape is proposed as the global shape which helps in correcting the positioning during updating. This entire procedure is repeated from coarse to fine resolution at each level in an image pyramid.

Fig.1. Landmarks marked on the image
(courtesy. MUCT database)

IV. AGEING MARKS

When people grow older age marks appear on their face including wrinkles and blemishes. These ageing marks decrease the beauty of the face image. Human skin changes with age and a wrinkle is created by slacked of facial muscle. After about 30 years old, facial wrinkles will be obviously visible, which is a beginning of skin maturing. Wrinkles usually appear on the surrounding of the face organs, like the regions of forehead, corner and bag of both eyes, between the sides of the noise and at the ends of mouth.

Normally wrinkles appear to people who get older, but there are some cases where some skin gets wrinkles even before it. People with these wrinkles will hesitate to put their images in its original form. It would be a boon for them if their wrinkles got removed from their images and looks younger. Researchers have been working from long time in the area of beautification of images [8]. Especially there are some works in the area of face modification, including digital makeups, changing the color, deformity adjusting etc. But there is no much works done in the area of removing age marks such as wrinkles in real time. This is achieved by using advanced form of edge preserved smoothing filter which uses weighted least square method for smoothing.

V. EDGE PRESERVED SMOOTHING USING WEIGHTED LEAST SQUARE METHOD

Multi scale It is always better to work on details at different scales rather than working on single scale. Multi scale image processing is achieved by using any of the multi-scale decompositions such as Laplacian pyramid [9]. As we know that such pyramids are created by linear filters which are produces halo artifacts near edges. In order to reduce these kinds of artifacts non linear filters are used. At this point comes the importance of edge preserved smoothing filters which are non linear filters.

The artifacts produced near the edges can be reduced by using advanced versions of traditional edge preserved

smoothing filters. Some of the different methods used are robust smoothing [10], anisotropic diffusion [11] and bilateral filter [12]. One different method is based on the weighted least squared framework. It was used originally in the denoising stage of images to reduce the ringing effect [13]. We found that this method is very much suitable to reduce the ageing marks such as wrinkles very effectively without affecting the face image.

According to [14] edge preserved smoothing should smooth as much as possible but at the same time as same as the original image. if the original image is given as w and the smoothed image is given as v, then the typical edge preserved smoothing filter is minimizing function

$$\sum_l (w_l - v_l)^2 + \gamma\left(b_{x,l}(v)\left(\frac{\partial w}{\partial x}\right)_l^2 + b_{y,l}(v)\left(\frac{\partial w}{\partial y}\right)_l^2\right) \quad (1)$$

where p is the spatial location of a pixel. Minimizing the first term gives the minimum distance between the original image and smoothed image. The second term achieves the smoothness by minimizing the partial derivatives of the original image w. Smoothness is controlled by the smoothness weights b_x and b_y. γ is the tem which is playing in between the two terms ie between the difference of images and smoothness value. If γ is increased, we will get a smoother image.

The smoothness weights b_x and b_y can be defined as explained in [14]:

$$b_{x,l} = \left(\left|\frac{\partial p}{\partial x}(l)\right|^{\alpha} + \varepsilon\right)^{-1} \quad (2)$$

$$b_{y,l} = \left(\left|\frac{\partial p}{\partial y}(l)\right|^{\alpha} + \varepsilon\right)^{-1} \quad (3)$$

where p is the log luminous channel of the input image w. The term α controls the sensitivity of the gradients of the smoothed image v and normally it lies between 1.2 and 2.0. The term ε is used to avoid division by zero situations. These smoothness coefficients are the main terms to preserve the axis aligned to the edges.

VI. PROPOSED ALGORITHM

Firstly, Image is captured using the webcam and send to the system. Then face detection is done on the image and the RGB image is converted into CIELAB color space. We consider the L component which is not affected by illumination changes. Face feature points are extracted using ASM and then the Wrinkles and Age spot detection are done. These age marks and wrinkles are cleared by the specialized filters such as the edge preserved smoothing filters.

A. Modified ASM

Modified Active shape models are applied to the image captured. Modified ASM generates 100 landmark points which covers whole face region, excluding eyes, nose and eye brow region of the face. Landmark points are used to extract the face region.

Fig. 2. Modified ASM land mark points (100 points)

Landmarks points [0-24] represent outer face region. Points [25-32] represent left eyebrow region. Points [33-41] represent left eye region. Points [45-51] represent right eyebrow region. Points [52-59] represent right eye region. Points [68-78] represent lip regions and remaining points from [79-99] covers nose position. Face mask is generated using convex hull Technique [1] using the outer face landmark points.

$$A\{k\} = (A\{k-1\} * B) \cup A\{k-1\} \quad (4)$$

Where B is one of the structural elements, A is the original image, * represents the hit-or miss transform and 'U' represents the Union operation.

For the detection of age marks only left eye, right eye, forehead and cheek regions are considered. Using ASM land mark points a specific mask is been generated

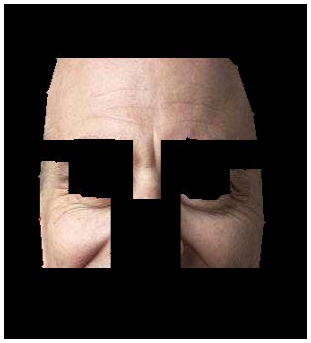

Fig. 3. Face mask created from the modified ASM

B. Detection of wrinkles and blemishes

After Modified ASM is fitted to the image, we will have 100 facial feature points. With the help of the face mask constructed we get the expected wrinkles regions of the face region. We use horizontal and vertical sobel filter for detecting the wrinkles in the specific region. The average edge strength in each region is defined as the quantification of wrinkles feature. We apply a threshold condition to the edge intensity for getting the correct wrinkles from the image. Main concentration will be on the forehead and eye corners.

We used Laplacian of Gaussian (LoG) filter for detecting the age spots and blemishes. Moles are excluded as it is not part of the age marks. But sometimes moles are wrongly classified as age marks and get removed in the process.

C. Removal of age marks

Wrinkles and age spots detected are removed or reduced by the modified edge preserved smoothing filter which works under weighted least square framework. With adjusting the smoothing factor we can remove the wrinkles and age spots from facial images partially or completely without affecting the quality of the face image.

VII. RESULTS

The method was implemented with OpenCV and used MUCT database for training and testing purpose of the ASM fitting. In the real time experiment, we have taken the images using Logitech pro-9000 webcam with a resolution of 800*600. We experimented with more than 300 images whose age ranges from 22-70. Our system was successful in identifying the marks and effectively reduced the intensity of those marks.

(a) (b)

Fig.4. (a) Original Image (b) Age marks removed image

(a) (b)

Fig.5. (a) Original Image (b) Age marks removed image

VIII. CONCLUSION

We presented a real time human face age marks removal method. We have used modified Active shape model (ASM) to locate the facial feature points. Ageing features like wrinkle and age spots detection is done and correspondingly the marks are effectively removed without affecting the face image. Anybody can visualize the wrinkle free and age spots reduced images of their own faces to get a feeling of going to younger age. Even though we have successfully implemented the age marks removal method there are still some challenges which has to be addressed in future such as hair on the face and moles detected as age spots.

ACKNOWLEDGMENT

Sincere thanks to Rajesh Paul, Arvind.C.S, Harinath.P and Sridhar.N for their support and help.

REFERENCES

[1] W. Chen, D. Y. Huang, and C. S. Fuh, “Automatic Skin Color Beautification,” Proceedings of ArtsIT, Ilan, Taiwan, pp. 157-164, 2010

[2] Dong Guo, Terence Sim , “Digital Face Makeup by Example”, IEEE Conf. on Computer Vision and Pattern Recognition (CVPR), Miami, USA, 2009

[3] Cootes, T. F., Taylor, C. J., Cooper, D. H., and Graham, J, “Active Shape Models — their Training and Application”, CVIU, .1995,

[4] Viola and Jones, "Rapid object detection using a boosted cascade of simple features", Computer Vision and Pattern Recognition, 2001

[5] Robert E. Schapire , Yoram Singer, Improved Boosting Algorithms Using Confidence-rated Predictions , Machine Learning,1999 pp. 80-91.

[6] Stefanaki C, Stratigos A, Katsambas A, "Topical retinoids in the treatment of photoageing". Journal of Cosmetology and Dermatology, June 2005

[7] C¸ Eliktutan, O., Ulukaya, S., and Sankur, B, “A Comparative Study of Face Landmarking Techniques”, EURASIP Journal on Image and Video Processing, 2013.

[8] ChanghyungLee,MorganT.Schramm,Mireille,Boutin,Jan and P.Allebach, “An Algorithm For Automatic Skin Smoothing In Digital Portraits”, ICIP 2009

[9] P. J. Burt and E. H. Adelson, "The Laplacian pyramid as a compact code," IEEE Transaction on Communications, vol. COM-31, pp. 532-540, Apr. 1983

[10] Black, M. J., Sapiro, G., Marimont, D. H., and Heeger,D.. Robust anisotropic diffusion. Image Processing, IEEE Transactions on 7, 3, 421–432, 1998

[11] Perona, P., and Malik, J, “Scale-space and edge detection using anisotropic diffusion”,IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 12, 629–639, 1990.

[12] Tomasi, C., and Manduchi, R, “Bilateral filtering for gray and color images”, Proceedings of the Sixth International Conference on Computer Vision, IEEE Computer Society, Washington, DC, USA, 1998.

[13] Lagendijk, R. L., Biemond, J., and Boekee, D. E, “Regularized iterative image restoration with ringing reduction”, Acoustics, Speech, and Signal Processing [see also IEEE Transactions on Signal Processing], IEEE Transactions on 36, 12, 1874–1888, 1988.

[14] Lischinski, D., Farbman, Z., Uyttendaele, M., and Szeliski, R, “Interactive local adjustment of tonal values”, Proceedings of ACM SIGGRAPH, ACM, New York, NY, USA, 646–653, 2006.