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Survey Of Facial Marks Detection Techniques

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Abstract- **Biometrics were mostly used to detect the criminals now a day's using various features like face, iris, eyes, fingerprints etc. But now days some other features like facial marks are too used for matching the images. Rather these features are not permanent and can't even uniquely identify the person but still these are used as these will narrow down the search in case of large databases. These methods which detect and count various types of facial marks are also used in skin treatments to overcome the problems of manual count that earlier exist. Here in this paper we surveyed various marks detection, identification and counting techniques which have their application in various areas. These techniques are proposed and even some are currently used by various agencies too.**

1. INTRODUCTION

In Forensics, Biometrics played an important role for detecting the criminals. Now a day's most current era of research is moving towards the techniques to improve detection, indexing and matching of biometrics like fingerprints, eyes, Iris and face. Out of which Face detection got more attraction in digital image processing. Digital image processing played an important role. The face recognition techniques defined so far used to detect only primary facial features like eyes, nose, lips, ears, hairs etc. These local features were used matching face images. But now a day's face recognition is extending towards detection of facial marks usually known as soft biometrics (or facial marks). However not only in forensics the image processing is now used in medical sciences in skin treatments too. In starting these techniques were developed to check the improvement in treatment of facial marks like acne, scars etc. As earlier methodology used was manual count that was time consuming and unreliable too. Therefore in recent years there has been an increasing interest in automatically detecting and counting Facial Marks using computer-based methods. Major categories of marks detected by current scenario of techniques is reddish papule, pustule, comedo, scars, Freckles, Mole, wrinkles, dark skin, abrasion etc. However many of these marks disappear after some time or days .That is why we define them as soft biometrics. But still they are used in Face detection techniques.

Facial marks are used in three ways

(i) To supplement the features in an existing face matcher.

(ii) To enable fast retrieval from large database using face images with marks.

(iii) To enable matching as retrieval for a partial or profile face images with marks.

These marks can't uniquely identify an individual, but can be used to narrow down the search for an identity.

Here in this paper we examined various techniques to detect facial marks including some traditional techniques as well as new, derived and proposed techniques given by various researchers. These techniques are used in various environments, like marks hidden under cosmetics, marks having color similar to that of skin as well as some differentiating between various types of marks etc. The data we are examining will be useful for future reference to find the best suited techniques in face matching and retrieval. Also it will somewhat compare these techniques too by the table defined at last in this paper.

Acne Lesion	Figure	Size	Color
Whitehead		Tiny	Whitish
Blackhead		Tiny	Black or brown
Papule		Less than 5mm in diameter	Pink
Pustule		Less than 5mm in diameter	Red at the base with a yellowish or whitish center
Nodule		5 to 10mm in diameter	Pink and red
Cysts		More than 5mm	Red

Fig. 1 Various types of Facial marks.

2. TRADITIONAL TECHNIQUES TO DETECT FACIAL MARKS

Manual counting and analysis- Till now many of the dermatologist still use to have manual counting of various marks for the treatment of the acne, scars etc. This is very time consuming and unreliable. Detecting the marks manually on the face of a patient is too time consuming and also classifying various scars or marks is not easily possible. Some of doctors now a day's uses image to find and count various types of marks which is still a manual system. That must be replaced by newer automatic techniques. As manual systems were there so forensics also not having much use to narrow down the search results however they may use them to uniquely identify the persons.

Pixel by pixel- In these techniques that was designed to compare two images pixel by pixel. In pixel by pixel method each and every pixel of image is compared with the corresponding pixel in second image if any changes were found it will report error. But this technique was not too successful as two images captured at different times will not always be same as the position of the objects in image will never be same at different times.

Cutaneous silicon rubber cast was used to make micro relief impression of the scars. Photos of the impressions made by scars on the cast were captured, and the depth was evaluated. A reduction in the depth – assessed visually – was used mainly for assessing the efficacy of treatment, although a 'degree of irregularity of the surface micro reliefs was also computed using the FFT. However, the overall procedure is complicated, expensive and requires experienced professionals.

3. DERIVED TECHNIQUES TO DETECT FACIAL MARKS.

Anil K. Jain and Unsang Park [1] propose to utilize micro features, namely facial marks (e.g., freckles, moles, and scars) to improve face recognition and retrieval performance. They first apply the Active Appearance Model (AAM) to detect and remove primary facial features such as eye brows, eyes, nose, and mouth. These primary facial features are subtracted from the face image. Then, the local irregularities are detected using the Laplacian-of-Gaussian (LoG) operator. Finally, we combine these distinguishing marks with a commercial face matcher in order to enhance the face matching accuracy. There method differs significantly from the previous studies in the following aspects: (a) It extract all types of facial marks that are locally salient and (b) It focus on detecting semantically meaningful facial marks rather than extracting texture patterns that implicitly include facial marks. Experimental results based on FERET (426 images, 213 subjects) and Mugshot (1,225 images, 671 subjects) databases show that the use of facial marks improves the rank-1 identification accuracy of a state of-the-art face recognition system from 92.96% to 93.90% and from 91.88% to 93.14%, respectively. They do not distinguish between the individual marks categories. Instead, there focus is to automatically detect as many of these marks as possible.

Biman Chandra Dey, Nirmal B., and Ramesh R. Galigekere addresses detection of acne scar-pixels based on color image processing. The RGB model is used to representing the data. Pixels from the background (skin) and from the lesions of interest (acne scars) were recorded from the images of 7 subjects, to build a knowledge-base *i.e.*, clusters associated with the skin and acne scars, respectively. The clusters were found to be fairly distinct in the RGB space. Consequently, classification (segmentation) is performed by minimum-distance-rule in the RGB space, by using Mahalanobis distance (MD). They have also implemented Bayes' method. The results have been validated with respect to the ground-truth extracted by manual segmentation of scars. The classifier based on MD performs better than that based on Bayes, with the average values of sensitivity and specificity of the former being 90.36 and 93.82, respectively.[2]

Hideaki Fujii, Takashi Yanagisawa, Masanori Mitsui, Yuri Murakami, Masahiro Yamaguchi,Nagaaki Ohyama, Tokiya Abe, Ikumi Yokoi, Yoshie Matsuoka, and Yasuo Kubota, proposes an extraction method using the spectral information of the various type of acne skin lesions (comedo, reddish papule ,pustule and scar) calculated from the multispectral images (MSI) of the lesions. They first removed the effect of shade and gloss in preprocessing, and then used the spectral information at each pixel for the classification. In the experiment, it shows the possibility of classifying acne lesion types by applying a combination of several linear discriminant functions (LDF's).[3]

Siddharth K. Madan and Kristin J. Dana, O.Cula model acne-like and non-acne regions using spatiotemporal features, and use a supervised learning approach to find the separating hyperplane between the regions in the feature space. The temporal component is an important feature because acne lesions change over time, while scars and other marks remain constant. Precise alignment is a challenge in computing meaningful temporal features. The images must be aligned to a subpixel level, exceeding the requirements of typical face alignment algorithms. We have acquired and aligned a time series acne dataset by

imaging a human subject with facial acne under the same illumination and pose on 39 different days over a period of three months. The resulting time-lapse video of skin with precision alignment is the first of its kind and impressively demonstrates the temporal evolution of acne lesions. We use this registered time-lapse set to train and test an acne lesion classifier[4]

Roshaslinie Ramli, Aamir Saeed Malik, Ahmad Fadzil M. Hani, Felix Boon-Bin Yap To develop algorithm with an automated acne grading method is the objective of this proposed method. This work presents an image segmentation method for acne lesions based on color features with K-means clustering. The segmentation results from randomly selected images show the sensitivity, specificity, positive predictive value and negative predictive value greater than 81%.[5]

Roshaslinie Ramli, Aamir Saeed Malik, Ahmad Fadzil M. Hani, Felix Boon-Bin Yap They proposed an algorithm to identify acne lesions, scars and normal skin features. They used photographs taken by Digital Single-Lens Reflex (DSLR) cameras. At the very first step Region of interest (ROI) for each part is cropped from the original images. The images are converted from RGB to CIELAB color space, thresholded to three clusters and segmented using minimum Euclidean distance. The segmentation results from randomly selected images show sensitivity and specificity of greater than 80%.[6]

Ziaul Haque Choudhury, K.M. Mehata completely focused to determine the facial marks which are covered by cosmetic items using global and local texture analysis methods. Therefore, to overcome such problems, They initially apply the (AAM) Active Appearance Model using PCA to detect the facial features. Some facial features such as eye brows, eyes, nose, and mouth are subtracted from the detected face image. They create a mean shape to detect the face automatically and also construct a mask for the face image. Finally, they apply canny algorithm to identify local irregularities by detecting the edges in the image and Speed Up Robust Feature (SURF) to extract the facial features. Therefore the detected facial marks were combined to enhance the face matching accuracy. The technique completely differs significantly from the previous studies in the following aspects: (1) initially It extracts all the facial marks that are locally salient and covered by cosmetic items. (2) It concentrates on finding semantically meaningful facial marks instead of extracting texture patterns that are implicitly based on facial marks. The proposed facial marks determination concept will be helpful to forensics and law enforcement agencies because it will supplement existing facial matchers to improve the identification accuracy.[7]

Unsang Park, Member, IEEE, and Anil K. Jain, propose to utilize demographic information (e.g., gender and ethnicity) and facial marks (e.g., scars, moles, and freckles) for improving face image matching and retrieval performance. An automatic facial mark detection method has been developed that uses 1) the active appearance model for locating primary facial features (e.g., eyes, nose, and mouth), 2) the Laplacian-of-Gaussian blob detection, and 3) morphological operators. Experimental results based on the FERET database (426 images of 213 subjects) and two mugshot databases from the forensic domain (1225 images of 671 subjects and 10 000 images of 10 000 subjects, respectively) show that the

use of soft biometric traits is able to improve the face-recognition performance of a state-of-the-art commercial matcher.

Nisha Srinivas, Gaurav Aggarwal, Patrick J. Flynn, Richard W. Vorder Bruegge we study the usability of facialmarks as biometric signatures to distinguish between identical twins. We propose a multiscale automatic facial mark detector based on a gradient-based operator known as the fast radial symmetry transform. The transform detects bright or dark regions with high radial symmetry at different scales. Next, the detections are tracked across scales to determine the prominence of facial marks. Extensive experiments are performed both on manually annotated and on automatically detected facial marks to evaluate the usefulness of facial marks as biometric signatures. Experiment results are based on identical twin images acquired at the 2009 Twins Days Festival in Twinsburg, Ohio. The results of our analysis signify the usefulness of the distribution of facial marks as a biometric signature. In addition, our results indicate the existence of some degree of correlation between geometric distributions of facial marks across identical twins.

4. VALIDATION

Table below summarize the validation done on Advanced Techniques discussed in section compared on the basis of methods to extract primary features of face and then the method used to detect the facial marks and whether its is learning based technique or uses existing knowledge base only and also which type of marks are detected by the technique

Sr. No.	Method Proposed or Implemented By	Types of Detected Facial Marks	Technique used to Extract the Primary Facial Features	Technique used to detect the Facial Marks	Learning based technique	Uses Knowledge Base
1.	Anil K. Jain and Unsang park[1]	Freckles, moles, and scars	Active Appearance Model (AAM)	Laplacian-of-Gaussian (LoG) operator	No	No
2.	Biman Chandra Dey,Nirmal B. [2]	Acne scars	Color based segmentation	Mahalanobis distance (MD)	yes	yes
3.	Hideaki Fujii, Takashi Yanagisawa[3]	Comedo ,reddish papule ,pustule ,scar		linear discriminant functions (LDF's)	yes	Yes
4.	Siddharth K. Madan and Kristin J. Dana [4]	Acne lesions	Images acquired under cross-polarized modality.	images acquired under cross-polarized modality.	Yes	Yes
5.	Roshaslinie	Comedones,pa	Region of interest	K-means	No	Yes

	Ramli, Aamir Saeed Malik [5]	pules, cysts pustules, nodules,	(ROI) Extracted	clustering		
6.	Roshaslinie Ramli, Aamir Saeed Malik [6]	Acne lesions, Scars	Region of interest (ROI) Cropped	Euclidean distance.	No	yes
7.	Ziaul Haque Choudhury, K.M. Mehata[7]	Facial Marks covered Under Cosmetics	Active Appearance Model (AAM)	SURF	Yes	Yes
8.	Unsang park and Anil K. Jain [8]	Demographic information (e.g., gender and ethnicity) and scars, moles, and freckles etc	Active Appearance Model (AAM)	Laplacian-of-Gaussian (LoG) blob detection and Morphological Operators	No	yes
9.	Nisha Srinivas, Gaurav Aggarwal [9]	Facial Marks used to distinguish between identical twins	Active Shape Model(ASM)	Fast Radial Symmetry Transform(FRST)	Yes	Yes

Table 1- Various technologies defined for automatic facial marks detection techniques

4. CONCLUSION AND FUTURE SCOPE

In this work we compared some existing techniques to detect the facial marks. These marks can be used for identification of a image in forensic science to retrieve the matching images from the existing database. Here we analyzed some techniques according to their properties which let the result that to find the primary face features like nose, lips, hairs etc the most efficient technology that is used is AAM i.e. Active Appearance Model. And for further detection of marks in image we can use various operators and distance measures according to their application in specified area. E,g. Laplacian-of-Gaussian (LoG) blob detection and Morphological Operators are used to identify the various types of marks present and SURF is used to detect the facial marks hidden under cosmetics. In Further studies we will try to compare these technologies based on some parameters using some tools like MATLAB etc.

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