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# Detecting Facial Retouching using SDL Technique

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## ABSTRACT

*Digitally altering, or retouching, face images is a common practice for images on social media, photo sharing websites, and even identification cards when the standards are not strictly enforced. This research demonstrates the effect of digital alterations on the performance of automatic face recognition, and also introduces an algorithm to classify face images as original or retouched with high accuracy. We first introduce two face image databases with unaltered and retouched images. Face recognition experiments performed on these databases show that when a retouched image is matched with its original image or an unaltered gallery image, the identification performance is considerably degraded, with a drop in matching accuracy of up to 25%. However, when images are retouched with the same style, the matching accuracy can be misleadingly high in comparison with matching original images. To detect retouching in face images, a novel supervised deep Boltzmann machine algorithm is proposed. It uses facial parts to learn discriminative features to classify face images as original or retouched. Metamorphosis between two or more images over time is a useful visual technique, often used for educational or entertainment purposes. A new technique is presented for the metamorphosis of one digital image into another to detect image forensics*

***KEYWORDS:*** *Image forensics, face recognition, face image retouching, face image alteration*



## I. INTRODUCTION

Face recognition is being increasingly used for both personal and security applications. Several of these applications such as controlled user authentication require a human in the loop. However, unattended applications such as surveillance, auto-tagging in media collection, and law enforcement require handling several other covariates such as disguise, aging, plastic surgery, and low resolution. Another covariate, which has received very little attention to date in the biometrics literature, is matching photographic images with retouched (tampered/doctored) face images.

### *Digital Image Forensics*

The development and ease of availability of image processing software and image capturing devices together with the ease of accessibility of the Internet has increased the ambivalence in the authenticity of the digital images. Uses of digital images as evidence for decision making or judgments and as support for a scientific argument are examples where not only ownership of the images is required to be established, but it is equally important to establish their authenticity.

Digital image watermarking and digital signatures have been used as active methods to restore the lost trust in digital images. These approaches embed some self-authenticating information in the digital media with the objective of assessing the authenticity and integrity of the digital images. Digital image watermarking belongs to the class of active approach for image forensics as it requires the knowledge of the authentication code and the method used to embed it into the image.

Instead, passive digital image forensics has been looked upon as the solution with the primary objective of validating the authenticity of the digital images by either detecting tampering or recovering information about their history. The passive authenticating methods are blind as these do not require the knowledge of the original image, but are based on the fact that most of the image capturing devices and image processing operations introduce distinct traces within the image generally referred to as the fingerprints. Passive digital image forensic methods study underlying fingerprints with respect to the two major working domains. The first domain pertains to source authentication where the purpose is to identify the device used for capturing the image and reconstruct its generation process. The second realm of digital image forensics is concerned with the detection of tampering to establish if the image has been manipulated and possibly identify the processes involved.

*A. Phases*

A digital image life cycle can be represented in three phases: acquisition, saving and editing. During acquisition phase, the diaphragm controls the amount of light from the real scene falling onto the image sensors, the shutter speed determines the time of exposure and the lens assembly focuses the light rays to form a coherent image onto the sensors. Digital cameras generally use either a charge-coupled device (CCD) or a complementary metal oxide semiconductor (CMOS) as image sensor. Each sensor is made of light sensitive diodes called photosites that convert photons falling on it into electric charge proportional to the intensity of the light. Each sensor captures the data for a single picture element or pixel in the image.

This will generate grayscale images because the sensors are unable to distinguish between colors. Usually, colors of an image are represented as a mixture of varying percentages of the three primary colors red, green, and blue. The color information is acquired by using a mosaic of the primary color filters known as the Color Filter Array (CFA). When it is laid over image sensors, only one of the primary color that matches the characteristics of the individual filter is allowed to pass and the other two colors are blocked for an individual pixel. Thus, brightness of one color per pixel is recorded. For example, a sensor with a green filter records brightness of green light only, falling on it. The color information of the neighboring pixels is used to interpolate the other two color components that were not recorded directly.
image and introduce new fingerprints too.

*B. Face Retouching*

Face makeup is a technique to change one's appearance with special cosmetics such as foundation, powder, cream etc. In most cases, especially for females, makeup is used to enhance one's appearance. With physical face makeup, the foundation and loose powder are usually used to change the texture of face's skin. Foundation is mainly used to conceal flaws and cover the original skin texture, while the loose powder is for introducing new, usually pleasant,texture to skin. Afterwards, applications of other color makeup, such as rouge, eye liner and shadow, etc., follow on top of the powder.Consider this scenario: when a customer enters a beauty salon, she selects an example image from a catalog and tells the makeup artist to apply the same makeup on her. Before actual task, it would be extremely helpful if she can preview the makeup effects on her own face.

However, this is difficult. Traditionally, people have two choices for trying out makeup. One is to physically apply the makeup, which is time-consuming and requires the patience of the participants. Alternatively, one may try on makeup digitally by way of digital photography and with the help of photo editing software, such as Adobe Photoshop TM. But using such photo editing software is tedious and relies heavily on the users' expertise and effort.

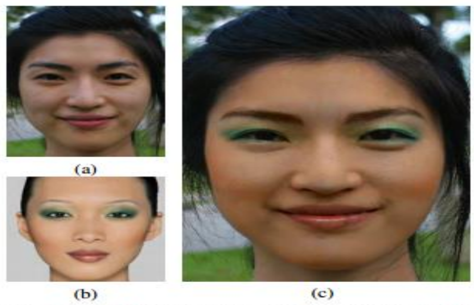


Figure 1. Face makeup by example. (a) A subject image, taken by a common user. (b) An example style image, taken from a professional makeup book [9]. (c) The result of our approach, where foundation effect, eye shadow, and lip highlight in (b) are successfully transferred to (a).

## II. LITERATURE REVIEW

1. *On the Impact of Alterations on Face Photo Recognition Accuracy*

This work is framed into the context of automatic face recognition in electronic identity documents. In particular we study the impact of digital alteration of the face images used for enrollment on the recognition accuracy. Alterations can be produced both unintentionally (e.g., by the acquisition or printing device) or intentionally (e.g., people modify images to appear more attractive). Our results show that state-of-the-art algorithms are sufficiently robust to deal with some alterations whereas other kinds of degradation can significantly affect the accuracy, thus requiring the adoption of proper detection mechanisms.

**Techniques used:** Face Recognition Algorithms

**Demerits:**

- Finally, alteration such as digital beautification, when applied with high strength, produce marked performance drop to all the system tested.
- Not involves in computing local binary patterns for face evaluation.

2. *Automatic Facial Makeup Detection with Application in Face Recognition*

Facial makeup has the ability to alter the appearance of a person. Such an alteration can degrade the accuracy of automated face recognition systems, as well as that of methods estimating age and beauty from faces. In this work, we design a method to automatically detect the presence of makeup in face images. The proposed algorithm extracts a feature vector that captures the shape, texture and color characteristics of the input face, and employs a classifier to determine the presence or absence of makeup. Besides extracting features from the entire face, the algorithm also considers portions of the face pertaining to the left eye, right eye, and mouth. Experiments on two datasets consisting of 151 subjects (600 images) and 125 subjects (154 images), respectively, suggest that makeup detection rates of up to 93.5% (at a false positive rate of 1%) can be obtained using the proposed approach. Further, an adaptive pre-processing scheme that exploits knowledge of the presence or absence of facial makeup to improve the matching accuracy of a face matcher is presented.

**Techniques used:** Automated makeup detector

**Demerits:** This method is not involved in improving the performance of the makeup detector and exploring methods to remove artifacts introduced by the application of makeup.

Therefore, it is essential to utilize both global and local information when detecting the presence of makeup.

3. *Recognizing Disguised Faces: Human and Machine Evaluation*

Face verification, though an easy task for humans is a long-standing open research area. This is largely due to the challenging covariates, such as disguise and aging, which make it very hard to accurately verify the identity of a person. This paper investigates human and machine performance for recognizing/verifying disguised faces. Performance is also evaluated under familiarity and match/mismatch with the ethnicity of observers. The findings of this study are used to develop an automated algorithm to verify the faces presented under disguise variations. We use automatically localized feature descriptors which can identify disguised face patches and account for this information to achieve improved matching accuracy. The performance of the proposed algorithm is evaluated on the IIIT-Delhi Disguise database that contains images pertaining to 75 subjects with different kinds of disguise variations. The experiments suggest that the proposed algorithm can outperform a popular commercial system and evaluates them against humans in matching disguised face images.

**Techniques used:** Automatically localized feature descriptors

**Demerits:** This study on face evaluation suggests that ethnicity and familiarity of faces can greatly affect the face recognition performance.

The proposed local approach (ITE based patch classification+LBP based recognition) does improve performance over traditional local approach (LBP based recognition).

However, the improved performance is only equivalent to the worst of human performance (Set UD) which favorably underlines the likely use of holistic facial features by humans.

4. *Plastic Surgery: A New Dimension to Face Recognition*

Advancement and affordability is leading to popularity of plastic surgery procedures. Facial plastic surgery can be reconstructive to correct facial feature anomalies or cosmetic to improve the appearance. Both corrective as well as cosmetic surgeries alter the original facial information to a great extent thereby posing a great challenge for face recognition algorithms. The contribution of this research is (i) preparing a face database of 900 individuals for plastic surgery, and (ii) providing an analytical and experimental underpinning of the effect of plastic surgery on face recognition algorithms. The results on the plastic surgery database suggest that it is an arduous research challenge and the current state-of-art face recognition algorithms are unable to provide acceptable levels of identification performance. Therefore, it is imperative to initiate a research effort so that future face recognition systems will be able to address this important problem.

**Techniques used:** Face recognition algorithms

**Demerits:** After surgery, the geometric relationship between facial features changes and there is no technique to detect and measure such type of alterations.

Due to the sensitive nature of the process and the privacy issues involved, it is extremely difficult to prepare a face database that contains images before and after surgery.

*5. Facial Makeup Detection Technique Based on Texture and Shape Analysis*

Recent studies show that the performances of face recognition systems degrade in presence of makeup on face. In this paper, a facial makeup detector is proposed to further reduce the impact of makeup in face recognition. The performance of the proposed technique is tested using three publicly available facial makeup databases. The proposed technique extracts a feature vector that captures the shape and texture characteristics of the input face. After feature extraction, two types of classifiers (i.e. SVM and Alligator) are applied for comparison purposes. In this study, we observed that both classifiers provide significant makeup detection accuracy. There are only few studies regarding facial makeup detection in the state-of-the art. The proposed technique is novel and outperforms the state-of-the art significantly.

**Techniques used:** facial makeup detector

**Demerits:** To improve the recognition accuracy of face matchers when matching makeup images against non-makeup images.

This method provides significant decrease in matching accuracy in presence of facial makeup.

## III. EXISTING SYSTEM

One of the alterations which can be expected to yield a similar effect on faces is makeup variations.In the existing system Facial makeup has the ability to alter the appearance of a person. Such an alteration can degrade the accuracy of automated face recognition systems, as well as that of methods estimating age and beauty from faces.Still there are several factors that continue to challenge the performance of face recognition systems.For instance, retouching can change the geometric properties of the face by altering the forehead and jaw line or the entire face sculpts. Makeup may make the face look slimmer in some ways, but the face shape in the image remains unchanged.These include factors related to aging, plastic surgery and spoofing.

- Face recognition algorithm suggested a significant decrease in matching accuracy when comparing facial images before and after the application of cosmetics.
- Makeup detection algorithms are unable to provide acceptable levels of identification performance.
- Plastic surgery can also be misused by individuals who are trying to conceal their identity with the intent to commit fraud or evade law enforcement.
- Edited images are detected using simple morphing and warping techniques.

**Disadvantages:**

- ✓ Accuracy is less.
- ✓ Detection of pool lighting, sunglass and morphing images are not well.
- ✓ Recognize the plastic surgery images are complex.
- ✓ Since retouching changes the appearance, it may also be compared with spoofing.

## IV. PROPOSED SYSTEM

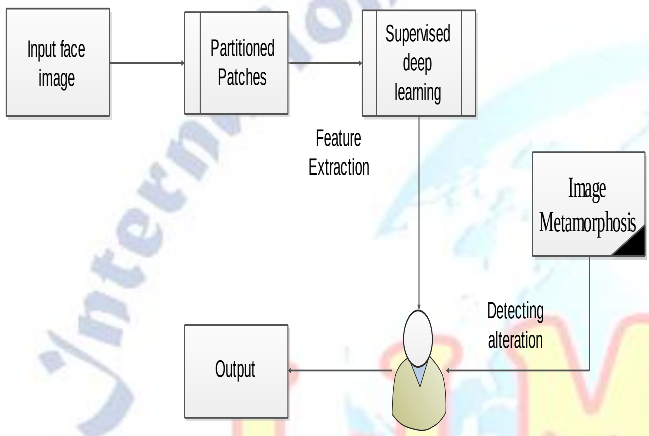
In this proposed method facial retouching detection is used for both personal and security applications.

- Facial retouching process altering facial features. Retouched images are used in the biometrics pipeline; recognition accuracy can be considerably affected.
- It uses facial parts to learn discriminative features to classify face images as original or retouched.
- The proposed supervised RBM can be learned using a labelled training database that consists of the two classes original and retouched.
- The face images are classified into four local facial patches.
- **“Deep learning”** algorithm is proposed for classifying face images as retouched or original.
- The proposed algorithm focuses on four facial patches and supervised features are learnt via deep learning framework to discriminate between original/unaltered and retouched variations. This helps in classifying the test images accurately.

Feature-Based Image Metamorphosis is used to detect the image forensic.The term "morphing" is used to describe the combination of generalized image warping with a cross-dissolve between image elements. This term is derived from "image metamorphosis".

**Advantages**

- ✓ Face retouching detection accuracy is high.
- ✓ Sunglass, pool lighting images detection are also well.
- ✓ Forensics image is detected




## V. FACE DETECTION TECHNIQUES

*Input Techniques:*

In this module, the test image is used for automatic extraction of the region of interest by calculating the mean of each row (column) and compared to the threshold as follows.

Image acquisition in image processing can be broadly defined as the action of retrieving an image from some source, usually a hardware-based source, so it can be passed through whatever processes need to occur afterward.

***Fig (a)Input face***

Performing image acquisition in image processing is always the first step in the workflow sequence because, without an image, no processing is possible. The input images are taken from file. These images are different format like jpg, tiff, gif mostly we are using jpg format because it will accept black image and colour image.

*Face patches*

In this module, the input face image is partitioned into four local facial patches. These partitioned patches are used for detecting retouching.

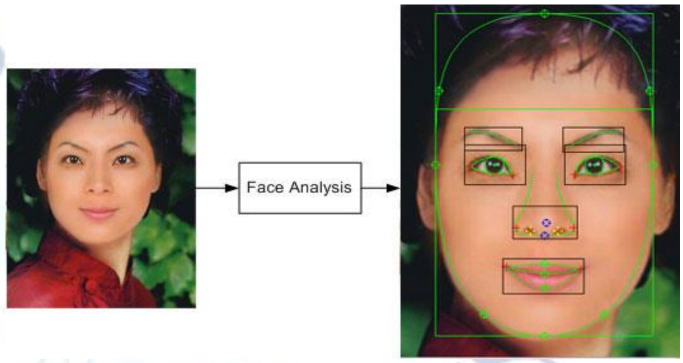



*Fig (b) Face patches*

The partitioned patches are the right and left periocular, nose and mouth regions are extracted from a full face (using Viola-Jones face and eye, nose, mouth detector).

***Learning Features Technique:***

In this module, the partitioned patches are computed for learning features. The hidden-layer representation learnt in this manner encodes class-specific features. In the proposed algorithm, by utilizing three layers; we are enforcing class-specific sparsity which helps in extracting features which are discriminative.The proposed supervised RBM can be stacked to form a deep learning framework (e.g. Deep Supervised Boltzmann Machine). Greedy layer-by-layer training is performed to learn the weights and parameters of the supervised RBM.The features also extracted to detect the image metamorphosis. The feature extraction for the image is computed by the holistic features of size and shape.

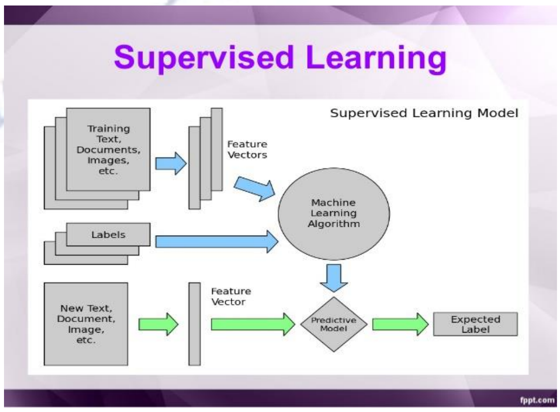
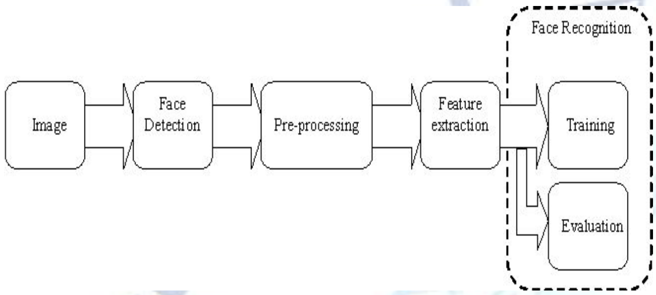



*Fig (c) learning Method*

*A. Evaluation result:*

In this module, the learned features are evaluated for automatic face recognition. The facial patches and supervised features are learnt via deep learning framework to discriminate between original/unaltered and retouched variations.To classify face images as original or retouched with high accuracy.To detect the image is edited or not.




## VI. ALGORITHM

**Deep learning –Retouching detection**

The "deep learning" algorithm is proposed for classifying face images as retouched or original.

- The proposed algorithm focuses on four facial patches this framework used to discriminate between original/unaltered and retouched variations.
- This helps in classifying the test images accurately.
- It uses facial parts to learn discriminative features to classify face images as original or retouched.
- In the proposed framework, four local facial patches are used for detecting retouching; the right and left periocular, nose and mouth regions are extracted from a full face.
- The features are learned for each facial patch.
- The output features obtained from the corresponding features are concatenated and given as input to a two-class classifier (SVM) for classification.

*Feature-Based Image Metamorphosis –Forensic image detection*

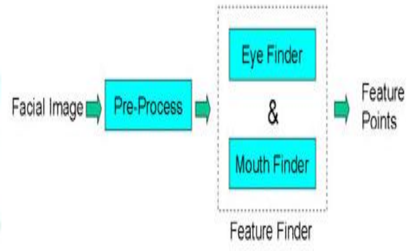
Feature-Based Image Metamorphosis is used to detect the image forensic.

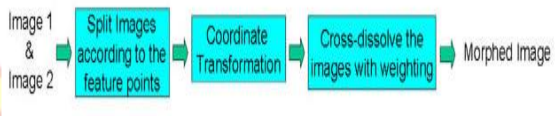
*Pre-Processing*

When getting an image containing human faces, it is always better to do some pre-processing such like removing the noisy backgrounds, clipping to get a proper facial image, and scaling the image to a reasonable size. So far we have been doing the pre-processing by hand because we would otherwise need to implement a face-finding algorithm

*Feature*

Our goal was to find 4 major feature points, namely the two eyes, and the two end-points of the mouth. Based on eye-finding result, we can then find the mouth and hence the end-points of it by heuristic approach.

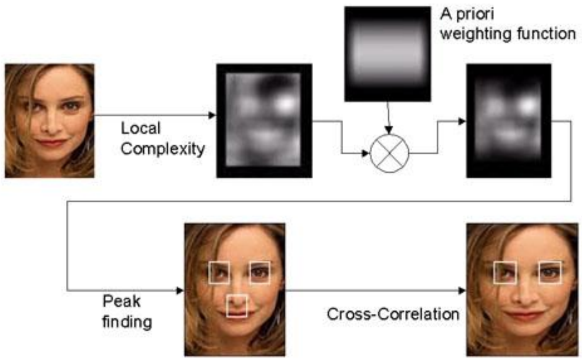



**Eye-finding**

- We assume that the eyes are more complicated than other parts of the face.
- The weighting function specifies how likely we can find eyes on the face if we don't have any prior information about it.

Afterwards, we find the three highest peaks in the weighted complexity map, and then we decide which two of the three peaks, which are our candidates of eyes, really correspond to the eyes.




- **Mouth-finding**
  After finding the eyes, we can specify the mouth as the red-most region below the eyes.
- Note that the mouth has relatively high red-ness and low green-ness comparing to the surrounding skin.

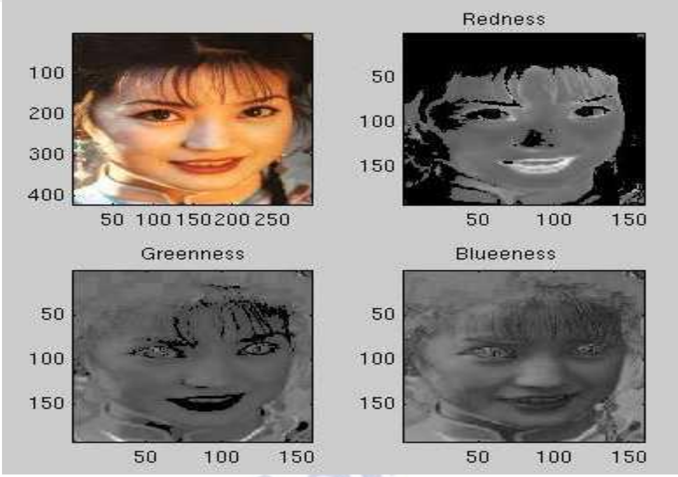
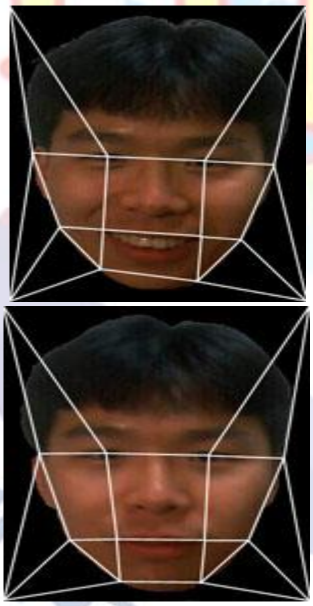



**Image Partitioning**

- The image is partitioned into feature points
- Since the feature points are, at different positions, when doing morphing between images, the images have to be warped such that their feature points are matched.
- Otherwise, the morphed image will have four eyes, two mouths, and so forth. It will be very strange and unpleasant that way.



**Coordinate Transformations**

- There exist many coordinate transformations for the mapping between two triangles or between two quadrangles.
- The pixel values are rearranged using the mapping of the bilinear transformation.

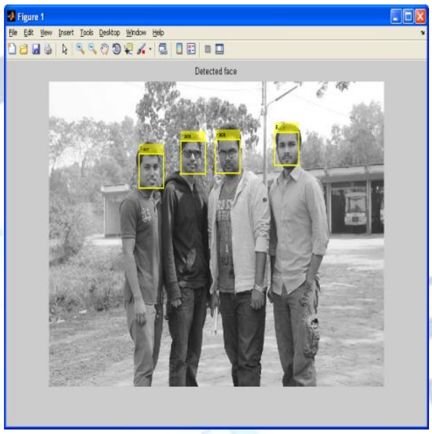
**Cross-Dissolving**

After performing coordinate transformations facial image, the feature points of these images are matched. i.e., the left eye in one image will be at the same position as the left eye in the other image. To detect face morphing, we need to detect the cross-dissolving as the coordinate transforms are taking place.

Finally the morphed images are detected using feature based image metamorphosis.

## VII. Experimental Results

*A. Face detection results*




## VIII. CONCLUSION

The novel supervised deep learning based algorithm to solve the problem of classifying face images as original or retouched is presented. The proposed algorithm shows a significant improvement compared to state-of-the-art algorithm for retouching detection. Additional experiments show that the improvement in classification accuracy can be attributed to the supervised DBM and to the form of the SVM used for classification. It uses facial parts to learn discriminative features to classify face images as original or retouched. Metamorphosis between two or more images over time is a useful visual technique, often used for educational or entertainment purposes. A new technique is presented for the metamorphosis of one digital image into another to detect image forensics.

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