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# OFFENSIVE IMAGE DETECTION

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Abstract— In our current web and mobile application development runtime nude image content detection is very important. This paper presents a runtime nudity detection method for web and mobile application development. We use two parameters to detect the nude content of an image. One is the number of skin pixels another is face region. A skin color model based on RGB, HSV color spaces are used to detect skin pixels in an image. Google vision api is used to detect the face region. By the percentage of skin regions and face regions an image is identified nude or not. The success of this algorithm exists in detecting skin regions and face regions. The skin detection algorithm can detect skin 95% accurately with a low false-positive rate and the google vision api for web and mobile applications can detect face 99% accurately with less than 1 second time. From the experimental analysis, we have seen that the proposed algorithm can detect 95% percent accurately the nudity of an image.

Keywords—Offensive, non-nudity, skin-colormodel, skin-detection, face-detection

## 1 INTRODUCTION

The huge amount of multimedia data on the Internet is fundamental to the great attention that Internet has attracted. Nevertheless, it has also allowed an increase in the amount of pornographic content, since there is a lack of information control on the Web. As a consequence, the interest on automatic pornography detection is rising especially due to parental/institutional control with Internet-surfing children and employees, and Internet security. This second issue refers to the fact that pornographic content may lead to pages with malicious threats. It is clearly presented in a recent report provided by Symantec [12] that there is a direct relationship between pornography and dissemination of malware. Nudity detection in images may be an initial step toward porn site identification. It is not surprising that this idea has already

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been investigated in the literature [7,11,13]. These previous works, as well as other approaches, have one characteristic in common: they employ filters to detect skin as a first level of nudity classification processes. Arentz and Olstad [1] point out that the identification of skin areas is the main factor for detecting nudity in images successfully. Besides, after the skin detection level, most of these strategies work by extracting features from the images, such as color [18], texture [15], shape [17] and location of skin pixels [12]. Image feature extraction has also received a great deal of attention in the recent literature on content-based image retrieval. Kalva et al. [9] introduced the idea that by dividing an image into independent zones one may be able to extract local features and to discard irrelevant information. According to the authors, the most relevant features in one image are provided by its central regions. It is important to mention that Kalva et al. [9] did not focus on nudity detection. They dealt with five classes: vehicle, people, domestic animal, motorcycle and CD/DVD

## 2 RELATED WORK

In this section we discuss some existing nudity detection methods that use skin filter based on color space combined with other features such as color histograms, texture analysis and shape measures. Most of these systems employ machine learning classifiers. One of pioneering work is done by Forsyth and Fleck [7]. They combine skin filter using color and texture properties, to detect bare parts in human body images. These skin regions are the fed to a cluster process, which attempts to group human figures using geometric constraints obtained from human body structure. The system attained 60% of precision on a test set composed of 138 nude images and 1,401 assorted control images, containing images of people but with no nude. Another work is conducted by Jiao et al. [6]. They first use a YUV and YIQ color space to detect skin areas in images. Then, the Sobel operator and the Gabor filter are applied to remove non-skin pixels. Finally, color features are extracted and provided to a SVM classifier. The proposed method obtains a precision of 89.3% on a test set composed by 1,200 nude images and 1,200 assorted non-nude images. Some of non-nude samples are images of people with no nudity. Zhu et al. [15] present a two-step adaptive framework for accurate skin-color detection. In the first step, they identify the Skin-Similar pixels using a generic skinmodel.

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Texture information is then used to train a Gaussian Mixture Model (GMM). A SVM classifier, using the spatial and shape features along with Gaussian parameters, is trained to separate the correct skin Gaussian component from the trained GMM. In comparison with traditional methods, this combination is able to achieve 88.9% of accuracy on a test set of 400 nude images and 400 assorted images.

Schettini et al. [5] propose a pornography detection model by combining color, edge, and texture features. They compare decision forest generated using CART (Classification And Regression Trees) and SVM. Their database consists of 1,500 pictures, being 750 pornography samples. The results show that SVM achieves the best performance, i.e. 90.4% of accuracy. Lee et al. [11] present a nudity detection algorithm based on learning-based chromatic distribution matching scheme that consists of an online sampling mechanism and the one-class-one-net neural network. The authors argue that the object's chroma distribution can be on-line determined so that the skin color deviation coming from lighting can be accommodated without sacrificing the accuracy. The results show detection rates of 86.4% and 94.8%, for nude and non-nude images respectively .

3 METHODOLOGY

In this section, we describe our image zoning strategy. In order to better illustrate the whole nudity detection process, we adopt the architecture most often applied in works that perform skin filter [1, 5, 6, 11, 15], as shown in Figure 1. First, input images are normalized and then segmented through a filtering mechanism. Here, however, instead of performing feature extraction directly on the entire image, we divide the images into zones which are then used for local feature extraction. Thus, features obtained from each zone are combined into a feature vector and submitted to SVM for classification on nude or neutral (non-nude) classes. Bellow, we present details about zoning strategy, as well as the remaining modules.

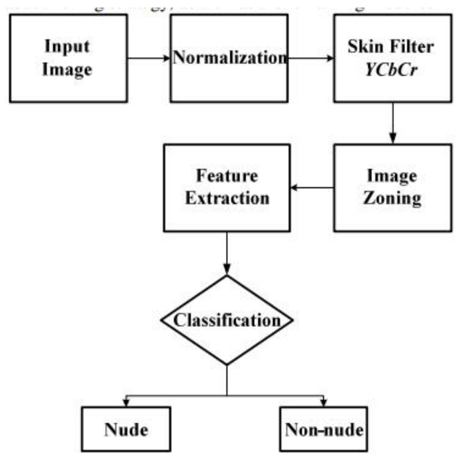


Figure 1. Overview of the automatic nudity detection

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As mentioned in the introduction, image nudity detection may be assumed as an initial step to identify porn sites. Therefore, input images must be obtained from the Internet. This fact leads us to deal with images provided with different formats and resolutions, which increases the complexity of an automatic nudity detection process. In order to provide images with the same size, format, and other standard aspects, a normalization step is then performed. Different configurations were used to partition the images (32x32, 64x64, 128x128, 256x256). The best results were achieved when the original images were re-sized to approximately 256 columns by 256 lines. Thus, at this step, all images were normalized to 256x256 and converted to JPEG format.

In pictures, the central region is the most representative, while the outer regions represent scenarios or other less important elements [9]. In this study, we adopt the hypothesis that nude images are composed by skin regions predominantly in their central region. Indeed, by observing nude images, it is possible to verify that naked body usually is found in a significant portion of the image and that the position of the naked body is close to the image center, as also observed in [11]. From this assumption, local feature vectors may be generated. Accordingly, the concept of zoning means that we have to define regions in the image and treat them independently, i.e., feature extraction algorithms analyze each area (zone) independently [9].

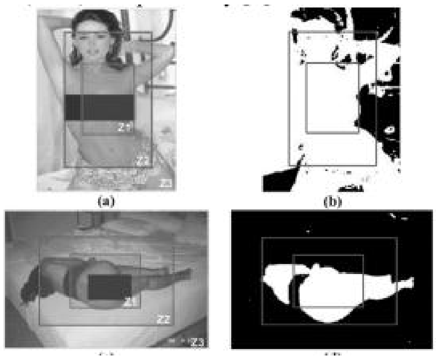


Figure 2. Images showing zoning results. (a) nude image vertically oriented and its zoning partition (b); (c) nude image horizontally oriented and its zoning partition (d).

## 4 RESULTS & EVALUATION

A series of experiments has been carried out to determine whether or not including a zoning module on automatic nudity detection architecture leads to increase detection rates. We also point out the best subset of features for this task. First, we present a description of the parameters settings on experiments, such as database, classifier parameters, and others.

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We used a database composed of 5,360 images. Neutral (non-nude) class was composed by 3,110 images (faces, different people, different environments, cars, motorcycles, airplanes, etc.) which were collected from Caltech [4] data repository. Nudity class was provided by Belém et al. [2], containing 2,250 images. In this class, are included nude scenes containing people of different ethnicities (African, Caucasian, Asian, Indian, European) under various light conditions As mentioned previously, all images are colorful and have been normalized and converted to JPEG format.

Classical holdout validation strategy was employed to evaluate performance achieved by SVM classifier, i.e. the database was partitioned into training and test sets. The training set was composed by 1,340 nudity images and 1,340 neutral pictures. We used the same amount of samples for each class in order to overcome bias. The remaining samples were used to compose a test set, e.g. 1,170 and 910 of neutral and nudity images respectively. Cross-validation strategy was used to fine-tune SVM. Our experiments indicated that SVM with RBF kernel outperformed polynomial kernel. In addition, penalty parameter C and γ (owing to the use of kernel RBF) were defined as C=100 and γ = 0.07.

Moreover, these experiments show that feature selection successfully reduced the number of features. The initial set of 06 features was decreased to 04 features, leading to a 33% of information reduction, while performance was only slightly decreased. Hence, feature selection may reduce complexity whilst keeping high accurate classifiers. We also observe that misclassified neutral pictures present high number of yellow and red pixels. Images which illustrated sand and rock formation also had high misclassification rates. These results demonstrate that image zoning may be widely used in different applications and in several future works. In addition, we observed that the time required to process each image can be considered as applicable in online systems, for example, plugins, search engines, audit systems, it was less than 30 milliseconds. It is important to note that although some previous works provide important information related to database, such as ethnicity, number of samples and light conditions, a process of direct and fair comparison is difficult due to the lack of benchmarking databases

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## 5 CONCLUSION

This paper presents a face-skin based lightweight and fast-frontend nudity detection technique for web and mobile application. The nudity concept can easily be used in any other system after applying a reliable face detection technique. Two human body parameters skin regions and face-skin regions are used. If the ratio of that parameters is above a threshold, then the input image is flagged as nudeimage. A powerful RGB and HSV color-based skin detection are used to detect skin regions which false-positive rate is low compare to other color-based skin detection method. For detecting face regions, google cloud vision api is used for testing web application images and mobile vision api is used in mobile application images. From the experimental result, the proposed nudity detection algorithm can detect image nudity 95% accurately with a low false-positive rate.

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