

# The Design of a Hybrid Feature Detector for Adult Images<sup>\*</sup>

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**Abstract**— Adult image detection is an important issue lately due to the parental control needs. Skin color detector is a typical solution for adult image detection. However, the performance needs to be improved due to the lack of color photo diversity. Even Bag-of-Visual-Words (BoVWs) approaches is another scheme to solve this problem, it is not easy to get efficient solution. In this paper, a hybrid feature detector for adult images is proposed. The method normalizes the local feature and global feature to become a hybrid feature which combines the benefits between BoVWs and skin-color-detector. Experimental results demonstrate that its computation time is shorter than the one of BoVWs technique and almost equivalent to the one of skin-color-detector. The most important fact of all is that the hybrid feature detector has achieved better accuracy ratio than the results by using BoVWs or skin-color-detector techniques.

**Index Terms**— *adult image, Bag-of-Visual-Words, hybrid detector, SIFT, Hue-SIFT.*

## I. INTRODUCTION

Image recognition research is an important study for computer vision to identify objects or features in an image which can be characterized by descriptors. Adult image detection can be seen as a kind of image recognition task.

Bag-of-Visual-Words (BoVWs) approach [1] is driven by collecting image database and processed by feature extraction with statistical methods for recognizing positive object (adult image object). Since the feature extraction needs a lot of image samples, this approach is generally time consuming to achieve better recognition performance. Lintao Lv et al. [1] proposed a high-level semantic features approach for adult images detection. It solved the typical problems of BoVWs (i.e. high false positive rate toward the bikinis images and insufficiency of filtering pornographic images with pornographic actions). However, there are some limitations of BoVWs: 1.) Noise feature influences words construction process. 2.) The computation time is costly. 3.) The loss of spatial information. Therefore, a typical BoVWs model is hard to be adopted for a real-time detection system.

For that reason, skin color is the most intuitive element for adult image detection and some articles [2-5] have applied skin-color-detector for this goal. Xiaoyin Wang et al. [6] proposed a naked body detection approaches to adult image recognition. This scheme is based on the navel and body features to represent the characteristics of entire naked body which ignores the detailed features of limbs or faces.

Accordingly, the key problem of this algorithm is only for the naked body detection. If the major figure of the test image is dressing tidily but exposing erotogenic parts, such a system would be not workable. In addition, the weakness of this concept is easily interfered by image cutting, lighting, shooting angle, and overridden by other object. Therefore, some other researches [7-8] have proposed BoVWs based technique, which is popular for object recognition and visual categorization [9-12].

Bag-of-Visual-Words (BoVWs) is a kind of solution for representing image by effective feature extraction. It is similar to Bag-of-Words (BoWs) in a text document. In an image, words (features or key points) are usually around the corners and edges of image objects, such as edges of face. SIFT and SURF are common choices for feature description. SIFT [9] is extracting distinctive invariant features from images that can be invariant to image scale and rotation. Consequently it was widely used in image mosaic, recognition, retrieval and etc... In [10], SIFT consists of four major stages: 1.) scale-space extrema detection, 2.) keypoint localization, 3.) orientation assignment and 4.) keypoint descriptor. It used Euclidean distance to determine whether the two vectors correspond to the key point in different image.

Hue-SIFT [12] is an extension of SIFT which is only based on grey level information. The Hue-SIFT method extends the limitation of SIFT approach and include the color information. Hence the main advantage of Hue-SIFT is that it does not rely on skin-color-detector or shape modeling.

In this paper, we proposed a hybrid feature detector which can construct the architecture to solve several real-world problems. For adult image detection, most adult images contain at least one of the following key elements: breast, vagina, and penis. From this point of view, our proposed approach has an important pre-processing, which is to divide the sensitive part from adult images to reduce the noisy effect for feature extraction. Furthermore, the structure we proposed provides good computation time for real-time applications.

This paper is organized as follows. In section 2, we will give the detailed description of the proposed approach. Section 3 demonstrates the experimental results. Finally, the conclusion is drawn in section 4.

## II. METHODOLOGY AND APPROACH

This paper purposes a hybrid feature approach for adult image detection. This hybrid feature approach combines both local feature and global feature extraction.

### Training Procedure

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In the beginning, a set of images are collected from the Internet. The image database covers the positive (adult) and non-positive (non-adult) images during the training procedure. Due to the specificity of our purpose to reduce the noises of data set, there are three types of objects which can distinguish the adult images from others, i.e. breast, vagina, and penis. During the training procedure, each type of images contains 400 samples for the training purpose.

After the pre-process, the local features are extracted for positive types or non-positive type by SURF technique [11]. Based on the local feature fields, the global features by color acreage, RGB's mean, variance, and local binary pattern [13] are also extracted. The combination of local feature and global feature are called hybrid feature in this study. This concept is different from traditional skin-color-detector since it considers the whole image to extract only skin feature. Therefore, our hybrid features can prevent interference by cutting, lighting shooting angle in images. In our methodology, the global feature is created by concatenating the horizontal and vertical gradient maps for the 16\*16 patch centered at the keypoint (local feature).

### Detection procedure

During the detection procedure, the hybrid feature detector will be executed from an image input. The total number of feature would be  $n$ . After feature extraction, every feature is calculated by SVM model which is got by training procedure. If a hybrid feature were classified to be a positive feature, the count number (sc) will increase one.

### III. EXPERIMENTAL RESULTS AND DISCUSSION

In this section, experiments are evaluated to verify the hybrid feature performance for adult image detection. A web spider was applied to download images from adult image forums. This study collected about 120,000 adult images and about 127,500 non-adult images (e.g. car, building, people,...etc). In addition, 1,200 adult images and 400 non-adult images are random selected to be in the training set. Therefore, there are basically four types of images (vagina, breast, penis, and normal images) in our experiments. During the comparison, skin-color-detector [2] and Hue-SIFT approach [9] are also measured.

The proposed evaluation system is based on OpenCV[14] for feature extraction. After the hybrid feature extraction and SVM classification processing, we can obtain the SVM model for detecting procedure. The whole image database is tested for adult image detection by naked body detector, Hue-SIFT, and our proposed model. In Table 1, the detecting accuracy ratio of naked body detector, Hue-SIFT, and our proposed approach is tabulated in Table 1.

Table 1. Accuracy rate comparison by naked body detector, Hue-SIFT and hybrid feature detector

	Adult image accuracy rate	Non-adult image accuracy rate
naked body detector	65.2%	81.2%
Hue-SIFT	84.8%	76.5%
hybrid feature detector	90.6%	82.1%

### IV. CONCLUSION

This study has proposed a hybrid feature detector to identify adult images. Four types of image content are applied for initial training model, which are breast, vagina, penis and other normal pictures. We applied SURF approach to gain local features, and RGB color space, LBP to gain global feature that are around each local feature from training set. To reduce the influence from traditional skin-color-detector, we normalized local feature and global feature to be a hybrid feature detector. It combines the advantages of global feature detector and local feature detector, and has better performance than naked body detector and Hue-SIFT approach. From the experimental results, the proposed scheme not only provides much better accuracy rate than both Hue-SIFT approach and naked body detector, but also proves it can be a real time solution for applications.

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