Detection of Pornographic Digital Images

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Abstract— In this paper a novel algorithm to detect explicit content or pornographic images is proposed using the transformation from the RGB model color to the YCbCr or HSV color model, moreover using the skin detection the image is segmented, finally the percentage of pixels that was detected as skin tone is calculated. The results obtained using the proposed algorithm are compared with two software solutions, Paraben's Porn Detection Stick and FTK Explicit Image Detection, which are the most commercial software solutions to detect pornographic images. A set of 800 images, which 400 pornographic images and 400 natural images, is used to test each system. The proposed algorithm carried out identify up to 68.87% of the pornographic images, and 14.25% of false positives, the Paraben's Porn Detection Stick achieved 71.5% of recognizing but with 33.5% of false positives, and FTK Explicit Image Detection achieved 69.25% of effectiveness for the same set of images but 35.5% of false positives. Finally the proposed algorithm works effectively to carry out the main goal which is to apply this method to forensic analysis or pornographic images detection on storage devices.

Keywords—Explicit Content, Pattern Recognition, Skin Detection, The YCbCr and the HSV color models.

I. Introduction

THE information on the Internet is becoming more and more plentiful. The juveniles should be prevented from getting access to adult information, such as adult images, so the development of adult image recognizing technology is urgently desired. However, it is difficult to recognize adult image accurately. So far, adult images can be divided into three categories, which are images of nude boy, close-up images of erotogenic parts, and images having pornographic action [1]. This kind of media is also available for children and is an increasingly problem for many parents.

Filtering images with adult classified content is very important for searching principal Internet browsers programs to avoid offensive content [2]. Nowadays there are some ways to stop pornographic images on computers, such as blocking unwanted sites or identifying images that show explicit content. There are some programs in the foreign market that allow blocking sites on Internet with offensive or explicit content such as: CyberPatrol, ContentProtect, NetNannny, Family.net and K9 Web Protection [3]. All these programs provide parental control to safeguard their children using the Internet. There exists some others programs which detect pornographic images within the computer such as: Surfrecon that offers a program for this purpose, Paraben's Porn Detection Stick [4] is another software, the company Access Data offers a software solution for informatics forensic call Forensic Toolkit (FTK 3.1), this software have a tool FTK Explicit Image Detection for this use.

There are some papers on this subject such as: the carried out by Forsyth and Fleck who developed software to detect naked people [5], Wiederhold and Wang proposed an algorithm for doubtful content images recognition [6], and Li Chen *et al* design a skin detector based-on Neural Network [7], P. Fuangkhon and T. Tanprasert develop a system to detect obscene pictures using nipple detection [8].

In this paper a novel algorithm to detect explicit images is proposed using two different color models YCbCr and HSV and compare with two software solutions Paraben´s Porn stick Detection and FTK Explicit Image Detection. It is based on image processing, skin detector, and pattern recognition techniques. First the image is transformed to YCbCr or HSV color model to discriminate all objects into the image that are not of interest. Next the threshold used for skin detection is calculated for each color model, using this threshold the image is filtered to segment a person or people shape within the image. Finally the image likelihood is estimated to know whether an image with explicit content is or not.

The paper is organized as follows. The Proposed System and an introduction of the RGB, HSV and YCbCr color models are shown in sections 2 and 3 respectively. Section 4 shows the threshold calculation, in the section 5 Skin Detection is shown. Image Classification is shown in section 6. The results are shown as a comparative between the proposed system using the two color models, and the systems Paraben's Porn Stick Detection and FTK Explicit Image Detection in Section 7. Finally the conclusions are given.

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II. Proposed System

The Figure 1 shows the proposed system, which has four stages: the image transformation from RGB to YCbCr, or HSV color model is done in the first stage. Filter stage is obtained using the skin detection with the proposed threshold. Next a Quantifier is used to count the number of skin pixels. Finally in the decision stage the images are classified by the percentage of skin that contains the image.

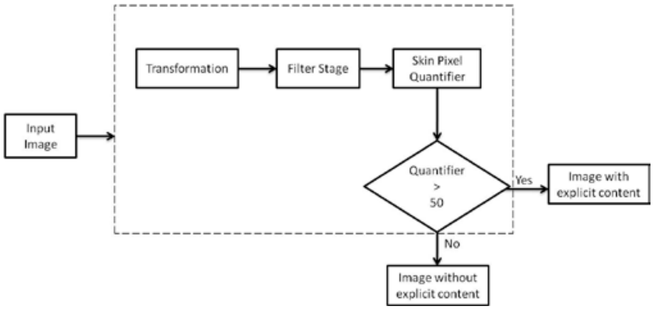


Fig. 1 Proposed System

To determine the threshold of our proposed system, a histogram analysis was performed. Figure 2 shows this stage.

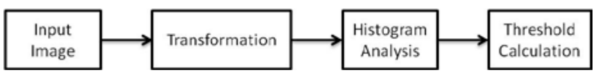


Fig. 2 Algorithm to Threshold Calculation

III. Color Models

A. *The RGB Color Model*

The RGB color model is an additive color model in which the primary colors red, green, and blue light are added together in various ways to reproduce a broad array of colors. The name comes from the initials of the three colors Red, Green, and Blue. The RGB color model is shown in the Figure 3.

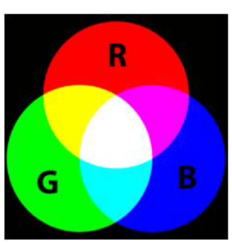


Fig. 3 RGB Color Model

The main purpose of the RGB color model is for sensing, representation, and display of images in electronic systems, such as televisions and computers.

The RGB color model is an additive in the sense that three light beams are added together to make a final color. To form a color with RGB, three colored light beams (one red, one green, and one blue) should be superimposed. Each of the three beams is called a component of that color, and each can have arbitrary intensity, from fully off to fully on, in the mixture. Zero intensity for each component gives the darkest color (no light, considered the black), and full intensity of each gives a white.

A color in the RGB color model is described by indicating how much of each of the red, green, and blue is included in each component which can vary from zero to a defined maximum value which depends of the application. In computing, the component values are often stored as integer numbers in the range 0 to 255.

B. *YCbC r Color Model*

The YCbCr color model is widely used in digital video, image processing, etc. In this format, luminance information is represented by a single component, Y, color information is stored as two color-difference components, Cb and Cr. Component Cb is the difference between the blue component and a reference value, and component and a reference value.

The YCbCr color model was developed as part of ITU-R BT.601 during the development of a world-wide digital component video standard. YCbCr is a scaled and offset version of the YUV color model. Y is the luma component defined to have a nominal 8-bit range of 16 – 235; Cb and Cr are the blue-difference and red-difference chroma components respectively, which are defined to have a nominal range of 16 – 240.

The transformation used to convert from RGB to YCbCr color space is shown in the equation (1):

$$\begin{bmatrix} Y \\ Cb \\ Cr \end{bmatrix} = \begin{bmatrix} 16 \\ 128 \\ 128 \end{bmatrix} + \begin{bmatrix} 65.481 & 128.553 & 24.996 \\ -37.797 & -74.203 & 112 \\ 112 & -93.786 & -18.214 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix} \quad (1)$$

The Figure 4 shows the transformation of the input image using the expression above.

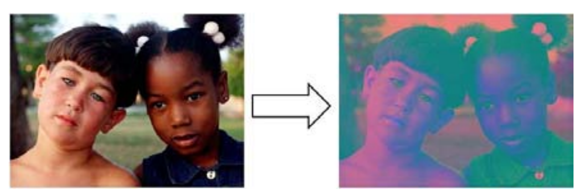


Fig. 4 Transformation from RGB to YCbCr color model

C. *HSV Color Model*

HSV color model (Hue, Saturation, and Value) is a no lineal transformation of the RGB color model, and the colors are the combination of the three values: the Hue (H), Saturation or color quantity (S), and itself value (V) [9]. These values are represented in a circular diagram, as shown in Figure 5.

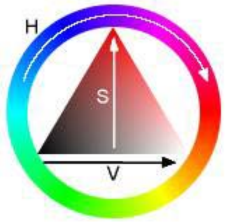


Fig. 5 HSV Color Model

The three magnitudes can have the following values:

Hue: The type of color (e.g. red, green, or yellow). These are represented as a degree of angle whose possible values range from 0° to 360° (although for some applications are normalized from to 0 to 100%).

Saturation: Is represented as a distance from the axis of the black-white glow. The possible values range from 0 to 100%.

Value: Represents the height in the black-white axis. The possible values range from 0 to 100%. 0 is always black. Depending on the saturation, 100 could be white or a more or less saturated color.

The transformation of an input image in RGB color model is achieved using the expressions (2) to (4) that are shown below.

$$H = \arccos \frac{\frac{1}{2}\left[(R-G)+(R-B)\right]}{\sqrt{\left[(R-G)^2+(R-B)(G-B)\right]}} \tag{2}$$

$$S = 1 - 3\frac{\min(R,G,B)}{R+G+B} \tag{3}$$

$$V = \frac{1}{3}(R+G+B) \tag{4}$$

The Figure 6 is a sample of the conversion to the HSV color model of an image in RGB color model.

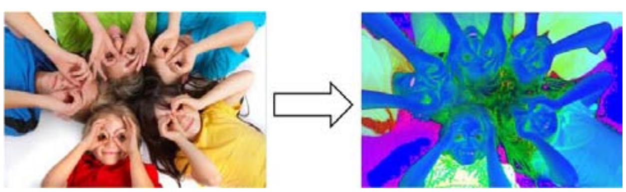


Fig. 6 Transformation from RGB to HSV color model

IV. Threshold Calculation

A. *YCbCr Histogram Analysis*

In contrast to RGB, the YCbCr color model is luma-independent, resulting in a better performance. The corresponding skin cluster is given as [10]:

$Y > 80$
$85 < Cb < 135$
$135 < Cr < 180$,
Where Y, Cb, Cr = [0, 255].

N. Sarris *et al*. [11] used only the chrominance components, Cb and Cr, to detect faces in color images, V. Neagoe and M. Neghhina [12] proposed a system to face detection using this color model.

Chai and Ngan [13] have developed an algorithm that exploits the spatial characteristics of human skin color. A skin color map is derived and used on the chrominance components of the input image to detect pixels that appear to be skin. Working in this color model Chain and Ngan have found that range of Cb and Cr most representatives for the skin-color reference map are:

$$77 \le Cb \le 127 \quad \text{and} \quad 133 \le Cr \le 173$$

However due to that our purpose is to find human skin from different races, the thresholds given above works only with a Caucasian people skin because the first threshold only finds people with white skin, and the second threshold segments people of different places of the world but some pixels are detected as skin but really not. For this reason is proposed a new skin threshold to segment people within the image regardless skin color.

A histogram analysis in the YCbCr color model of many images was necessary to determine the optimal threshold. The results expressed in Figure 7 and 8 shows the histograms values which help to decide the best possible threshold for different people who have different skin color.

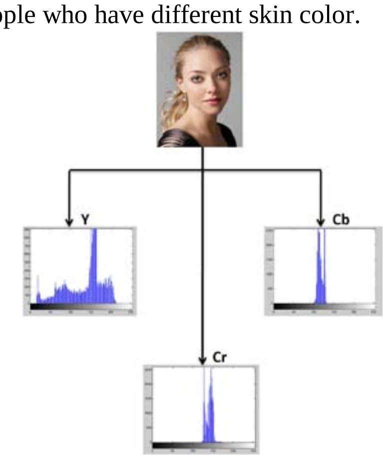


Fig. 7 White Skin Girl

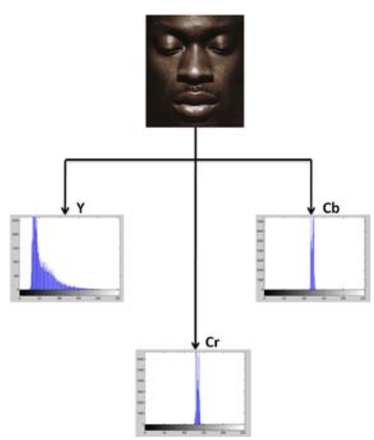


Fig. 8 Black Skin Man

As observed in the images above, the luminance Y histogram is so different for both cases white and black skin because the pixel values are concentrated in opposite of the histogram, so only the Cb and Cr chrominance histograms are used to propose a new threshold which includes people with different skin color from white to black skin.

After exhaustive image histogram analysis, the optimal range threshold was:

$$80 \le Cb \le 120 \quad \text{and} \quad 133 \le Cr \le 173$$

B. HSV Histogram Analysis

I. Aldasouqui and M. Hassan [14] designed an algorithm to human face detection using this color model.

A histogram analysis in the HSV color model was performed to determine the threshold. Figure 9 and 10 are images with white and black skin. These histograms were necessary to identify the values range for our purpose, i.e. to segment a person or people in one image.

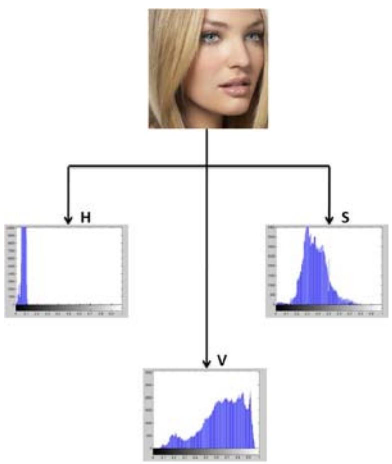


Fig. 9 White Skin Girl

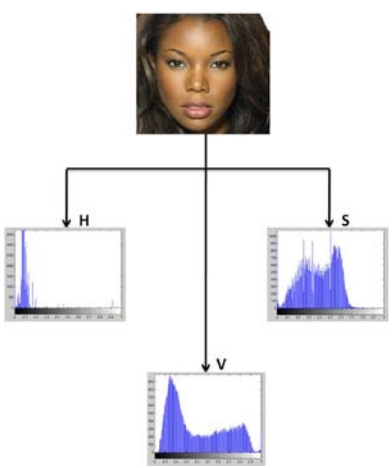


Fig. 10 Black Skin Girl

The histograms observed previously show the values that have the images of people with different races. After an extensive analysis the threshold decided was the following:

$0 < H < 0.25$
$0.15 < S < 0.9$
$0.2 < V < 0.95$
Where H,S, and V are in the range from 0 to 1.

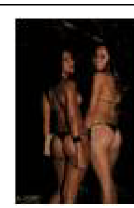
V. Skin Detection

Skin detection can help detect a human limb, torso, or face within a picture. Lately many methods of skin identification within a digital image have been developed. Skin color has proved to be a useful and robust method for face detection, localization and tracking. There have been a number of researchers who have looked at using color information to detect skin. Jones and Regh [15] constructed a color model using histogram-learning techniques at RGB color model. Yang and Auhuja [16] estimated probability density function of human skin using a finite Gaussian mixture model whose parameters are estimated through the EM algorithm. There are other researchers who have developed papers about the different models of skin detection as Vezhnevets *et al*.[17] Kakumanu *et al*.[18], and Kelly *et al*.[19].

Once the color transformation has been made, the next stage is to proceed to pixel detection with human skin. This was carried out by using the thresholds proposed in this paper, which works in different color models.

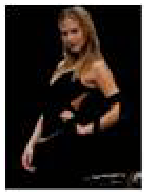
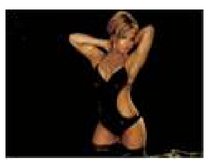
The Table I show some example of the skin detection using the proposed thresholds for images of different races of people.

Table I Skin Detection using the proposed threshold to YCBCr color model

Input Image	**YCbCr threshold**
	
	
	

In the Table I, can be observed that the proposed threshold to the YCbCr color model works efficiently in people with different skin color.

Table II Skin Detection using the proposed threshold to HSV color model

Input Image	**HSV threshold**
	
	
	

The Table II shows the segmentation in basis to human skin color using the proposed threshold to the HSV model color. This table contains some examples of people with white, brown and black skin, the proposed threshold works correctly.

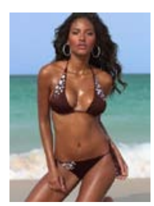
VI. Image Classification

To determine if the image has a explicit content or pornographic, the Skin Pixel Quantifier counts the pixels that the previous stage detect as skin color, then using (4) the skin percentage is calculated to know if the image have objectionable content.

$$skin\ percentage = \frac{\#skin\ color\ pixels}{\#image\ pixels\ in\ total} x100 \qquad (4)$$

To consider an image as explicit content or pornographic image, the skin percentage must be more than 50% or equal. The Table III shows some examples of the image classification using all the proposed system to classify the images.

Table III Image Classification

Input Image	Images Classification		
	Color Model	Proposed Classifier	Skin Percentage
	YCbCr		60.64%
	YCbCr		56.36%
	YCbCr		2.39%
	HSV		75.55%
	HSV		28.17%
	HSV		39.35%

In the Table III can be seen some examples using the two methods to detect explicit content or pornographic images.

Skin detection can be used as the basis for detection of the images with explicit content because there is a considerable relationship between the images with large areas of skin and pornographic images or with explicit content.

VII. RESULTS

A test to see the performance of the proposed system was using different images from Internet. The system can process different kind of images, as images in different lighting conditions and images with different size.

The input images for testing are classified in: a) images of naked people or with explicit content and b) natural images. In the images of naked people Asians, Caucasians, Europeans, Latin Americans and a little amount of people with black skin can be found. A natural images one that by its nature does not contain explicit or pornographic content. In the set of natural images there are different kinds of images such as: dressed people, animals, plants, cars, cartoons, landscapes and others were also obtain from Internet.

First the input image is converted from RGB model color to YCbCr or HSV color model. After this stage, skin detection is used to identify the areas that contain some skin tone, and in this way only get the image of the person or people within the input image.

At this point, all skin areas detected are taken, and proceed to count the amount of pixels that there exists within the image to estimate the likelihood that this image is classified as an image with pornographic content or not.

For this test, the set was used had 400 adult images which all are of naked people, and 400 natural images.

Using the proposed system was obtained the following results that show in the Table IV:

Table IV Results of Proposed system

Color Model	Pornographic Images Recognizing	False Positives
YCbCr	68.87 %	14.25 %
HSV	68.25 %	18.25 %

The Table IV shows the percentage of explicit content or pornographic images recognizing using the two methods which are using the proposed thresholds to skin detection.

As mentioned in the section 1, there exists software to detect explicit content images which are Paraben's Porn Detection Stick and FTK 3.1 Explicit Image Detection that are used to make a comparison between the proposed system and these software solutions.

Paraben's Porn Detection Stick is a thumb drive device that will search through all the images on your computers, scan them for pornographic content, and create a report of suspected pornographic images [4]. It works with software that is within the USB device, only the user selects the sensitivity to start the search within the computer, the range of the sensitivity is the following: 0 Fewer False Positives to 100 More False Positives; The images are classified in Highly Suspect, to compare the proposed system with this software, three test was done using different thresholds for each experiment. The results obtained are shown in the Table V.

Table V Results obtained with Paraben's Porn Stick Detection

	1st Experiment	2nd Experiment	3rd Experiment
Sensitivity	65	75	100
Recognize	66.25 %	68.25%	71.50%
False Positives	23.25 %	28.75%	33.50%

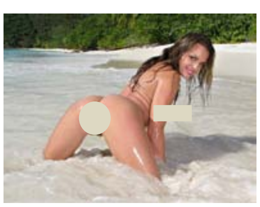
Also software was used from Access Data is called Forensic Toolkit 3.1 Explicit Image Detection, to make another comparison between the proposed system and its system to detect images. It makes a forensic image of the device that have to analyze, after the analysis began with three algorithms to determine the percentage of explicit content of an image. The description of the three algorithms used for evaluate the images was obtained from [20] and was shown in the Table VI.

Table VI Explicit Image Detection Profile Types

Profile Name	Level	Description
X-DFT	Default (XS1)	This is the most generally accurate, it is always selected.
X-FST	Fast (XTB)	This is the fastest. It scores a folder by the number of files it contains that meets the criteria for a high likelihood of explicit material. It is built on a different technology than X-DFT and does not use "regular" DNAs. It is designed for very high volumes, or real-time page scoring. Its purpose is to quickly reduce, or filter, the volume of data to a meaningful set.
X-ZFN	Less False Negatives (XT2)	This is a profile similar to S-FST but with more features and with fewer false negatives than X-DFT. Apply this filter after initial processing to all evidence, or to only the folders that score highly using the X-FST option. Check-mark or highlight those folders to isolate them for Additional Analysis.

To test its system, the same set of input images was used using three profiles that have. Some examples of the results that were obtained using FTK Explicit Image Detection are shown in the Table VII.

Table VII Results obtained with FTK 3.1

Input Image	Algorithms used		
	X-FST	X-DFT	X-ZFN
	93	21	93
	99	11	99
	99	42	99
	11	0	11
	11	11	11

The Table VII shows the explicit content percentages of an image, knowing this the results of the recognizing are shown in the Table VIII. An image is considered as explicit content or pornographic image if two of the three algorithms result with more than 80.

Table VIII Percentage of Recognizing

Recognize	False Positives
69.25 %	35.50%

Other test to prove the efficiency of the system, the system was proved using 100 pornographic images, and the results that was obtained, are shown in the Table IX.

Table IX Results of False Negatives

System	Recognize	False Negatives
Proposed System HSV color model	76%	24%
Paraben's Porn Detection Stick	86%	14%
FTK 3.1 Explicit Image Detection	74%	26%

VIII. Conclusion

This paper proposed an algorithm to detect explicit content or pornographic in color images, using the YCbCr or HSV color model and a method of skin detection which works effectively although in some images it could find some errors, due to the image lighting conditions when was taken.

The YCbCr and HSV color models are an important method to be able to decrease all the lighting problems that the image could be had; this is achieved using components of chrominance Cb and Cr only for the YCbCr color model, in the case of the HSV color model, all the components are taken to decrease this problem.

The importance of comparing the proposed system with the two software solutions was done to know whether the proposed system could do the same work as the software solutions offer, and this way know whether the input image is a pornographic image or not, at final could prove that the proposed system carry out effectively, although the tools have a wide threshold that the proposed system. Even so the proposed system achieved a 76.25% and 77.75% to the YCbCr and HSV color model respectively, for explicit images detection.

References

[1] Xiaoyin Wang; Changzhen Hu; Shuping Yao; "An Adult Image Recognizing Algorithm Based on Naked Body Detection", Computing, Communication, Control, and Management 2009. (CCCM 2009). ISECS International Colloquium on, pp. 197 – 200, 2009.

[2] Jorge A. Marcial Basilio, Gualberto Aguilar Torres, Gabriel Sánchez Pérez, L. Karina Toscano Medina, Héctor M. Pérez Meana, "Explicit Image Detection using YCbCr Space Color Model as Skin Detection", In Proc. Of 5th WSEAS Int. Conf. on Computer Engineering and Applications (CEA '11), pp. 123 – 128, 2011.

[3] C. Habis, and F. Krsmanovic, "Explicit Image Filter," Stanford Univ., 2005.

[4] (2011) The Paraben's Porn Stick Detection website. [Online]. Available: http://paraben-sticks.com/porn-detection-stick.html.

[5] D. A. Forsyth. M. Fleek, and C. Bregler, “Finding naked people”, Proc.Forth European Conference on Computer Vision. pp 593-602, 1996.
[6] G. Wiederhold and J. Z. Wang, “WIPE (TM): Wavelet Image Pornography Elimination; A System for Screening Objectionable Images”.
[7] Li Chen, J. Zhou, Z. Liu, W. Chen and G. Xiong, “A Skin Detector Based on Neural Network”, In IEEE 2002 International Conference on Communication, Circuits and Systems and West Sino Expositions, vol. 1, 615 – 619, 2002.
[8] P. Fuangkhon and T. Tanprasert, “Nipple Detection for Obscene Pictures”, In Proc. Of WSEAS Int. Conf. on Signal, Speech and Image Processing, pp. 315 – 320, 2005.
[9] Jorge A. Marcial Basilio, Gualberto Aguilar Torres, Gabriel Sánchez Pérez, L. Karina Toscano Medina, Héctor M. Pérez Meana, and Enrique Escamilla Hernández, “Explicit Content Image Detection”, In Proc. Of Signal & Image Processing: An International Journal (SIPIJ) Vol. 1, No. 2, pp. 61-72, 2010.
[10] G. Kukharev, A. Novosielski, “Visitor identification elaborating real time face recognition system”, In Proc. 12th Winter School on Computer Graphics (WSCG), Plzen, Czech Republic, pp. 157 – 164, Feb. 2004.
[11] N. Sarris, N. Grammalidis, nd M. Strintzis, “Detection of Faces and Facial Features in Images using a Novel Neural Network Technique”, In Proc. Of WSEAS Int. Conf. on Neural Network and Applications, pp. 6361-6366, 2001.
[12] Victor-Emil Neagoe, Mihai Neghina, “Face Detection Using a Dual Cross-Validation of Chrominance/Luminance Channel Decisions and Decorrelation of the Color Space”, In Proc. Of 14th WSEAS Int. Conf. on Computers, pp. 391-396, 2010.
[13] D. Chai, and K.N. Ngan, "Face segmentation using skin-color map in videophone applications". IEEE Trans. on Circuits and Systems for Video Technology, 9(4): 551-564, June 1999.
[14] Iyad Aldasouqi, and Mahmoud Hassan, “Human Face Detection System Using HSV”, In Proc. Of 9th WSEAS Int. Conf. on Circuits, Systems. Electronics, Control & Signal Processing (CSECS’10), pp. 13-16, 2010.
[15] M. J. Jones and J. M. Regh, “Statistical color models with application to skin detection”, In Proc. Of the CVPR ’99, vol. 1, 274-280, 1999.
[16] M. H. Yang and N. Ahuja, “Detecting human faces in color images ”, In International Conference on Image Processing (ICIP), vol 1, 127-130, 1998.
[17] V. Vezhnevets, V. Sazonov, A. Andreeva, “A Survey on Pixel-based Skin Color Detection Techniques”, In Proceedings of the GrapiCon, 85-92, 2003.
[18] P. Kakumanu, S. Makrogiannis, N. Bourbakis, “A survey of skin-color modeling and detection methods”, In *Pattern Recognition*, Vol. 40, pp. 1106-1122, 2007.
[19] W. Kelly, A. Donnellan and D. Molloy, “Screening for Objectionable Images: A Review of Skin Detection Techniques”, In Machine Vision and Image Processing Conference (IMVIP ‘08), 151 – 158, 2008.
[20] FTK 3.1 User Guide.

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