

Application to detect obscene images in external devices using CNN

Arya Surendran
Department of Computer Science,
College of Engineering Munnar,
Idukki, Kerala, India.
aryasu005@gmail.com

Samuel Stephen
Department of Computer Science,
College of Engineering Munnar,
Idukki, Kerala, India.
samsteve007@gmail.com

Nisy John Panicker
Department of Computer Science,
College of Engineering Munnar,
Idukki, Kerala, India.
nisyjohn13@gmail.com

Abstract—In this developing stage of our nation, spreading of obscene images has become a major issue among the teenagers. There are certain techniques to avoid online obscene images and videos. There is a major possibility to transfer such images via external devices. This paper says about how to avoid the transfer of obscene images via external devices. When an external device is connected to the system and if the method detects obscene image the system will automatically rejects the external device. The detection of obscene images is done in three steps which includes skin color detection, face detection and a fine detection using Convolutional Neural Network (CNN). The method results in 98.425% of accuracy,

Keywords— *Face Detection; Fine Detection; Pornographic Image Detection; Skin Color Detection*

I. INTRODUCTION

Puberty is the period when an adolescence reach physical growth and sexual maturity [1]. It is marked with bodily changes and change in feeling towards opposite sex due to increase in sex hormones. The adolescence period or the so called teenage starts from late childhood and ends with early adulthood. In this crucial stage, adolescence is influenced by peer pressure especially the opposite sex peers [2]. A survey proved that 93% of boys and 68% of girls watch pornographic images.

At the age of puberty, there will be an anxiety for all to know more about sexuality [3]. This anxiety forces them to watch pornographic images and videos. Watching such images and videos cause them to try what they have seen [4]. Since at this age it is impossible for them to get the pleasure from opposite sex, they may be forcefully led to masturbation [5]. For a teenager, doing such activities will cause a very large energy loss which results in a weak body. We all know that only a sound body can hold a sound mind; when the body becomes weak, the mental stability also fluctuates.

India being in its developing stage, spreading of obscene images and videos has become a major issue among the

teenagers. Such images and videos are spread via Internet. There exist certain parent control [6] methods to avoid obscene images from web-portals [7]. Major possibility lies in transferring such images and videos via external devices too. So far, there exists no method to avoid obscene images from offline applications such as desktop applications.

This paper says about how to avoid the transfer of obscene images and videos via external devices. When an external device is connected to the system and if the method detects obscene image in it, the system will automatically eject the external device. The detection of obscene images is done in three steps namely skin color detection, face detection and a fine detection using Convolutional Neural Network (CNN) [8].

This paper says about an application for detecting obscene images and rejects such external devices from a PC using image processing and CNN. Section 2 describes about the existing system. Sections 3 and 4 include the system architecture and methods used for implementation. Sections 5 and 6 include the results and screenshots. And finally section 7 concludes the whole paper.

II. EXISTING SYSTEM

There are certain techniques to avoid obscene images in an online portal. Speed and recognition accuracy are the two important things to recognize pornographic images in online portal. There are certain existing methods to recognize obscene images. Most of the methods are based on Content Based Image Retrieval (CBIR) [9]. This method describes the contents of images by extracting some visual features (such as color, texture, outline, etc.). The pornographic image recognition technology based on the content can be done in various ways – using the rule based on the image; based on image retrieval technology; considering the pornographic image classification as the binary classification and recognition of pornographic image based on the CNN [10, 11].

The pornographic image recognition technology based on content using the rule based method on the image is to estimate whether it is pornographic according to the rule or model [12]. Since the pornographic images are complex and it has unfixed body movements, it is very difficult to obtain the precise result of recognition. With this idea, skin color model was introduced which could filter the images using skin color according to the threshold value. If the skin color area is greater than this threshold, the image would be estimated as pornographic, if not it is considered as non-pornographic image. Though this is the easiest method, it has very low accuracy.

The pornographic image recognition technology based on content using the image retrieval technology [13, 14] has an image database. The image database contains a vast of both the pornographic and non-pornographic images. The image to be recognized is used as the query image, and it is compared with the images in the database. This image is recognized as pornographic or non pornographic image by comparing the number of retrieved images. The result is based on the most retrieved images. Since there are a variety of pornographic images, it is difficult to build the image database.

The pornographic image recognition technology based on content can consider the pornographic image classification as the binary classification [15]. This method describes the content of pornographic image by considering the low-level visual features such as color, texture, outline, etc., and they adopt the machine learning method to get the classification model based on those feature vector. The trained model recognizes the images [16, 17]. This method achieved better results than the other existing methods, but the choice of feature is difficult. The professional staffs with professional knowledge can only do the feature selection.

The pornographic image recognition technology based on content can also be done using CNN [11]. This method has a large database of pornographic images. Firstly the training of CNN [10] using the images in the database to identify the features are performed as we have discussed in the previous paragraph. In previous method, the feature selection is done by the professional staffs with professional knowledge. But in this method, CNN will find out the features of the images by itself during training [26]. Then making use of this trained model, identification of whether the image is pornographic or not can be done. This method has high accuracy compared to other existing systems for identifying obscene images in online portal.

III. SYSTEM ARCHITECTURE

The system uses three steps to predict whether an image is pornographic or not [27]. The three steps include skin color detection, face detection and fine detection. The combination of these three steps increases the accuracy to find the obscene images.

The paper aims in developing an application to detect obscene images from external device to stop the transfer of such images. The working can be explained as follows:

- The Application is installed to a Personal Computer.
- An external device is connected.
- The software scans the contents in the external device.
- If it detects any obscene images, the external device will be automatically ejected.
- Else, it will give access to the external device.

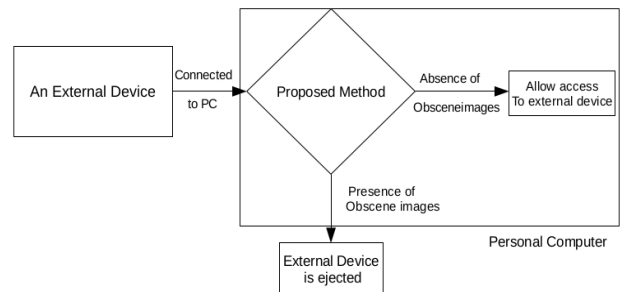


Fig. 1. Workflow of the system

Java code is developed to read the image contents of an external device, before it is being used. While the developed system is reading the contents, any obscene images are detected, the system will automatically eject the external device. This action can prevent obscene images to be transferred via external devices.

IV. METHODS

In this developing stage of our nation, spreading of obscene images and videos has become a major issue among the teenagers. This causes a major problem for the future of the nation since it affects the mental health of the present teenagers [18]. There are certain techniques to avoid online obscene images and videos [3, 18]. There is a major possibility to transfer such images and videos via external devices. This paper says about how to avoid the transfer of obscene images and videos via external devices. The main aim of this paper is to stop circulating such images and videos through external devices. This can be done only by detecting such images from external devices and eject the device from the system.

The detection of obscene images is done in using skin color detection, face detection and a fine detection using Convolutional Neural Network (CNN). Foremost, skin color detection is done on the input image using YCbCr color model [27]. If the skin color of the image is greater than the threshold value as mentioned in the below paragraph, the image is passed on to the next step of the method i.e., face detection. If the face detection step results in a non-facial image, fine detection is performed. In this last step, the input image is compared with the trained model of CNN [27]. If the features of input image match with those in the database, the image is recognized as pornographic.

The methods used in this application are skin color detection, face detection and fine detection. The image files

from the external device are extracted by checking the extensions of the filenames. These image files first undergo skin color detection to check whether it is a human image. If it is a human image then the image file will undergo face detection to find out whether it is a facial image or not. If it is not a facial image then the image will be given to fine detection to find whether it is a pornographic image or not. If it detects as a pornographic image then the access to the pen-drive will be denied by ejecting the pen-drive automatically.

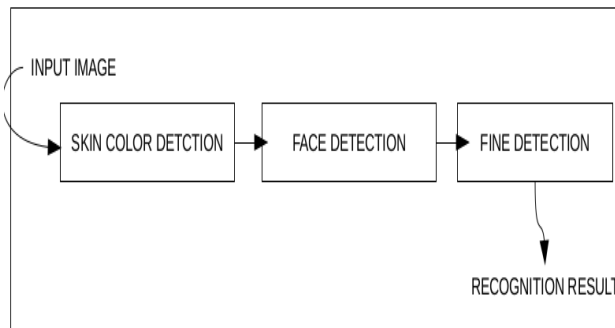


Fig. 2. Methods used in the system

A. Skin Color Detection

The most commonly used color space in digital images is RGB color space [3]. This color space encodes colors as an additive combination of three primary colors: red (R), green (G) and blue (B). It is often visualized as a 3D cube where R, G and B are the three perpendicular axes. The main advantage of the RGB space is its simplicity. As the chrominance components are almost dependent of luminance component in the RGB space we consider YCbCr space to recognize skin color area [18].

There are non-linear relations between chrominance (Cb, Cr) and luminance(Y) of skin color in the high and low luminance region. The skin detection model for detecting the skin color of the images is done by a fixed threshold value [9]. The threshold value of the skin color model in YCbCr color space is: $(Cb > 97.5 \text{ AND } Cb < 142.5) \text{ AND } (Cr > 134 \text{ AND } Cr < 176)$.

B. Face Detection

Skin color detection is the first step that could be done for face detection [22]. Skin color detection is already performed on the input color image so that the computational complexity will be reduced. A suitable color space for skin color detection is very important because the accuracy of skin color detection affects the result of face detection system. Here YCbCr color space is used for skin color detection. Adaboost algorithm along with Haar-like feature is chosen as face detection algorithm [23].

C. Fine Detection

In the fine detection, a database of the pornographic image is used to train the CNN model [8]. The pornographic image can be detected using the trained model. In CNN, a small portion of the image called the local area is given as the input of the lowest layer of the hierarchy, and the information is

transmitted to different layers [24]. From these, the most significant feature of the observed data can be obtained. The structure and training method of CNN are important for the working of fine detection [25]. The CNN after training can detect pornographic images [26].

V. RESULT

The application extracts images files from the external devices using the filenames. The filenames with '.jpg', '.png', '.bmp' and '.tiff' are considered as images. These files are tested using the application[28].

The application is tested using ten thousand obscene images and ten thousand normal images. While testing with obscene images few of them were predicted as normal images. And when normal images were tested few images were predicted as obscene images.

	POSITIVE	NEGATIVE
TRUE	9730	9985
FALSE	115	270

Fig. 3. Confusion Matrix

The falsely predicted obscene images were group photos of nude people. Some of the group photos contain more than ten individual and some of them were focused from long distance which were not clear. The falsely predicted normal images were some sand statues of nude people. The sand statues other than nude people's statues were predicted as normal images.

VI. SCREENSHOTS

A pen-drive is connected to a PC where the application is running. The image files from the external device are extracted by checking the extensions of the filenames. These image files first undergo skin color detection to check whether it is a human image. If it is a human image then the image file will undergo face detection to find out whether it is a facial image or not. If it is not a facial image then the image will be given to fine detection to find whether it is a pornographic image or not. If it detects as a pornographic image then the permission to access the pen-drive will be denied by ejecting the pen-drive automatically. If they are not obscene images the application will give permission to access the pen-drive.

A pen-drive is connected to a PC where the application is running. The pen-drive has only normal images and no obscene images. Thus the application should give permission the user to access the pen-drive. The output is given below:

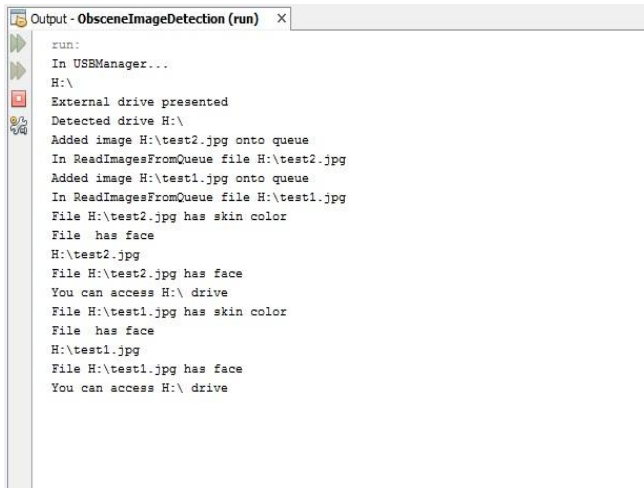


Fig. 4. Screenshot 1

A pen-drive is connected to a PC were the application is running. The pen-drive has both obscene images and normal images. Thus the application should deny the permission for the user to access the pen-drive and the application automatically ejects the pen-drive. The output is given below:

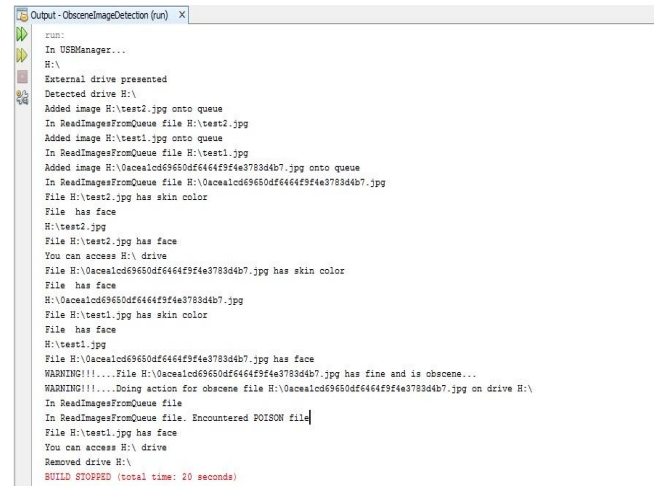


Fig. 7. Screenshot 4

A pen-drive is connected to a PC were the application is running. The pen-drive has only obscene images and no normal images. Thus the application should deny the permission for the user to access the pen-drive and the application automatically ejects the pen-drive. The output is given below:

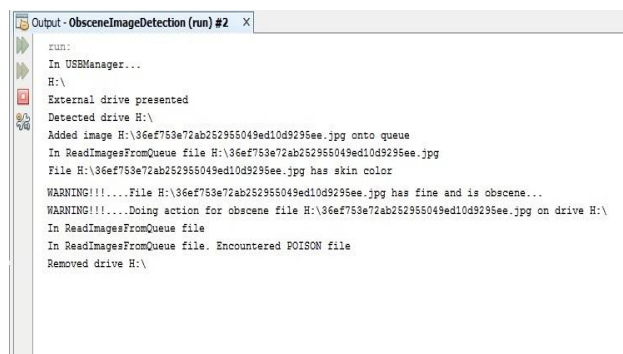


Fig. 5. Screenshot 2

The application still runs after the ejection of the pen-drive. And the application cannot find the same pen-drive after ejecting it automatically. The screenshot is given below:

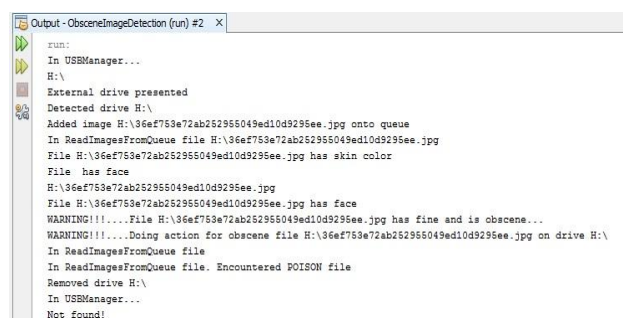


Fig. 6. Screenshot 3

ACKNOWLEDGMENT

First and foremost, I would like to thank my Guide, Mr. Samuel Stephen, Assistant Professor, Department of CSE, College of Engineering Munnar, for his valuable guidance and advice. Without his help this work would have never been completed.

I would like to thank my class tutor, Miss. Nisy John Panicker Assistant Professor, Department of CSE, College of Engineering Munnar, for her support and guidance to complete the work.

Also, I would like to thank all the teachers of the Computer Science Department of the college for providing me a good environment and facilities to complete this work without that, I would have faced many difficulties while doing this study.

Above all, I owe my gratitude to the Almighty for showering His abundant blessings upon me. And last but not the least I wish to thank my parents and my friends for helping me to complete this work successfully.

REFERENCES

- [1] Adolescent sexuality. (2017, March 4). In *Wikipedia, The Free Encyclopedia*. Retrieved 10:25, March 23, 2017, from https://en.wikipedia.org/w/index.php?title=Adolescent_sexuality&oldid=768476623.
- [2] Pathan, Swaleha S. "ADOLESCENT'S ATTITUDE TOWARDS THE OPPOSITE-SEX." *Researchers World* 2.4 (2011): 192.
- [3] Block pornography on internet (2017, March 3) In *webroot*. Retrieved 10:25, March 23, 2017, from <https://www.webroot.com/in/en/home/resources/tips/pc-security/how-to-block-pornography-on-internet-connected-devices>.

- [4] Sexual attraction. (2017, February 22). In *Wikipedia, The Free Encyclopedia*. Retrieved 10:23, March 23, 2017, from https://en.wikipedia.org/w/index.php?title=Sexual_attraction&oldid=766804451.
- [5] Heterosexuality. (2017, February 16). In *Wikipedia, The Free Encyclopedia*. Retrieved 10:21, March 23, 2017, from <https://en.wikipedia.org/w/index.php?title=Heterosexuality&oldid=765774045>.
- [6] Parental controls. (2017, March 22). In *Wikipedia, The Free Encyclopedia*. Retrieved 10:10, March 23, 2017, from https://en.wikipedia.org/w/index.php?title=Parental_controls&oldid=771625069.
- [7] Web portal. (2017, March 8). In *Wikipedia, The Free Encyclopedia*. Retrieved 10:17, March 23, 2017, from https://en.wikipedia.org/w/index.php?title=Web_portal&oldid=769313487.
- [8] Convolutional neural network. (2017, March 16). In *Wikipedia, The Free Encyclopedia*. Retrieved 06:58, March 25, 2017, from https://en.wikipedia.org/w/index.php?title=Convolutional_neural_network&oldid=770642407.
- [9] Sui, Lei, et al. "Research on pornographic images recognition method based on visual words in a compressed domain." *IET Image Processing* 6.1 (2012): 87-93.
- [10] Convolutional neural network (2017, March 3) In *a Beginner's Guide*. retrieved 10:25, March 23, 2017, from <https://adeshpande3.github.io/adeshpande3.github.io/ABeginner%27s-Guide-ToUnderstanding-Convolutional-Neural-Networks/>.
- [11] O'Shea, Keiron, and Ryan Nash. "An introduction to convolutional neural networks." *arXiv preprint arXiv:1511.08458* (2015).
- [12] Shih, Jau-Ling, Chang-Hsing Lee, and Chang-Shen Yang. "An adult image identification system employing image retrieval technique." *Pattern Recognition Letters* 28.16 (2007): 2367-2374.
- [13] Liu, Bei-bei, et al. "Pornographic images detection based on CBIR and skin analysis." *Semantics, Knowledge and Grid, 2008. SKG'08. Fourth International Conference on*. IEEE, 2008.
- [14] Choi, Byeongcheol, Byungho Chung, and Jaecheol Ryou. "Adult image detection using Bayesian decision rule weighted by SVM probability." *Computer Sciences and Convergence Information Technology, 2009. ICCIT'09. Fourth International Conference on*. IEEE, 2009.
- [15] Zhu, Hong, et al. "An algorithm of pornographic image detection." *Image and Graphics, 2007. ICIG 2007. Fourth International Conference on*. IEEE, 2007.
- [16] Lopes, Ana PB, et al. "A bag-of-features approach based on hue-sift descriptor for nude detection." *Signal Processing Conference, 2009 17th European*. IEEE, 2009.
- [17] Döring, Nicola M. "The Internet's impact on sexuality: A critical review of 15 years of research." *Computers in Human Behavior* 25.5 (2009): 1089-1101.
- [18] Internet Security (2017, March 3) In *sophos*. Retrieved 10:25, March 23, 2017, from <https://www.sophos.com/threatcenter/reassessment-request/utm.aspx>.
- [19] Yin, Haiming, Xiaodong Xu, and Lihua Ye. "Big skin regions detection for adult image identification." *Digital Media and Digital Content Management (DMDCM), 2011 Workshop on*. IEEE, 2011.
- [20] Saini, Harpreet Kaur, and Onkar Chand. "Skin segmentation using rgb color model and implementation of switching conditions." *Skin* 3.1 (2013): 1781-1787.
- [21] Kovac, J., Peer, P., & Solina, F. (2003). *Human skin color clustering for face detection* (Vol. 2, pp. 144-148). IEEE.
- [22] Wu, Yanwen, and Xueyi Ai. "Face detection in color images using AdaBoost algorithm based on skin color information." *Knowledge Discovery and Data Mining, 2008. WKDD 2008. First International Workshop on*. IEEE, 2008.
- [23] Krishna, M. Gopi, and A. Srinivasulu. "Face detection system on AdaBoost algorithm using Haar classifiers." *International Journal of Modern Engineering Research* 2.5 (2012): 3556-3560.
- [24] LeCun, Yann, and Yoshua Bengio. "Convolutional networks for images, speech, and time series." *The handbook of brain theory and neural networks* 3361.10 (1995): 1995.
- [25] Simard, Patrice Y., David Steinkraus, and John C. Platt. "Best Practices for Convolutional Neural Networks Applied to Visual Document Analysis." *ICDAR*. Vol. 3. 2003.
- [26] Zhou, Kailong, et al. "Convolutional Neural Networks Based Pornographic Image Classification." *Multimedia Big Data (BigMM), 2016 IEEE Second International Conference on*. IEEE, 2016.
- [27] Arya Surendran, Samuel Stephen. "Detection of Obscene images and Ejection of external devices." *International Conference on Electronics, Communication and Aerospace Technology ICECA 2017 (IEEE)*, Vol. II, pp. 110-113. (To be published)
- [28] Arya Surendran, Samuel Stephen. "Detection of Obscene images using CNN in external devices." *International Conference on Research trends in Engineering, Science & Technology (IER-RTEST'17) pages 118-122*. (To be published)