International Journal of Information and Computation Technology.
ISSN 0974-2239 Volume 3, Number 6 (2013), pp. 539-548

http://www. irphouse.com /ijict.htm

A new Technique for Extracting Image Information beyond Visibility

Neelam Bhardwaj[1] and Suneeta Agarwal[2]

[1]Computer Science Dept., Hindustan Institute of Technology and Management 23rd Mile Stone, Agra-Delhi Highway, India.
[2]Head, Computer Science Dept. Motilal Nehru National Institute of Technology Allahabad, India.

Abstract

Extraction of hidden image information is a latent research area. A significant work has been done towards encoding and decoding of information in an image, but to dig out the actual lost information due to defects caused by over layering of materials like ink, dust, whitener, paints, pasted paper etc is still a gray area. We propose a new image scanning technique based on sensing of light passed through the subject images instead of the conventional image scanning i.e. based on sensing of reflected light from their surface. After processing the images acquired by proposed scanning technique, the obtained results shows its efficacy in terms of the ability to bring out hidden information and objects. Although this scheme is applicable for physically available images only but it may evolve in several useful industrial as well as civil applications.

Keywords: Image processing; extraction; hidden information; image scanning; acquisition set-up.

1. Introduction

The important contents of image may be hidden or lost by intentional or unintentional reasons. Intentional information hiding means encoding of an image where as unintentional loss of image information is due to presence of defects on it. Images may be defected because of two main reasons i.e. either due to over layering of material, (additive defects) resulting in hiding of image information or due to removal of substance from their surface e.g. scratches and resulting in loss of image information. Watermarking (Potdar et al, 2005) (Le et al, 2010), encryption (Patel and Bilani, 2011) and Stenography (Cheddad et al, 2010) are well known data embedding or encoding techniques. Image forensic techniques (Redi et al, 2011) are also available. All the above mentioned techniques uses pattern recognition techniques (Swaminathan et al, 2008) w.r.t models available in database to recover image data.

In case of defected image, the first step is to locate the defected pixels. Different defect detection approaches (Bruni et al) (Song et al, 1996) are experimented. Many image in painting techniques (Ravi et al, 2013) are also available to restore the defected portions of image for both type additive as well as scratch defects (Bruni and Vitulano, 2004). The lost or damaged image portion is recovered by using its surrounding undamaged information.

The additive defects i.e. by over layering of materials like ink, dust, whitener, paints, pasted paper etc may hide some of the unique and important image objects. Unique object means the object which is not present at any other portion of image and the probability of recovering such lost image objects during in painting is very low. *To extract such hidden objects to retrieve the originality of images during in painting is still a gray and latent research area.*

In this paper we have presented a technique to extract the hidden or lost image information with the help of new scanning approach and showed its efficacy. Though, this scheme is applicable for physically available images only but may evolve in several useful applications in textile industry, document investigations, defect detection, image in-painting etc. This paper is organized in five parts i.e. introduction, proposed image scanning technique, procedure for hidden information extraction, results and contributions and conclusion.

2. Proposed Image Scanning Technique

In conventional image scanning techniques (Valtsavias et al, 1994), the reflected light from the image surface is sensed by the focal plane array (sensors) of image acquisition device and the luminous intensity of acquired image varies according to the colors & homogeneity of image surface.

In the proposed technique, the light is passed through the subject image and then sensed for image acquisition. In this case, the image thickness variation plays major role for luminous intensity variation of captured image. Based on this idea, we have prepared a scanning and image acquisition set-up as shown in fig.1. This apparatus consist of a white colored 5w bulb as light source, wooden box, a transparent glass to hold the subject image and 5 mega pixel Sony cameras as image capturing device.

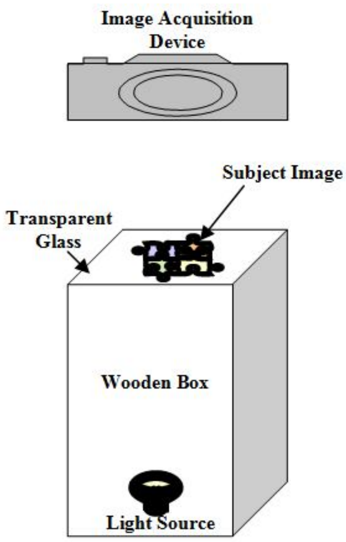

Figure 1: Proposed image scanning & acquisition set-up.

3. Procedure for Hidden Information Extraction

The complete procedure has three steps- I) image scanning and acquisition by proposed set-up, II) image analysis and processing and III) identification of hidden objects. During image scanning and acquisition, Camera flash & room light were kept OFF and light source i.e. white colored bulb was kept ON. The Scanning was done in dark night and open space to minimize the effect of reflection. The procedure is illustrated in fig.2.

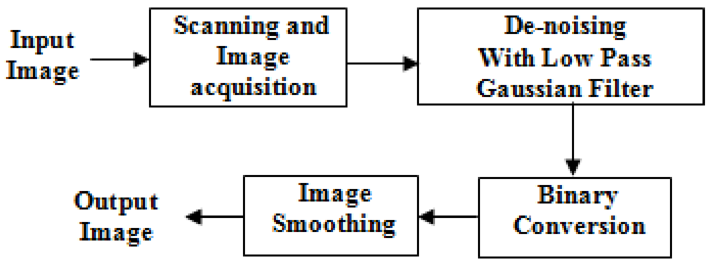

Figure 2: Hidden information extraction procedure.

The image processing is done in luminous intensity region using MATLAB 7.0 with input image acquired by proposed scanning set-up and output image with hidden objects only. The basic used image processing algorithm is given below-

Step1. Color to HSI conversion
Step2. Gaussian Low Pass filtering to remove noise
Step3. Binary conversion
Step4. Object segmentation
Step5. Output image with hidden image information

4. Results and Contributions

The obtained results are in justification with Beer-Lambert law. The hidden information beneath the additive defects makes the image thickness almost double at these locations while the lost image information due to removal of material from their surface (scratch defects) makes the image thickness almost half at these locations. This results in very less or very high luminous intensity in case of additive defects and scratch defects respectively, if these images are acquired by the proposed scanning technique. The intensity values of image at defected portions become differentiable as compared to the rest of image. We have taken various input images with intentionally hiding some information using whitener, ink-spray, over printing and paper pasting. The results obtained are very encouraging and discussed below-

4.1 Extraction of Hidden Information

The input image of fig.3 is an old photograph having some scratches over it. The input image of fig.4 is created by applying whitener over the actual image . The input image of fig.5 is generated by printing alphabets on same colored back ground and then pasting of plain white paper sheet over the printed sheet. The hidden information beneath the defects is beyond visibility in these input images as shown in fig.3a and fig.4a. The images of fig.3b, fig.4b , fig.5a and fig.5b are the corresponding images acquired by using the proposed scanning and acquisition technique. The hidden information now becomes visible in these images.

As per our expectation, the image locations having hidden information are shifted at lower side of gray levels histograms of image acquired by proposed technique. The reason is, more thickness at locations of hidden information due to additive defects as compared to remaining portion of image, for passing of light through them. The hidden objects are then extracted by processing further these images. The threshold value for binary conversion is selected as first effective valley point at lower side of histograms as shown in fig.4(c) and fig.5 (c). The actual chromatic information is still missing.

a b

Figure 3: Input image is an old photograph. a) Image scanned with conventional scanning. b) Image scanned with proposed scanning.

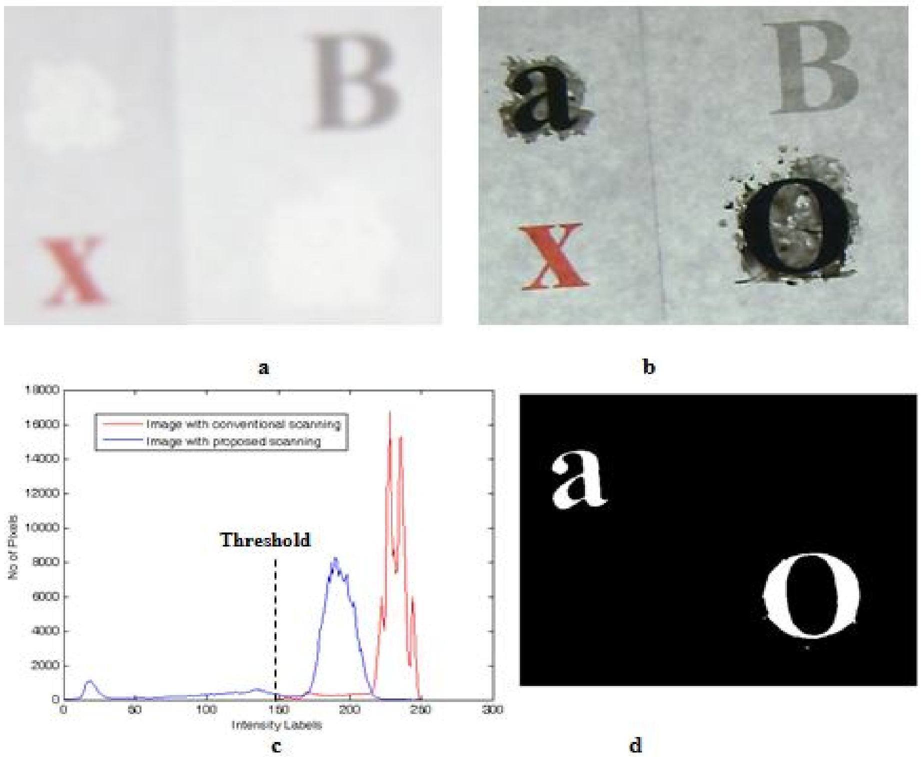

Figure 4: Input image is a data sheet having alphabets hidden with whitener. a) Conventionally scanned image. b) Image with proposed scanning. c) Histogram of fig.4a and 4b. d) processed image with hidden objects.

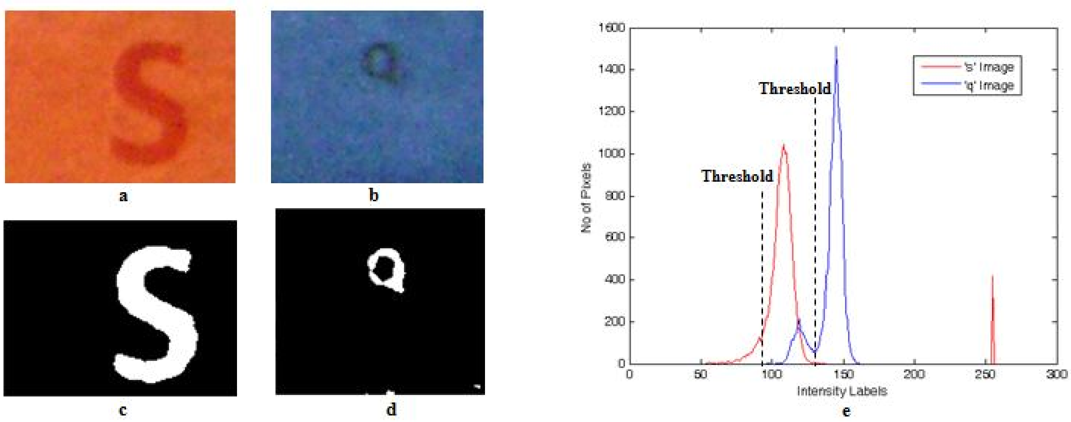

Figure 5: Input image is a data sheet with alphabets print on similar color back ground and also pasted with a plane sheet of paper a) and b) Image with proposed scanning c) and d) processed images with hidden objects. e) Histogram of fig.4a and 4b. Investigation about objects having very low contrast with background.

The contrast of image acquired by proposed scanning is very good as compare to that of with conventional scanning. Even the defect objects which are not physically distinguishable become visible with good contrast. It is shown that the scratches in image with conventional scanning shown in fig.6a, is not identifiable where as in image with proposed scanning shown in fig.6b, it becomes clearly visible. This outcome is not possible with the help of available contrast enhancement approaches.

As expected these scratches locations also shifts at higher side of histogram as shown with marked threshold in fig.6c. In case of additive defect also, the object of low contrast with background also becomes distinguishable and are shifted at lower side of histogram as shown in fig.7.

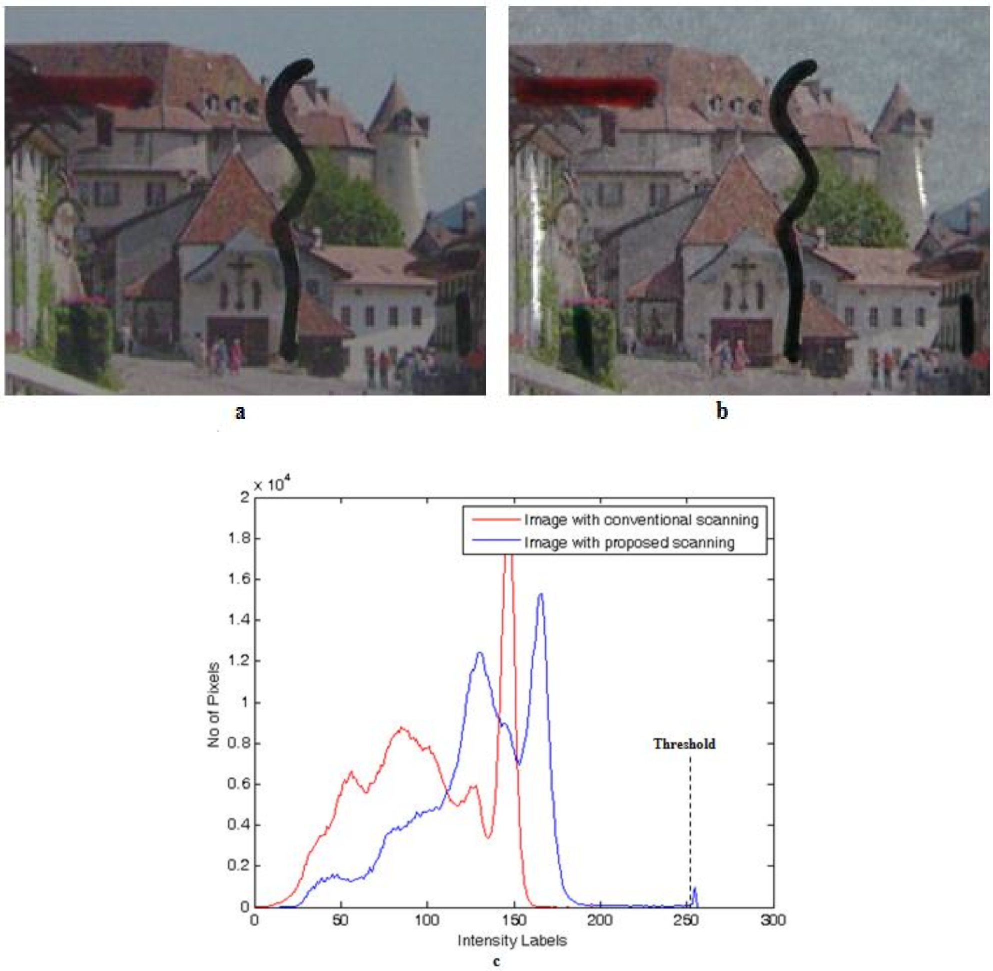

Figure 6: Input image is a scratched image a)image with conventional scanning. b) image with proposed scanning. c)Histograms of images of fig.6a and 6b.

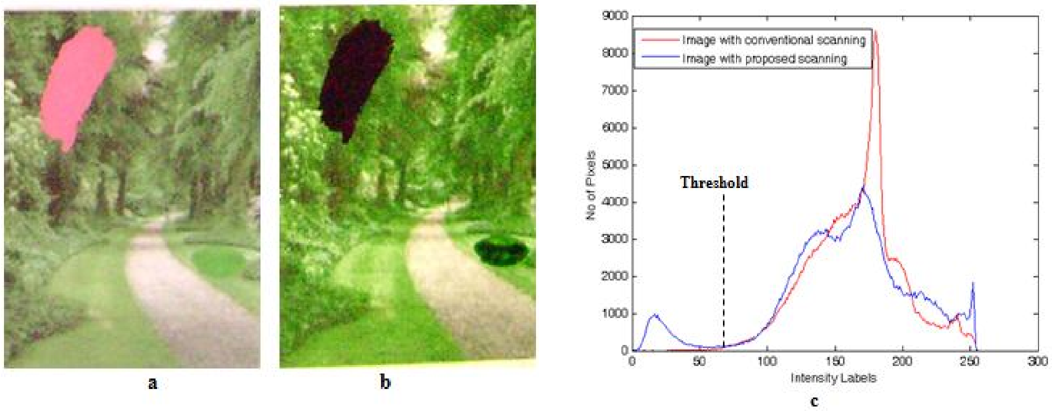

Figure 7: Input is an image with additive defect objects similar to background a) image with conventional scanning. b) Image with proposed scanning. c) Histograms of images of fig.7a and 7b.

4.2 Difference Image

An input images is prepared by applying different colors on actual physically available images. it as shown in fig.8a. As expected outcome, in the difference image of the images scanned by proposed technique and by conventional technique, only the image locations with added colors remains highlighted after thresholding. The of difference image histogram in fig.8d also reflect only two portions i.e. one portion with very low intensity and other with high intensity. In image forensic, it may help to identify the tempered image portions easily.

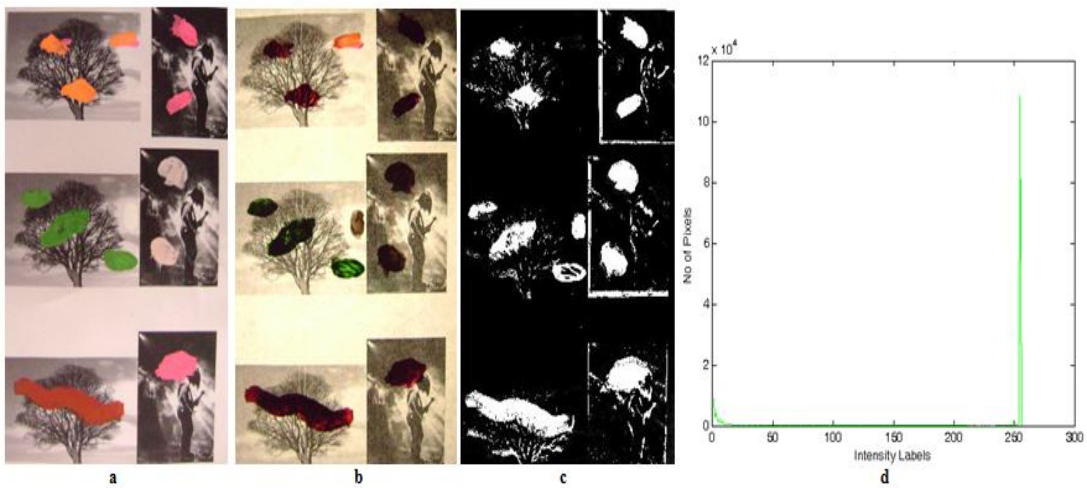

Figure 8: Input image is an Image defected with layering of different colors. a) Image scanned by conventional method. b) Image scanned by proposed method. c) Difference Image after intensity thresholding. d) Difference image histogram.

5. Conclusion

The obtained results are satisfactory and encouraging. The proposed scanning scheme is able to dig out the hidden information beyond visibility. It will be helpful in image in-painting towards originality. The enhanced contrast of scanned image may also be very helpful for image forensic. Even the objects with similar backgrounds are also identifiable which is difficult otherwise. We are developing engineering prototype of proposed scanning technique for better results and exploring it towards very useful industrial as well as civil applications. Presently it has a limitation for non light transmitting images. In future, work to overcome this limitation using the light source in IR (Cubero et al, 2011) and x-ray region may also be explored.

References

[1] Baltsavias, Emmanuel, P.Bill (1994), Scanners - a survey of current technology and future needs, ISPRS Commission I symposium, Italien, In proc. *IAPRS*, **30**, 1, pp. 130-143

[2] Bertalmio, M Sapiro, G Caselles, V Ballester (2000), Image Inpainting, In Proc. *SIGGRAPH 2000*, Annual Conference Series, pp. 417-424.

[3] Bruni V, A J Crawford, A Kokaram and D Vitulano, Visual perception of semitransparent blotches :detection and restoration, *Brain, Vision and AI* Intech Bruni Vittoria and Domenico Vitulano,(2004) A generalized model for scratch detection, *IEEE Transactions on Image Processing*, **13**, *1*, pp. 44-50.

[4] Cheddad Abbas, Joan Condell, Kevin Curran, Paul Mc Kevitt (2010), Digital image steganography: Survey and analysis of current methods, *Elsevier: Signal Processing*, **90**, *3* , pp. 727-752

[5] Cubero S, N Aleixoa, E Molto, J G Sanchis, J Blasco (2011), Advances in machine vision application for automatic inspection and quality evaluation of fruits and vegetables, *Springer: Food and Bioprocess Technology*, **5**, *4*, pp. 487-504.

[6] Le Thi Hoang Ngan, Kim Hung Nguyen, Hoai Bac Le (2010), Literature Survey on Image Watermarking Tools,Watermark Attacks and Benchmarking Tools, In proc. *Advances in Multimedia (MMEDIA)* , Second International Conference, pp. 67 - 73

[7] Patel Komal D, Sonal Belani (2011), Image Encryption, Using Different Techniques : A Review ,*International Journal of Emerging Technology and Advanced Engineering*, **1,** *1*

[8] Potdar, V.M., Perth, Song Han ,Chang (2005), A survey of digital image watermarking techniques, In proc. *Industrial Informatics*, 3rd IEEE International Conference, pp. 709 - 716

[9] Ravi S, Pasupathi P, Muthukumar S, Krishnan N (2013), Image in-painting techniques - A survey and analysis, in Proc. Innovations in Information Technology (IIT), 9th IEEE International Conference,pp. 36-41

[10] Redi Judith A, Wiem Taktak, Jean-Luc Dugelay (2011),Digital image forensics: a booklet for beginners, *Multimedia Tools and Applications* , *Springer*, **51**, *1*, pp. 133-162,

[11] Song K.Y, J. Kittler, M. Petrou (1996), Defect detection in random color textures, *Image and Vision Computing*, *Elsevier*, **14**, *9* , pp. 6683

[12] Swminathan Ashwin, Min Wu,K. J. Ray Liu (2008), Digital Image forensics via intrinsic fingerprints, *IEEE Transactions on Information Forensics and Security*, **3,** *1*, pp. 101-117.