Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 13 Issue 08, August-2024

A Novel Versatile Method of Generating Soft Halftone Proofs

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Abstract
Soft color halftone proofing is the most important requirement in the reproduction of digital color images. Soft color halftone proofs built from individual color separations screened at a required screen angle, in case of AM screening and only screened, in case of FM screening, might give a printer the exact prediction of colors and tonal gradations. The present work is an attempt to solve the problem of screened soft color halftone proofing with a versatile approach.

***Keywords*: color halftone, amplitude modulation, frequency modulation, multiply, progressive proofs.**

1. Symbols

AM: Amplitude Modulated
FM: Frequency Modulated
DPI: Dots per Inch
K: Black
C: Cyan
M: Magenta
Y: Yellow
R: Red
G: Green
B: Blue

2. INTRODUCTION

Digital soft color halftone proofs are the most important requirements in predicting the results of print production. Digital proofs on color monitor always take a fore seat once an image is ready for further processing especially in print production. Existing image-editing tools like Adobe Photoshop, Corel Photo-Paint, have not provided any readily available imaging filter tools that may create soft color halftone proofs with wide range of screening methods like AM with various dot sizes or FM screening. The filter tool like ‘color halftone’ in Adobe Photoshop 7.0 create a special effect with AM anti-aliased round dots with different screen angles, which is equivalent to soft-screened proof of one kind. The ‘halftone’ tool of Corel Photo-Paint 11 provides similar facility to create AM based screened proof. Corel Paint Shop Pro 9.0 also provides similar facility for creating soft halftone proofs. These above-mentioned filters to generate color-screened images are not versatile as already mentioned. In the present work an attempt has been made to fill that lacuna in soft color halftone proofing which is capable of producing both AM and FM soft color halftone proofs.

3. EXPERIMENTAL PROCEDURES

The Adobe Photoshop 7.0 has been selected as the main platform to work with.

3.1 For the new method of generating soft color halftone proofs main procedure steps are as follows

1. Editing the sample image in RGB color mode.
2. Converting to CMYK color mode using suitable setup.
3. Doing necessary corrections.
4. Separating the four plates (K, C, M and Y) by splitting the channels, this creates four gray images corresponding to each process color.
5. Generating halftones either AM or FM for the four plates.
6. Converting four plates to one-bit gray image and then to CMYK color mode and colorizing four halftone plates using the process colors.
7. Combining all the four plates in separate layers, in a single file.
8. Apply ‘multiply’ (layer blending) effect for selected layers to create subtractive mixing of colors for the layers i.e. individual color printers as shown in figure.1.
9. Judge the final soft color halftone proof and progressive proofs.

International Journal of Engineering Research & Technology (IJERT)
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Table: 1: Filenames and other details at various stages of AM proof generation

Original Image	Resolution (DPI)	Gray Images (Splitted)	AM Halftone Images	AM Halftone Images (Colored*)	Dotshape	Screen Angle (Degree)	LPI
flrgb or flcmyk	144	flcmyk_K	flcmyk_K_am	flcmyk_K_amc	ellipse	45	36
		flcmyk_C	flcmyk_C_am	flcmyk_C_amc	Do	75	36
		flcmyk_M	flcmyk_M_am	flcmyk_M_amc	Do	105	36
		flcmyk_Y	flcmyk_Y_am	flcmyk_Y_amc	Do	90	36

* Color used: Photoshop CMYK, values are given in percentages, e.g. for cyan plate C=100%, M=0%, Y=0%, K=0%, similarly for M, Y and K plate.

Progressive proofs: flcmyk_CM_amc, flcmyk_CY_amc, flcmyk_MY_amc

Final Proof: flcmyk_am_proof

Table: 2: Filenames and other details at various stages of FM proof generation

Original Image	Resolution (DPI)	Gray Images (Splitted)	FM Halftone Images	FM Halftone Images (Colored*)	Screening
flrgb or flcmyk	144	flcmyk_K	flcmyk_K_fm	flcmyk_K_fmc	Diffusion dither
		flcmyk_C	flcmyk_C_fm	flcmyk_C_fmc	Do
		flcmyk_M	flcmyk_M_fm	flcmyk_M_fmc	Do
		flcmyk_Y	flcmyk_Y_fm	flcmyk_Y_fmc	Do

* Color used: Photoshop CMYK, values are given in percentages, e.g. for cyan plate C=100%, M=0%, Y=0%, K=0%, similarly for M, Y and K plate.
Progressive proofs: flcmyk_CM_fmc, flcmyk_CY_fmc, flcmyk_MY_fmc
Final Proof: flcmyk_fm_proof

Figure.1 shows layer blending effect “Multiply” in Photoshop 7 of three layers containing colors in ‘Cyan’, ‘Magenta’ and ‘Yellow’ circles, to generate colors red, green and blue and black, which is equivalent to subtractive mixing of colors.

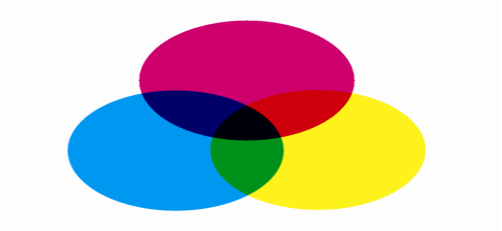

Figure 1: “Multiply” layer blending effect in Photoshop 7 of three layers ‘Cyan’, ‘Magenta’ and ‘Yellow’ which is equivalent to subtractive mixing of colors.

In labeling the figures from fig.2-fig.29, the filename of the images are given in the parenthesis.
Here both Amplitude Modulated and Frequency Modulated screening is done to generate both type of halftone proofs. Fig.2 and fig.3 are the rgb and cmyk color originals. Fig.4 to fig.7 are the cyan, magenta, yellow and black plates in gray respectively.

International Journal of Engineering Research & Technology (IJERT)
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Figure 2: Original RGB image (flrgb)

Figure 3: Original CMYK image (flcmyk)

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Figure 4: Cyan part in gray (flcmyk_C)

Figure 5: Magenta part in gray (flcmyk_M)

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Figure 6: Yellow part in gray (flcmyk_Y)

Figure 7: Black part in gray (flcmyk_K)

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Figure 8: AM halftoned Black (flcmyk_K_amc)

Figure 9: AM halftoned Cyan (flcmyk_C_amc)

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Figure 10: AM halftoned Magenta (flcmyk_M_amc)

Figure 11: AM halftoned Yellow (flcmyk_Y_amc)

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Figure 12: Progressive Proof: Cyan and Magenta (flcmyk_CM_amc)

Figure 13: Progressive Proof: Cyan and Yellow (flcmyk_CY_amc)

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Figure 14: Progressive Proof: Magenta and Yellow (flcmyk_MY_amc)

Figure 15: AM halftoned Proof (flcmyk_am_proof)

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Figure 16: FM halftoned Black (flcmyk_K_fmc)

Figure 17: FM halftoned Cyan (flcmyk_C_fmc)

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Figure 18: FM halftoned Magenta (flcmyk_M_fmc)

Figure 19: FM halftoned Yellow (flcmyk_Y_fmc)

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Figure 20: Progressive Proof: Cyan and Magenta (flcmyk_CM_amc)

Figure 21: Progressive Proof: Cyan and Yellow (flcmyk_CY_amc)

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Figure 22: Progressive Proof: Magenta and Yellow (flcmyk_MY_amc)

Figure 23: FM halftoned Proof (flcmyk_fm_proof)

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ISSN: 2278-0181
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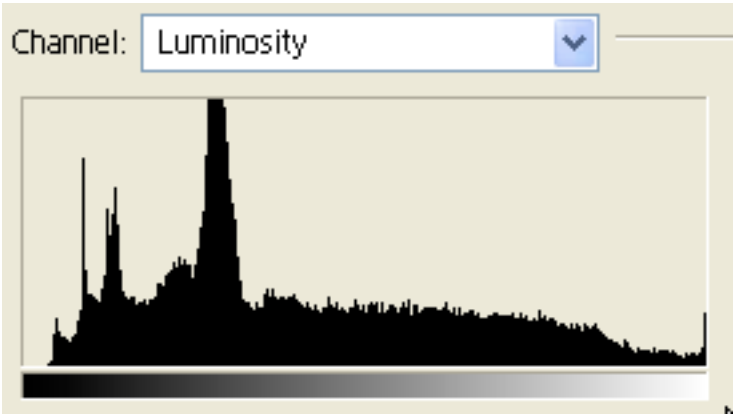

Figure 24: Histogram of figure 2 (flrgb_hg)

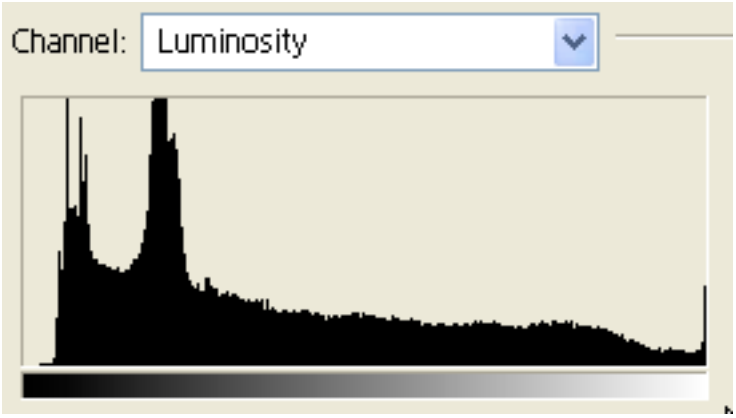

Figure 25: Histogram of the figure 3 (flcmyk_hg)

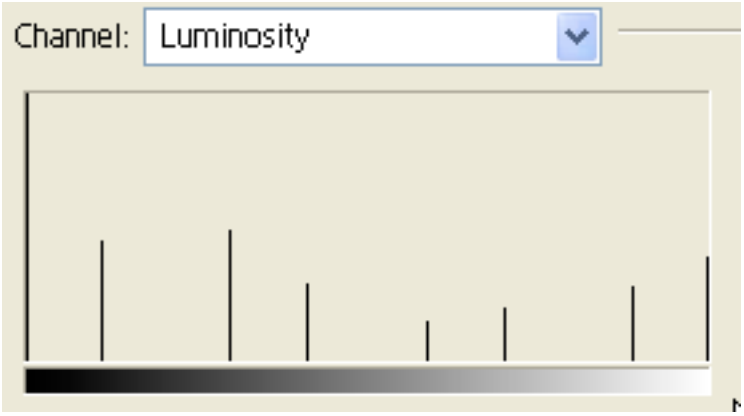

Figure 26: Luminosity histogram of the figure 15 (am_hg_2)

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ISSN: 2278-0181
Vol. 13 Issue 08, August-2024

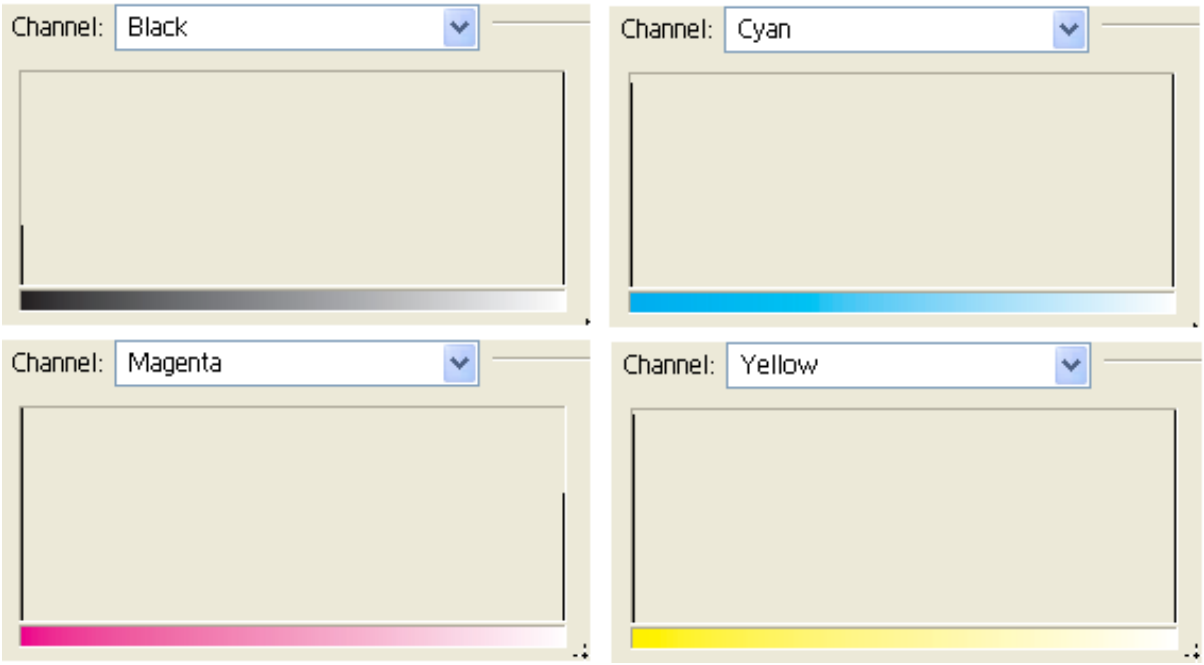

Figure 27: K, C, M and Y histograms of the figure 15 (am_hg)

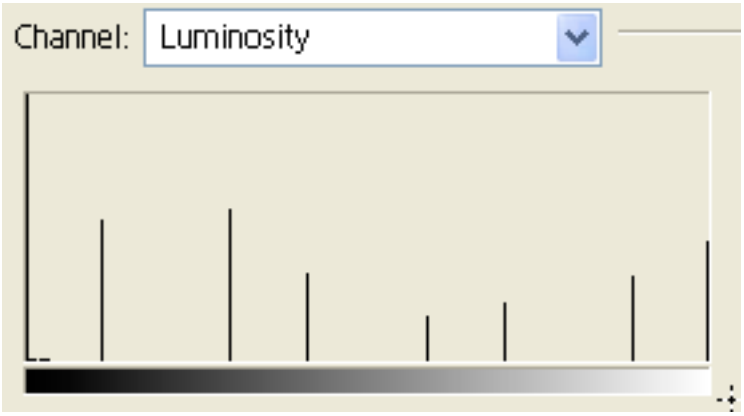

Figure 28: Luminosity histogram of the figure 23 (fm_hg2)

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ISSN: 2278-0181
Vol. 13 Issue 08, August-2024

Figure 29: K, C, M and Y histograms of the figure 23 (fm_hg)

4. RESULTS AND DISCUSSIONS

Fig.8 to fig.11 are the AM screened K, C, M and Y plates respectively. Dot shape, screen angle, screen frequency (Lines per inch) and resolution (DPI) of the original images and filename details are given in the Table-1. Fig. 12 is cyan-magenta, fig 13 is cyan-yellow and fig.14 is magenta-yellow, progressive proofs. Fig.15 is the AM halftone proof. Fig.16 to fig.19 are the FM screened K, C, M and Y plates respectively. Dots per inch of the original images, type of screening used and filename details are given in the Table-2. Fig. 20 is cyan-magenta, fig 21 is cyan-yellow and fig.22 is magenta-yellow, progressive proofs. Fig.23 is FM halftone proof. Fig.24 and fig.25 are the luminosity histograms of the fig.2 and fig.3 respectively and their image-wise difference is evident in the histograms especially in darker tones. Fig.26 is the luminosity histogram of the fig.15 which shows few histogram tones because of using pure and single tone color. Fig.27 contains histograms of K, C, M and Y channels of the fig.15 which show pure and single tone K, C, M and Y colors (as intermediate tones are not available in the histograms of K, C, M and Y) are used to make AM proof. Like that fig.28 is the luminosity histogram of the FM proof (fig 23) which shows few histogram tones because of using pure and single tone color. Fig.29 contains histograms of K, C, M and Y channels of the fig.23 which show pure and single tone K, C, M and Y colors (as intermediate tones are not available in the histograms of K, C, M and Y) are used to generate the FM proof also.

5. CONCLUSIONS

The method presented here is more versatile i.e. having wider applications as both AM and FM halftone proofs can be generated. Proofs of good quality (having more image details and C, M, Y, K plates colorized with pure colors, i.e. one color not mixed with other color) can be generated by this method for both types of halftoning.

6. ACKNOWLEDGEMENTS

1. Adobe Photoshop 7.0, Adobe Systems Incorporated, 1990-2002, USA.
2. Corel Photopaint 11.633, Corel Corporation, 2002, USA
3. Matlab 6.1, The Mathworks, Inc, 1984-2001, USA

4. REFERENCES

1. Kundu, P, 2013, A Novel Approach to Non-halftone Binary Image Transformations, Digital Halftoning and Color Halftone Proofing, PhD Thesis- page no.226, Jadavpur University, Jadavpur, West Bengal, INDIA.