A Novel Approach to Non-Halftone Binary Image Transformations, Digital Halftoning and Color Halftone Proofing

SYNOPSIS

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SYNOPSIS

A Novel Approach to Non-Halftone Binary Image Transformations, Digital Halftoning and Color Halftone Proofing

Transforming gray images to binary ones through non-halftone binarization (algorithm driven digital line conversion methods) and novel digital halftoning techniques and building multicolor soft halftone proof would always find their general and special application in the field of printing and imaging science and engineering. This present research work concentrates on such type of approaches to the design of image transformation methods for converting gray scale images to non-halftone binary and halftone images and generation of multicolor soft halftone proofs.

Non-halftone binary image transformations

Generation of non-halftone binary images as may be required for various imaging processes, while maintaining the maximum image details are the main objective in this category.

In this section various novel non-halftone image transformation methods are proposed for binary images. They might be

1. Row-wise and column-wise processing
2. Blockwise processing,
3. Processing based on pixel location and path based on location.
   - 3.1. Processing the image column-wise
   - 3.2. Processing the image row-wise
   - 3.3. Processing the image in arbitrary path
   - 3.4. Processing the image diagonally
     - 3.4.1 Starting point of the diagonal is Left Top or Right Bottom (LTRB)
       - 3.4.1.1 LTDAVFTC (Left top diagonal alternate vector spiral with first turn clockwise)
       - 3.4.1.2 LTDAVFTAC (Left diagonal alternate vector spiral with first turn anti-clockwise)
       - 3.4.1.3 LTDVLB2RT (Left top diagonal vectors, left bottom to right top)

3.4.1.4 LTDVRT2LB (Left top diagonal vectors, right top to left bottom)

3.4.1.5 RBDAVFTAC (Right bottom (starting point) diagonal alternate vector spiral with first turn anti-clockwise. 5 is reverse of 1)

3.4.1.6 RBDAVFTC (Right bottom diagonal alternate vector spiral with first turn clockwise. 6 is reverse of 2)

3.4.1.7 RBDVRT2LB (Right bottom diagonal vectors, right top to left bottom. 7 is reverse of 3)

3.4.1.8 RBDVLB2RT (Right bottom diagonal vectors, left bottom to right top. 8 is reverse of 4)

3.4.2 Starting point of the diagonal is Right Top or Left Bottom (RTLB)

3.4.2.1 RTDAVFTC (Right top diagonal alternate vector spiral with first turn clockwise)

3.4.2.2 RTDAVFTAC (Right top diagonal alternate vector spiral with first turn anticlockwise)

3.4.2.3 RTDVRB2LT (Right top diagonal vectors, right bottom to left top)

3.4.2.4 RTDVLT2RB (Right top diagonal vectors, left top to right bottom)

3.4.2.5 LBDAVFTAC (Left bottom (starting point) diagonal alternate vector spiral with first turn anti-clockwise. 5 is reverse of 1)

3.4.2.6 LBDAVFTC (Left bottom diagonal alternate vector spiral with first turn clockwise. 6 is reverse of 2)

3.4.2.7 LBDVLT2RB (Left bottom diagonal vectors, left top to right bottom. 7 is reverse of 3).

3.4.2.8 LBDVRB2LT (Left bottom diagonal vectors, right bottom to left top. 8 is reverse of 4)

1. Row-wise and column-wise processing

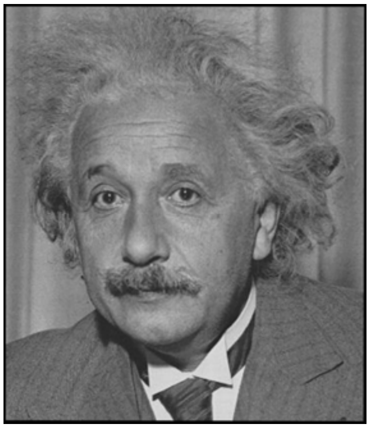

Figure 1: Sample Image

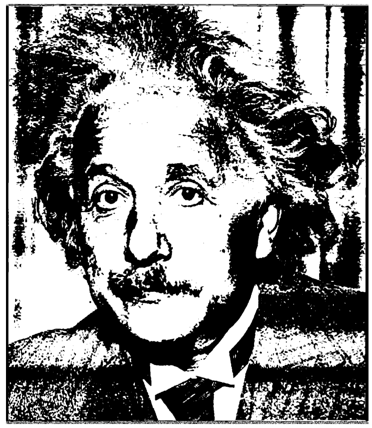

Figure 2: Row-wise processing

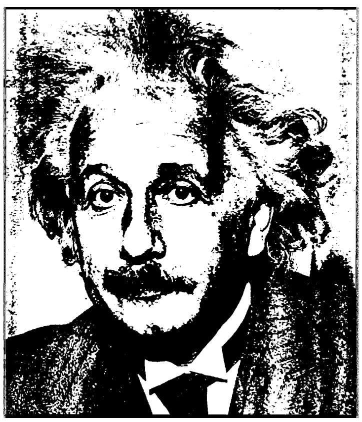

Figure 3: Column-wise processing

Fig.2 and fig.3 is obtained by selecting each row and each column of the fig.1 respectively and thresholding it. Fig.2 and fig.3 produces fewer image details.

2. Blockwise processing

Figure 4: (ebt4)

Figure 5: (ebt7)

Fig.4 is obtained by selecting 16 by 16 block size of the original image fig.1 and processing it. In fig.5 we see considerable loss in image details due to increase in blocksize i.e. 128 by 128.

3. Processing based on pixel location and path based on location.

3.1 Processing the image column-wise

Figure 6: nop 100 **(**ltein1)

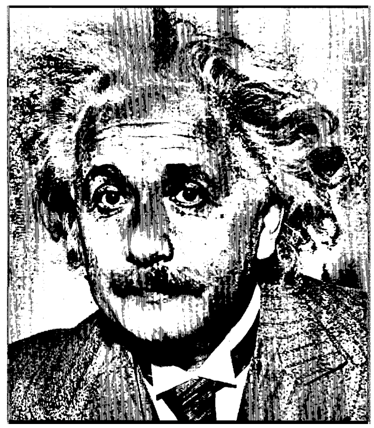

Figure 7: nop 400 **(**ltein3)

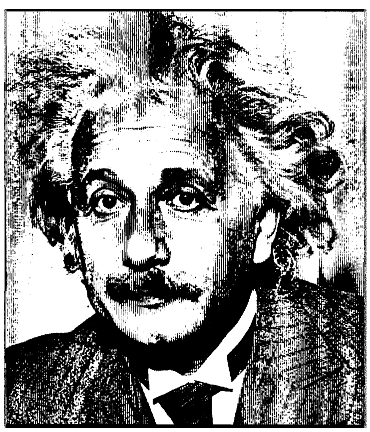

Figure 8: nop 750 **(**ltein5)

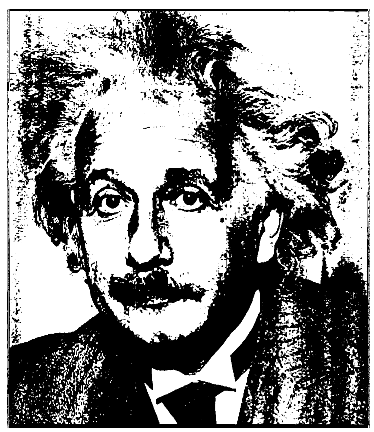

Figure 9: nop 2400 **(**ltein7)

Fig.6 is having more image details and image details are lost slowly from fig.6 to fig.9 as the number of pixels (nop) processed at a time is increased from 100 to 2400 which is given in parenthesis beside the figures.

3.2 Processing the image row-wise

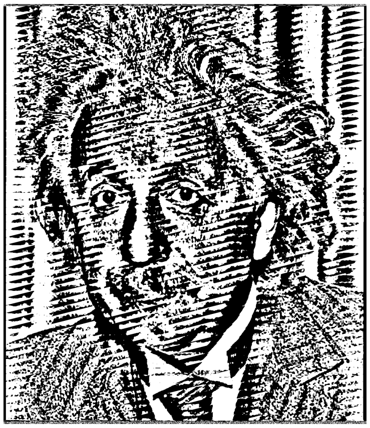

Figure 10 (LocThreshRow_ein1)

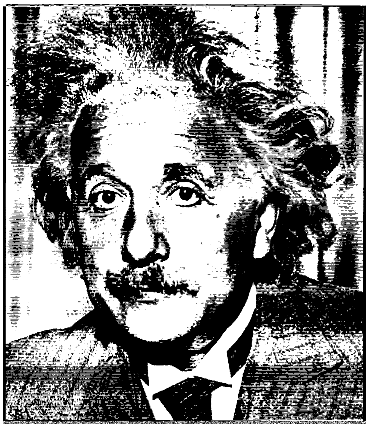

Figure 11:

(LocThreshRow_ein5)

Fig.10 and fig.11 are processed with nop 100 and 750 respectively. The fig.10 contains more image details than fig.11 but fig10 contains some visual artifacts.

3.3 Processing the image in arbitrary path

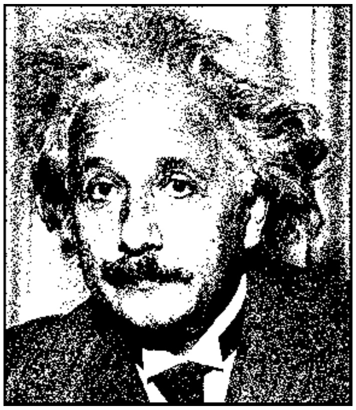

Figure 12: nop 10

(pathth_ein1)

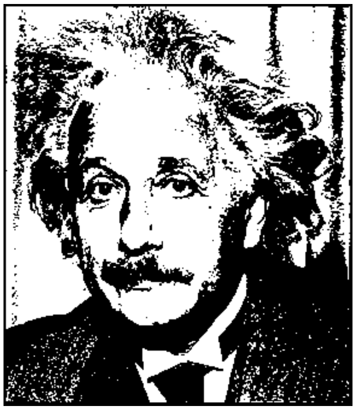

Figure 13: nop 5000

(pathth_ein6)

Fig.12 and fig.13 are processed with nop 10 and 5000 respectively. Fig.13 contains less image details due to increase in nop.

3.4 Processing the image diagonally

3.4.1 Starting point of the diagonal is Left Top or Right Bottom

3.4.1.1 LTDAVFTC (Left top diagonal alternate vector spiral with first turn clockwise)

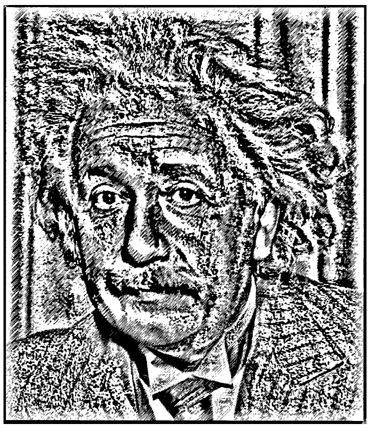

Figure 14: (ein1L1)

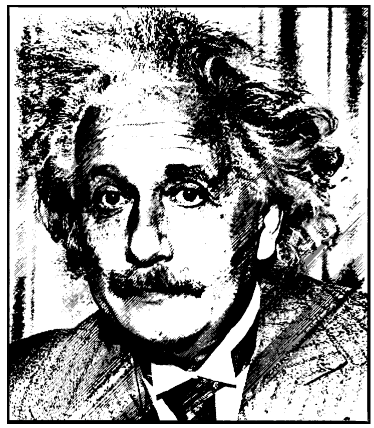

Figure 15: (ein3L1)

Fig.14 and fig.15 are processed with nop 50 and 500 respectively. There is a sharp decrease in image details due increase in nop as is evident in fig.15.

3.4.2 Starting point of the diagonal is Right Top or Left Bottom

3.4.2.1 RTDAVFTC (Right top diagonal alternate vector spiral with first turn clockwise)

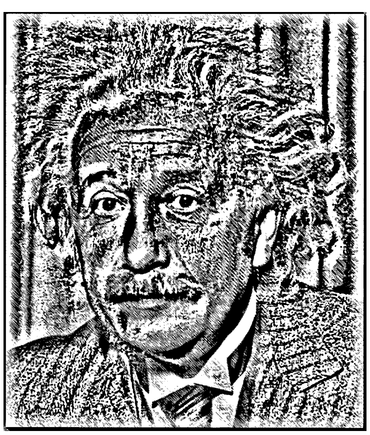

Figure 16: (ein1R1)

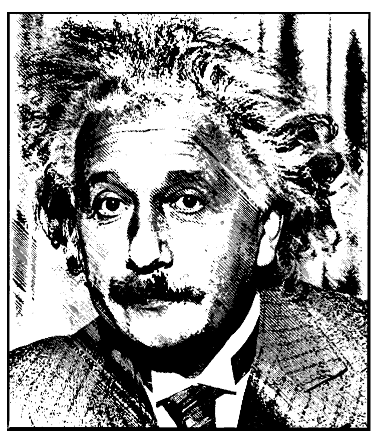

Figure 17: (ein3R1)

Figure 16 and figure 17 are processed with nop 50 and 500 respectively. In fig.16 image details are more than figure 17, as it is processed with less nop.

Filenames are given in parenthesis for the fig.4-fig.17

Digital Halftoning

Here two novel transformation methods are applied to process, gray images to generate halftones.

They proposed methods might be,

1. Halftoning by pre-embedding the pattern
2. Halftoning by simulating character-writing pattern

1. Halftoning by pre-embedding the pattern

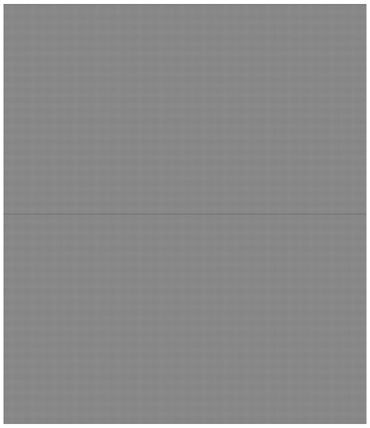

Figure 18: Pattern to be embedded

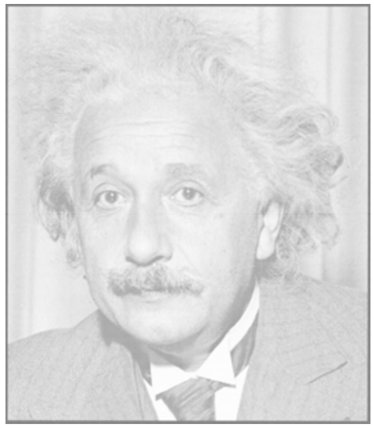

Figure 19 : Pattern embedded sample

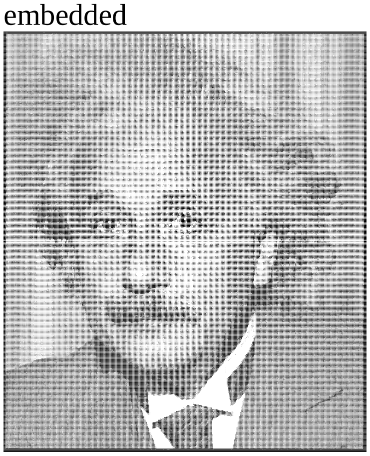

Figure 20: Pattern embedded sample after halftoning

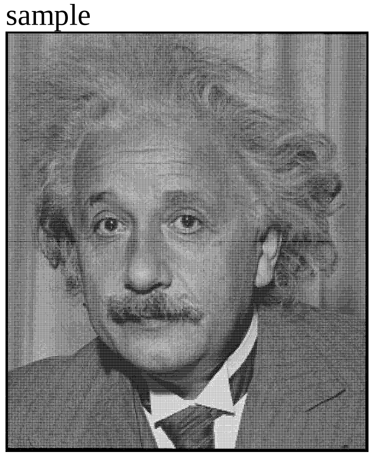

Figure 21: Sample image of figure 1 is Halftoned using pattern

Figure 1 is used as a sample image here. Pattern of figure 18 is embedded with fig.1 to get fig.19. Fig.20 is the halftone obtained after embedding the pattern. Figure 21 is the halftone using the pattern.

2. Halftoning by simulating character-writing pattern (CWP)

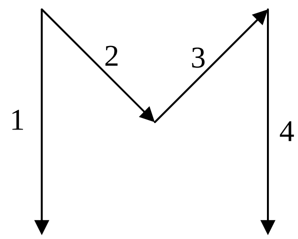

Figure 22 Writing Stroke Sequences of a Character 'M'

Figure: 23

Mask matrix							
0	0	0	0	0	0	0	0
0	1	7	0	0	14	15	0
0	2	8	0	0	13	16	0
0	3	0	9	12	0	17	0
0	4	0	10	11	0	18	0
0	5	0	0	0	0	19	0
0	6	0	0	0	0	20	0
0	0	0	0	0	0	0	0

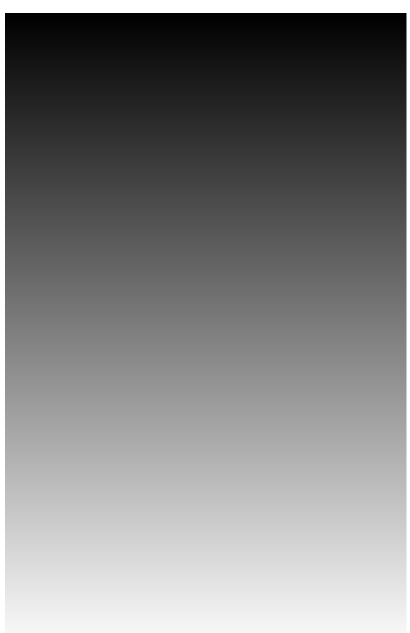

Figure 24: Sample Image grayscale ramp

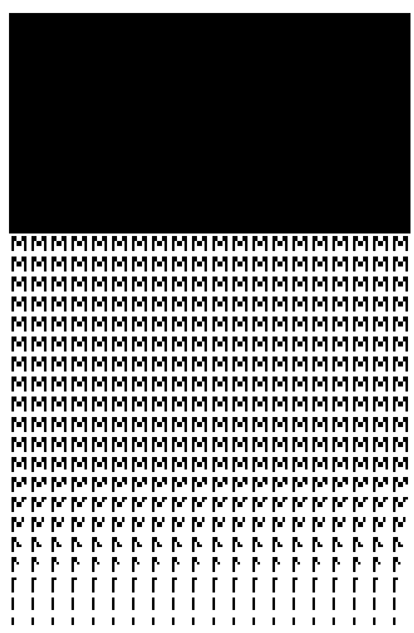

Figure 25: Output using CWP

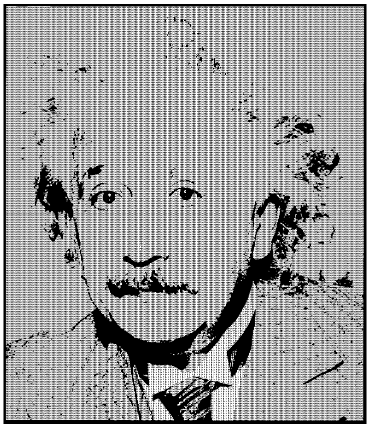

Figure 26: Output using CWP

Figure 22 is the character writing pattern (CWP). Fig.23 is the mask matrix corresponding to the character writing pattern. Fig. 25 is the halftone output of the sample fig. 24 using the CWP. Fig. 26 is the output halftone of fig. 1 using CWP.

Color Halftone Proofing

Proposed novel method of soft halftone proofing through amplitude modulated and frequency modulated techniques are the main objectives of this section.

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

Main procedure steps to soft proofs are as follows

1. Editing the image in RGB mode
2. Converting to CMYK mode using suitable setup
3. Doing necessary corrections
4. Separating the four plates (Black, Cyan, Magenta and Yellow) by splitting the channels, this creates four gray images corresponding to each process color.
5. Generating halftones for the four plates.
6. Converting four plates to single bit grayscale and then to CMYK mode and colorizing four halftone plates using the process colors.
7. Combining all the four images in separate layer in a single file.
8. Apply ‘multiply’ (layer blending) effect for individual layers to create subtractive mixing of colors for the layers i.e. individual color printers.
9. Judge the final soft halftone proofs and progressive proofs.

Figure 27: Original CMYK

Figure 28: AM halftone proof

Figure 29: FM halftone proof

Figure 27 is the original CMYK image. Fig.28 and fig.29 are the amplitude modulated and frequency modulated halftones produced by procedure as mentioned above. The soft halftone produced by this method is of good quality as compared to proofs produced by other methods.