<http://www.codeforge.com/read/77997/enhence.txt__html>

http://www.mathworks.com/matlabcentral/fileexchange/34524-edge-detection/content/EdgeDetection/IFDedgedetection.m

%% Image Processing and Fuzzy logics to detect the edge of a given image.

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%For further information email to kprasad.iitd@gmail.com

%More implement about the algorithm see the research paper of Tamalika and A.K.Ray

% on Threshold selection using Fuzzy set theory and other research papers

% of same author.

%%Start of coding, Symbols have their usual meaning

%% Input Image

clear all;

clc;

A=[];

piA=[];

%Using 16 fuzzy edge templets that show the possible direction of the edge

%s in the image and then calculating the divergence between the origin

%image and the 16 fuzzy templets.

%Take any one example and uncomment it ;

%Reading the pixel of the image using imread function of the matlab

% %for rice image

% III = rgb2gray(imread('rice.tif'));%name of the image

% II = imcrop(III,[80 30 240 200]);

%

%III = rgb2gray(imread('self\_fig.tif'));%name of the image

%II = imcrop(III,[50 40 650 400]);

III = rgb2gray(imread('canny1.tif'));%name of the image

II = imcrop(III,[5 5 560 450]);

%%For Tree image;

%III = rgb2gray(imread('1.2.03.tiff'));%name of the image

% %II = imcrop(III,[35 94 430 355]);

%III = imread('1.4.09.tiff');%name of the image

% %For lena photo

% III = rgb2gray(imread('lena.tiff'));%name of the image

% II = imcrop(III,[35 94 430 355]);

I = double(II);

[r,k] = size(I);%no of row and column is I

%% Selection of the 16 fuzzy templets

a=0.3; b=0.8;

t1 = [a a a; 0 0 0; b b b];

t2 = [a a b; a b 0; b 0 0];

t3 = [b b b; 0 0 0; a a a];

t4 = [b a a; 0 b a; 0 0 b];

t5 = [b a 0;b a 0; b a 0];

t6 = [a 0 b;a 0 b; a 0 b];

t7 = [0 0 0; b b b; a a a];

t8 = [0 b a; 0 b a; 0 b a];

t9 = [a a a; b b b;0 0 0];

t10 = [a b 0; a b 0;a b 0];

t11 = [0 0 0; a a a;b b b];

t12 = [0 a b; 0 a b; 0 a b];

t13 = [b b b; a a a; 0 0 0];

t14 = [b 0 a; b 0 a; b 0 a];

t15 = [b 0 0; b 0 a; a a b];

t16 = [0 0 b; 0 b a; b a a];

%% Initization of algo

xmax = max(max(max(I)));%maximum pixel/element of the image;

%converting into the fuzzy domain from the original image;

fim = I/xmax;%fim is the image data of the input image in the fuzzy domain,all value of the fim in the interval of [0 1];

%initializing the edge image as zeros matrix i.e black box;

fedgeim = zeros(r,k);%in fuzzy domain

%Increaing the boreder line of the iamge i.e to increase the row and column

%by 2 in the first and last by taking the mirror image of the immediate

%existing rows and columns respectively;

r1 = fim(2,:);%Copy of all element in the 2nd row of fim

r2 = fim(r-1,:);

c1 = fim(:,2);

c2 = fim(:,k-1);

b1 = [0 r1 0];

b2 = [0 r2 0];

b3 = [c1 fim c2];

bfim = [b1;b3;b2];%bfim = Border fuzzy image matix

bfim(1,1) = fim(1,1);

bfim(r+2, k+2) = fim(r,k);

bfim(1,k+2) = fim(1,k);

bfim(r+2,1) = fim(r,1);

%finding Hesitation degree or intuitionstic fuzzy index

%c = input("Enter the value of pi ");

c= 0.2;

pibfim = c\*(1-bfim);

pit1 = c\*(1-t1);pit2 = c\*(1-t2);pit3 = c\*(1-t3);pit4 = c\*(1-t4);pit5 = c\*(1-t5);pit6 = c\*(1-t6);pit7 = c\*(1-t7);

pit8 = c\*(1-t8);pit9 = c\*(1-t9);pit10 = c\*(1-t10);pit11 = c\*(1-t11);pit12 = c\*(1-t12);pit13 = c\*(1-t13);

pit14 = c\*(1-t14);pit15 = c\*(1-t15);pit16 = c\*(1-t16);

%Calculation of the maximum of the divergance value between the 16 templets

%and the original image of the same size let the original image denoted by

%A this A arew formed by taking the 3x3 matrix in the border matix i.e from

%bfim

%Considering the fuzzy templats as mask of size 3x3 and then we will slide

%this matix in the fuzzy matrix i.e in the fim not inj the bfim

for i = 2:r+1

for j = 2:k+1

A = [bfim(i-1,j-1) bfim(i,j-1) bfim(i+1,j-1) ; bfim(i-1,j) bfim(i,j) bfim(i+1,j) ; bfim(i-1,j+1) bfim(i,j+1) bfim(i+1,j+1)];

piA = [pibfim(i-1,j-1) pibfim(i,j-1) pibfim(i+1,j-1) ; pibfim(i-1,j) pibfim(i,j) pibfim(i+1,j) ; pibfim(i-1,j+1) pibfim(i,j+1) pibfim(i+1,j+1)];

%3x3 matrix for determining the divergence with the tempelets t1,

%t2...15,16.

%we calculate the divergence of 3x3 matrix at a time and then

%taking the minimun element of the matrix for all 16 fuzzy

%tempelets;

%d1 is a matrix of 3x3 = divergence with original matix and

%fuzzy templets 1

d1 = 2 - (1-A+t1).\*exp(A-t1)-(1-t1+A).\*exp(t1-A)+ 2- (1-(A-t1)+pit1-piA).\*exp(A-t1-(pit1-piA))-(1-(pit1-piA)+A-t1).\*exp(pit1-piA-(A-t1));

min1 =min(min(d1));

%d2 is the matix of 3x3 = divergence matix with orinigal matrix and fuzzy tempelts 2.

d2 = 2 - (1-A+t2).\*exp(A-t2)-(1-t2+A).\*exp(t2-A)+2-(1-(A-t2)+pit2-piA).\*exp(A-t2-(pit2-piA))-(1-(pit2-piA)+A-t2).\*exp(pit2-piA-(A-t2));

min2 =min(min(d2));

d3 = 2 - (1-A+t3).\*exp(A-t3)-(1-t3+A).\*exp(t3-A)+2-(1-(A-t3)+pit3-piA).\*exp(A-t3-(pit3-piA))-(1-(pit3-piA)+A-t3).\*exp(pit3-piA-(A-t3));

min3 =min(min(d3));

d4 = 2 - (1-A+t4).\*exp(A-t4)-(1-t4+A).\*exp(t4-A)+2-(1-(A-t4)+pit4-piA).\*exp(A-t4-(pit4-piA))-(1-(pit4-piA)+A-t4).\*exp(pit4-piA-(A-t4));

min4 =min(min(d4));

d5 = 2 - (1-A+t5).\*exp(A-t5)-(1-t5+A).\*exp(t5-A)+2-(1-(A-t5)+pit5-piA).\*exp(A-t5-(pit5-piA))-(1-(pit5-piA)+A-t5).\*exp(pit5-piA-(A-t5));

min5 =min(min(d5));

d6 = 2 - (1-A+t6).\*exp(A-t6)-(1-t6+A).\*exp(t6-A)+2-(1-(A-t6)+pit6-piA).\*exp(A-t6-(pit6-piA))-(1-(pit6-piA)+A-t6).\*exp(pit6-piA-(A-t6));

min6 =min(min(d6));

d7 = 2 - (1-A+t7).\*exp(A-t7)-(1-t7+A).\*exp(t7-A)+2-(1-(A-t7)+pit7-piA).\*exp(A-t7-(pit7-piA))-(1-(pit7-piA)+A-t7).\*exp(pit7-piA-(A-t7));

min7 =min(min(d7));

d8 = 2 - (1-A+t8).\*exp(A-t8)-(1-t8+A).\*exp(t8-A)+2-(1-(A-t8)+pit8-piA).\*exp(A-t8-(pit8-piA))-(1-(pit8-piA)+A-t8).\*exp(pit8-piA-(A-t8));

min8 =min(min(d8));

d9 = 2 - (1-A+t9).\*exp(A-t9)-(1-t9+A).\*exp(t9-A)+2-(1-(A-t9)+pit9-piA).\*exp(A-t9-(pit9-piA))-(1-(pit9-piA)+A-t9).\*exp(pit9-piA-(A-t9));

min9 =min(min(d9));

d10 = 2 - (1-A+t10).\*exp(A-t10)-(1-t10+A).\*exp(t10-A)+2-(1-(A-t10)+pit10-piA).\*exp(A-t10-(pit10-piA))-(1-(pit10-piA)+A-t10).\*exp(pit10-piA-(A-t10));

min10 =min(min(d10));

d11 = 2 - (1-A+t11).\*exp(A-t11)-(1-t11+A).\*exp(t11-A)+2-(1-(A-t11)+pit11-piA).\*exp(A-t11-(pit11-piA))-(1-(pit11-piA)+A-t11).\*exp(pit11-piA-(A-t11));

min11 =min(min(d11));

d12 = 2 - (1-A+t12).\*exp(A-t12)-(1-t12+A).\*exp(t12-A)+2-(1-(A-t12)+pit12-piA).\*exp(A-t12-(pit12-piA))-(1-(pit12-piA)+A-t12).\*exp(pit12-piA-(A-t12));

min12 =min(min(d12));

d13 = 2 - (1-A+t13).\*exp(A-t13)-(1-t13+A).\*exp(t13-A)+2-(1-(A-t13)+pit13-piA).\*exp(A-t13-(pit13-piA))-(1-(pit13-piA)+A-t13).\*exp(pit13-piA-(A-t13));

min13 =min(min(d13));

d14 = 2 - (1-A+t14).\*exp(A-t14)-(1-t14+A).\*exp(t14-A)+2-(1-(A-t14)+pit14-piA).\*exp(A-t14-(pit14-piA))-(1-(pit14-piA)+A-t14).\*exp(pit14-piA-(A-t14));

min14 =min(min(d14));

d15 = 2 - (1-A+t15).\*exp(A-t15)-(1-t15+A).\*exp(t15-A)+2-(1-(A-t15)+pit15-piA).\*exp(A-t15-(pit15-piA))-(1-(pit15-piA)+A-t15).\*exp(pit15-piA-(A-t15));

min15 =min(min(d15));

%d16 is the matix of 3x3 = divergence matix with orinigal matrix and

%fuzzy tempelts 16.

d16 = 2 - (1-A+t16).\*exp(A-t16)-(1-t16+A).\*exp(t16-A)+2-(1-(A-t16)+pit16-piA).\*exp(A-t16-(pit16-piA))-(1-(pit16-piA)+A-t16).\*exp(pit16-piA-(A-t16));

min16 =min(min(d16));

%Selecting the minimun divergence among the 16 divergence values

%and is positioned at the center of the templets position for the

%edge iamge i.e in edgeim.

dd = [min1 min2 min3 min4 min5 min6 min7 min8 min9 min10 min11 min12 min13 min14 min15 min16];

fedgeim(i-1,j-1) = max(dd);

end

end

%We wil get the edge image in the fuzzy doamin as edgeim matrix So we have

%to tranforming back in the image pixel domain i.e in the intercal [1

% 255] domain

fedgeimmax = max(max(fedgeim));

edgeim = double((1/fedgeimmax)\*(fedgeim));

% edgeimage = uint8(edgeim); %this is the matrix of edge in the 1-255

% figure, imshow(edgeimage);

% figure, imshow(uint8(I));

%% Out put

tt = 255\*edgeim;

ttt = uint8(tt);

subplot(2,2,1),imshow(uint8(I))

title('original image');

%figure, imshow(ttt);

subplot(2,2,2),imshow(ttt)

title('Edge without threshold');

%Set a threshold

for i = 1:r

for j = 1:k

if ttt(i,j)>45

ed(i,j) = 255;

else

ed(i,j) = 0;

end

end

end

subplot(2,2,3),imshow(ed);

title('After applying threshold 45');

%applying the morphological oprators of matlab i.e bwmorph

med = bwmorph(ed,'thin');

subplot(2,2,4), imshow(med);

title('after applying morphological thin fun');