مجلة القادسية للعلوم الصرفة المجلد 13 العدد 1 لسنة 2008
المؤتمر العلمي الاول لكلية العلوم المنعقد في 26-27 اذار لسنة 2008

Utilizing hybrid methods for edge detection

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Abstract:

Wavelet transform can decompose images into various multi resolution sub bands. In these sub bands the correlation exists. Most edge detectors are based on- local measurements of the image variations and edges are generally defined as 'block' where the image intensity has a maximum variation[1]. The image variations can be examined by derivative operators, such as gradient, Laplacian, Sobel and Roberts operators. In this paper we have used a standard method of edge detection Sobal, Perwit, Robert, Kirsch and Robinson. In addition we have used the wavelet transform in three levels, in each of these level the HL, LH return to the original size. Also,a hybrid method (wave late transform + perwit) to improve the image edge detection have been used.More over the standard deviation to the (2*2) block of the (LL)in the level (3) has been applied. The threshold to the block of the of HL, LH,HH of different size in the level 3,2,1 has been computed compared with the standard deviation results of the third (LL) band. And when the comparison completed we shall construct the image and finally apply the Perwit operator to the constructed image.

1-Introduction:

Recently, wave late transforms have evoked considerable interest in the signal processing community. They have found applications in several areas. Such as speech coding, edge detection data compression, extraction of parameters for recognition and diagnostics, etc. [2][3], since wave late provide a way to represent a signal on various degree of resolution, they are a convenient tool for analysis and manipulation of data. In this transform if we take the original image of 512,512 is decomposed into 4 sub images of 256*256 in the sub band decomposition of level 1. They are LL,LH,HL and HH bands. The sub image of the LL band is the coarse image of the original image. Similarly, the LL band is decomposed into the LL,HL,LH, and HH bands of 128*128 in level 2. Finally, the LL band in level 2 decomposed into the LL,LH,HL and H bands of 64*64 in level 3 . Therefore the LL band in level 3 is coarser than the LL band in level 2 and soon. It is easy to know that the edge in the LH, HL and HH bands in level 3 should be highly correlated with the edge estimated in the LL band in level 3 [4][5][6]. Also edge detection is a fundamental tool used in most image processing application to obtain information from the image as a precursor step to feature extraction and object segmentation. This process detects outlines of an object and boundaries between objects and the background in the image. An edge detection can also be used to improve the appearance of blurred or anti-aliased image stream. The basic edge detection operator is a matrix area gradient operation that determines the level of variance between different pixels. The edge-detection operator is calculated by forming a matrix centered on a pixel chosen as the center of the matrix area. If the value of this matrix area is above a given threshold, then the middle pixel is classified as an edge.

Examples of gradient-based edge detectors are Roberts, perwit and Sobel operators [7].

All the gradient-based algorithms have kernel operators that calculate the strength of the slope in directions which are orthogonal to each other, commonly vertical and horizontal. Later, the contributions of the different components of the slopes are combined to give the total value of the edge strength [8].

2-Algorithms used for edge detection :

2-1-Algorithm {*sobel operators*}:

Input:gray image and color image.
Output:image with detection edge.
Step(1): get the ith pixel at location (i,j) and its neighbors.
Step(2): overlapping pixel values with constant values of mask.
Step(3): compute the gradient at location (x,y)

$$\nabla F=|\, gx2 + y2|\ 1/2$$

Step(4): put the ith pixel at location (i,j) after processing at the screen.
Step(5): move to the next pixel location and the procedure is represented.

2-2-Algorithm {*perwit operators*}:

Input:gray image and color image.
Output:image with detection edge.
Step(1): get the ith pixel at location (i,j) and its neighbors.
Step(2): overlapping pixel values with constant value of mask.
Step(3): compute the gradient at location (x,y)

$$\nabla$$

$$f=|gx2+gy2|\ 1/2$$

Step(4): put the ith pixel at location (I,j) after processing at the screen.
Step(5): move to the next pixel location and the procedure is repeated.

2-3-Algorithm {*Robert operators*}:

Input:gray image and color image.
Output:image with detection edge.
Step(1): get the ith pixel at location (I,j) and its neighbors.
Step(2): over lapping pixel values with constant value of mask.
Step(3): compute the gradient at location (x,y)

$$\nabla f==|gx2+gy2|\ 1/2$$

Step(4): put the ith pixel at location (I,j) after processing at the screen.
Step(5): move to the next pixel location and the procedure is repeated.

2-4-Algorithm {*kirsch compass mask*}

Input:gray image and color image.
Output:image with detection edge.

Step(1): get the ith pixel at location (i,j) and its neighbors.
Step(2): overlapping pixel values with constant values of mask.
Step(3): select the maximum value produced from step 2.
Step(4): put the ith pixel at location (I,j) after processing at screen.
Step(5): move to the next pixel location and the procedure is repeated.

2-5-Algorithm (Robin compass mask}:

Input:gray image and color image.
Output:image with detection edge.

Step(1): go to the ith pixel at location (i,j) and its neighbors.
Step(2): overlapping pixel values with constant values of mask.
Step(3): select the maximum value produced from step(2).
Step(4): put the ith pixel at location (I,j) after processing at screen.
Step(5): move to next pixel location and the procedure is repeated.

<u>3-Algorithm Discrete wavelet transform[DWT]:</u>

Step(1): convolution the low pass filter with rows and save the result.
Step(2): convolution the low pass filter with columns (of result from step 1) and low pass_low pass (LL) sub image.
Step(3): convolution the result from step1, the low pass filtered rows with high pass filtered on the columns, by taking every other value to produce the low pass_high pass (HL) sub image.
Step(4): convolution the original image with the high pass filters on the rows and save the result.
Step(5): convolution the results from step(4) with low pass filter on the columns, sub samples to yield the high pass_low pass (HL) sub image.
Step(6): to obtain the high pass_high pass(HH) sub image, convolute the columns of the result from step 4 with high pass filter.
Step(7): go to step(1).

<u>4-Algorithm [inverse DWR]:</u>

Step(1): insertion_ zero to column to the (LL) and save the result to LL0.
Step(2): convolve the low pass filters with rows and save the result to LL0L.
Step(3): insertion_ zero to rows to (LL0L) and save the result to LL0L0.
Step(4): convolve the low pass filters with columns two (LL0L0) and save result to (LL0LL).

<u>5-Predictive edge detection:</u>

Step(1):For each block of the LL band in level (3) compute standard deviation , for the other bands of ther levels do :
Step(2):LL=8;
Step(3):Record in stdder[LL];
Step(4):For i=2 : 0
Step(5): For band= 4*i+1 : 4 *I +3
Step(6):W=2 $^{3-i}$
Step(7) For each block (w*w)
If stdder[LL]≤threshold[band]then
Discard the corresponding w*w block of next level and mark this block and fill with zero.
Else transmit the corresponding w*w block of next level.
End for
End for
End for
End for

<u>6- The standard deviation:</u>

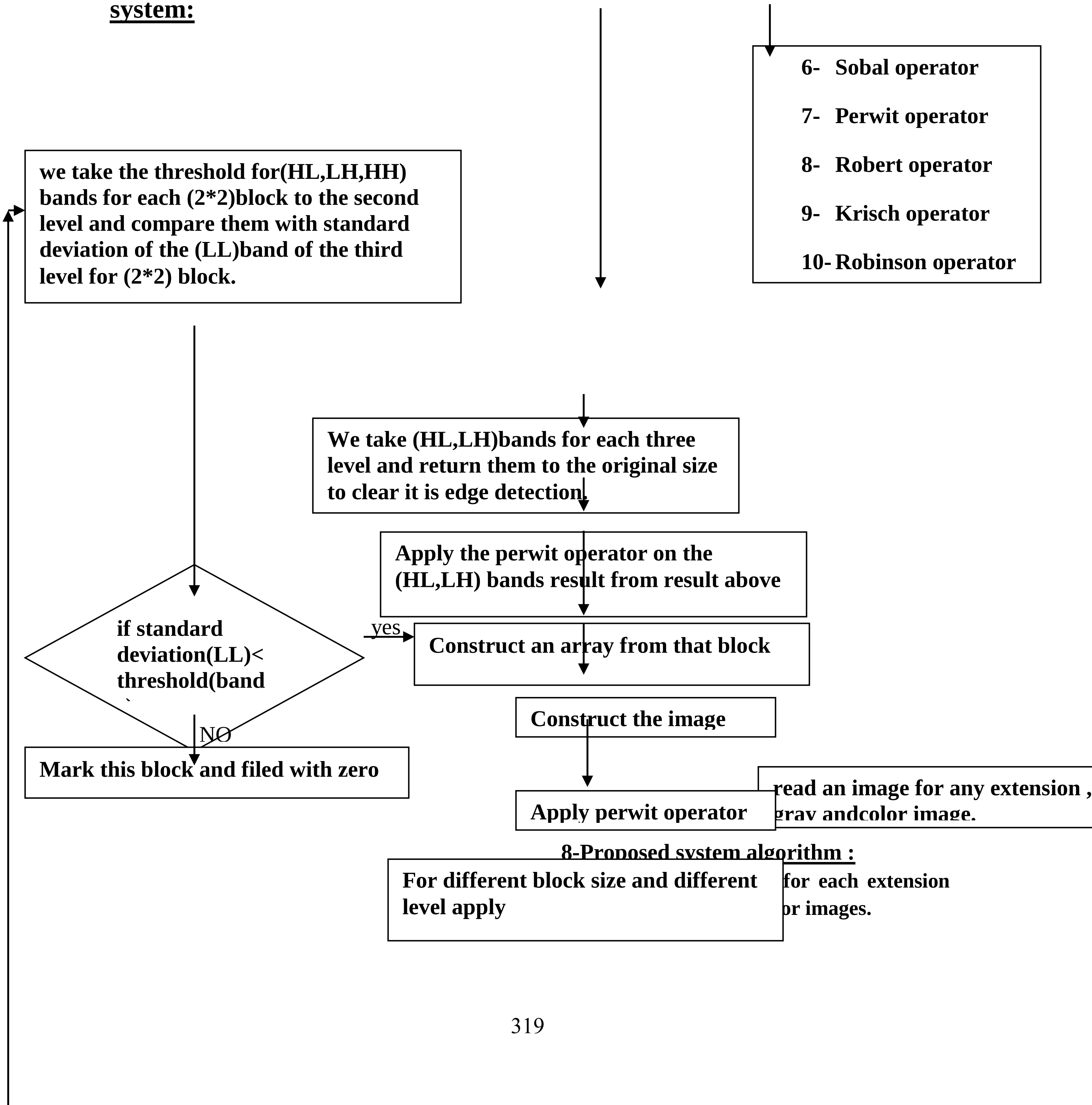
The used of the standard deviation of black of transform coefficients edge detection. Denoting an N*N image f(x,y) and μ is the mean value, δ is the standard deviation. They are computed as :

$$\mu = \frac{\sum\sum f(x,y)}{N*N}$$

$$\delta = \frac{\sqrt{\sum\sum(f(x,y\_-\mu))^2}}{N*N}$$

for each sub band we can setup a threshold to do edge detection.

7-The Structure of proposed system:



8-Proposed system algorithm :

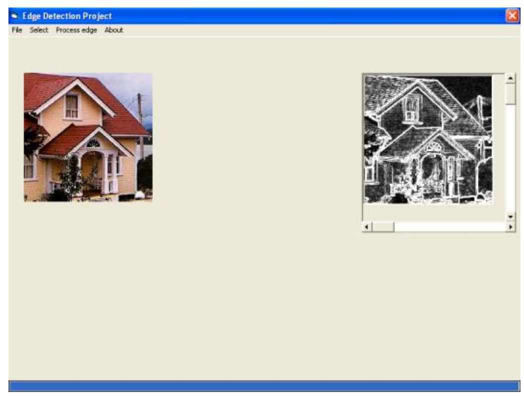
for each extension

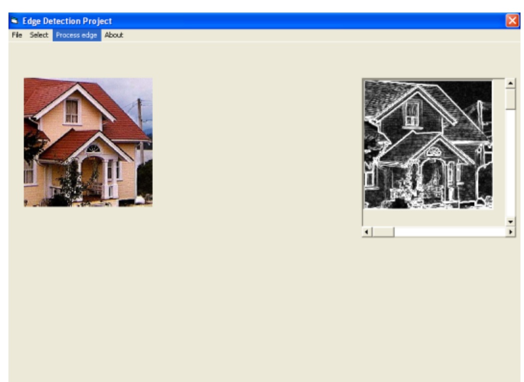
or images.

2. apply the sobel, perwit Robert, kirsch, robinson method for each images.
3. composed the images into (LL,HL,LH,HH) bands for the first level.
4. reconstruct the HL,LH to the original size to improve the edge detection. Then apply the perwit operator [this mean use the hybrid method [wave late transform + perwit].
5. take the LL result from step(3) and repeat step(3) to produce the level two.
6. repeat the step(4) to the HL, LH bands of second level.
7. decomposed the LL result from second level from step(5) into LL, HL,LH,HH bands to produce third level.
8. repeat step(4) to the HL, LH band result from step(7).
9. take the LL band result from the third level and compute the standard deviation for each(2*2) block.
10. compute the threshold to the (LH,HL,HH) band result from step (7) for each (2*2) block.
11. compare the result of step (9) with result of step (10).
12. if standard deviation (LL)< threshold(bands) then construct the arrays of images from that's bands.
13. else marked this block and fill with zero.
14. apply the perwit operator to the image construct from step(12).
15. repeat the step from step(9) to step(14) for (LH,HL,HH) band of other level (2,1)with different block.
16. END.

9-Study case:

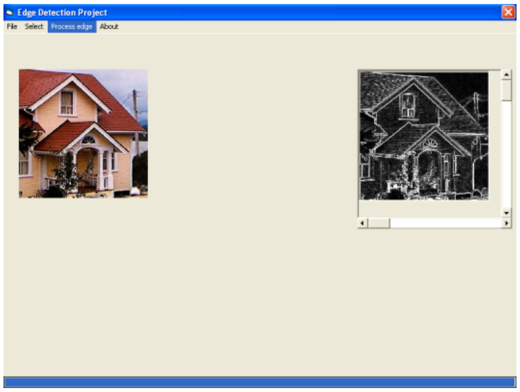
1) **Sobal operator**



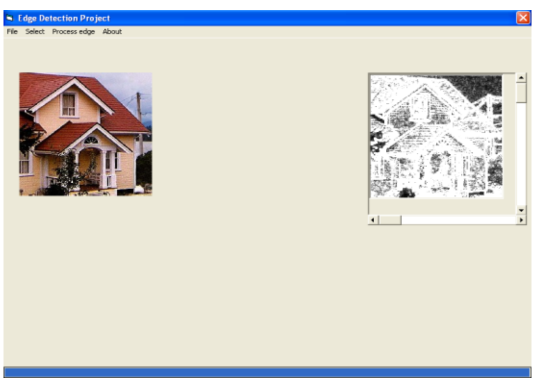


2) Perwitt operator:

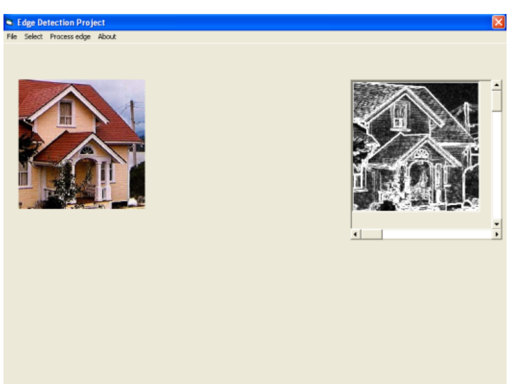
3)Robert operator



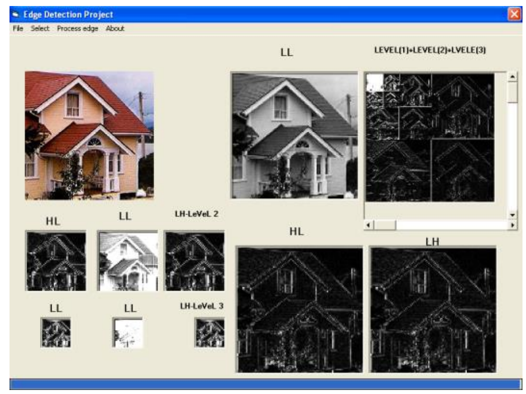
4)Kirsch operator:



5)Robinson operator:

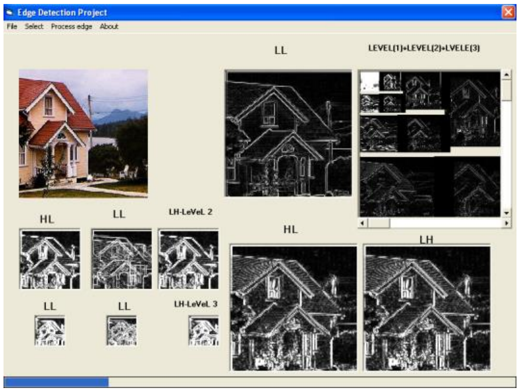


6) The figure blow show the use of wavelat transform and take each band in each level reconstructed these bands to the origional size to show the the edge detection appearly.



7) Wavelat transform+prewitt operator:

In this method we use the hybrid method after reconstructed the size of the band to the origional size from the wavlate then use the prewitt operator to the each band to improve the edge detection in each bands.



8) the figure below show the use of standard deviasion to the (LL) band in the third level and compute the threshold to the (HL,LH,HH) bands in the first level and compare the result ,then use the prewitt operator to the comparision result image.

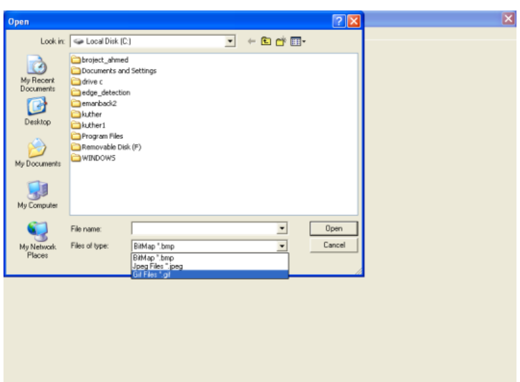
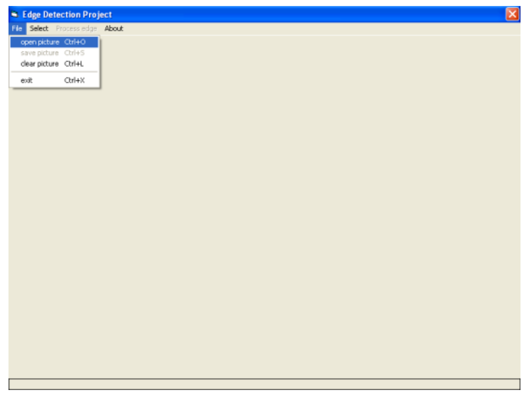


Figure (1) show how to open the image and the extension of the image

Below the main menu in our work which contain the first submenu is file option which include the file to be sopened(ctrl+o) where the figure(1) show thi process ,the save option(ctrl+s)to save the image result,the clear picture (ctrl+L) to remove the image,exit(ctrl+x).

The second option use to select which method we used in our work(sobel(ctrl+e,prewitt(ctrl+p),roberrt(ctrl+r),kirsch(ctrl+k),robinson(ctrl+b),wavelat,wavelat+prewitt,the last method which depend upon the standard deviasion and thershold.



10-Conclusion:

1. **when we use the hybrid method (wave late transform + perwit) the detection of the edge become very appear.**
2. **when we take the (LH,HL) band reconstruct them to the original size the edge detection increase and become very appear.**
3. **when we apply the standard deviation of the (LL) band of level three and compare it with (HL,LH,HH) bands of each level, we can see the image construct from these is very appear.**
4. **the perwit operator applying to the result from step (3) we obtain very good result and we can see the high edge detection.**
5. **when the value of standard deviation (LL) of level three is greater then the threshold (bands) and discard the value of band the construct images is not appear for this reason we fill these values with zero.**

6. **the bands in the level three is very appear them band in level (2) and this level is become is appear than level (1).**

11-Reference :

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