A Hybrid Refinement Technique to Prognosticate Mammogram Images using Adaptive Gabor Kuwahara Filter

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Abstract - The most vigorous disease that comes in women as well as men is Breast Cancer. Mammography is a method to diagnosis cancer and its stage. Radiologists when analysis the mammogram images they may misclassify due to inefficient pre-processing. To get the good accuracy in image enhancement the image can be pre-processed using the several pre-processing techniques. Here filter plays a vital role to improve the accuracy. An advanced filter is proposed such as combining the kuwahara filter and Gabor filter. Which minimizes the noise but the edges don't blur out in object. Using the Gabor filter, it can be efficient to give the human visual system. When applying the filter to the edges of images it gives the highest response in the place of the texture changes. In the proposed algorithm we combining the both algorithms *to* give a better result and minimize the error rate. Because Kuwahara reduce the noise without blur the edges. Gabor can report the minute texture or pattern changes in the edges.

Keywords: Digital Mammography, Image Edge Detection, Human visual system, filtering, isotropy.

I. INTRODUCTION

The unrestrained cell growth in the breast area is commonly refer as breast cancer. This typically result is a lump or mass. Most of the breast cancer rooted in lobules (milk glands) or in the ducts that connects the lobules to the nipples. In 2019 an estimation by American cancer society 268,600 new case were suggested as breast cancer. The aggressive growth of breast cancer will be identified among women and approximately 2,670 patients were diagnosis and identified the present of breast cancer. So almost 41,760 women and 500 men were normally died due to breast cancer as per survey. Number one disease in India that causes high dead rate among women is breast cancer which has the high rates as 26% per 100,000 women suffer from this disease and 13% per 100,000 of women die due to this disease. The change in life style and food habit are the common reason. Even though when the disease is identified earlier the mortality rate can be controlled. Mammography is the traditional way of detecting the breast cancer. But most often the radiologist can misclassify the tumour. Because in some women the breast tissues are thick so it is hard and risk to predict. The false positive in the identification gives unwanted stress. Digital Mammography is considered as a successful technique for breast cancer detection and classification. When the mammogram images are pre-processing using the image processing techniques it gives the better accuracy.

II. LITERATURE REVIEW

1. M. Santhanaraj, Immanuel Alex Pandian proposed that they identified the impose problem in design digital filter. The Problem states to design filter with less complexity and low computation time. The power of architecture is a vital factor. The input and output constraints should accurately evaluate. The filter must have parameters both between communication component and filtering section.

2. Anirudh Singhal discussed the Butterworth filter, Chebyshev filter, Notch filter, Comb filter and Bessel filter and gave some quality-based papers about design filter. After discussing the methods of each filter, the strength and weakness of each method is compared in table and he gave the review of filters.

3. Giuseppe Papari, Nicolai Petkov, and Patrizio Campisi suggested a paint like effect and which deteriorate as blurring. And he proposed to produce high standard quality from very little image as input domain

4. Aditya Goyal, Akhilesh Bijalwan, Mr. Kuntal Chowdhury. It is condemnatory to select a best cost-effective algorithm for image smoothing. The method used to give a great effect when it is applying on the images.

 DOI : 10.35291/2454-9150.2020.0192

The portability and efficiency of the guided filter makes the image smoothing and beneficial one.

5. Krzystof Baertyzel suggested when correlate with kuwahara filter it is more efficient to remove the noise as that of adaptive median filter. And it retains its intensity. The result is analysed by MSE algorithm. Adaptive Kuwahara filter is very quick and efficient when compare to adaptive median filter.

6. Jan Eric Kyprianidis et.al., proposed a non - photorealistic rendering technique to transfer the colour images and videos into painting abstraction. For that they apply kuwahara filter to the feature in the local shape and derive the smoothen tensor structure contrary to conventional edge preserving filter. It creates painting like flattering effect and preserving shape boundaries. It produces temporally coherent without extra processing.

7.Sourabh Kumar Kashyap et.al., proposed that Gabor filters have maintained their popularity in feature extraction. It is best in the detection of face detection, iris recognition, matching the finger prints.

8.Tuder Barbu et.al., suggested that Gabor filter banks for 2D and produces 3D face feature vectors. This supervised classifier is developed for these vectors. The recognition process is completed by threshold-based face verification method. By combining they obtained the satisfactory results for the effectiveness of this recognition approach,

III. PROPOSED METHOD

In the proposed method mammogram images were pre-processed by applying the hybrid filtering techniques. We need a highly efficient algorithm to reduce the noise from digital mammogram images. When an image is captured, transmitted, compressing, decompressing errors or noise can arise. This can be reduced by pre-processing. For that purpose, image filtering plays a vital role and image can be taken for further processing, such as, segmentation, feature extraction and classification. Noise reducing algorithm were widely used in medical imaging. The important process done by digital filters are,

i) overwhelming unwanted noise
ii) Refining image edges
iii) Eliminate some defects
iv) Envisaging certain features in images
v) Renovating partly destroyed images

In this paper we discuss abut filters used commonly to reduce the noise from digital medical images. We proposed the highly resourceful algorithm which can give a better accuracy as a result. In context filter the output image depends on the input image. When the coordinate is (x, y) the output image is depending on the neighbourhood of the pixel at their coordinate. The filter window has the odd integer as its size such as, 3x3,5x5,7x7,9x9. The main problem of context filter is its performance.

1) Kuwahara Filter:

For reducing the adaptive noise in the images, a non-linear smoothing filter can be used call kuwahara filter. Mostly linear less intensive which is applied to reduce noise blurs the edges. However, kuwahara filter is applied to smoothed the edges and preserves the edges. Kuwahara is an edge preserving filter. It softens the current images and attempt to preserve the edges. The current pixel values are replaced by mean of neighbours and it has least variances. Contour plays an important role when kuwahara filter is applied. But does not affects the sharpness of contour, because if the contour is affected in smoothing it causes serious problem during segmentation. Kuwahara filter satisfies this requirement. It is applicable for all the window size. Filter which sustain the place of the edges and their sharpness is defined as edge preserving filter. Kuwahara is a non-linear filter [6].

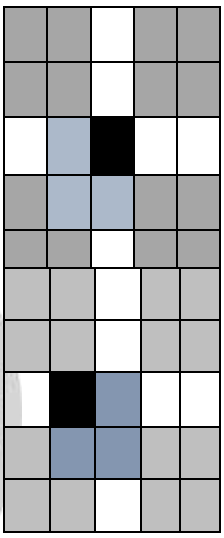


Fig:1 Highlighted four areas in Kuwahara filter.

Four areas were divided into 5x5 as its window size represented in fig 1. The central pixel is enclosed by four regions. For each region average brightness value and its variances are calculated. The Final assessment of pixel is mean of central pixel which determined as average of brightness value of region whose variances is lowest one.[1] The expression is used to calculate mean and variance of the final assessment.

$$m_k = \frac{1}{(n+1)*(n+1)} \times \sum_{(i,j)\,\epsilon\,\omega k}^{\omega(f(i,j))} \quad \longrightarrow 1$$

$$\delta_k^2 = \frac{1}{(n+1)*(n+1)} \times \sum_{(i,j)\,\epsilon\,\omega k} [\delta(f(i,j)) - m_k] \quad \longrightarrow 2$$

 DOI : 10.35291/2454-9150.2020.0192

The result is most desirable as reducing the maximum noise when the\ window size is increased. [1].

2) Gabor Filter:

For texture analysis Gabor filter is used which is a linear filter. The filter is used to scrutiny that in which particular direction at a localized region and at specific frequency the image has particular texture. Gabor filter with different frequency and orientation is used to extracting the useful features from an image. It has also been widely used in pattern analysis. Gabor filter are special class of band filters. i.e., they allow a certain band of frequency and reject the other [18]. Gabor filter are completely symmetric on both sides(isotropy), monomodal and cantered(localization) and smooth and infinitely desirable(regulated). orientation is appealed by many current visions which is similar to humanoid visual system. In 2D Gabor filter is a gaussian kernel function modulated by a sinusoidal plane wave.[16] The orientation such as curvilinear structure (CLS) spicules and fibrous tissues, pectoral muscle edges, parenchymal tissue edges, breast boundary and noise can be smoothening from the bank of Gabor filter [7].

Applying the filter to the edges of image it gives the highest response in the place of changes in texture.

Let $x=[x_1 * x_2]$ be the image coordinate. the impulse response of a Gabor filter g(x) is then given by,

$$G_{mn} = \frac{1}{2\pi a_n b_n} e^{-1/2xT\ Amnxejk0Tmnx} \rightarrow 3$$

$$g(x,y,\lambda,\theta,\psi,\sigma,\gamma)=\exp(-x'^2+\gamma^2 y'^2)/2\sigma^2 *\exp(i(2\pi x'/\lambda+\gamma)) \rightarrow 4$$

Sigma is the standard deviation of the gaussian function used in the Gabor filter.

Applying Gabor filter in an image can be done as,

Step 1: Dividing the image in to 8x 8 sub blocks.

Step 2: Compute the feature for 4 different scales at 4 different angles.

Step3: It gives 4 different angles for each scale.

Step 4: Calculate mean and standard deviation to obtain Gabor features vector.

3) Adaptive Gabor Kuwahara Filter:

It is framed by merging two other filtering algorithms. The Kuwahara filter and Gabor filter. The major feature of kuwahara filter is to blur the intensity and remove even a small noise without damaging the edges. Whereas the major task of the images it gives the highest response at edges and at pint where texture changes.

1) Proposed Algorithmic Model:

The Window size is rigorously defined in Kuwahara filter. In the proposed method window size can be change. In the Gabor filter the highest response is to change in the orientation and point where the edges have a change in their texture.

The initial window size can be taken as 3x3,

Step 1: The filtering windows were divided into four areas. Initially each four squares have four-pixel values ω_k, k= {10,1,2,3} which were the value of colour intensity.

Step2: For each squares of the specific area its mean m_k and variance ƍmin2 are calculated

$$M_k = \frac{1}{N_k} \times \sum_{(x,y)\in 0_k} \omega(f(x,y)) \rightarrow 5$$

$$ƍ_k^2 = \frac{1}{N_k} \times \sum_{(x,y)\in \omega_k} [\omega(f(x,y))-m_k] \rightarrow 6$$

Step 3: The window size is increased by value 1

Step 4: New window size is calculated as mean $\overline{m_k}$ and variance $ƍ_k^2$

Step 5: If the new area $ƍ_k^2$ is smaller than the basic area of the variance then the new value is taken.

Step 6: This will continue for the four areas.

Step 7: The resulting is the average of smallest variance of four areas.

Step 8: After the image is filter by Kuwahara filter by the smallest variance of the average basic area.

Step 9: The Gabor filter is applied on the image by dividing the image.

Step 10: Compute the features for the scale. Calculate mean and standard deviation to obtain the feature vector.

Step 11: From the feature vector the symbolic feature of an object is represented which are used for pattern processing.

 DOI : 10.35291/2454-9150.2020.0192

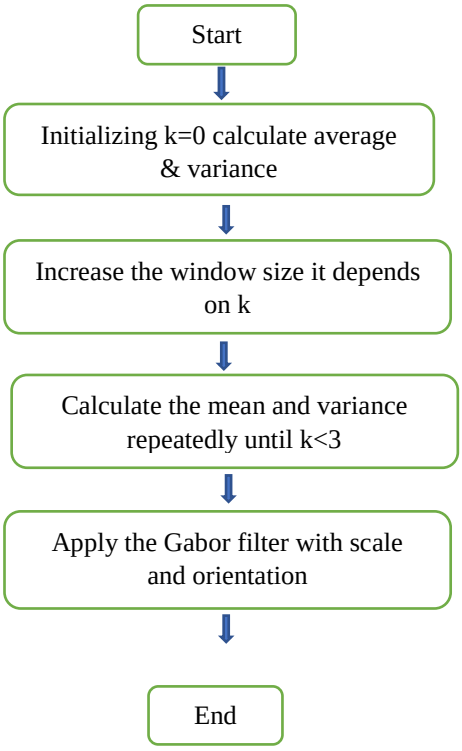
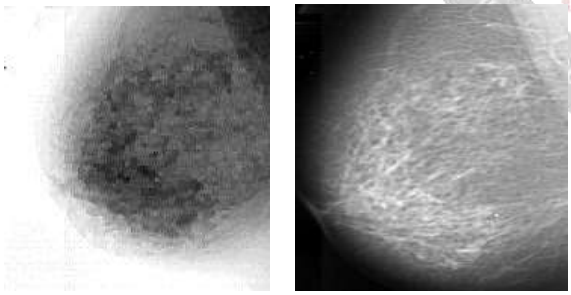


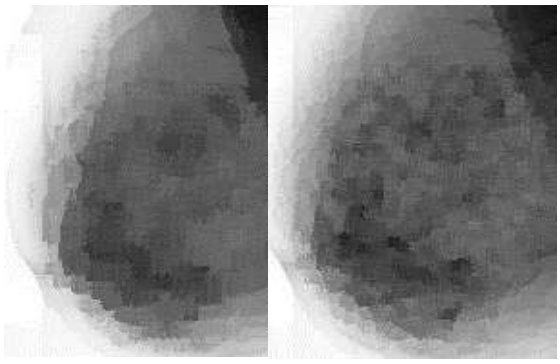
Fig 2. Adaptive kuwahara Gabor filter algorithm flow.

IV. EXPERIMENTAL RESULT & DISCUSSION

Kuwahara filter with different window size is applied in the images. The window size increase it gives the satisfactory result. When we compare to low window size. The edges are preserved using this type of filter. And to get the more accurate result the image is further filter using Gabor filter. Gabor filters have maintained their popularity in feature extraction.



(a) **(b)**



(c) **(d)**

Fig 3. Applying Kuwahara filter Window Size =

a) Original Image b)**5x5,c)7x7,d)11x11**

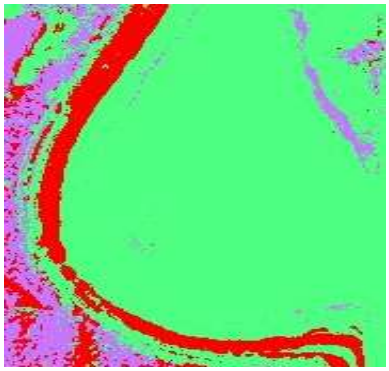
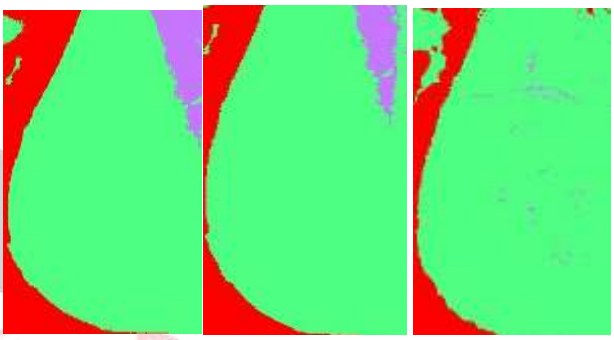


Fig 4. Applying Gabor Filter alone



(a) **(b)** **(c)**

Fig 5. Applying Adaptive Kuwahara Gabor filter

Window Size a)5x5 b)7x7 c)11x11

Error Rate:

a) Out of bag error: 7.587% when window size is 3x3 and applying the Adaptive Kuwahara Gabor filter, b) Out of bag error: 0.16% when window size is 5x5 and applying the Adaptive Kuwahara Gabor filter c) Out of bag error: 0.038% when window size is 11x11 and applying the Adaptive Kuwahara Gabor filter.

The suggested algorithm assurances to reach better results. From experimental result it is examine that adaptive Kuwahara Gabor filter gives good result than applying the Kuwahara and Gabor filter separately. It gives the lower error rate when the window size is increased. so Adaptive Kuwahara Gabor filter is considered as a strong contender than kuwahara and Gabor filter.

V. CONCLUSION

It is easy to notice that the modified kuwahara and Gabor filter gives a promised enhancement by combining the both filters as Adaptive Kuwahra Gabor filter. The vital feature is that persevering the image edges. The edges of the images have low grade changes when the suggested approaches are appeal and it removes the noise efficiently. It is very fast in it pertain especially compare to other filters. when combining the both filters it gives great accuracy with minimum error rate when training the

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image. It gives better accuracy in segmenting the image. And it can be taken for further classification with good result.

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 DOI : 10.35291/2454-9150.2020.0192