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A NOVEL IMPROVED GRADIENT NOISE TOLERANT METHOD FOR ENHANCED EDGE DETECTION

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ABSTRACT

Edge Detection is the process of identifying the sharp changes that occur in the brightness of an image. In order to study the objects in an image it is necessary that the Edges are clear and predictable which is not the case in real time images. Identifying Edges becomes a tedious process when real time images are considered. An Improved Gradient Noise Tolerant (IGNT) method involves the processes of observing the fine details of the image by omitting the irrelevant data including the noisy data and detecting the edges of the objects and features in the image using Preprocessing, Thresholding, Binarization and Feature Extraction, which are experimented, analyzed and the results obtained are discussed in this paper.

Keywords: *Otsu's method, Edge Detection, threshold, features, object, LoG, Canny, pyramid.*

1. INTRODUCTION

Edge Detection, is a mathematical method which aims to identify points in digital images, initiating the study at which the image brightness changes sharply or, more formally the points at which the image is having discontinuities. The points in an image predicting the brightness changes are typically classified to form a set of curved line segments termed edges. [4]

In the case of an ideal process, applying an edge detector to an image may lead to a set of connected curves indicating boundaries of objects and surface marking. The result may also correspond to discontinuities in orientation [14]. Thus, the results produced by the Edge Detection algorithm are often a reduced set of data or the filtered data, which omits out information such as the irrelevant data, preserving the properties of the image. Once the results of Edge Detection have successfully been organized, the subsequent tasks of interpreting the information contents in the original image maybe substantially simplified. However, the process is not always as simple as that specified, especially for the real time images [16]. Edges extracted from non-trivial images contain edge curves which are not connected, or missing edges. It may also contain false edges not corresponding to interesting phenomena in the image, thus complicating the very task of interpreting the image data.

The concept of image processing involves several forms like segmenting the image, cropping, enhancing the image, de-noising, de-blurring the image and detecting edges. Each of these processes is used for the detection of Edges by reducing the data processed. In the same way, edge detection is also used for locating some required information, objects in the images, predicting their size and shape, gathering the important events in the image, segmenting some layers, identifying spots in medical images, etc,.

Edge detection is a process of tracing the information of images like shapes, texture and significant features. It is one of the basic processes for several image processing techniques in computer vision. It identifies the variations in image intensities, image brightness and image contrast [9]. The process of edge detection is traditionally done by several algorithms namely, Canny, Sobel, Prewitt, Laplacian, Robert, morphological edge detection etc [13] [10].

Edge detection portrays the edges of the gray scale image so that the locations where a sudden change in the pixel value are identified and located as edges. This process is carried out in four major steps namely, Filtering, Detection, Enhancement and localization. Edge detection always comes out with representing the edges in white and other locations in black. Edge detection has a wide application in machine vision gauging, processing medical images, de-noising medical

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image, brain tumor detection, vehicle distance tracking, vehicle number plate tracking, remote sensing images, etc.

The ability to identify each individual object uniquely is a requirement, for applying it in different area. In order to identify the objects and classify them, it is required that the edges in the image be studied. The study basically is coverage of the Edge Detection methods for the detection of fine details and removal of irregularities obtained by the analyses of edges.

IGNT method automatically performs clustering based image Thresholding by extracting the features of the images. Pre-processing, Thresholding, binarization and feature extraction are the major steps involved in the method. Laplacian Image Pyramid is used for repeated smoothing and noise removal. Otsu's algorithm is used for the process of Thresholding. In feature Extraction the Canny Edge Detection technique is implemented. A classification of the pixels into classes and calculation of optimum threshold by separating the classes is performed, representing a minimal combined spread.

2. LITERATURE REVIEW

Evaluating the Edge detection techniques used in the concept of image processing has given rise to a number of popular Edge Detection techniques. All the techniques have encountered the best possible results [16].

Detecting the Edges by calculating the gradient magnitude [8] and predicting the orientation with the help of convolution masks is seen in the traditional methods. They are typically based on the convolution kernel [17]. The differences seen in the Classical methods are basically based on the creation of the kernel. The gradient and the angular magnitude are extracted for detection [14]. By increasing or adding constant vector values to the kernel, smoothing of Edges is obtained.

Although simplicity was an achievement, the inaccurate results obtained due to noise were of concern. Edge Detection techniques are still in the development phase due to the presence of noise. Convolving the Gaussian filter using Laplacian [1] is another technique. Standard derivatives are obtained and the pixels with zero crossing are considered [11].

In order to detect the presence of curves advanced techniques involving an Image pyramid is used. Repeated smoothing and sub-sampling by low pass filters and detection of differences in adjacent levels by high pass filters is seen in the pyramid.

Increased error rate and decreased Edge Detection lead to a state with error rate that is inversely proportional to the signals. A non-maximal suppression technique with hysteresis Thresholding inculcated the process of removing errors. Optimal Edge Detection methods contributed a large amount towards the reduction of errors.

Detecting the Edges in an image using the traditional and the optimal method began to be considered as just a specific part as the applications of Edge Detection increased.

The use of Edge Detection with Fuzzy Logic considering the fuzzification function and the adaptive threshold, its use with Genetic and Neural Networks considering the chromosome population in the later and the neuron propagation in Neural Networks has established a constant look through capability in Soft Computing [3].

Apart from the above mentioned Edge Detection techniques there are others that are formed as a combination of methods [12]. To bring about a change and to examine improvement in the performance of the techniques, a transition from the linear to the Non-Linear methods based on the diffusion coefficient was made [15].

Color based detection and the segmentation of an image based on the contrast and texture of the image gained importance as color and lines gained its importance in differentiating the object in an image. A calculation of the wavelet transform was used. Apart from algorithms that exploit the Thresholding, algorithms were also developed to detect Edges based on the concept of local signals. An adaptive technique using an adaptive Thresholding was also developed. The norm today is of performing Edge Detection automatically using automatic algorithms to calculate the threshold and detect Edges [5].

Canny Edge Detector is an Edge Detection operator that uses multi-stage algorithm for finding the wide range of edges [11]. The main aim of the Canny algorithm is to provide optimal Edge Detection. After the image is preprocessed and the

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process of Thresholding is completed, the Edge Detector is applied to the image. The detector recognizes the features predicting the fine details of the image or object using the procedure shown in *Figure 1* [13].

Non-Maximal Suppression is used as an intermediate step in many of the computer vision algorithms. It is often used along with Edge Detection algorithm. It is a process in which zero is set to all the pixel values that are not actually placed on the ridge top so as to produce thin lines in the output. Canny Edge Detector is determined by three parameters, they are,

1) Gaussian kernel
2) Upper threshold
3) Lower threshold

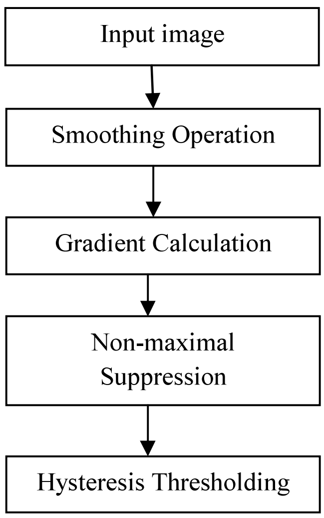

Figure 1. Extraction using Canny Edge Detector

In summary the algorithm first converts the image into a grayscale image using luminance conversion. Followed by, the use of filters to reduce the noise. The gradient and the angular magnitude of the image are calculated.

In order to separate the pixels with higher magnitude and gradient value non-maximal compression is performed. Finally to avoid the reduction of valid edges hysteresis Thresholding is applied. In order to avoid the presence of noise in the image the upper threshold is kept as low as possible. Thus, we reach the resulting product with reduced noise and an intimate feature extraction using Edge Detectors.

3. IGNT METHOD

The IGNT Edge Detection method is the proposed method for edge detection in an image, which involves four steps considerably.

i) Preprocessing
ii) Thresholding
iii) Binarization
iv) Feature Extraction, as shown in *Figure2.*

The first step i.e Preprocessing stage is used for the elimination of redundant data and Discontinuity Removal with the employment of smoothing and sampling.

The second step is used to calculate the threshold limit which is done by means of Otsu's algorithm. Then the third step is to obtain the Binarized image with the help of Thresholding stage. Finally, the directional characteristics of the Binary image are extracted to provide a noise free edge detected image.

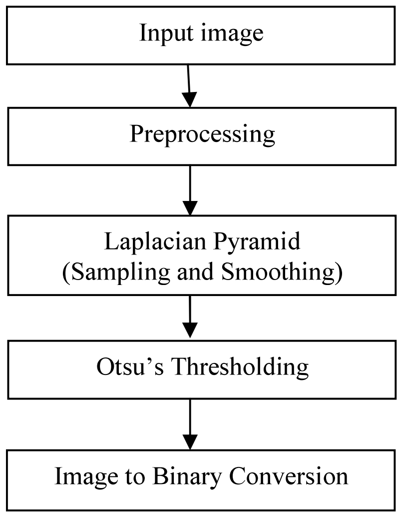

Figure 2. Feature Extraction using Proposed Method

3.1 PREPROCESSING

An image is an artifact that shows the visual perception. Images may be of two dimension or more and may be captured by any device, at any circumstance. This image, given as an input is raw data consisting of redundant data, unclear features and discontinuities.

The image considered may also contain improper background and embedded shapes, thus

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denying the exact detection of the features in the image. The processes of overcoming redundancy and discontinuity is inculcated in preprocessing, thus making it a necessity. IGNT process begins with preprocessing, which involves Laplacian Pyramidal Transformations. An Image Pyramid is a multi-scale signal representation in which the signal or an image is subjected to repeated smoothing and sub-sampling. They are mainly used for computing the image features from an image [18].

Image pyramid is used in computer vision, image processing and signal processing applications. It is useful in representing scale-space and in multi-resolution analysis [20]. Laplacian image pyramids based on the bilateral filter provides a good structural framework for image enhancement and manipulation.

Image pyramids can be classified into two as

- Low pass pyramid and
- Band pass pyramid

Low pass pyramid:

In the low pass filter the process of smoothing the image using the appropriate smoothing filter is seen. This is followed by the process of sub-sampling.The process is repeatedly applied until a well smoothed smaller image is obtained. As a result of processing an image with gradual increase in smoothing is obtained. In addition the spatial sampling density decreases level by level in the image. The image finally obtained viewed as a graphical representation looks similar to a pyramid from which the name "Image pyramid" is obtained.

Band pass pyramid

Band pass filter involves the filtering of the differences between the adjacent levels in the pyramid including some interpolation performed between representations at the adjacent level of resolution for enabling pixel wise difference computation.

Image pyramid thus is a collection of images in which the size can be reduced or expanded. Here the Laplacian pyramid is used. Gaussian filtering and Laplacian transform are the basic concepts of the Laplacian pyramid. The pyramid is used to reconstruct the unsampled image from the original image thus producing smoothed and sampled images. [19].

LAPLACIAN PYRAMID

The Laplacian pyramid is a representation of a hierarchy of images formed by the decomposition of the original image [11]. In the hierarchy obtained each level is a correspondent to different bands of image frequencies. The difference between levels in the Gaussian pyramid helps in the formation of this hierarchy. For an image I the laplacian pyramid L(I) is calculated using:

$$L(I) = G(I) - EXPAND(G(I+1))$$

These representations involves the following

- Reduction of noise
- Textural analysis
- Object recognition and,
- Image feature labeling.

Implementation of Laplacian pyramid involves the methods of reduction and expansion. Reduction is a process as the name predicts, reduces the size of an image as required. Example a 9x9 block is reduced to a 3x3 block. In contradiction Expansion is a process of maximizing the size of the image as required. For example a 3x3 block is expanded to form a 9x9 block.

LAPLACIAN PYRAMID REDUCTION:

Image Pyramid being an obvious technique for sampling an image, Laplacian pyramid is an essential tool in the field of image processing. Consider the original image, which is convolved using Gaussian kernel. A low pass filtered image is obtained from the low pass filter and the difference between the original image and the low pass filtered image is observed. The difference of the images produces the Laplacian pyramid level-1 image.

Level-1 image is further subjected to the Gaussian kernel thus producing a new low pass filtered image. The difference between the low pass filtered image and level-1 image results in level-2 Laplacian image as shown in *Figure 3*.

Laplacian pyramid uses the concept of a laplacian transform instead of the Gaussian filtering technique. The image is convolved using a Gaussian kernel which is the low pass filtered version of the original image.

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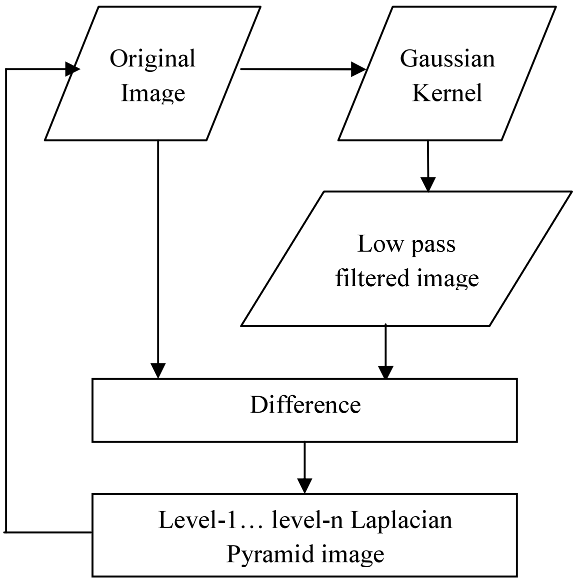

Figure 3. Process involved in the Laplacian Pyramid Reduction.

The difference between the original image and the low pass filtered image is considered as the laplacian. Continuing the process, results in a set, representing the band pass version of the image. Thus the laplacian is the set of resulting band pass filters. In this method, the images are sampled and further sub-sampled forming a decomposition of the original image into a hierarchy of images. The size of the pyramid may be increased or decreased in order to obtain sampled data that is used for matching the query image with the image in the database.

LAPLACIAN PYRAMID EXPANISION

The pyramid forms a combination of a number of levels of images. Each level in the Laplacian pyramid obtained corresponds to a reduced format of the previous level. The result obtained as the final output of the Laplacian pyramid reduction is to be expanded in order to remove the unnecessary pixels from the image. Laplacian expansion process comprises the following stages.

1) Get the input image, (i.e.) the output of the Laplacian pyramid reduction.
2) In the image, each pixel is processed as a 3x3 block by assigning values for each such pixel.
3) As given, the process is repeated for each pixel in the image due to which the size of the image is expanded as per the requirement.

The Laplacian method is performed in the presence of the Gaussian pyramid in which each level of the Gaussian increases the size of the original image. The band pass filter obtained in each level represents the difference between successive levels of the Gaussian pyramid. Thus the smoothed data is obtained from the query image for further processing.

In the absence of these methods to extract required points from the image and the matching of the query image directly with the database image may lead to mismatch resulting in a false value. In order to avoid such mismatching, the Laplacian algorithm is used to remove the presence of noise thus enabling the best possibility of extracting the features of the image. It is also applied in order to remove the unwanted data that may include the background of the image or the unknown values with the corresponding pixel values of the image during the process of expansion.

Finally the process of Preprocessing produces an image that contains continuous data formed by the combination of the discontinuous data thus resulting in an image that is free from noise, redundant data and discontinuities.

3.2 THRESHOLDING

Otsu's method automatically thresholds by clustering or by reducing gray level image into binary image for further processing. The algorithm considers the image as containing two clusters of pixels for which the optimal threshold is calculated separately. Otsu's method is an optimal method for Thresholding large objects from an entire background image. Otsu's method can be extended as a method of multilevel Thresholding popularly known as the Multi-Otsu's Method [7].

Otsu's THRESHOLDING

In order to make the segmentation process robust the levels of Thresholding should be selected by the system automatically [21]. This automatic selection is possible only if there is enough amount of knowledge about the objects, its environment and its applications. Knowledge of the selected object includes the following:

Characteristics of the objects

- Size of the object
- The part of the image that contains the object or the pixels forming the object and

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- The knowledge of the presence of different object and the total number of objects in the image.

As the process begins, the threshold that minimizes the weighted with-class variance is first found which is similar to maximizing the variance between two classes. The process is straight away performed on the gray level histogram making it fast. Assumptions are made in the process about the histograms, statistics and object illumination they are

- Histogram (and the image) is bimodal.
- There is no use of spatial coherence, nor is there use of any other notion of the object structure.
- The process assumes to involve stationary statistics that can also be modified to be locally adaptive.
- It also assumes to have uniform illumination implicitly. The bimodal brightness behavior is seen from the object appearance.

The algorithm yielded by the method consists of the following procedure;

1) Calculate the histogram and probabilities for each intensity level of the image.
2) Set up initial parameters as $\omega_i(0)$ *and* $\mu_i(0)$, the class probability and the class mean respectively.
3) Assign t=1 then update ω_i *and* μ_i and Compute σ_b^2(t), the minimal intra class variance.
4) Desired threshold corresponds to maximum σ_b^2(t).
5) The corresponding threshold levels are calculated.
   σ_{b1}^2(t) – the greater max and
   σ_{b2}^2(t) – the greater or equal maximum.
6) Finally, the desired threshold is given by, $\frac{threshold_1 + threshold_2}{2}$.

In order to perform the Otsu's Thresholding, there is a requirement of knowledge about the selected objects, environment and their characteristic features. The method is applied to a gray level image, enhancing the speed of Thresholding. The levels for Thresholding in this method are chosen by minimizing the variance of two clusters of pixels separated by the threshold operator.

In Otsu's method of image Thresholding, gray level images are efficiently separated into two classes producing two fairly distinct classes that exit in the image. Thresholding is applied to these distinct classes. The question of enabling a more efficient method points in the direction of choosing the best threshold value for the Binarization process.

3.3 BINARIZATION

Binarization is the process of converting the gray levels into two possible values (0's or 1's). This binarization is achieved by fixing the threshold limit. That optimal threshold limit is obtained by otsu's Thresholding which is calculated in the previous stage. If the pixel value exceed threshold limit that pixel is considered as an logical 1 otherwise the pixel is to be logical 0.

3.4 FEATURE EXTRACTION

Feature extraction is one of the dimension reduction methods, in this proposed method our features are directional information of an image. In IGNT method the directional information of binarized image can be extracted by traditional canny edge detection method. During preprocessing the high frequency information of an image is boosted. So that the discontinuity of the image edges due to Gaussian noise is eliminated and perfect edge detection is produced.

Also the directional information of binarized image will have no high frequency noise, since the Otsu's Thresholding during binarization will have less effect due to high frequency noise.

Best results are obtained by using a Canny Edge Detection algorithm with good detection that could mark the real edges of the images as much as possible, an algorithm providing maximum localization, (i.e.) the edges marked are optimal and produces a high probability of edges representing the original edges in the real image and an algorithm that marks the edges only once. They are extracted in such a way it does not lead to false Edge Detection or results with noise.

4. RESULTS AND ANALYSIS

The IGNT edge detector is a very efficient method for noise removal and it transfers the discontinuous data points to continuous data points in various images. It inculcates the ability to

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remove any type of noise present in an image with high accuracy.

Extracting the features from an image is a time consuming process if it involves a large set of data. Thus leading to, difficulties in image matching.

The Canny Edge Detection technique overcomes these difficulties by identifying the features of the image by calculating the gradient and hysteresis threshold.

The performance of the IGNT method is evaluated with the help of simulation results using MATLAB software. From this analysis it can be seen that the IGNT method performs well as compared to the other method.

The purpose of evaluating the method computationally is established by high level technical computing and data analysis methods like MATLAB.

IGNT method is analysed using the latest version of MATLAB called MATLAB 2013. Windows, Mac OS and Linux are the operating systems used to run MATLAB and the performance is measured using the virtual cores in terms of CPU time.

Multi threading is used for multiple operations. Hyper threading in Intel cores contributes to the multi core appearance in the computers.

2 GB Ram memory and a half of the core is used in Windows Task Manager. Pentium processor helps the data to be computed without any congestion in data bus increasing the performance.

Bweuler is a Euler number of a binary image. It computes the Euler number of the binary image by considering by the patterns of concavity and convexity in a local 2x2 neighborhood.

Eul = bweuler (BW, n),

which returns the Euler number for the binary image BW. The Eul value obtained at different noise levels for different techniques is compared with the Eul value obtained for the IGNT method in Table 4.1

Table 4.1. Bweuler a table calculated for the edge detection techniques.

Eulers Binary					
Noise level	Canny	IGNT	Log	Prewitt	Sobel
0.001	199	36	470	258.33	107
0.041	570	118	1063.7	1996	1222.3
0.071	643.5	120	1264	1464	950.33
0.141	959.5	122	1564	1756.7	1616
0.171	1075	128	1659.7	1965.3	1916.7
0.241	1122.5	126	1791	1868.7	1728.7
0.271	1017.5	178	1804	1666.3	1547.3

This value returned Eul is a scalar and is the total number of holes in the objects. In this bweuler method, extra objects are added when there is an increase in the noise level.

Figure 5. Represents a histogram comparing, the results produced by the IGNT method for various levels of noise, with the results produced by other Edge Detection techniques for various samples of noise. It can be seen that, there is a steady increase in the addition of objects with increase in the noise level.

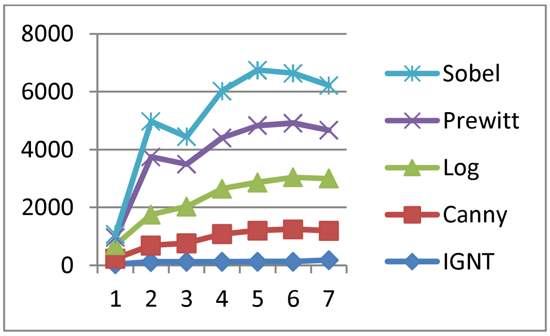

Figure 5. Comparison and Representation of all the Edge Detection Technique using Euler's Method.

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In the IGNT method the extra objects are added when there is an increase in the noise level when compared to other existing methods and this is achieved because noise is suppressed in the IGNT algorithm.

The results obtained for high frequency low frequency and both high and low frequency are relatively studied in *Figure 4.*

IGNT method is studied by relating the histograms obtained for high frequency and low frequency noise of different ranges.

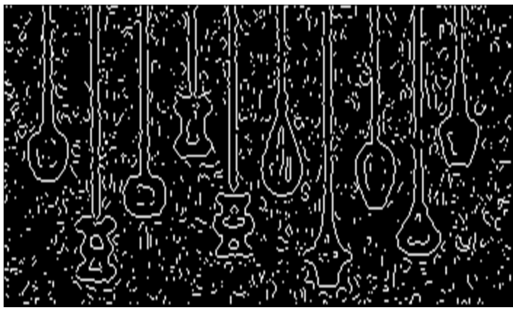
The tables given provide the analysis of the Log, Perwitt, Canny, Sobel and the proposed method at various ranges of noise and Euler values.

The histogram provides a pictorial representation of the analysis done.

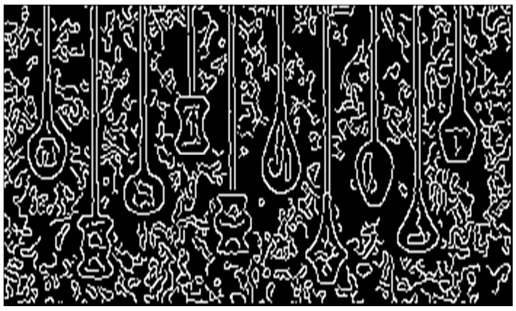
Low Frequency Noise Analysis

a) Original Image

b) Log Edge Image



c) *Canny Image*



d) *IGNT Image*

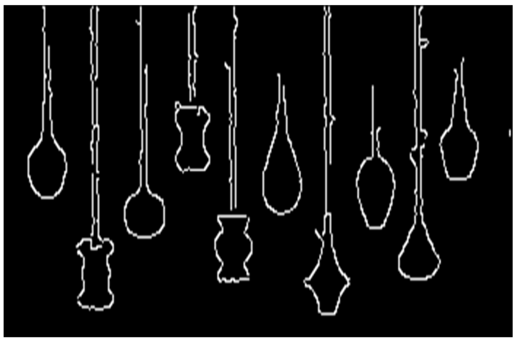


Figure 4: Low Frequency Noise Analysis a) Original Image b) Log Edge Image c) Canny Edge Image d) IGNT Edge Image

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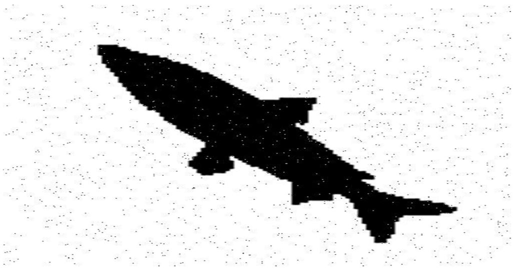
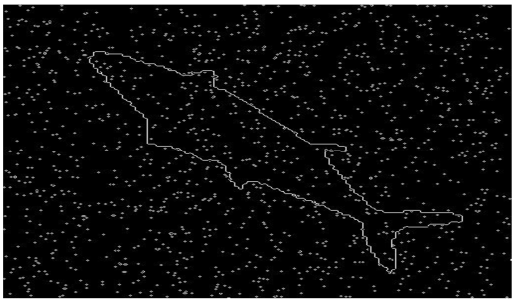
High Frequency Noise Analysis

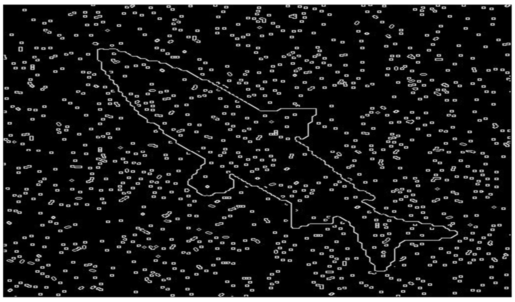
a) Original Image



b) Log Edge Detection



c) Canny Image



d) IGNT Image

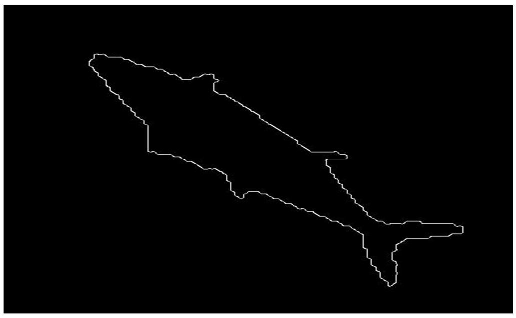
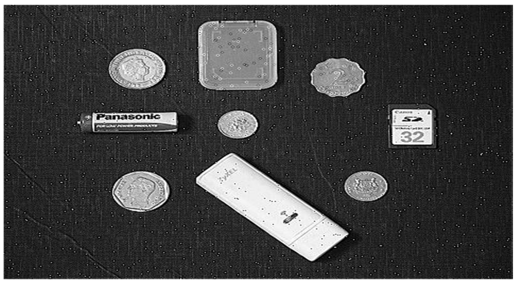


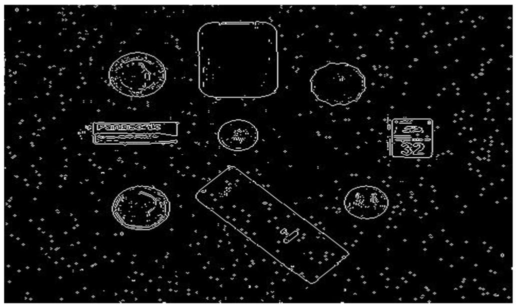
Figure 4: High Frequency Noise a) Original Image b) Sobel Edge Image c) Canny Edge Image d) IGNT Edge Image

Both High and Low Frequency Noise

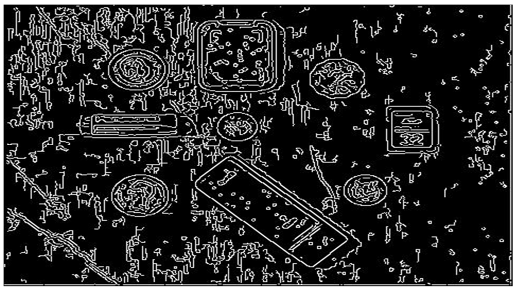
a) Original Image



a) Log Edge Detection



a) Canny Image



a) IGNT Image

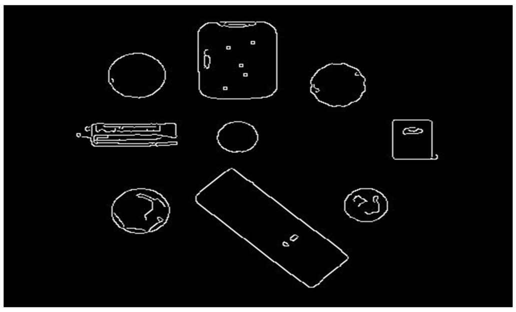


Figure 4: Both High and Low Frequency Noise a) Original Image b) Log Edge Image c)Canny Edge Image d)IGNT Edge Image.

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Table 4.2. A table predicting both high and low frequency noise calculated for the edge detection techniques.

Both High and Low Frequency Noise						
Sigma	Noise	Log	Prewitt	Sobel	Canny	IGNT
0.01	0.1	4439	4446	3091	1887	61
	0.2	5203	5972	5706	2287	66
	0.3	5414	4805	4425	2050	87
	0.4	5419	4105	4026	1762	230
	0.5	5443	4646	4718	1459	412
0.41	0.1	4284	4479	3031	1768	63
	0.2	5328	5902	5785	2159	62
	0.3	5515	4697	4405	1909	72
	0.4	5445	4118	4090	1785	273
	0.5	5307	4652	4769	1497	612

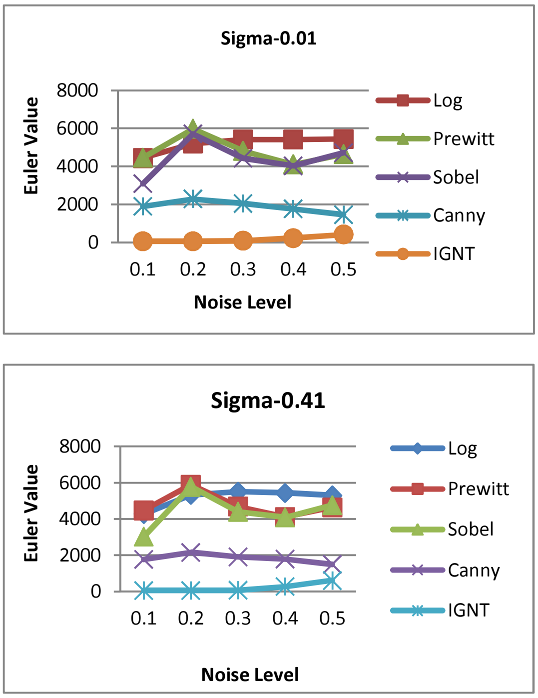

Figure 6. Comparison of the Edge Detection Techniques for both high and low frequency noise at different noise levels and Sigma values

In Table 4.2 and Figure 6 the Euler values obtained for Sobel, Prewitt, Canny, Log Edge and the proposed method are analysed with noise level ranging from 0.1 to 0.5 and with two sigma values 0.01 and 0.41. The values obtained using the proposed method does not deviate much from the noise level, thus detecting most of the Edges at the lowest Euler Value.

Table 4.3. A Table Calculating Edges using Sigma (Low Frequency Noise).

Low Frequency Noise					
Sigma	Log	Prewitt	sobel	canny	IGNT
0.01	1323	330	187	329	18
0.11	1327	341	193	332	15
0.21	1335	358	193	333	16
0.31	1351	381	235	340	18
0.41	1373	369	250	343	20

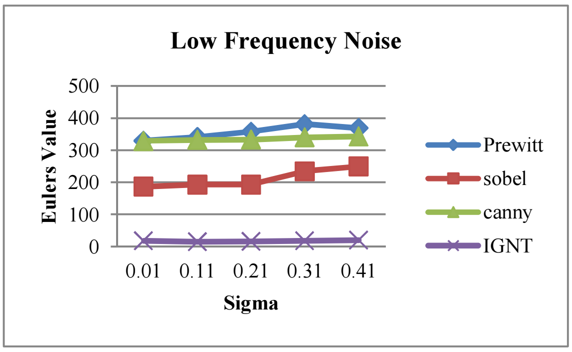

Figure 7. Comparison of the Edge Detection Techniques using Euler's Method with Low Frequency Noise

Table 4.3 and Figure 7 represent the results obtained using low frequency noise at a range of about 0.01 to 0.41 Sigma values. Here to the results for the IGNT method are obtained at a lowest Euler value.

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Table 4.4. A Table Calculating Edges using High Frequency Noise

High Frequency Noise					
Noise level	LOG	Prewitt	Sobel	Canny	Proposed
0.001	470	258	107	199	36
0.101	1444	1493	1040	906	146
0.201	1703	1990	1947	1091	138
0.301	1764	1608	1487	1046	148
0.401	1800	1400	1368	1101	682
0.501	1812	1517	1556	1146	831

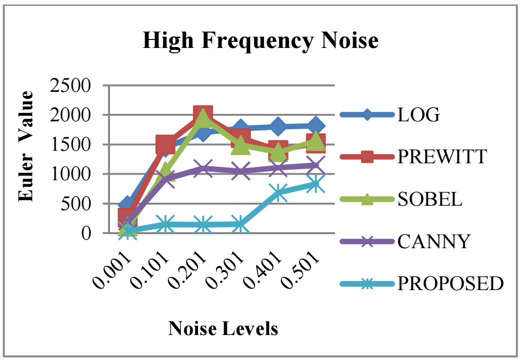

Figure 8. Comparison of the Edge Detection Techniques using Euler's Method with High Frequency Noise.

Table 4.4 and Figure 8 are presented to represent the results obtained using High frequency noise. A little deviation of the proposed method into the higher Euler values can be seen in the table and the Histogram indicating the requirement of higher Euler values for higher noise levels.

5. CONCLUSION

Detection of the Edges forms a major concept to study the objects in the image. In the IGNT method a combination of some of the popular Edge Detection techniques such as the Laplacian of Gaussian, Otsu's method and the Canny Edge Detector is used. The advantages seen in each method contributes to the IGNT method. The limitation seen in one is overcome by the other, thus forming a well formed Edge Detection algorithm. Laplacian of Gaussian algorithm provides the reduction and expansion of the data using Image pyramids. Thus the results obtained are smoothed and sub-sampled according to the requirement. The reduction and expansion of data and the smoothing and sub-sampling provided bring about a large increase in the signal to noise ratio.

Otsu's method helps in the transformation of the data to be processed leading to a specific amount of required continuous data being given to the next process which is seen in the discontinuity removal. Finally, the Canny Edge Detector involving an increase in signal to noise ratio and increase in the localization of the edges using hysteresis Thresholding and non-maximal suppression contribute towards the process of feature extraction in the IGNT method.

The IGNT method can reduce the CPU time even when executed in low configuration processors whereas the existing system fails to execute fast in low configuration processors. The existing system also fails to suppress the noise when the noise level exceeds. This is because it considers the noise pixels as objects and processes. Thus failing in the attempt to, eliminate the increased noise.

But the IGNT method performs well even for increased noise levels. Thus this methodology when implemented in real time processing of images like mine ore detection, tracking vehicle number, biomedical image processing will perform efficiently when compared with the traditional methodologies of Edge Detection. Edge Detection method is a very important step for extracting the features from an image which may be used for image identification. When applying Edge Detection to an image with noise, it effectively removes the noise and detects Edge details with accuracy. It is simpler and more efficient for computating edges and also for the detection of Edges with very less consumption of time, making the process very simple to implement. The IGNT method provides good results as compared to the other Edge Detection techniques. This method can be effectively used in the area of image processing, especially for process involving large databases.

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