Seed Quality Analysis Using Image Processing

Mr. Sandip Ramdasrao Mokle[1], Prof. H. K. Waghmare[2], Prof.Dr. Sanjay Patil[3]
[1, 2, 3] Dept of Electronics & Telecommunication Engineering
[1, 2, 3] Marathwada Institute of Technology, Aurangabad- 431002

Abstract- *Globally, wheat is the leading source of vegetable protein in human food, having higher protein content than other major cereals like maize and rice. In terms of total production tonnages used for food, India is currently at second rank as the main human food crop. Determining the quality of wheat is critical. Specifying the quality of wheat manually requires an expert judgment and is time consuming. Sometimes the variety of wheat looks so similar that differentiating them becomes a very tedious task when carried out manually. To overcome this problem, Image processing can be used to classify wheat according to its quality. The seed quality identification is very important in agriculture. Before boring the seed in farm it must be viewed properly and then sowed. In the current scenario the farmers are taking more efforts in their farm and also spending more time and money. But in spite of their hard work they do not get proper profit. So the technology can come for rescue here. There are certain limitations to human eye to observe the seed. So the electronic world helps us to separate the faulty seeds from quality seeds. The image processing algorithm is implemented using Matlab. The proposed technique is defined with the assistance of computerized image processing mechanism on MATLAB.*

Keywords*-* Image processing, Feature extraction, Segmentation, Identification, Classification

I. INTRODUCTION

WHEAT is one of the most important cereal crops. The quality of wheat has distinct effect on the yield of heat, so the proper inspection of wheat quality is very important. During grain handling operations, information on grain type and grain quality is required at several stages before the next course of operation can be performed. In the present grain-handling system, grain type and quality are rapidly assessed by visual inspection. This evaluation process is, however, tedious and time consuming. The decision- making capabilities of a grain inspector can be seriously affected by his/her physical condition such as fatigue and eyesight, mental state caused by biases and work pressure, and working conditions such as improper lighting, climate, etc. In the traditional method experts can identify the quality of grain by handpicking. The inspection of the quality of different types of wheat manually is critical and time consuming. Digital image analysis offers an objective and accuracy quantitative method for estimation of morphological features. Zayas et al.(1989) applied the digital image analysis parameters technique to discriminate wheat classes and varieties. Taking wheat grain as an example, the shape detection and description method of similar round object are studied. Then a grain shape description method is considered based on some feature points of wheat grain. Computer vision is a novel technology for acquiring and analysing an image of a real scene by computers and other devicesin order to obtain information or to control processes. The core technique in computer vision is always related to image analysis/processing, which can lead to segmentation, quantification and classification of images and objects of interest within images. Computer vision has proven successful for online measurement of several food products with applications ranging from routine inspection to the complex vision guided robotic control (Gunasegaram, 1996). The application of computer vision in certain foods such as bakery products, meat and fish, vegetables, fruits, grains, prepared consumer foods etc. is analysed by Sun et al. (2003).Image processing system involves changing the nature of an image with a computer and suitable software in order to either improve its pictorial information for human interpretation or render it more suitable for autonomous machine perception (MacAndrew, 2004). Image processing helps in accurate and fast determination of important food products. (Velioğlu et al., 2011).

Many researchers across the world are actively working in the area of seed quality inspection but still there is plenty of scope to carry out further research in this area. These researches depend on various morphological, textural, and colour features for classification of seeds. This idea is mainly included in machine vision. Machine vision attempts to impersonate sensory perception of human beings produce digital image suitable for further processing make modern image acquisition techniques highly demanding.

Seed Technology basics:-

Seed testing is used for good agricultural work. Its used for quality parameter during seed handling & the test report is used for documentation purpose on seed quality. Seed quality is used for checking viability. Seed testing is determining the standards of a seed lot namely physical purity, moisture, germination, vigour & thereby enabling the farming community to get quality of seeds.

- **Germination Test**

Germination is defined "the emergence & development of seedling to a stage where the aspects of its essential structure indicates whether or not its able to develop further into a plant under favorable conditions in the soil (ITSA 1984).

The conditions prescribed by

ISTA include the following variables:

- Temperature (level and regime, e.g. constant Day and night or fluctuating)
- Light (+/- light or period of day/ night cycles)• Substrate (sand, top of sand, top of paper, Between paper and pleated paper)The ISTA rules also indicate days of first and last Count to standardize the duration of the test period. Germinated seeds are counted regularly during the prescribed germination period from the indicated 'first count' to 'final count'. The final test result is grouped into the following classes:

1. **Normal germinants:** The cumulative number of seeds which have developed into seedlings of normal and healthy appearance with all essential structures of a seedling. This also includes seedlings where possible damage is caused by secondary infection.
2. **Abnormal germinants:** The cumulative number of seeds which have germinated during test period but in which seedlings show abnormal or unhealthy appearance e.g. lacking essential structures such as cotyledons, or being discolored or infected by seed borne pathogens.
3. **Unterminated seeds:** Seeds which have not germinated by the end of test period. These are grouped into following subclasses: a. hard seeds, which are seeds that remain hard because they have not imbibed. Fresh seeds, which are seeds that have not germinated although they appear firm and healthy.

c. Dead seeds, which are seeds that are soft, or showing other signs of Textural algorithms

This type of algorithm is used in Iran afterward its used by all other countries. Besides the extracted textural features from gray level images, GLCM (gray level co-occurrence matrix), GLRM (gray level run length matrix) (Majumdar and Jayas, 1999), LBP (local binary patterns),LSP (local similarity patterns) and LSN (local similarity numbers) matrices were produced from gray level images and textural features were extracted from these matrices. LSP and LSN texture analysis methods have been developed theoretically and computationally in Machine Vision Laboratory (MVLab) of Ferdowsi university of Mashhad, Iran. decomposition. d. Other seeds, e.g. empty seeds.

The final evaluation of the germination test is reported as germination percentage or germination capacity, which counts 'normal germinants'.

- **Seed vigor test:**

Vigor testing is an important component of seed testing because it's more sensitive test than germination, and because loss of vigor may be noted much earlier than loss of germination. Seed vigor directly determines the emergence potential of a seed lot and physical and genetic aspects of seeds also affect their storage, processing an transport. AOSA defines seed vigor as 'those seed properties that Some of the methods for

Seed vigor testing are summarized below:

i. Germination percentage of normal seedlings after imposition of stress – such as color accelerated aging,
ii. Biochemical tests – such as tetrazolium or electrolyte conductivity, and
iii. Seedling growth.

A vigor test cannot replace a germination

II. RELATED WORK

All the tests explained above are normally performed manually. These tests are generally costly, time-consuming, and the results of tests may vary from laboratory to laboratory. So there is a need of objective system which will provide consistent results.

A machine vision system will be able to perform the Tests fast, consistent and it will also reduce the human Interference. The work related to application of machine vision in seed testing is explained below. Saco, et.al. Developed a system for automated seed vigor assessment.

This system contains a flatbed scanner which is used to capture the images of seedlings; this scanner is interfaced with computer. The images obtained were processed by computer to calculate the vigor index based on sample mean of various statistics acquired from morphological Features of the image seedlings. The system was tested for lettuce seedlings grown in dark for three-day. The vigor index computed by system was compared with vigor index computed manually using dividable seedling measurements. In best case, the percentage difference between manual and computer determinations of the vigor index was only 0.99% forgot 1. In worst case, percentage difference was14.71% for lot 9. These values were much acceptable than the variation in results from laboratory to Laboratory.

A. L. Hoff master, et.al. Proposed an image processing computer application to automatically assess the vigor of three-day-old soybean seedlings.

An image of soybean seedling was captured using flatbed scanner. The soybean seedlings were segmented from the background and converted into various digital formats. These representations were used to segment the seedlings into normal and abnormal categories. The normal seedlings are further processed to perform length measurement. Using skeletonization, a 1- pixel wide summary structure of the seedling were obtained. To calculate actual length of the seedlings, the cotyledon portion of the seedling skeleton is removed. After removing the cotyledons, skeletons were further processed to calculate length of seedling. The weighted sum of these length meaurements along with the speed and uniformity of growth values produces the vigor index representing the vigor of thseedling. Seed vigor is an important parameter in determining seed quality. Seed vigor tests are generally useful for evaluation of large seeded agronomic crops which are not useful for smaller seeded vegetable and flower species. Seedling growth rate can also be used to access vigor in seeds. For this

Purpose, Robert L. Genève, et.al. Designed a system o evaluate early seedling growth rate using flat-bed scanner. A flat-bed scanner is used to obtain the digital images of seedling emergence and transparent medium is used to facilitate scanning. This system was tested for six small seeded species (cauliflower, tomato, pepper, impatiens, Vince, and marigold).Twelve seeds per species were sown in plastic Petrifies containing either one piece of blue blotter, two pieces of germination paper or one piece of a clear, uncoated cellulose film. Before placing seeds on film, water was added to the Petri dish. Each species were evaluated after 2 days of radicle emergence. Digital image analysis of these images was done. Three analysts separately evaluated same set of seeds.

Scans Were made for seeds on the cellulose film through the Petri dish with the lid removed. Comparison of all the results was done which shows there was no statistical difference between the blotter paper and cellulose film for tomato, pepper, impatiens, Vince, and marigold. Cauliflower seedling length was greater on paper than cellulose film and blotter. These results Indicated that the cellulose medium could be suitable substitute for germination paper and blue blotter when imaging for vigor assessment. The length or area of each seedling was computed by computer-aided analysis using available software (MacRhizo). This software was able to measure root Length and not customized for measuring individual Seedlings'. Oakley, et.al. Developed a system for computer aided image analysis of digital images to evaluate seedling growth as a measure of seed vigor. A flatbed scanner was used to capture the images of seedlings. Similarly, software was developed to calculate seedling growth and in most cases a vigor Index has been calculated based on seedling growth, growth uniformity and germination percentage .vigor index for six seed lot has been measured based on cotyledon area of seedlings produced in plug under controlled environmental conditions. For 25seeds standard germination test was conducted by Placing in four replicate of plastic petri dishes containing one piece of blue blotter with 5.25 mL of water sealed with Parafilm and placed in germination chamber held at 23oC with 40µmol.s-1m-2 from cool White fluorescent lamps. After 18 days from sowing, normal seedlings were calculated. This is repeated for each seed lot. Saturated salt accelerated aging vigor tests were conducted using one-hundred seeds of each seed lot for 48h. Germination percentages were evaluated using standard germination conditions immediately after saturated salt accelerated aging. Seed moisture content on a fresh weight basis was measured before and after accelerated aging. Each vigor test was repeated. Seedling growth rate was measured using four replicates containing nine seeds per seed lot. Petri dishes containing one piece of clear, uncoated cellulose film are used for this test. Precautions are taken in order to avoid contamination. Before placing seeds on the film water was added to dish. Petri dishes were sealed with Para film and placed in single germination chamber held at constant 23oC with 40µmol.s-1m-2 from cool white fluorescent lamps. The images of Petri dishes were captured using a flat-bed scanner provided with base and top lightning. Petri dishes were scanned with lids on once every 24 h from 4 to 7 days after imbibition. Using above procedures seedling length, area and growth rate were measured over a four day period. The results of all experiments showed that all the six Impatiens seed lots had high standard germination percentage greater than 96%. Computer-

Description of SIFT Algorithm Stages

a) Scale-space extreme detection: This is used to achieve invariance to image scaling, build a multilevel image pyramid (different scales). Subsequently, a difference of Gaussian function is used over all scales to find interested points.

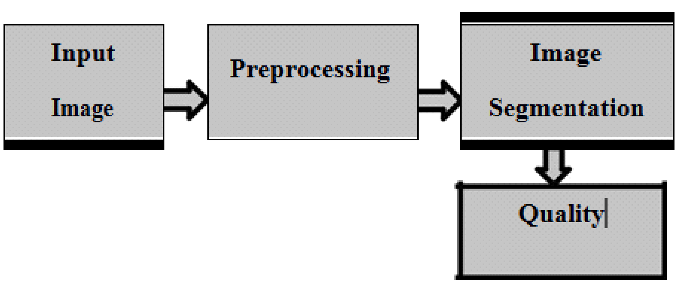
b) Key point localization: Every interested point, using approximation of Taylor expansion to determine exactly location, scale and remove all Weak interested points (key points)
c) Orientation assignment: Determine local image gradient direction for each key point, using global histogram to summarize gradient near each key point. We obtained key points that are invariance to Orientation, scale, and location.
d) Key point descriptor: The Gradient of local image gradients are determined at the selected scale in the region around each key point. This stage protects key points against effect of local shape distortion and change in illumination.

Matching

Key point's descriptors are generated for both training Images and test image. These key points can be used to find an object in training image that may be existed in test image that has other objects as well. Matches were evaluated by Euclidean distance of the matched point in the training images and test image. Fig 1 illustrates the stages of Sift algorithm.

Image acquisition

The images were acquired in two ways: the first image Acquisition system consist of scanner (hp 1370), Pentium IV Computer unit and the second image acquisition system consist of digital video camera (Sony Handy cam model DCR-SR47E and Sony



III. CONCLUSION

After going through the research work reported by various researchers in the field of quality inspection of wheat varieties and applications of image analysis in grain industry, it has been concluded that Image processing technique has the potential to become a vital component of automated food processing operations. Image processing is recognized as being the core of computer vision with the development of more efficient algorithms assisting in the greater implementation of this technique. The automated, objective, rapid and hygienic inspection of wheat grains can be achieved by the use of image processing and greater processing speed of algorithms are continually developing to meet the necessary online speeds. Image analysis based on texture, morphology and color features of grains is essential for various applications in the grain industry including discrimination of wheat classes, to assess grain quality and to detect insect infestation. Image processing modifies pictures to improve them (enhancement, restoration), extract information by analysis, recognition, and change their structure i.e. Composition, image editing.

Now a-days nature of grains is a vital prerequisite to shield shoppers from sub-standard items. Yield is the most detectable trademark to ranchers while the product is in the ground; however when the result of the product, the processed rice, achieves the business sector, quality turns into the key determinant of its deal capacity. Nature of a grain is an essential prerequisite throughout today's business sector. There are such a large number of second rate quality grains landing to the market step by step. Today in rice exchange; rice of low quality is sold without being taken note. Be that as it may, there is no helpful strategy to distinguish these sub-par quality grains in the business sector. Consequently, this has turned into a significant issue for both the customer and the legislatures. This anticipates will help in recognizable proof and arrangement of assortments of wheat using image processing.

IV. FUTURE SCOPE

This study can be carried forward by using Image Processing technique for Classification and Grading of different varieties of wheat grains and other cereal grains. Mat lab programming can be used for determining morphological and colour parameters which have better accuracy and has less computational cost. Moreover, research can be done on different variety of wheat and different feature set can be used.

MATLAB Programme:-

```
clc, clear all, close all
workspace;        % Make sure the workspace panel is showing. format short g;
format compact;
% fontSize = 25;
image = imread('E:\mokle\Wheat7.jpg'); im = image;
image = double(image); figure(1),
imshow(im); title('Original Image')
[rows, columns, numberOfColorChannels] = size(im); if numberOfColorChannels > 1
r = im(:,:,1);
g = im(:,:,2);
b = im(:,:,3);

red = sum(sum(r)); green = sum(sum(g)); blue = sum(sum(b));

if red >0.325 && green > 0.325 color = 'yellow'; disp('color is yellow');
elseif blue >0.325 && green > 0.325 disp('color is cyan');
elseif blue >0.325 && red > 0.325 disp('color is magenta');
elseif red >0.35 disp('color is red');
elseif green >0.35 disp('color is green');
elseif blue >0.35 disp('color is blue');
elseif red < 0.30 && green <0.30 && blue <0.30 disp('color is black');
elseif red > 0.325 && green >0.325 && blue >0.325 disp('color is black');
end
im = rgb2gray(im); figure(2), imshow(im);
title('Grayscale Transformed Image') end
filter = fspecial('gaussian'); Ifilt = imfilter(im,filter); figure(3),
imshow(Ifilt), title('Filtered gray image')
Iadj = imadjust(Ifilt); figure(4), imshow(Iadj);
title('Contrast Adjusted Image')

background = imopen(Iadj,strel('disk',25)); %15 figure(5),
imshow(background),
title('Morphologically Operated      Grayscale Image');

bw = im2bw(background,.99); figure(6),
imshow(bw);
title('Morphologically Operated      BW Image')
stats = regionprops(bw,'Centroid',...
'MajorAxisLength','MinorAxisLength');
centers = stats.Centroid;
diameter = mean([stats.MajorAxisLength stats.MinorAxisLength],2); radii = diameter/2;
disp('radii = '); disp(radii);
disp('diameter = '); disp(diameter);

area = regionprops(bw, 'Area'); centroid = regionprops(bw, 'Centroid');

disp('area = '); disp(area);
disp('centroid = '); disp(centroid);

bw_neg = ~bw; figure(7), imshow(bw_neg),
title('Negative of Morphologically Operated BW Image')
edge1 = edge(bw_neg,'sobel'); edge2 = edge(bw_neg,'prewitt'); edge3 = edge(bw_neg,'canny'); edge4 = edge(bw_neg,'roberts'); edge5 = edge(bw_neg,'log');
edge6 = edge(bw_neg,'zerocross');
figure(8), imshow(edge1)
title('Edge Detected Image using    sobel operator')

figure(9), imshow(edge2)
title('Edge Detected Image using prewitt method')

figure(10), imshow(edge3)
title('Edge Detected Image using canny method')
figure(11), imshow(edge4)
title('Edge Detected Image using roberts method')
figure(12), imshow(edge5)
title('Edge Detected Image using log operator')
figure(13), imshow(edge6)
title('Edge Detected Image usig zero cross method')
[B,L] = bwboundaries(edge4,'noholes'); figure(14);
imshow(label2rgb(L, @jet, [.5 .5 .5]))
hold on
for k = 1:length(B) boundary = B{k};
plot(boundary(:,2), boundary(:,1), 'w', 'LineWidth', 2)
end
title('Edge Detected Gap Filled Image')
% Partition of the gray scale image using a threshold of 50
T = 0.196; % equivalent to threshold value of 50 in a scale of 0 to 255 bw1 = im2bw(image,0.99);
bw2 = imfill(bw1,'holes');
% Detection and cleaning of noise regions mylabel = bwlabel(bw2);

tam = zeros(1,max(max(mylabel))); for (i = 1:max(max(mylabel))) tam(i) = size(find(mylabel==i),1); end
mayort = max(max(tam)); posic = find(tam==max(tam));
bw2(find(mylabel~=posic)) = 0; bw4 = bw2;

perimeter = bwperim(edge4); contador99 = sum(sum(perimeter)); limites = zeros(contador99,2);
[limites(:,1) limites(:,2) zetas] = find(perimeter==1); figure(15),
```

imshow(image);
title('Original image with the detected borders') hold on, plot(limites(:,2),limites(:,1),'.','MarkerSize',4), hold off;

% Segmented original image in white background i = find(~bw4==1);
R = image(:,:,1);
G = image(:,:,2);
B = image(:,:,3);
R(i) = ones(length(i),1);
G(i) = ones(length(i),1);
B(i) = ones(length(i),1);
image(:,:,1) = R;
image(:,:,2) = G;
image(:,:,3) = B; figure(16), imshow(uint8(image));
title('Segmented original image in white background') if color == 'yellow'
disp('Seed quality is fine'); else
disp('Seed quality is degraded'); end

```
Warning: Image is too big to fit on screen; displaying at 50%
color is yellow
Warning: Image is too big to fit on screen; displaying at 50%
Warning: Image is too big to fit on screen; displaying at 50%
Warning: Image is too big to fit on screen; displaying at 50%
Warning: Image is too big to fit on screen; displaying at 50%
Warning: Image is too big to fit on screen; displaying at 50%
radii =
```

545.41
diameter = 1090.8
area =
Area: 787645
centroid =

```
    Centroid: [525.78 418.21]
Warning: Image is too big to fit on screen; displaying at 50%
Warning: Image is too big to fit on screen; displaying at 50%
Warning: Image is too big to fit on screen; displaying at 50%
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Warning: Image is too big to fit on screen; displaying at 50%
```

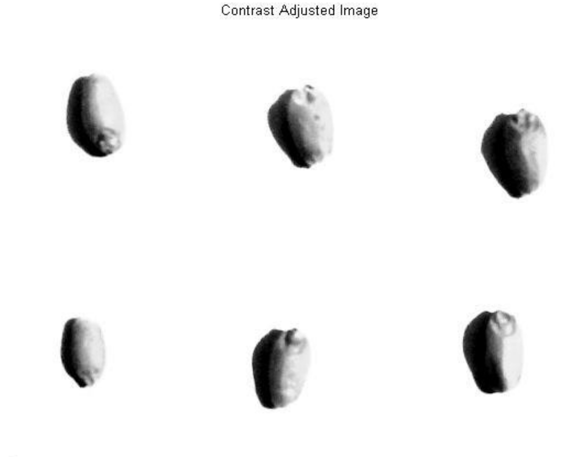
Seed quality is fine

Original Image

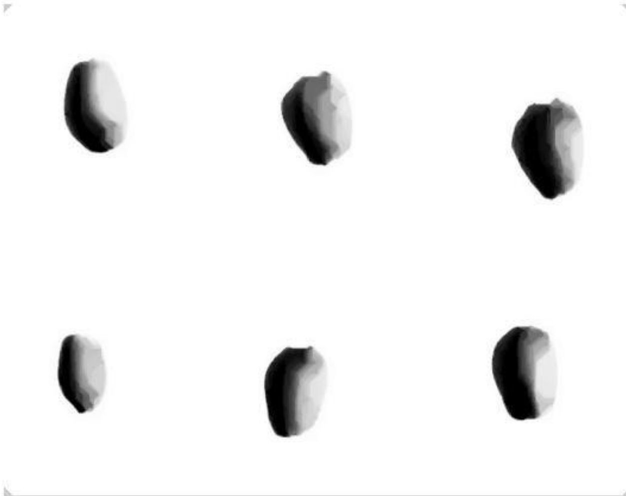
Grayscale Transformed Image

Filtered gray image

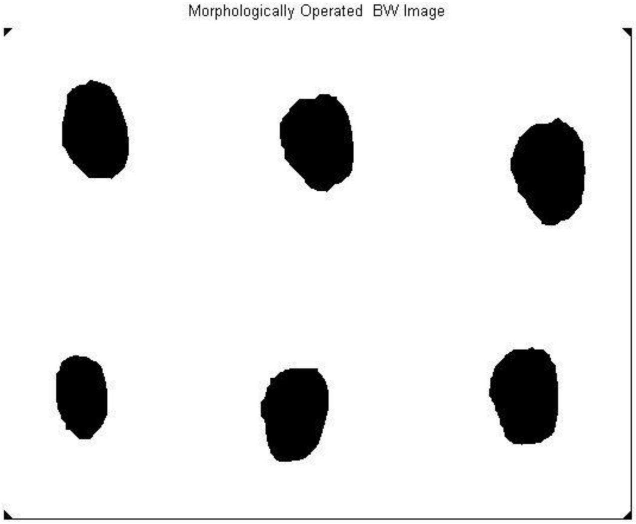
Contrast Adjusted Image



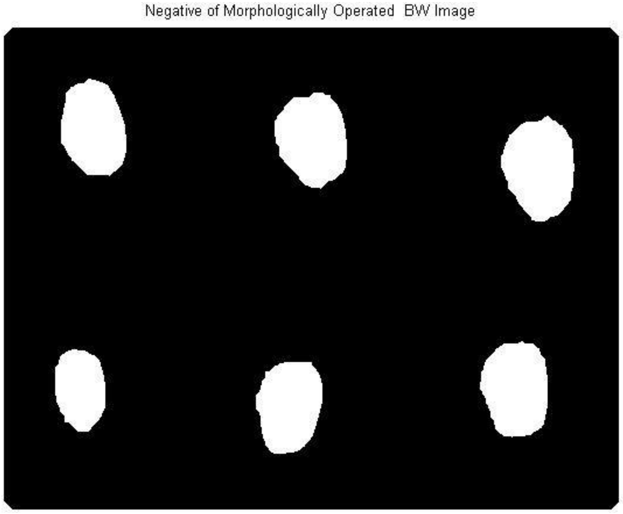
Morphologically Operated Grayscale Image



Morphologically Operated BW Image

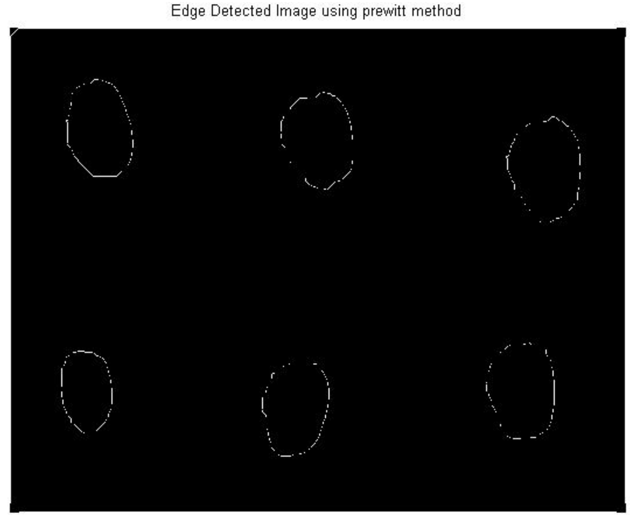


Negative of Morphologically Operated BW Image

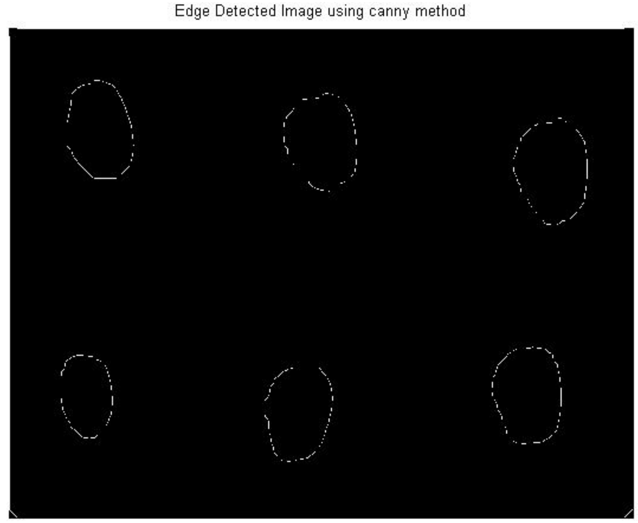


Edge Detected Image using sobel operator

Edge Detected Image using prewitt method



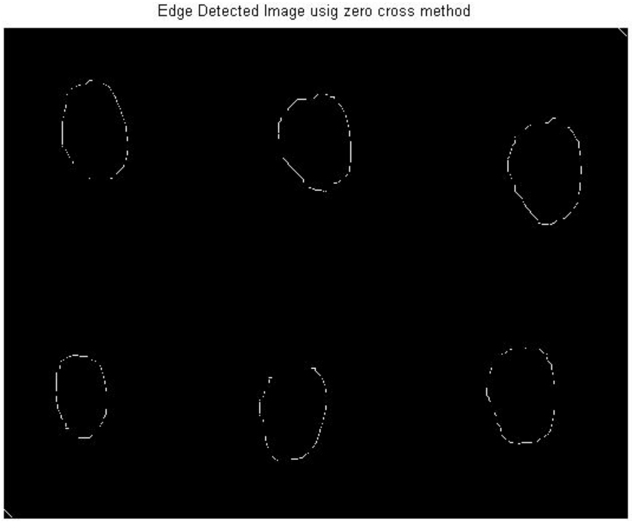
Edge Detected Image using canny method



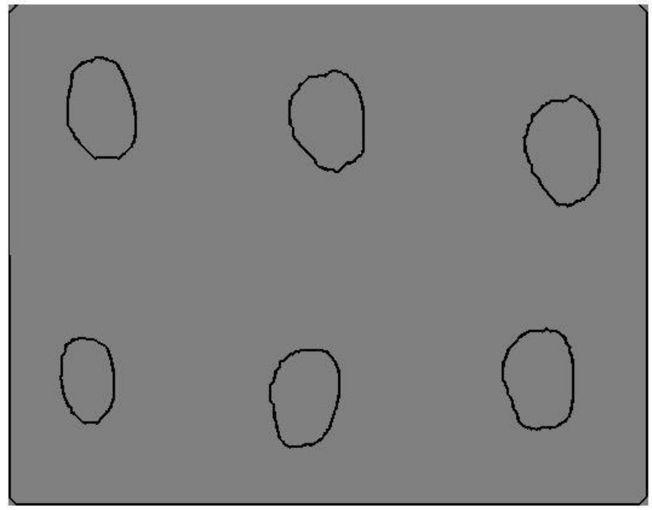
Edge Detected Image using roberts method

Edge Detected Image using log operator

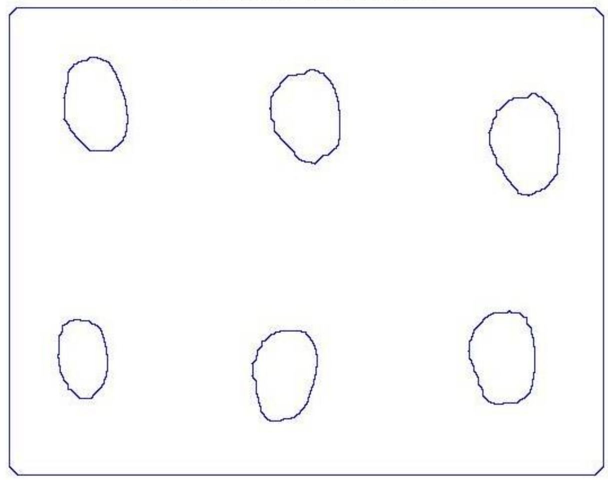
Edge Detected Image usig zero cross method



Edge Detected Gap Filled Image



Original image with the detected borders



Segmented original image in white background

REFERENCES

[1] Abutaleb AS, "Automatic thresholding of grey-level pictures Using two-dimensional entropies." Pattern Recognition, 47 (1), 22-32, 1989

[2] Bahar Gumuş, Murat O.Balaban, Mustafa Unlusayın, "Machine Vision Applications to Aquatic Foods:A Review," Turkish Journal of Fisheries and Aquatic Sciences 11: P171-181,2011.

[3] Ballard, D. A., & Brown, C. M. “Computer vision.” Englewood Cliffs, NJ, USA: Prentice-Hall, 1982
[4] Deserno TM, Handels H, Meinzer HP, Tolxdorff T (eds) (2010)’ “Bildverarbeitungfür die Medizin 2010”, Algorithmen Systeme Anwendungen, Springer, Berlin
[5] Tanzila Saba, Amjad Rehman and Ghazali Sulong,“An intelligent approach to image denoising”,Journal of Theoretical and Applied Information Technology, © 2005 -2010, JATIT & LLS.
[6] A. Buades, B. Coll, and J. Morel, “Nonlocal image and movie denoising”, International Journal of Computer Vision, Vol. 76, No. 2, 2008, PP. 123–139.
[7] M. Mahmoudi and G. Sapiro, “Fast image and video denoising via nonlocal means of similar neighborhoods”, IEEE Signal Processing Letters, Vol. 12, No. 12, 2005, pp. 839–842.
[8] A. Rosenfeld and A. C. Kak, “Digital Picture Processing”, 2nd ed. New York: AP, 1982, vol. 1/2.
[9] B. Chanda, B. B. Chaudhuri, and D. Dutta Majumder, “A modified scheme for segmenting noisy images,”IEEE Trans. Syst., Man, Cybern., vol. 18, no. 3, pp. 458–467, 1988.
[10] B. Chanda and D. Dutta Majumder, “A note on use of gray-level co-occurrence matrix in Threshold selection,” Signal Process, vol. 15, no. 2, pp. 149–167, 1988.
[11] J. S. Weszka and A. Rosenfeld, “Threshold evaluation techniques,” IEEE Trans. Syst., Man, Cybern., vol. SMC-8, pp. 622–629, 1978.
[12] P. K. Sahoo, S. Soltani, A. K C. Wong, and Y.C. Chen, “A survey on thresholding techniques,”Computer Vision Graphics Image Processing, vol. 41, 1988, pp. 233-260.
[13] Kanchan Deshmukh, Ganesh Shinde, “Adaptive Color Image Segmentation Using Fuzzy Min-Max Clustering”, Engineering Letters, 13:2, EL_13_2_2 (Advance online publication: 4 August 2006)
[14] G. M. Matheron, “Random Sets and Integral in Geometry”, New York: Wiley, 1975.
[15] J. Serra, “Image Analysis Using Mathematical Morphology”, London, U.K.: Academic, 1982.
[16] R. M. Haralick and L. G. Shapiro, “Computer and Robot Vision”, Reading, MA: Addison- Wesley, 1992, vol. 1. International Journal of Distributed and Parallel Systems (IJDPS) Vol.3, No.1, January 2012 155
[17] P. T. Jackway, “Gradient watershed in morphological scale-space”, IEEE Trans, Image Processing, vol. 5, pp. 913–921, 1996.
[18] P. Salembier and J. Serra, “Morphological multiscale image segmentation,” in Proc. Visual Communication and Image Processing, Boston, MA, 1992, pp. 620–631.
[19] P. Salembier, “Morphological multiscale segmentation for image coding,” Signal Process, vol. 38, pp. 359–386, 1994.
[20] U. sivarajan, K J Jayapragasam, Y F Abdul Aziz, K Rahmat, “Dynamic contrast enhancement Magnetic resonanace imaging evaluation of Breast Lesions: A morphological and Quantitive analysis”, J Hkcoll Radiol, 2009
[21] “Digital Image Processing”, 3/E by Rafael C. Gonzalez, Richard E. Woods, ISBN-10: 013168728X
[22] Sukhvinder singh, Sukhbeer singh, “Parallel image processing concepts”, IJCCT vol.1, August 2010