

# Implementation of USG Ovarian Cancer Image Segmentation using Genetic Algorithm

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**ABSTRACT:** In medical field, image processing such as image acquisition, registration, feature extraction, segmentation etc. plays a vital role in diagnosis of disease. Analysis of Ultrasound Image aids to diagnosis of abnormalities in organs and the diseases. As USG is painless and unlike to X-ray no exposure of radiation is required and hence safe, is the best and most widely used popular diagnosis tool preferred by gynaecologist in order to evaluate health of a woman. In medical, among all gynaecological malignancies, ovarian cancer has the worst prognosis due to its late diagnosis and overall 5-year survival rate is approximately 45%, due to primarily late stage diagnosis of disease and only 14% of patient survives after 5yrs of diagnosis [Times of India, Dec-14]. Segmentation of ovarian USG image will help to detect and locate the abnormalities which will help to diagnose ovarian cancer in its early stage. In this paper Genetic Algorithm is used for segmentation technique which is used for automatic detection and classification of ovarian cancer. It also covers survey on different techniques for ultrasound image segmentation.

**KEYWORDS:** Segmentation, Ovarian Ultrasound Image, Genetic Algorithm, Otsu's thresholding, K-Means

## I. INTRODUCTION

In medical, image data analysis is used to extract the meaningful information of organs such as size, shape, internal structure etc. Image analysis involves various processes such as, image acquisition, registration, feature extraction, segmentation etc. Ultrasonography and the determination of the levels of a tumor marker called Cancer-Antigen 125 (CA125) are the most commonly used techniques for detecting ovarian cancer. In the case of ultrasonography, the accuracy and reproducibility of the visual interpretations are most often dependent on the skill of the observer. The CA125 marker has been found to be elevated only in 50% of stage 1 cancers. Furthermore, CA125 can also be raised in other malignancies such as uterine and pancreatic, and sometimes in certain benign conditions. This system could enhance the cancer detection rate in its early stage by follicle information and also return good quality segmented images using Genetic algorithm. Image segmentation partitions the ovarian USG image into large no of segments and process of segmentation continues till the area of interest is observed and uses OTSU thresholds to binarize the image and k-means clustering along with genetic algorithm used for segmentation. Obtained result compared with output of Mean Shift algorithm used for segmentation. There are mainly two approaches to segmentation namely edge segmentation and region segmentation. In segmentation stage the correctness of the subsequent steps is affected and hence it is the most important and difficult stage. Genetic algorithm is a class of probabilistic optimization algorithms, powerful in finding optimal feature vectors. Identification of approximate global optimal region in Genetic Algorithm is a quick process. To merge regions with similar characteristics, we have used grey level and texture. The segmentation done through Genetic Algorithm is efficient when compared to the image segmentation done by conventional algorithms.

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## II. RELATED WORK

[1] presented the texture-based segmentation method it is a pixel classifier, based on four texture energy measures associated with each pixel in the images. The 25 two-dimensional feature masks are derived from 3 basic one-dimensional vectors to evaluate the classification results. Four of those features are selected as the bases for the automated clustering procedure. The segmented images produced as the result of applying the algorithm to an example image are presented and discussed. [2] GA used here helps to resolve the problems of determining the contour's initial position and contour's entrapment within local minima which is no longer exist and the only thing needed for specifying the contours' initial positions is the center of the circles which could be found by determining the image's center of gravity. The algorithm allows user to process only the region where the tissue is instead of processing whole imagereduces segmentation time. In paper [3] various techniques are revised for computerized cancer detection and classification using ultrasound images in the literature. The techniques developed in the four stages (pre-processing, segmentation, feature extraction and classification) are summarized and the advantages and disadvantages are discussed also different performance matrices are discussed. In paper [4] hierarchical normalized cuts (HNCuts ) with mean shift is implemented for segmentation biomarker segmentation of ovarian cancer image. It is flexible, robust, accurate, and high-throughput minimally supervised segmentation algorithm. Frequency weighted mean shift is used to generate color pyramid, that is RGB values in image. In the papers [5,8,12] segmentation is done by thresholding technique In [5,8] segmentation threshold of image is selected by genetic algorithm. Simulation of GA implementation is done on Texas DSP instruments TMS320C6000. GA adjusts crossover and mutation probability to get optimized solution. Experimental result shows that segmentation of ovarian image by GA is more accurate than OSTU thresholding[6] Applications of genetic algorithm in medical image segmentation is explained in detail by UjjwalMaulik[6]. Also revised the genetic algorithm best solution in an optimization problem and concluded GA – an evolutionary algorithm is best suitable for large space problem where accuracy is crucial point. Jyothi R Tegnoor [7] proposed SVM classifier to determine whether the ovary is normal, cystic or polycystic ovary. The follicle detection is based on SVM classification and uses two parameters, namely, number of follicles N and the size of the follicles S. Paper [9] MLP networks are a proposed as useful and flexible tool where the case is of missing data. This study is one step towards developing a blood test that would aid doctors in the diagnosis of ovarian cancer. Kirsch template technique [10] is proposed to detect the ovarian cyst. To implement automatic cyst, detection four stages in pre-processing are proposed and kirsch template is used for segmentation and Gaussian filter is used for speckle noise reduction. [11] Proposes the otsuthresholding as an easy and efficient technique for image segmentation. Research also covers iterative and custom approach to implement otsu threshold. [13] states the SURF technique as one of the good technique in ovarian follicle cell growth detection. This technique is based on Haar wavelet responses and can be calculated efficiently with integral images where Speeded Up Robust Features (SURF) is a local feature detector and descriptor that can be used for tasks such as object recognition or registration or classification or 3D reconstruction. Nearest Neighbour algorithm (NN) and Genetic Algorithms (GA), [14] are used to assist pathologist and lab technician to study endothelin protein in placental cell. Image is processed to detect protein expression.

The work in this paper is divided in two stages. 1) Follicle Detection 2) Cancer Classification. Follicle detection and segmentation is done by applying otsu threshold and GA is applied to segment USG image followed by thresholding. GA randomly select the population and adjust its crossover and mutation probability to get fitness function. The algorithm keeps iterating until meets the terminal condition. Result compare with Mean Shift Algorithm implementation.

Paper is organized as follows. Section II describes OSTU threshold followed by genetic algorithm segmentation. The flow diagram represents the step of the algorithm. In Section III experimental results are show with output segmented images. Section IV presents experimental results showing results of images tested. Finally, Section V presents conclusion.

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## III. SYSTEM OVERVIEW

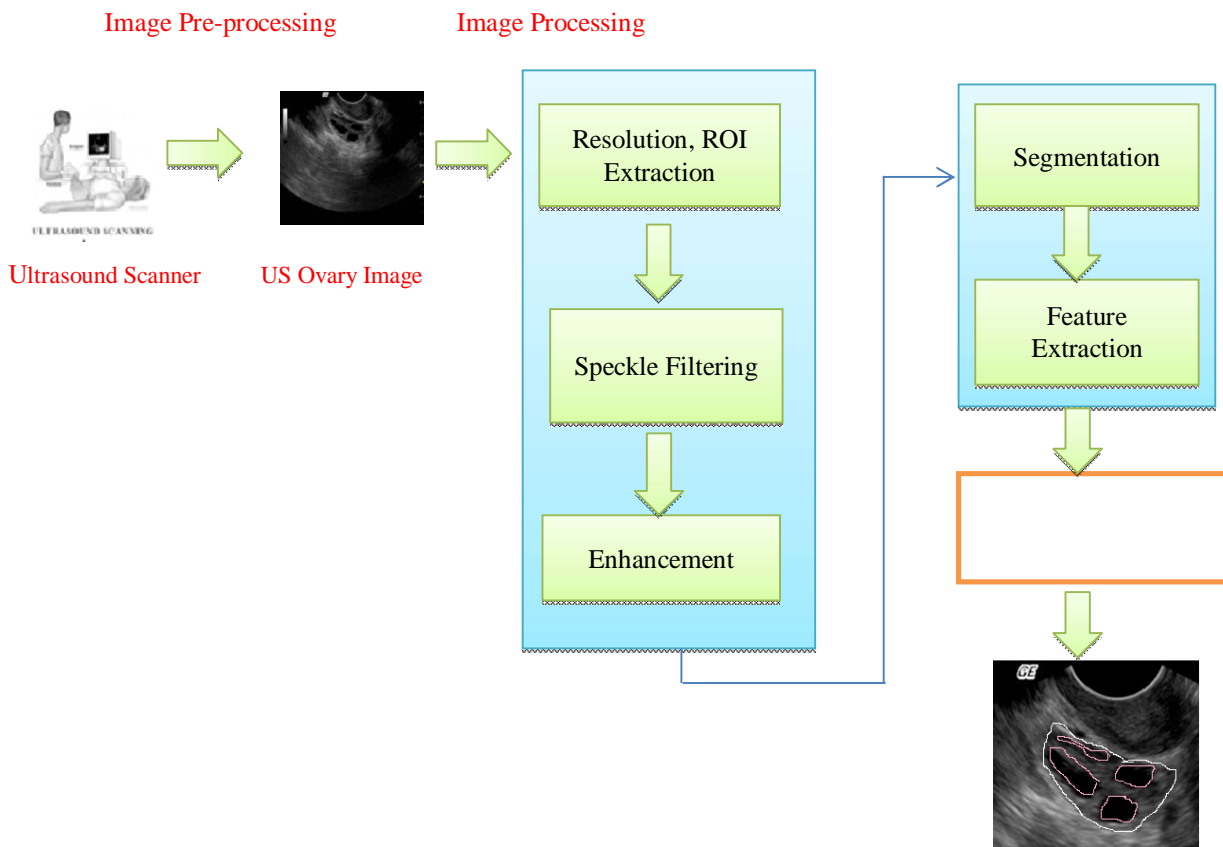


Fig. 1 Ultrasound Image Analysis

The ultrasound machine has transducer which places on body organ of interest by applying jelly on it. Transducer transmits high radio frequency (1 to 5 megahertz). These RF signals hits the body tissues, bones and displays binary image on machine monitor. Ultrasound diagnosis is safe, painless, less costly, requires less time and machine is portable and hence popular diagnostic tool in medical system [3]. Apart from this, images obtained are of low qualities and consists speckle noise, artificial borders. Therefore, these images required to process to get desired information. Fig. 1 shows the ultrasound image processing steps. The follicles are the regions of interest (ROIs) in an ovarian ultrasound image, which need to be detected by using image processing techniques. This is basically an object recognition problem. Thus, the basic image processing steps, namely, pre-processing, segmentation, feature extraction and classification, applies on US images. Image segmentation is one of the earliest and most important stages of image processing and plays an important role in both qualitative and quantitative analysis of medical ultrasound images. Segmentation is the process in which region of interest are extracted or distinguish from its background. Generally original image is divided into its subset till region of interest cannot be further divide.

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## Algorithm:

### OSTU

OSTU Principle as the image segmentation standard. In this method, we can directly calculate the threshold without pretreatment to histogram. This algorithm is simple and is a remarkable method for selecting the threshold. Here's the fundamental principle. The gray value of a grey-scale map is 0~255. The total number of pixels is defined as N,  $n_i$  is the number of pixels which is gray value is  $i$ . By normalizing the histogram, the following equations could be obtained

$$p_i = \frac{n_i}{N}$$

$$\sum_{i=0}^{255} n_i = N$$

Where  $P_i$  is the probability of pixel with grey value. the probability  $\phi$  and mean value  $\mu_0$  of the background can be calculated as

$$\theta_0 = \sum_{i=0}^m p_i \quad \mu_0 = \frac{\sum_{i=0}^m ip_i}{\theta_0}$$

### Genetic Algorithm:

Following fig shows the GA flow

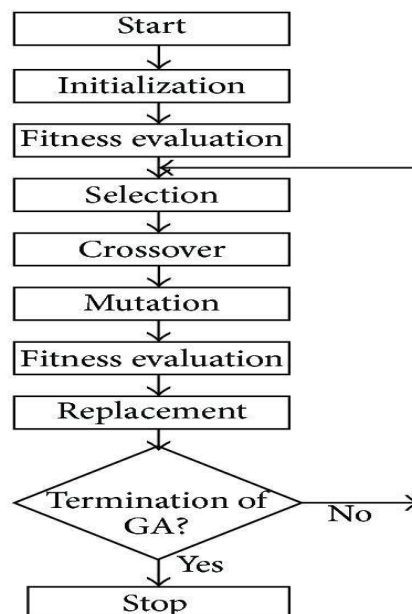


Fig.2 GA Flow

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A genetic algorithm repeatedly cycles through a loop which defines successive generations of objects:

1. Compare each object with the final goal to evaluate fitness.
2. Discard the objects that least fit the goal.
3. Use crossover to generate the next generation of objects.
4. Simply copy some objects--as is--to the next generation.
5. Add some objects with random mutations into the next generation.

**Step 1.**Initialize population with random individuals (candidate solutions)

**Step 2.**Evaluate (compute fitness of) all individuals

**Step 3.**WHILE not stop DO

- Select genitors from parent population
- Create offspring using variation operators on genitors
- Evaluate newborn offspring
- Replace some parents by some offspring

OD

At runtime beginning of a genetic algorithm, a large population of random chromosomes is created.

1. Test each chromosome to see how good it is at solving the problem at hand and assign a fitness score accordingly. The fitness score is a measure of how good that chromosome is at solving the problem to hand.
2. Select two members from the current population. The chance of being selected is proportional to the chromosomes fitness. Roulette wheel selection is a commonly used method.
3. Dependent on the crossover rate crossover the bits from each chosen chromosome at a randomly chosen point.
4. Step through the chosen chromosomes bits and flip dependent on the mutation rate.

**Step. 4**Repeat step 2, 3, 4 until a new population of N members has been created.

A GA operates through a simple cycle of stages:

1. Creation of a "population" of strings,
2. Evaluation of each string,
3. Selection of best strings and
4. Genetic manipulation to create new population of strings

## IV. EXPERIMENTAL RESULT

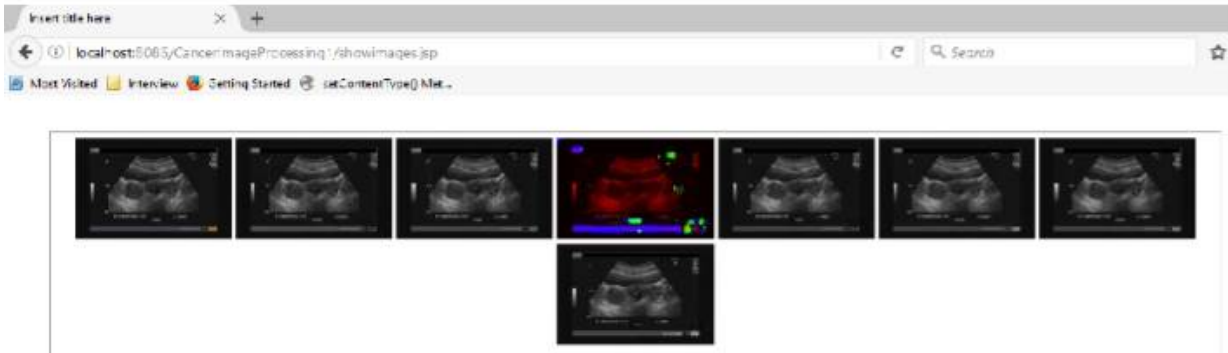
We use the Ovarian USG image dataset obtained from patient and sonography centers. 50 images are processed. Image dataset is categorized as trained image, test images and cancer images. Obtained patient images are trained by using OSTU threshold and K means cluster and are compared with test image. Each cancer image which is to be diagnosing for cancer is segmented by GA and compared with test image dataset. Comparison result obtained based on parameter as, precision, recall and fitness value of image. Finally output is displayed as set of segmented image and graph of precision, recall and fitness. Also display stage of cancer.

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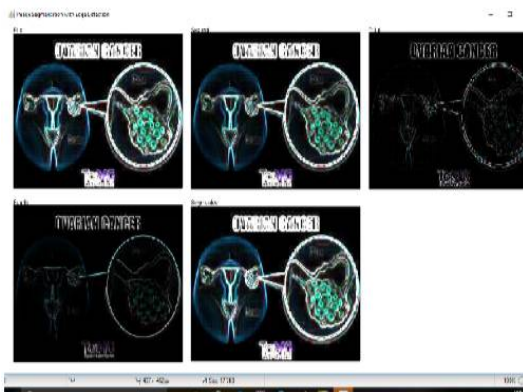
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Disease Stage:	Stage-1
Threshold Value:	153
Precession:	0.5918367346938775
Recall:	0.40816326530612246
Fitness:	0.4831320283215327
	<a href="#">Back</a>

Fig. 3 Result- Colour transform Segmented USG images with disease stage, Threshold Value, Precision, recall, Fitness





RESULT	
	
Disease Stage:	Stage-2
Threshold Value:	188
Precession:	0.5918367346938775
Recall:	0.40816326530612246
Fitness:	0.4831320283215327
Folical Count:	1
Folical Pixel:	26225
	<a href="#">Back</a>

Fig.4 (a) (b)

Fig. 4.GA Segmentation (a) GA segmented images (b) Diagnosis characteristics

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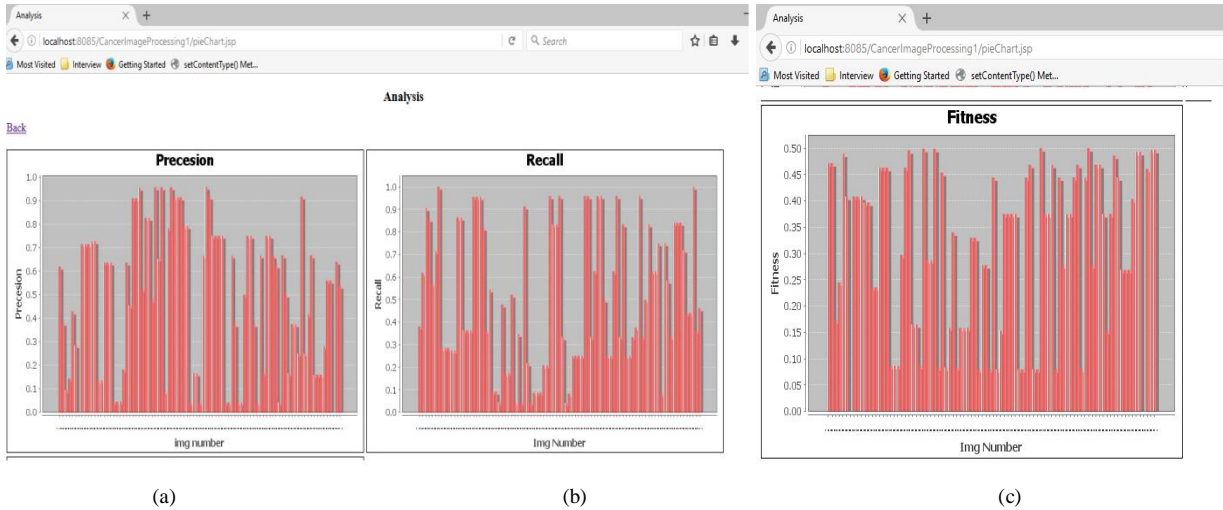
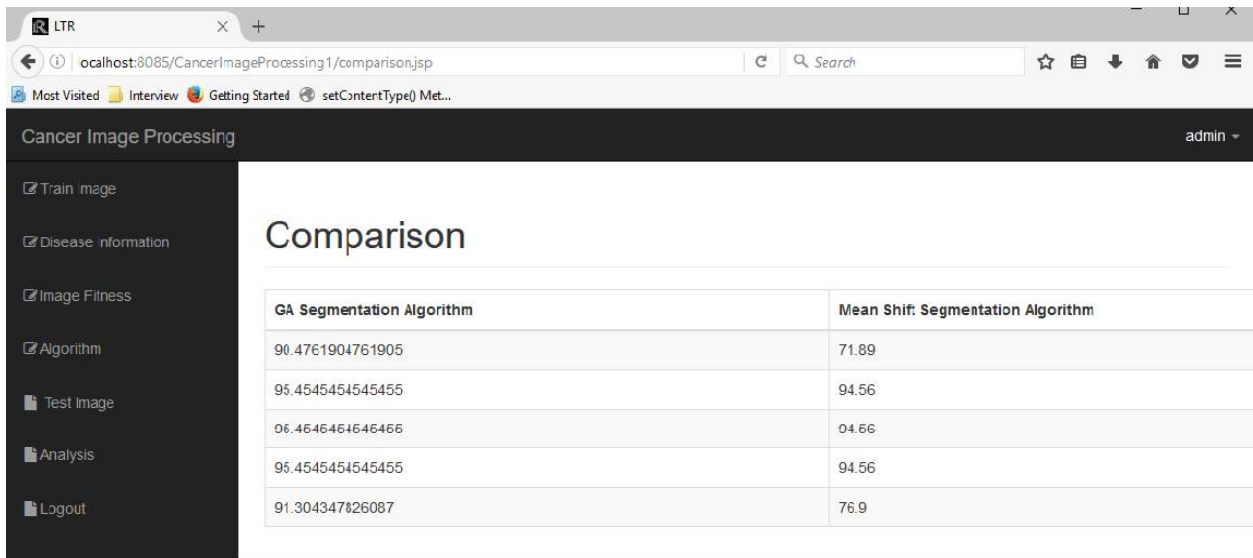


Fig.5 Result Analysis (a) Image Precesion (b) Image Recall (c) Image



The screenshot shows a web application interface for 'Cancer Image Processing'. The main content area displays a 'Comparison' table comparing the performance of a GA Segmentation Algorithm and a Mean Shift Segmentation Algorithm across five different image numbers.

GA Segmentation Algorithm	Mean Shif: Segmentation Algorithm
90.4761904761905	71.89
95.4545454545455	94.56
06.4646464646466	04.66
95.4545454545455	94.56
91.304347826087	76.9

Fig. 6 Comparative Result

## VI. CONCLUSION

We have implemented an automatic detection of ovarian cancer in its early stage. The system provides detail diagnosis of USG image by providing information as, size if image, no of follicles detected, precision, recall, fitness and no of pixcel in detected follicle. System provides comparative result with mean shift algorithm. From segmented images output obtained and image information, GA an evolutionary algorithm is proved as best method todetect ovarian cancer in its early stage.

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