Polycystic Ovarian Follicles Segmentation Using GA

K. Himabindu, S. Narasimhulu, Ch. LawrenceDhreeraj, and T. Sarath

Abstract Up to 5–15% of the women affects the reproductive system this abnormality syndrome called Polycystic Ovarian Syndrome (PCOS). Polycystic ovary syndrome (PCOS) has been a gynecological endocrine syndrome that proffers the consequence in health issues of menstrual dysfunctions, androgynism and also infertility. Usually it occurs in reproductive aging women. PCOS directs to unsuitable follicle development of the ovaries that are seized at a former stage. Periodic measurements of the dimension and description of follicles over several days are the crucial means of enquiry by physicians. In this paper, a new algorithm for automatic detection of follicles in ultrasound image for ovaries is suggested. The proposed algorithm uses various edge based methods are using for Ovaries follicles segmentation that is GA with Sobel and GA with Canny. Hence, we compare the variety of these techniques and demands assures the GA with Canny operator provides a better performance on ovarian follicle.

Keywords Ovarian follicle segmentation · Genetic Algorithm · Edge based methods · Polycystic ovary syndrome

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1 Introduction

Polycystic ovary syndrome (PCOS) could be an intricate state characterized by elevated hormone levels, discharge irregularities, and/or tiny cysts on one or each vary [1]. Generally, up to 5–14% women at the age of 18–44 years are suffering from Ovarian Syndrome, it makes most common endocrine irregularity among reproductive age [2]. Hence women need to consult health care professionals to resolve problems with fat, acne, amenorrhea, extreme hair growth, and infertility usually receive a verdict of PCOS. Most of the women with PCOS are suffers with endovascular cancer, cardiovascular disease, dyslipidemia, and type-2 diabetes [3]. The ovarian follicles are having structured with filled spherical fluid. Polycystic ovarian syndrome ultrasound image shown in Fig. 1.

During the follicular phase, a tiny low cohort of follicles begins to develop. A whole perceptive of ovarian follicle dynamics is vital within the field of biotechnology and human reproduction. For ladies endure assist generative medical aid, the ovarian ultrasound imaging has turn into a valuable tool in infertility management. Periodic dimensions of the follicles size over many days the first suggests of analysis by the physician [4]. Polycystic Ovarian (PCO) ultrasound image is analyzed by the quantity of follicles, follicle size identification, that distribution, and evaluate the number of follicles ratio to ovarian volume. Detection of PCO, pelvic ultrasound image is important and gives accurate result. Most of the cases the analysis of ultrasound images are physically. So far there is so much of variance occurs among different gynecologists/radiologists. Hence, in this paper to detect the PCO stage segment the pelvic ultrasound imagery and to detect the edges in a PCOS image is an exigent task and to use a variety of edge detection algorithms on PCOS ultrasound imagery. Then it provides comparison description of edge detection on segmentation.

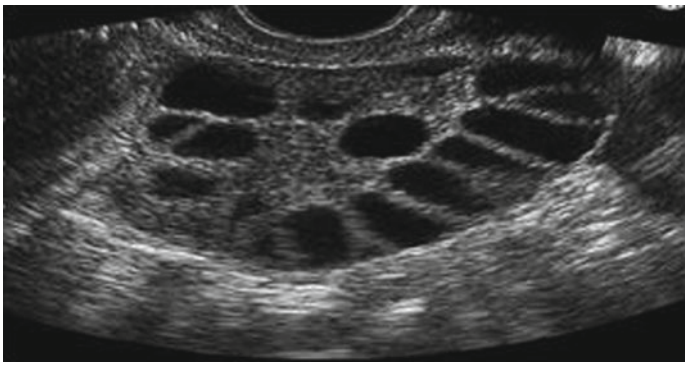

Fig. 1 Polycystic ovary syndrome

2 Image Segmentation

Image segmentation is the method of segment a digital image into various segments [5]. To modify and/or remodel the image into meaningful for easy analysis, this is the main objective of segmentation. The segmentation have various techniques. It is sub divided the image into several parts, the aim of image segmentation that can be customized and analyzing easily [6]. Image segmentation is specially used to trace the object and boundaries. Each of the pixels in a region is related to some uniqueness or compute accurately. Currently we have a tendency to discuss concerning the conception of edge detection. Edge detection may be extremely developed within the image process. Region boundaries and edge are one among the techniques that are closely connected with edge detection via segmentation. The edges consist of many mathematical strategies to focus at coordinates in digital image segmentation and additionally image brightness with change accuracy are more professionally as discontinuous via various strategies of edge detection. It principally targeted on feature detection and feature extraction [7].

2.1 Edge Detection with Sobel Operator

The method of Sobel edge detection for image segmentation finds edges via the Sobel estimate to the derived. It precedes the edges at those points where the grade is maximum. The Sobel methods perform a 2-D spatial gradient compute on a picture so highlights region of high spatial frequency that communicate to edges. Generally, it's habituated notice and calculable absolute gradient magnitude at every purpose in n input gray scale image [8]. This methodology relies on convolving the image. The Sobel image has tiny, distinguishable and numeral valued filter, arise the horizontal and vertical track. Its low expansive within the term of computation. As per the Sobel operator PCOS ultrasound image shown in Fig. 2.

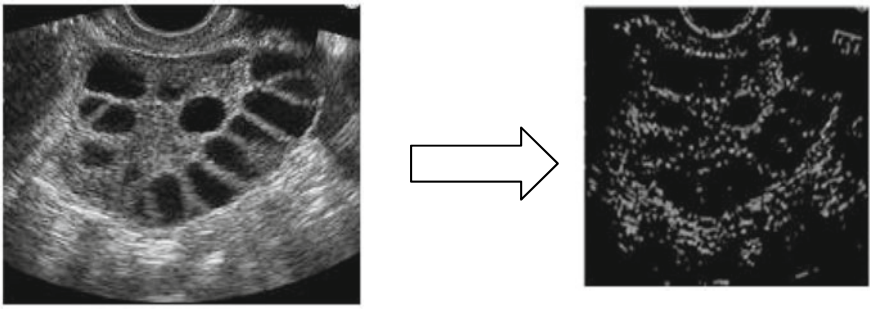

Fig. 2 Follicles segmentation with Sobel operator

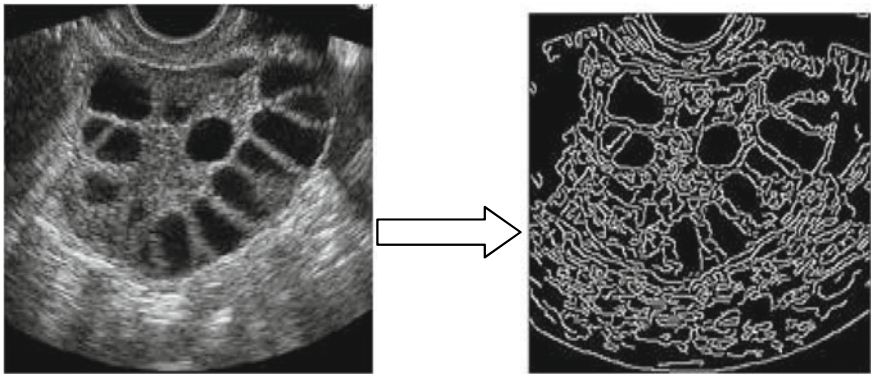

Fig. 3 Follicles segmentation with Canny operator

2.2 Edge Detection with Canny Operator

To find edges by separating noise from the image is completed by Canny edge detection that may be an important technique. Canny edge detection is a technique to extract helpful structural in sequence from dissimilar vision objects and significantly decrease the amount of information to be processed. Canny methodology is superior methods without worrying the options of the edges within the image later on it applies the tendency to find the edges and also the serious worth for threshold. Hence, an edge detection justifies to think about these necessities are often enforced in a very broad sort of the positions [9, 10] (Fig. 3).

2.3 Genetic Algorithm for Edge Detection

The follicle edges are formed based different edge detection operators are used for identifying the follicle size of PCOS ultrasound images. For improving the edges of ovaries this paper Sobel, Canny, Sobel with Genetic Algorithm and Canny with Genetic Algorithm edge detection operators are applied on ultrasound images for identifying the ovary size [11–14]. Generally, Genetic Algorithm (GA) is used for reducing the Mean Square Error (MSE). The GA algorithm follows under considerable steps [15].
Algorithm:

Step 1 First select the edge detected input image of PCOS ultrasound image.
Step 2 For 3 * 3 operator mask applying Genetic Algorithm.
Step 3 Then Perform above masking operators edge detection on the selected image.
Step 4 Finally compare the result obtained image with ideal expected output image using on GA fitness function and update the mask.

Step 5 Repeat Step 3 until optimization gets stopping criteria. Step 6: finally, the result is shown.

3 Result and Discussions

The combination of Sobel with GA optimized operator and Canny with GA optimized operator applied on PCS ultrasound image for getting better edge detection shown in Table 1 (Figs. 4 and 5).

According to Table 2, GA optimization operator was applied on ultrasound PCOS image. And the table describes comparison of output before applying GA optimization and output after applying GA optimization. Here two performance parameters are used that is PSNR (Peak Signal to Noise Ratio), MSE (Mean Square Error). Higher PSNR is always provides the better image quality. Hence, in this work GA with Canny operator provides the better edge image comparing to GA with Sobel operator.

Table 1 GA optimized operator with Sobel and Canny operators output for PCOS

Generation	f-count	Best f(x)	Max. constraint	Stall generations
1	10,400	0.599056	0.01535	0
2	20,600	0.592432	0.03143	0
3	30,800	0.58887	0.0009729	0
4	41,000	0.585385	0.04252	0
5	51,200	0.592975	0.002514	0
6	61,400	0.592975	0.002514	1
7	71,600	0.592786	0.592786	1
8	81,800	0.591543	0.0004562	0

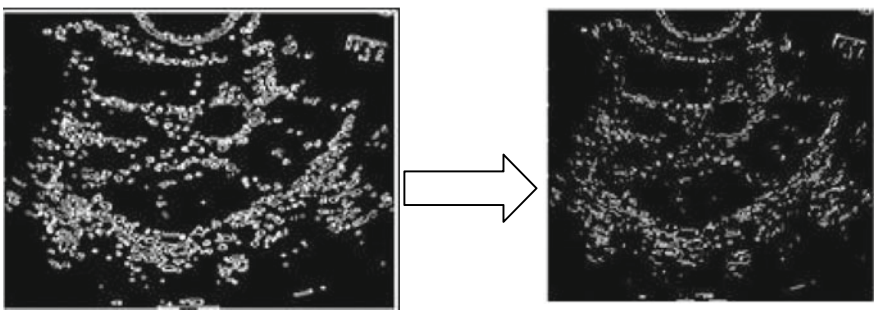

Fig. 4 Sobel with Genetic Algorithm

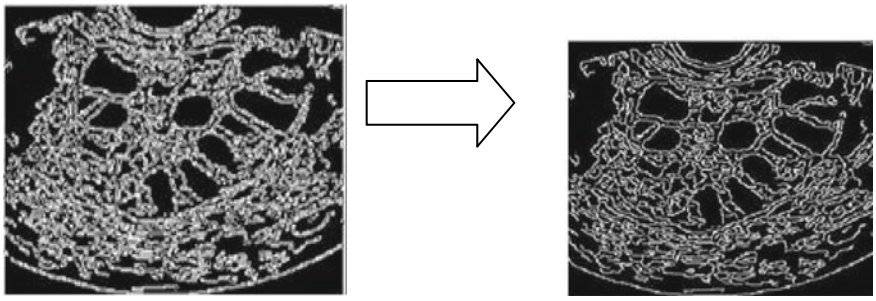

Fig. 5 Canny with Genetic Algorithm

Table 2 MSE and PSNR output value before and After GA optimization for PCOS image using Sobel and Canny operator

Calculated value	Output before GA optimization for PCOS image		Output after GA optimization for PCOS image	
	Sobel	Canny	Sobel	Canny
MSE	0.6062	0.6069	0.5915	0.5929
PSNR	5.0061	5.0073	5.2502	5.2512

$$PSNR = 10 \cdot \log_{10}\left(\frac{MAXP_I}{MSE_r}\right) \tag{1}$$

where MAX PI represents maximum pixel value in the image.

4 Conclusion

In this paper, for ovarian follicle segmentation we have applied different techniques such as Canny, Sobel, GA with Sobel and GA with Canny edge detection operators on PCOS ultrasound images. In this approach GA optimization was done before and after. Finally, after GA with Canny optimization operator provides the accurate result for PCOS image follicle segmentation.

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