Automatic Follicle Detection in Ultrasound Images of Ovaries

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Abstract - *Ovarian follicle detection is an effective tool used in infertility treatment. Here a new algorithm of modified fuzzy logic is used for ovarian follicle recognition from a series of ultrasound images. Prolonged time and variable results by the various clinicians make the detection inconvenient for the patients, thus making automatic and fast detection of follicular monitoring necessary. Noise, detecting multiple follicles that are very close to each other as one follicle region without finding the boundary of individual follicles, and not being fast enough to be used in real-time clinical practice are the limiting factors which results in low performance of computerized detection. To overcome these limitations, we handle noise by singular value decomposition-based image compression followed by an anisotropic diffusion scheme for multiplicative speckle, and detect follicles by performing different segmentation techniques like modified fuzzy and contour segmentation. The classification of the follicles is performed using back propagation neural network and the detected result is sent to the patient via email.*

*Key Words***: Follicle, Fertility treatment, Modified fuzzy, Contour segmentation, Back propagation neural network.**

1. INTRODUCTION

Ultrasonography is a non-invasive imaging modality of obstetrics and gynaecology [1]. In reproductive medicine, transvaginal ultrasound examination is primarily used for monitoring follicular growth during ovarian stimulation and for estimating ovarian reserve [2]. The number and size of ovarian follicles, number of antral follicles (follicles that are 2-8 mm in average diameter) [3], and growth rate of dominant follicles (follicles that are larger than 10 mm in average diameter) [4] are the primary endpoints of measurement for ovarian follicle monitoring [2]. Ovarian follicular monitoring is essential for guiding the amount and duration of medications for ovarian stimulation, ovulation induction and intrauterine insemination, controlled ovarian hyperstimulation for oocyte (egg) retrieval, in vitro fertilization (IVF) and fresh embryo transfer, egg donation cycles, and for women who electively freeze their eggs or embryos for future use. Performing ultrasound scans every 2-3 days is necessary to optimize ovarian response, the yield of eggs, and the ultimate success of an IVF cycle. Since measuring follicles is done manually and requires multiple visits, it becomes tremendously inconvenient given the number of examinations that need to be done at fertility centres and hospitals [5]. Moreover, ultrasound images analysed by different technicians or medical experts can lead to inconsistent results and interpretations [6]. Hence, automated follicular monitoring has the great potential to maximize pregnancy success of IVF treatment on a large scale. In medical image processing, first images are pre-processed and enhanced, then features are extracted and selected, and finally, images are classified and segmented [7].

Here we use modified fuzzy and contour segmentation for segmentation purpose to get more accuracy with minimum processing time. The classification of the follicles is performed using back propagation neural network and the detected result is sent to the patient via email.

2. METHODS

The ultrasound images of follicles were given as input to the follicle detection algorithm for detecting the follicles in the inputted image without requiring the presence of a medical expert.

2.1 Follicle Detection Algorithm

1)Initially the image given as input is read.

2)color conversion to grayscale image from the rgb image is done by using the function rgb2gray in MATLAB R2014a.

3)median filter is used to reduce noise in an image by preserving useful details in it and by removing the unwanted details from it. Histogram equalization is used to enhance the contrast of the image and the image is then converted to binary by thresholding.

4)modified fuzzy segmentation is used to increase the accuracy of segmentation.

5)active contour analysis defines a separate boundary or curvature for the regions of target object for segmentation. Thus, the active contour segmentation is used for the separation of pixels of interest for different image processing.

6)GLCM feature extraction gives a measure of the variation in intensity at the pixel of interest. It considers the relation between two pixels at a time, called the reference and the neighboring pixel.

7)Finally classification of images is done using back propagation neural network and the report is sent to the user via email.
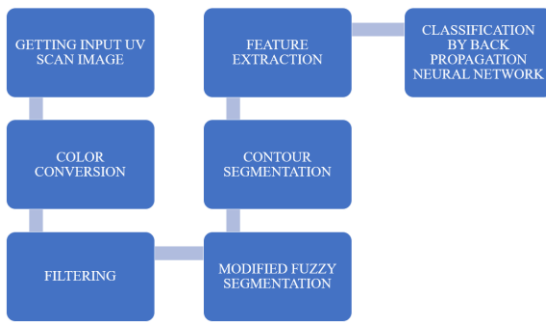

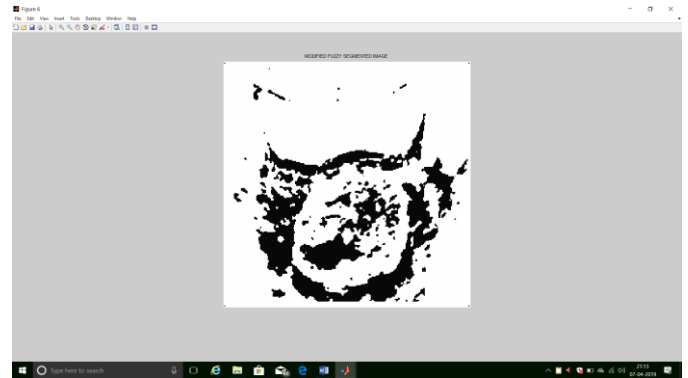
Fig -1: Block diagram of detection algorithm

3. RESULTS

The proposed algorithm successfully detects the follicles and outperform the conventional methods. The fig -2 shows the input image given to the algorithm.
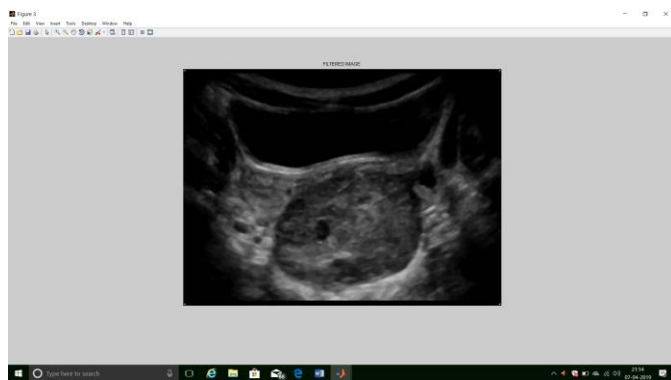

Fig -2: Original image

The fig-3 and fig-4 shows the filtered image after the filtering process and the modified fuzzy segmented image respectively. The fig-5 shows the detected stage after the classification of follicles.
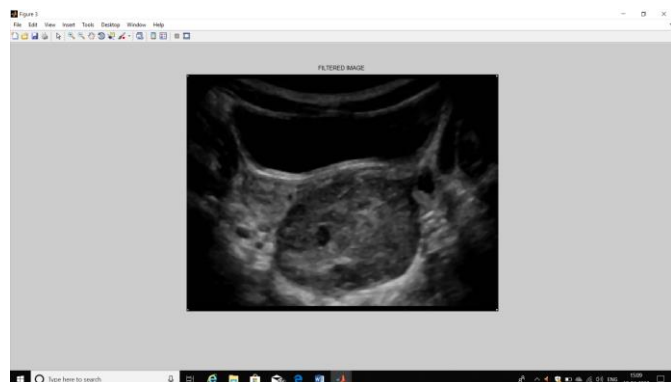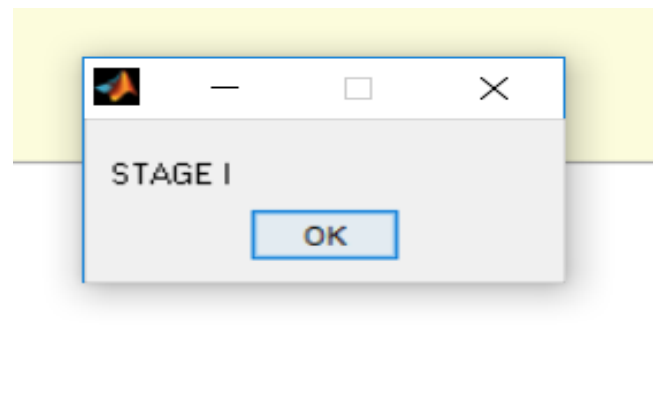

Fig -3: Filtered image

Fig -4: Modified fuzzy segmented image

Fig -5: Classification of follicles into stages

4. CONCLUSION

The proposed system detects the follicles within few seconds. In the proposed algorithm modified fuzzy segmentation is used and classification of the follicles is performed using back propagation neural network which makes the detection more time efficient and the detected result is sent to the patient via email.

REFERENCES

[1] Deutchman, Mark E., and Ricardo Hahn. "Obstetric ultrasonography." Primary Care: Clinics in Office Practice 24.2 (1997): 407-431.

[2] Lebbi, I., and R. Ben Temime. "The significance of monitoring folliculogenesis." IVF Lite 2.1 (2015): 6.

[3] Depmann, Martine, et al. "Fluctuations in anti-Müllerian hormone levels throughout the menstrual cycle parallel fluctuations in the antral follicle count: a cohort study." Acta obstetricia et gynecologica Scandinavica 95.7 (2016): 820-828.

[4] Hu, Xiaokun, et al. "New Perspectives on Criteria for the Determination of HCG Trigger Timing in GnRH Antagonist Cycles." Medicine 95.20 (2016).

[5] Potočnik, Božidar, Boris Cigale, and Damjan Zazula. "Computerized detection and recognition of follicles in ovarian ultrasound images: a review." Medical & biological engineering & computing 50.12 (2012): 1201-1212.

[6] Ata, Baris, and Togas Tulandi, "Ultrasound automated volume calculation in reproduction and in pregnancy." Fertility and sterility 95.7 (2011): 2163-2170.

[7] Chatap, Niranjan J., and Ashish Kr Shrivastava. "A Survey on Various Classification Techniques for Medical Image Data." International Journal of Computer Applications 97.15 (2014).

[8] Rose T. Faghih, Aaron K. Styer, Emery N. Brown "Automated Ovarian Follicular Monitoring: A Novel Real-Time Approach" IEEE(2017) 978-1-5090-2809-2/17 .

[9] Rabiu, I. O., A. D. Usman, and A. M. S. Tekanyi. "A Review on Computer Assisted Follicle Detection Techniques and Polycystic Ovarian Syndrome (PCOS) Diagnostic Systems." International Journal of Computer Trends and Technology (IJCTT) 1.6 (2012).

[10] Hiremath, P. S., and Jyothi R. Tegnoor. "Automated ovarian classification in digital ultrasound images." International Journal of Biomedical Engineering and Technology 11.1 (2013): 46-65.