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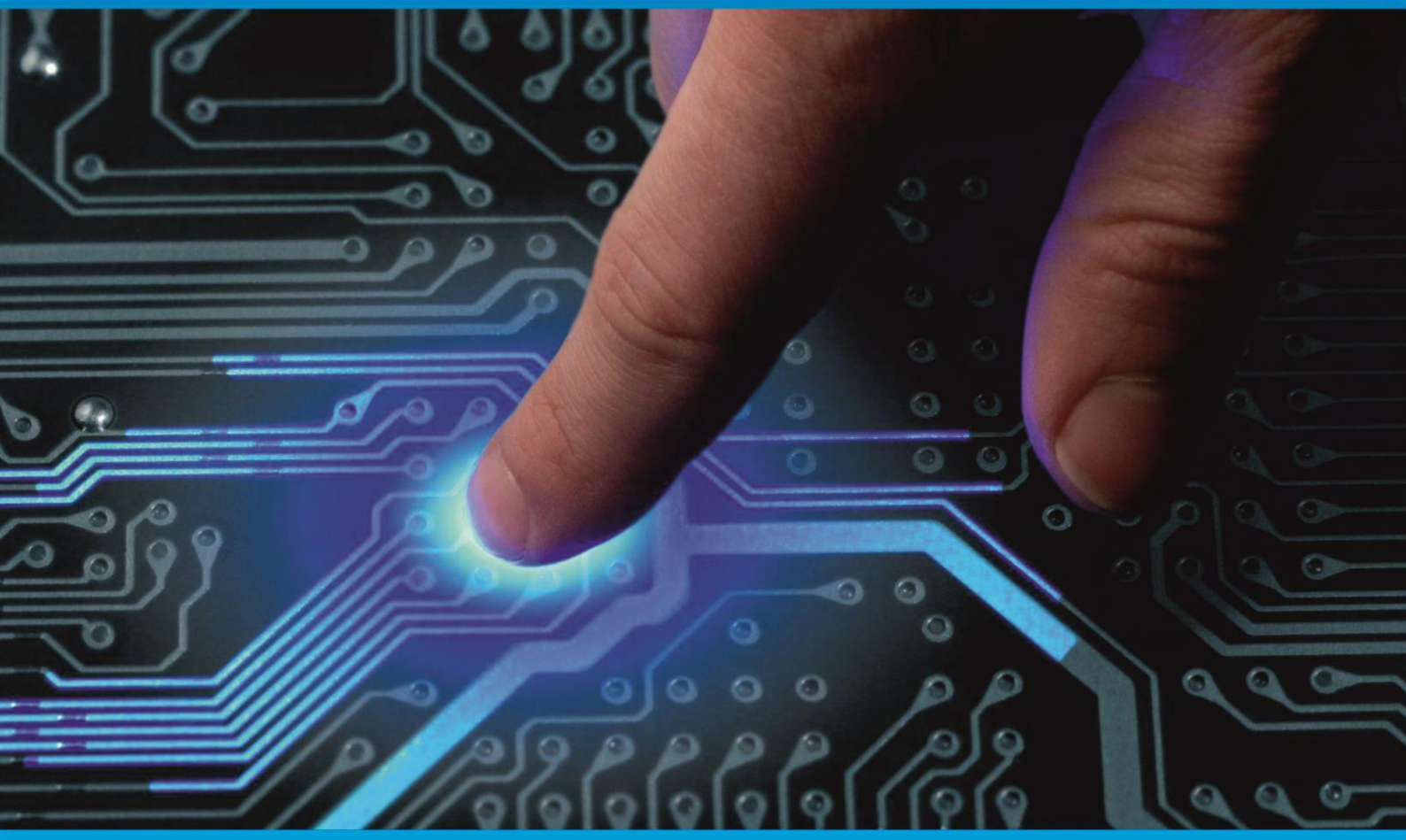

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Follicle Segmentation Using Spectral Clustering Algorithm from Ultrasound Image of Ovary

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ABSTRACT: Polycystic ovary syndrome (PCOS) is a hormonal disorder seen in women most commonly these days. This occurs due to the formation of cysts in the ovaries. The cyst formed are called follicles. These follicles create a special pattern that will be observed using ultrasound imaging. The size, shape and number of cyst formed will give us the important information that will be useful for the diagnosis of these diseases. In this paper, a spectral clustering algorithm will be used for the automatic segmentation of follicles from ultrasound images. The result obtained is then compared to the result that is obtained by the k-means clustering algorithm.

KEYWORDS: PCOS, follicle detection, ultrasound, spectral clustering.

I. INTRODUCTION

Polycystic ovarian condition (PCOS) is the most widely recognized endocrine irregularity in ladies of conceptive age and conveys with it huge wellbeing hazards, including fruitlessness, endometrial hyperplasia, diabetes, and cardiovascular infection. The workup of PCOS has advanced to incorporate the utilization of pelvic ultrasonography (US). Ovarian imaging is urgent in the assessment of patients with suspected PCOS. Although discoveries of polycystic ovaries are normally seen at routine Ultrasound and are regularly not related to PCOS, attention to the rules and definitions utilized in the analysis of PCOS is significant, particularly in patients who are being assessed for ovulatory brokenness or hyperandrogenism. The imaging report ought to be explicit and must have to incorporate ovarian volumes and antral follicle checks, notwithstanding other relevant discoveries. Since patients oftentimes allude to radiologic imaging as a piece of clinical workup, and polycystic ovaries are a typical coincidental finding in ladies going through Ultrasonography for other gynecologic protests, radiologists should know about the current demonstrative rules for PCOS, the part of imaging in the workup for this irregularity, and the relevant announcing boundaries for the pelvic US. Currently, in most cases, the analysis of ultrasound images are done by medical experts manually. This sometimes becomes tedious and might end up in having errors. Therefore, there is a need for making the process of detecting the number of follicles through ultrasound images automatically thereby reducing the manual work and maintaining accuracy.

Many researchers have done and tried different approaches to do the automatic segmentations of follicles from ultrasound image such as active counter method, edge-based method, object growing method, morphology, k-means algorithm etc. In this paper, another method is proposed in this direction mainly based on a clustering technique called Spectral clustering.

Image segmentation is the process in which a digital image is divided into various subgroups of pixels. These groups are called image objects. By dividing the image into image objects the complexity of the image is reduced and does analyse the image become easier.

Clustering is a technique that is used to group the same type of objects. Each group is called a cluster. Every class will have different characteristics from every other cluster. We have different clustering algorithms to complete the task of clustering. The most commonly used algorithms are the k-means algorithm and spectral clustering algorithm. Since the pixels in the image at different characteristics and based on those characteristics we can cluster the pixels into several clusters and this can be done using image segmentation.

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II. PROPOSED METHOD

The medical images that are obtained from an ultrasound may have low contrast issues. The image needs to be enhanced before implementing the algorithm. Histogram equalization is used to cure to enhance the contrast of the image and increasing the quality of the image. From the result obtained, the spectral clustering algorithm is implemented. The result will be incorporated with a lot of noise, these noises will be cleared using a median filter. Morphological erosion is applied and the processed image will be obtained.

Spectral clustering algorithms implemented on the equalized image. The working of spectral clustering algorithm is as follows [10]:

1. Create a similarity graph between our *N* objects to the cluster.
2. Compute the first k eigenvectors of its Laplacian matrix to define a feature vector for each object.
3. Run k-means on these features to separate objects into k classes.

The algorithm for the proposed method is given below [8]:

Step 1: Start.
Step 2: Load the ultrasound image to be segmented.
Step 3: A histogram of the image needs to be calculated.
Step 4: The histogram is equalized by removing the pixels having the highest and lowest intensity values with a cutoff per cent of 15 and the image is remapped.
Step 5: Reshape the equalized image into a 2-dimensional array.
Step 6: Spectral clustering algorithm is performed on the array.
Step 7: The pixel positions which are labelled under the cluster which specify the follicle regions are extracted and replaced by the intensity value (0), i.e., black. The rest of the pixel is replaced by value (255), i.e., white.
Step 8: The labelled array is reshaped into the image.
Step 9: Apply Median filter
Step10: Morphological erosion operation performed to get the final segmented image. Step 11: Stop.

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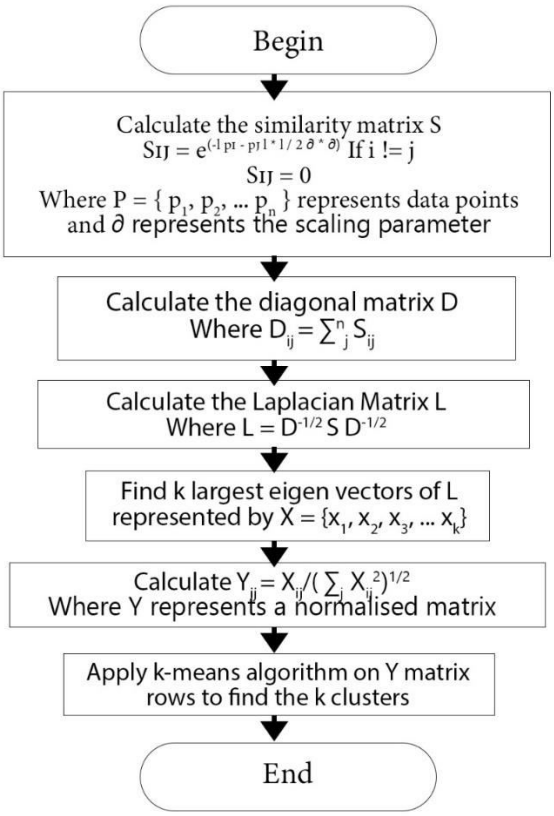

Fig 1 – Algorithm Flowchart

III. EXPERIMENT RESULTS

The proposed procedure was tested on a sample of ultrasound image and the result is shown as below.

Case 1-

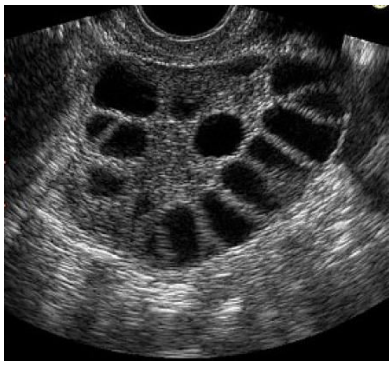

Fig 2. Original image

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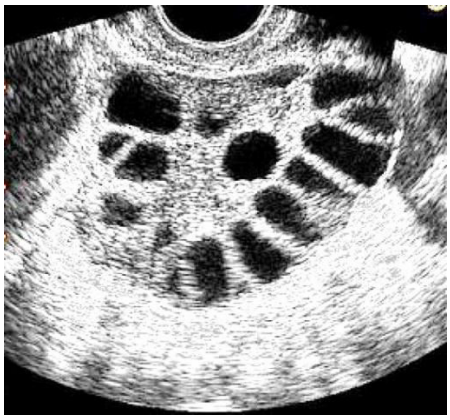

Fig 3. After Histogram Equalization

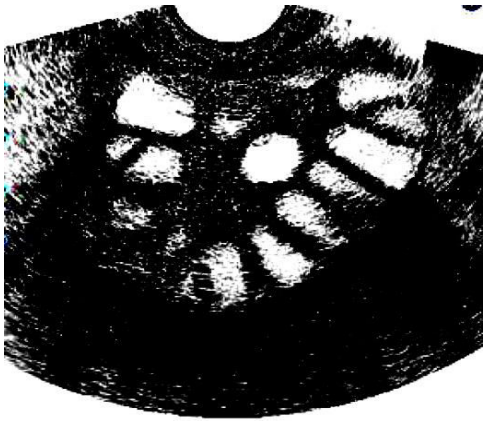

Fig 4. After Clustering

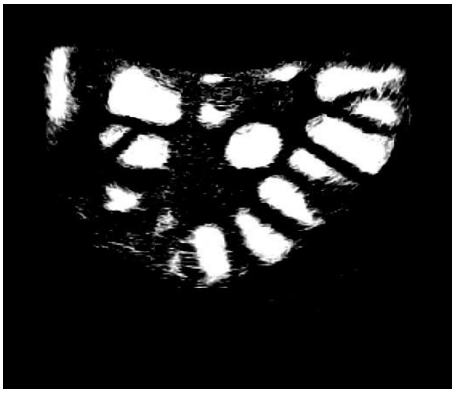

Fig 5. After applying median filter

Fig 6. After Morphological erosion

Case 2:

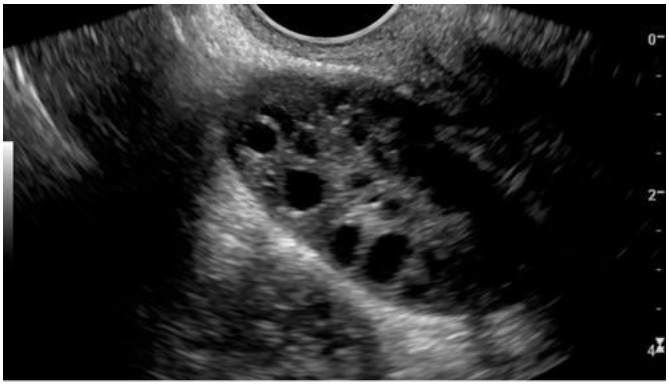

Fig 7. Original image

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Fig 8. After Histogram Equalization

Fig 9. After Clustering

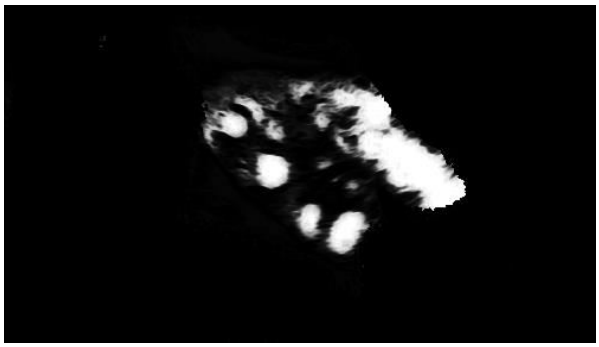

Fig 10. After applying median filer

Fig 11. After Morphological erosion

IV. CONCLUSION

The proposed method uses the spectral clustering algorithm to automatically segment the follicle regions from the ultrasound image of ovaries. The contrast of the image is enhanced by histogram equalization before applying the clustering algorithm. Later, morphological operations were applied to make the cluster segment properly. There are two types of error possible, type 1- where the follicle is not detected, type 2- detecting the follicle that does not exist. From the experiment, we can conclude that the proposed method works fine when compared to the k-means algorithm. This method will help in automatically segmenting the follicles from the ultrasound image and does the burden of manual detection of follicles by medical experts is reduced. Further, this algorithm can be tested on a larger data set.

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