# Image Segmentation for detecting Polycystic Ovarian Disease using Deep Neural Networks

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*Abstract*— Polycystic Ovaries in females in today's age is a matter of concern.It can hinder the fertile nature of female and cause many more issues.Polycystic Ovaries can be detected by ultrasound.It can create a lot of problems if not taken seriously.For leading a good life females should be aware of this disease also.In approximate 70 per cent of this kind of cases remain undiagnosed. In past studies feature extraction using Convolutional Neural Network has proposed manually,here we try to propose a methodology in which we will add segmentation prior CNN so as to delete or eliminate redundant data and to achieve better accuarcy .Segmentation allows to divide the data or images so as deeply extract the exact information what is needed.

*Keywords*— Deep neural network,region growing,CNN

## I. INTRODUCTION

PCOS/PCOD in women these days is becoming prevalent and affect women a lot. One of the major reason that leads to infertility in women is Polycystic ovarian syndrome (PCOS).PCOS is a state in female's body which leads to growth of multiple sac in ovaries that are filled with fluid. A recent study has revealed that about 18% of the women in India, mostly from the East, suffer from this syndrome. PCOS is featurized by weight gain, irregularity in menstrual cycle, acne,patches, oily skin and darkened acne marks, hypertension and metabolic abnormalities/dysfunction. Frequent metabolic traits such as hypertension, hyperinsulinemia, abdominal obesity and dyslipidemia, resistance of insulin like chronic anovulation, hyperandrogenism and polycystic ovaries which ends with the serious diseases like coronary disease, endometrial hyperplasia and type 2 diabetes mellitus these are the long term consequences.Recent studies revealed that PCOS can be linked with malignancies like cancerous conditions of the Endometrium, Breast,uterine in early reproductive age. Due to the criteria to determine PCOS are still changing there is no exact value how many women are affected but estimated one of 10-15 woman are affected with PCOS. Many women are diagnosed of having PCOS when they reach age 20-30. However, PCOS can also affectingwoman as young as 11 years old [4]. In the 2012 NIH Conference confirm that the Rotterdam criteria is the best criteria to detect PCOS, and Endocrine Society Guideline also supporting these criteria

[5]. Rotterdam criteria are criteria that proposed in 2003, One of the Rotterdam criteria is Polycystic Ovaries (PCO). The criteria to detect PCO that is at least one of the ovary have volume equal or more than 10 cm3, or have more than 12 follicles with 2-9 mm diameter But still the doctor need to analyze the ultrasound image to indicate PCO. Using Convolutional Neural Network (CNN) we try to classify the ultrasound image to determine PCO class or nonPCO class. CNN used because its already proved to be the best approach for image classification In previous work, there are some system that classify ultrasound image automatically by using CNN image. In this research, image segmentation is added between feature extraction and cnn so as to eradicate unwanted data and to detect the disease with high accuarcay and precision.CNN proves good results for detecting multiple objects as it works in layers.



Figure 1 Polycystic Ovary Syndrome[14]

## II.   IMAGE SEGMENTATION IN MEDICAL FIELD

Image segmentation is the process of dividing  a digital image into multiple parts or segments[1]. More accurately, image segmentation is the process of providing a label to every pixel in an image such that pixels with the same label share certain features. The aim of segmentation is to obtain region of interest (ROIs) providing all masses and find out thedoubtful mass candidates from the ROI. [2].Image segmentation allows to work on particular area of interest so that as to achieve the outlier or unusal area.

Table 1

| Title & Year of research | Method Deployed | Outcome |
|---|---|---|
| Ultrasound Image Analysis of Kidney Stone using Wavelet Transform 2014 | Fuzzy c-means clustering Backpropagation Neural Network[6] | increases accuracy and yield of diagnosis of kidney stone. |
| Design and analysis performance of Kidney Stone Detection from Ultrasound Image by Level Set Segmentation and ANN Classification 2014 | Level set segmentation wavelet filters, multilayer Perceptron with back propagation | accuracy of 98.8%[7] is achieved |
| Liver Tumor Detection for CT Images using image Segmentation techniques 2016 | CLAHE Method FC, | Better accuarcy |
| Ovarian Follicle Detection for Polycystic Ovary Syndrome using Fuzzy CMeans Clustering [2013] | Fuzzy C-Means Clustering | Value of MSE is lesser, so the efficiency of the algorithm is better |
| Brain image segmentation | Split and merge technique is applied,Hybrid method and fuzzy threshold | |

## III.   RELATED WORK

B.Cahyono et.al  have approached deep learning for classifying ultrasound images.CNN(Convolutional Neural Network) used for feature extraction.Author stated that Optimization of CNN is quite difficult.In future work ,author proposed more dropout rate and better weight inialization.Classification of ultrasound image using the Convolutional Neural Network to PCO and non PCO class has a good outcome and robust, since the system extract the feature of each image spontaneously. The proposed scheme does not need to openly define the method for feature extraction. The system can attain performance of 100% micro-average f1-score with average of 76.36% in the testing phase[8].

H Prassana kumar et.al proposed a new approach to the segmentation problem in medical ultrasound.Despeckled images were used for segmentation by C-V method and have more computional time Proposed method that is ICV algorithm can get the right result with less iterations and computational time. These results are suitable for feature extraction and classification of PCOS images to conclude whether a possible sac is a real sac or not.[9]

Simi M S et.al  evaluated infertility in women by comparing The accuracy of two different classification algorithms that are J48 and random forest and random forest algorithm proved to be more effective than J48 algorithm[10]

Seatiawati et al. in  use Particle Swarm Optimization to cluster ultrasound image with modified non-parametric fitness function. Using a contrast enhancement can yield better consequence on follicle measurement. Machine Learning approaches are recommended to categorize all follicle features that previously extracted[11].

Bedy Purnama et al. use three machine learning approach to classify ultrasound image that is NN-LVQ, KNN using Euclidian distance, and SVM. Ultrasound image preprocessed using low pass filter, histogram average, binarization, morphology to obtain binary image, and edge detection.[12] The feature of the image still extracted manually using Gabor Wavelet before going to classification. The best result is 82.55% using SVM and 78.81% using KNN with k=5.

The study done by the author depicted two algorithm J48 and ID3 for classification and Information gain subset evaluation is used here and neural fuzzy rough set evaluation technique is proposed for better accuracy.Error rate were also considered.J48 algorithm proved to have approximate error rate.Neural fuzzy rough set evaluation gives better results.

## IV.   PROPOSED METHODOLGY

Our proposed system is using image segmentation  approach to classify ultrasound images. We will try to explore more on image segmentation which is based on regions.Specifically, we are enchancing past research of Convolutional Neural Network that the best approach for image classification by merging image segmentation alongwith CNN.Rotterdam criteria used for classifying this.Flowchart of proposed work:Following are some steps that we will take in our research .
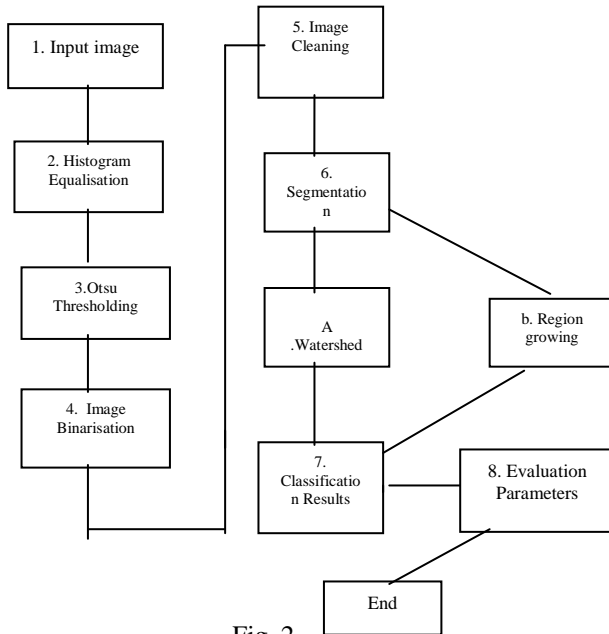
Fig. 2

**a.** **Ultrasound image**: An ultrasound image that has grayscale colored data with JPG format is given as input to the system. There are right and left ovaries present within the ultrasound images. There can also be single ovary ultrasound images as well.



**Fig. 3**

**b.** **Histogram equalization:** For increasing the brightness of image it is important to enhance its quality for which this technique is applied. The uniform intensity is applied on the image due to this process which helps in improving image's quality. Steps of performing image equalisation in matlab are
Step1:Read the image.
        i=imread('imagename.jpg');
Step2:Use the formula of histogram equalisation
        P=histeq(i);
Step3: Show real and modified image by formula

Imshowpair(i,P,'NEWIMAGE')
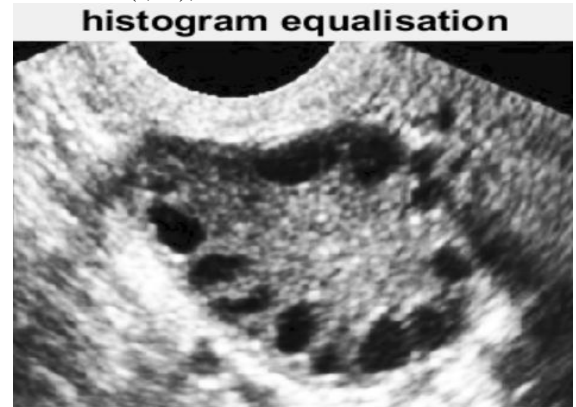Step4:Show histogram by formula
        Imhist(I,64);



Fig.4

**c.** **Image enhancement:** It is possible to adjust the brightness level of an image. The original image and scalar value are multiplied by one of these methods. The used scalar value and brightness level of image are proportional to each other. The brightness of image will increase as per the increase in the scalar value being used.

**d.** **Threshold method:** For achieving the follicle's form, two different types of threshold methods are compared. Global Basic Threshold and Otsu Threshold are the two different methods used in this process. The background class and object class present in binarization process are differentiated using a separator which is the threshold value achieved in the process. The image morphology is performed through the binarization process.

**e.** **Binarisation of Image**:For seprating background and foreground images it is used. Formula used in matlab is:
        BW = im2bw(I,level)

**f.** **Image Cleaning**: It involves specific removal of specific objects.Following are the formulas used in matlab.
        BW2 = bwmorph(BW,operation)
        BW2 = bwmorph(BW,operation,n)

**g.** **Segmentation Method**:Segmentation method can be any it can be region based, watershed.Region based is used to detect objects and watershed is used to separting foreground and background areas.Pseudocode for watershed approach is as follows:

1. Calculate a gradient magnitude that is called segmentation function. Formula for the same is: gmag=imgradient(I);
2. Calculate foreground markers
3. Calculate background markers.
4. Adjust the segmentation
5. Compute the watershed transform

6.  Show the results

Pseudocode for region based approach is as follows:

1.  Firstly determine the initial seed point.
2.  Check out other seed points if they are matchng with initial seed point.If they are matching go to step 3 else go to step 4
3.  Make clusters from that points
4.  Determine the similar seed region, if found go to step 3 and stop if no seeds found

**h. Classification**:This is used to classify the severity of the disease whether disease is mild,moderate or at high level.Classification method although involves several methods.Classification can be done by KNN or it can be performed via neural networks also.Classification results by KNN are as under:
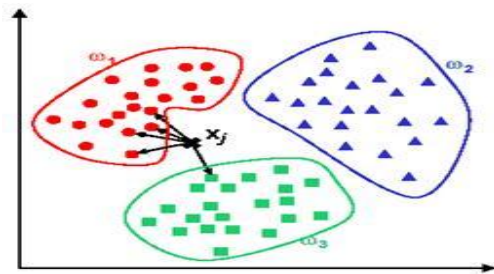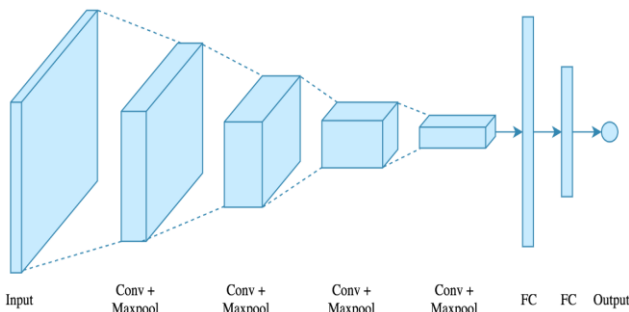


Figure 5 Classification via by KNN[16]



Input    Conv + Maxpool    Conv + Maxpool    Conv + Maxpool    Conv + Maxpool    FC    FC    Output

Figure 6 CNN Architecture[15]

## V. CONCLUSION

In this paper proposed methodology for detecting PCOD disease has explained.Proposed methodology will generate accurate results.This methodology will yield to give minimum execution time so as to save the time of doctors as it basically segment the images and then classification results will be applied accordingly.Classification results will be able to classify the disease according to its severity that is high,medium or low.

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