Automated Detection of Polycystic Ovarian Syndrome using Neural Network Algorithm

Deeksha Manish Singh
Computer Engineering Department,
Saraswati College of Engineering,
Kharghar, Maharashtra, India.
deeksha2703singh@gmail.com

Kardam Hitendra Acharya
Computer Engineering Department,
Saraswati College of Engineering,
Kharghar, Maharashtra, India.
kardamacharya14@gmail.com

Omkar Eknath Mestry
Computer Engineering Department,
Saraswati College of Engineering,
Kharghar, Maharashtra, India.
omkarmestry3@gmail.com

Prof. Arti Gore
Computer Engineering Department,
Saraswati College of Engineering,
Kharghar, Maharashtra, India.
abs_14284@gmail.com

***Abstract*—The ovarian ultrasound imaging could be a good tool in infertility treatment. Monitoring the follicles is extremely important in human reproduction. Periodic measurements of the scale and shape of follicles over several days are the primary means of evaluation by doctors. Today monitoring the follicles is finished by non-automatic means with human interaction. This work could also be very demanding and inaccurate and, in most of the cases, means only an additional burden for doctors. The detection of PCOS is often done using blood tests and ultrasound images of the ovaries that detect multiple follicles. This provides the accurate results of if women are suffering PCOS or not. The proposed methodology goes to be accustomed detect multiple follicles that indicate the sign of PCOS. Using image-preprocessing techniques we'll be enhancing the quality of the image to make it ready for the classification phase. Neural network algorithms that are best for such processed have gotten accustomed classify the syndrome. The experimental results demonstrate the efficiency of the tactic.**

Keywords—Multiple Follicles, ultrasound images, neural network algorithm.

I. Introduction

Polycystic ovary syndrome (PCOS) [1] also called as Stein-Leventhal syndrome, may be a condition that affects a woman's hormone levels. Women with positive PCOS produce higher-than-normal amounts of male hormones. This hormone imbalance causes them to skip menstrual periods and makes it harder for them to urge pregnant. PCOS also causes excessive hair growth on the face and body, and baldness. And it can contribute to long-term health problems like diabetes and disease. contraception pills and diabetes drugs can help fix the hormone imbalance and improve symptoms. PCOS maybe a common problem with hormones that affects women during their childbearing years (ages 15 to 44). Between 2.2 and 26.7 percent of ladies during this people have PCOS. Many ladies have PCOS but don't comprehend it. In one study, up to 70 percent of ladies with PCOS hadn't been diagnosed. PCOS affects a woman's ovaries, the reproductive organs that produce estrogens and progesterone — hormones that regulate the cycle. The ovaries also produce little amount of male hormones called androgens. The ovaries release eggs to be fertilized by a man's sperms. the discharge of an egg every month is named ovulation. gonadotropic hormone (FSH) and gonadotropic hormone (LH) control ovulation. FSH stimulates the ovary to supply a follicle — a sac that contains an egg — and so LH triggers the ovary to release a mature egg.

Causes of Polycystic Ovary Syndrome (PCOS):- The precise reason behind PCOS isn't clear, although variety of abnormalities is documented in women with PCOS. There's some evidence for an inherited (genetic) cause for PCOS, although no specific chromosomal mutation has been identified because the cause. it's been shown that the ovaries of ladies with PCOS may produce excessive amounts of male hormones, or androgens, which cause disruptions within the cycle and impaired fertility. PCOS is additionally related to insulin resistance, or an impaired ability to utilize insulin, and this abnormality is additionally likely associated with the reason behind PCOS. The presence of small cysts within the ovaries isn't specific for PCOS, since women who don't have PCOS may have ovarian cysts. Therefore the presence of cysts isn't likely to be the reason behind the symptoms of PCOS.

Symptoms of PCOS may include:

Periods & fertility	Hair & skin	Mental & emotional health	Sleep

• No periods or periods that are:
  • irregular
  • infrequent
  • heavy
• Immature ovarian eggs that do not ovulate
• Multiple cysts on the ovaries
• Difficulty becoming pregnant
	• Excess facial and/or body hair (hirsutism)
	• Acne on the face and/or body
	• Scalp hair loss (alopecia)
	• Darkened skin patches (acanthosis nigricans)
		• Mood changes
		• Depression
		• Anxiety
			• Sleep apnoea (a sleep disorder in which abnormal pauses of breathing occur during sleep)

Table 1. PCOS Symptoms

II. LITERARURE SURVEY

Bayesian Regression and K-Nearest Neighbor Technique Based Classification of Biomedical Objects[1]:-The methodology is regarding a hybrid method which integrates Bayesian regression, pairwise comparison, and therefore the neighbor method nearest to k that's proposed Polycystic ovary syndrome (PCOS) has been a gynecological endocrine disorder that proffers the consequence in health problems with menstrual dysfunctions, androgynism and also infertility. Usually it occurs in reproductive aging women. Infertility is an unsuccessful ovulation, for instance: a technique during releasing of an egg from the ovary. Several factors cause infertility; one among which has been the irregular number and therefore the dimension of follicle development in ovulation phase. Such abnormality has been the primary symptom of PCOS. Approximately 5-10 you look after women in reproductive age are having this effect of abnormality. In contemporary years, transabdominal and/or transvaginal ultrasound have turn out to be the foremost generally utilized as diagnostic techniques for the popularity of PCOS. PCOS directs to unsuitable follicle development of the ovaries that are seized at a former stage and don't get mature. This has been one among the causes for infertility. Therefore, it's pivotal for screening the patients at a former stage for restricting any severe impact of the disease. Women having PCOS are at hazard of improving a diversity of symptoms/intricacies involving variant systems, l, gynecological, metabolic, physical, cardiac, and psychological.

Artificial Neural Network and Texture Features for Follicle Detection [2]:- Ultrasound images within the ovary reveal variant echo-texture designs for variant objects along with follicles, speckle noises, artifacts with other tissues. Usman et.al, [11] utilized the grey Level Co-occurrence Matrix (GLCM) method for extracting features of second order texture for the various objects existing within the image. Moreover, Multi-Layer Perceptron (MLP) was applied to categorize the recognized objects regarding the derived texture features into non- follicles and follicles.

Elman neural network for polycystic ovary classification[3]:- Elman Neural Network was invented by Jeff Elman. Elman Neural Networks is made employing a feed forward specification and adds connections to the previous layer (extra nodes). This extra node contains a representation of the contents of 1 layer that existed when the pattern was previously trained. This extra set is named a network context unit.

Automatic Detection of Follicles in Ultrasound Images of Ovaries using Edge Based Method: - Automatic diagnosis of follicles in ultrasound images of ovaries applying new algorithm is recommended by Hiremath et.al, [19]. it's conventional seeing method (preprocessing, segmentation, extracting feature and also classification). The suggested algorithm utilizes technique supported edge for segmentation. The preprocessing engages Gaussian low pass filter instead contourlet transform to despeckle the ovaries' the ultrasound images. The categorization is consistent with 4σ intervals round the mean feature (geometic) values. The evaluation has been completed utilizing sample ultrasound images of ovaries and therefore the outcomes are matched with the inferences derived by doctor.

III. RESOURCE AND METHODOLOGY

Fig.1. illustrates the process of follicle detection proposed in this paper

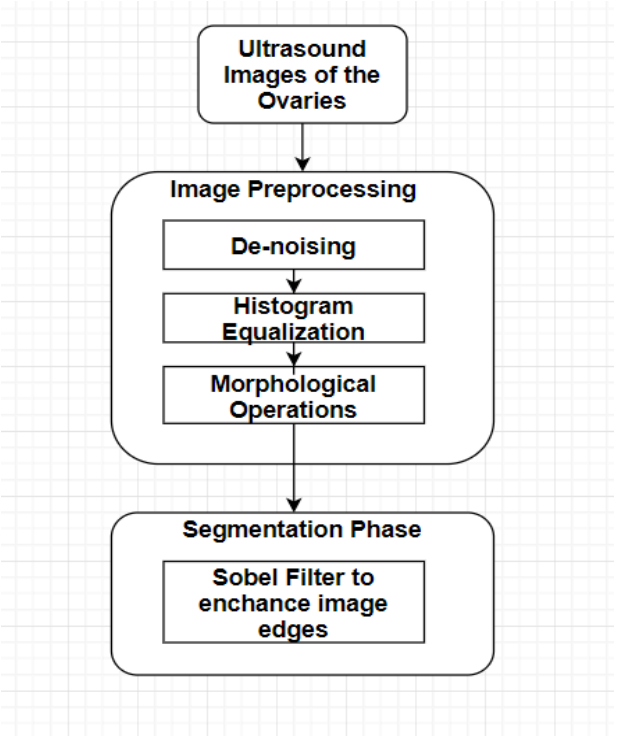

Fig.1 Block diagram for segmentation

A. Resource

The type of probe and frequency of the ultrasound wave emitted determines the quality of the image. The higher the ultrasonic frequency the lesser will be the depth of penetration due to attenuation. The highest frequency, 6 MHz is used to image pelvic organs with a satisfactory resolution. Probes with arrays of piezoelectric elements arranged either in a curvilinear or convex sector shape is developed to provide a better fit on the abdomen. It also offers a wider view field than with the linear-array configuration.

B. Segmentation

- Image Pre-processing:- Image preprocessing techniques are used to locate regions of interest and to enhance the clarity and contrast of the regions.. This technique includes denoising, negative transformation, histogram equalization and morphological operation:
- De-noising Ultrasound images are known to be disturbed by speckle noise due to the mode of the acquisition of the images; that is the head of the ultrasound machine is not moist. In this research, adaptive Wiener filter was employed to drastically

reduce the speckle noise in the images. The adaptive nature of this filter will be able to track the varying characteristics of each of the pixels.

- Negative Transformation Negative image transformation was employed to calculate the complement of the images. In a gray scale image, the dark area becomes lighter and light area becomes lighter. This operation inversed the intensity values of the pixels and enhanced the clarity of the regions of interest.

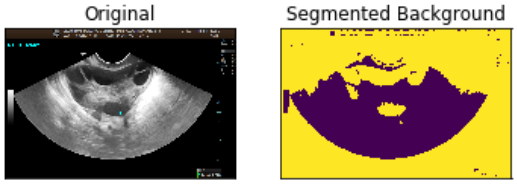

Fig.2 Segmented image

- Segmentation: - In this phase, three techniques were applied to achieve a better segmentation. Then, image subtraction was applied to remove any undesired intensity values. Furthermore, objects at the extreme borders were cleared because follicles are not known to be at the edges of the ovary. The second technique was Sobel filter operation. This was applied to define the vertical and horizontal edges of the objects present in the ultrasound images of the ovary. Then, active contour without edge method was applied to segment the image. The segmentation was carried out by deforming a closed contour controlled by internal and external energy through number of iterations (1600). The internal energy controls the smoothness of the boundaries of regions of interest. The external energy drives the contour to fit to the boundaries of the region of interest.

C. *Proposed Methodology*

Convolution Neural Networks (CNN) are the foundation of implementations of deep learning for computer vision, which include image classification, and hence this method suits best for the detection of pcos.Ultrasoud images are give as input for the feature extraction process. TensorFlow helps build CNN architectures with tremendous flexibility, for tasks like image classification and object detection. The process of training a CNN model with regards to the convolution layer is to identify the kernels that work best for a given task based on a given training dataset. Kernels are the only parameters that automatically learn during the training process in the convolution neural network layer. Activation function for non-linear data used is ReLU.

The most popular form of pooling operation is the max pooling, which extracts patches from the input feature maps and then outputs the maximum value in each patch, and lastly discards all the other values. Unlike height and width, all the other parameter like the depth dimension of feature maps remains unchanged.

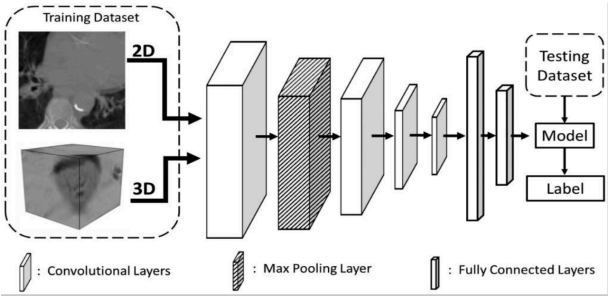

Fig.3 Convolution Neural Network 2D

The output feature maps of the ultimate convolution or pooling layer is typically flattened, i.e.it is transformed into a one-dimensional array of numbers vectors, and connected to one or more fully connected layers, called the dense layers, in which every input is connected to every output by a learnable weight respectively. Once the features extracted by the convolution layers and downsampled by the pooling layers are created, they are mapped by a subset of fully connected layers to the final outputs of the network. The final fully connected layer typically has the same number of output nodes as the number of classes motioned. Each fully connected layer is followed by a nonlinear function, like ReLU.

The score is calculated that provides us how much accurate our model is. Different values of epochs were used to check the variations in the value of accuracy with the loss function (cost function).

No. of epochs	Score (in %)
10	63
50	66
80	97

Table 2. Accuracy on the basis of epochs

From the data (Table 1) we can see that more the epochs, more the accuracy. Increasing the epochs increases the computational time.

The data that was taken was too small as compared to the other disease detection models and hence the results cannot be considered as fully complete.

IV. Conclusion

The model takes ultrasound images of the ovaries as input and the new data is compared with the trained data to give result as positive or negative depending o the features extracted. Convolution neural Networks proved to be one of the best methods to detect pcos images. Due to less data the accuracy was less, but as the trained data increases the accuracy of the model increases.

V. Future Scope

This system can be used in hospitals and radiology centres for quick analysis of PCOS patients as it does not require any man power. This system can be further

designed in order to give a complete report with precautions to be taken by the patient with PCOS. Other scopes of this project can detection of diabetes Type 2 and heart related diseases as they are symptoms of PCOS.

VI. Conclusion

The proposed methodology gives a better view of the ultrasound images that were difficult to read before. The execution time taken is also very less and hence very time consuming. After the segmentation phase, the images can be used to detect PCOS disease by counting the number of follicles and applying neural network on the data.

VII. References

[1] Alonso, F.C., Pérez, C.J., Arias-Nicolás, J.P. and Martín, J. Computer-aided diagnosis system: A Bayesian hybrid classification method. Computer methods and programs in biomedicine 112 (1) (2013) 104-113.

[2] Usman, A.D., Isah, O.R. and Tekanyi, A.M.S. Application of Artificial Neural Network and Texture Features for Follicle Detection. African Journal of Computing & ICT 8 (4) (2015) 111-118.

[3] I F Thufailah1, Adiwijaya2, U N Wisesty3 and Jondri4 1,2,3,4 School of Computing, Telkom University, Telekomunikasi 1 St, West Java, ID.

[4] Bian, N., Eramian, M. G., and Pierson, R. A. "Evaluation of Texture Features for Analysis of Ovarian Follicular development". Med Image Comput Comput Assist Interv, pp.1-11, 2011.

[5] Haralick, R. E., Shanmugam, K., & Dinstein, I. Textural features for image classification. IEEE Transactions on Systems, Man and Cybernetics, SMC, vol. 3, no. 6, pp.610-621, 1973.

[6] Viher, B., Dobnikar, A. and Zazula, A, "Cellular Automata and Follicle Recognition Problem and Possibilities of Using Cellular Automata for Image Recognition Purposes". International Journal of Medical Informatics, 49, 231–241, 1998.

[7] Ashika, R, "Ovarian Follicle Detection for Polycystic Ovary Syndrome using Fuzzy C- Means Clustering". International Journal of Computer Trends and Technology, 4(7), 2146- 2149, 2013.

[8] Bian, N., Eramian, M. G., and Pierson, R. A, "Evaluation of Texture Features for Analysis of Ovarian Follicular development". Med Image Comput Comput Assist Interv, 1- 11, 2011.

[9] "An implementation of Elman neural network for polycystic ovary classification based on ultrasound images" Thufailah, Adiwijaya, U N Wisesty and Jondri from School of Computing, Telkom University, Telekomunikasi 1 St, West Java, ID.