Review Article

Role of Artificial Intelligence in PCOS Detection

Anushka Agrawal, Ranjit Ambad[1], Radhika Lahoti[2], Parikshit Muley[3], P.S. Pande[4]

Clinical Embryology, Datta Meghe Medical College, Wanadongri, [4]Chemistry Assistant Professor, Yeshwantrao Chavan College of Engineering, Nagpur, [1]Department of Biochemistry Datta Meghe Medical College, [2]Clinical Embryologist Datta Meghe Medical College, Shalinitai Meghe Hospital and Research Centre, Wanadongri, Hingna, [3]Department of Physiology Jawaharlal Nehru Medical College, Datta Meghe Institute of Medical Sciences Sawangi Meghe, Wardha, Maharashtra, India

Abstract

Polycystic Ovary Syndrome (PCOS) is an endocrinal disorder which affects females aged between 12 and 45 years. It is the disorder in which the cyst is formed in the ovary. The oocyte does not get mature at its natural which and form a fluid-filled sacs known as cyst. When there are many cysts in the ovary, it is then known as polycystic ovary. It may affect both the ovaries. It causes absent menstrual cycles, weight gain, hirsutism, pigmentation, and decrease in hair volume. There are some studies which say that this is a lifestyle disorder, but the main reason is not known yet. PCOS leads to an obstacle in conceiving. It can be suppressed by some changes in lifestyle patterns such as daily exercise and food patterns. Artificial intelligence (AI) is a science and engineering subject that deals with intelligent behavior. It is a subfield of computer science that has improved human existence in a variety of ways. AI is a combination of reasoning, learning, problem-solving perception, and language understanding. A general introduction to the subject of AI creates a new revolution in the world and creates a great scope in future to describe machines that mimic human nature in association with "cognitive" functions of human mind, such as "learning" and "problem-solving."AI is the technique in which the human work is totally handled by machines. In various domains, AI has recently outperformed humans, and there is enormous potential in healthcare. The health-care system deals with a massive volume of data that is difficult to examine using standard approaches. AI's success in health-care offers improved illness prevention, detection, diagnosis, and treatment. There are many inventions in machines which can take over the manual work. The AI can reduce the percentage of human error and provides the best and fast result. Together, human people and innovation may pave the road for better health-care services. The ability for a system to automatically learn and improve is provided by machine learning, a branch of AI logically planned. Its main objective is to create new machine learning algorithms that allow users to access specific datasets and use the information for analysis and research the unstructured. Applications of machine learning support significant change, particularly in businesses such as health care that deal with data identification, image recognition, prediction, and identification. Much critical attention has been paid to PCOS screening. In order to address this problem, the current study was created to investigate a noninvasive way to aid in PCOS screening. Our research demonstrates that the suggested algorithm successfully detects PCOS (mean area under the curve of 0.978), suggesting that deep learning may be a potent technique for PCOS identification. In addition, research findings may suggest the exceptional potential of using scleral pictures to diagnose diseases. A fruitful study area may emerge from the integration of AI and characteristics taken from scleral pictures. This article mainly is about PCOS and the role of AI for its diagnosis and better results. The transvaginal ultrasound machine is a noninvasive means of examining the human ovary to show important aspects for PCOS diagnosis. The key characteristics that distinguish ovarian pictures are the number of follicles and their diameters. As a result, PCOS is diagnosed by manually counting follicles and measuring their diameters. This procedure is time-consuming, labor-intensive, and prone to errors. So to make this process easy and error free the introduction of AI is needed.

Keywords: Follicle, hirsutism, polycystic ovary syndrome, transvaginal ultrasound machines

Introduction

Polycystic Ovary Syndrome (PCOS) is a prevalent reproductive and endocrinologic condition that affects 6%–10% of women. Irregular menstrual cycles, weight increase, skin darkening, hypertension, diabetes, metabolic abnormalities/dysfunction, and infertility are all symptoms of PCOS. It is a lifetime

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Address for correspondence: Dr. Ranjit Ambad, Department of Biochemistry, Datta Meghe Medical College, Shalinitai Meghe Hospital and Research Centre, Nagpur, Maharashtra, India.
E-mail: ambad.sawan@gmail.com

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syndrome as its root cause is not known yet. It may affect one or both the ovaries. Hyperandrogenism, a clinical sign of PCOS, due to which it leads to facial hair growth, cysts in ovaries, and absent menstrual cycles.

Technology has transformed our world and changed our lives over the last few decades, making them easier on a daily basis. Numerous ways in which new technology are transforming humanity. The health-care industry is now heavily reliant on machine learning, a research area that enables computers to learn without being explicitly taught. Machine learning is able to handle absurdly large datasets, transform analyzed data into useful clinical insights, and assist in the diagnosis of a variety of diseases.[1-5]

Artificial intelligence (AI) is a combination of reasoning, learning, problem-solving perception, language understanding, etc. A general introduction to the subject of AI creates a new revolution in the world and creates a great scope in future to describe machines that mimic human nature in association with "cognitive" functions of human mind, such as "learning" and "problem-solving." AI applications are now all over the place. With AI s belief, real-world problems can be solved quickly and with high accuracy. AI is being used by many healthcare industries to make better results and decrease the human errors. Many researcher applies AI to automatically classify ultrasound images. Through clinical practice, AI is capable of "learning" traits from a significant amount of data to diagnose diseases. AI has the capability to give the results with less or no errors and to remove or delete the unwanted and unuseful data from its function. In PCOS, the AI is used to detect the stage of PCOS and the condition of the fallopian tube and uterus by ultrasound waves. It also detects the size of the follicle and the amount of cyst in ovary.

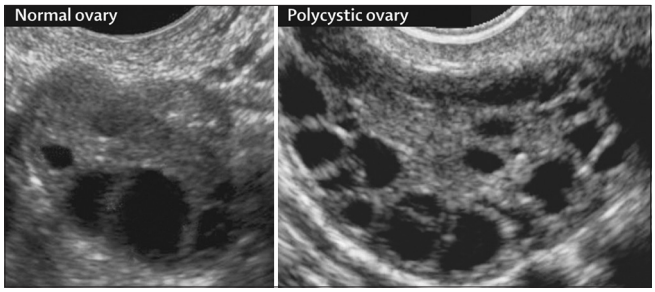

Figure 1: Ultrasound image of normal ovary and polycystic ovary

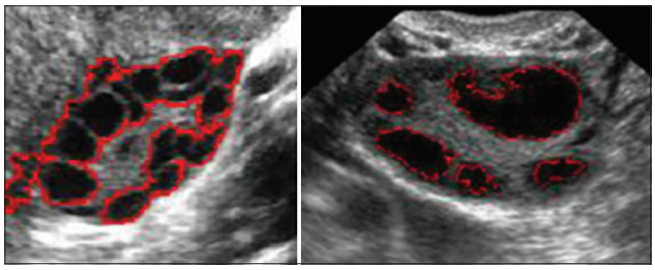

Figure 2: Follicle detection image

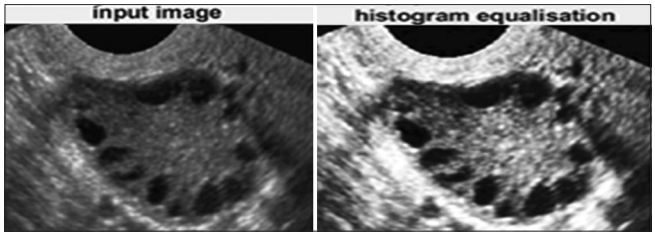

Figure 3: Input image and histogram equalization

Studies claim that PCOS is typically hereditary, despite the fact that its exact origins are still unknown. Since there is no discernible pattern for this medical illness, it is exceedingly unexpected and has no known remedy. Both patients and physicians struggle with the time and expense of undergoing several medical examinations and scans. Early diagnosis and treatment are crucial since modest lifestyle modifications can prevent long-term health problems including type 2 diabetes and cardiovascular illnesses [Figures 1-3].[6-10]

Discussion

PCOS is the most frequent gynecological endocrine condition that has a negative impact on women's health (polycystic ovarian syndrome). It is more common in reproductively aged women. PCOS is distinguished by irregular menstrual cycles, weight gain, skin darkening, hypertension, diabetes, metabolic abnormalities/dysfunction, and infertility. In humans, infertility is defined as an inability to conceive due to a failed ovulation.

Many women are diagnosed with PCOS between the ages of 20 and 30 years. PCOS causes abnormal follicle growth in the ovaries. Inside the ovaries, there are several little fluid-filled sacs holding small cysts and clusters of pearl-sized follicles, each harboring an undeveloped egg. The cysts cause unbalanced hormone properties. Doctors often review your medical history and may offer pelvic testing, blood tests, and ultrasound waves to examine the appearance of your ovaries and the thickness of the lining of your uterus.

AI is a synthesis of reasoning, learning, problem-solving perception, language understanding, and so on. A broad introduction to the subject of AI sparks a new revolution in the world and opens up new opportunities in the future to describe robots that replicate human nature in conjunction with "cognitive" capabilities of the human mind, such as "learning" and "problem-solving" AI is currently widely used all around us. With AI, real-world issues may be resolved quickly and with great accuracy.

The progression of PCOS during different life stages is poorly established because of a shortage of cohort studies with a long-term follow-up. A study evaluated clinical and biochemical markers in PCOS women with healthy controls who first attended a health center at the age of 29 and returned 6 years later. In this longitudinal study, aging was linked to an

increase in the frequency of monthly menstrual cycles, a drop in serum testosterone levels, and a decrease in IR.

The pathophysiology of PCOS is mostly determined by a genetic predisposition as well as some prenatal and postpartum environmental factors. Increases in glucocorticoids production due to intrauterine growth retardation or small for gestational age (or both) caused by high levels of androgens during the intrauterine period could cause epigenetic modifications and raise the risk of PCOS.

A noninvasive ultrasound machine is used to scan inside body parts. This machine images the ovary to detect abnormal alterations such tumors, cancer, and polycystic ovary. PCOS is made clear depending on the number and size of the follicle. Follicles are the fluid-filled sacs which contain oocytes in them. As per the Rotterdam consensus, PCOS is defined as the existence of at least 12 follicles measuring smaller than 9 mm in an ovary. Computer-assisted methods for detecting follicles and diagnosing PCOS make physicians' jobs easier. Image de-noising, segmentation, morphological operations, feature extraction, and other image processing techniques are all available for the diagnosis of polycystic ovary.

Chen *et al*. devised a method for measuring follicles in ovarian 3D ultrasound images. In the framework, local and global information about the ovary were combined. The information was then utilized to calculate the follicle sizes and locations. A clustered marginal space learning approach was presented to handle challenges connected to multiple object detection in a high-dimensional space. A database-guided graph-cut segmentation approach was then used to detect follicles. This research adds to our understanding of follicular formation in the human ovary. However, the projected rates of missed detection and false detection of 19.7% and 22.5%, respectively, were excessively high.

Ultrasound pictures are critical for detecting follicles in PCOS patients. Manual follicle detection takes longer and can lead to issues such as inter- and intra-observer inconsistency, which can have a negative impact on women's health. Therefore, the use of techniques and machines are needed for the detection of the follicles.

Soni and Vashisht devised a method in which a grayscale-colored ultrasound image was used as the input. For higher quality and brightness level, the input image is upgraded by histogram equalization. The backdrop class and object class are separated using two different types of threshold methods: Global Basic Threshold and Otsu Threshold. Binarization of the image is used to distinguish between the background and foreground images. To differentiate the image's foreground and background, region-based and watershed methods are used. Finally, a cellular neural network (CNN) is utilized to divide the image into two categories: PCOS and non-PCOS.

Faghih *et al*. suggested a cellular neural network-based technique (CNN). This approach is divided into four phases. The follicle's rough location is determined in the first step of CNN. Follicles are enlarged to the boundary position in the second CNN. The location of recessive follicles is determined by the third CNN. Finally, a genuine and phantom follicles are blended in the last phase of CNN to distinguish the impacted follicles.[11-16]

In a study by Lv *et al.* suggested an automated deep learning method that looked at the possibility of detecting PCOS through scleral abnormalities. The dataset, which includes the full-eye pictures of 721 Chinese women, 388 of whom had PCOS, was used to apply the algorithm. The proposed technique uses enhanced U-Net to segment scleral pictures from full-eye images, and then applies a Resnet model to extract deep features from the segmented scleral images. To achieve classification, a multi-instance model was finally created. To evaluate the effectiveness of our method, a number of performance indicators were used, including area under the curve (AUC), classification accuracy, precision, recall, precision, and F1-score. Results revealed that their approach had a classification accuracy of 0.929 and an average AUC of 0.979, demonstrating the enormous potential of deep learning in the identification of PCOS.

It is required to classify data linked to PCOS to effectively distinguish PCOS affected and unaffected patients. Many AI-based classifiers have been utilized in the research to classify follicles and diagnose of polycystic ovarian syndrome (PCOS). Studies claim that PCOS is typically hereditary, despite the fact that its exact origins are still unknown. Since there is no discernible pattern for this medical illness, it is exceedingly unexpected and has no known remedy. Both patients and physicians struggle with the time and expense of undergoing several medical examinations and scans. Early diagnosis and treatment are crucial since modest lifestyle modifications can prevent long-term health problems including Type 2 diabetes and cardiovascular illnesses.

Conclusion

Using segmentation and classification of ultrasound pictures of the ovary, AI has been proven to be the best method for detecting polycystic ovarian syndrome (PCOS). PCOS is a hormonal condition that affects a woman's menstrual cycle, resulting in infertility and the formation of cysts in the ovaries. Early diagnosis and therapy are suggested to overcome PCOS. By learning traits in self-correcting aspects, AI may diagnose PCOS.

AI techniques such as neural networks, Convolution Neural Networks (CNN), support vector machines, Bayesian Classifier, logistic regression, k-nearest neighbor, and others are used in various research projects to identify and diagnose PCOS.

Together, human people and innovation may pave the road for better health-care services. The ability for a system to automatically learn and improve is provided by machine learning, a branch of artificial intelligence logically planned. Its main objective is to create new machine learning algorithms

that allow users to access specific datasets and use the information for analysis and research of the unstructured. Applications of machine learning support significant change, particularly in businesses like health care that deal with data identification, image recognition, prediction, and identification.

Much critical attention has been paid to PCOS screening. In order to address this problem, the current study was created to investigate a noninvasive way to aid in PCOS screening. Our research demonstrates that the suggested algorithm successfully detects PCOS (mean AUC of 0.978), suggesting that deep learning may be a potent technique for PCOS identification. In addition, research findings may suggest the exceptional potential of using scleral pictures to diagnose diseases. A fruitful study area may emerge from the integration of AI and characteristics taken from scleral pictures.[17-18]

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Conflicts of interest

There are no conflicts of interest.

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