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Unveiling Pcos: A Deep Learning Approach

Prof. Neethi Narayanan [1], Sona Maria Simon [2], Sonica R [3], Sredha Anil [4], Parvathy Krishna S [5]

[1] Assistant Professor, Department of Computer Science and Engineering, LBSITW, Trivandrum
[2],[3],[4],[5] U. G Scholars, Department of Computer Science and Engineering, LBSITW, Trivandrum

ABSTRACT

Polycystic Ovary Syndrome (PCOS) stands as a significant hormonal disorder among women, exerting a profound impact on their lives, often leading to complications like infertility. Recognizing the importance of early intervention, our project, PCOS Detection Using Deep Learning, aims to facilitate early detection and enhance diagnostic accuracy through personalized treatment plans tailored to individual variations. By leveraging features such as hormonal levels, menstrual patterns, physical characteristics, and ultrasound scan reports via our secure website, our deep learning system learns patterns from a diverse dataset encompassing both PCOS and non-PCOS cases. This approach not only enhances individual outcomes but also contributes to a deeper understanding of the multifaceted nature of PCOS. Our website prioritizes security, accuracy, and efficiency, requiring minimal training for ease of use, with the overarching goal of providing an effective healthcare solution that promotes early intervention and improves the quality of life for those affected by PCOS.

I. INTRODUCTION

Polycystic Ovary Syndrome (PCOS), a frequently encountered hormonal imbalance in individuals of reproductive age, is marked by irregular menstrual patterns, heightened androgen levels, and the presence of polycystic ovaries. Timely and precise identification of PCOS is vital for both managing the condition effectively and averting potential complications. Conventional diagnostic techniques typically encompass a blend of clinical assessment, blood analyses, and imaging investigations, yet their accuracy and efficacy may be limited. Deep learning, a subset of artificial intelligence, utilizes intricate neural networks to analyse extensive datasets. An exemplary application of deep learning in PCOS detection lies in the analysis of medical imaging, particularly ultrasound scans of the ovaries. Through rigorous training, deep learning models can identify specific characteristics linked to polycystic ovaries, enabling a more objective and consistent assessment. Furthermore, these algorithms can amalgamate data from diverse sources, including clinical records and biomarkers, augmenting the accuracy of diagnosis. The integration of PCOS detection via deep learning represents a significant advancement in women's healthcare. Given the syndrome's common occurrence and subtle symptoms, it frequently evades detection or receives inaccurate diagnoses. The utilization of deep learning in PCOS detection offers numerous benefits. Firstly, it enables early identification of the syndrome, facilitating prompt intervention and management to mitigate long-term health risks. Secondly, by leveraging large, diverse datasets, deep learning models continually refine their accuracy and adaptability, accommodating variations in patient demographics and clinical presentations. Additionally, the automated nature of deep learning algorithms streamlines the diagnostic journey, potentially reducing subjectivity and variability associated with human interpretation.

II. LITERATURE REVIEW

[1] Samia Ahmed Md. Sazzadur Rahman, Ismate Jahan, M. Shamim Kaiser, A. S. M. Sanwar Hosen, Deepak Ghimire, Seong-Heum Kim,"*A Review on the Detection Techniques of Polycystic Ovary Syndrome Using Machine Learning,"* in IEEE Access, vol. 11, pp. 86522- 86543, 2023.[1]

An extensive analysis of diverse methodologies utilized in discerning Polycystic Ovary Syndrome (PCOS) via machine learning techniques has been reviewed in this paper. The authors, Samia Ahmed Md. Sazzadur Rahman, Ismate Jahan, M. Shamim Kaiser, A. S. M. Sanwar Hosen, Deepak Ghimire, and Seong-Heum Kim, are likely to explore the utilization of machine learning algorithms in analyzing diverse data sources pertinent to PCOS diagnosis, including hormonal profiles, ovarian ultrasound images, and clinical manifestations. These machine learning techniques hold promise in enhancing the precision and speed of PCOS diagnosis by uncovering intricate patterns and correlations within these intricate datasets that may elude human observation. Overall, the article provides a complete overview of the current state-of-the-art in machine learning-based detection techniques for PCOS which highlights the opportunity for future research and clinical application in this important area of women's health.

[2] N. Jan, A. Makhdoomi, P.Handa and N. Goel, *"Machine learning approaches in medical image analysis of PCOS,"* 2022 International Conference on Machine Learning, Computer Systems and Security (MLCSS), Bhubaneswar, India, 2022[3] Leslie ChingOw Tiong and HeeJeong Jasmine Lee , Jan 2021. [2]

Investigates the use of machine learning (ML) techniques for the analysis of medical pictures in the context of PCOS (polycystic ovarian syndrome) has been reviewed in this paper. This paper likely explores a myriad of ML algorithms and methodologies utilized in interpreting medical images associated with PCOS, such as ultrasound scans or magnetic resonance imaging (MRI). The authors probably delve into how machine learning can streamline the analysis of these images, facilitating the identification of characteristic features indicative of PCOS. Moreover, the paper may touch upon the challenges and opportunities inherent in employing ML for medical image analysis, addressing concerns like data quality, model interpretability, and the potential integration of these approaches into clinical settings. Overall, this paper serves as an invaluable resource for comprehending the evolving landscape of machine learning applications in PCOS medical imaging, offering insights into advancements that have the potential to heighten diagnostic precision and streamline the assessment of this intricate syndrome.

[3] A. K. M. Salman Hosain,M. H. K. Mehedi and I. E. Kabir,*"PCONet: A Convolutional Neural Network Architecture to Detect Polycystic Ovary Syndrome (PCOS) from Ovarian Ultrasound Images,"* 2022.[3]

An innovative method for PCOS detection utilizing Convolutional Neural Networks (CNNs) has been reviewed in this paper. The proposed PCONet is meticulously crafted to extract pertinent features from these images efficiently, harnessing the capabilities of deep learning. With convolutional layers integrated into its architecture, the network autonomously learns hierarchical representations from input images, enabling it to discern PCOS-associated patterns. The paper likely delves into the training process, validation outcomes, and potentially compares PCONet with existing methodologies to showcase its efficacy in accurately identifying PCOS from ultrasound images. In summary, the paper likely adds valuable insights to the expanding literature concerning the utilization of deep learning methodologies for medical image analysis, specifically focusing on the diagnosis of PCOS from ultrasound images of the ovaries.

[4] A. Denny, A. Raj, A. Ashok,C. M. Ram and R.George, *"i- HOPE: Detection And Prediction System For Polycystic Ovary" Syndrome (PCOS) Using Machine Learning Techniques,"* TENCON 2019. [4]

An innovative system dedicated to detecting and predicting Polycystic Ovary Syndrome through the application of machine learning has been reviewed in this paper. The i-HOPE system likely employs a diverse array of machine learning techniques, including feature extraction, classification algorithms, and potentially predictive modeling. The paper probably provides insights into the dataset utilized, the methodology applied, and the performance metrics employed to assess the system's accuracy. Moreover, the term "i-HOPE" hints at an emphasis on intelligent and optimistic diagnosis, possibly incorporating user-friendly interfaces or decision support tools. Overall, this research advances the field of healthcare informatics by proposing a machine learning-driven solution for PCOS detection and prediction, with promising implications for early intervention and enhanced patient outcomes. In essence, the paper likely provides a holistic solution for the detection and prediction of PCOS through the utilization of machine learning techniques.

[5] M. Sumathi, P. Chitra, R. Sakthi Prabha, and K. Srilatha, *''Study and detection of PCOS related diseases using CNN*,'' 2021. [5]

The use of Convolutional Neural Networks (CNNs) in research and disease detection related to Polycystic Ovary Syndrome (PCOS) has been reviewed in this paper. Given the intricate nature of PCOS and its potential health ramifications, the utilization of CNNs, known for their efficacy in image analysis, suggests a particular emphasis on medical imaging data. The study may involve analysing various medical images, such as ultrasound scans or other diagnostic imaging modalities, to discern patterns and features indicative of PCOS-related diseases. Through the utilization of CNNs, the research likely aims to refine the precision and efficiency of PCOS-related disease diagnosis, potentially driving advancements in medical image analysis and the development of more effective diagnostic tools. In summary, leveraging CNNs for the analysis of medical images, the research endeavours to elevate the precision and efficiency of diagnosing PCOS-related diseases, potentially fostering advancements in medical image analysis and the creation of more potent diagnostic instruments for PCOS and its correlated conditions.

III. METHODOLOGY

The main aim of developing a PCOS (Polycystic Ovary Syndrome) detection system using Deep Learning (DL) is to improve the accuracy, efficiency, and early detection of PCOS in women. Early Detection and Diagnosis can facilitate early identification of PCOS by leveraging deep learning algorithms to analyse medical data, such as ultrasound images and hormone levels. Early detection enhances the precision and accuracy of PCOS diagnosis compared to traditional methods. Deep learning models can learn intricate patterns and relationships within complex datasets, potentially leading to more reliable diagnostic outcomes. It provides healthcare professionals with an objective and consistent tool for PCOS detection. Deep learning models can eliminate some of the subjectivity associated with manual interpretation of medical images or clinical data, leading to more standardized results. It streamlines the screening process for PCOS, particularly in large populations. Automated detection using deep learning can significantly reduce the time and effort required for manual examination, enabling healthcare providers to handle a higher volume of cases. Using PCOS Detection Using Deep Learning will potentially reduce healthcare costs associated with PCOS by identifying cases earlier and preventing the progression of complications. Early intervention may lead to more cost-effective treatments and a decrease in long-term healthcare expenses and also improve overall patient outcomes by enabling prompt and accurate diagnosis, leading to timely management strategies.

System Design:

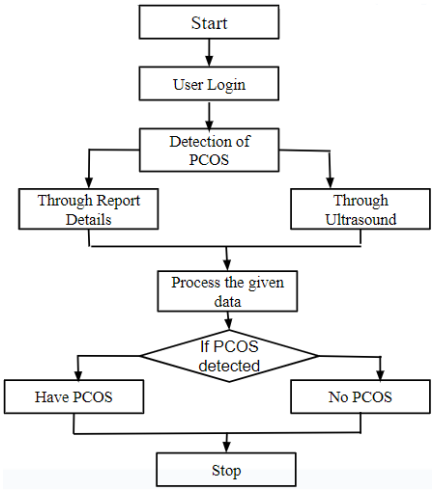

Fig 1 Flow chart of the System

The proposed methodology outlines a systematic approach for the development of a robust PCOS detection system which

utilizing Deep Learning (DL), aiming to enhance the accuracy and efficiency of diagnosis, leading to early intervention and improved healthcare outcomes. Deep Learning (DL) techniques, particularly neural networks, have shown promise in assisting with the detection and diagnosis of PCOS.

The first interface of our website has the login module. The user can login to the website through the login credentials. Once the user login to the website, they will be directed to a page where the user is provided with two options for detecting PCOS. In the first option, the user can enter the information from the medical test report like the level of hormones, pulse rate etc through which PCOS can be detected. Otherwise, the user can also detect PCOS by adding the images of medical record like ultrasound scan report. This data is processed by the deep learning model and based on the study made by the deep learning model PCOS is detected.

Here, we used three models for training the ultrasound scan and also for detecting the PCOS using ultrasound scan. All the three models i.e the VGG model, ResNet50 model and InceptionV3 model along with its accuracy rate will be displayed as three options. The user can detect PCOS by choosing the model from the options and can detect ultrasound scan using the model which the user prefer.

IV. RESULT AND EVALUATION

A. *Result Of Model Used For Detecting PCOS Using Ultrasound Scan*

Here we are using three different types of models for training the data (Vgg model, ResNet50, Inception30). After training the data the performance of the models are taken. Each model show different accuracy and loss level. They are as in the graph below.

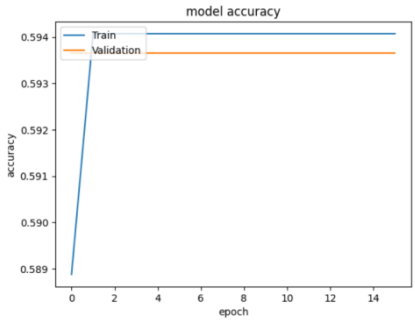

Fig 2 VGG model accuracy rate

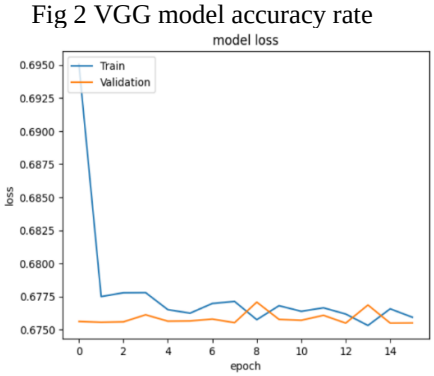

Fig 3 VGG model loss rate

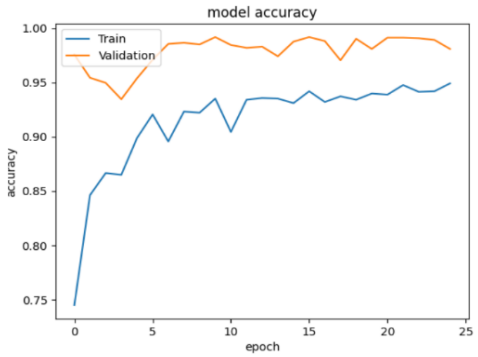

Fig 4 ResNet30 accuracy rate

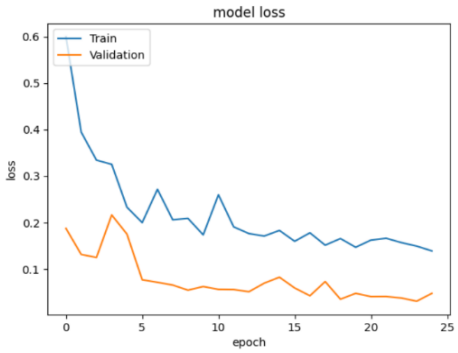

Fig 5 ResNet30 loss rate

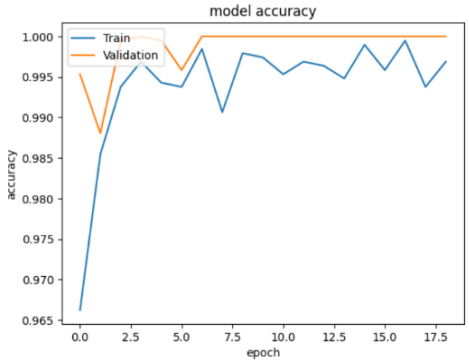

Fig 6 InceptionV3 accuracy rate

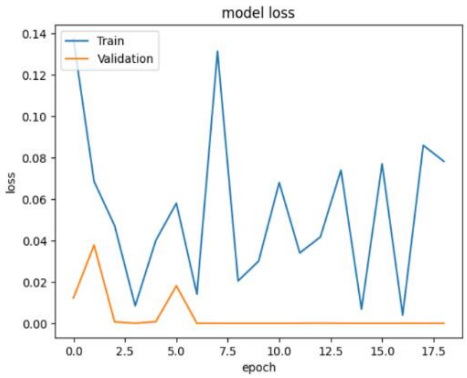

Fig 7 InceptionV3 loss rate

B. Evaluation Of Model Used For Detecting PCOS Using Ultrasound Scan

From the three models InceptionV3 shows the highest accuracy rate. The user can choose any model among the three.

TABLE I - ACCURACY OF MODEL USED FOR DETECTING PCOS USING ULTRASOUND SCAN

MODEL	VGG Model	ResNet50	InceptionV3
Accuracy	0.59365	0.9452	1.00000
Loss	0.6759	0.1579	0.0043

C. Result And Evaluation Of Model Used For Detecting PCOS Using Manually Entered Data

As we did in ultrasound scan, we are using 3 different models and the most accurate one among them ANN_model. The performance of each of the model is as given as below

TABLE II- ACCURACY OF MODELS USED FOR DETECTIONG PCOS BY MANUAL ENTRY OF DATA

Model	**Accuracy**
Decision Tree Classifier	0.7222222222222222
Random Forest Classifier	0.8333333333333334
ANN_model	0.8518518518518519

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[1] Samia Ahmed Md. Sazzadur Rahman, Ismate Jahan, M. Shamim Kaiser, A. S. M. Sanwar Hosen, Deepak Ghimire ,Seong-Heum Kim,"*A Review on the Detection Techniques of Polycystic Ovary Syndrome Using Machine Learning,"* in IEEE Access, vol. 11, pp. 86522- 86543, 2023.

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