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DETECTION OF POLYCYSTIC OVARY SYNDROME USING DEEP LEARNING

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Abstract: Polycystic Ovary Syndrome (PCOS) is a prevalent endocrine disorder affecting many women, characterized by various symptoms and ovarian irregularities. Accurate and timely diagnosis is crucial for appropriate treatment and management. This project proposes an innovative approach to PCOS detection that leverages both manual input data and advanced medical imaging techniques. The primary objective of this project is to develop an automated system for PCOS detection, enhancing diagnostic accuracy and streamlining the process. This approach combines manual input of some key features associated with PCOS, with the use of ultrasound imaging of the ovaries. It takes a patient-centered approach, ensuring that individuals suspected of having PCOS are provided with an accurate and efficient diagnosis. The process begins with the collection and preprocessing of patient data. Manual input data is collected, and based on predefined criteria, a decision is made to proceed with an ultrasound scan. If indicated, high-quality ultrasound images of the ovaries are obtained, which serve as input to a specialized Convolutional Neural Network (CNN). The CNN is trained on a labeled dataset of ultrasound images, enabling it to detect specific patterns associated with PCOS. By analyzing the ultrasound image, the CNN provides an assessment of the likelihood of PCOS.

Keywords: PCOS detection, Manual data analysis [physical symptoms], Image based analysis[ultrasound Image], Random Forest, Convolutional Neural Network.

I. INTRODUCTION

PCOS is a hormonal condition in women of reproductive age, often starting in adolescence. Difficulty in becoming pregnant may arise due to irregular ovulation. Symptoms can vary over time. PCOS is a leading cause of infertility. Ovaries are an important part of the female reproductive system, they're located in the lower belly on either side of the uterus. Women have 2 ovaries that grow eggs and secrete the hormones estrogen and progesterone. During the menstrual cycle, an egg grows in a sac called a follicle within the ovaries. Normally, the follicle breaks open to release the egg, but if it doesn't, fluid can accumulate, forming a cyst.

This condition, when it occurs frequently, is linked with hormonal imbalances and is known as polycystic ovary syndrome (PCOS). PCOS can lead to various symptoms like irregular periods, Hirsutism, acne, hair loss, skin darkening and excess androgens. Many women with PCOS may develop these ovarian cysts due to the follicles not rupturing properly. PCOS diagnosis relies on a comprehensive approach, integrating physical examination, blood tests, and ultrasound scanning. Depending solely on any single test is not advisable.

Therefore, we propose a system that combines the results of physical examination and ultrasound scanning of ovarian images to enhance diagnostic accuracy. This integrated approach ensures a more reliable diagnosis, leading to better management and treatment outcomes for individuals with PCOS.

II. LITERATURE SURVEY

[1] This research enhances follicle segmentation by coupling different segmentation strategies and employing a Logistic Regression classifier for identifying follicular features. An upgraded sampling technique incorporating oversampling and under sampling addresses class imbalance in medical datasets. Statistically significant features characterizing PCOS are selected using an Extreme Gradient Boosting model. Integration with a CNN model and hyperparameter tuning further boosts performance, as demonstrated through rigorous testing on benchmark datasets..

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[2] This paper employs a CNN as an image classifier to detect cysts through segmentation and feature extraction methods. Utilizing input ultrasound images as training data, the algorithm categorizes test data to determine ovarian condition and assess parameters like area, solidity, extent, and perimeter affected by the cysts.

[3] In this paper they included ten machine learning models with high order SVM yielding the best performance (94% accuracy) due to its effectiveness in handling overlapping data. This model offers a clinical decision support system for PCOS identification and staging, aiding in patient care prioritization. Limitations include sample size constraints, necessitating validation in diverse clinical settings.

[4] In this paper they extensively compared machine learning models, finding Random Forest's multi-voting aspect excelling with 93.5% accuracy. Selecting 7-8 attributes out of 31, we confirmed their relevance via Principal Component Analysis (PCA), aligning closely with our decisions. Random Forest's flexibility and mitigation of overfitting make it our preferred choice, outperforming Naive Bayes and decision trees.

[5] This suggested a fusion model that combines the ultrasound image with clinical information to determine whether the patient has PCOS or not. The best model created, which combined clinical features with picture feature extraction using Mobile Net architecture, obtained 82.46% accuracy..

III. SCOPE AND METHODOLOGY

Scope

The project aims to develop a diagnostic system for polycystic ovary syndrome (PCOS) by integrating physical examination and ultrasound scanning results. It involves designing software for data processing, integrating algorithms for seamless correlation of findings, and creating a user-friendly interface. The system will undergo rigorous testing, validation, and implementation in clinical settings. Training and support for healthcare professionals will be provided, and ongoing monitoring and improvement mechanisms will ensure its effectiveness and reliability in diagnosing PCOS accurately.

Methodology

A diverse dataset of medical records and ultrasound images from patients with and without PCOS will be gathered. The dataset will incorporate manual input features to determine the necessity of an ultrasound scan. Ultrasound images will be obtained using appropriate medical imaging equipment and then preprocessed to ensure compatibility with deep learning algorithms. For the decision to conduct an ultrasound scan, manual input features will be utilized to assess whether a patient's condition warrants further evaluation for PCOS confirmation. This determination can be made using machine learning algorithms that is Random Forest. If an ultrasound scan is deemed necessary, high-quality ultrasound images of the ovaries will be collected. These ultrasound images will be utilized as input for a Convolutional Neural Network (CNN) trained on a labeled dataset. This dataset will accurately identify PCOS-affected and non-affected ovaries. The CNN will learn to detect specific patterns associated with PCOS from the ultrasound images. Subsequently, the trained CNN will process the ultrasound image of the patient's ovaries, providing an output indicating the likelihood of PCOS based on the image analysis.

IV. SYSTEM ARCHITECTURE

The system architecture for this project comprises two main components: the manual data input module and the ultrasound image processing module. In the manual data input module, users enter their physical symptoms such as height, weight, BMI, acne, hirsutism, skin darkening, irregular periods, and hair loss. This data is fed into a machine learning algorithm, specifically Random Forest, to classify the input as either normal or abnormal. If the result is normal, the system provides a corresponding output. However, if the result is abnormal, indicating a potential presence of PCOS, the system prompts the user to upload an ultrasound scan of their ovaries to further clarify the diagnosis. In the ultrasound image processing module, the uploaded ultrasound image undergoes image processing using a customized Convolutional Neural Network (CNN) architecture. This CNN is trained to classify ovaries as infected (indicating the presence of cysts characteristic of PCOS) or non-infected. By analyzing the ultrasound image, the CNN provides a classification output indicating whether the ovaries are affected by PCOS. The system architecture thus integrates manual data input with machine learning classification and ultrasound image processing using CNNs.

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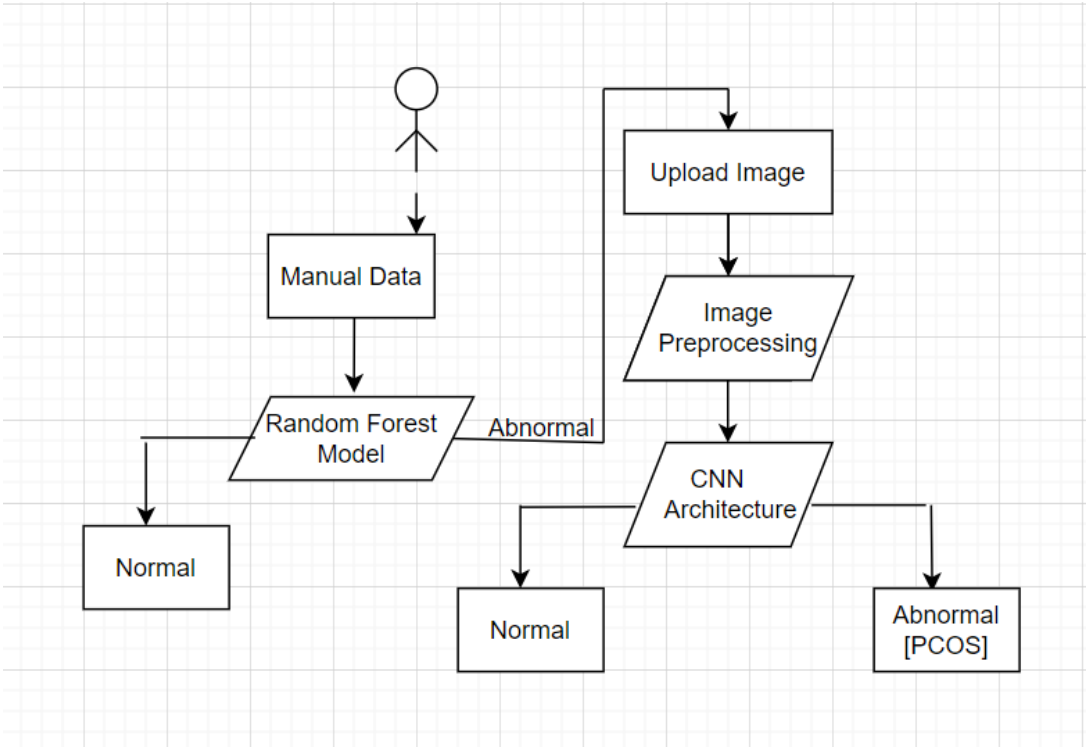

Fig. 1: System architecture

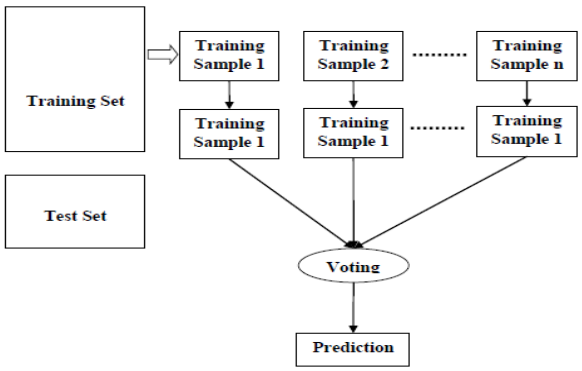

Fig. 2 Random Forest architecture

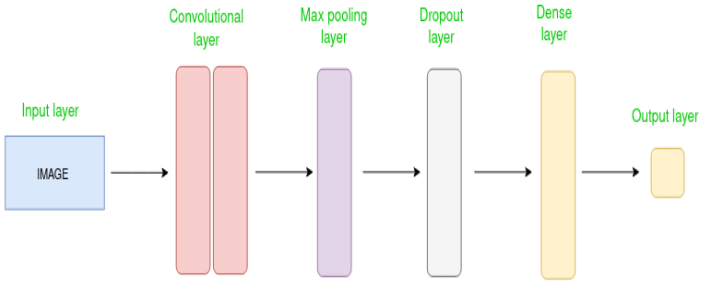

Fig. 3 CNN architecture

V. CONCLUSION

This project aims to develop a new system for detecting PCOS in women. Current methods only focus on one type of methodology, which is not sufficient for making accurate decisions. Therefore, we have incorporated two types of methodologies: physical examination inputs and image processing of ovarian ultrasound images.

The inclusion of manual input features enables personalized patient assessment, while our CNN model enhances diagnostic accuracy through ultrasound image analysis (96.72%). Through rigorous data preprocessing and model training, our system ensures compatibility with clinical workflows and reliable performance in practice. It will be easy to use and improve healthcare professional workflow. The project is feasible with existing resources and could significantly improve the early detection of PCOS, leading to better treatment outcomes and potentially saving lives.

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