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Deep Learning Based Polycystic Ovary Syndrome (PCOS) Identification

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Abstract - Polycystic ovary syndrome (PCOS) is a common endocrine disorder affecting reproductive-aged women, characterized by hormonal imbalance and ovarian cysts. Timely and accurate diagnosis of PCOS is crucial for effective management and prevention of associated complications. In this paper, we propose an automated diagnostic system for PCOS using deep learning and convolutional neural networks (CNNs). The dataset comprises ultrasound images of ovaries categorized into infected (PCOS) and not infected (non-PCOS) classes. Two CNN architectures, a deep CNN model and a CNN model with a last layer replaced by a support vector machine (SVM), are implemented and evaluated. Evaluation metrics include accuracy, precision, recall, and F1-score, demonstrating promising performance in accurately distinguishing between PCOS and non-PCOS cases. This automated diagnostic system offers a reliable and efficient approach for PCOS diagnosis, potentially reducing dependence on manual interpretation of ultrasound scans and improving healthcare outcomes for affected individuals.

Key Words**:** Polycystic ovary syndrome (PCOS) , Deep learning, Convolutional neural networks (CNNs), Data augmentation, Ultrasound Scans

1. INTRODUCTION

Polycystic Ovary Syndrome (PCOS) is a prevalent endocrine disorder affecting women of reproductive age, characterized by hormonal imbalances, irregular menstrual cycles, and the presence of ovarian cysts. The multifaceted nature of PCOS presents diagnostic challenges, often requiring a combination of clinical evaluation, biochemical assays, and imaging studies for accurate diagnosis. Timely identification and management of PCOS are crucial for preventing long-term complications such as infertility, cardiovascular disease, and metabolic disorders.

In response to the diagnostic complexity of PCOS, this project aims to develop an advanced machine learning (ML) and deep learning (DL) model for efficient detection and classification of PCOS based on medical imaging data. By harnessing the power of computational techniques, we endeavor to enhance clinicians' diagnostic capabilities, streamline patient care pathways, and improve health outcomes for individuals with PCOS.

The primary objective of this project is to construct a sophisticated ML/DL framework capable of accurately identifying PCOS from medical images, such as ultrasound scans or pelvic MRI images. Leveraging a diverse dataset comprising images from both PCOS-infected and non-infected individuals, the model will be trained to recognize patterns and features indicative of PCOS pathology.

Throughout this endeavor, we will explore a variety of ML and DL algorithms, including convolutional neural networks (CNNs), support vector machines (SVMs), and ensemble methods. These models will undergo rigorous training and validation using annotated image datasets, ensuring robust performance and generalizability across diverse patient populations. The project scope encompasses data preprocessing, feature extraction, model training, validation, and evaluation using established performance metrics such as accuracy, sensitivity, specificity .Additionally, efforts will be directed towards model interpretability and explainability to enhance clinical adoption and trust in the developed system.

By adhering to best practices in ML/DL model development, validation, and deployment, we aim to deliver a reliable and effective tool for assisting healthcare professionals in the early detection and classification of PCOS. This project aligns with broader initiatives in women's health and precision medicine, aiming to improve diagnostic accuracy, personalized treatment approaches, and overall quality of care for individuals affected by PCOS worldwide.

2.Existing System

PCOS diagnosis can be tricky, because not everyone with PCOS has polycystic ovaries (PCO), nor does everyone with ovarian cysts have PCOS, hence the pelvic ultrasound as a stand-alone diagnosis is not sufficient. Since PCOS is a hard-to-diagnose widespread hormonal disorder, blood tests, symptoms, and other parameters with the help of a computer can form a new and easy method to diagnose it. The data was obtained from the website Kaggle, and the dataset is called Polycystic Ovary Syndrome. In this system various machine algorithms were employed by utilizing seven classifiers. Results demonstrated that Linear Discriminant classifier exhibits the best performance in terms of accuracy, while in terms of sensitivity, the KNN classifier had the best result. Our research excelled among all in terms of accuracy and varied in precedence with precision. MATLAB had shown substantial results and a great model fitting embedded approaches, scoring a high accuracy and precision outcome compared to other studies. Other improvements on the overall PCOS prediction can involve employing preprocessed ultrasound images with the features presented in the dataset.

Challenges:

Limited Feature
Set Dataset.
Algorithm-Specific Limitations

3.Proposed Algorithm

The proposed system aims to revolutionize Polycystic Ovary Syndrome (PCOS) diagnosis through advanced machine learning (ML) techniques and computer-assisted methodologies. PCOS, a prevalent hormonal disorder in women, often poses challenges in accurate diagnosis due to its varied symptoms and diagnostic methods. To address this, our system leverages ML algorithms and data augmentation techniques to develop robust diagnostic models. By integrating pelvic ultrasound images and blood test results, our model can effectively differentiate between PCOS-positive and PCOS-negative cases.

Data augmentation plays a crucial role in enhancing the dataset's diversity, thereby improving the model's generalization ability. Through techniques like random flipping and rotation, we generate augmented images to enrich the dataset for both PCOS-positive and PCOS-negative classes. This augmentation process ensures that our model can effectively learn from diverse input data and improve its performance in real-world scenarios.

The use of deep convolutional neural networks (CNNs) further enhances the diagnostic accuracy of our system. By constructing deep CNN architectures and training them on augmented datasets, we enable our models to extract meaningful features from input images and make accurate predictions. Additionally, the incorporation of support vector machines (SVM) in the CNN architecture enhances the model's predictive capabilities, particularly in handling complex classification tasks like PCOS diagnosis.

Furthermore, our system addresses class imbalance issues commonly encountered in medical datasets. By employing techniques like Synthetic Minority Oversampling Technique (SMOTE) and Edited Nearest Neighbors (ENN), we ensure a balanced distribution of PCOS-positive and PCOS-negative instances in the dataset. This ensures that our models are not biased towards the majority class and can effectively learn from both classes, resulting in more accurate and reliable predictions.

Overall, the proposed system offers several advantages in PCOS diagnosis, including improved accuracy, robustness, and efficiency. By harnessing the power of ML, data augmentation, and advanced CNN architectures, our system can provide healthcare professionals with reliable tools for early and accurate PCOS detection, thereby facilitating timely intervention and reducing the risk of long-term complications associated with the disorder. Additionally, the system's ability to handle class imbalance issues and incorporate interpretability features ensures transparency and trustworthiness in its diagnostic predictions.

4. System Architecture

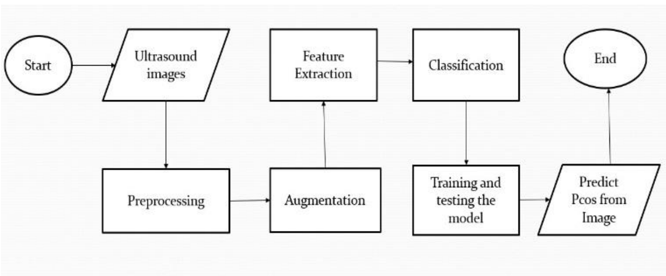

Fig : System Architecture

5.Results And Discussions

The PCOS data considered for analysis is split randomly into Train, test and validation data. The model was trained on a dataset of PCOS-IMAGE-DATASET containing infected and notinfected ovary images. The images were loaded and preprocessed using several libraries such as TensorFlow, Keras, OpenCV, PIL, and NumPy. The dataset was split into training and validation sets, and data augmentation techniques were applied to improve the model's performance.

The model is based on a sequential architecture, with convolutional layers using ReLU activation functions and max pooling layers. The final layer is a dense layer with a sigmoid activation function, which outputs the probability of the input image being infected with PCOS.

The trained model was saved and loaded in the Flask application, allowing it to make predictions on new, unseen images. The application displays the original image, the predicted label, and the probability score.

The system's performance could be enhanced by integrating Optical Character Recognition (OCR) to extract textual information from the identified tablets, such as brand, model, dosage, and other relevant details. By combining YOLO for precise tablet detection and OCR for textual information extraction, the system could provide a comprehensive solution for automating tablet identification and retrieving detailed specifications.

Overall, the application demonstrates the potential for using machine learning algorithms for medical image classification tasks, offering quick and accurate access to pertinent information in our digital and fast-paced world.

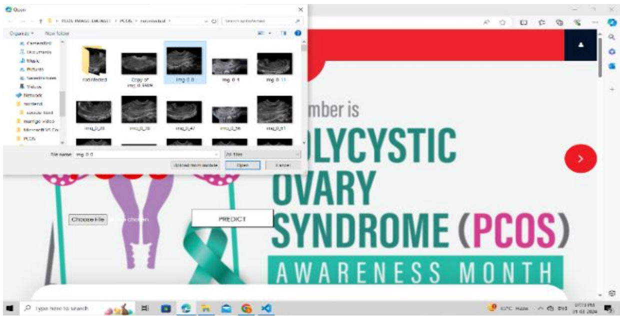

Fig 1. Uploading an Image

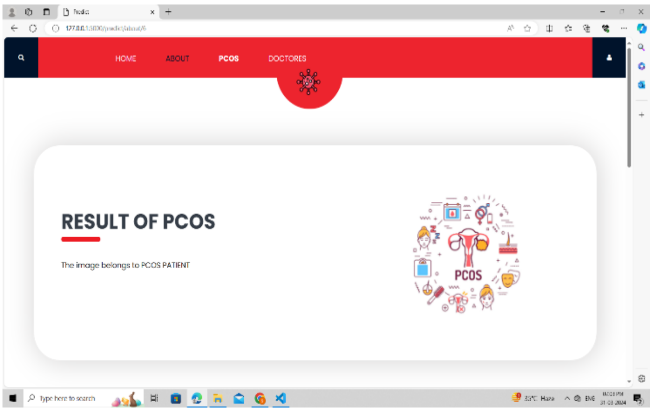

Fig 2. Result of Pcos patient

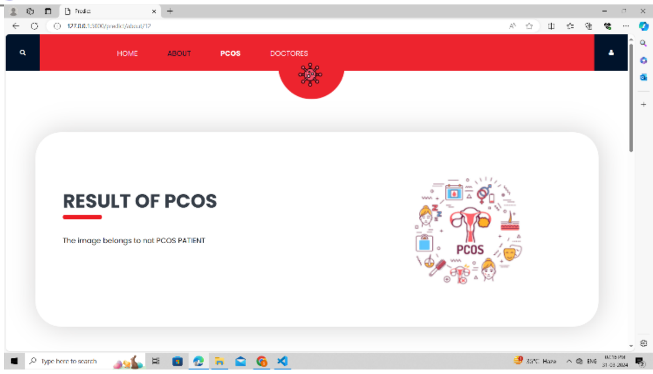

Fig 3. Result of Non-Pcos Patient

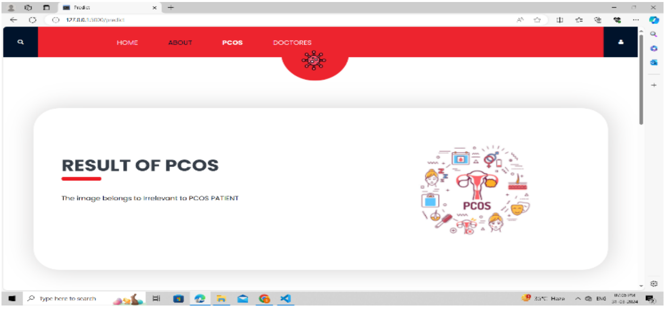

Fig 4. Result if the input is not only the image of pelvic Scans

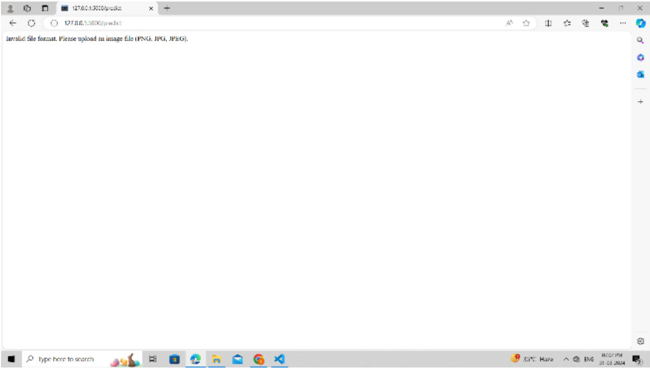

Fig 5. Result if the given input is not only in the image format

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