JAYPEE INSTITUTE OF INFORMATION TECHNOLOGY

MINOR PROJECT SUMMARY SHEET SEM 5

TOPIC : PCOS Detection using Ultrasound Images and Explainable AI (XAI)

Batch : B2

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Summary Sheet

Motivation Behind the Project

The primary motivation for this project is to address the lack of transparency in AI models used for diagnosing Polycystic Ovary Syndrome (PCOS) from medical images. Existing solutions often act as black-box models, making it difficult for clinicians to trust their predictions. This project bridges the gap by incorporating explainability through Grad-CAM, enabling better adoption in clinical settings and improving diagnostic accuracy.

Type of Project

- **Development cum Research Project**:
  The project involves both the development of a PCOS detection system and research into enhancing model interpretability through explainable AI (XAI).

Critical Analysis of Research Papers and Gaps in Work

- **Gap Identified**: From the study of 5–7 research papers related to PCOS detection, we observed a gap where existing deep learning models lacked explainability mechanisms. This project addresses this gap by integrating Grad-CAM to provide visual explanations for predictions.
- **Technologies Learned**:
  - Deep learning frameworks: TensorFlow, Keras
  - Web development: Flask
  - Image processing techniques
  - Explainable AI (XAI) methods like Grad-CAM

Overall Design of Project

The design incorporates:

1. **Flowchart**: Illustrating the workflow from image input to prediction and explanation display.
2. **UML Diagram**: Showing interactions between system components such as data preprocessing, model prediction, and Grad-CAM visualization.
3. **Workflow Model**: Depicting the step-by-step process of training, deployment, and web-based prediction.

Features Built and Programming Language Used

- **Features**:
    1. PCOS detection from ultrasound images using a fine-tuned MobileNet model.
    2. Grad-CAM for visual explainability of predictions.
    3. Flask-based web application for real-time predictions.
- **Programming Languages and Tools**:
    - Python for model development and web application.
    - TensorFlow/Keras for deep learning.
    - Flask for web deployment.

Proposed Methodology

The project is completed using the following methodology:

1. **Data Collection**: Ultrasound image dataset sourced from Kaggle.
2. **Data Preprocessing**:
    - Image resizing and normalization.

- Data augmentation to improve model generalization.

3. **Model Development**:
    - Fine-tuned MobileNet for PCOS classification.
    - Grad-CAM integration for explainability.
4. **Web Deployment**:
    - Flask used to deploy the model as a web application.
    - Users can upload images and receive predictions with heatmap visualizations.

Algorithm/Description of the Work

- **MobileNet Fine-tuning**: A pretrained MobileNet model is fine-tuned using transfer learning on a labeled dataset for binary classification (PCOS-positive/negative).
- **Grad-CAM**: Generates heatmaps highlighting image regions contributing to model predictions.
- **Flask Integration**: Enables seamless user interaction by providing an intuitive interface for uploading images and receiving results.

Division of Work Among Students

1. **Student 1**: Data collection, preprocessing, and augmentation.
2. **Student 2**: Model training and Grad-CAM implementation.
3. **Student 3**: Web application development and Flask integration.
4. **Collaborative Efforts**: Testing, debugging, and report writing.

Results

- **Accuracy**: Achieved high accuracy in detecting PCOS from ultrasound images.
- **Explainability**: Grad-CAM successfully highlighted relevant regions in images, providing interpretable results.
- **Deployment**: A fully functional Flask-based web application was developed, offering real-time PCOS predictions with heatmaps.

Conclusion

This project successfully developed a PCOS detection system that combines deep learning and explainable AI. The integration of Grad-CAM ensures trust and transparency in model predictions, making it a reliable tool for healthcare professionals. Deployment as a web application enhances accessibility, paving the way for real-world implementation in clinical settings.