🩺 Skin Cancer Classification Using Transfer Learning

Abstract

Skin cancer is one of the most common forms of cancer worldwide, and early diagnosis is critical for effective treatment. This project focuses on developing a deep learning model capable of classifying skin cancer images as either benign or malignant. By leveraging the power of transfer learning through the VGG16 model pretrained on ImageNet, we enhance the model's ability to learn complex patterns from relatively limited medical image data. The trained model achieved promising accuracy, demonstrating the potential of AI-assisted diagnostic tools in healthcare.

Introduction

Skin cancer poses a significant global health burden, with millions diagnosed annually. Manual diagnosis through dermatoscopic examination can be time-consuming and subjective, often leading to inconsistent results. Recent advancements in deep learning have revolutionized image classification tasks, offering new avenues for accurate, automated cancer detection.

This project aims to build a Convolutional Neural Network (CNN) model, utilizing the VGG16 architecture via transfer learning, to classify skin lesion images into two categories: benign (non-cancerous) and malignant (cancerous). This approach helps in creating a supportive diagnostic system for medical professionals.

Project Overview

- **Dataset Source**: Kaggle - "Skin Cancer: Malignant vs. Benign"
- **Data Format**:
  - Training and Testing images stored under benign and malignant subfolders.
- **Model Architecture**:
  - Pretrained VGG16 model without top layers.
  - Custom fully connected layers added for final classification.
- **Image Size**: Standardized to 224x224 pixels.
- **Training Strategy**:
  - Data augmentation using ImageDataGenerator.
  - Fine-tuning custom layers on the skin cancer dataset.

Methodology

1. **Data Collection**:
   - Dataset automatically downloaded using KaggleHub.

    - Organized into training and testing folders based on labels.
2. **Preprocessing**:
    - Resized all images to 224x224.
    - Applied data augmentation (rotation, zoom, shift, etc.) to improve model robustness.
3. **Model Design**:
    - Loaded VGG16 pretrained weights (without the final classification layers).
    - Added new layers: Flatten -> Dense -> Output (2 neurons with softmax activation).
    - Frozen the VGG16 base layers during initial training to retain learned features.
4. **Compilation and Training**:
    - Optimizer: Adam
    - Loss Function: Categorical Crossentropy
    - Metrics: Accuracy
    - Trained over multiple epochs while tracking validation performance.
5. **Evaluation**:
    - Plotted training and validation accuracy/loss curves.
    - Tested the model with unseen images and observed predictions.

Results

- **Training**:
    - Achieved high training and validation accuracy, with relatively low loss.
    - No major signs of overfitting due to augmentation techniques.
- **Prediction Samples**:
    - Randomly selected test images were classified correctly.
- **Visualization**:
    - Accuracy and loss graphs demonstrated a healthy learning process.

Conclusion

The application of transfer learning through the VGG16 model provided a highly effective solution for the classification of skin cancer images. By utilizing pretrained features and fine-tuning on the specific dataset, the model achieved promising results even with limited data.

This project demonstrates how AI can be integrated into the medical field to assist in faster, more accurate diagnoses, ultimately leading to better patient outcomes. Future work could involve expanding the dataset, experimenting with other architectures, or deploying the model as a web application for real-time clinical use.