

Thyroid Cancer Classification from Ultrasound Images Using CNN

Introduction

Thyroid cancer is a major endocrine malignancy, and its early detection significantly improves treatment outcomes. This project aims to classify thyroid ultrasound images into three distinct types of cancer: Papillary Thyroid Carcinoma (PTC), Follicular Thyroid Carcinoma (FTC), and Medullary Thyroid Carcinoma (MTC). We employ a convolutional neural network (CNN) to build a multi-class classification model trained on a publicly available dataset.

Dataset

We utilized the "Thyroid Ultrasound Images" dataset hosted on Hugging Face. It contains 298 ultrasound images, equally distributed across the three classes (around 100 per class), thereby eliminating class imbalance concerns. The dataset includes high-quality grayscale images annotated by medical experts.

Dataset Link:

https://huggingface.co/datasets/FangDai/Thyroid_Ultrasound_Images

Each image was resized to 224x224 pixels, normalized, and converted into 3-channel images to ensure compatibility with CNN architectures.

Methodology

We built a deep learning model using TensorFlow and Keras. The key components include:

- Preprocessing:
 - Resizing to 224x224
 - Normalization (pixel values scaled to [0,1])
 - 3-channel conversion for grayscale images
- Model Architecture:
 - Custom CNN consisting of multiple convolutional layers with ReLU activations

- MaxPooling layers to reduce spatial dimensions
- GlobalAveragePooling2D layer to reduce overfitting and aggregate spatial features
- Dense layers followed by softmax activation for multi-class output
- Training Setup:
 - Optimizer: Adam
 - Loss Function: Sparse Categorical Crossentropy
 - Metrics: Accuracy, Precision, Recall, F1 Score
 - Epochs: 125
 - Validation split: 20%

Evaluation Metrics

We evaluated the model using multiple metrics to assess classification performance across all three classes. Such as confusion matrix or classification report.

Conclusion

Our CNN model achieved over 91% accuracy in classifying thyroid cancer types from ultrasound images. The balanced dataset and robust preprocessing steps contributed to the model's effectiveness.

Code Link: <https://www.kaggle.com/code/eminaanapaydn/thyroid-cancer-detection>

Evaluation Metrics Table

| Metric | Value |
|---------------------|--------|
| Validation Accuracy | 91.67% |
| Average Precision | 92% |
| Average F1 Score | 92% |
| Average Recall | 92% |