Blood Clot/ Stroke Detection using DenseNET

Introduction

This document details the process of developing an automated image classification system for heart strip images. The goal of this project is to classify two types of heart strips: 'CE' and 'LAA' using machine learning techniques. For this, we employ deep learning, specifically convolutional neural networks, to process the images and classify them accordingly.

Previous Solutions

Traditionally, heart strip images are examined and classified manually by medical professionals, which is a time-consuming and error-prone process. With the advancements in machine learning and artificial intelligence, however, automated image classification can streamline this process and increase its accuracy and efficiency.

Dataset

The data used for this project is downloaded manually from Kaggle's Mayo Clinic Strip AI competition. It comprises of training and test datasets with heart strip images, labelled 'CE' or 'LAA'. The number of images in the training set is 754, and there are 4 images in the test set. Additionally, the images are labeled with data such as the patient ID, center ID, and image number.

Proposed Method

The proposed method involves using the DenseNet architecture, a convolutional neural network known for its efficiency and effectiveness in image classification tasks. The model is pre-trained on the ImageNet dataset, and then fine-tuned on the heart strip dataset.

The images are preprocessed to a consistent size and then fed into the model for training. The model is trained to minimize the binary cross-entropy loss, and the Adam optimizer is used for this purpose.

To handle the class imbalance in the dataset, we calculated class weights and used them in the training process to ensure that both classes are treated equally during the training of the model.

Evaluation Method

The performance of the model was evaluated using a number of standard metrics, including the F1 score, accuracy, and confusion matrix. The F1 score is a measure of the model's accuracy on the dataset. It is defined as the harmonic mean of the model's precision and recall. In this project, we implemented a custom F1 score function for Keras using backend functions. This score gives a good balance between precision and recall and is a suitable metric when the data distribution is imbalanced, which is the case in this dataset.Accuracy is a common evaluation metric for classification problems. It is the fraction of predictions our model got right, meaning it's the total number of correct predictions divided by the total number of predictions. Though it's a straightforward metric, it may not be the best to use when classes are imbalanced. A confusion matrix is a table that describes the performance of a classification model on a set of data for which the true values are known.

Results and Discussion

The DenseNet model was successfully trained on the heart strip dataset and achieved promising results. The F1 score was used to evaluate the model, and it performed well on both the training and test sets. However, due to the limited size of the test set, further validation is needed to confirm the model's effectiveness. Also, additional steps like data augmentation can be considered to improve the model's performance.

Moreover, the model's interpretability can be enhanced by visualizing the convolutional layers, which can provide insights into which features the model is learning from the heart strip images.
Overall, the application of deep learning to the classification of heart strip images shows great potential for aiding in medical diagnoses and should be further explored with larger and more diverse datasets.