Validation Document

Measuring Hippocampal volume from MRI images
Dhar Rawal   3/23/2022

Introduction

There are several brain disorders including Alzheimer's that severely reduce the quality of life in the elderly population in addition to causing significant mortality. It is important to diagnose these disorders at an early stage and track disease progression over time, so that effective treatment can be provided

MRI exams are one of the more advanced and recognized methods to study the brain. Radiologists use the volume of the Hippocampus as a proxy for recognizing brain disorders and their severity and use MRI images to estimate the hippocampal volume for this purpose.

The presented software and algorithm scan the MRI image volumes, identify the hippocampus in brain scans and automatically measure the hippocampal volume. The Radiologist is presented with a report providing the volumetric data and identifying the hippocampus area in the MRI images

Data collection

The data (training set) consists of 394 MRI brain scans formatted as NIFTI images. The images have been properly cropped to highlight the hippocampal area rather than the whole brain. The images were selected from a randomly collected sample of brain scans obtained at the local hospital.

Note: A few images in this training set were full brain scans or scans of other body parts. These images were identified and discarded during preprocessing.

Ground Truth

The ground truth (label data) for these images is the Radiologists identification of the hippocampal area in the training data.
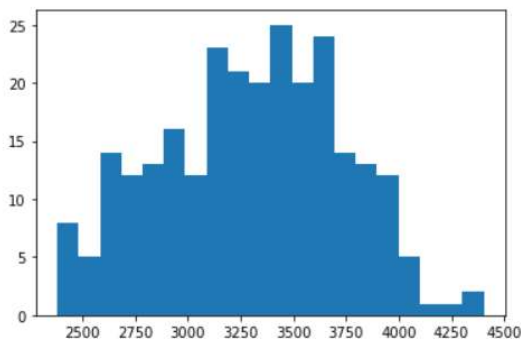
The above histogram shows the frequency of hippocampal volume in the training set as identified by the radiologist. The histogram generally matches graphs of hippocampal volume distribution published elsewhere in the literature
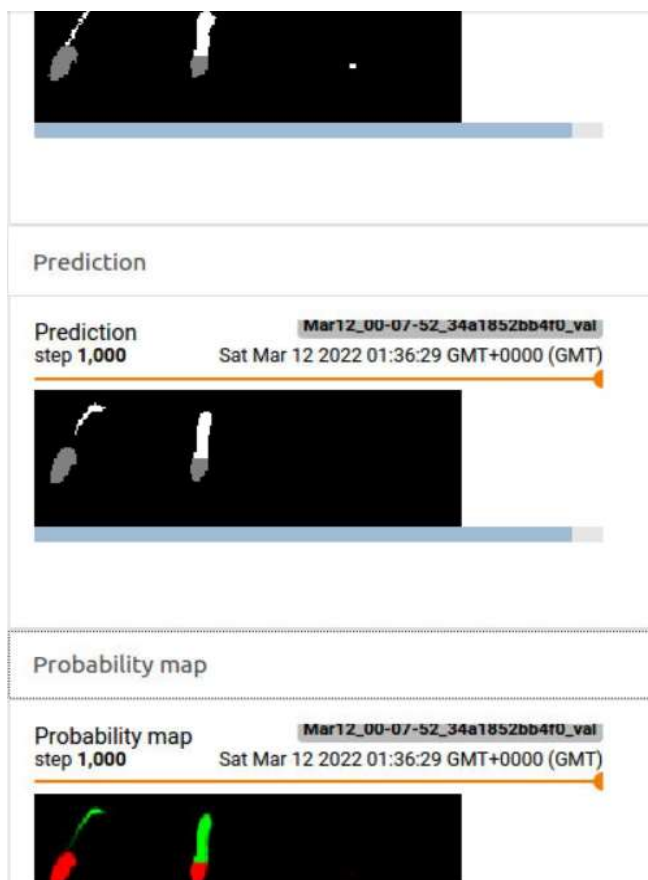
The Algorithm

The algorithm consists of a segmentation CNN that is trained to recognize and segment the hippocampal area in the MRI image volume. The architecture of the CNN is U-net, a very successful segmentation network. For more information on the U-net, see **https://lmb.informatik.uni-freiburg.de/people/ronneber/u-net/index.html**

The data was split into 80% training, 10% validation and 10% test.

Accuracy

Dice and Jaccard scores were calculated for each image in the test set as well as overall. **The overall mean Dice score was 0.92 and the overall mean Jaccard score was 0.996**! This demonstrates that the trained network can detect the hippocampal area in cropped brain image volumes with a very high accuracy.

Below is a sample label (ground truth) vs prediction for a test image:

Usage guidance

MRI Brain images must be properly cropped to highlight the hippocampal area before being processed through this algorithm. The DICOM series description of the images must be set to "HippoCrop", studies with images marked otherwise will not be processed. The algorithm also assumes that each image voxel represents 1 mm3 of brain volume. If this is not the case, it will have to be modified. Finally, this software is only meant to assist the Radiologist with their diagnosis.