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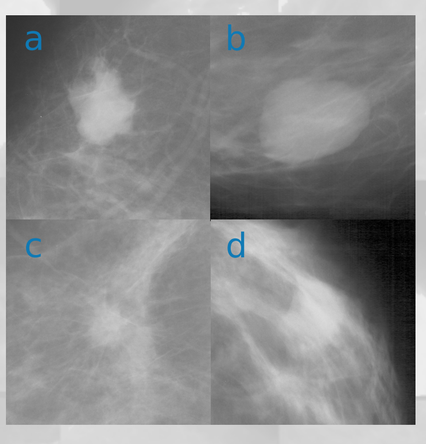
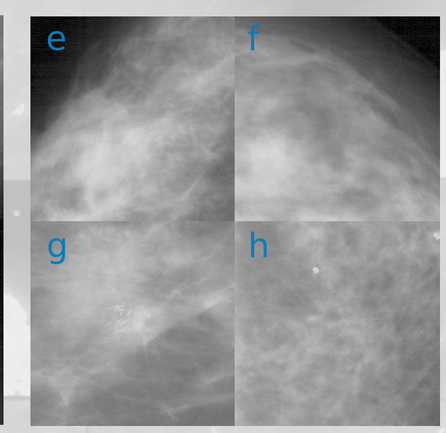
Mammography interpretation Tool Using Computer Vision

Abstract

Convolutional Neural Networks (CNNs) are machine learning structures able to implement aspects of biological vision systems. They can be used in Computer Vision applications to recognise and classify objects in given imagery. This project aims at producing a mammary gland screening tool using CNNs.
The minimum deliverable is a tool that is able to segment volumes with densities that differ from the expected in a provided mammography sample. The project aims at highlighting suspected regions of malignant tumour in these segments. The system would ideally be able to assist doctors in the assessment of mammography samples.



Masses
malignant: a,c
benign : b,d



Calcifications
malignant: e,g
benign : f,h

Methods

The first step was to find adequate data so that the classifiers could be trained. After that the pieces of imagery were decompressed and cropped to square images containing the abnormalities. The CNNs were trained using select Mammograms from the DDSM like the ones above.
The GUI is based on caffe, a Deep Learning framework, to Classify a single image or an entire folder, to prepare the data and finally to train and test the output networks. It involves the use of Matlab OpenCV and scripts, all combined in a Graphical Java Application so that every one of the above actions can be executed with a few clicks.

Implementation

Model 2 training output results

1. Pre trained models that can be used out of the box for image classification.
   Model 1: Malignant, Benign
   - Accuracy:72%
   Model 2: Mass, Calcification , Background
   - Accuracy: 81%
2. Functionality enabling the radiologist to fine-tune the same or other pre-trained models with mammograms similar to the ones the classifier will be called to classify.
3. Ability to import and use any caffe model as a classifier or as a basis for fine-tuning.
4. DDSM specific functionality including drawing the borders of the abnormality as given by the dataset's ground truth

Evaluation

The evaluation is still in progress but the main parts of the evaluation are the following.

1. A quantitative evaluation of the results of the classifiers.
2. An evaluation form on the usability and the practicality of the software completed by radiologist both working in practices and investigation.

Future Development

This application can be used as a tool for the investigation of mammary gland tumours.
Many time consuming processes of the training have been automated investigation can be faster.
Ideally an extension of this tool can be used by hospitals that use their own data to dynamically train and use the classifications as a guide to a faster and more precise diagnosis.