

Real Time Breast Histology Image Classification with a Mobile Phone

Kenji Ikemura, MD.

3/1/2018

Background: Deep learning, specifically convolutional neural network, has made a breakthrough in the complex task of computer image recognition. In this study, depthwise separable convolutional neural network (DS-CNN) is used in classifying breast cancer histology images on the computer and on the mobile phone in real time. The study propose that DS-CNN can be applied for histological image analysis and its network can be transferred to a commercially available mobile phone for real-time histological image analysis captured through the mobile phone camera.

Method: This study utilizes the DS-CNN on breast cancer images (training and test datasets) downloaded from publicly available repository: <https://rdm.inesctec.pt/dataset/nis-2017-003>. Training set images are augmented by rotation and mirroring the images. DS-CNN is trained to match the goal to classify breast histology images between 4 categories: i) normal, ii) benign, iii) carcinoma in situ, and iv) invasive carcinoma. Finally, the trained DS-CNN is deployed on to a mobile phone to classify the images captured through the mobile phone camera. The output on the mobile phone screen are the real-time image from the camera and its probability of it being one of the 4 categories (in highest to lowest rank order). Accuracy of DS-CNN is assessed by whether its output class with highest confidence matches the true class in the test dataset.

Results: The trained DS-CNN accuracy on the computer reached as high as 86% in 4 class classification. On the mobile phone, accuracy reached 69% in 4 class classification and 83% in 2 class classification (normal or benign vs. in situ or invasive). Training time took less than 30 min on 1.4 GHz Intel Core i5 dual-core CPU. Latency for evaluation on mobile phone was less than 1 second.

Conclusion: DS-CNN is a fast and efficient neural network architecture that can learn to distinguish histological images even with limited sample size and computational power. The architecture can be deployed onto a mobile phone and maintain relatively good accuracy through the phone camera. It is likely that the accuracy can be increased by expanding the dataset.