A Pilot Benchmarking Study of Deep Neural Network Performance on Low Magnification Pathology ROIs

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Deep Neural Networks (DNNs) have successfully demonstrated superior overall performance in many image classification and recognition tasks on H&E histology images. Reported studies typically utilize high quality (20x or 40x) Whole Slide Images (WSIs) in order to deliver optimal performance. However, it remains uncertain how well DNNs can perform on lower quality region-of-interest (ROI) histology images in real life scenarios. The NCI Patient Derived Models Repository (PDMR) database hosts a catalog of low magnification (4x) ROIs of tissue histology images across a total of 60 cancer models, providing an ideal test case for evaluating DNNs performance in real life scenarios. This study used 5 pre-trained models to benchmark the NCI PDMR database ROIs on a selected set of popular DNN classifiers. Overall, on the binary carcinoma vs. sarcoma classification test, the downsizing models have reached 89.57% top-1 accuracy on 4X ROIs and the patch-based models have reached 84.18% top-1 accuracy on 4x ROIs. On the multiclass carcinoma classification test, the downsizing models reached 72.06% top-2 accuracy on 4X ROIs and the patch-based models reached 78.07% top-2 accuracy on 4x ROIs. With such accuracies, the goal is to utilize the DNNs to perform crucial tele-pathological tasks in underdeveloped countries and rural areas, enabling scientists to take a cell phone picture and feed that image into a battery powered small computer for a quick screening on the field.

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