Deep Learning-Based Microscope Image Analysis for Cell Viability Estimation in MTT Assays

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Cell viability analysis (MTT assay) can detect subtle changes in cellular metabolic activity at low concentrations, providing a sensitive assessment of cytotoxicity and survival capability. Despite its relatively low reagent cost, it finds wide application in large-scale experiments. However, due to the insolubility of the MTT reduction product, it requires dissolution before detection. It poses risks of chemical residue and biohazardous waste if mishandled, potentially harmful to both experimenters and the environment. Moreover, the process usually takes 2 to 4 hours, depending on experimental design and procedural steps. Therefore, we attempted to directly predict the absorbance of MTT after reaction with cellular images under a microscope. In this study, we employed both a semantic segmentation model and a ResNet for feature extraction from images. After obtaining two sets of feature vectors, regression was performed. In the network design, the semantic segmentation model was utilized to draw attention to the details of individual cells in the images, while the Convolutional Neural Network model (ResNet) enabled the model to globally focus on the entire microscopic image for regression. The purpose of incorporating the semantic segmentation model was to capture intricate details of cells in the images. The ResNet allowed the model to have a global perspective on the entire microscopic image for regression. As a result, the model achieved an RMSE of 0.0294 on the test set, showcasing its effectiveness in combining the strengths of both semantic segmentation and Convolutional Neural Network models for feature extraction and regression tasks.

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