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A Proposed Framework for Improving the Detection and Classification of Ki67 Expression in Astrocytoma Histopathological Images

Abstract

Detecting and classifying the Ki67 expression is a challenging process. The inconsistency in staining intensity and the variations in image quality are the main factors that may reduce the performance of an automated system. Therefore, this study proposes a framework that objectively improves detecting and classifying Ki67 expression in astrocytoma histopathological images. The proposed framework began with implementing the double stain normalization procedure to reduce the colour-staining intensity variations. Then, the system automatically enhanced the morphological features of the Ki67 expression. The following step was to segment the enhanced images by using the U-Net network model. The last step of the proposed framework was to localize and classify the Ki67 expression based on the modified YOLOv3 model. In conclusion, the proposed YOLOv3 model produced a high detection result with a mean average precision of 0.80 for detecting Ki67-positive cells and 0.87 for detecting Ki67-negative cells.

Keywords

Astrocytoma; Image Enhancement; Image Segmentation; Ki67 expression; Stain Normalization; YOLOv3