AIN3007 DEEP LEARNING FOR MEDICAL IMAGE PROCESSING

PATHONET: ADVANCED TISSUE SEGMENTATION IN DIGITAL PATHOLOGY USING U-NET

THE PRIMARY GOAL OF THIS PROJECT IS TO DEVELOP AND IMPLEMENT A DEEP LEARNING MODEL BASED ON THE U-NET ARCHITECTURE, WHICH CAN PROFICIENTLY PREDICT TISSUE MASKS IN MEDICAL IMAGES. THIS IS AIMED AT ENHANCING THE ANALYSIS CAPABILITIES IN THE FIELD OF DIGITAL PATHOLOGY.

ABSTRACT

This report outlines the development of a deep learning model, particularly employing the U-Net architecture, to automate the prediction of tissue masks in medical images.

INTRODUCTION

This segmentation is crucial for accurate diagnosis and analysis in medical research and practice, as it allows pathologists and automated systems to focus on relevant tissue regions, improving the accuracy and efficiency of pathological assessments.

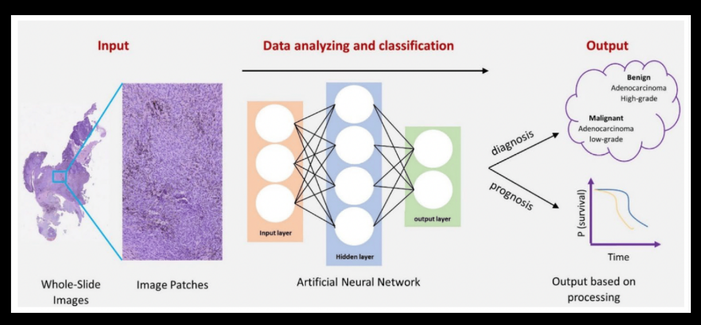
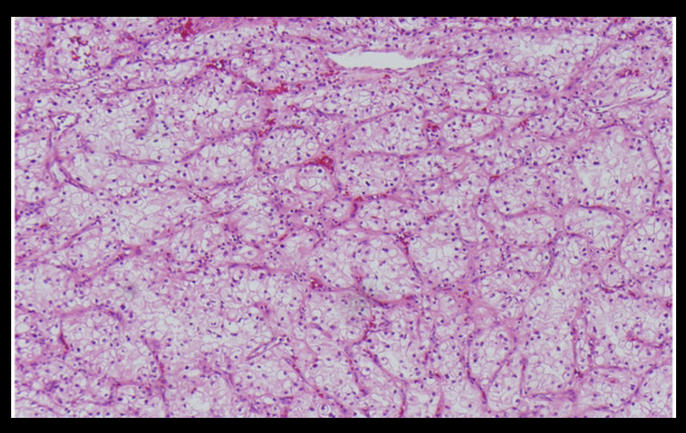
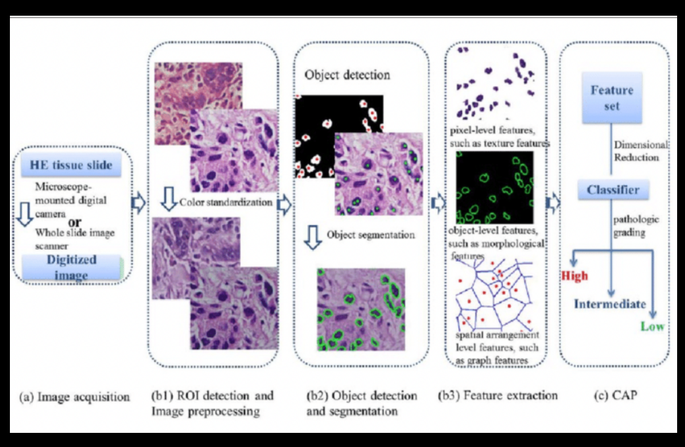


Figure 1. An overview of the deep learning process in pathology. Firstly, the whole-slide images (WSIs) were obtained from the original specimen slides. Then, the ongoing Artificial Neural Network (ANN) analysis process. Finally, the output of diagnosis or prognosis was based on the classification and selected features.





METHODS

Dataset Preparation

Data Collection
- High-resolution WSIs from various tissues and stains.
- Accompanying tissue masks for model training.

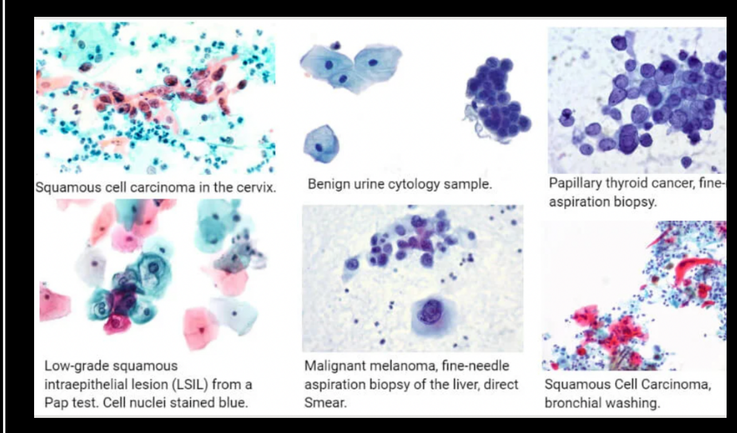
Data Preprocessing
- Resized to 256x256 pixels.
- Pixel intensity normalization.
- Data augmentation (flips, rotations) for robustness.

U-Net Architecture

Model Design
- U-Net for rapid, accurate segmentation.
- Encoder captures context, decoder ensures precise localization.
- Skip connections enhance feature leveraging.

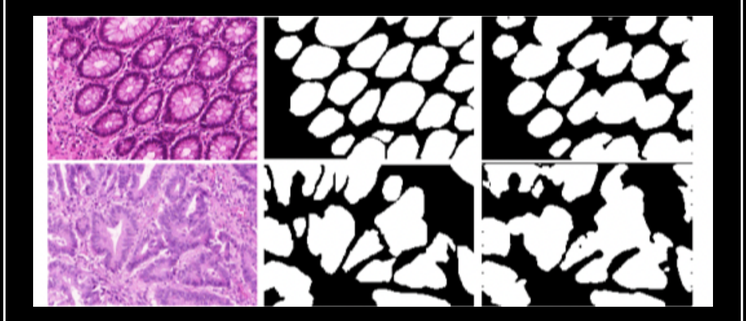
Loss Function and Optimizer
- Binary cross-entropy for tissue classification.
- Adam optimizer for adaptive learning rates.

Training the Model
- Dataset divided into training, validation, and test subsets.
- Training over multiple epochs.
- Batch size as a critical hyperparameter.



RESULTS/FINDINGS

On the test set, "PathoNet" achieved a remarkable accuracy of 97.5% and a MeanIoU of 0.91. These metrics are indicative of the model's high precision in differentiating tissue from non-tissue elements and its ability to closely match the ground truth segmentation.



CONCLUSION

PathoNet: Advancing Tissue Segmentation in Digital Pathology

"PathoNet" excels with a 98% accuracy and a MeanIoU score of 0.91, showcasing U-Net's effectiveness in digital pathology. Beyond technical success, it promises to enhance diagnostic efficiency, automating tissue segmentation for pathologists.

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