SIIM23 ANNUAL MEETING + InformaticsTECH Expo
JUNE 14-16 | AUSTIN, TX
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AI-Enhanced Metastatic Nodal Tumor Detection on Neck CT Scans

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Introduction

Cancer staging by detection of metastatic cervical lymphadenopathy is an important step of clinical decision-making for patients with head and neck squamous cell carcinoma (HNSCC). Computed tomography (CT) has improved the ability to detect such metastatic lymph nodes. However, patients with HNSCC at high-risk sites routinely undergo lymphadenectomy due to the limited ability of CT to detect and assess subcentimeter lymph nodes.

Hypothesis

We hypothesize that we can use deep learning (DL) algorithms to detect early metastatic lymph node tumor invasion on CT in an effort to ultimately reduce the morbidity from unnecessary lymphadenectomies. For this purpose, we use a DL model for the lymph node (LN) segmentation task as a proof of concept for LN segmentation.

Methods

We used neck CT scans from 221 healthy patients. Soft-tissue windowed 2D CT slices were used. We used a contour and bounding box detection technique to remove irrelevant background regions in the slices to improve training time and feature extraction capability in our DL model without performance degradation (Figure 1). We then trained an Attention UNet shown in Figure 2 over our preprocessed data and corresponding lymph node masks. The UNet architecture learns the feature importance of the lymph node regions and generates LN masks as output.

Results

The Attention UNet achieved a dice score of 80.69% on the test set.

Conclusion

Machine learning algorithms may serve as support tools in lymph node segmentation for clinical and research purposes. Currently, the smallest LN is not detectable without expert intervention. However, DL shows promising outcomes in this domain that may automate the detection system with improved accuracy and faster inference time.

Figure(s)

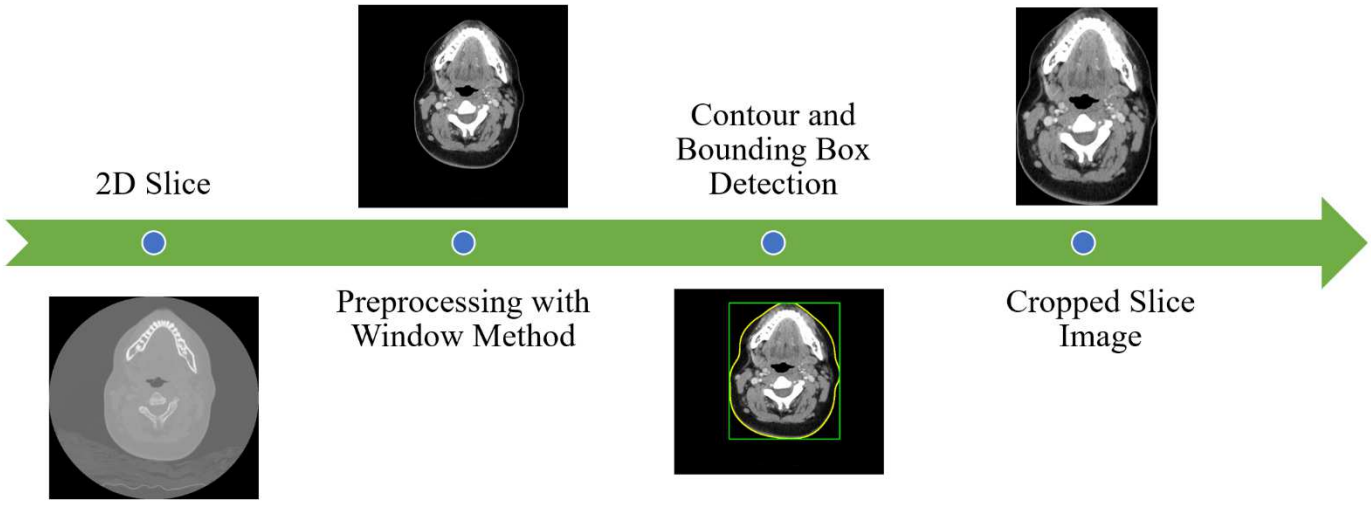

Figure 1. Image Preprocessing technique

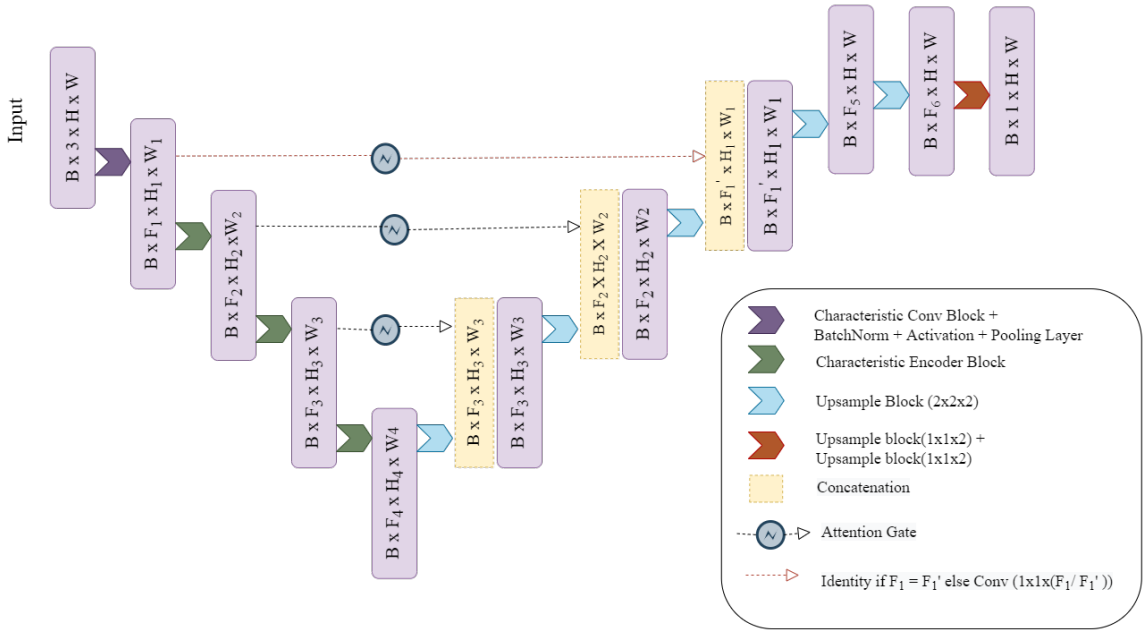

Figure 2. Attention UNet Architecture used for Lymph Node Segmentation Task

Keywords

Applications; Artificial Intelligence/Machine Learning; Clinical Workflow & Productivity; Emerging Technologies; Imaging Research