Lesion Detection using Three-Dimensional CBCT Image Segmentation using Deep Learning

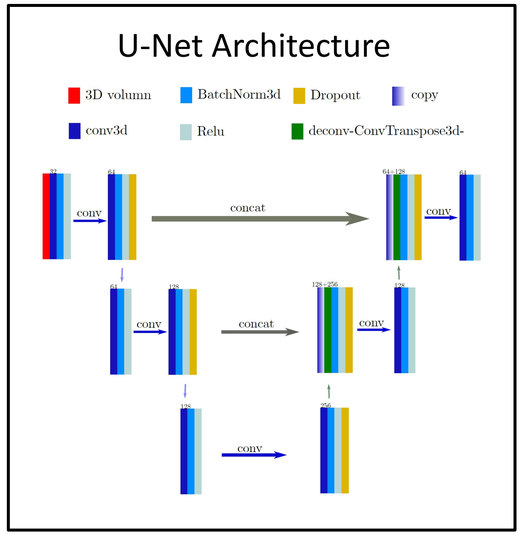
Ajey Musuwathi Rajkumar, Industrial Engineering
Mentor: Dr. Hao Yan, Asst Professor
School of Computing and Augmented Intelligence

Research Project Objective

- The goal of this project is to implement an efficient and accurate 3-D semantic segmentation on CBCT dental imaging for accurate lesion detection using a 3D U-Net method.
- Applying this technology in diagnostic medical imaging can lead to early detection of various types of lesions, which is vital for medical diagnosis.
- In this project, the research team utilized high-resolution 3D CBCT images for lesion detection and performed a multi-class segmentation on the collected data from the medical school of the University of Pennsylvania.
- Finally, the research team used the deep 3D U-net architecture that presented a network and a training strategy that relies on the substantial use of the data augmentation techniques for the annotated samples.

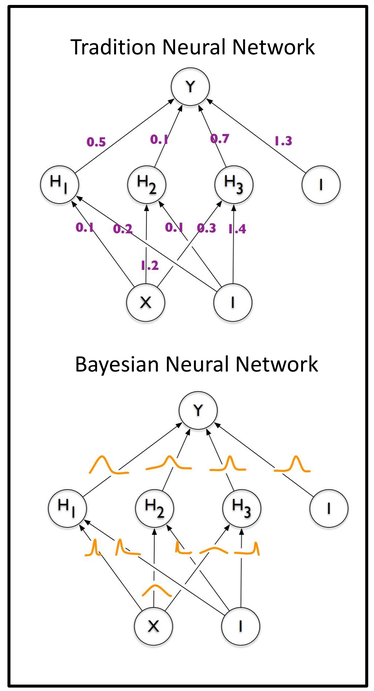
Research Project Background

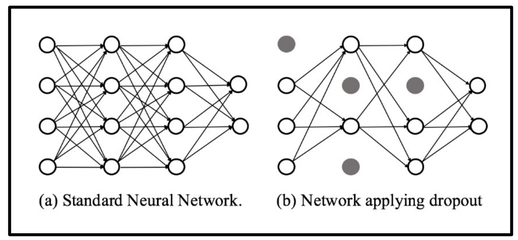
- This project is being done in collaboration with the team from the department of endodontics and department of oral medicine at the university of Pennsylvania who collected the data samples and labelled them for our deep learning training.
- We collected around 35 high resolution samples with an input criteria and processed them into a suitable format for training our model.
- The model architecture used was a Bayesian U-Net with the approximate structure shown below.



Methodology

- The 3D image data received was in 16-bit format and the higher resolution was maintained to preserve information.
- Data normalization was also performed to aid in faster training times
- A method of regularization using dropouts was implemented to prevent overfitting and make the model robust to a wider range of data and account for all the different angles and views.
- For model evaluations, different metrics were measured and studied to better the model. The accuracy metric and the f1-score were the main focus as these metrics presented a holistic picture of the model prediction.
- In addition to the evaluation metrics, we also studied the uncertainty outputted by the model and produced variance maps to further understand the areas where the model needs to improve.





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