MED-SAM and UNet for Surgical Tool Segmentation: A Comparative Analysis

452 Final

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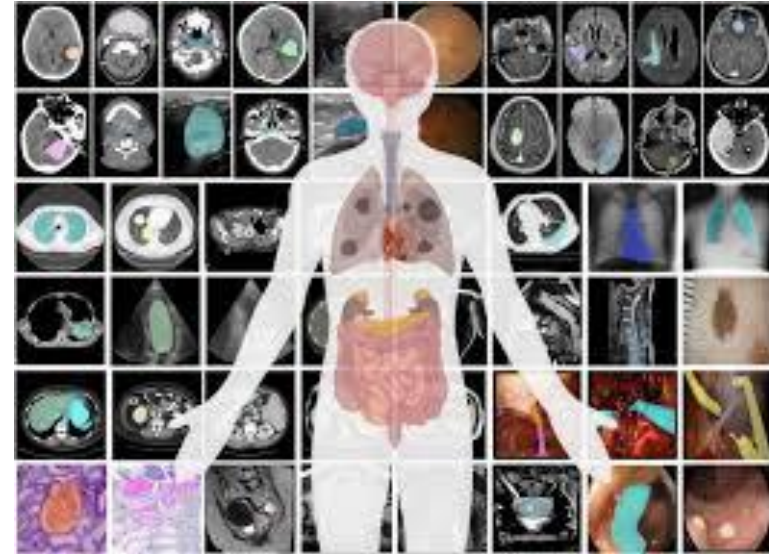
Slides Contain Surgical Images Ahead
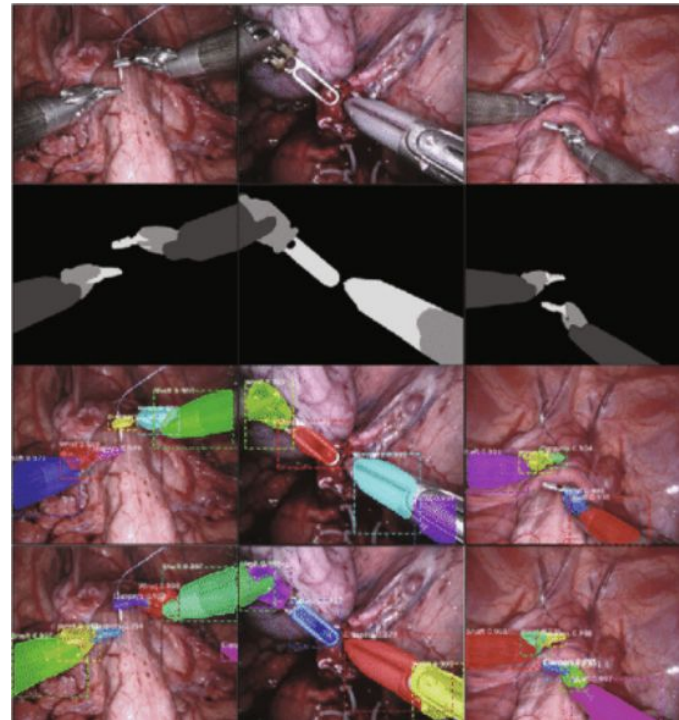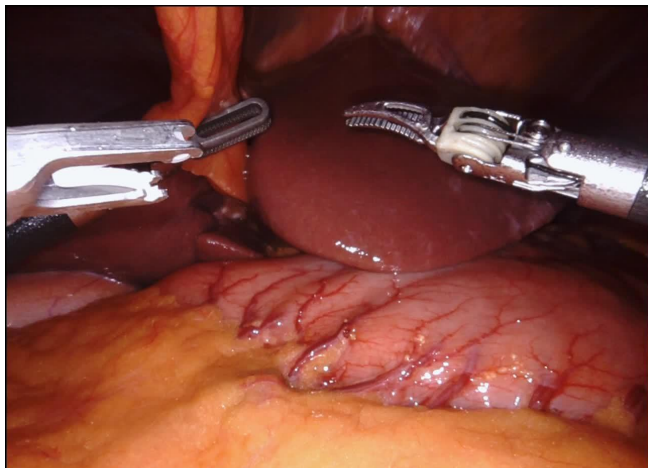
Motivation

- Image segmentation in the medical field
- Use Cases
    - Diagnosis
    - Disease Monitoring
    - Tumour Detection/ and Monitoring
    - Tissue identification
    - Anomaly and Artifact Detection
    - Pathological Cancer Screening
    - Cell Growth Tracking
    - Etc....
- Impact

Project Description

- Surgical tool segmentation
- Med SAM & UNet comparative analysis

Specific Problem Reviewed

- A specific problem the team reviewed
  - Using the same dataset, researchers developed a model for the scene segmentation of the DaVinci surgical procedures using both real image data, and 3D simulation data at MICCAI 2022
    - Their goal included accurate surgical scene 3D renditions
    - They then published this dataset on Kaggle for public use
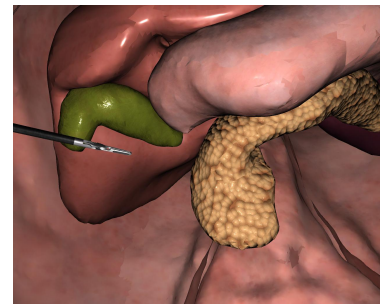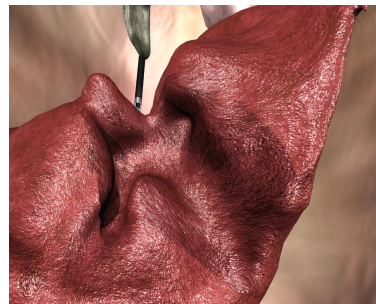
Reference Study for MED-SAM

- "Segment Anything in Medical Images"
- Aimed to use MED-SAM as a general segmentation tool
- Accuracy varies with image clarity

U–Net Reference Study

- "Medical Image Segmentation Using Automatic Optimized U–Net Architecture Based on Genetic Algorithm"
    - This study aimed to improve U-Net performance using a genetic algorithm

Another U-Net Reference Study

-   "Half-UNet: A Simplified U-Net Architecture for Medical Image Segmentation"

Similar Datasets

1. Kvasir-SEG Dataset (https://www.kaggle.com/datasets/debeshjha1/kvasirseg)
2. TotalSegmentator Dataset (https://github.com/wasserth/TotalSegmentator)
3. Promise12 Dataset (https://paperswithcode.com/dataset/promise12)

Our Dataset

Surgical Scene Segmentation in Robotic Gastrectomy

- https://www.kaggle.com/datasets/yjh4374/sisvse-dataset/data
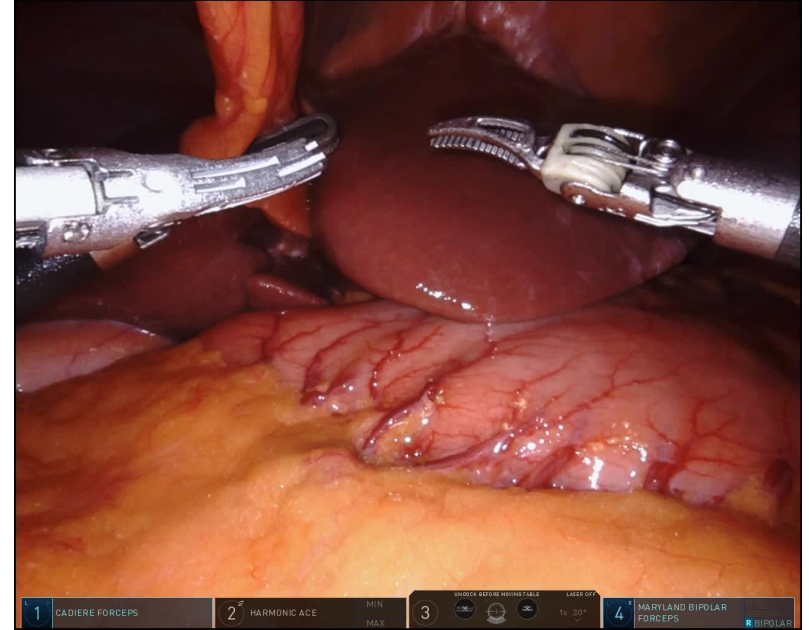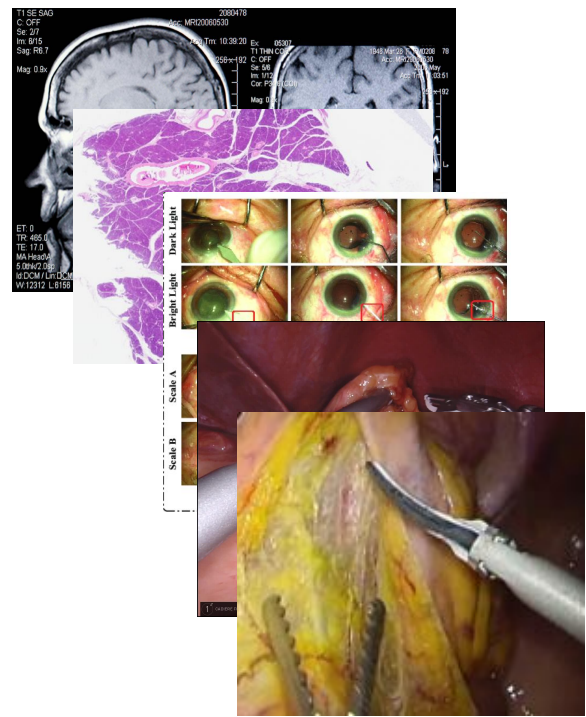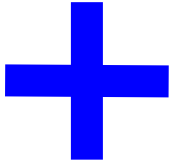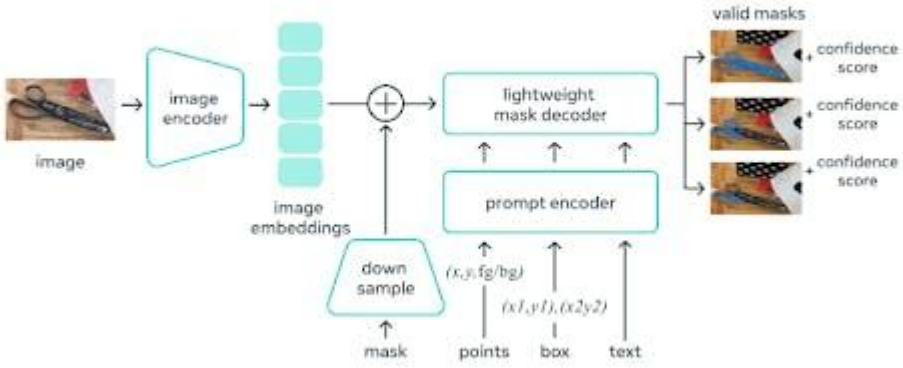
What is Med SAM

- Segment Anything Model fine-tuned for usage in the medical imaging domain
- Developed by the Bo Wang laboratory at the University of Toronto
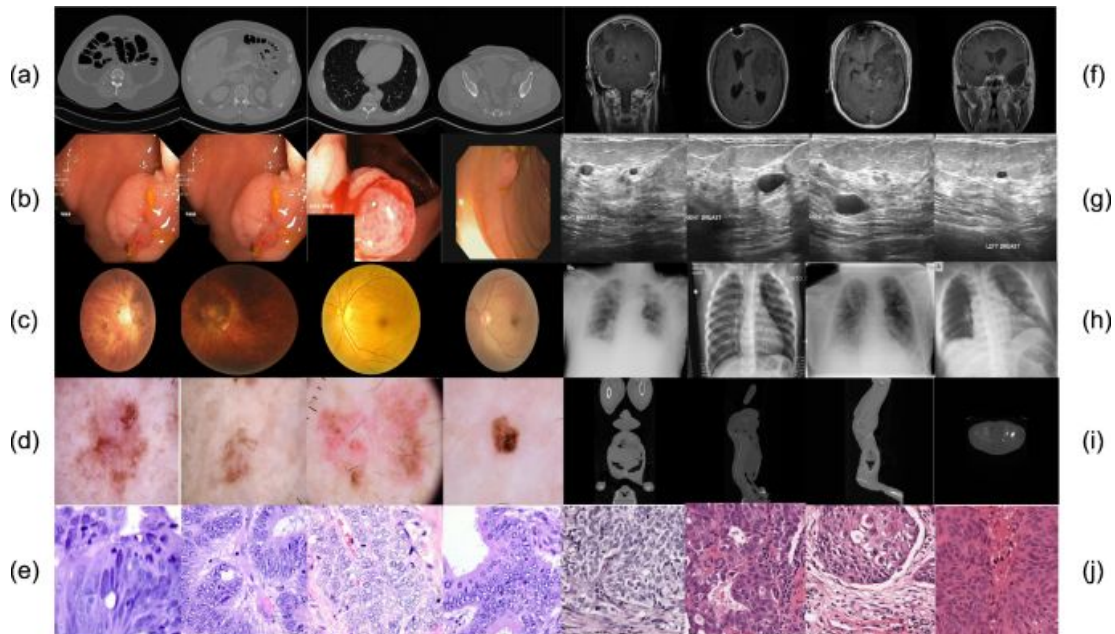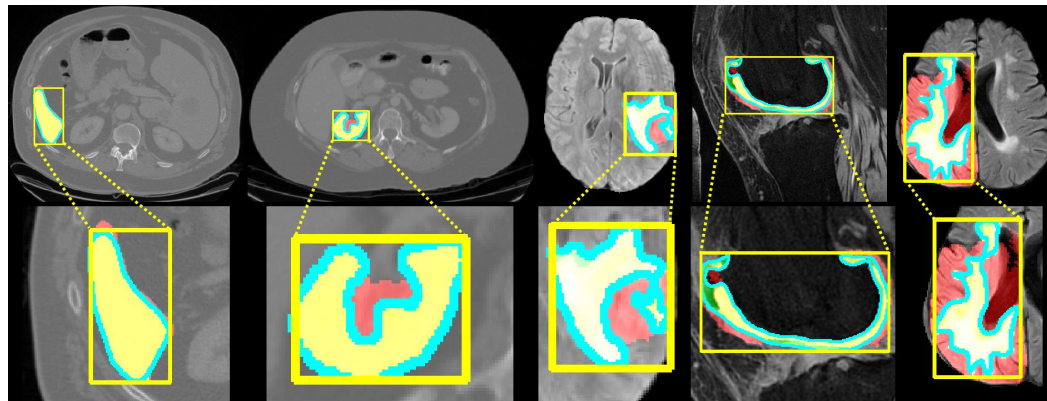
Med SAM Architecture
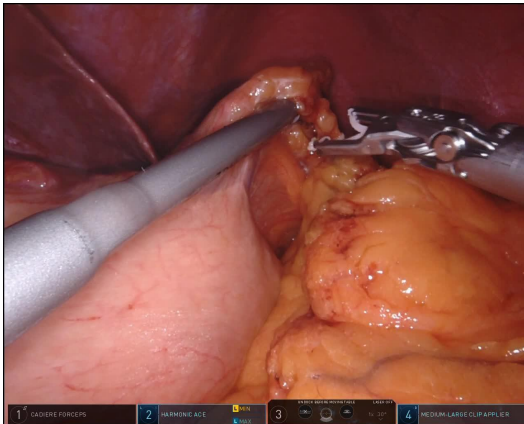

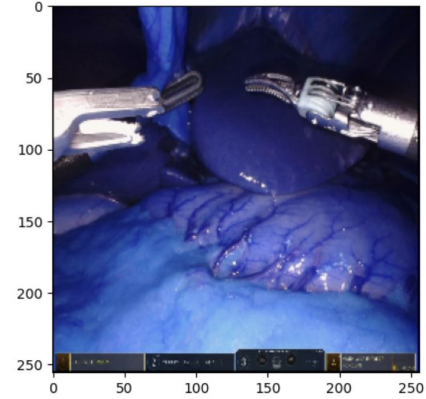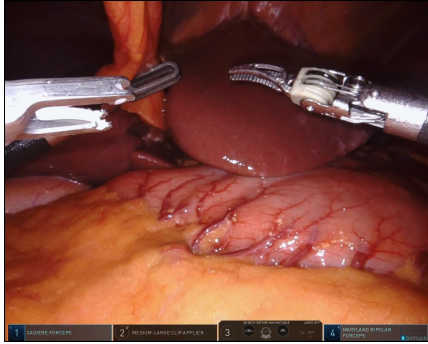Universal segmentation model

Why We Chose Med SAM

- Open Source
- Sufficient Documentation
- Fine Tuned Segment Anything Model
- Available GUI support
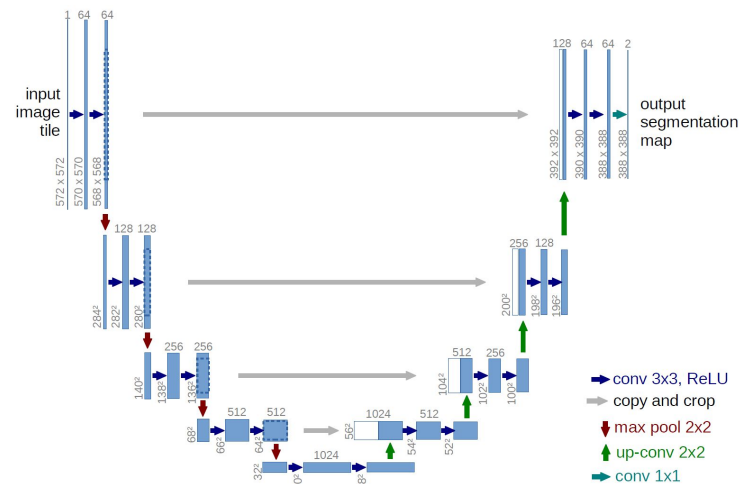
Results I: Tool Segmentation Using Med SAM

Predicted mask

What is U-Net

- U-Net is a CNN
- It segments images by classifying pixels

U–Net Architecture

U-Net is a CNN Made up of:

1. Encoder
2. Bottleneck
3. Decoder
4. Output Layer

Why we chose U-Net

- It is meant for segmentation
- U-Net is very applicable in Biomedical Settings
- Computationally efficient

Results II: U–Net

The finished U-Net code with results was only on one device which stopped working earlier today when we were finishing the slide-show. If we can't get it to work soon, we will take it to Canada Computers and Electric to repair the device and retrieve the results.
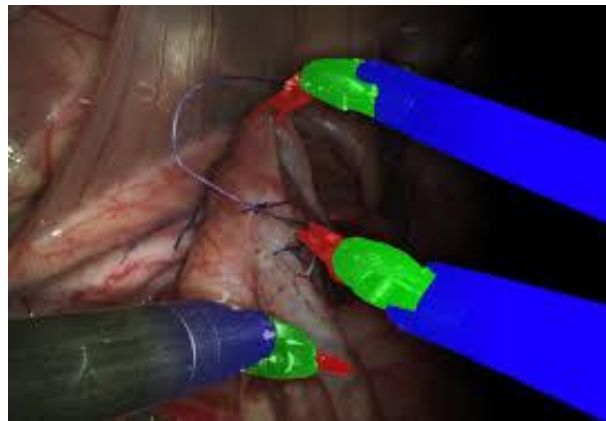
Results will be delivered ASAP.

Future Directions

Our Next Steps for the Project:

- Fixing UNet Results technical issue before final submission
- Getting a mask on the surgical tool itself with Med SAM
- Getting numerical results to accompany out final results for the final report

Conclusion

- We found that Med-SAM was efficient and effective in segmentation of the DavinCi surgical tools in relation to organic tissue