Cleveland Clinic Innovations

Microsurgical and Supermicrosurgical Decision Support System

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PRODUCT

An AI-based platform capable of processing images from intricate surgical procedures to offer real-time clinical decision support.

VALUE PROPOSITIONS

Create clinical decision support for micro and supermicro surgery

Increase quality of surgical outcomes

Enhance new surgeons training and intra-procedure decisions

Reduce cognitive load and fatigue

DEVELOPMENT STAGE

A prototype solution has been developed at the Cleveland Clinic. The next phase of technology development will complete in early 2025.

INTELLECTUAL PROPERTY

Currently filing patent application

CONTACT INFORMATION

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UNMET NEED (PROBLEM)

Microsurgery and supermicrosurgery are highly specialized surgical disciplines involving the use of high precision instruments and advanced magnification techniques with operative microscopes to perform intricate procedures on small, delicate structures noted to be 0.3 to 0.8 mm. Tissue transfers, nerve coaptations, intricate anatomic dissections and lymphatic surgery can be life and limb saving. These surgeries often require exceptional skill, and keen attention to detail. Highly specialized training is required, and the learning curve can be steep. Implications of technical errors during surgery can result in compromised patient outcomes and great expense for both the patient and the healthcare system. Surgeons are required to make decisions during these delicate operations relying on their expertise, experience, and manual dexterity. However, inadequate practices may arise in certain situations due to several limiting factors:

- Strained visibility and depth perception
- Fatigue and cognitive load
- Lack of available training scenarios introduces long lead time to surgical expertise
- Clinical decision support based upon the anatomy, the instruments, or the specific surgical procedure

The inventors believe that technical limitations and challenges remain despite advancements in the field and that these can be overcome with the application of artificial intelligence.

SOLUTION

The inventors have enabled an artificial intelligence informed, computer vision based, surgical decision support systems will help individual surgeons, and their surgical teams optimize microsurgery and supermicrosurgery procedures and related outcomes. Early enablement has demonstrated proof-of-concept. The next phase of enablement has started with a focus on hardening the existing image and video processing pipeline, optimizing existing method for vessel edge and instrument detection, the introduction of clinical decision support, and establishing real-time processing benchmarks.

Focusing on lymphatic vessels, the inventors have demonstrated feasibility of image recording, image processing, and model-based identification of an instrument and anatomical structures.

- Gather surgical field recordings and separate high-level image frames
- Label images to identify one type of instrument (Figure 1) and vessel edges (Figure 2)
- Apply image processing model with convolutional neural network (CNN) foundation
- Add image overlay to instruments and vessel edges.

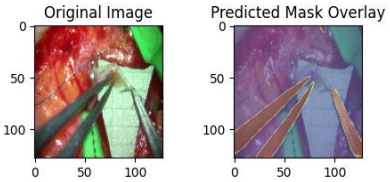

Figure 1 Instrument Detection

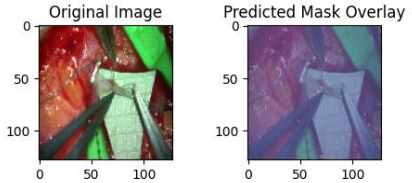

Figure 2 Vessel Edge Detection