Date: 11/17/2021

Project Title: 'Microsurgery without instruments'
Virtual augmentation of the surgical field to allow surgeons to explore obscured angles through real time hiding the instruments from the surgical scene.

Objective: To develop an image processing toolbox that provides real-time surgical scenes in which the surgical instruments look transparent.

Introduction: Nowadays, minimally invasive surgeries are the most advanced surgical modalities in many specialties. These techniques have several advantages in comparison to classic surgical procedures such as minimizing tissue trauma, shorter surgery time, rapid postoperative recovery, and shorter postoperative hospital stay. Minimally invasive and image-guided surgery are becoming more applicable and routine by incorporating advanced image computer vision techniques in capturing and processing videos of surgical scenes. Still, inherent limitations such as narrow surgical corridors induce challenges such as obscured surgical scenes that affect the surgeon's view of wider tissues in which they are operating. To improve the surgical view while performing through these narrow corridors, we would like to introduce an image processing toolbox that will eliminate the instrument from the captured surgical scene and subsequently improve the view and perception of scenes for surgical teams.

Methodology and Tasks: In this project, we will work with a multi-camera setup that provide two different but complementary views of the scenes during microscopic procedures.

- The Performer (P) view will be captured by the microscopic camera and will represent the normal view seen by the performer looking at the surgical scene containing the instrument.
- The Observatory (O) view will be capture by the supporting endoscopic camera and will represent the view of the region hidden from view by surgical instruments.

The main tasks in this project are summarized as follows:

1. The O view is rendered and transformed to simulate P view, segmented to the shape of the hidden regions, and superimposed to the P view, so that the surgical instruments look transparent.
2. The processing time and superimposition rendering error are calculated.
3. After an initial exploration and implementation using a non-clinical setup, the toolbox will be evaluated in a simulated, clinical training environment.

Practical Information: The Interactive Technologies research group at the School of Computing, the Department of Applied Physics, and the Microsurgery Center of Eastern Finland at Kuopio University Hospital. **The ideal candidate** is working towards their master's degree in computer science, applied/medical physics, photonics, computer/electrical/mechatronics engineering, or related fields. Being familiar with computer vision, linear algebra, 3D vision (or being willing to learn it), and programming in OpenCV, MATLAB, or Python environments are required. The candidate can work on this project for a duration of 4 to 6 months to satisfy their internship or degree requirements. To apply, please send your **course transcripts, academic CV, and a short cover letter** stating your background and academic plans to project supervisors listed below by **December 3, 2021**.

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