Utilities for HMD Based Medical Training
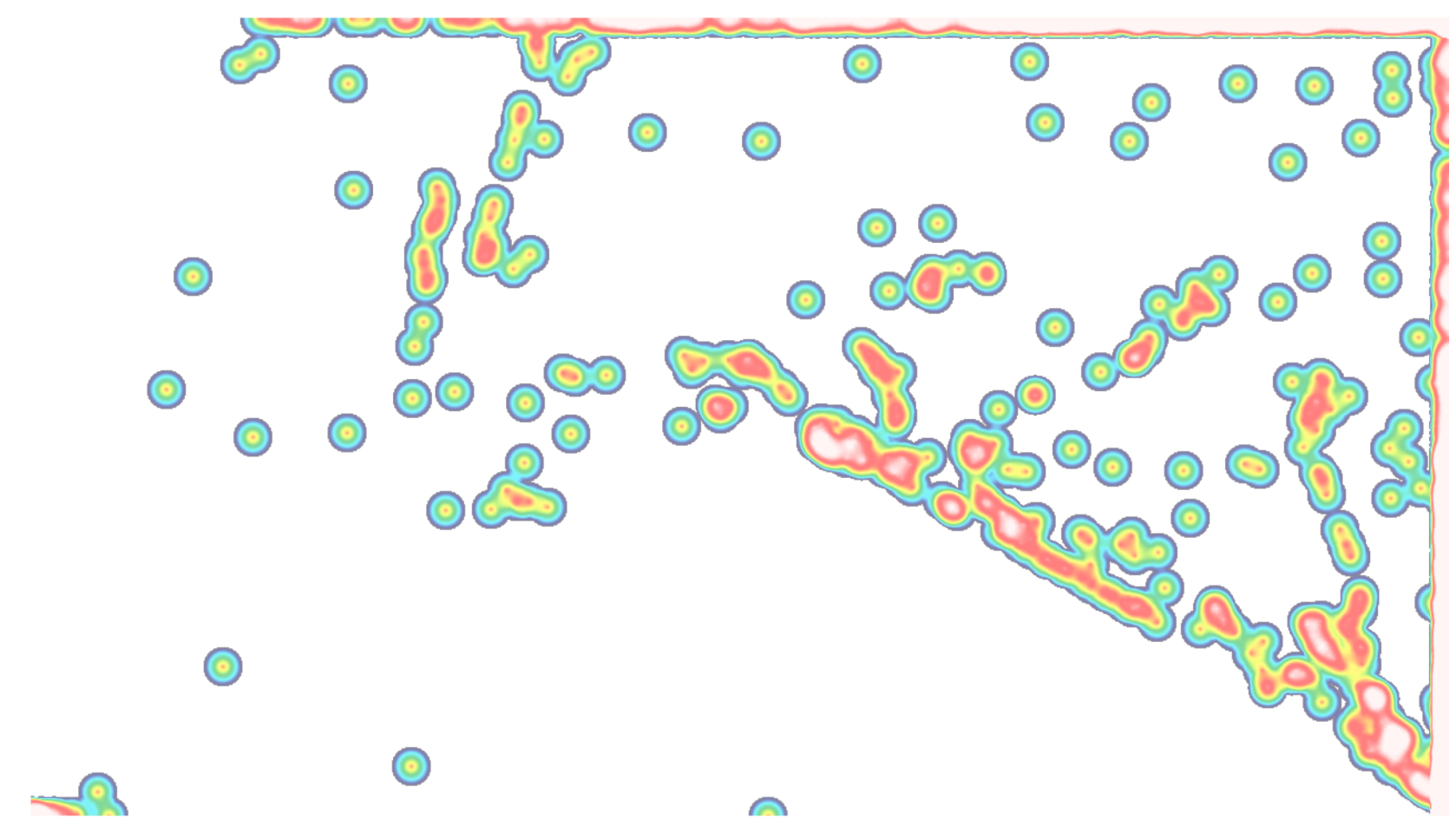
Computer Integrated Surgery II
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Team Members: Allan Wang, Prateek Bhatnagar
Mentors: Ehsan Azimi, Chien-Ming Huang, Peter Kazanzides, Nassir Navab, and Camilo Molina

Introduction

- This project consists of two key utilities:
  - **Semi-automated tutorial generation:**
    Users can use a HMD to generate text and image based tutorials using voice commands to navigate
  - **Eye gaze tracking and heatmapping:**
    Eye gaze of the user is tracked during the medical procedure to analyze the positions in the scene they are looking at this may be used for performance evaluation and UI optimization
- These tools will be used in conjunction with an existing training application that runs on the HoloLens. These tools allow for seamless creation of training experiences for the training application as well as provide gaze data for analysis.

The Problem

- Use of head mounted displays (HMDs) for training of medical procedures provides an intuitive and repeatable way to teach complex techniques and develop muscle memory. In their current state the creation of new medical procedure modules for this type of training is done by hand and is a long and time intensive activity. Furthermore, there aren't any performance analytics, or supporting information of the test subjects in the current training systems

- Most augmented reality (AR) based medical training systems are in their infancy. There are no tools that allow for typical medical professional to easily create or utilize HMD-based tutorials.

- In order to promote acceptance of these types of medical training systems, ease of use and the ability to provide analytics and intelligent feedback based on the users would be will be key factors.

The Solution

- Our mentor, Ehsan Azimi, has created a tool that reads tutorials from JSON and image files to generate tutorials; thus, our aim was to expand this training toolkit to facilitate tutorial creation and feedback.

- We have implemented a HMD-based tool for users to readily create text and image based tutorials, as well as a software module to collect eye gaze tracking data while a user is learning from a tutorial.

- We used the Microsoft HoloLens and Pupil Labs binocular eye tracker add-on for our implementation.

- Unity was used to create the tutorial generation app and as the frontend for the eye-tracking software.

Workflow for tutorial generation

Transparent Heatmap of User eye-gaze tracking data

Outcomes and Results

- Tutorial Generation Tool:
  - This implementation utilizes Microsoft's Speech Recognition libraries for dictation and voice commands.
  - The HoloLens web camera is used to capture images at each step.
  - Final output is a JSON file with the text, and directory with image files. This can be read and displayed by the existing software.

- Eye gaze Tracking:
  - Uses a remote PC with proprietary pupil labs software along with Python backend scripts to generate heatmap from gaze input
  - HoloLens Application that works in conjunction with the Remote PC to display Heatmap Data

Future Work

- Part of our team will continue working on the project in order to enhance the analytics capabilities with regards to the eye gaze tracking capabilities and analysis and expand it to be useful in a 3D work environment
- Furthermore, the goal of integrating our teams modules with our sister project team that is working on specialized training of particular procedures is also a an area that will be worked on
- Future implementations should add the ability to create virtual markers

Lessons Learned

- The Microsoft HoloLens is a powerful educational tool, but it's software capabilities are still limited to programmers.

Credits

- Tutorial generation tool: Allan Wang
- Eye gaze tracking tool: Prateek Bhatnagar

Publications

- Azimi, Ehsan, et al. Evaluation of Optical See-Through Head-Mounted Displays in Training for Critical Care and Trauma.
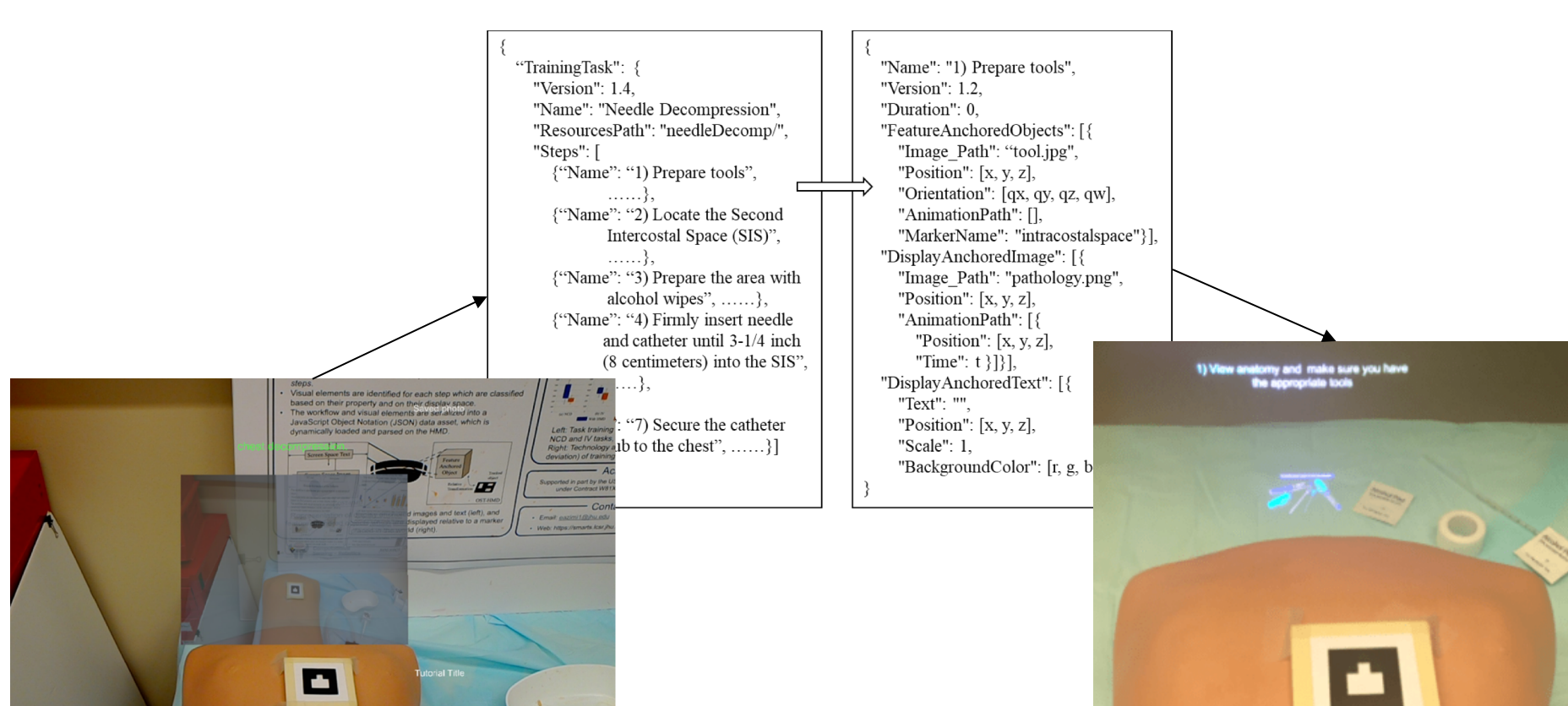
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