AR-Assisted Medical Training:

Tutorial Generation & Eye Gaze Tracking Analysis

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Review of Project and Goals

- Create a software tool to facilitate the **semi-automated creation** of medical training tutorials
  - Capture speech and visual data
  - Provide a user-friendly AR interface to generate JSON training files
- Use **eye gaze tracking data** to facilitate performance analysis
  - Facilitate image capture for tutorials
  - Generate heatmaps during training
Current State: Tutorial Generation

- Voice commands implemented
  - “Next,” “Snap,” “Start recording”
- Dictation implemented
  - Saving to JSON files
- Images can be saved
Current Functionality
Software Structure
Current State: Gaze Tracking

- Gaze Tracking works!
  - Gaze tracking calibration works
  - The Capture service is able to stream the tracked eye coordinates
- The Unity application is able to
  - Display a generated Heatmap
  - As well as aid with calibration
- The current workflow:
  - Pro - It works
  - Con - Its very inefficient
  - Requires a small overhaul
Control Flow for Heatmap

- Start
- Start Pupil Capture Service
- Detection For both eyes is enabled and HMD Relay is engaged
- Perform HMD to Pupil labs calibration
- Load Calibration scene
- Heatmap Visualization scene loaded
- Display cumulative Heatmap to Hololens
- Current Heatmap
- End

- Calibration data - stored temporarily by pupil capture service
- Gaze Tracking Data streamer started
- UDP Stream
- Coordinate Position Receiver
- Heatmap generation module

Colors:
- Executing on Remote Machine
- Executing on Hololens
Current Functionality: Gaze Tracking

Black is set to be Transparent for the Hololens
Documentation

- Currently using Github to track changes
- Code has been commented
- OneDrive Used as a secondary backup

```csharp
public void OnDictationStart()
{
    renderer matériel.color = Color.red;
    dictationOutputText.color = Color.red;
    ToggleRecording(); // toggle dictation recording
}

public void OnNextStep()
{
    stepCount++; // increment step counter
    stepCountDisplayText = "Step " + stepCount.ToString(); // update step number
    dictationOutputText = "Say, \"Start recording\" to record text.\"; // reset instructional text
    cameraStatusText = "Camera ready"; // reset camera status
    renderer matériel.color = Color.white;
    dictationOutputText.color = Color.white;
}
```
Progress

- **Minimum**
  - Working demo of tutorial editor ✔
    - *Speech-to-text ✔*
    - Generation of 2D heatmap of gaze ✔

- **Expected**
  - Working demo of tutorial editor
    - *Speech-to-text ✔*
    - *Image capture, In Progress*
  - Generation of 2D and 3D heatmap of gaze
    - *In Progress*

- **Maximum**
  - Working demo of tutorial editor
    - *Speech-to-text*
    - *Image capture*
    - *Marker creation*
    - *Expertise levels*
  - Using 3D and 2D gaze tracking heatmaps to optimize processes
  - Testing with ventriculostomy procedure under guidance of medical professional
Potential obstacles

- **Tutorials**
  - Displaying captured image to a texture in Unity to have a “live preview”

- **Heatmaps**
  - Interface between spatial heatmap and captured image
  - Streaming Heatmap related data to and from the hololens
  - Possible Inability to run python directly on the Hololens itself - there seems to be no ‘EASY’ way

- **Recording Video off the Hololens**
## Upcoming Milestones

<table>
<thead>
<tr>
<th>Date</th>
<th>Milestones</th>
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<tbody>
<tr>
<td>March 18</td>
<td><strong>User Interface ✔</strong>&lt;br&gt;  - Able to accept voice commands&lt;br&gt;  - Synchronizing with video feed</td>
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<td>March 31</td>
<td><strong>Text-to-Speech &amp; 2D Heatmaps ✔</strong>&lt;br&gt;  - Able to generate text-based tutorials&lt;br&gt;  - Gaze-tracking implemented with 2D heatmaps</td>
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<td>April 15</td>
<td><strong>Image Capture, Working Demo &amp; Single User Trial</strong>&lt;br&gt;  - Tutorials include both text and images&lt;br&gt;  - Have neurosurgeon create training module</td>
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<td>April 28</td>
<td><strong>Marker Creation &amp; 3D Heatmaps</strong>&lt;br&gt;  - Implement ability to create virtual markers&lt;br&gt;  - 3D heatmaps added</td>
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<td>May 6</td>
<td><strong>Final Report &amp; Demo</strong>&lt;br&gt;  - Have demo ready for live demonstration&lt;br&gt;  - Complete final report and presentation</td>
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Immediate Goals

- Complete photo capture: Generated tutorials will now be able to match the manually created JSON training files
- Integrate gaze tracking as a parallel process with the generator app
- Optimise Workflow for gaze streaming implementation
1. Evaluation of Optical See-Through Head-Mounted Displays in Training for Critical Care and Trauma.