Data Collection System for Smart Endoscope Project

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Background

• What is Sinusitis?

• What is Sinus Surgery? [2]
  - Traditional
  - Ballon
  - Endoscopic (FESS)
Motivation

- Surgeons have to manually operate the endoscope during the entire operation.
- The whole surgery can take up to one and a half hours.
- About 260,000 sinus cases performed in the US annually. [3]
- Endoscopic Sinus Surgery has been becoming the mainstay. [4]
Proposed Solution

REMS by Galen Robotics

+ 

Machine Learning

= 

Smart Endoscope + a happy Dr. Ishii :)
Project Scope

- Robot Development
- **Experiment Design and Setup**
- **Experiment and Data Collecting**
- **Data Processing**
- Machine Learning

...
Technical Approach

- Monitor and Gaze Tracker
- Endoscope
- Pointer Tool
- Head Sensor
- Flat Field Generator
- EM Tracker
- Windows Box
- Linux Box
- Data Log

Heat Map
Video Stream
6DOF Sensor Data
Positions and Orientations
6DOF Sensor Data
6DOF Sensor Data

Long Sequence
2D Coordinates
Long Sequence
6D Coordinates

Video Stream
Video Stream
6DOF Sensor Data
6DOF Sensor Data

CT, SSM Registration; Label Propagation; Analysis…
Technical Approach

• Tracking System Integration
  • Aurora EM Tracking System
  • 3 6DOF Sensors
  • Flat Field Generator
  • Gazepoint Gaze Tracker
• Tool Adapters Design
  • Pointer Tool
  • Endoscope Sensor Adapter
  • Head Sensor Adapter
Technical Approach

• Data Logging System

  • Linux OS: Arurora Software/SDK, ROS

  • Windows OS: Gazepoint Software/SDK
Apparatus/BoM

1. Aurora System (Ordered)
   1. Aurora 6DOF Reference, 25mm Disc  x 2
   2. Aurora 6DOF Cable Tool, 2.5 x 12mm
   3. Aurora 6DOF Probe
   4. Aurora Tabletop 50-70 Field Generator
   5. Aurora V3 System Control Unit Kit
   6. Aurora 4-port Sensor Interface Unit

2. Gazepoint GP3 Eye Tracker (Ordered)

3. Monitor for Endoscope Video Streaming

4. Windows Workstation

5. Linux Workstation

6. 3D Printed Adapters
Deliverables

• **Minimum**: Hardware for a functional data collecting system.

• **Expected**: Hardware and software for a functional data collecting system.

• **Maximal**: Hardware and software for a functional data collecting system; data post processing program.
## Dependencies

<table>
<thead>
<tr>
<th></th>
<th>Dependency</th>
<th>Solution</th>
<th>Alternative Plan</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tracking Systems</td>
<td>Communicate with Dr. Taylor and Dr. Huang</td>
<td>Borrow similar equipment from Dr. Boctor</td>
<td>Solved</td>
</tr>
<tr>
<td>2</td>
<td>CAD Program</td>
<td>Download thru WSE Software Support</td>
<td>Student Design Lab/ CIIS Lab</td>
<td>Solved</td>
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<tr>
<td>3</td>
<td>3D Printers and Machine Shop</td>
<td>Contact WSE Manufacturing</td>
<td>Contact Outside Vendors</td>
<td>Solved</td>
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<tr>
<td>4</td>
<td>Familiarity with Surgery Process</td>
<td>Contact Dr. Ishii to shadow real cases</td>
<td>Read Papers about FESS</td>
<td>In Progress</td>
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<tr>
<td>5</td>
<td>Familiarity with Surgical Tools</td>
<td>Communicate with Dr. Inshii and Dr. Iordachita</td>
<td>Contact Dr. Razavi</td>
<td>In Progress</td>
</tr>
<tr>
<td>6</td>
<td>Experience with Tracking Systems</td>
<td>Communicate with Dr. Taylor and Dr. Boctor</td>
<td>Contact Equipment Manufacturers</td>
<td>Planned</td>
</tr>
<tr>
<td>7</td>
<td>Experience with ROS</td>
<td>Taking Robot System Programming with Dr. Whitcomb</td>
<td>Contact Paul Wilkening</td>
<td>In Progress</td>
</tr>
<tr>
<td>8</td>
<td>Gazepoint Software Able to Log</td>
<td>Communicate with Dr. Huang, Cong and Xingtong</td>
<td>Contact Gazepoint</td>
<td>Planned</td>
</tr>
<tr>
<td>9</td>
<td>Continuous Feedback from Mentors</td>
<td>Schedule a weekly meeting</td>
<td>Communication thru Emails</td>
<td>In Progress</td>
</tr>
<tr>
<td>10</td>
<td>Availability of Dr. Ishii</td>
<td>Schedule ahead with Dr. Ishii</td>
<td>No Alternative</td>
<td>Planned</td>
</tr>
</tbody>
</table>
Schedule

Milestones

1. Project Proposal
2. Tool Adapters Design Completion
3. Hardware Integration Completion
4. Software Development Completion
5. First Test and Troubleshooting
Management Plan

1. Weekly meetings with mentors

2. Follow schedule and milestones

Reading List

Reference

1. MAYO FOUNDATION FOR MEDICAL EDUCATION AND RESEARCH. https://www.mayoclinic.org/endoscopic-sinus-surgery/img-20007106
2. AMERICAN SINUS INSTITUTE. https://www.americansinus.com/types-of-sinus-surgeries/
Q&A