INTRODUCTION

Background
- 17,700 new spinal cord injuries in the United States each year
- A corpectomy (removal of a vertebra) followed by the insertion of a system to stabilize the spine is often needed to prevent further injury and complications

Problem
- Training methods for corpectomies are limited, leading to support staff needing excess time and help identifying required tools/components

Needs Statement
- An augmented-reality application to improve training processes for, effectively teach about, and assist OR staff during spinal surgery in proper instrument recognition and use.

PROPOSED SOLUTION

Final Design
- An augmented-reality application built in Unity for the Microsoft HoloLens 2 that helps scrub techs to train and gather information on the tools in the T2 Corpectomy System
- The scrub tech begins the training by staring at a specific physical marker to bring up a holographic menu containing a family of tools
- Tools can be selected to bring up additional information such as their name, description, and a gif of how to use or assemble the tool
- Below is an example scene of the tool menu as scene by the HoloLens
- The scrub tech can move around the tool, rotate it, and alter its size for better viewing

Tool Menu
- The scrub tech can select specific tools on the menu using a head gaze and pinch command
- The scrub tech’s head gaze is shown with a small, opaque circle. To select an object, they place their head gaze on the object and perform a pinch command anywhere in space
- We originally wanted to use a head gaze and dwell command to select tools but could not get this method working

IMAGE TARGET RELIABILITY TESTING

Methods
- Tested ability of HoloLens 2 to identify different image targets at varying distances and at different distances

Results
- HoloLens 2 was able to correctly and reliably identify different image targets in different orientations in the same viewing space
- HoloLens 2 was able to correctly and reliably identify images of targets at distances ranging from ~30cm to ~110cm
- Image targets provide a reliable method of user interface with the training system

3D TOOL MANIPULATION TESTING

Methods
- Tested HoloLens 2’s responsiveness to hand movements and intended tool manipulation

Results
- HoloLens 2 was able to correctly and reliably track the user’s hand movements
- Intended tool manipulations were correctly tracked
- Due to current application settings, tools were only manipulable if in the very center of the HoloLens’ field of view

CLINICIAN FEEDBACK

Methods
- Provided Medtronic and two surgeons (Dr. Chua & Dr. Rajpal) with a prototype application/presentation to determine optimal uses and additional functionality

Results
- Ultimately determined that our application will likely be used as a training tool outside of the operating room
- Suggested inclusion of images, instructional videos, etc. to provide user with additional information about each tool
- Interactive learning with tools & components has great potential in clinical setting

MANUFACTURING COST, MARKET ANALYSIS, PATENTING, REIMBURSEMENTS

Manufacturing Costs
- HoloLens 2 is $3500; outsourced
- No other physical components to manufacture
- Programming costs over the semester estimated ~$10,000

Market Analysis
- Overall Market: Spinal pain industry costs the US $88 billion per year
- Target Gap: A high efficacy, low cost system to help lower surgery cost
- Market Size: The 1.62 million spinal surgery patients and their hospital staff can benefit largely from the system
- The main userbase will be the OR staff, making the main customer target being the hospitals purchasing this system for its employees
- System costs will be offset by increased surgery efficacy and efficiency, limiting end effect on costs for the patients

Patentability
- No patent pending for our solution
- Actual product (software) not patentable because it is a form of text
- Solution workflow too ideologically simple to patent (it is just another method of training)

Reimbursement
- Our application will be integrated with Medtronic’s T2 Corpectomy System, typically used for medically necessary corpectomies that are already covered by Medicare
- Increase in price of the procedure may or may not occur
- If there is an increase in price, the patient may or may not see this increase depending on their insurance
- Applicable codes:
  - 63981, 63982: Vertebral corpectomy

CONCLUSIONS

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REFERENCES