Small-Scale Robotic Surgery and Lesion Targeting System

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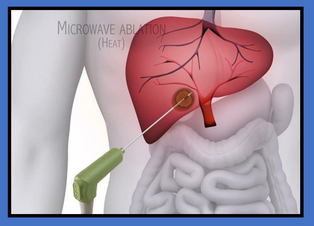
Medtronic

DESIGN CENTER COLORADO

Project Background

- Project Goal: Create an inexpensive, semi-autonomous, portable surgical robot
- Increases accessibility with multiple smaller robots for multiple patients
- Reduces experience required by clinician for performing surgery
- Handles an Emprint Probe for ablation surgery
- Our prototype performs lesion ablation and targeting, but future products could handle different equipment and surgeries

HUGO RAS Surgical Robot



Liver Ablation Procedure

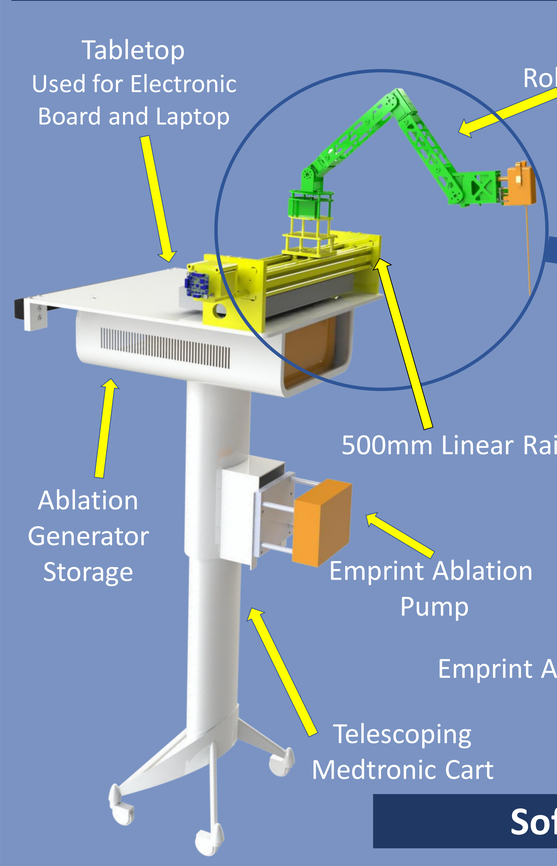
Critical Design Specifications

✓	Size - Less than 150 pounds
✓	Portability - Transportation via cart
✓	Cost - Less than $10,000
✓	Range of Motion - Chest cavity (~20 inches x 10 inches)
✓	Control System - Integrate with Emprint, System Navigation accuracy of +/- 5mm
✓	Minimize Ferromagnetic Material

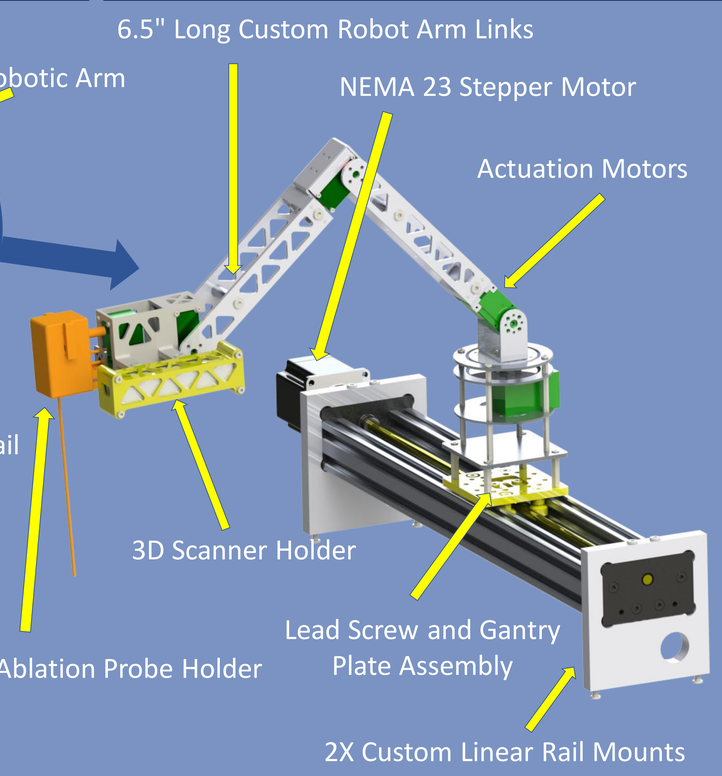
Stretch Goals:

✓	Software - 4 separate modules that operate the robotic system
✓	Targeting Capability - Identify a lesion site

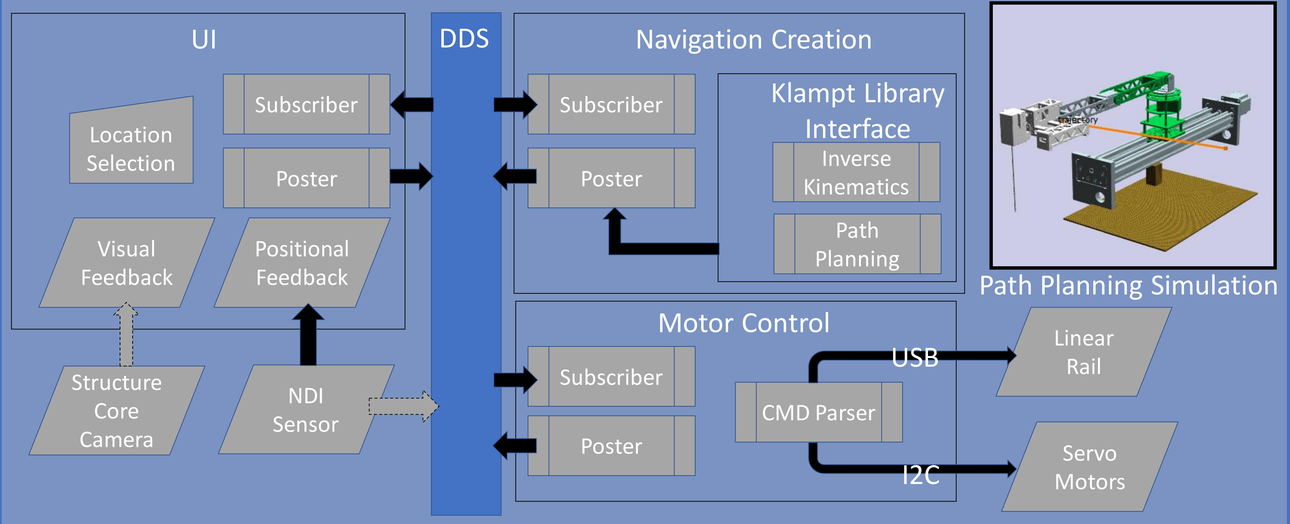
Overall Cart



Robotic Arm



Software System



Path Planning Simulation

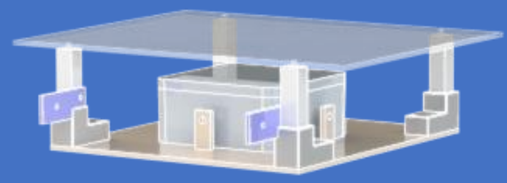
Robot Arm Cascade Servo Motors – 1.47 Nm

Robot Arm Base Servo Motor – 3.43 Nm

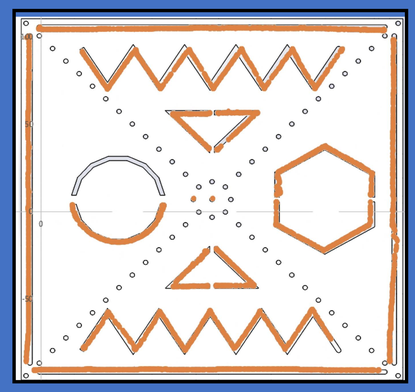
Trinamic TMCM-1140 Controller Board with StallGuard2

Testing

- Motors/Electronics
- Rail Accuracy/Calibration
- NDI Accuracy & Sensitivity



Custom Test Bench



Overlay Image of the Tracking Pattern and the Resulting Graph

Outcomes

- Prototype cost: ~$1500 Design Costs, ~$6500 Total Cost with medical systems
- Prototype Weight: 94 lbs Full Cart/Arm
- Estimated accuracy: +/- 5mm
- Range of motion: 20 inches x 10 inches

Future Steps

- Fully incorporate the 3D scanner & GUI
- Add feedback loop for live corrections from Emprint
- Add plastic shell and design plastic tarp to cover device for sterility

Acknowledgements: Keith Malang | Chris Brown | Andrew Chriss | Derek Westmoreland | Julie Steinbrenner | Daria Kotys-Schwartz | Idea Forge Staff

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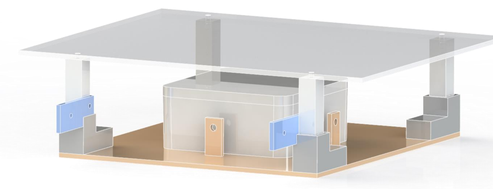

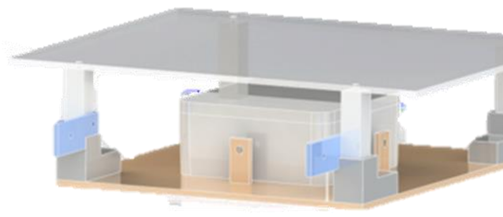

Above is the robotic system that was integrated with Medtronic's Emprint Antenna and is respisible for positioning the probe to a desired location. The Ablation Cart holds all required electronic and hardware equipment necessary for operating the robotic device along with allowing it to be portable. The linear rail (yellow), arm (green), and end effector (orange), are the main components that maneuver the Emprint Antenna over our desired range of motion, the chest cavity.