Carpal Tunnel Release Surgery Simulator

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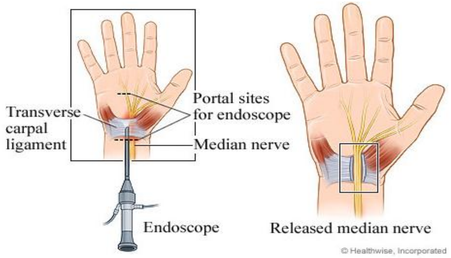
Introduction

Motivation

- Simulators reduce costs and provide a reusable training tool
- No current simulators incorporate haptics and realistic visuals for a low cost



Surgical Background

- The carpal tunnel surrounds the median nerve , which allows for feeling and movement of the hand
- When the hand is overused, the joints and ligaments can become inflamed, resulting in increased pressure on the median nerve
- This pressure results in pain, numbness and tingling sensations known as carpal tunnel syndrome
- Carpal tunnel release surgery is the cutting of the carpal tunnel to relieve pressure on the median nerve
- The surgeon makes a small cut at the base of the wrist and inserts an endoscope, then releases a blade and pulls back, cutting the ligament.

Final Design

Software / Hand Model

- Realistic silicone hand model helps create accurate tension and feeling during surgery simulation.
- Hand can be used repeatedly with minimal wear after each simulation.
- Software allows feedback of the simulated procedure.
- Provides accurate images of the endoscopic view with smoothly transitioning display.

Wii Remote / IR Sensor

- Eliminated unnecessary circuitry of Wii Remote and streamlined design.
- Used the infrared camera technology from the Wii Remote to sense the LED lights and track movement of endoscope during simulation.

Sensor Housing

- Enclosed sensor and microcontroller in affordable electronics box.
- Fashioned IR transparent plastic to one side.

LED Housing

- One issue was that the LEDs stuck out and often fell out of the housing.
- Enclosed the LEDs within the housing and streamlined the circuitry on printed circuit board (PCB).

Testing & Results

Accuracy

- Standard deviation of 0.5 mm

Survey

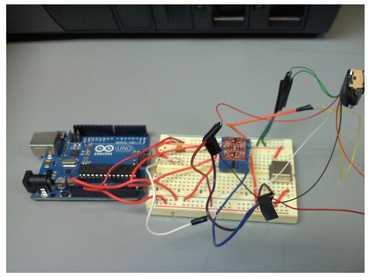
- 10% increase in productivity of simulator

Client Feedback

- Improved professional appearance.
- Client felt the design was a realistic and useful training tool for surgeons.
- Simulator is intuitive and easier to use than previous model.
- Realistic haptics (resistance while cutting).
- Accurate weight.
- Program is easy to use.

Design Criteria

- The simulator should be as realistic as possible
  - Feel and weight of instruments
  - Resistance felt when ligament is cut
- The simulator should have an overall professional appearance
- Ease of use
  - Intuitive setup and operation
  - External devices must not interfere with surgical procedure
  - Hardware must easily communicate with software
- Durable
  - Must withstand repeated simulations
- Accurate Feedback
  - 1 mm precision of movement



Future Considerations

- Find a sensor similar to the one found in the Wii.
- Order the PCB boards and solder the components.
- Smoother transitions between picture frames.
- Integrate calibration memory.
- Replicate the device to have two functional simulators.
- Create application to call and run the simulator.
- Allow compatibility for both PC and Mac.

Acknowledgements & References

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[1] Husney, MD, Adam, and David Pichora. "Endoscopic Carpal Tunnel Release Surgery." *Health*. N.p., 21 Oct 2010. Web. 6 Dec 2011. <http://www.health.com/health/library/mdp/0,,zm2464,00.html>. url: http://www.health.com/health/library/mdp/0,,zm2464,00.html