CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)

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Project Number

S1306

Project Title

Real-time Feedback Modules to Enhance User Learning in Surgical Simulation

Abstract

Objectives/Goals

The objective of a surgical simulation is to
a) Simulate as precisely as possible a real surgical procedure
b) Gauge user performance based on a set of metrics
c) Augment user learning through accurate and intelligent feedback
Advancements in (a) and (b) suggest that surgical simulators today are viewed more as a practicing tool for those already familiar with surgical procedure complexities, than a teaching tool in which a user, new to a procedure, can learn that procedure from scratch. Progress in (c) has been confined to basic textual and visual feedback, both of which are not utilized as instructional tools but as directional ones. Their remains an untapped potential for surgical simulators to teach novice surgeons and medical students the intricacies of surgical procedures rather than merely provide a platform to practice.

Methods/Materials

This 12-month research study focuses on the innovative design and construction of three unique and open-source feedback modules: step-by-step monitoring system, audio-assisted commands, and an intelligent video assessment system, whose main focus is to augment the user learning of a specific surgical procedure. The workflow monitoring system aims to break down a complex procedure into a dynamic chart of easy-to-follow steps that the user can comprehend. Audio-assisted commands aim to communicate and convey procedural information with the user, ingraining the contents of the procedure in their mind. Lastly, the video assessment system intends to replay the users action accurately and intelligently pinpoint areas that need improvement.

Results

Formative research on a working prototype have validated a positive combinatorial of feedback configurations on end user performance and learning. The metrics measured include time, path length, size of operating site, number of errors, and error recognition time; an improvement of 22.2%, 90.3%, 13.7%, 58.3%, and 37.6% was observed in these metrics, respectively.

Conclusions/Discussion

In the future, my plan is to license these open-source feedback modules as additional features to commercial simulators in the market today. The prototype is highly versatile and can also be leveraged across a multitude of surgical procedures as well as other industries. Several components of the prototype have also been proposed to be patented.

Summary Statement

The design and implementation of three unique real-time feedback modules to enhance user learning and foster a "teaching" environment in virtual reality surgical simulators.

Help Received

I conducted the research and used lab equipment at Stanford University School of Medicine under the supervision of Dr. LeRoy Heinrichs, MD, PhD, who was my mentor for the project.