TIPSlite:
interactive laparoscopy training
wherever there is sufficient internet connectivity

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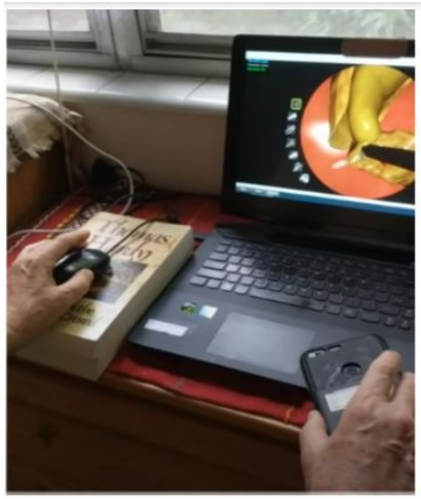
Introduction

The pandemic has reduced access to training – a familiar problem for underserved locations.

In response, SurfLab prototyped **TIPSlite**, a physical and software interactive laparoscopy training interface that can be used wherever there is sufficient internet connectivity.

Surgeon-educators have called the interface " truly innovative", "responsive to the time and location constraints of medical students and physicians", and "a solution for remote, pandemic, international and continuing education outreach".



TIPS^{lite} phone-based 4-dof haptic interface (mouse for weak hand) © J.Peters.

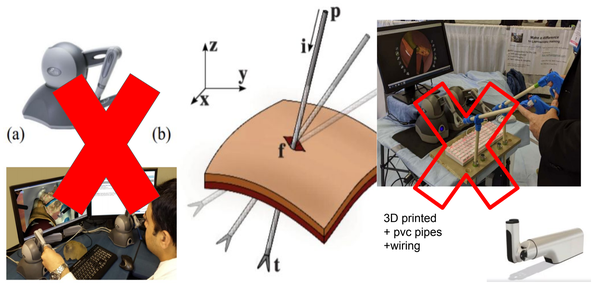
Method

Requirements for deploying TIPSlite:

- thin client (laptop) for display from the remote simulation server
- an upright fixed cell phone pen to serve as pivot point (trocar) in contact with a flipped
- smartphone acting as a surgical instrument.

Users download a thin client and a phone app (Android play or Apple store).

The upright-clamped cell phone pen tip acts as a fulcrum point. The down-flipped phone allows the full range of motion of laparoscopic surgery tools: three rotational degrees-of-freedom (up-down, left-right, axial rotation) and insertion or retraction. See middle Fig. below

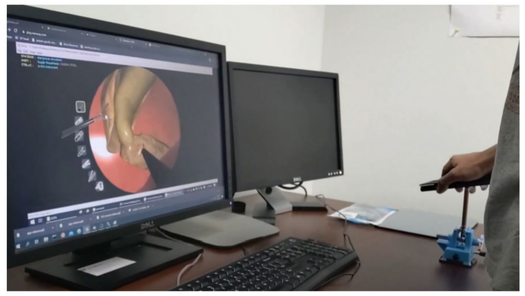


Alternatives have unwanted degrees of freedom (dof) above left or are more complex to deploy right above.

Disconnecting from the fulcrum (lifting the phone) resets and allows switching the tool. Vibration and sound provide collision and cauterizing feedback. A computer mouse is used to retract tissue with the non-dominant hand. A remote server runs the Toolkit for Illustration of Procedures in Surgery (TIPS).

Contributions

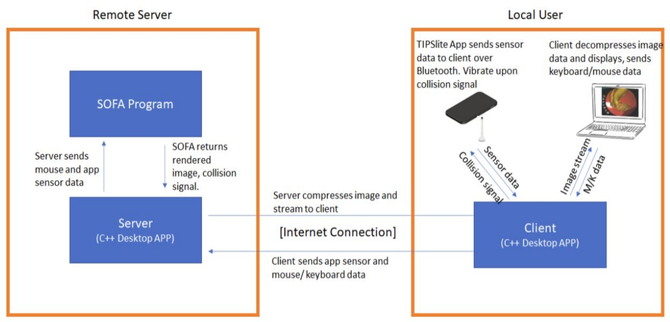
- 1st cellphone-based 4-dof surgery simulation controller ©J.Peters
- Cross-platform (Android, iphone)
- remote simulation



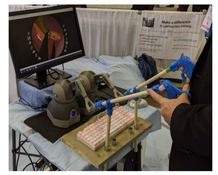
Preliminary Results:

To date, 14 users have been debriefed in a design-analysis cycle, SurfLab tested numerous prototype app options and remote server options both under Apple testflight and Android.

TIPSlite has been used at home, at work, and in a cafeteria experiencing negligible latency at 50Mb/sec.
TIPSlite currently uses Bluetooth LE to connect phone and thin client for low latency and low energy consumption. See the system diagram below



Next steps



TIPS training [1] with force feedback devices provides hands-on experience of complex surgical sequences (See above right).

We aim to test the hypothesis that the key benefits of TIPS training can be experienced using TIPSlite.

This will free institutions and learners from difficult to deploy and difficult to maintain haptic devices and software, and make interactive laparoscopic training available in underserved locations.

Acknowledgments

This work supported in part by NIH R01 EB018625 (Grace Peng)

References

[1] Sarov,M.,Gao,R.,Youngquist,J.,Sarosi,G.,Kurenov,S.,Peters,J.: An authoring interface for surgeon-authored VR training Itl JI of Comp Assisted Radiology and Surg. 13, 1–14273 (2018)

TIPS web pages
https://www.cise.ufl.edu/research/SurfLab/TIPS/index.php

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