Google Glass in the OR: Rapid Montioring of Surgical Blood Loss

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Introduction: Rapid assessment of blood loss is vital in guiding intraoperative fluid management, but visual estimates by providers are demonstrably inaccurate. Recently, a mobile vision platform has been developed for photometric assessment of blood loss on sponges via an iPad interface [1]. Because the algorithmic analysis is performed on a remote server, the potential to use virtually *any* front-end device for imaging and display exists. One such device is Google Glass. As a wearable computing platform, Glass enables previously inaccessible levels of mobility and intuitive control through the use of its integrated display, camera, and speech recognition capabilities. As an egocentric vision system[2], Glass also presents interesting considerations for diagnostic image analysis (e.g., repeatibility, completeness, background variability). In this pilot study, we assessed the stability of photometric blood loss measurement from images of lap sponges captured by the Glass platform.

Methods: Synthetic whole blood (Laerdal, Inc. Stavanger, NO) was poured and dispersed onto an 18x18 surgical laparotomy sponge in a simulated operating rom environment. The user issued a vocal command to a Glass device, which initiated a 10s video recording of the sponge as it was held up by the user in an egocentric fashion. To vary background conditions, this procedure was repeated while facing a different direction. The captured videos were transmitted to a proprietary server where all 298 frames of each video were individually extracted, downsampled, and filtered to remove frames in which the sponge had not been fully raised into view. The two framesets were batch-processed using Feature Extraction Technology (FET, Gauss Surgical, Inc., Los Altos, USA), a novel image analysis platform, to measure Hb content from the image. The resulting prediction of sponge Hb mass (g) per frame was stored for analysis. Repeatability and stability of the measure was assessed across all image processing outputs from both framesets.

Results: The mean +/- SD of Hb mass on the sponge was 1.3 +/- 0.1g in the first frameset (n = 204 extracted images) and 1.4 g +/- 0.2 g in the second frameset (253 images), sampled over two different backgrounds. Across both framesets, the mean +/- SD of Hb mass was 1.3 g +/- 0.1g. The corresponding CV ratios were 4.5% (frameset 1), 11.7% (frameset 2), and 10.3% (combined), indicating low variability in the algorithm's measurement of Hb mass across variable background conditions and repeated measures.

Conclusion: Wearable computing platforms have the potential to capture valuable intraoperative image data and augment user experience. The Glass platform demonstrated

viability in imaging sponges for blood loss assessment with significant repeatibility and background invariance. Using Glass with Feature Extraction Technology may aid the user (e.g., circulating nurse) in their ability to rapidly count sponges and simultaneously assess surgical blood loss.

***** Dr. Cannesson is a scientific advisor to Gauss Surgical, Inc.

REFERENCES

[1] Holmes AA, et. al., Clinical Evaluation of a Novel System for Monitoring Surgical Hemoglobin Loss. Anesthesia & Analgesia. In Press. (2013)

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FIGURE 1. Image processing and FET output from frameset 1 (frame 180) of bloodied sponge images captured using Glass.

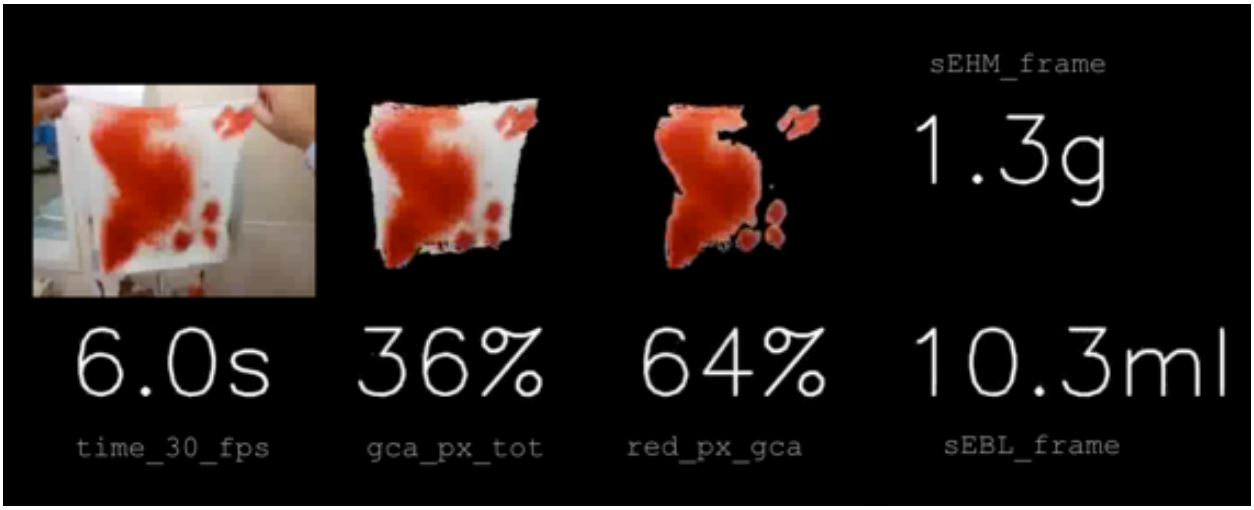
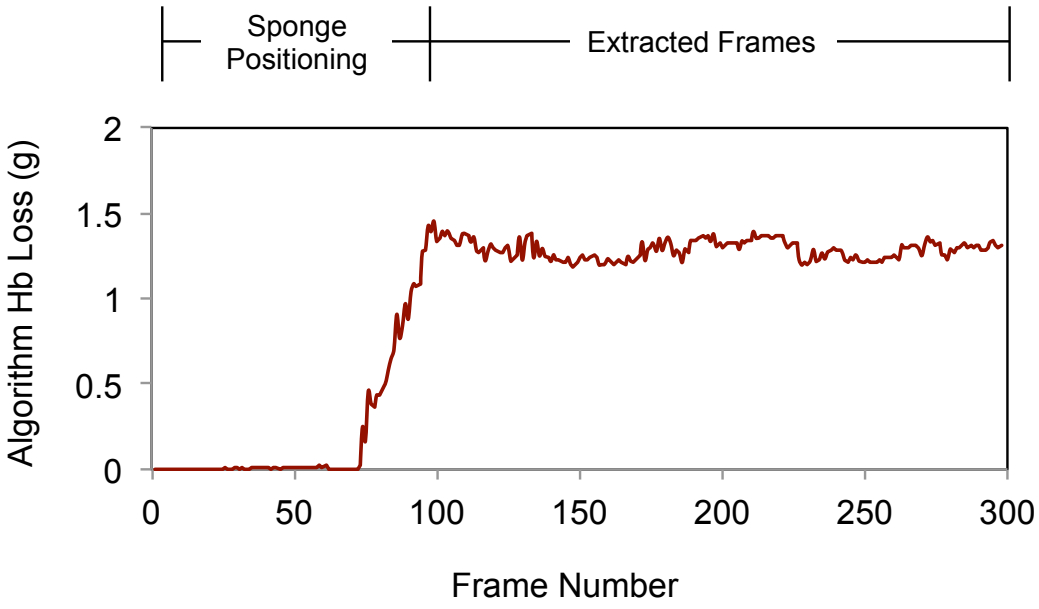


FIGURE 2. Algorithm prediction of Hb loss (g) across first frameset of images from Google Glass.


Sponge Positioning
Extracted Frames
Algorithm Hb Loss (g)
2
1.5
1
0.5
0
0
50
100
150
200
250
300
Frame Number