visionAV

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   * *{increases visibility of difficult engineering issues}*
   * *{fundamentally different motivations}*

## Introduction

Utilization of simulation-based training for healthcare providers has expanded rapidly since the early 2000’s, when the first “high fidelity” patient simulator mannequins were made available by manufacturers at price points accessible to smaller programs. Over that time, simulation technology has diviersified considerably, lowering per-item cost while deepening the technology “stack” required for an appropriately-equipped laboratory.[[1]](#footnote-24) Though buy-in costs have remained high, the health education sector views simulation technology as valuable,[[2]](#footnote-25) and there is growing evidence improved education outcomes are beginning to show across an increasing spectrum of psychomotor skills.[[3]](#footnote-26)[[4]](#footnote-27)[[5]](#footnote-28)

Audiovisual (AV) systems are an essential part of the technology stack for modern simulation laboratories; they are complex, expensive, specialized services which are difficult to maintain without access to a network or AV specialist. In addition to engineering challenges, the decoding, encoding, and transmission of AV data is deeply mired in a crytpic network of patent protections and proprietary technologies.[[6]](#footnote-29) Simulation laboratories in need of AV services have few options: select one of several commercially available products, contract for a customized system, or develop their own.

These items encourage vendor dependence, especially in resource limited laboratories, and increase the dfficulty of accurate decision-making by consumers. Vendors are not forthcoming on details related to the architecture, implementation, or performance of their service, and, if it is made available, the information is generally written in a marketing language that conflates and obfuscates technical details.[[7]](#footnote-31)

Given that AV systems are an essential debriefing tool, and that debriefing is the most important part of simulation,[[8]](#footnote-32) difficulty matching tool to task is likely to degrade Return on Investment (ROI) for a simulation laboratory and its constituents.

*visionAV*, an open-source data and audiovisual (AV) platform for medical simulation, offers a service-equivalent model for the capture and utilization of AV data in medical simulation laboratories. It is based on patent- and royalty-free technologies, implemented with modern architecture patterns, and targeted at commodity hardware. In all, *visionAV* lowers the cost-of-entry for simulation laboratories seeking an AV solution and provides a needed focal point for the medical simulation community to examine critical issues related to AV service.

## References

Kennedy, Cassie C., Eric K. Cannon, David O. Warner, and David A. Cook. “Advanced Airway Management Simulation Training in Medical Education: A Systematic Review and Meta-Analysis.” *Crit Care Med* 42, no. 1 (2014): 169–78.

McKinney, James, David A. Cook, David Wood, and Rose Hatala. “Simulation-Based Training for Cardiac Auscultation Skills: Systematic Review and Meta-Analysis.” *Journal of General Internal Medicine* 28, no. 2 (2013): 283–91.

William C. McGaghie, PhD, MD S. Barry Issenberg, Elaine R. Cohen, MD Jeffrey H. Barsuk, and MD Diane B. Wayne. “Does Simulation-Based Medical Education with Deliberate Practice Yield Better Results Than Traditional Clinical Education? A Meta-Analytic Comparative Review of the Evidence.” *Acad Med* 86, no. 6 (2011): 706–11.

Zimmerman, Steven. “Google’s Royalty-Free Answer to HEVC: A Look at AV1 and the Future of Video Codecs,” 2017. <https://www.xda-developers.com/av1-future-video-codecs-google-hevc/>.

1. Consider that in 2003, access to a mannequin such as SimMan (now SimMan Classic) *was the definition of* a “high fidelity” simulation program. Ten years later, a properly equipped program would have *one or more* “high fidelity” mannequins, several “mid”- and “low”- fidelity mannequins, dedicated simulation space, and an AV system able to capture at least one room. [↑](#footnote-ref-24)
2. **THIS NEEDS A CITATION!!** [↑](#footnote-ref-25)
3. Cassie C. Kennedy et al., “Advanced Airway Management Simulation Training in Medical Education: A Systematic Review and Meta-Analysis,” *Crit Care Med* 42, no. 1 (2014): 169–78. [↑](#footnote-ref-26)
4. PhD William C. McGaghie et al., “Does Simulation-Based Medical Education with Deliberate Practice Yield Better Results Than Traditional Clinical Education? A Meta-Analytic Comparative Review of the Evidence,” *Acad Med* 86, no. 6 (2011): 706–11. [↑](#footnote-ref-27)
5. James McKinney et al., “Simulation-Based Training for Cardiac Auscultation Skills: Systematic Review and Meta-Analysis,” *Journal of General Internal Medicine* 28, no. 2 (2013): 283–91. [↑](#footnote-ref-28)
6. Steven Zimmerman, “Google’s Royalty-Free Answer to HEVC: A Look at AV1 and the Future of Video Codecs,” 2017, <https://www.xda-developers.com/av1-future-video-codecs-google-hevc/>. [↑](#footnote-ref-29)
7. As an example, see advertisers’ use of megapixel calcuations for advertising digital cameras. [↑](#footnote-ref-31)
8. **THIS NEEDS A CITATION!!** [↑](#footnote-ref-32)