



Dual Handheld and Video Otoscope

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ABSTRACT

Otoscope is a device for looking inside of an ear canal, and can be categorized into two types: handheld and video. Instructor guidance when teaching otoscope techniques for animals poses a challenge. The challenge arises with each type of the otoscope as they both don't allow synchronous feedback to instructors. An otoscope was designed to include key features from both the handheld and video otoscope to address client requirements.

MOTIVATION

- Veterinary student poses a safety concern to the animal during examinations as their technique and fluency using the otoscope.
- A device that provides a simple approach will benefit students during examinations as they will be guided by instructors afar.
- Aspects of this device can be transferred to use on humans.

PROBLEM STATEMENT

The current designs of handheld otoscopes for animal practice do not allow video transfer to a distant view compared to a video otoscope, which is practiced differently in simulations. The goal is to design a handheld otoscope with video capabilities to allow student-performed examinations to be visualized to the faculty for assessments.

BACKGROUND RESEARCH

- A dog's ear is composed of distinct structures that veterinarians classify into the outer, middle, and inner ear [1].
- A beam splitter is utilized to direct incident light, allowing a portion to pass through to the lens while reflecting at a 45-degree angle towards the camera [2].
- A color accuracy in cameras can be measured using metrics like Delta E (ΔE) for color difference, and influenced by factors such as white balance, saturation, color gamut, sensor characteristics, lens quality, lighting conditions, and calibration. [3]
- The field of view (FOV) of microscopes and otoscopes defines how much of a sample can be seen at once, determined by angles and distance to object.[4]

DESIGN SPECIFICATIONS

- The otoscope resembles features of a traditional otoscope (using lenses) and a video otoscope (ability for distant view).
- External light source that is bright to view the inner ear canal
- Wireless connection to external device for video viewing
- Maintain below budget
- Structurally similar to the current traditional otoscope model

FINAL DESIGN

Beam Splitter
Lens
Fiber Attachment
Camera Casing

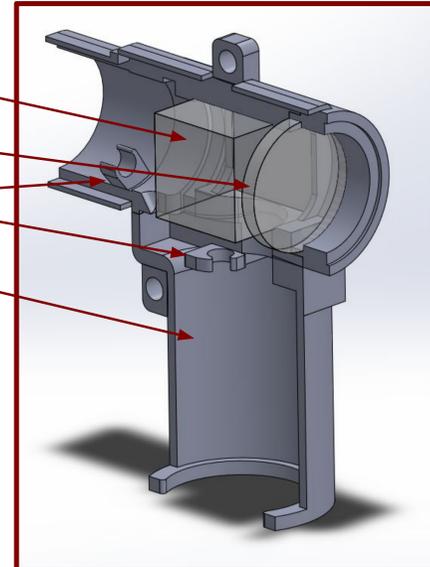


Figure 1 - Final otoscope model



Figure 2 - Otoscope Prototype

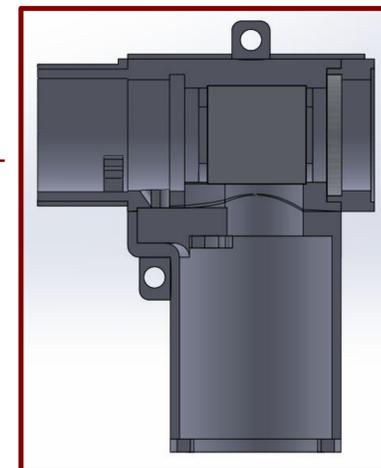


Figure 3 - Final otoscope model/side

TESTING

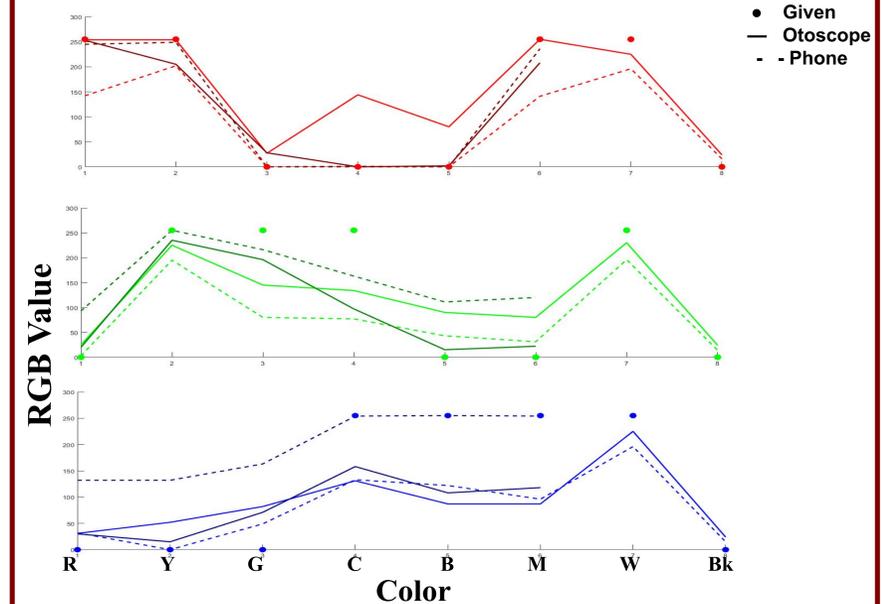


Figure 3- Color Testing Results. a) R-value, b) G-value, c) B-value. Legend: R-Red Y-Yellow G-Green C-Cyan B-Blue M-Magenta W-White Bk-Black.

Table 1 - Field of view and Brightness Testing Results

	Field of View [4]	Brightness (Lux)
Welch Allyn Otoscope	15.2°	175
Dual Functioning Otoscope (Camera)	14.0°	280
Dual Functioning Otoscope (Lens)	13.8°	280

FUTURE WORK & DISCUSSION

- While a working prototype has been developed, further mechanical testing is required to assess rigidity and drop resistance to ensure long-term usability.
- Evaluating the educational value of the device is essential. Conducting comparison studies with veterinary students can help determine whether the prototype improves the speed and effectiveness of learning otoscopic techniques.
- More than \$200M invested into remote medical education and real-time OR-support technology startups in 2024. [5][6]
- Global otoscope market reached USD 222.0 million in 2024, and is forecast to hit USD 332.5 million [7]

ACKNOWLEDGEMENTS & REFERENCES

- [1] "Examining and medicating the ears of a dog." Veterinary Teaching Hospital. <https://hospital.vetmed.wsu.edu/2022/01/04/examining-and-medicating-the-ears-of-a-dog/>
- [2] D. R. Paschotta, "Beam Splitters," www.rp-photonics.com. https://www.rp-photonics.com/beam_splitters.html (accessed Nov. 27, 2023).
- [3] Prabu KumarPrabu is the Chief Technology Officer and Head of Camera Products at e-con Systems, "What is color accuracy? how to measure color accuracy? - e-con systems," e. <https://www.e-consystems.com/blog/camera/technology/what-is-color-accuracy-how-to-measure-color-accuracy/> (accessed Dec. 3, 2024).
- [4] <https://tagamo.com/blog/explaining-field-of-view-for-microscopes/>
- [5] https://www.proximie.com/press/proximie-raises-80m-to-let-surgeons-virtually-scrub-in?utm_source=chatgpt.com
- [6] https://caresyntax.com/news/caresyntax-raises-180-million-funding-to-accelerate-growth-and-adoption-of-precision-surgery-2?utm_source=chatgpt.com
- [7] https://www.imarcgroup.com/otoscope-market?utm_source=chatgpt.com

MATERIAL COSTS

Light Components	\$ 170.32
Camera	\$ 39.99
Previously Owned Materials Beam Splitter, Lens	\$ 143.99
3D Printing and Fabrication Costs	\$21.62
Total	\$ 376.92