Dual Handheld And Video Otoscope Unit

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Abstract

Teaching otoscope techniques for animals poses a challenge, where guidance from instructors is crucial for success. Otoscopes can be broadly categorized into two types: handheld and video. A challenge arsies with each type as they both do not incorporate live feedback and a lens. An otoscope was designed to include these key features. Various designs were proposed to address the client requirements.

Motivation

- Novice veterinary students pose a safety concern for the animals due to the precise technique needed for an effective exam
- A device that incorporates a simplistic, inexpensive approach will benefit students who will be guided by their instructor from afar
- Aspects from this device can be transferred to use on humans

Problem Statement

The current designs of handheld otoscopes for animal practice do not allow for videoing, while a video otoscope does not allow for users to view through a lens. The device will incorporate video capabilities and a lens to allow students to be monitored by faculty.

Background Research

- A dog's ear consists of various structures that veterinarians categorize as the outer, middle, and inner ear [1]
- A beam splitter is used, which allows incident light to pass through to the lens and reflect at a 45 degree angle to the camera [2]
- A traditional handheld otoscope includes a battery for the light source, magnifying lens, and specula

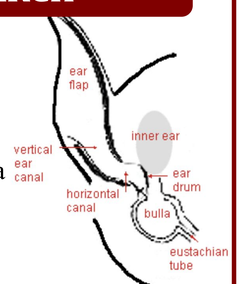

Figure 1: Front Diagram of Dog's Ear [1]

Design Specifications

- Incorporates handheld otoscope lens and video relay ability
- External light source
- Reasonable around 200 mm in height, 31 mm in handle diameter
- Under 2 lb in weight
- Non-difficult for novice veterinary students to use
- Similar to otoscope currently practiced by students

Final Design

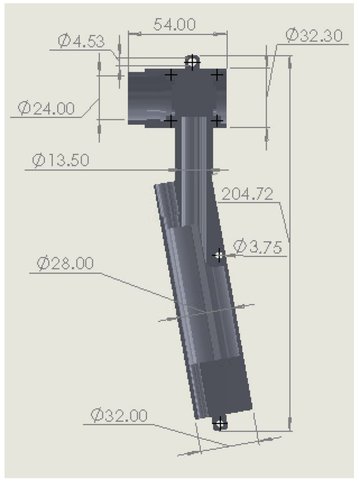

Figure 2: Final Solidworks Design- Component A - Otoscope Body

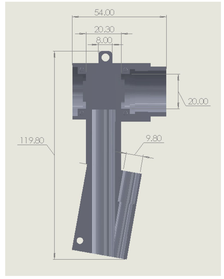

Figure 3: Final Solidworks Design- Component B- Symmetrical Cover

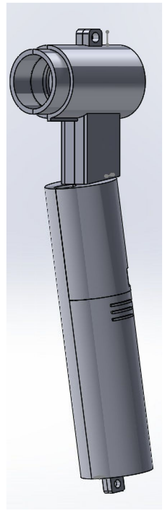

Figure 5: Final Solidworks Design- Constructed Device

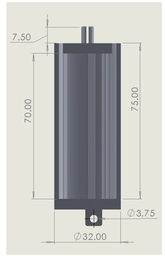

Figure 4: Final Solidworks Design- Component C- Battery Case

All units in mm

Figure 6: Dual Handheld and Video Otoscope Unit

Functional otoscope with optical piece inside. Can be view through traditional handheld method and through video on a separate screen at the same time.

Material Cost

Table 1: Materials and Cost

Material	Cost
PLA for 3D Printing	$34.08
Cameras and Optical Components	$274.11
Light Source	$25.31
Hardware (MakerSpace Materials)/miscellaneous	$1.15

Total Cost: $334.65

Budget: $5,000

Testing

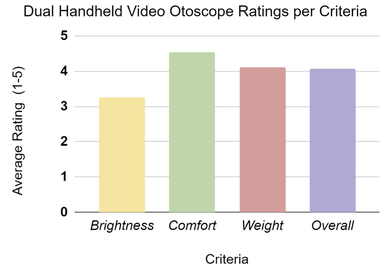

Figure 7: Average Ratings of Criteria

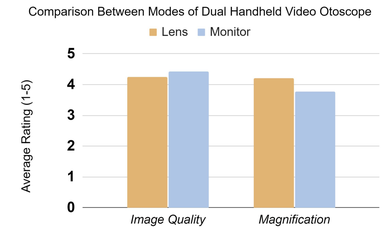

Figure 8: Comparisons of Otoscope Modes

- Survey data was collected from 23 individuals with varying experiences with an otoscope in various disciplines
- Verbal responses were documented and used to outline future improvements
- Participants were given an ear model and asked to identify a shape inside

Discussion and Future Work

Discussion:

- Magnification was rated higher in lens than in monitor. Accuracy not achieved as expected from the PDS
- Image quality was rated higher on the monitor compared to the lens. This aligns with the PDS
- Comfort and weight align with the PDS expectations
- 76.9 % of participants said they preferred the prototype for teaching compared to a handheld otoscope

Future Work:

- Function of the LED requires improvement regarding brightness and power source
- Internal wiring and circuit of battery is oriented poorly in the current prototype
- Purchase a camera where focus can be adjusted manually
- Find a monitor function that allows magnification of the video
- Print with material that is polished on the surface to avoid bumps

Acknowledgements

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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).