



Accessible Glaucoma Monitoring with Acoustic Tonometry

THE "SILENT BLINDER"

Glaucoma is a chronic eye disease characterized by elevated intraocular pressure (IOP), resulting in optic nerve damage and permanent vision loss¹



Constant IOP Fluctuations

High IOP → Optic nerve damage → Irreversible blindness

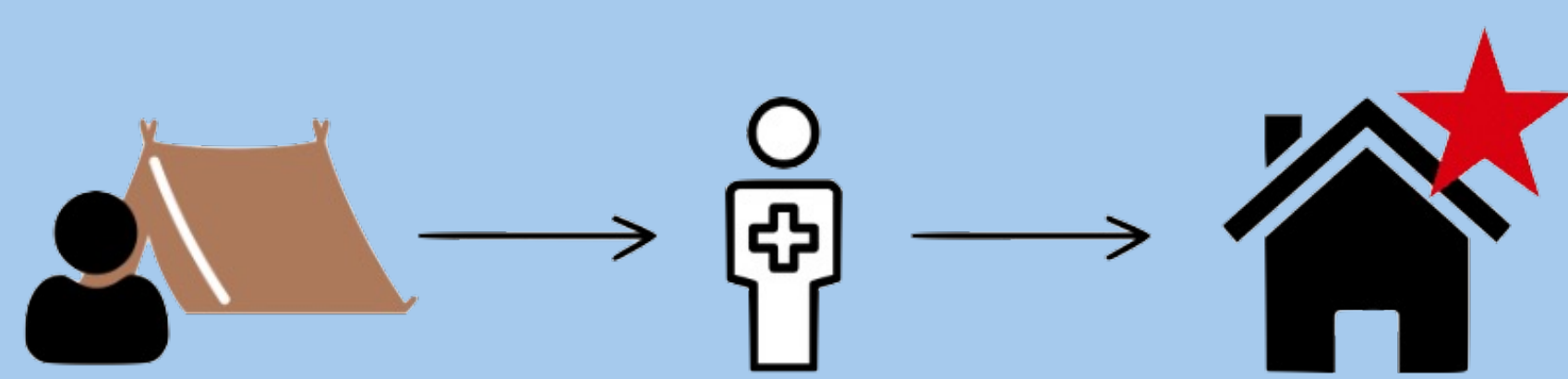


Infrequent Follow-Up Appointments

Static IOP measurements → Lack of understanding and awareness

Glaucoma patients need an indicator of adverse disease progression to motivate timely follow-up care in order to decrease the incidence rate of glaucomatous vision loss

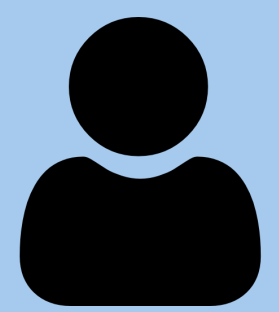
PATIENT WORKFLOW



Glaucoma patient is diagnosed at eye camp → Receives treatment from ophthalmologist at base hospital → Uses OcuSound to monitor IOP at home

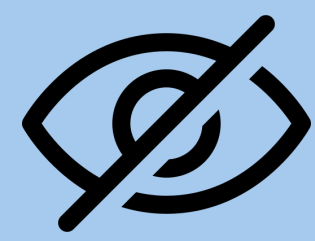
- Improves long-term disease management
- Encourages self-advocacy for vision care
- Reduces transportation and medical expenses

GLOBAL IMPACT



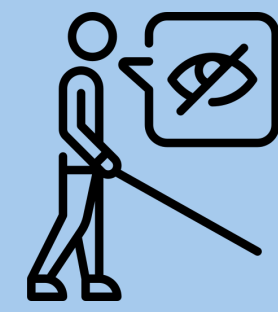
111.8M

Glaucoma patients in 2040² (Allison, 2020)



0.15%

Progress to permanent vision loss annually³ (Olttramari, 2024)



>\$9500

Average annual income lost due to vision disabilities⁴ (Zipia, 2023)

\$1.6B

Potentially saved with Ocusound annually

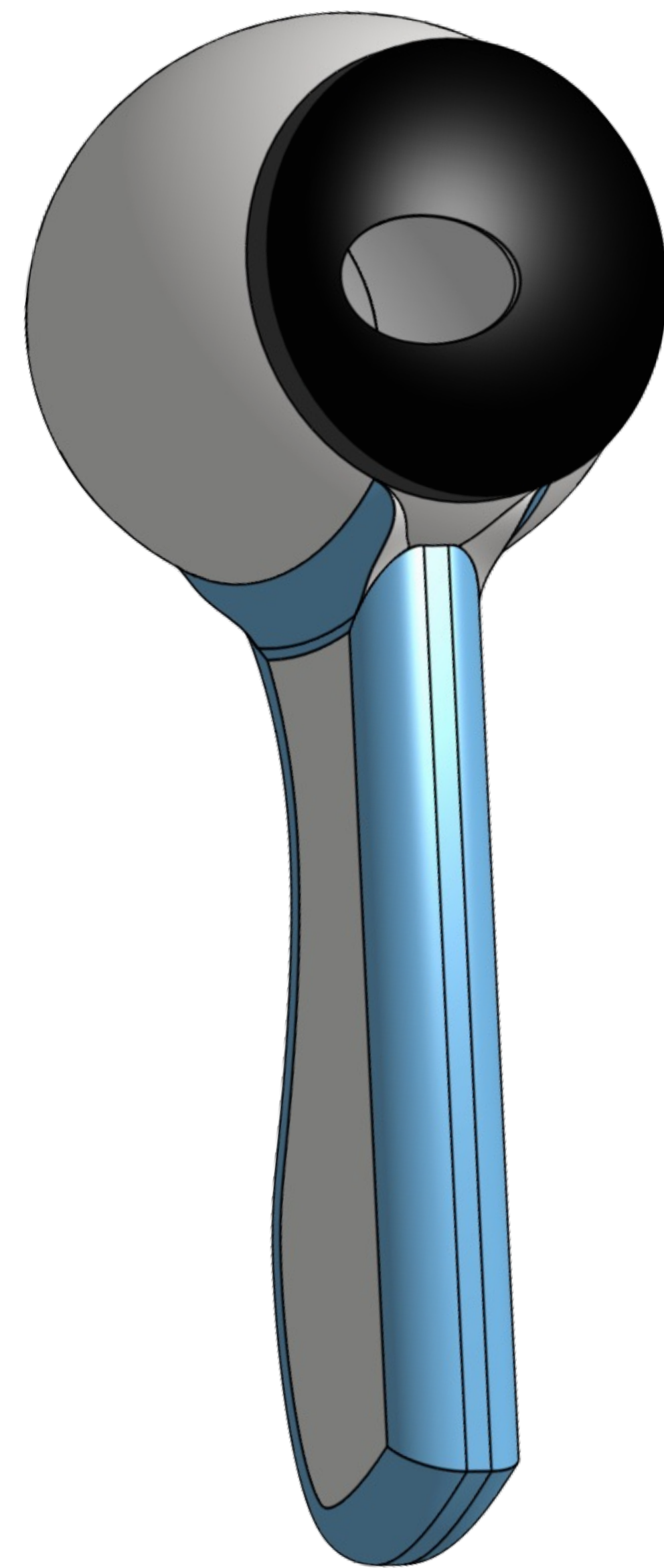
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Faculty Mentors: Nicholas Durr, Ph.D; Neha Rajan

OUR PRODUCT

Empowering glaucoma patients to track disease progression with routine self-monitoring of intraocular pressure at home



OcuSound Acoustic Tonometer Model

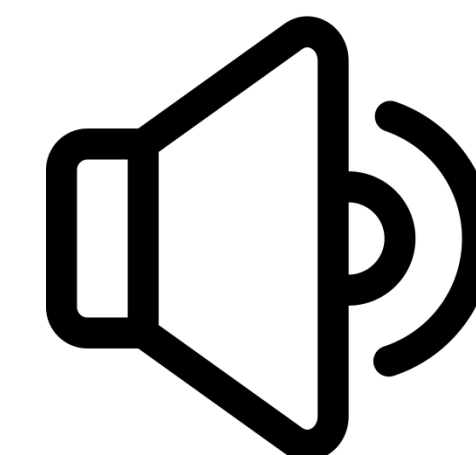
- ✓ **Low-Cost**
- ✓ **Noncontact**
- ✓ **Accurate**
- ✓ **Intuitive**

<\$50 USD

OcuSound's inexpensive hardware and software innovations increases patient access



OcuSound's accurate signal-processing algorithm takes pressure measurements in less than 5 seconds



OcuSound uses sound waves and the acoustic properties of the eye for noncontact IOP evaluation

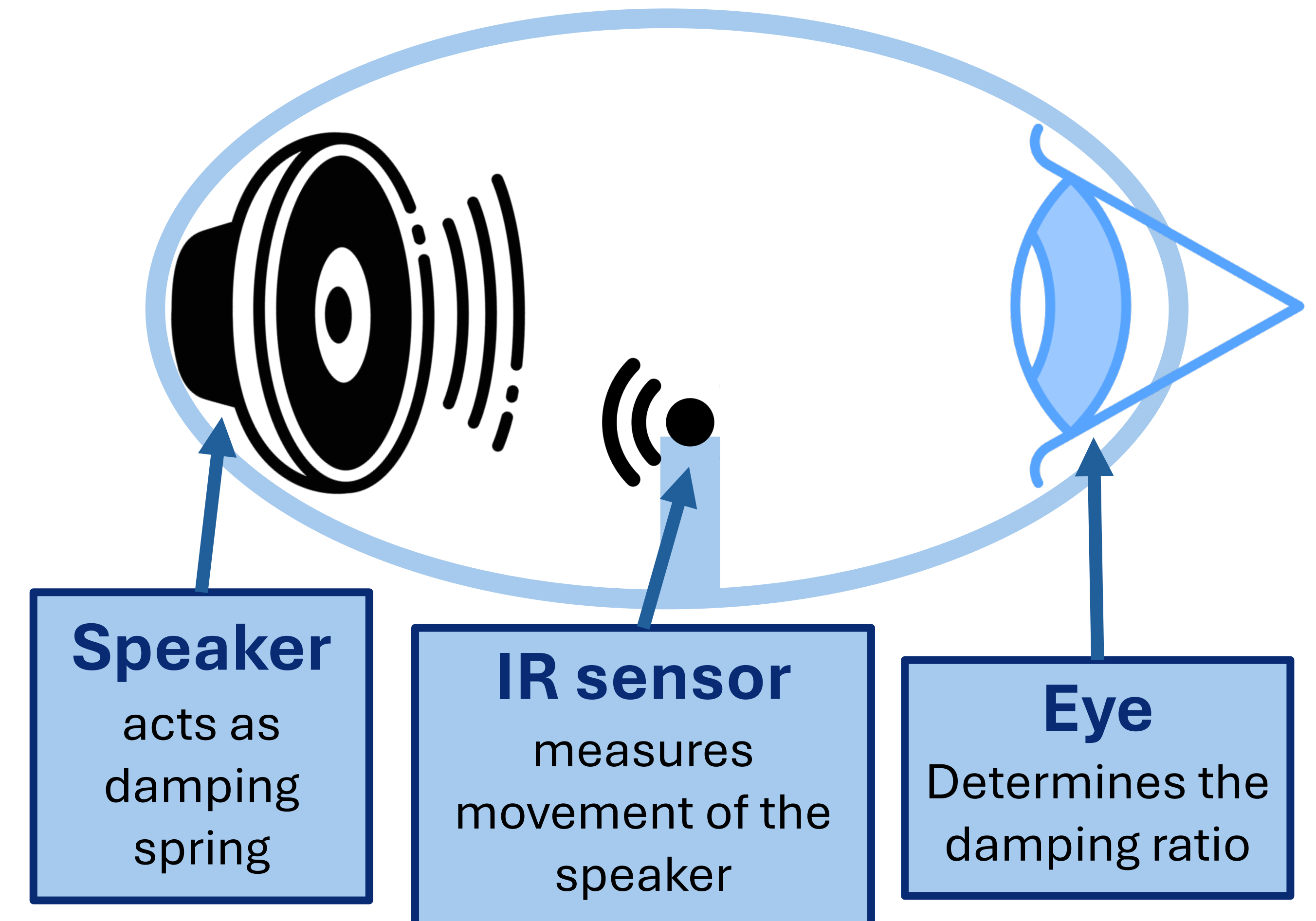


OcuSound outputs an intuitive result of IOP measurement for timely follow-up to prevent irreversible vision loss



JOHNS HOPKINS
BIOMEDICAL ENGINEERING

HOW IT WORKS

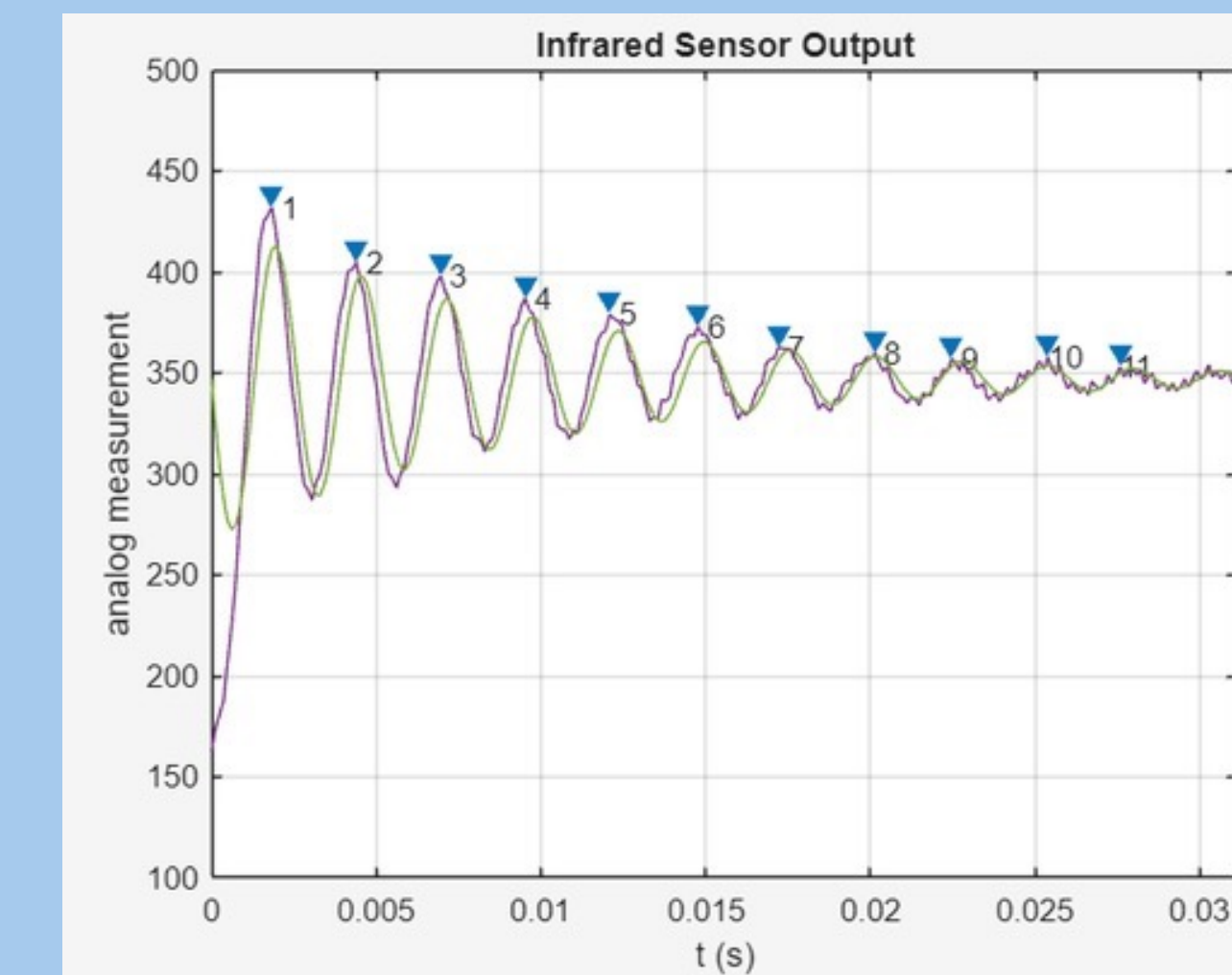


Speaker
acts as damping spring

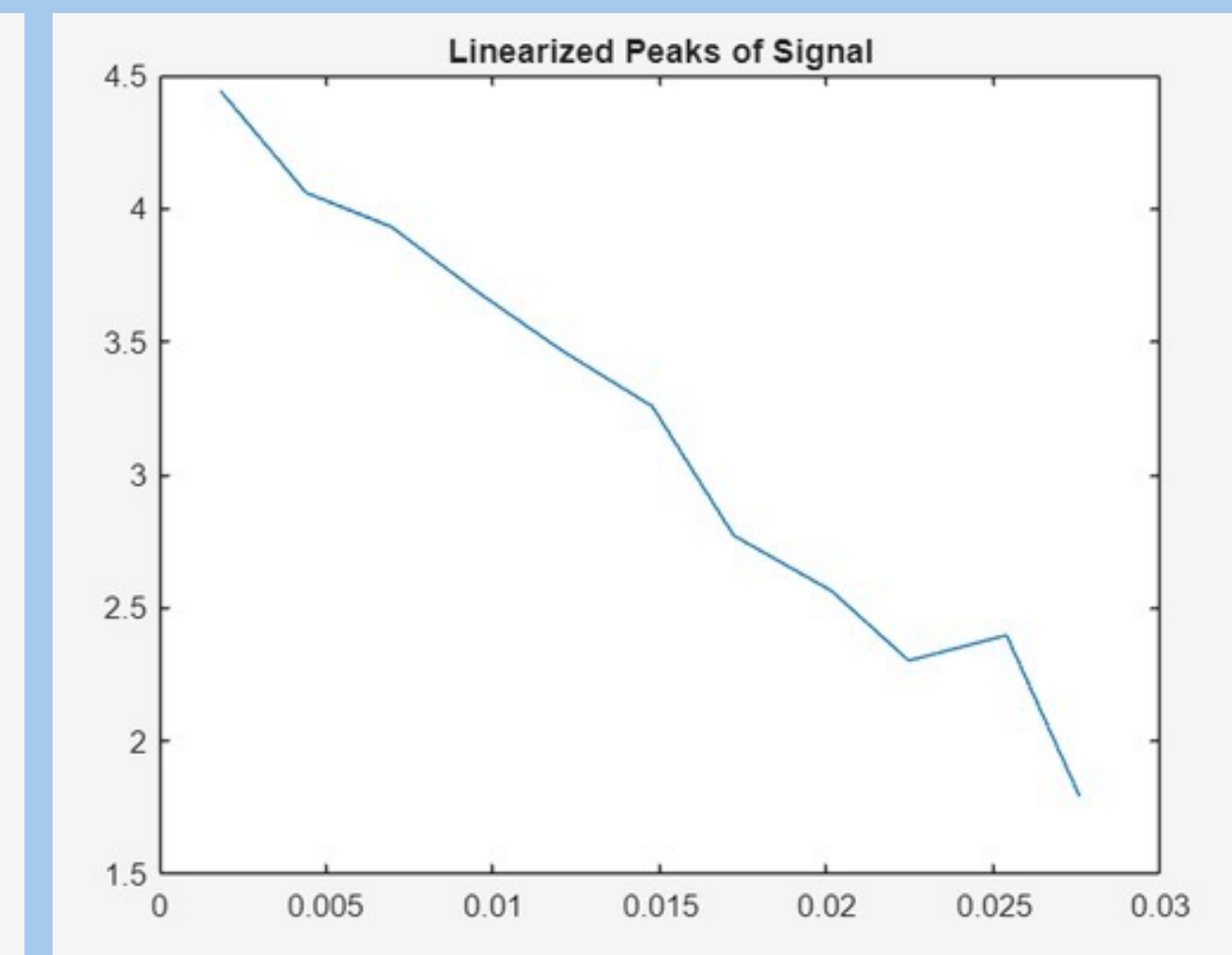
IR sensor
measures movement of the speaker

Eye
Determines the damping ratio

SIGNAL PROCESSING



Signal from IR sensor output



Logarithm of Peaks

- Peaks of signal determined from the IR sensor output
- Linearized logarithm of peaks is taken to obtain a negative slope
- Negative slope represents the speaker decay rate
- $\zeta = \lambda / (\sqrt{\lambda^2 + w^2}) < 1$ solves for the damping ratio which has a polynomial fit with IOP
 - ζ = damping ratio
 - λ = decay rate
 - w = angular frequency

REFERENCES

1. Glaucoma. National Eye Institute. Accessed April 22, 2024. <https://www.nei.nih.gov/learn-about-eye-health/eye-conditions-and-diseases/glaucoma>.
2. Allison, K., Patel, D., & Auluck, O. (2020, November 24). Epidemiology of glaucoma: The past, present, and predictions for the future. *Cureus*. <https://www.cureus.com/articles/94577-epidemiology-of-glaucoma-the-past-present-and-predictions-for-the-future>.
3. Olttramari, L., Mansberger, S. L., Souza, J. M. P., de Souza, L. B., de Azevedo, S. F. M., & Abo, R. Y. (2024, January 25). The association between glaucoma treatment adherence with disease progression and loss to follow-up. *Nature News*. <https://www.nature.com/articles/s41586-024-02000-2>.
4. Average Global Income (2023): What Is The Median Income Worldwide? Zipia. Published April 13, 2023. Accessed April 22, 2024.