

## ABSTRACT

- Gap detection and frequency analysis of acoustic stimuli provide the basis for sound discrimination.
- Patients with impaired gap detection or frequency discrimination are often associated with several hearing disorders, including tinnitus, auditory processing disorders, language impairment, and dyslexia.
- Mice have emerged as the most common experimental animal model for studying human hearing impairments because of the ability to manipulate their genomes.
- As a result, developing an experimental setup to reliably assess gap detection and frequency discrimination abilities of mice offers the opportunity to screen animal models for understanding the pathogenic mechanisms of hearing disorders and learning disabilities.

## INTRODUCTION

- Purpose of the research: access gap detection and frequency discrimination in mice through the utilization of the acoustic startle reflex (ASR).
- ASR is a reflexive contraction of skeletal muscles in response to an unexpected loud sound. In rodents, ASR is measured by placing the animal on a platform that transmits the downward reflex force.
- When a weak pre-stimulus sound is delivered precisely before the startle-eliciting loud sound, the ASR is attenuated; a condition known as pre-pulse inhibition (PPI).
- PPI provides a useful method for assessing sound detection and discrimination because of its ability to detect and process the pre-stimulus sound.
- The apparatus, shown in Figure 1, is based on the ASR to access frequency discrimination in mice. However, the platform does not provide sufficient means to secure the mice for accurate detection.
- Main goal of research: devise a mechanism to replace the platform and better secure the mice to improve the accuracy of detection.

## METHODS & RESEARCH DESIGN

- Objective: generate tinnitus in mice and cure the disorder utilizing electrical simulation.
- After inducing tinnitus, an analysis of the absence or presence of tinnitus must be conducted before curing the disorder.
- The procedure for testing the absence or presence of tinnitus in mice is as follows:
  - In each testing session, the mouse is allowed to acclimate to a constant background pure tone.
  - After the acclimation period, the mouse is subjected to "pre-pulse" and "startle only" trials.
  - In pre-pulse trials, the pre-pulse contains a gap or frequency change from the background pure tone.
  - The downward movement force produced by the animal on the platform is recorded immediately before the pre-pulse and recorded again during the startle stimulus.
  - The ASR is measured as the difference of the downward force generated during the startle stimulus from the baseline level.
  - Pre-pulse inhibition of the ASR is then calculated to determine the animal's ability to detect a gap or discriminate sound frequencies.
  - The downward force generated from the ASR is analyzed using MATLAB.
- To improve the ASR analysis and the accuracy of detection, various designs were devised to replace the platform in an effort to better secure the mice during testing.
- Figure 2: schematic of the Honeywell force sensors that will be used in place of the platform.
- Figures 3-6: four initial SOLIDWORKS models designed as additional components/adaptors to the sensors.
- Figure 7: the final SOLIDWORKS model that will be used as an additional component/adaptor to the sensor.

## RESULTS

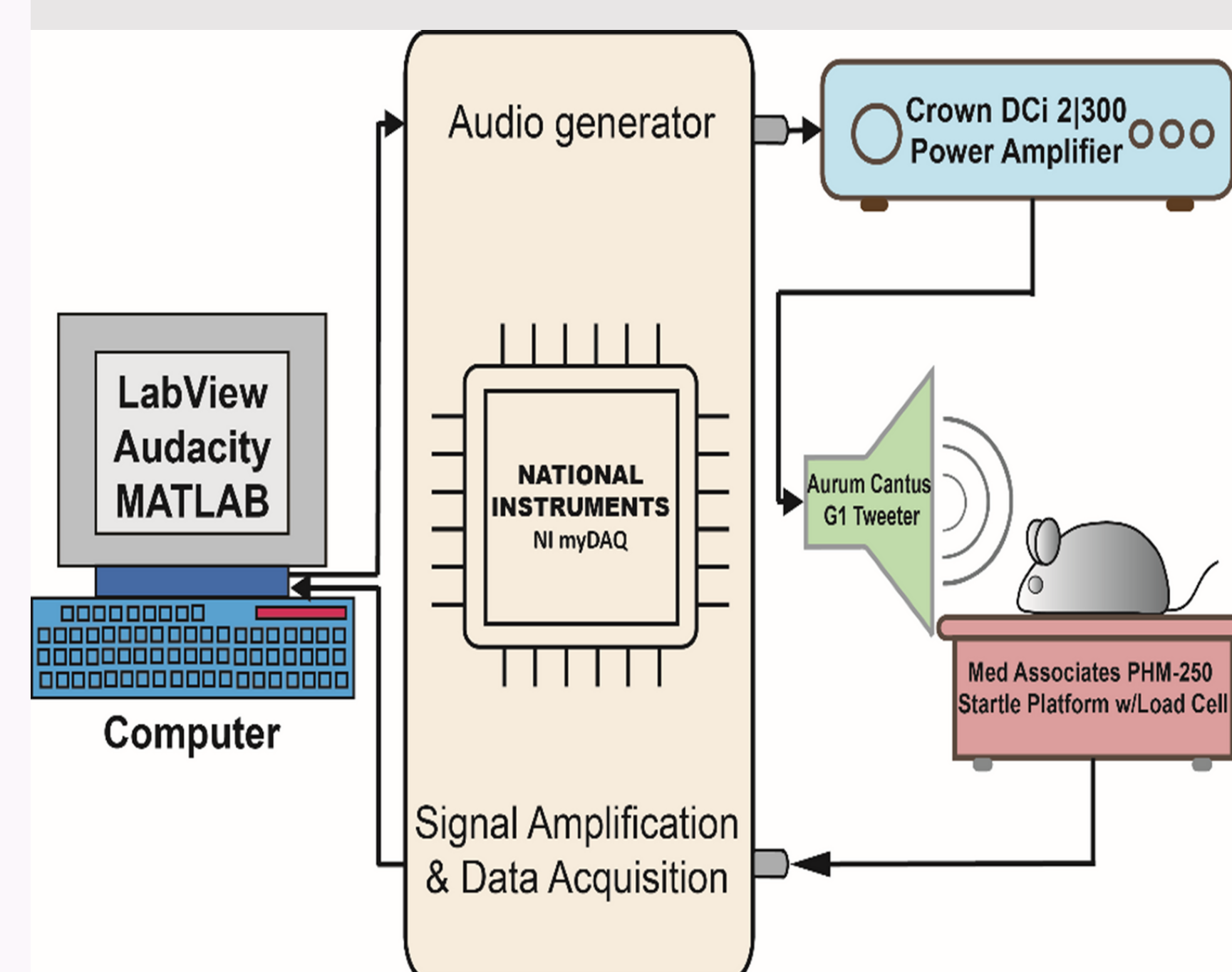


FIGURE 1

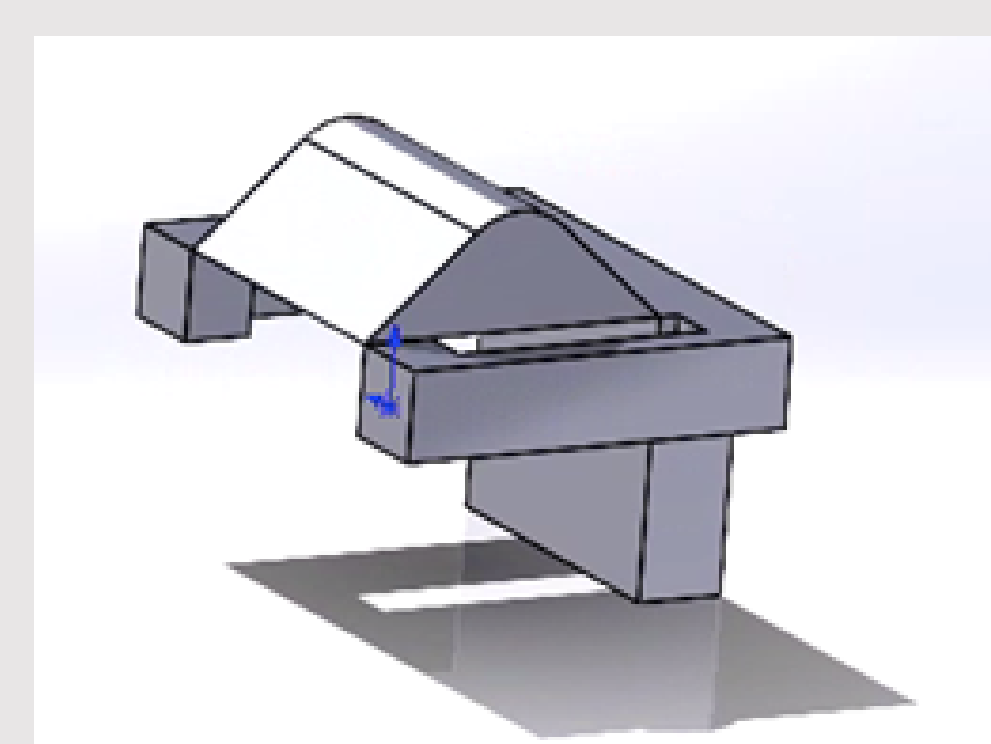


FIGURE 3

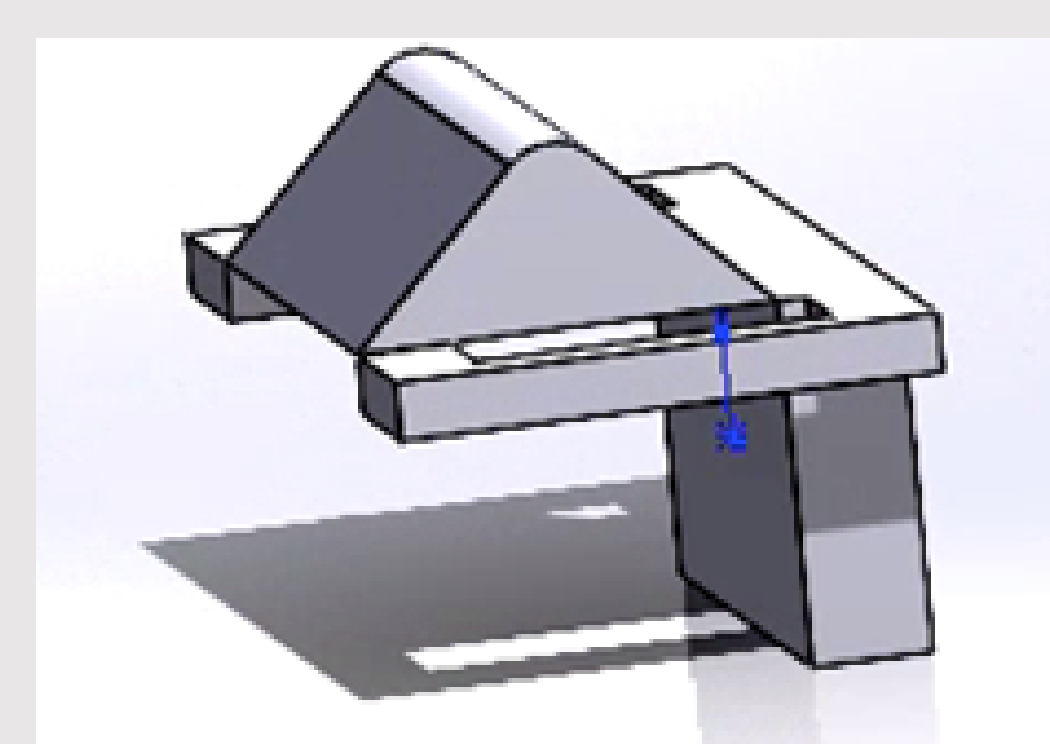


FIGURE 4

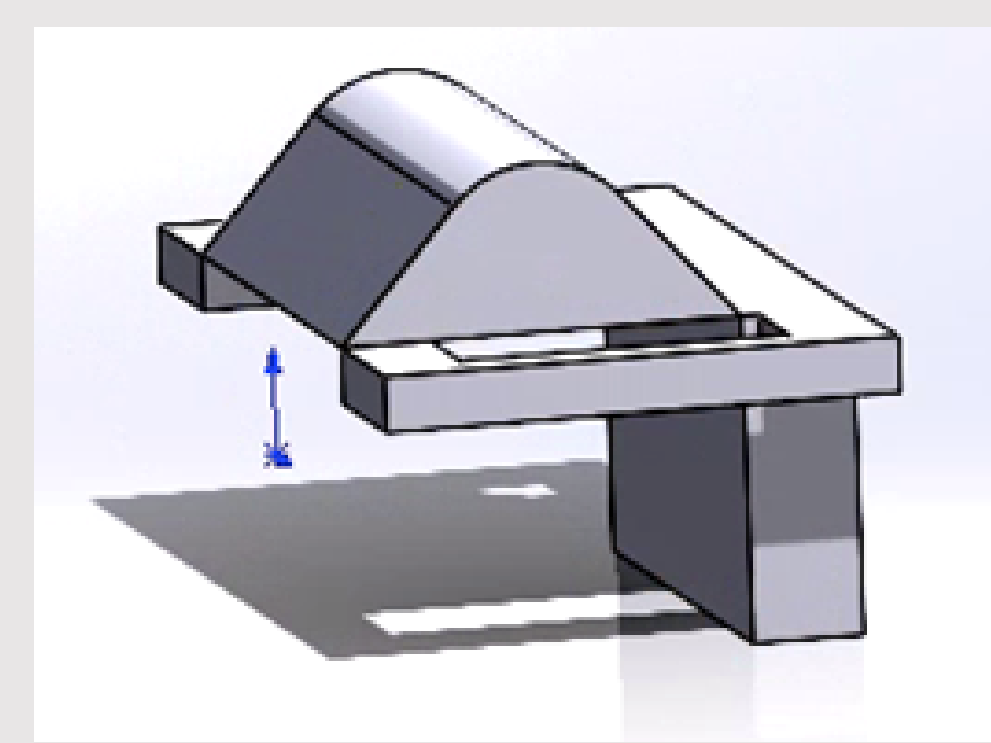


FIGURE 5

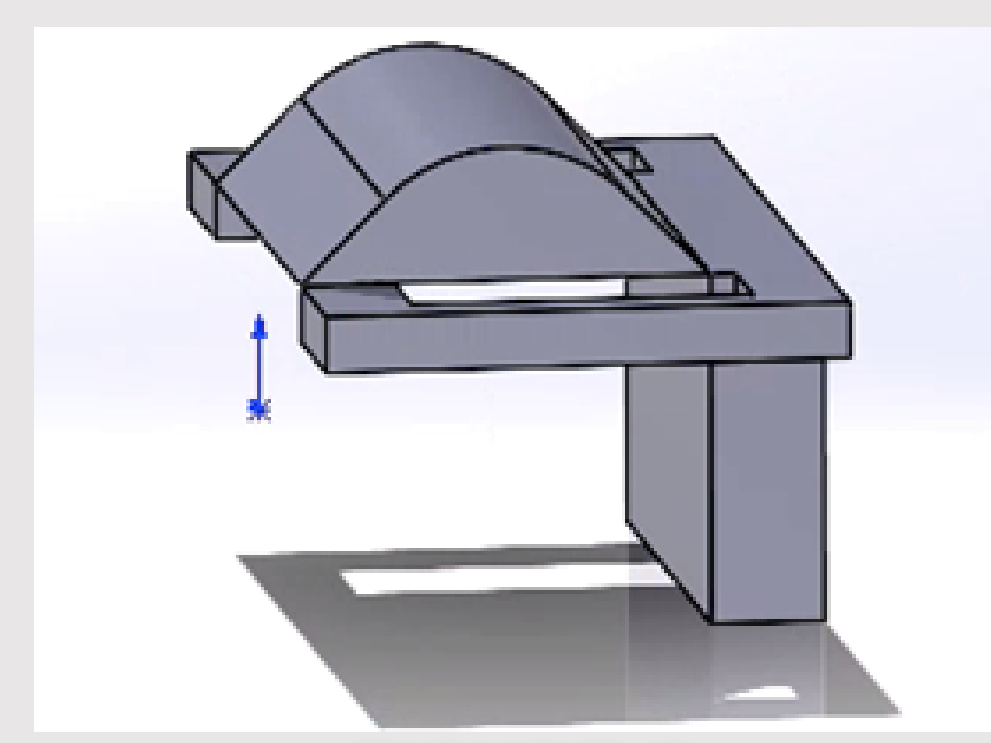


FIGURE 6

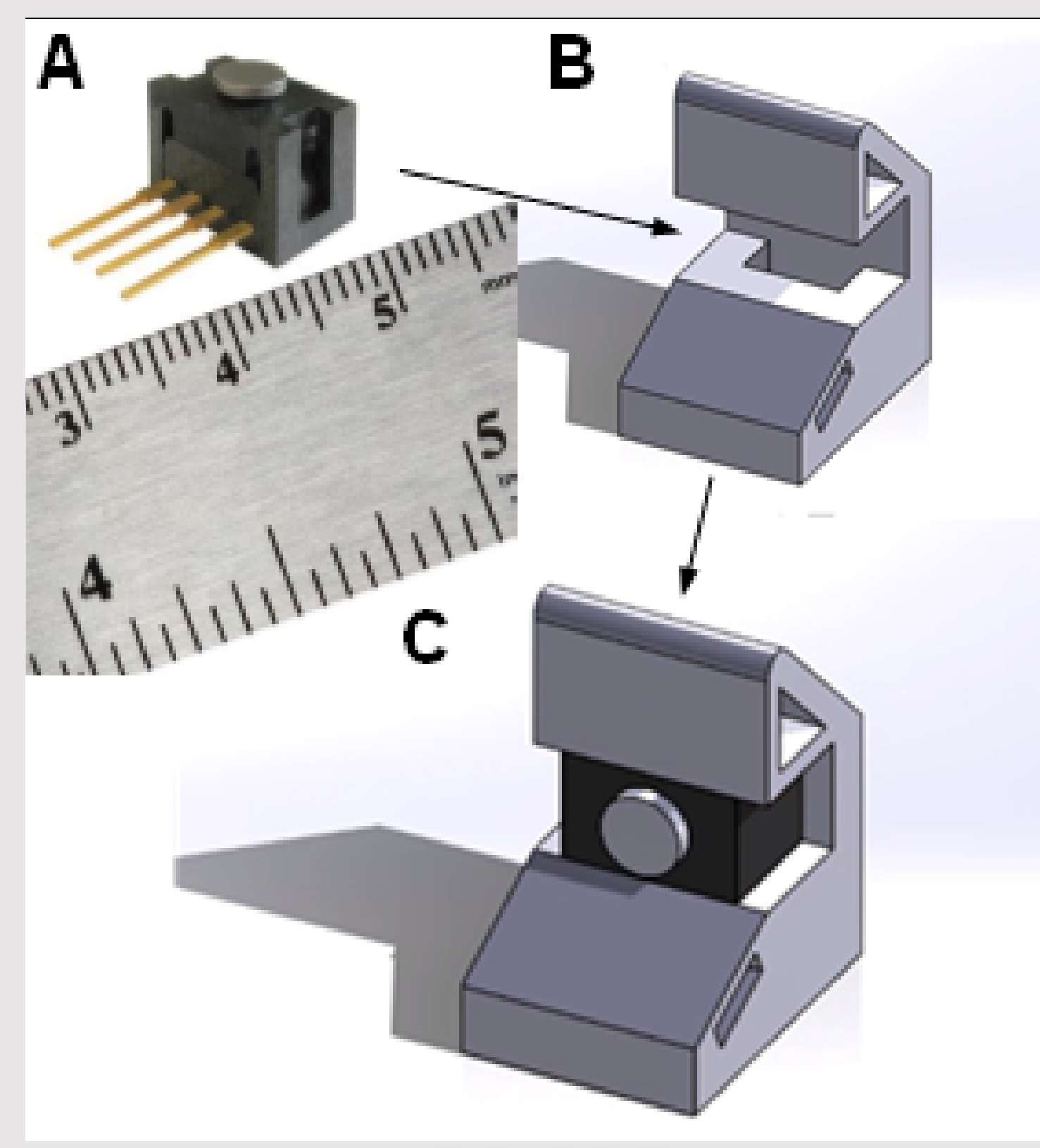


FIGURE 7

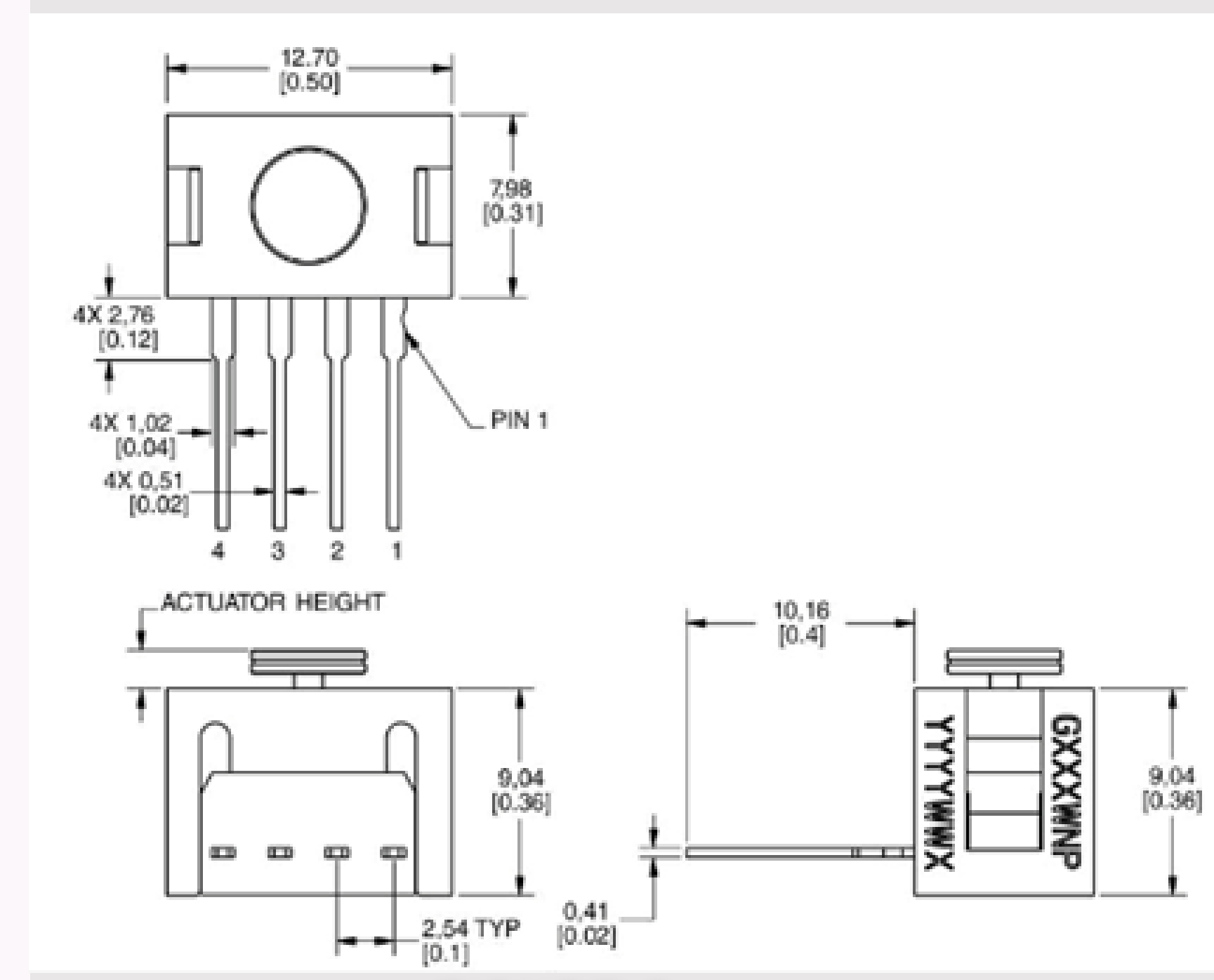


FIGURE 2

## REFERENCES

- Clause, Amanda et al. "An acoustic startle-based method of assessing frequency discrimination in mice." *Journal of neuroscience methods* vol. 200,1 (2011): 63-7. doi:10.1016/j.jneumeth.2011.05.027
- Langguth, Berthold. "Non-Invasive Neuromodulation for Tinnitus." *Journal of audiology & otology* vol. 24,3 (2020): 113-118. doi:10.7874/jao.2020.00052

## DISCUSSION & CONCLUSION

The main goal of the research project is satisfied with the final SOLIDWORKS model, as shown in Figure 7. A mechanism was devised to replace the platform and better secure the mice in an effort to improve the ASR analysis and the accuracy of detection. The custom-made mechanism will allow for precise analysis of the absence or presence of tinnitus. The data obtained from this analysis will confirm tinnitus has been induced and enable the cure of the disorder utilizing electrical simulation.