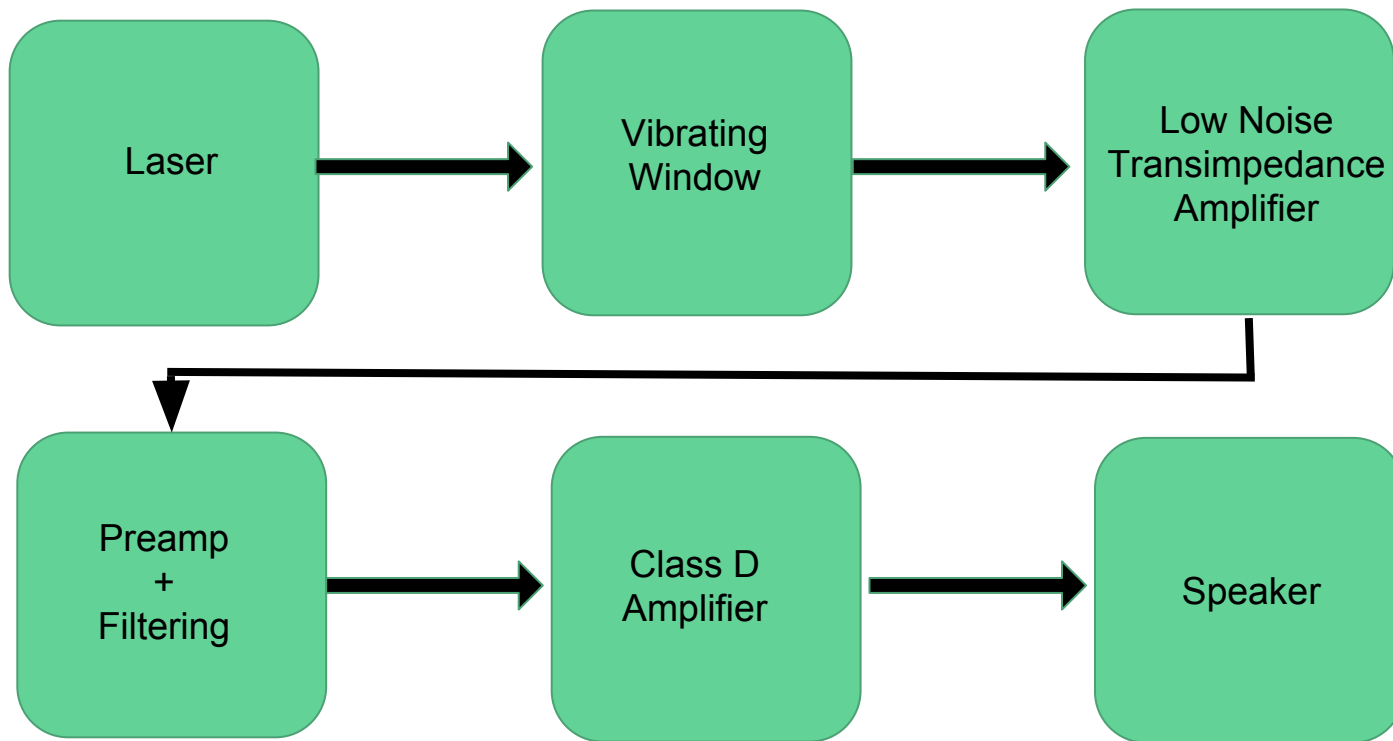# Laser Snooper
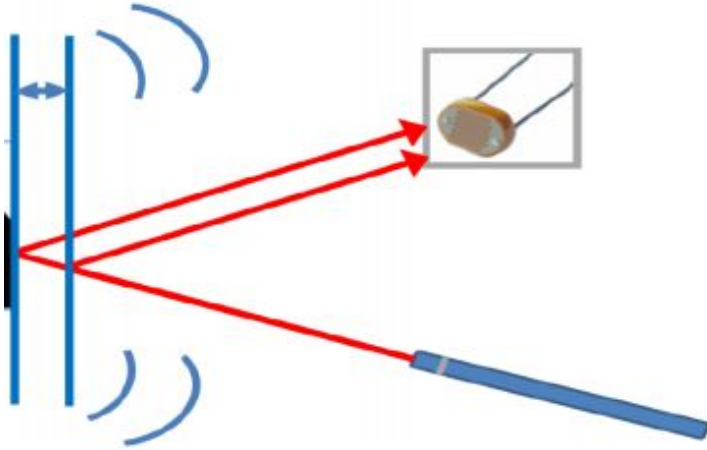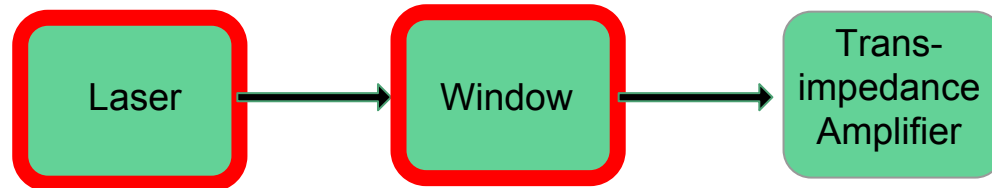
Julian Alverio, Mark Chounlakone, Justin Tunis

Overview

Laser-Window Interaction

As the window vibrates, the laser's path is altered and the photodiode detects the changes in intensity

Laser → Window → Trans-impedance Amplifier

Transimpedance Amplifier

$$R_f$$

$$A$$

Photo Device

$$I_s$$

$$0v$$

$$V_{out} = -I_s \times R_f$$
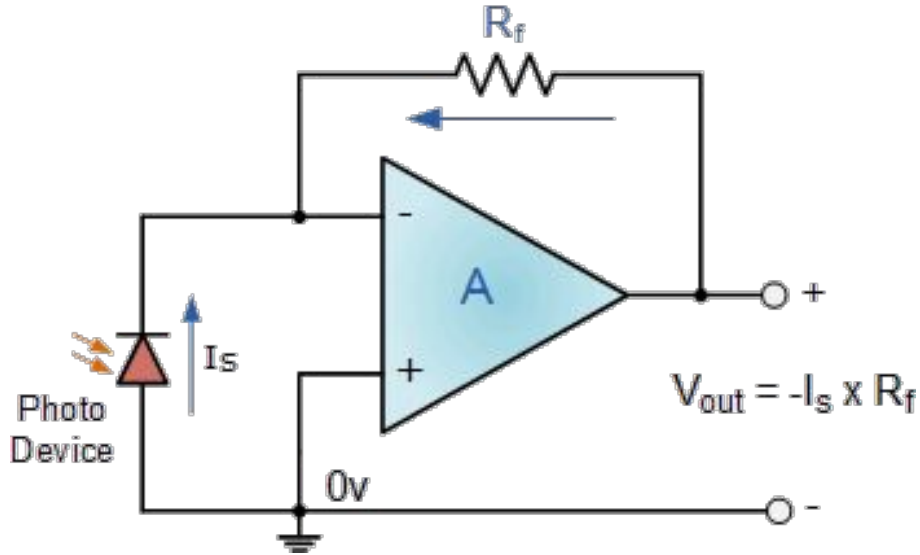
Goal: Convert Tiny Current to Voltage

Main Solution: Low noise transimpedance amplifier

Laser → Window → Trans-impedance Amplifier
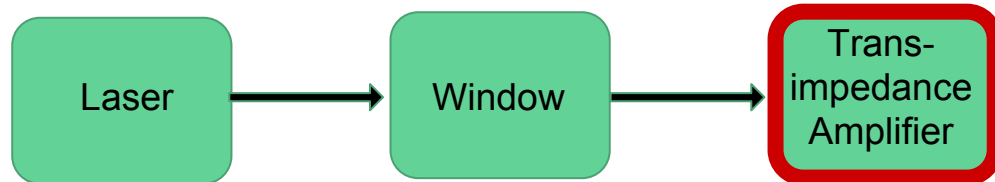
Noise Reduction
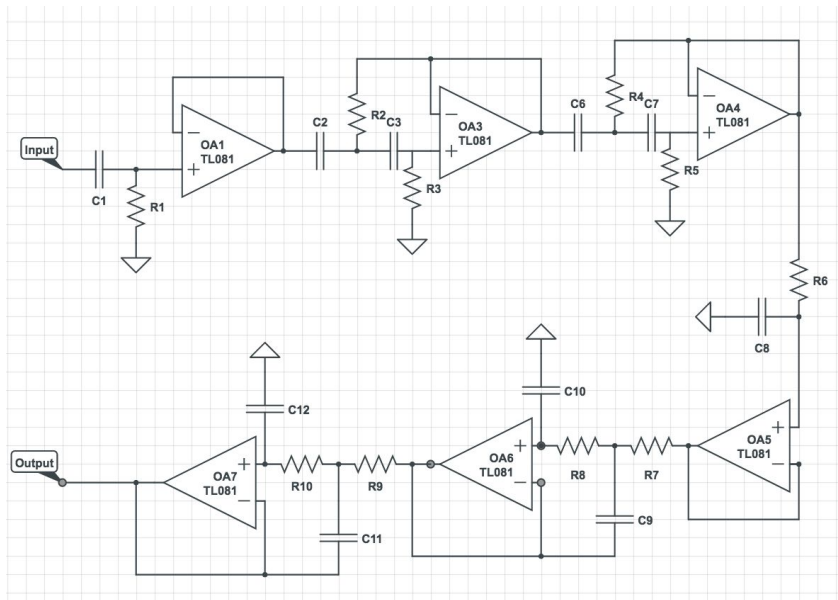
Vocal Band: 300Hz - 3kHz

Goal: Remove any noise not in this frequency range (ex. AC hum, phototransistor/component noise, other non-speech audio)

Main Solution: Bandpass Filter (5th-Order Butterworth Bandpass Filter)

Amplification

Input

C

Triangular wave generator

Switching controller
and output stage

Low-pass filter
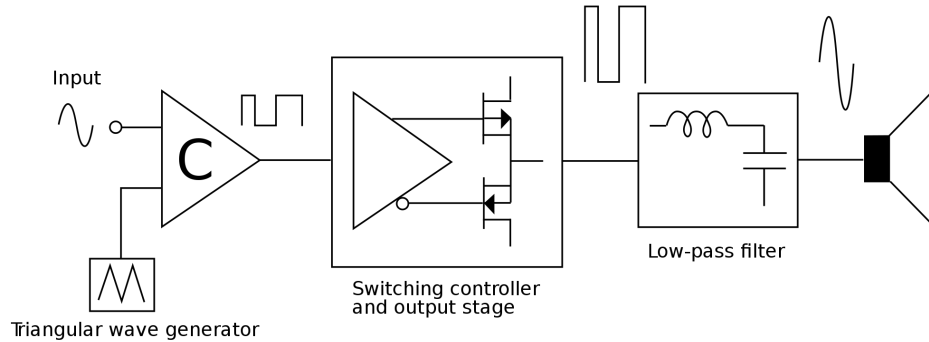
Goal: Amplify the signal to an audible range

Solution: Class-D amplifier to feed our speaker

Class D Amplifier

Speaker
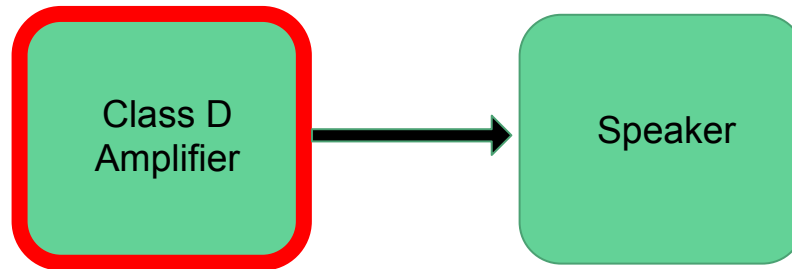
Potential Project Extensions

1. Laser Intensity Modulation
   a. Pink noise reduction
   b. Potentially requires developing a variable laser diode driver
2. Voice Changer
   a. If the signal is clean enough we can add vocal modulations
   b. Frequency selection and mixing
3. Laser Communication
   a. Just directly sending messages over a laser.
   b. Potentially requires developing a variable laser diode driver that varies with audio
   c. Could use pulse density generator to communicate.

Mitigating Risks

Risk	Countermeasure
Laser Alignment	Using visible light instead of IR
Noise in 300Hz - 3kHz Frequency Range	Depending on source of noise, modulating the signal could help; foam blocks to remove mechanical noise
Detecting Light Intensity Changes	Video
Window Reflectivity	Video

Timeline

	4/16	4/17	4/18	4/19	4/20	4/21	4/22	4/23	4/24	4/25	4/26	4/27	4/28	4/29	4/30	5/1	5/2	5/3	5/4	5/5	5/6	5/7-5/17	5/18
Spec Out Circuits and Order Parts																							
Test basic functionality with mirror and speaker																							
Optimize and Tune Circuit, Restest																							
Build transmitter and receiver, test on window																							
Build Receiver positioning platform																							
Implement modulation to clean up noise																							
Replace visible laser with infra-red																							
Final Debugging/revisions																							
Get Final Checkoff																							
Write Final Report																							

Questions?