

Musicscope: A musician oscilloscope and Audio Effects Learning System for Guitar Pedals

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Team ID: 408J - Pentasonic Distortion

Project Goal

- Our goal was to design and development of a multi-effects guitar pedal featuring real-time audio signal processing and a user interface for visualizing the processed waveform.

Project Description

- Our system is conceived as an educational tool tailored for musicians with practical experience in effect pedals but limited background in signal processing or electronics, targeting educators, hobbyists, and beginner effect pedal builders.
- The core project goal is to design and create a multi-effect guitar pedal that effectively teaches basic signal and electronics concepts through hands-on interaction.
- To achieve this, we are developing an Arduino-based signal processing system that will convert guitar signals into readable digital data, enabling real-time audio analysis and effect modulation. We use Analog Devices' EVAL-ADAU1467 Board to digitally simulate effects, and to switch between the physical effect pedal, and multiple digital effects.
- The system will feature a user interface that visually presents both the original guitar waveform and the processed waveform after the applied effect, allowing users to directly compare and understand the impact of signal manipulation.

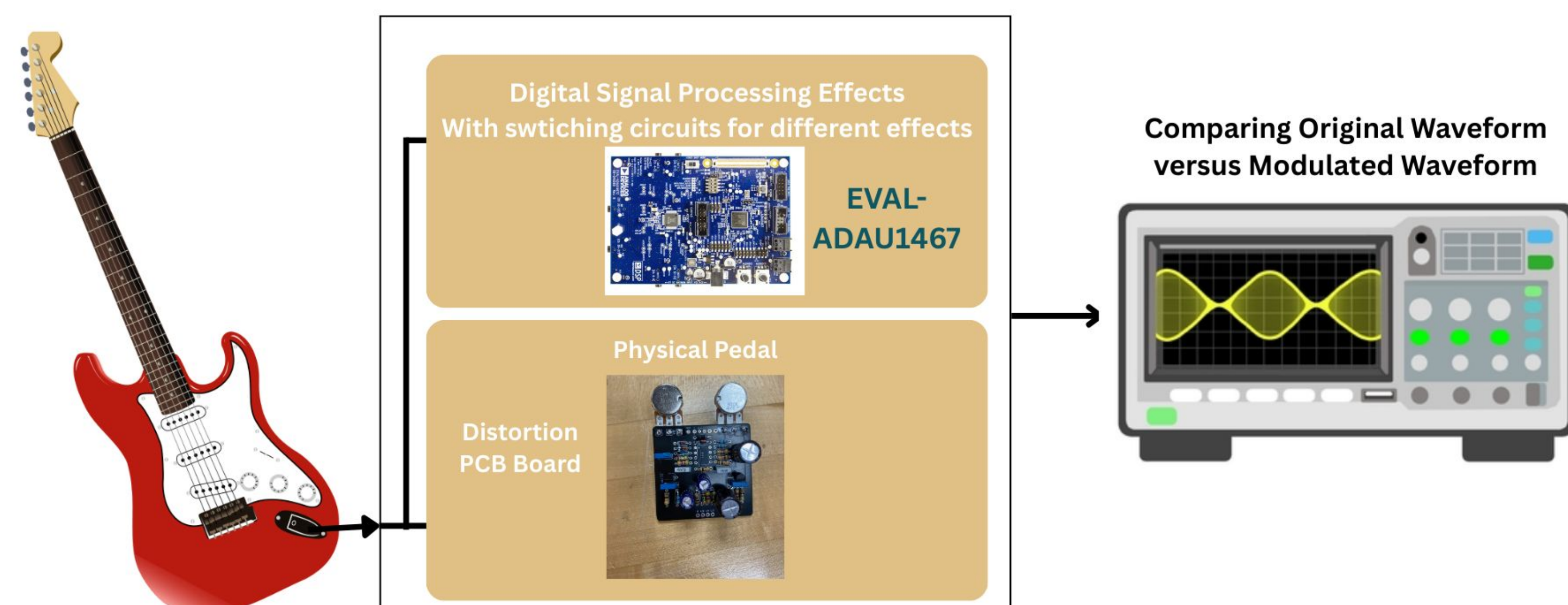
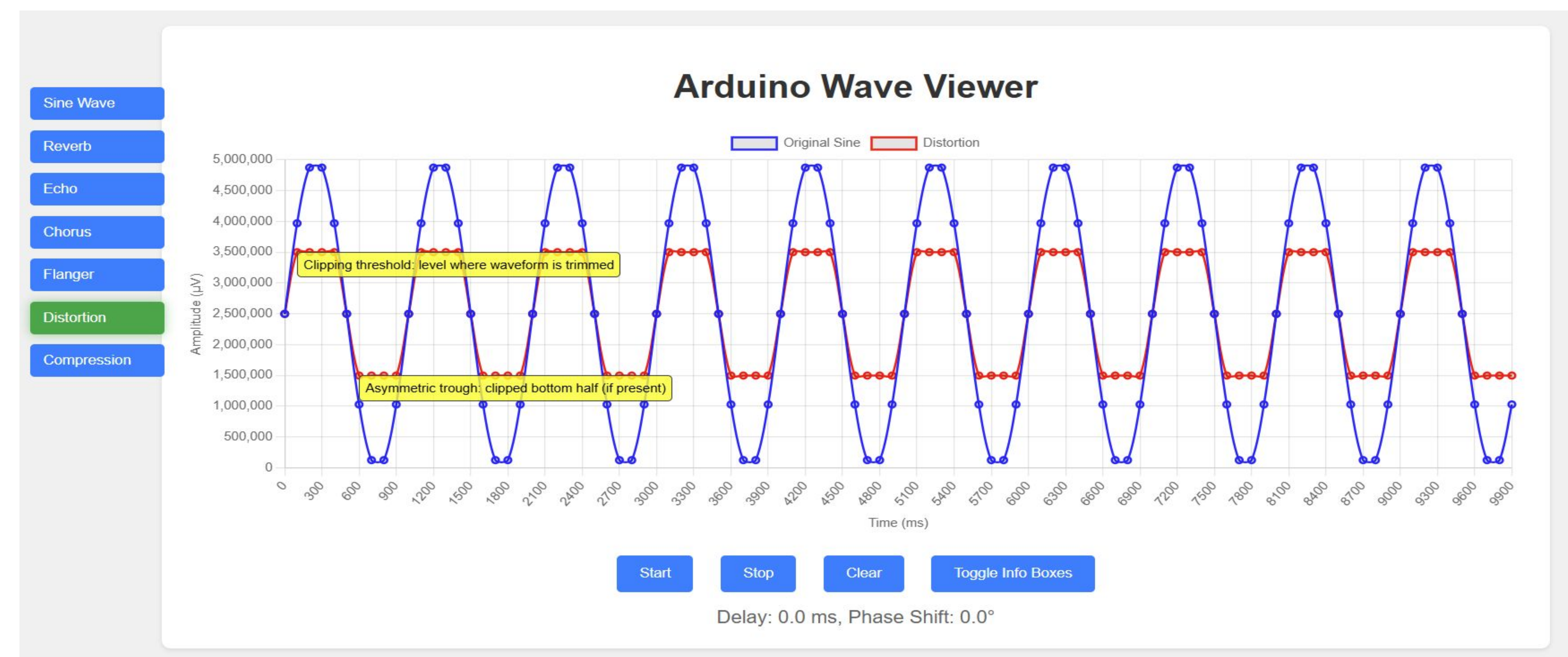


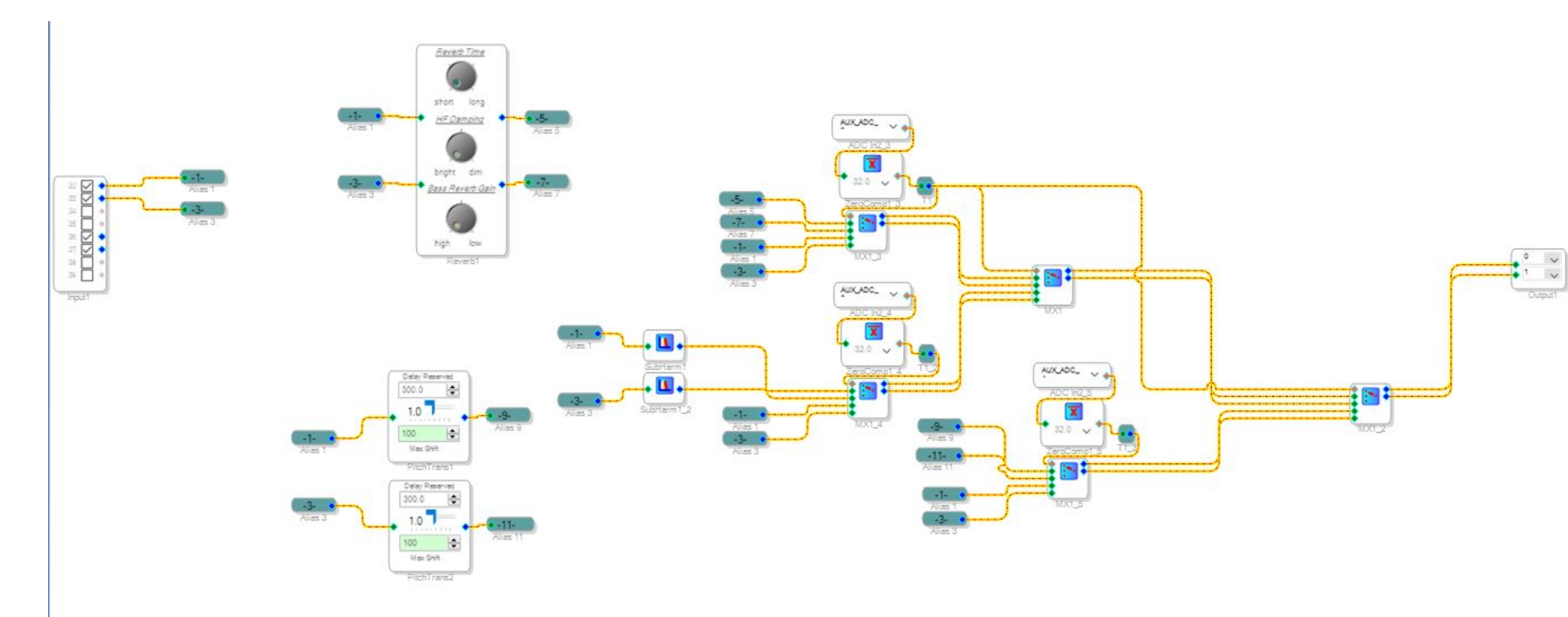
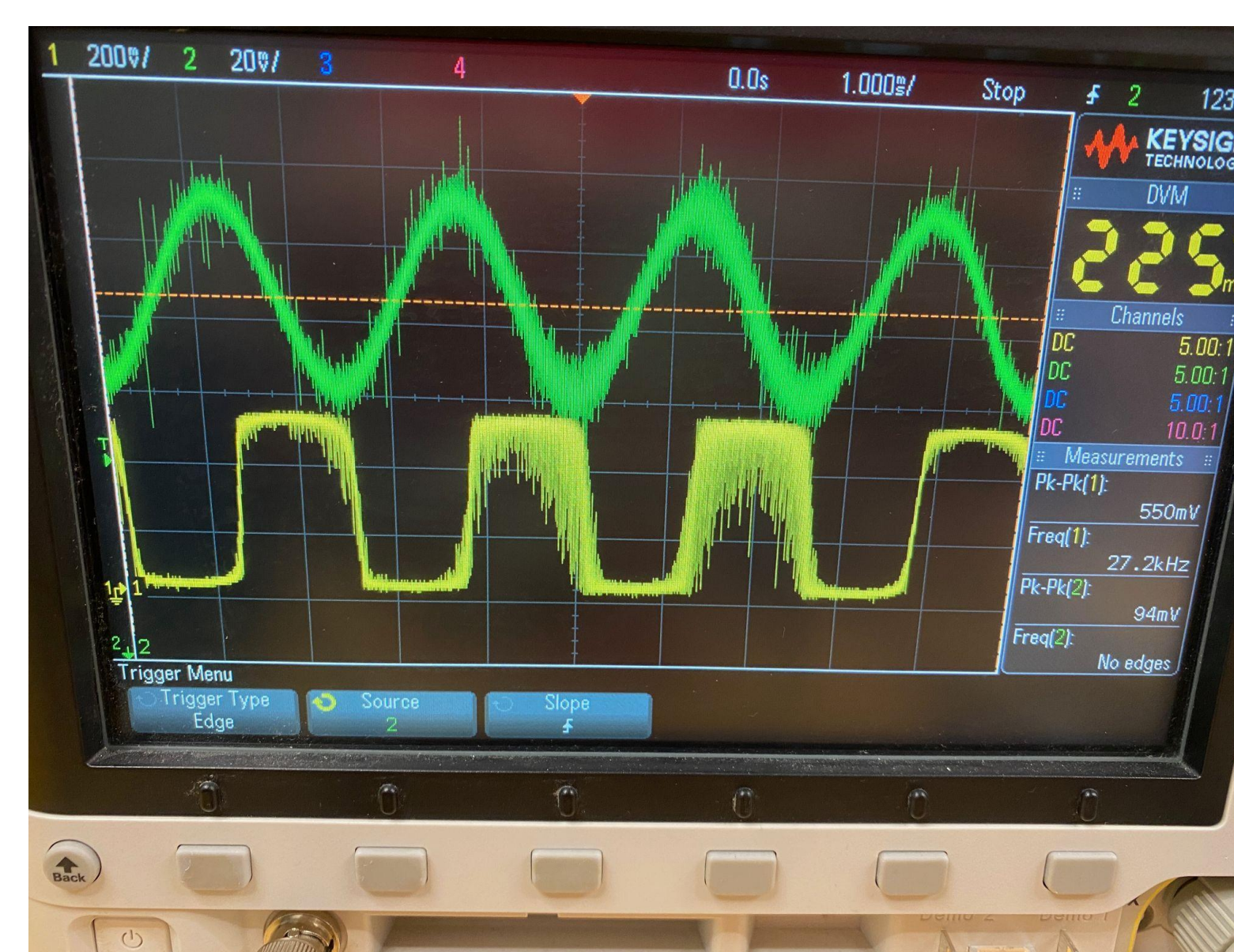
Figure 1: General Flow Chart For Design

Data Analysis for Signal Capturing



- Here is our browser-based tool in action, teaching about distortion.
- It streams analog data from an Arduino (or any serial-output board) to your web page in real time. Under the hood it uses Node.js with Express to serve a static front end, the serialport library to read raw ADC samples, and WebSockets to push each sample into a live-updating chart.

Prototype / Final Design



- For the signal modulation, we use distortion to modulate the signal, and the below image is the amplification and overdrive effect on the signal.
- Yellow is the distorted signal and green is the original signal. For the distortion effect, we built a pcb assembled circuit board to modulate the signal.
- The PCB board has potentiometer that is capable of controlling the volume and the blend of the distortion effect
- This is the general flow chart for the GUI of the DSP board. With the GUI, you can easily add effects and creates switches for different effects.