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# Short Range Imaging Using Ultrasonic Signals

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# Short Range Imaging Using Ultrasonic Signals

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## Project Overview

Develop hardware and software to make distance measurements using ultrasonic signals. The main goal is to use the signals to create 2D and 3D images at short ranges and in confined spaces.

## Hardware

- Teensy 3.6 Microcontroller and Audio Shield
- Microphones and Speakers
- Microphone amplifier PCB (Printed Circuit Board)

## Software

- Arduino
- Multisim
- Audacity
- Ultiboard
- Matlab

## Methods

- Tested microcontroller's ability to play audio
- Developed code to play and record audio simultaneously
- Tested different microphones and speakers between 5 kHz and 42 kHz
- Designed hardware setup and performed distance measurements
- Compared results and determined ideal frequency range
- Cross-correlated input and output signals

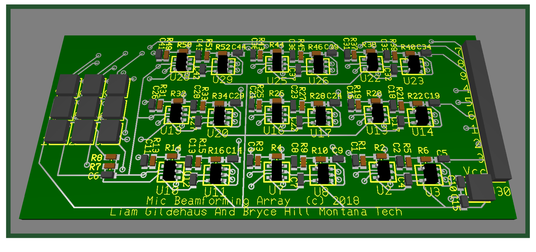


**Figure 1. Microphone Amplifier PCB**

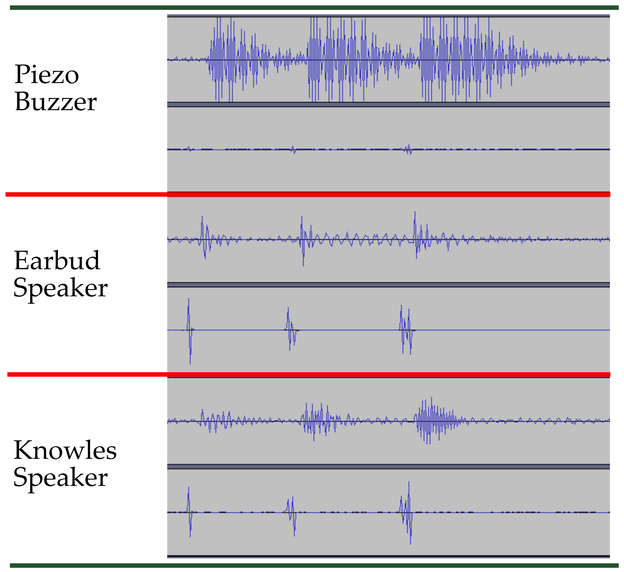


**Figure 2. Speaker Comparison**

## Results

- Evaluated three speakers with similar input signals
- Lowered the signal frequency from 40 kHz down to 25 kHz
- Increased I2S sample rate from 44.1 kHz to 176 kHz
- Maximum resolution for distance measurements is to nearest 2 mm

## Conclusions

- The piezo buzzer exhibited undesired ringing
- Identified signal frequency range
- Future work
  - Find a more suitable speaker
  - Obtain accurate distance measurements
  - Expand to an array of 2 microphones and speakers

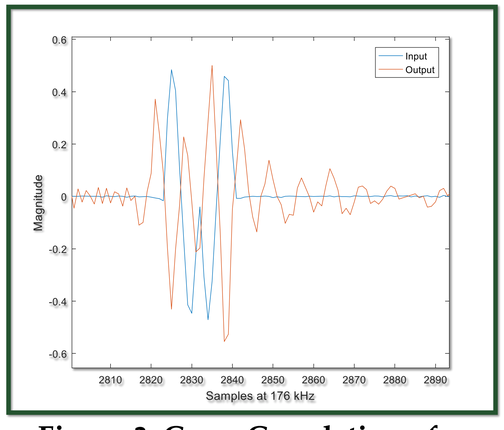


**Figure 3. Cross Correlation of output and input**

## Acknowledgments

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