SCALED DOPPLER SOUND SENSOR

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ABSTRACT

- The subject of the project was infrasound, which is sound below 20Hz. The wave lengths are constructed in numerous ways, however, to human ears it is very difficult to hear. These sounds can be found in nature. An example of infrasound found in nature would be a thunderstorm or a waterfall. They are also produced and sensed by elephants. In this senior design project, the idea for infrasound will be explored for various reasons such as finding lost people in areas where satellite signals cannot reach, navigation in GPS denied environments, and even in missile detection.
- Our design for a sensor revolves around using the doppler effect of a spinning sensor to capture a waveform and use the location of minimum and maximum peaks to detect a direction in which sound is coming from. Due to technological, logistical, and budgetary constraints, we decided to scale our design to audible sound range. Using audible sound for the prototype would allow us to build and test accurately and effectively within our means. After the core operating concepts are established, it could be scaled back down to infrasound range with better equipment, such as a better sensor, low frequency microphone, and higher quality hardware materials.

MOTIVATION

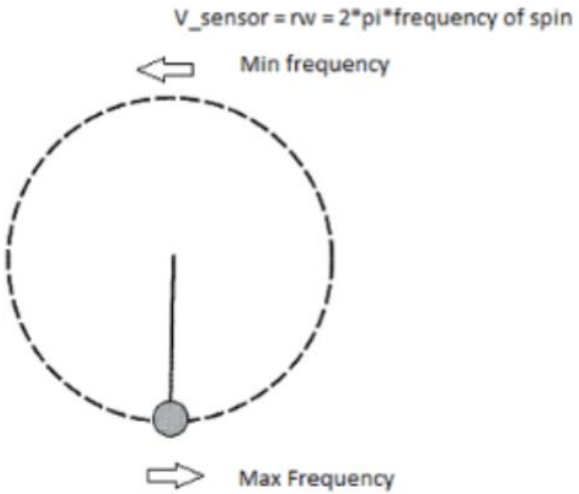
The goal of this project is to be expand upon previous research and solve a small piece of the "puzzle" that is infrasound and create a device that could assist or improve the process of pinpointing a location without using satellite signal and using fewer sensors.

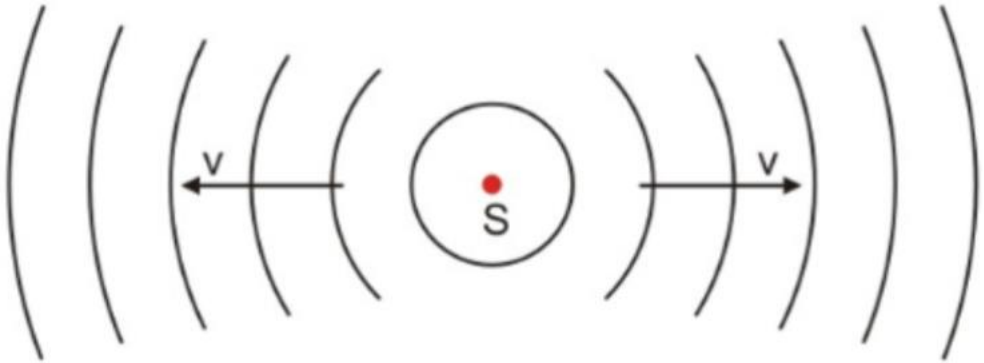
ENGINEERING DISCIPLINES

- Digital Signal and Processing - Filtering noise and analyzing wave peaks
- Embedded Systems - Using controller and a driver
- Wave physics - Fourier transform

THEORY

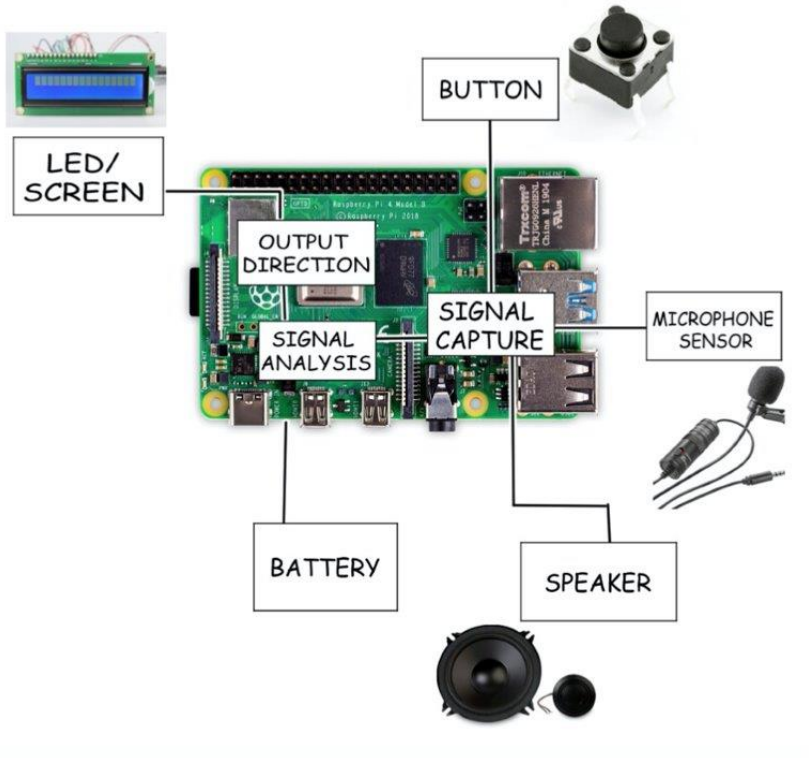
- A sensor will be sprung around in a circle detecting sounds in a certain frequency
- The location of the sound will produce a max frequency while the signal across from it will be the min frequency. Calculations will then be made from there.

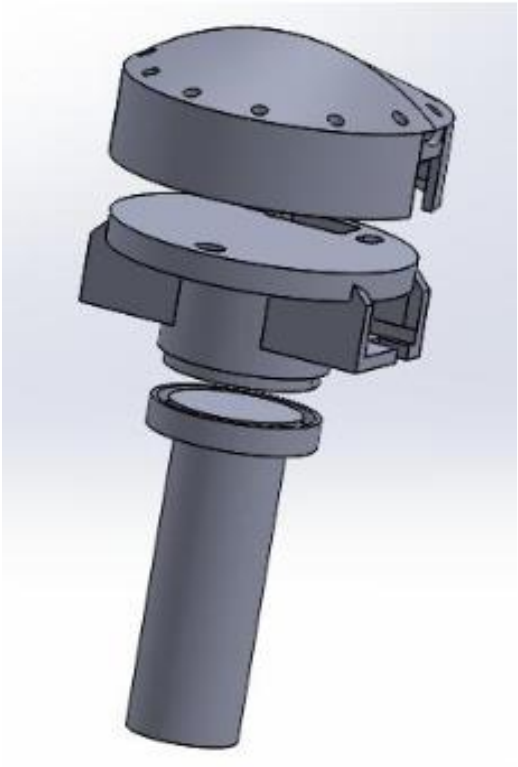




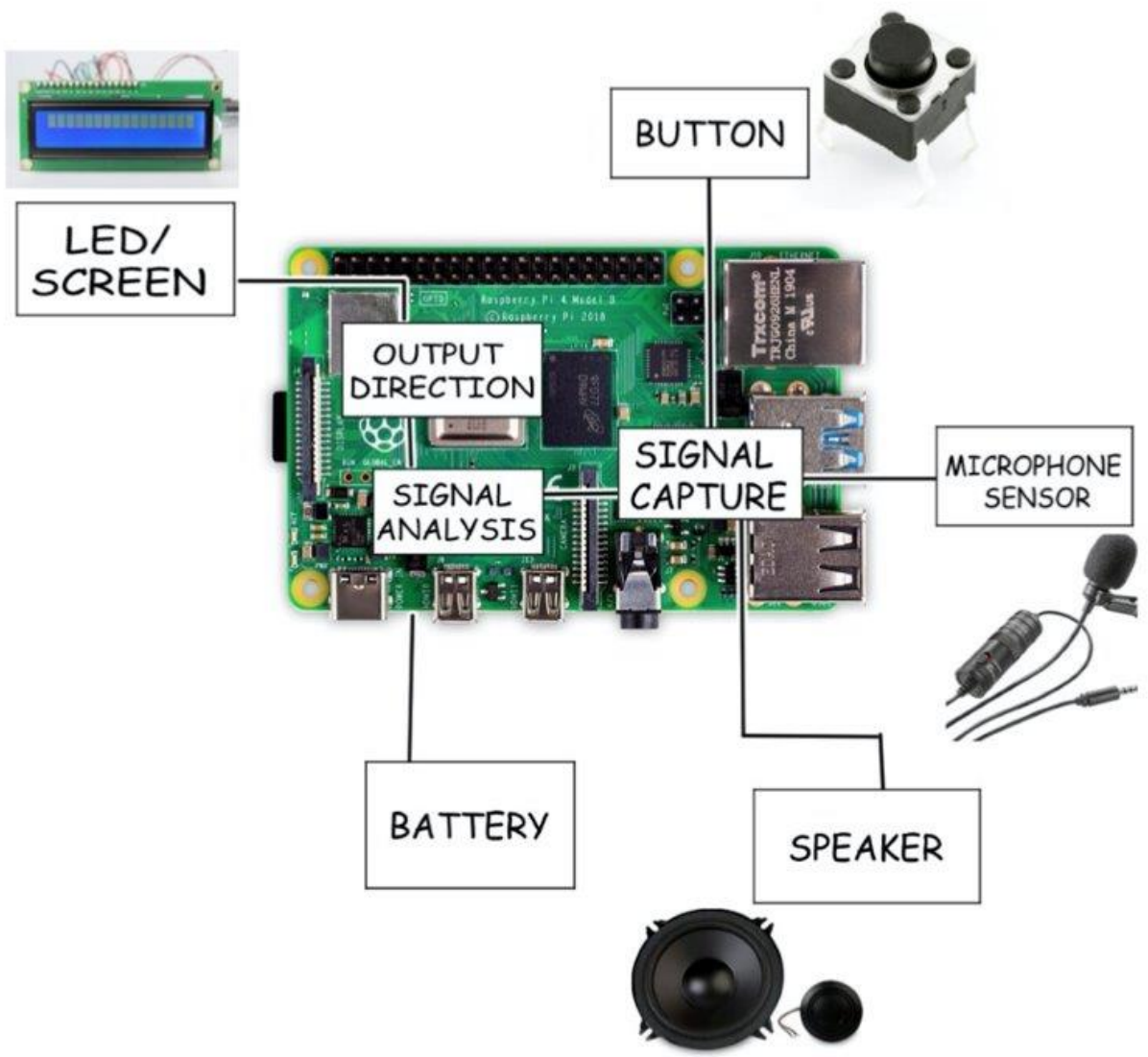
$$f_{sensor} = \frac{(c \pm v)}{c} * f_{source} = \frac{(343m/s \pm 2\pi r)}{343m/s} * f_{source}$$

SYSTEM COMPONENTS



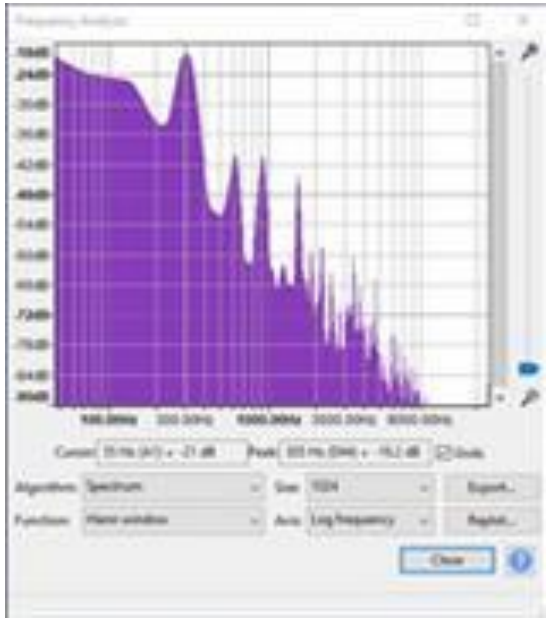


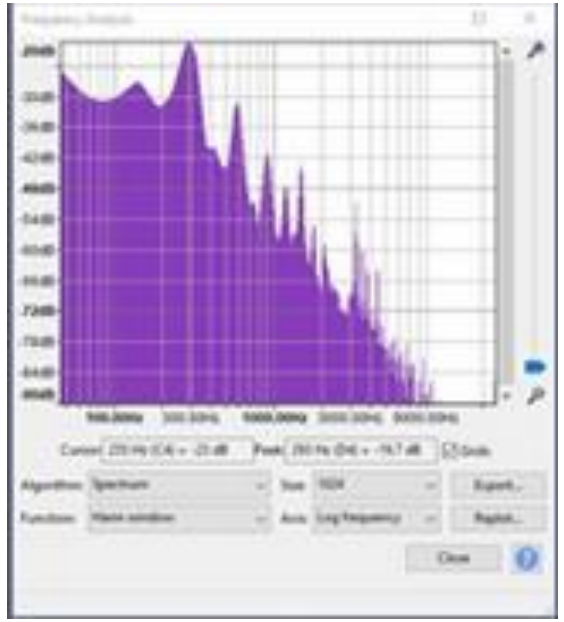
SYSTEM ARCHITECTURE



RESULTS

- Unable to complete/test project due to Coronavirus
- Frequency shift found from tests during initial prototyping





FUTURE IMPROVEMENTS

The assembly could be made from better material, perhaps carbon fiber, if the means were available.

Implementation of a drone

Scaling to infrasound frequencies

Improved user interface