Acoustic Levitator

In this project we will make an acoustic levitator, analyze how it works, and predict the largest item at a particular density that we will be able to levitate. In order to do this, we would first begin by constructing an acoustic levitator. The file to 3D-print the main structure is available online, so we could use the printer in the makerspace to print the main apparatus.[[1]](#footnote-0) Once the main apparatus is printed, we attach the transducers and wire them up. We use an Arduino to control the apparatus, and the code for this can also be found online in the same place as the file for the 3D-print. When the physical apparatus is finished, we can do some calculations to figure out what the largest object of a certain density we can levitate. We do not know yet what this entails, but the results can be found in a paper written about this project.[[2]](#footnote-1) But for the added complexity we could try to derive where those results came from.

There are some potential difficulties that we expect. The first being that the transducers are not very reliable in terms of their construction. It is noted that the positive and negative terminals labeled on the transducers are often wrong.[[3]](#footnote-2) This is easy to test but is time consuming and will have to be done carefully. The transducers also are noted to have different strengths to them, but it is not yet known to us how to test them, or how much it matters. For the best results it would be ideal to have transducers that put out about the same amount of force, but not necessary. Another potential difficulty is figuring out how to analyze the system. At this time, we do not know what this entails, it could very well be too complex to do as an advanced lab project.

Materials needed:

* 72 transducers
* Arduino (nano is used originally, but we can probably use an uno)
* Dual motor drive board
* Power switch
* DC variable adaptor
* DC connector
* Wires
* Acoustically transparent material to protect the transducers from falling objects

Equipment needed includes:

* 3D printer
* Soldering iron, tin and flux
* Hot glue gun
* Multimeter
* Cable peeler
* Misc. hand tools
* Drill
* Oscilloscope

Agande Gball

In this project we will make a ball that senses acceleration, forces, and distance traveled. We will use an Arduino and an accelerometer to get this information. We will first make our sensor using an Arduino that connects to Wi-Fi and an accelerometer. This needs to be fairly compact because we will need to place it inside of the ball. Making this seems straight forward. It seems like we can just wire the Arduino to the accelerometer and a battery, and then we are good to go. We need to somehow get these components into a small bound system, that way the parts all stay together when being jostled around. Once the sensor unit is complete, we need to cut a small hole in a foam ball and hollow out a spot for the sensor. Once the sensor is in place, we put back the piece of the ball that we cut out, and tape it shut. The code to do the calculations can be found online, but we could modify it to get even more information.[[4]](#footnote-3) As of right now, the code can only tell us the acceleration of the ball, and how far it fell if dropped straight down. We could probably modify it to give us forces and calculate the distance in both the horizontal and vertical direction.

Some problems that we may run into. This project seems pretty straight forward, and maybe a little too easy for an advanced lab project. We do anticipate having trouble securing the components together. It seems like the components are fragile and it seems like they should be secured more than just taped together like in the video.[[5]](#footnote-4) We could possibly 3D print an apparatus that holds the components together and also protects them. It also might be difficult to modify the code to get out more information. Finding the force should be easy because we have the acceleration and mass, but figuring out how to get distance traveled might be more difficult.

Materials needed:

* Arduino MKR1000
* SparkFun triple axis accelerometer breakout ADXL345
* Li-Po battery 3.7 V 1200 mA
* Jumper wires
* 6 inch foam ball

Equipment needed:

* Multi meter
* Tape
* 3D printer possibly
* Knife

Ultrasonic Distance Sensor

An ultrasonic distance sensor emits pulses of ultrasonic sound waves, marking the time when each pulse is sent out. It then uses a sensor to receive reflected ultrasonic sound waves, calculating the difference in time between emission and reception. If the air composition, density, temperature, and pressure is known, the speed of sound through the air is known, and the distance to the object can be calculated within a certain margin of error.

1. <https://www.instructables.com/Acoustic-Levitator/> [↑](#footnote-ref-0)
2. <https://aip.scitation.org/doi/pdf/10.1063/1.4989995> [↑](#footnote-ref-1)
3. <https://youtu.be/ABjRnSYw-4k> [↑](#footnote-ref-2)
4. <https://create.arduino.cc/projecthub/zeijlon-systems/azande-gball-6c0695?ref=search&ref_id=physics&offset=8> [↑](#footnote-ref-3)
5. <https://youtu.be/skAw9_b8-TE> [↑](#footnote-ref-4)