Instruction Manual: Ultrasonic Suspension DIY Learning Kit

Introduction to Acoustic Levitation

- What is **acoustic levitation**? It's an interesting phenomenon that uses sound waves to apply force to objects.
- How does the kit work? It utilizes the fact that sound waves carry mechanical energy to create a force opposite to gravity, causing the object to suspend.
- Unlike **magnetic levitation**, acoustic levitation can be used for various materials (even insects), although the force is weaker.
- Safety Precautions (low-voltage, handling electronic components, proper wiring practices).

Components Checklist

- Verify all items from the Packing List are present:
    - **3D-printed TinyLev** (x1)
    - **Arduino Nano** with mini USB cable (x1)
    - **10mm 40kHz Transducers** (x76)
    - **L298N Dual Motor Drive Board** (x1)
    - **DC Power Adaptor 9V** (x1)
    - **Power Switch** (x1)
    - **DC female connector** (5.5 X 2.1mm) (x1)
    - **Button** (x3)
    - **Jumper wires** (Some)
    - **Black and red wire** (Some)
    - **Exposed wire** (Some)

Assembly Phase 1: Preparing the Transducer Arrays

1. **Understand the Array:** The kit has two opposing transducer arrays, which create the standing wave (likely a top and bottom section of the 'C' frame).
2. **Transducer Placement:** Insert all **76 transducers** into the designated circular spots on the two ends of the **3D-printed TinyLev Frame** (as seen in the images).

3. **Wiring the Array:** Using the **exposed wire**, carefully follow the specified pattern (typically a concentric or spiral wiring schematic, which will be provided with the kit instructions) to connect the positive and negative leads of the transducers in sequence. *This step requires precision and may involve soldering.*
4. **Connecting Main Leads:** Solder the **black and red wires** to the main connection points of the finished transducer arrays. These will connect to the driver board.

Assembly Phase 2: Building the Control Circuit

1. **Mounting the Control Board:** Secure the **Arduino Nano** and the **L298N Dual Motor Drive Board** to the base/control platform (the cardboard/mounting plate shown in image).

2. **Button and Switch Assembly:** Wire the three **buttons** and the **Power Switch** to their designated spots on the control platform.
3. **Power Input:** Connect the **DC female connector** to the power circuit on the mounting platform.

Assembly Phase 3: Wiring the System

1. **Driver to Arduino:** Use **jumper wires** to connect the L298N driver board's control pins to the appropriate digital output pins on the Arduino Nano.
2. **Arrays to Driver:** Connect the main black (negative) and red (positive) leads from the two transducer arrays to the motor outputs (e.g., OUT1/OUT2 and OUT3/OUT4) of the **L298N driver board**.
3. **Buttons to Arduino:** Wire the control buttons to the necessary digital input pins on the Arduino.
4. **Power Wiring:** Connect the power source from the **DC female connector** to the L298N's power input and the Arduino Nano's power pins (or use the mini USB cable for a cleaner look).

Operation & Testing

1. **Initial Power Test:** Plug in the **DC power adaptor (9V)** and switch the unit on. The control boards should power up (lights may illuminate).
2. **Transducer Activation:** Press the control buttons. The buttons are used to change the frequency or phase of the arrays, which creates the standing wave required for levitation.
3. **Levitation Test:** Carefully place a very small, lightweight object (like a tiny foam bead or piece of styrofoam) into the space between the two arrays.
4. **Fine-Tuning:** Use the buttons to cycle through the levitation modes until the object is suspended in the air. The object will be suspended in the **nodes** of the ultrasonic standing wave .

Troubleshooting

- **The unit doesn't power on:** Check all connections to the Power Switch and the DC Female Connector. Ensure the power adaptor is working.
- **The arrays power on, but nothing levitates:** Check the detailed wiring of the 76 transducers for any breaks or incorrect polarity. The relative phase between the two arrays is critical; this is usually controlled by the pre-installed program via the buttons.
- **The object is pushed away instead of suspended:** This can indicate a phase or frequency issue. Try cycling through the button functions.