Electric Project - Ultrasonic Levitation System

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I. AIM

This experiment aims to construct an ultrasonic levitation system and demonstrate its ability to levitate lightweight objects with the help of high-frequency sound waves.

II. THEORY

1) *Arduino Uno:* Arduino Uno is a microcontroller board with having ATmega328P chip on it. The board has multiple digital and analog input/output pins that can be used to connect to different sensors and other electronic components. Arduino Uno is programmed using Sketch programming language based on C Language.
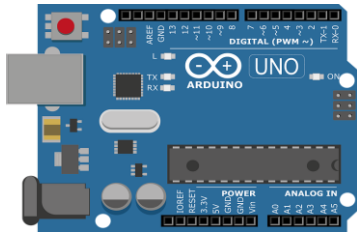
2) *Ultrasonic Sensor:* An ultrasonic sensor emits a highfrequency sound wave, usually between 40 and 200 kHz, which travels through the air and bounces off an object. The sensor then detects the echo of the sound wave.
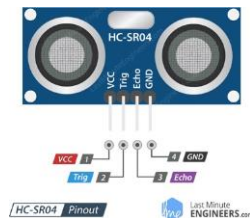
3) *L298 N Motor Driver Controller:* The L298N chip contains two H-bridge circuits, each consisting of four transistors that can control the current flow to the motor. It has two output pins on each driver's side, and input and power must be given on the same side. This driver is widely used in robotics projects due to its low cost.

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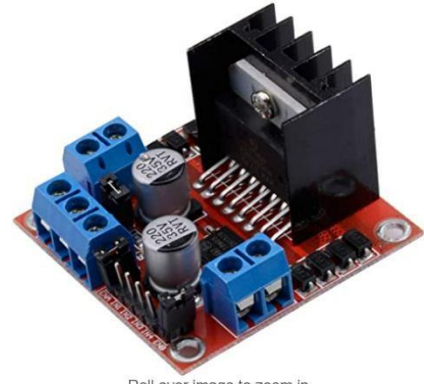
Sound waves propagate in the air as a series of compression and rarefactions. When these waves come in contact with a surface, they are reflected, transmitted or absorbed depending on the properties of the surface.

In the case of this system, the transducer generates highfrequency sound waves focussed on the reflector. This reflector reflects the waves to the transducer creating a standing wave pattern containing nodes and anti-nodes.

When an object is placed at a node, it experiences a force upward due to the pressure differences created by the sound waves. This force can be used to counteract the force of gravity, thus allowing the object to levitate. This is because particles at nodes are in a state of minimum displacement and maximum pressure, creating a stable equilibrium supporting the object's weight.

This system has a wide range of applications, including studying micro-gravity environments in the fields of biology and chemistry especially. This system can also manipulate biological cells and microorganisms without physically touching them.

This system is limited to microscopic and lightweight objects only. Also, this system is delicate and pretty sensitive to minor temperature and humidity changes. This system will work more efficiently when the environment is filled with noble gases such as helium and nitrogen.

Advancements in technology have led to the development of advanced ultrasonic levitation systems, which can levitate some

larger objects also. Also, researchers have made this process advanced by applying ultrasonic waves instead of sound waves.

III. INSTRUMENTS REQUIRED

1) : Arduino Uno
2) : Ultrasonic Sensor
3) : L298 N Driver Module
4) : Jumper Wires for Connection
5) : Battery with Connector

IV. PROCEDURE

1) : Create a base to put the transmitter and receiver on opposite sides.

2) : No matter which is the transmitter and which one is the receiver, both parts have components.
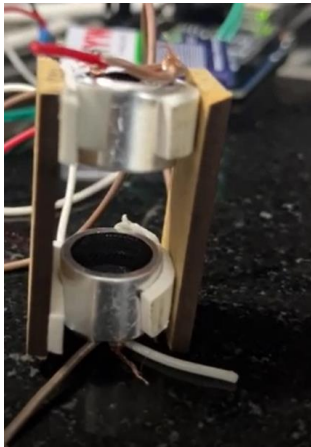
3) : Now, unsolder both parts from the ultrasonic sensor.

4) : As the circuit given above, make all the connections and soldering required.

5) : Finally, upload the Arduino code required to the Arduino Uno and connect it to a battery to provide an external supply.

6) : Now, take a styrofoam particle and see if it levitates after making all the connections.

7) **Circuit Diagram:**
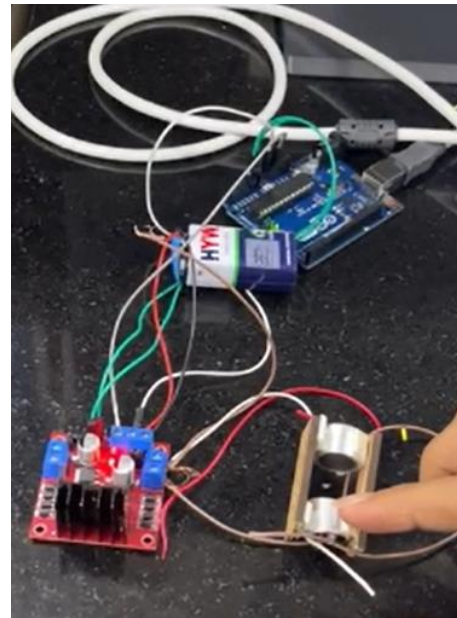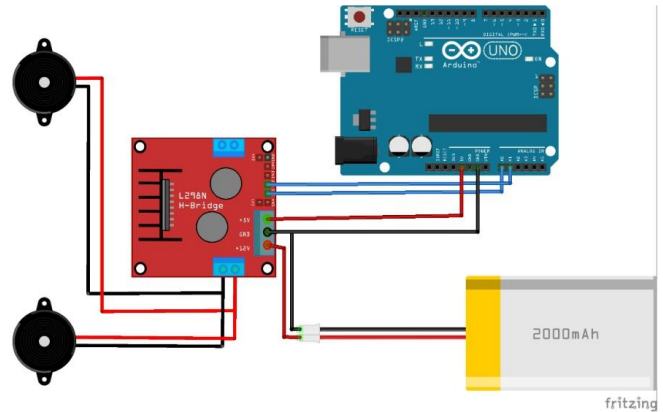
V. RESULTS AND OBSERVATIONS

1) : We observed a non-contact levitation system which will be very helpful in material science and biology.

2) : We also observed that this is limited to lightweight only, as mentioned in theory. Though the material we used was styrofoam, if its size is extensive, it won't levitate.

3) : We also observed changes in stability when the temperature changed. We experienced this when we tried in two conditions - one in the hostel room in AC and one in the electric lab.

VI. ACKNOWLEDGEMENT

The project's success is not from any person but from both members. Though the efficiency of the project could still be better, we did learn many new concepts. We want to thank Prof. Arup Sir, who constantly monitored and pressured us to make

this project happen. Also, we want to thank all the staff members of Electric Members who gave us all the required equipment. Also, we want to thank some of our peers who guided us in this experiment in some critical situations.

VII. REFERENCES

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