Engineering Education

Group 2 Magnetophiles

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DIVISION OF ELECTRICAL & COMPUTER ENGINEERING

Objective:

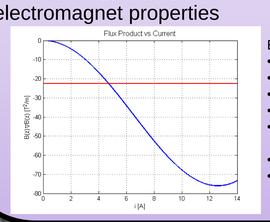
Design an apparatus to suspend a diamagnetic mass in the air without physical support and allow an operator to control its movement in multiple dimensions. The device should be designed for portability to and from classroom environments.

Levitation

- Utilizing the diamagnetic properties of pyrolytic carbon, levitation was theorized to be achieved using a battery of electromagnets under the material.

$\boldsymbol{B}(z)\boldsymbol{B}'(z) = -\frac{\rho\mu_0 g}{|\chi|}$, baseline flux product

$\boldsymbol{B}(r,\theta) = -\frac{Nia^2\mu l}{4\pi}\left(\hat{r}\frac{2cos\theta}{r^3} + \hat{\theta}\frac{sin\theta}{r^3}\right)$, flux as a function of electromagnet properties



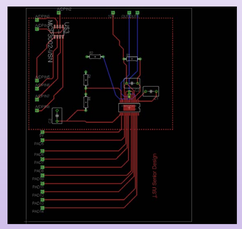
Electromagnet Specifications
- N = 280
- i = 14A max per magnet
- |r| = 58.609 mm
- a ≈ 25.5
- μ_r ≈ 5000

- AWG 16 Magnet Wire
- 99.8% Pure Iron core

Accessory Board:

Design Includes:

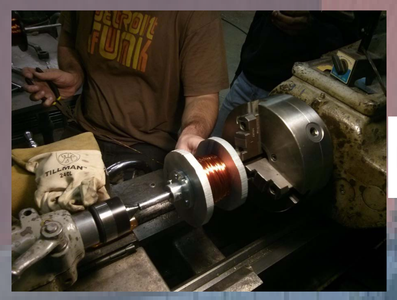
- 2 Sided Board
- Analog to Digital Converter
- DC Motor Driver
- Wire pads for connection to Raspberry Pi 2



Results:

We winded on the plastic bobbin that we made in the lab, we tried several times with and without the core in the bobbin and every time it snapped

We tried winding the magnet on a rod then tapping it and this again failed so we changed the design to a different magnet with less turns and stronger core



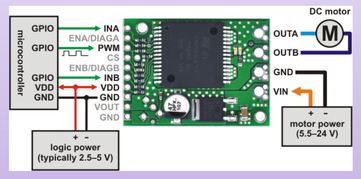
We then used a more magnetic thicker core to get the final magnet

Power Supply:

- Output power for our supply is 500 watts
- Output voltage is 12V with trim voltage being from 11-13V
- Output current is 42A
- Ripple noise is 120mV peak to peak

Coil Driver:

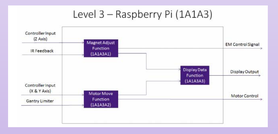
- Operating voltage is from 5.5V to 24V
- Output Current has a max of 30 amps and a 12 amp continuous
- PWM operates up to 20kHZ
- Motor indicator LEDs
- 3V compatible inputs



Raspberry Pi 2:

- The Raspberry Pi 2 is faster in running concurrent programs compared to the Arduino

- Higher clock speed then Arduino, 900Mhz vs 16 Mhz
- Higher sampling rate: 40Mhz vs 16 Mhz from Arduino



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