## Carnegie Mellon University RC Maglev Trains



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## Background

Magnetic Levitation Trains (**Maglev**) trains, utilizing

electromagnetism fundamentals, revolutionize travel by

achieving levitation above magnetic surfaces, eliminating

friction with the trackway and enabling propulsion at

remarkable speeds.

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## **Use Case**

**Problem**: Resources for learning about Maglev trains are either expensive or inaccessible for the average enthusiast or electromagnetics beginner. Many models lack interactivity hindering the learning experience as users do not have control over the train's movement along the track.

**Solution**: Develop an affordable, accessible, and remote-controlled Maglev train intended for train enthusiasts and beginners alike.

**Areas**: Signals and Systems, Circuits, Software, and Devices

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## **Use-Case Requirements**

- User Testing will determine benchmarks
- Speed (0.6 mph minimum for early prototype [450 cm diameter])
- Levitation (0.8 1.2 inches)
- Response Time (5 seconds)
- Stability (Carrier doesn't shake as it moves along on the track)
- Detects objects blocking track (stops when an object in front of the carrier)
- Speed Detector (5% error threshold)

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## **Technical Challenges**

## Arduino

- Determining and varying the amount of current needed in the propelling coils to make train movement smooth

#### Sensors

- Carrier's sensors consistently detect objects while moving

## Levitation

- Constant levitation between train and track, stability Mellon University

## **Technical Challenges**

## **Slopes and turns**

- Speed stays consistent going up and down slope and through turns

## Train stops

- Approaching/departing a stop, speeding up/slowing down, etc.



## **Solution Approach**

#### **Train Stops**

- RFID System
  - Card coded with train stops
  - Communicates with Arduino
  - Manipulate current and speed

#### **Detecting Blocked Track**

- Lidar
  - Detect 360 degrees (filter to appropriate range)
  - Communicates with Arduino
  - Stops train, cuts current off



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## **Solution Approach**

#### Speed

- Digital Potentiometer
  - For propelling coils
  - Connected to Arduino
  - Manually increase/decrease current
    - Increase/decrease speed

#### **Levitation Stability**

- Lengthened Sides
  - Contacts with side of track
  - Keeps train on track



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# Testing, Verification and Metrics Speed

• Using Arduino configured speed detector (IR sensor configuration)

#### Levitation

• Visible height above the track, no signs of contact with the track

### Stability

• Remains on track at high speeds and curves



## **Testing, Verification and Metrics** Response Time

- RFID signal to Arduino Have Arduino print out time offset
- Arduino to Circuit Time manually

#### **Speed detection**

• Manually calculate speed in straight ways, compare with the Arduino speed detector

#### **LiDAR Sensor**

• Manually calculate distance of obstructing object, compare to the LiDAR sensor

## **Division of Labor**

#### Angel

- Design the track and carrier
- Adjust magnets to maximize levitation and propulsion of the system
- Design circuit for "propelling" coils
- Create speed detection circuit

Areas: Devices/Circuits

#### Emanuel

- Design the track and carrier
- Design circuit for "propelling coil"
- Arduino Integration
  - Digital
    - Potentiometer
  - Power Source Distribution

Areas: Devices/Circuits

#### Myles

- Design the track and carrier
- Arduino Integration
  - RFID Scanner
  - LiDAR Sensor
  - Speed
     Detector

Areas: Software/Circuits Carnegie Mellon University

## Schedule

#### A2: RC Mag Lev

Project start: Two, 1/16/2024

ECE Design Experience Abiye, Emanuel; Mwathe, Mylanc Mylanc

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