HoverRail

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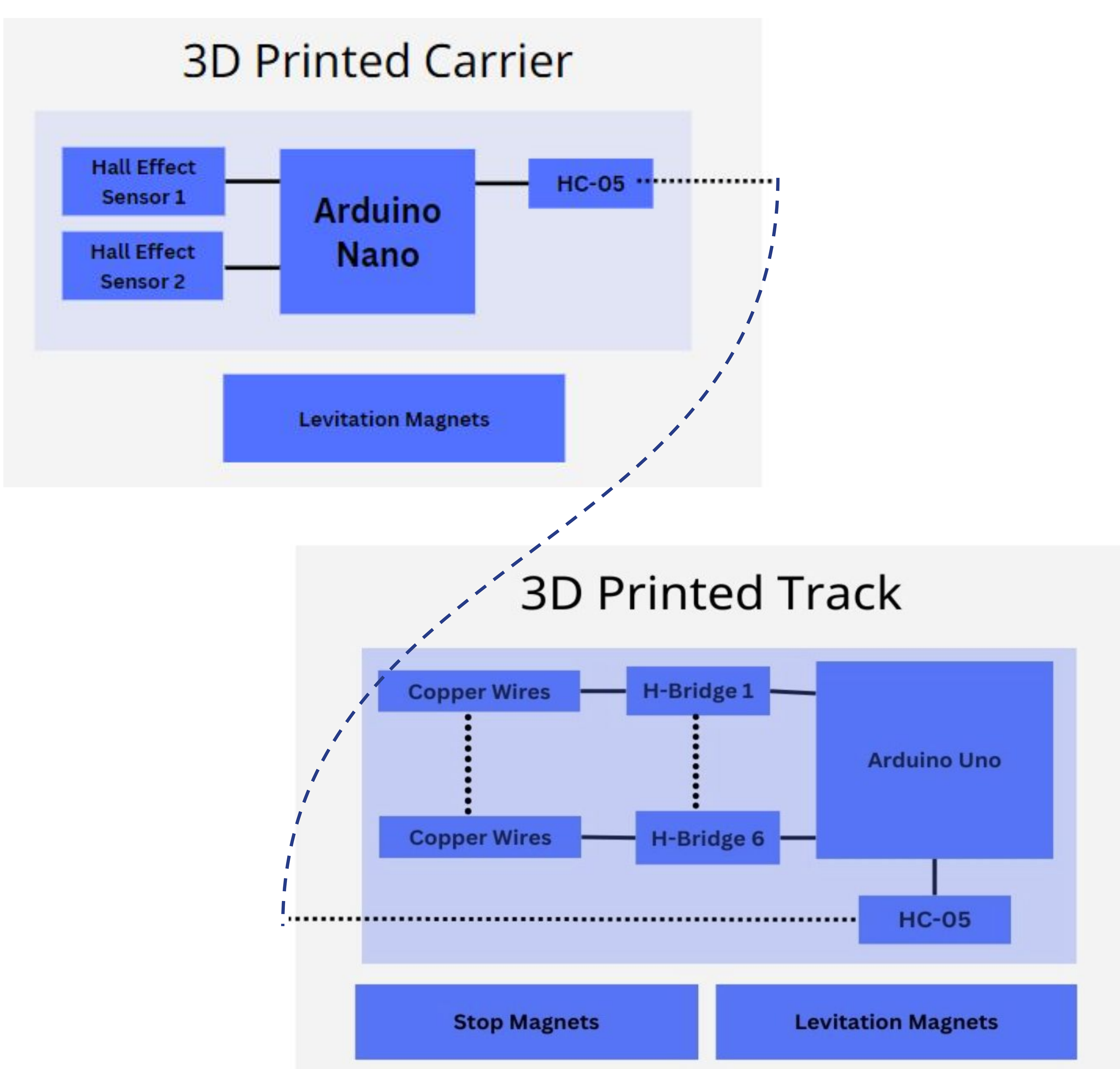
Product Pitch

HoverRail introduces an affordable, accessible, and remote-controlled Maglev model train set, addressing the current market gap for interactive educational tools. With precise levitation capabilities reaching 0.8 inches, and responsive remote control under 3 seconds, HoverRail ensures a seamless user experience. Its stability, affordability under $450, and commitment to safety make it an ideal platform for enthusiasts and students to explore the fundamentals of Maglev technology, propelling the future of transportation education.

System Architecture

HoverRail consists of 2 subsystems:

- 3D Printed Carrier - Sensing stops, Obstructed Objects
- 3D Printed Track - Turning on coils, controlling current polarity

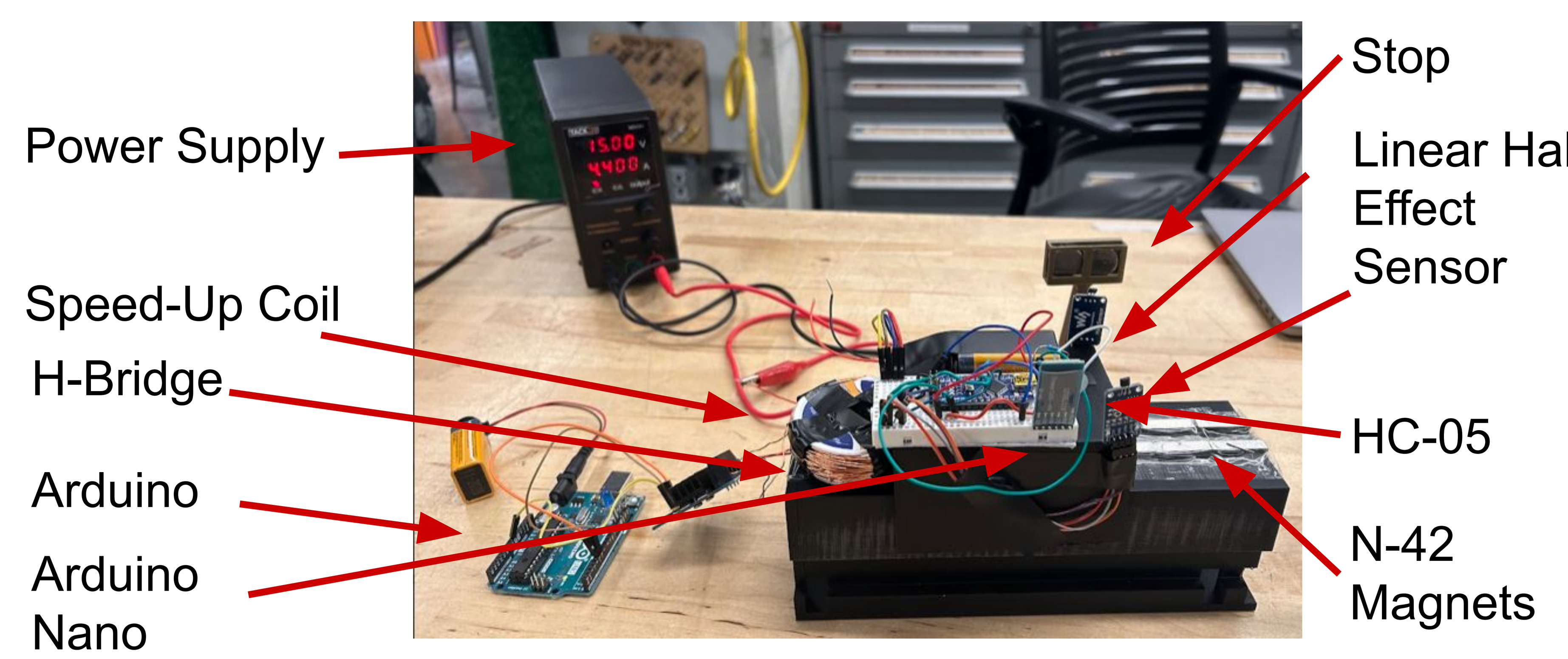


System Description

Our system utilizes two subsystems: the carrier and the track. The carrier employs two linear hall effect sensors for detecting magnetic field changes when passing N-42 Magnets on stops. An HC-05 Bluetooth module transmits sensor data to the track system. N-42 Magnets on the carrier enable levitation against the track. An Arduino Nano controls these components.

The track system features N-42 Magnets for levitation and stop detection. It incorporates six speed-up coils made of Copper Wire, each connected to H-Bridges for PWM current control. An HC-05 module receives data from the carrier's HC-05, adjusting coil current via the H-Bridges. The track system is managed by an Arduino Uno.

Carrier and Track Systems Implemented Together



System Evaluation

Levitation - Manually verify our carrier's height above the track
Propulsion - Calculating using Magnetic Field formula, Linear Hall Effect Sensor to compare coils, Visually testing smoothness of carrier moving along track
Response Time/Communication -
Measure the time it takes from signal dispatch to the actual stopping by logging in to the Arduino terminal.
Stability - Manually verify that the track remains stable through levitation and propulsion
Sensing Linear Hall Effect - Test each possible output with LED circuit

Category	Goal	Results and Design Tradeoffs
Levitation	0.8 inch	1.1 in (2.6 cm) of levitation (w/ the rectangle double magnet track)
Propulsion (Speed Up Coils)	Create a magnetic field strong enough to propel the carrier across the track	Propels the carrier at 12 Milli-tesla (Magnetic field of the coil)
Response Time / Communication	Signal should be sent fast enough to exhibit smooth travel between stops, not cause significant slow down	50ms delay
Stability	Carrier should remain visibly stable while along track	Track (2 rows of rectangle magnets) and Carrier(Circle magnets) are visibly stable
Sensing - Linear Hall Effect	Detect the magnetic fields of stops (magnets) along the sides of the track	Detects magnets within 1.5 cm of the linear hall effect

AWG	Radius (inches)	Turns	Amps (A)	**Magnetic Field (MilliTesla)**
24	0.25	100	5.1	**1.16192**
18	0.75	102	5.1	**5.10339**
24	0.25	400	3.2	**4.6477**
30	0.75	600	0.5	**2.94313**
32	0.75	700	0.23	**1.57948**
24	0.75	396	2.5	**9.712345**
22	0.75	230	5.1	**11.50766**

Conclusions & Additional Information

https://course.ece.cmu.edu/~ece500/projects/s24-teama2/

We are happy with what we were able to achieve this semester and the product we have to showcase. This project has the potential to educate individuals on a type of technology that can revolutionize travel while teaching the fundamentals of electromagnetics.

If we had more time to work on this project, we would add more sensing capabilities to the carrier such as the ability to detect stops along the track and change to the speed. Additionally, we would consider adding an interface to make the technology more user friendly.

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