CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
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Project Number
J0819

Project Title
A Self-Propelled Magnetic Levitation System for Launching Airplanes

Abstract

Objectives/Goals
The purpose of this project was to build a magnetically propelled levitating car and to get it going fast enough to launch a small hobby airplane. I am interested in magnetic levitation and magnetic propulsion and have done science fair experiments relating to these subjects for the past two years. I wanted to see if I could design an electromagnetic device to launch an airplane. This could save energy. I had read an article that said that scientists would like to build something like this for the future.

Methods/Materials
The track I built has lengthwise parallel permanent magnetic strips and a center row of alternating permanent magnets. I designed and built a maglev car that has permanent magnets on the four corners for levitation, and controllable switching electromagnets along the centerline for propulsion. I built a car circuit board that has a bipolar Hall-effect sensor to determine the track magnet polarity. My car circuit board then uses an H-bridge circuit to switch the car's electromagnet polarity to push off the rearward track magnets and pull towards the forward track magnets. I measured the time it took the maglev car to accelerate down the track and then calculated the ending speed. I tested six different settings for the Hall-effect sensor for a total of more than fifty tests.

Results
In my results I found that I only needed a 9-volt battery to power the car instead of the 30 volt DC train transformer I had planned to use. The maglev car went down the track fastest with four small electromagnets instead of two. Changing the position of the Hall-effect sensor changed the ratio of magnetic attraction and repulsion forces and affected the maglev car's speed. The alternating electromagnetic forces caused the car to bounce at start-up, but I found ways to eliminate the bounce. On my short 0.41-meter long maglev track, the maglev car quickly accelerated to 2.52 kilometers per hour.

Conclusions/Discussion
To launch a hobby RC airplane I would need a much longer track with more powerful magnets in order to propel the car and airplane to 9-16 kilometers per hour. I see the potential of maglev propulsion to launch airplanes at airports in the future.

Summary Statement
I designed and built a maglev car and track to launch airplanes; the car has a bipolar Hall-effect sensor to determine magnetic polarities and uses an H-bridge circuit to switch the on-board electromagnetic polarity.

Help Received
My science teacher assisted me in researching my topic; my dad helped locate needed parts; Steve Roberts helped with the design idea for the bipolar Hall-effect switch; my mom helped edit my report.