Electromagnetic Train

PROJECT PLAN

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Revised: April 23th, 2017/Version 2

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1 Introduction

1.1 Project statement

The project is about electromagnetic train. We are building a track using a 18 AWG bare copper wire and build a train using a AA battery or a AAA battery and some N52 Neodymium magnets.

1.2 purpose

The purpose of this project is to compare which turns per inch has the better speed and efficiency of the system. We need to understand the principle behind of the electromagnetic train. The important of the project is to understand the Lorentz Force applied.

1.3 Goals

Our goals for the project is to build a prototype of the Simple Electromagnetic Train and to understand the physics behind how it works. We need to optimize the speed and the efficiency of the system by finding the optimal numbers of turns per inch ratio of the coil and compare how many turns per inch in order for a train to finish the track with the fastest speed. Next semester, we would like to improve the efficiency of the battery and the increase the speed of the train.

2 Deliverables

We need magnet and copper wire to form the track and the train in the project and we need something that we could turn the copper wire into coil shape. Besides that, we need a board that can hold the shape of the tracks and prevent it to deform.

Magnet:

1. strong

2. round shape

Copper wire:

1. bare copper wire

2. round shape

Wooden stick:

1. eco-friendly
2. round shape
3. bigger than the side of the magnets

Board:

1. eco-friendly
2. not heavy
3. uneasy to bend it (strong)

3 Design

Our goal here is to build our own version of a simple electromagnetic train. Similar to this version from Physics Stack Exchange .

Figure 1[1]

According to Physics Stack Exchange, the system works by using the magnets (which are conductive) to connect the battery's terminals to the copper coil, thus creating a small circuit around the battery. This small circuit generates a magnetic field that propels the battery + magnet "train" forwards/backwards depending on the direction of the magnets' polarity.

3.2 Proposed System Block diagram

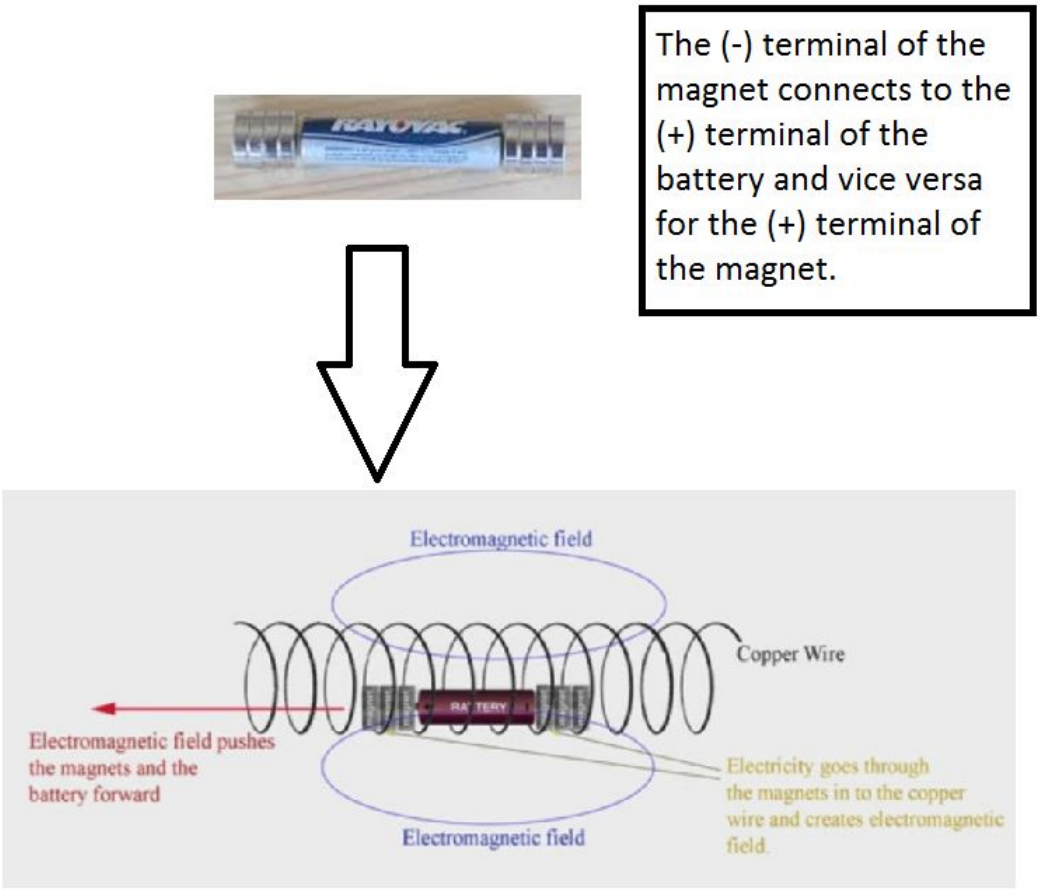


Figure 2

3.3 Assessment of Proposed methods

We have a choice in terms of the size of battery (AA or AAA) we want to use and the diameter of the magnet to connect to it. We decided on going with AA batteries along with slightly wider (in terms of diameter) neodymium magnets.

3.4 Validation

Plenty of experimentation would be involved in deciding what specs would work best for us. We ended up deciding 0n using AA batteries along with neodymium magnets.

4 Project Requirements/Specifications

- Electromagnetic train will move at high speed through the tracks (coil) until the battery is depleted.
- Velocity and efficiency of electromagnetic train should be at optimum level
- Electromagnetic train should be able to be observed clearly when it speeds through the tracks.
- Magnet should stay intact on the battery.

4.2 Non-functional

Not applicable for our project

4.3 Standards

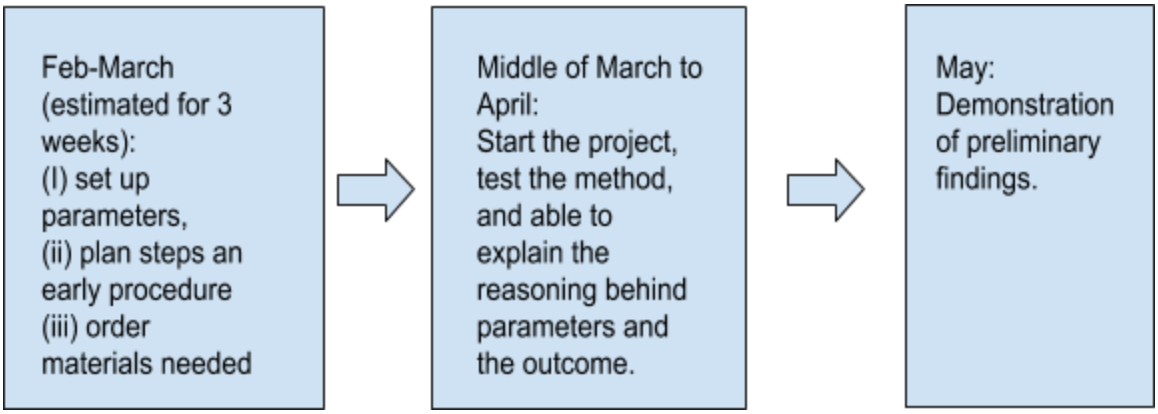
Since we aren't measuring the amount of electric/magnetic field produced, our project DOES NOT satisfy IEEE Standard 644. Apart from that, however, it does.[2]

5 Challenges

At this stage, we have an issue regarding the equipment and accuracy of the testing.

- Equipment
    1. In terms of equipment, we try to find a driller or any tools that can make a uniform turn of the copper wire track.
    2. We overcome this issue only by using a pvc pipe with diameter of ½ inch after we measured the the diameter of the battery, magnets, and copper wire.
- Accuracy of the testing
    1. The distance between the turns of the copper coil has to be uniform in order to make sure the battery last for a cycle.
    2. This is quite challenging as we have to manually create the distance and make sure it is in 9 turns per inches.

6 Timeline



6.1 First Semester

Based on Figure 1, a large model should be done by the end of this semester. This is explained in the chart above.

6.2 Second Semester

Based on the discussion with the team members and advisor, in second semester, we should just improve the design of the final product.

7 Conclusions

To sum it all, our plan for is to create an electromagnetic train that can travel at a fast speed while being efficient at the same time. Our goal is to produce a prototype for the electromagnetic train and understand the principle behind it. Moreover, we need to find the optimal level of both the velocity and efficiency of electromagnetic train. In the next semester, we would like to improve the speed and efficiency of the train. Moreover, we will also explain the physics of the train both overall quantitatively and qualitatively. Lastly, we will also build a more complex circuit with some obstacles.

8 References

[1] "How does this "simple" electric train work?" Electromagnetism - How does this "simple"electric train work? - Physics Stack Exchange. http://physics.stackexchange.com/questions/150033/how-does-this-simple-electric-train-work.

[2] "644-1994 - IEEE Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields From AC Power Lines." IEEE Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields From AC Power Lines - IEEE Xplore Document. http://ieeexplore.ieee.org/document/467478/.