Magnets store data! :)

The inside of a HDD (Hard Drive Disc).

You can find this in older laptops, and desktops, mainly used for storage, not for booting an operating system.

HDDs usually use 'SAS' or 'SATA' for connecting to a device.

This is a 3.5 inch HDD. That refers to the disc size. These HDDs are found in desktop computers!

Question

How far can a electromagnet rotate a bar magnet in 5 seconds?

Variables

There are 3 types of variables in my experiment.

Independent variable: The distance from the electromagnet to the bar magnet in inches.

Dependent variable: The time it took to rotate 90°with a maximum of 5 sec.

Controlled variables:The magnets, time to rotate, electromagnet, string, wires, battery, ruler, and 5 inch max distance will stay the same for each test.

Background

These are my reasons of choosing the topic: I like computers and I want to make one. I made a contraption like a hard disc drive, (HDD) which can store 'one' or 'zero', (1 bit). This is my first part of my computer, soon I will make a actual HDD, that can store 1 byte of data, (8 bits). Most HDDs are one terabyte or more, one terabyte is 2^{40} bytes! This system can be used to write numbers. This is called binary. Binary is ones and zeros, 166 in binary is 1010011. Binary works by starting at the right and multiplying by 2 if you go left.

Research

Ferromagnetic	can be strongly magnetic can be used in electromagnets
Magnet	attracts or repels iron, nickel, cobalt, and magnets
Electromagnet	a magnet that can be turned on and off with electricity
Attract	moves matter closer
Repel	moves matter farther

Hypothesis

Here is my hypothesis: If the electromagnet is less than 4 inches away it should rotate in the time period because, there is enough time for it to rotate the bar magnet. The electromagnetic field will be strongest at 1-4 inches, which will let the magnet rotate to store data. The electromagnet won't be able to rotate the bar magnet in 5 seconds because the electromagnetic field will be to far away at 5 inches.

Materials

Materials needed for this experiment:

Stand for bar magnet with ruler and string

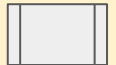
Electromagnet

Bar magnet

Wire

Battery

Switch **(optional but highly recommended)**



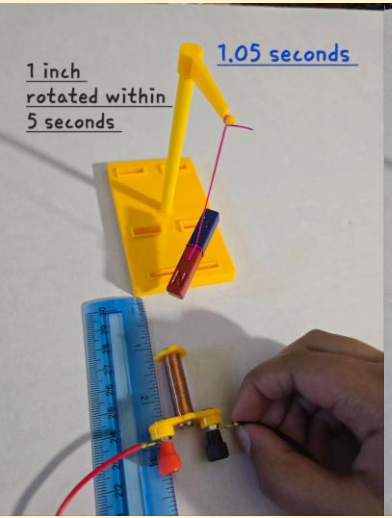
Procedures

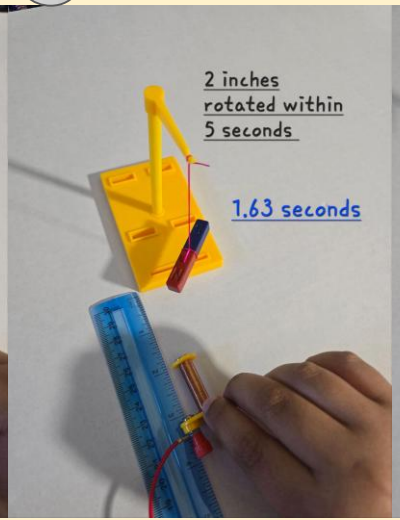
1. Setup the stand attach the string and bar magnet to the stand.
2. Attach wires and battery to the electromagnet on the table.
3. Place the ruler in front of the stand.
4. Place the electromagnet at the 1 inch mark.
5. Turn on the electromagnet and start a stopwatch.
6. End the stopwatch when the bar magnet rotates 90 degrees (1.5708 radians).
7. Repeat step 5 and 6 at 2-5 inches.

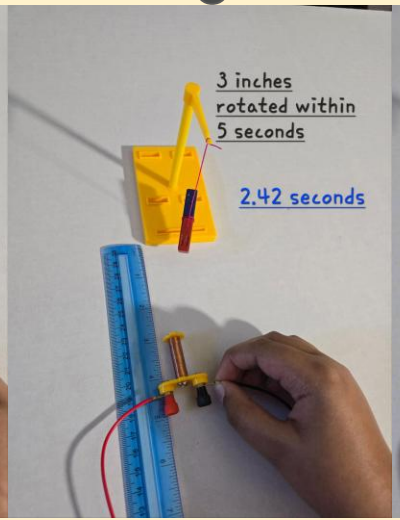
Data Table

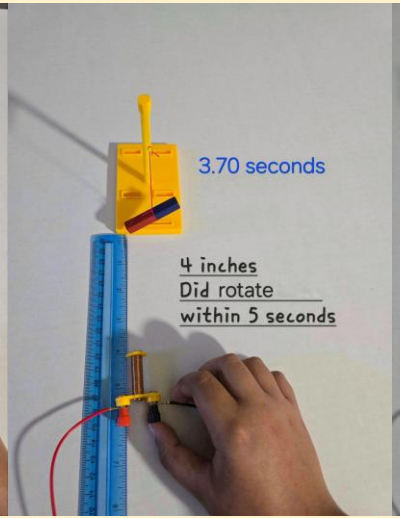
Distance	Time to rotate
1 in	1.05 seconds
2 in	1.63 seconds
3 in	2.42 seconds
4 in	3.70 seconds
5 in	took too long

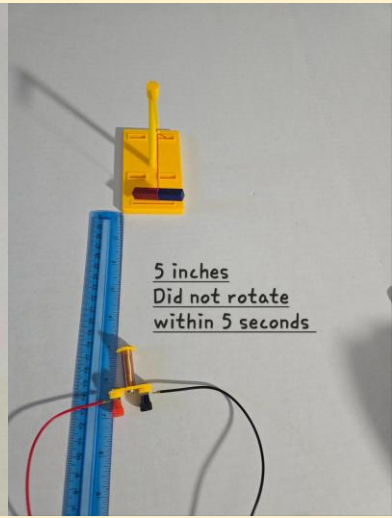
Project pictures!

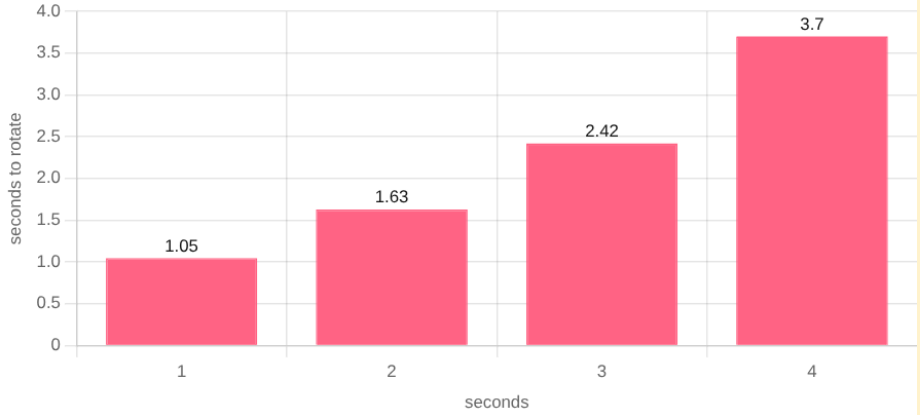


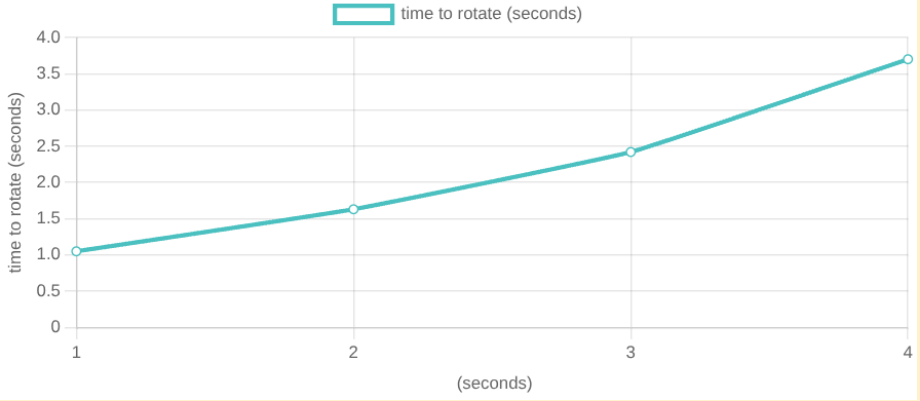












Note 5 inches did not rotate so it is not shown

Observations

Observation 1: Each time I did the experiment the electromagnet only rotated the bar magnet at 1-4 inches.

Observation 2: At 5 inches the bar magnet can't rotate.

Observation 3: The closer the magnet is to the electromagnet the faster the magnet rotates.

Data Analysis

Information from the line graph: The number of seconds that it takes for a bar magnet at 1-5 inches to rotate. It also shows that the electromagnet rotates the bar magnet faster at 1 inch.

Project Conclusions

My project supports that the magnets will rotate only if the magnets are at 4 inches or less from each other.

To improve my experiment, I would make an actual hard disk drive that can store 1 byte (8 bits) of data.

Further Research

Did you know that you can store data with magnets? Magnets can attract or repel metals like iron, nickel, and cobalt. This force is used in HDDs to flip spots on a disc from '1' to '0' or '0' to '1' to store data. My experiment uses electromagnets to rotate another magnet to show '1' or '0'. My experiment is similar to a HDD because it uses an electromagnet to switch '1' and '0'. It is amazing that a piece of metal can store the internet and fits in your hand!

References

https://www.google.com/ as a search engine

https://en.wikipedia.org/wiki/Electromagnet

For HDD info:
https://www.youtube.com/watch?v=wtdnatmVdIg