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S2_5 Immortal Mice

A. Erojo, T. Berry, B. Taylor

Department of Physics and Astronomy, University of Leicester, Leicester, LE1 7RH

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Abstract

The constant changing of batteries in wireless computer mice is an endless problem that plagues both computer enthusiasts and the general public alike. We explore the idea of having a dynamo built into a wireless mouse and seeing if it is able to offset the battery usage of the mouse. We calculated that the dynamo would need to produce an emf of 0.0018V to maintain the battery charge. We took 0.050T as the point where components would be damaged by the magnetic field, and from this we saw that the dynamo would only be viable to gamers and not the general public.

Introduction

In this paper we explore the idea of having a dynamo built into a wireless mouse and seeing if the dynamo can offset the mouse battery usage with the constraint that the the magnet does not damage the mouse itself. The dynamo will be a coil of wires with magnet enclosed, designed such that the magnet cannot leave the confines of the coil. The dynamo will be connected to an AC to DC rectifier, and a rechargeable AA battery, with the battery being connected to the wireless mouse itself.

Equations

The equation that we begin with is the magnetic flux:

$$\Phi_B = \int B \cdot dA \tag{1}$$

With Φ_B being the magnetic flux, Wb, B is the magnetic field of the magnet, T, and A is the surface enclosed by the wire loop, m^2. Since the dynamo is in a coil, the surface area will be that of a circle $A = \pi r^2$, resulting in equation 1 turning into:

$$\Phi_B = BA_{Circle} = B\pi r^2 \tag{2}$$

The emf produced by the dynamo is calculated by:

$$\varepsilon = -N\frac{d\Phi_B}{dt} \tag{3}$$

With ε being the emf, V, N being the number of turns in the coil and $\frac{d\Phi_B}{dt}$ is the rate of change of flux enclosed by the circuit. As assumed with the magnet not leaving the enclosure of the coil, the magnetic flux will remain constant. This results in being able to insert equation 2 into equation 3. We will also be making t constant.

$$\varepsilon = -N\frac{\Phi_B}{t} = -N\frac{BA}{t} \tag{4}$$

Equation 4 will be used to make a graph, with multiple plots corresponding to different lengths of times for the magnet to move through the coil due to differing mouse swipe speed.

$$V = IR \tag{5}$$

Equation 5 will be used to calculate the voltage required by the mouse while it is in motion, with V being voltage, V, I being current, A and R being resistance, Ω.

Results and Discussion

With the size of a wireless mouse as the constraint, we estimated a coil of diameter of 0.015m would be appropriate. The diameter of the wire with insulating was 0.61mm, AWG 30 [1]. The width of a mouse is about 5.0cm which we divided by the width of the wire to obtain an N value of 82, which was rounded down to 80 to fit in the mouse. We made the assumption that in each swipe that the magnet would fully travel through the coil. The type of mouse swipes that would be taken were categorised as fast, normal and slow and were estimated to last 0.25, 0.50 and 1.0 seconds respectively. These values were used in equation 4 to plot figure 1 of max emf against magnetic field strength of the magnet.

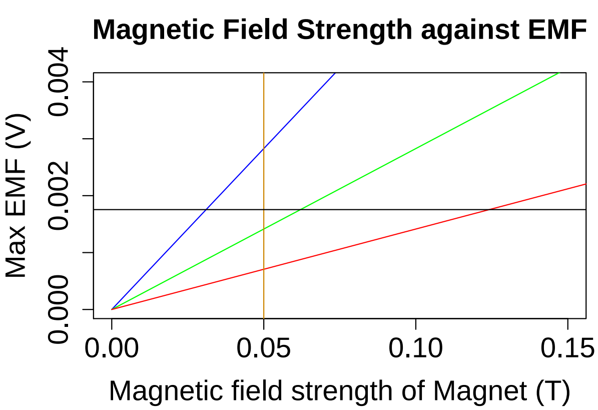

Figure 1: Graph of magnetic field strength of magnet against max voltage produced. Blue, green and red lines represent times of 0.25s, 0.50s and 1.00s respectively. Horizontal line is the voltage required by the wireless mouse and vertical line is the magnetic field that is sure to damage the mouse.

In figure 1 we plotted a vertical line at 0.050T to represent the magnetic field that would be deemed too dangerous for the electrical components of the mouse. When the wireless mouse is in a circuit with a rechargeable AA battery, the current it uses when it is in motion is 12mA [2]. The internal resistance of the AA battery when it is at room temperature is 0.15Ω [3]. By using equation 5 and substituting in the current as 12mA and resistance as 0.15Ω, it is found that the emf required to maintain the charge on the battery would have to be at least 0.0018V. This voltage was shown in figure 1 as the horizontal black line.

From the graph it can be seen that the emf required can be offset by fast swipes of the mouse within a tolerant value for the strength of the magnet. However it can also be seen that at normal and slow swipes, it will require a magnet with magnetic field of over 0.050T to be able to offset the charge loss by moving the mouse.

For the regular population they would normally be using slow and normal swipes for work or ordinary browsing, where as in the gaming community such players of first person shooters or multi-player online battle arenas, the competitors will constantly be moving the mouse quickly in the hopes of aiming and shooting enemies first. The dynamo would not be viable in the general public but it could see use in the gaming world.

Conclusion

We explored the idea of integrating a dynamo into a wireless mouse. A graph of emf against strength of the magnet was plotted with differing times for the magnet to pass the coil. We discovered that the concept would not be viable for the general public but could see applications in the gaming world.

References

[1] `https://www.druflon.com/wiretable2.html` [Accessed 22 November 2017]

[2] `http://powermouse.wikispaces.com/file/view/microsoftmousebatteryexecsummary+(1).pdf` [Accessed 22 November 2017]

[3] `http://data.energizer.com/pdfs/batteryir.pdf`[Accessed 22 November 2017]