Energy Harvesting for Remote IoT Sensors

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Abstract

Internet of Things (IoT) is a growing industry that is emerging to connect wireless protocols such as sensors, gadgets, and Bluetooth technology into an all-inclusive infrastructure network. These devices require a power source; usually an AA battery. Within the IoT infrastructure inside an aircraft are remote sensors, often in inaccessible, isolated locations inside the physical structure. Technological advances have hit a point where the efficiency and power consumption statistics are favorable allowing energy harvesting techniques to be used to provide constant charging to a battery. Both academic and industrial stakeholders are aiming to develop state-of-the-art technological design solutions by evolving existing energy harvesting technology to a point where the potential output exceeds the power demands of the system and negates the function of using a battery as an energy storage device. This project outlines the specifications for harvesting wasted energy such as vibrational kinetic energy at the resonant frequencies from an aircraft's internal vibration.

Introduction

The objective of this project was to create a localized and independent energy harvesting device to trickle-charge an AA battery during the flight of an aircraft.
The basic principle was modeled after power generation basics and achieved using principles of electromagnetism through Faraday's Law of Inductance and Magnetic repulsion.

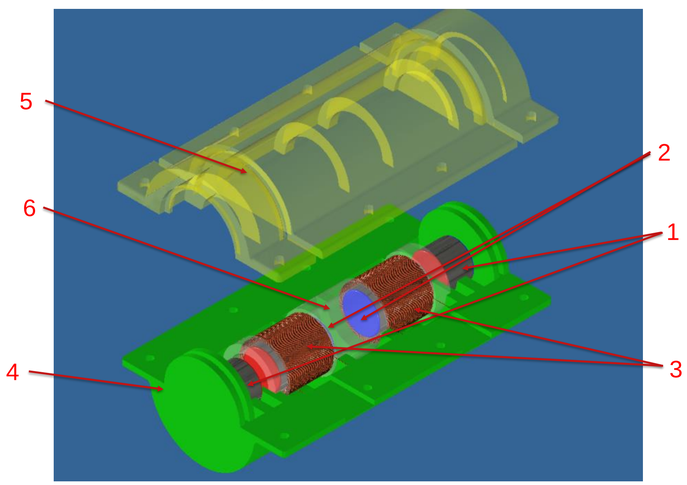
Magnetic Induction

Magnetic induction can be used to generate power using a combination of permanent magnets and inductive motor wire. In accordance to Faraday's Law of Induction, an electrical potential is induced across a coil when a magnetic field changes in close proximity to its center. The characteristics of a power generator are determined by the magnetic field strength of the permanent magnets, the area of the coil through which the magnetic field passes, and the speed at which the magnetic flux changes.

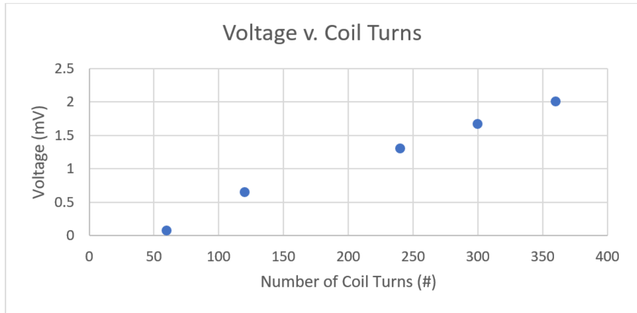
Methods and Materials

Eight Total Components

1. 2 Neodymium Grade N52 Endcap Magnets
2. 2 Neodymium Grade N52 Oscillating Magnets
3. Enamel-plated motor wire
4. Housing (3D Printed)
5. Housing covers (3D Printed)
6. Delrin Tube (3D Printed)



Results



Discussion

- The device functions properly and in accordance with the research that was conducted to prototype it.
- Due to the outbreak of COVID-19 during the testing & optimization phase of this project, further testing on the physical device proved impossible without access to a lab.
- Without more test results and optimization, development and production of a power rectification circuit proved impossible.

Conclusions

Previously, the airline industry would pay thousands in maintenance costs of changing the batteries in these aftermarket sensors within the aircraft. This device creates a solid base and first step into vibrational energy harvesting techniques to minimize or negate those costs in the future.

Acknowledgements

The authors would like to acknowledge the assistance from Astronics Director of Electrical Engineering, Stephen Lingle and Project Engineer Addison Merchut as well as faculty support from Dr. Nicholas Pohlman, Associate Professor of Mechanical Engineering and Dr. Mohammad Moghimi, Assistant Professor of Electrical Engineering both of Northern Illinois University.