Global Scientific JOURNALS

GSJ: Volume 7, Issue 2, February 2019, Online: ISSN 2320-9186
www.globalscientificjournal.com

Increasing Battery Efficiency Through The Usage Of Piezoelectric Material

INTRODUCTION

The problem of charging the electric wheelchairs used by our orthopedically disabled citizens is a common nuisance. The limited battery capacities and their long recharging times prevent them from getting too far away from their homes. Replacement batteries are both expensive and heavy, making it an undesirable option.

To tackle this problem, we created our own electric wheel chair design, by implementing piezo electric crystals within the inner tires. By this way, we were able to produce a certain amount of electricity through the pressure applied on the crystals when the tires are rotating, thus increasing the battery life time. The fact that the piezo sensors are much cheaper and reliable than the nickel-metal hybrid batteries is also a very major economic advantage. Compared with solar energy, piezo sensors are much cheaper and their energy conversion process does not depend on weather conditions. Through our design, people with disabilities will be able to move comfortably without the problems of charging and high electricity consumption. Its energy savings also benefit a sustainable nature.

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THEORY

Piezoelectric is the process in which some certain crystal and ceramic materials create a specific electric field and potential difference through the outer pressure applied on them. After the application of pressure, a potential difference is observed between the poles of the material. This property, discovered by French physicists Pierre Curie and Jacques in 1880, is used to convert mechanical energy into electric energy, or vice versa. No emission is released during this process and therefor some scientists consider piezoelectric to be the energy source of the future. Piezoelectric is also the basic working principle of sonars, microphones and lighters. One difficulty of using such materials is the fact that they do not have a linear structure thus it is relatively difficult to operate such systems. Therefor precise electric circuits and systems should be installed with piezo sensors for reliable and effective results.

Its basic principle includes polarization density differences within the material. When a balanced pressure is applied from both sides to an ionized crystal with a constant polarization, the distance between the poles of the material decreases. The poles become closer and thus the charges on both surfaces of the material increase, creating a potential difference. When this crystal is combined with a conductor, a current is obtained. Thus mechanic effect is converted into electric energy. The most common crystals used for this process are quartz and tourmaline.

SIMPLE MODEL

Figure 1: Piezoelectric crystals implented within the inner surfaces of the tires on a wheelchair

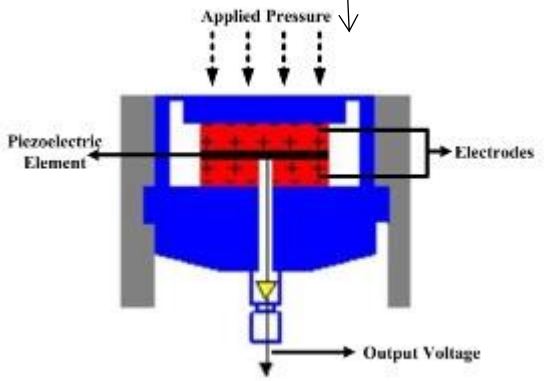

Figure 2: The structure of the implemented piezo electric crystal materials

3. ANALYSIS

When the tires of the wheel chair rotate, a pressure (provided by the weight of the user) will be applied on the piezo electric crystals within the inner tires. Piezoelectric material will then turn this pressure force into an electrical energy, which can be stored within a battery given the right circuit system and usage of diodes. By this way, the life-time and efficiency of batteries used in electric wheel chairs can be increased, decreasing the need to charge or replace old batteries.

4. CONCLUSION

Piezoelectric crystals are relatively cheaper than batteries and will thus provide economic convenience in long term. It is also a clean energy source since no greenhouse gases are emitted through the energy conversion process.

These simple systems must be adopted in the future where clean and cheap energy will be a priority. Such systems can also be implemented on other transportation vehicles including electric cars in further research.

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