From a Single Moment of Force to Sustainable Energy: Achieving Optimal Frequency for Piezoelectricity

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Piezoelectric ambient energy harvesting is a unique way to create electrical energy. The piezoelectric effect explains that when a crystal is compressed it produces a potential difference or voltage, making it a versatile way to harvest energy. The problem however with piezoelectric energy harvesting, is that it is very inefficient if that applied force is at a low frequency. It requires an optimal vibration to generate electrical energy effectively, an unattainable feature with existing systems. This project introduces a novel approach to turning one moment of force into multiple, increasing frequency. In the system, there is a charged material in between two piezoelectric materials, so that when they are under stress and polarize, it gets agitated by the like charges produced and vibrates against them. Thus achieving optimal frequency. Through finding the need, prototyping and analyzing (the three gears of innovation), different variables were explored such as force produced, charge required and frequency of vibration. With certain control variables, this system can produce 168.325Hz from the force of a footstep (500N). This exhibits about 73mN of force on the piezoelectric crystal at that frequency. Increasing the efficiency of piezoelectric energy harvesting from less than 1%, to around 25% - 60% (its potential efficiency). Therefore the efficiency of a 0.01% efficient system is increased by 84% more of its original efficiency (0.0184%). In conclusion, the hypothesized design has experimental and calculated data to back its practicality. Therefore, it is a completely original alternative to efficiently harvest ambient energy.

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