A footstep and piezoelectric sensor-based power generation system

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Abstract. In this paper, the energy harvesting capacity of piezoelectric material is applied a footstep energy generation system. Conventional fossil fuels have raised concern about sustenance of the environment. As a means of reducing dependence on fossils fuels, the piezoelectric sensor is touted as a viable replacement. Piezoelectric materials are used to generate alternating current (AC) and direct current (DC) for powering communication devices, lightings and battery charging. 500 modified piezoelectric tiles were assembled to generate required power was then routed to an electronic processing unit containing a microcontroller, voltage rectifier and regulator circuitry. The output can deliver power to a phone, light bulb and battery. Using footsteps, the designed system delivered a maximum power of 4.25 W with full load current of 2.08 A. The 12V 10 Ah battery charging time is 31.25 hours and the full load battery life is 4.81 hours. The designed system was verified via simulation and experimentally. This system can be useful during when grid electricity is disrupted.

1. Introduction

Electricity has become a very important part of human life, starting from domestic use to industrial activities. There is hardly any task that does not require electricity as most modern technologies rely on electricity to work. Electricity can be generated from two types of energy resources which are renewable energy resources and non-renewable energy resources. Non-renewable energy resources such as gas and oil have negative environmental impacts due to their global warming emissions [1]. Despite its negative effects on the environment, the energy consumption in Malaysia and the rest of the world, still mainly depends on non-renewable energy resources like oil, gas and coal. Therefore, alternate sources of energy which are free of pollution should be explored.

Apart from the health and environmental hazards of fossil fuel, the need for access to power may arise in disaster conditions where the electricity grid might have been disrupted. In such condition, survivors may require a power generation source for small torches, heaters or communication device like phone to reach emergency services [2].

Despite the widespread electrification efforts, there still exists remote locations that suffer the unavailability of grid electricity. Even in locations provided with grid electricity, unexpected outages can occur. The application of an alternative energy source like the piezoelectric material can enable power generation in such scenarios thereby creating a power supply for increased productivity or emergency communication purposes.