Biokinetic Energy Scavenging Through Human Ambulation

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The use of the human body as a power source has been the subject of research during the past and present decades. On an average, a 68 kg person was found to possess about 67 Watts to 80 Watts of recoverable power while performing normal daily activities such as walking and lying quietly respectively. Some of this stored energy has been effectively used as a power source for operating radios, wrist watches, mobile battery chargers, and implantable medical devices in the past decade.

The present work is based on the electrical power extracted from a human leg using the flexure of the knee while walking. Data was collected from a group of volunteers in the age of 19-25 years both male and female, and it was found that on an average, the leg exerted a force of 8.896 N without exercise and a force of 133.4 N upon strenuous exercise. This force when applied through an angle of 70º during flexion amounts to a total power of 1.82 watts during a stride time of 2.055 sec. With an average lower limb length of 0.4m, this gives a torque of 3.078 N-m approximately.

Based on this torque value, a spiral torsion spring made of 75 % carbon steel with the dimensions of 1.524 x 0.013 x 8.13×10^{-4} m was designed to store this mechanical energy. A DC generator rated at 1400 - 4200 RPM and 130 mA was used to convert this to the corresponding electrical power. An over running clutch and a retaining pawl were used to prevent the spring from unwinding during every step of the gait cycle. A short rod, bent at an angle of 90º provided the actual connection with the leg, to coordinate with the flexion-extension movement of the knee. The final device produced an output power of 27 mWatts achieving an efficiency of 1 %.

The output power produced using the present method is higher than that obtained by the conventional shoe mounted devices developed previously. This power can be either stored in a capacitor to be used when considered necessary or directly connected to implanted medical equipment like pace makers and defibrillators. Higher power values can be achieved depending on the pace of walking and muscular strength of a person. However, the weight of the final device remains a concern which can be addressed by further investigation of light weight materials to build the parts and use of more efficient dc generators.