Hadi AlAssaf (COE) Khalil Farhan (MCE) Yazan AlKhatib (CVE)

POWER WITH EVERY STEP

Situation: Satisfying the needs for clean energy by utilizing human footsteps.

STRUCTURE

Problems

- Heavy footfall and environmental consequences, such as rain and dust, heavily distress the tiles [1].
- Temperature changes in the environment cause expansion and contraction in the tile.
- The more durable the material, the more costly.

Solutions

- Making the surface and base of the tile 100% recycled rubber and recycled steel respectively [2].
- Placing the tiles indoors in a controlled temperature environment.

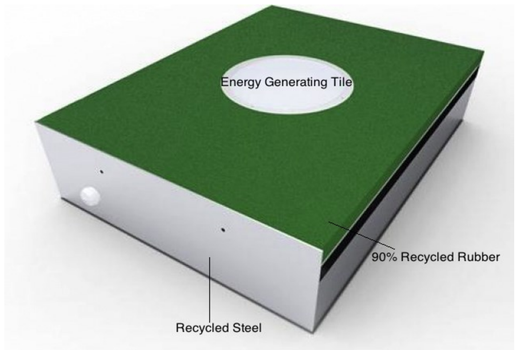

Figure 1: The tile's structure and material.
Credited: http://www.pavegen.com/technology

Evaluation

- The use of durable rubber and steel prepare tile's durability against heavy footfall.
- The controlled temperature indoors prevents the tiles from expanding and contracting.
- The use of recycled and recyclable materials minimizes environmental hazards while guaranteeing cost-effectiveness [3].

MECHANISM

Problems

- Downward displacement and tilting of tiles causing motion disruption.
- Friction between neighboring tiles.
- Non-uniformed stress distribution across tiles for enhanced power efficiency [3].

Solutions

- Attenuating dampers to eliminate the tiles' downward motion.
- Attaching guiding pins to separate and prevent tiles from tilting.
- Using radial edges on the plates to cancel the effects of friction.
- Utilizing Springs below the tiles to achieve optimum power delivery.

Figure 2: inner components of the plate.

Evaluation

- Generating eco-friendly energy from daily activities.
- Minimizing required maintenance by simplifying the tiles' components.
- Achieving mass production with compact tile design.

Component	Price per plate (Dhs)
Steel sheets	1.825
Recycled Rubber casing	2.25
Springs	20
Pins and sockets	4.8
Rechargeable batteries	1.83
Regulators and circuit components	2
Brass reinforced PZT	51.2
Total	83.6

Figure 3: A price estimate table.
Credited: http://www.alibaba.com
http://www.piezo.com

POWER

Problems

- The produced voltage can become unsustainable.
- Circuit chips and batteries consume power.
- The large number of tiles makes it difficult and costly to detect problems.

Solutions

- Dividing tiles into subdivisions with sensors to detect failures to reduce the number of electrical components.
- Installing voltage regulators at the electric line's end to sustain the produced voltage [5].
- Selecting passive elements with minimal power loss.

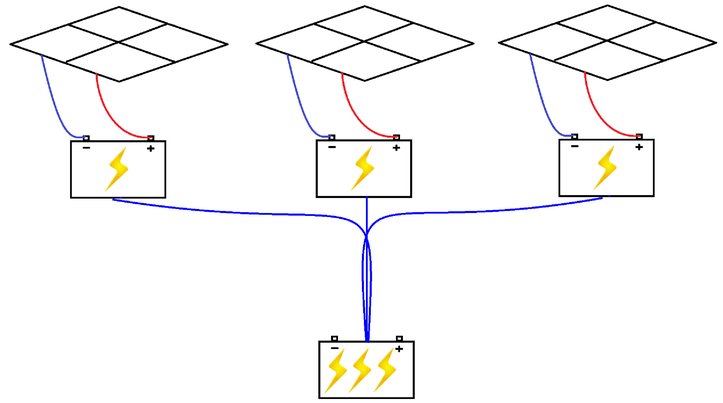

Figure 4: The collection and distribution of power from small batteries to a central one.

Evaluation

- Less sensors and batteries saving power and cost.
- Transistor regulators sustain needed voltage [4].
- Passive elements are small and minimize losses.

References

[1] F. Duarte, F. Casimiro, D. Correia, R. Mendes, A. Ferreira. (2013). "A New Pavement Energy Harvest System." Renewable and Sustainable Energy Conference. [Online]. pp. 408-413. Available: http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=6529704 [Mar. 9, 2013]

[2] Xiang Shu, Baoshan Huang. (2013, Dec.). "Recycling of waste tire rubber in asphalt and portland cement concrete." Internet: ‧http://dx.doi.org/10.1016/j.conbuildmat.2013.11.027, Nov. 27, 2013. [Mar. 4, 2014]

[3] J. Cramm, A. El-Sherif, J. Lee, and J. Loughin. "Investigating the Feasibility of Implementing Pavegen Energy." Internet: https://elk.library.ubc.ca/handle/2429/42973, 2011. [Mar. 1, 2014]

[4] T. Jose, B. Boban, and T. Sijo. (2013, Mar.). "Electricity generation from footsteps; a regenerative energy resource." International Journal of Scientific and Research Publications. [On-line]. 3(3), Available: http://www.ijsrp.org/research-paper-0313/ijsrp-p15102.pdf [Mar. 4, 2014]

[5] J. Song, J. Zhou, and Z. Wang. (2006, Jul.). "A technology for harvesting electricity from the environment." Piezoelectric and Semiconducting Coupled Power Generating Process of a Single ZnO Belt/Wire. [On-line]. 6(8), pp. 1656-1662. Available: http://pubs.acs.org/doi/full/10.1021/