Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting information

Sustainable Freestanding Biomechanical Energy Harvesting Smart Back Pack as a Portable-Wearable Power Source

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Calculation of the applied force

Here the external force using a linear motor. Hence, the force were calculated with equation,

$$F = m \times a \qquad \textbf{- (1)}$$

F = Force

m = Mass

a = Acceleration

Example:

m = 2.144 Kg

a = 10 m/s

Hence,

F = 2.144 Kg × 15 m/s

F = 21.44 N

Calculation of peak power and power density

$$Power = I^2 \times R \qquad \textbf{- (2)}$$

Power Density = Power/ Area **- (3)**

No	Materials	Triboelectric charge	Role of Action
1	Aluminum		Electrode
2	Copper		Electrode
3	Wool	Positive	Contact Material
4	Paper	Positive	Contact Material
5	Jeans	Positive	Contact Material
6	Polyethylene	Negative	Contact Material
7	PDMS	Negative	Active layer

Table S1. Triboelectric series: a list that rank various materials used for the SBP-TENG electrical studies, according to their tendency to lose electrons (positive) and gain (negative).

No	Device	Application	Mode of operation	Active layer	Contact material	V_{oc}	I_{sc}	Area	Ref
1	TESM	Self-Powered High-Resolution and Pressure-Sensitive Triboelectric Sensor Matrix for Real-Time Tactile Mapping	Single electrode (Contact and separation)	PDMS	Aluminum	17 V	150 nA	1 cm^2	[1]
2	TF-TENG	Transparent and Flexible Self-Charging Power Film and Its Application in a Sliding Unlock System in Touchpad Technology	Sliding mode	FEP	Human finger	31.5 V	224 nA	----	[2]
3	BD-TENG	Biodegradable triboelectric nanogenerator as a life-time designed implantable power source	Contact and separation	BDP1	BDP1	40 V	1 µA	6 cm^2	[3]
4	KFE	Personalized Keystroke Dynamics for Self-Powered Human Machine Interfacing	Contact and separation	FEP	Human finger	26.8V	23.5 µA	-----	[4]
5	SR-based TENG	Stretchable-Rubber-Based Triboelectric Nanogenerator and Its Application as Self-Powered Body Motion Sensors	Sliding motion	Rubber	Aluminum	65 V	7.5 $\mu A\ m^{-2}$	29.04 cm^2	[5]
6	HMI	Triboelectrification Based Motion Sensor for Human-Machine Interfacing	Contact and separation	PDMS	Human Skin	42.6 V	0.2 µA	------	[6]
7	SS-TENG	Human Interactive Triboelectric Nanogenerator as a Self-Powered Smart Seat	Contact and separation	Kapton film	News Paper	13 V	1.75 µA	25 cm^2	[7]
8	**SBP-TENG**	**Sustainable Freestanding Biomechanical Energy Harvesting Smart Back Pack as a Portable-Wearable Power Source**	**Contact and separation**	**PDMS**	**Wool**	**142 V**	**5.9 μA**	**12 Cm^2**	**Present work**

Table S2. Comparison of the proposed SBP-TENG with other reports

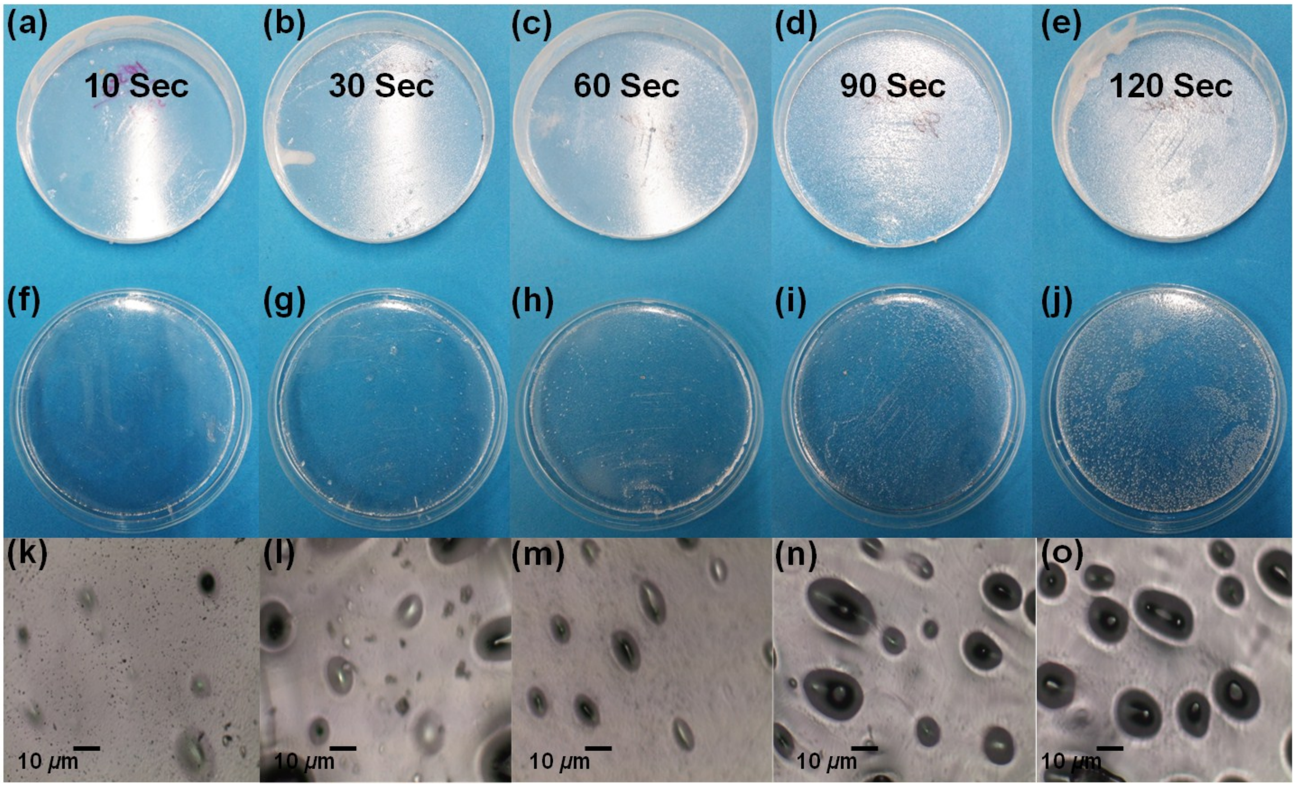

Figure S1. (a-e) Photograph of surface treated ABS plastic petri dish with acetone at different timing (10 – 120 sec). (f-j) Photograph of surface modified PDMS after solidification. (k-o) Top view FE-SEM image of surface modified PDMS.

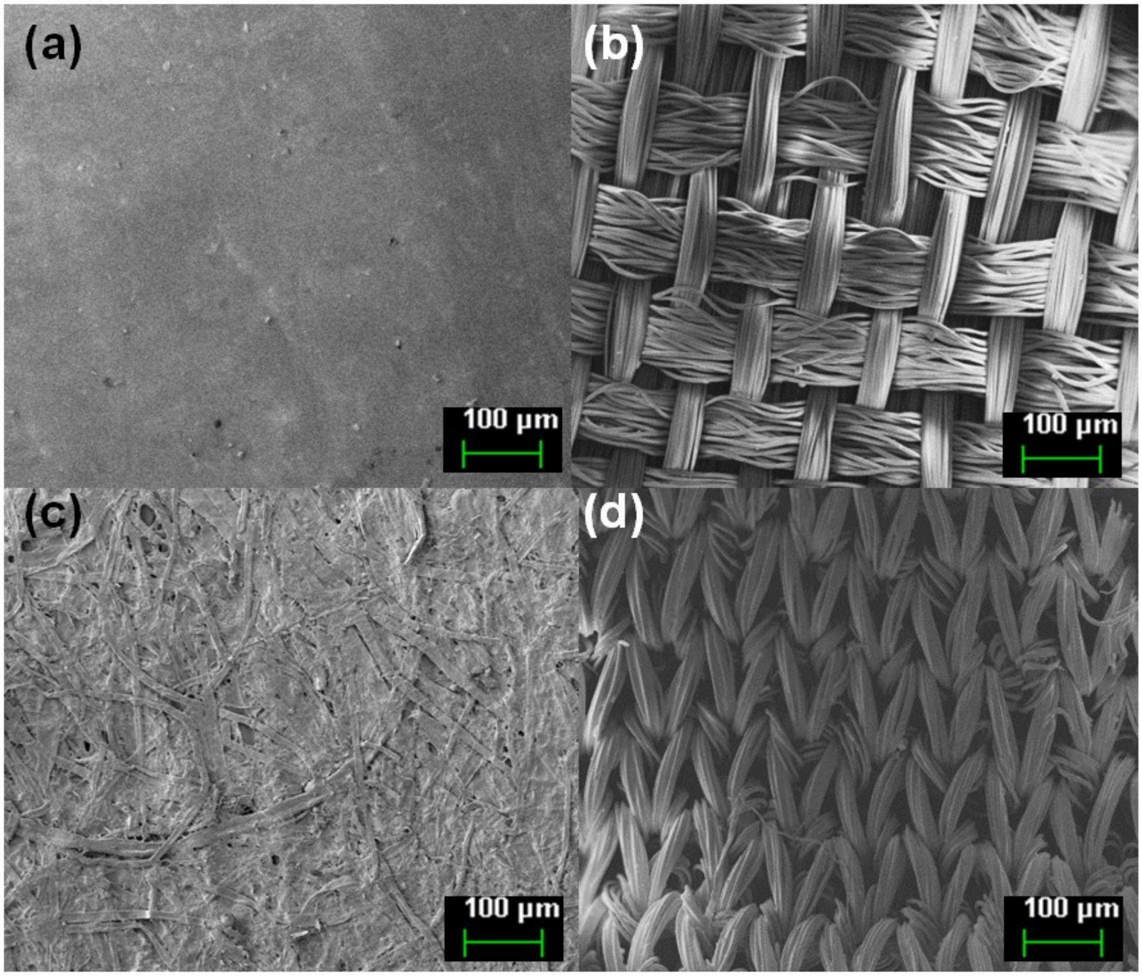

Figure S2. (a-d) Top view FE-SEM image of positively charged triboelectric contact materials: polyethylene, jeans, paper and wool.

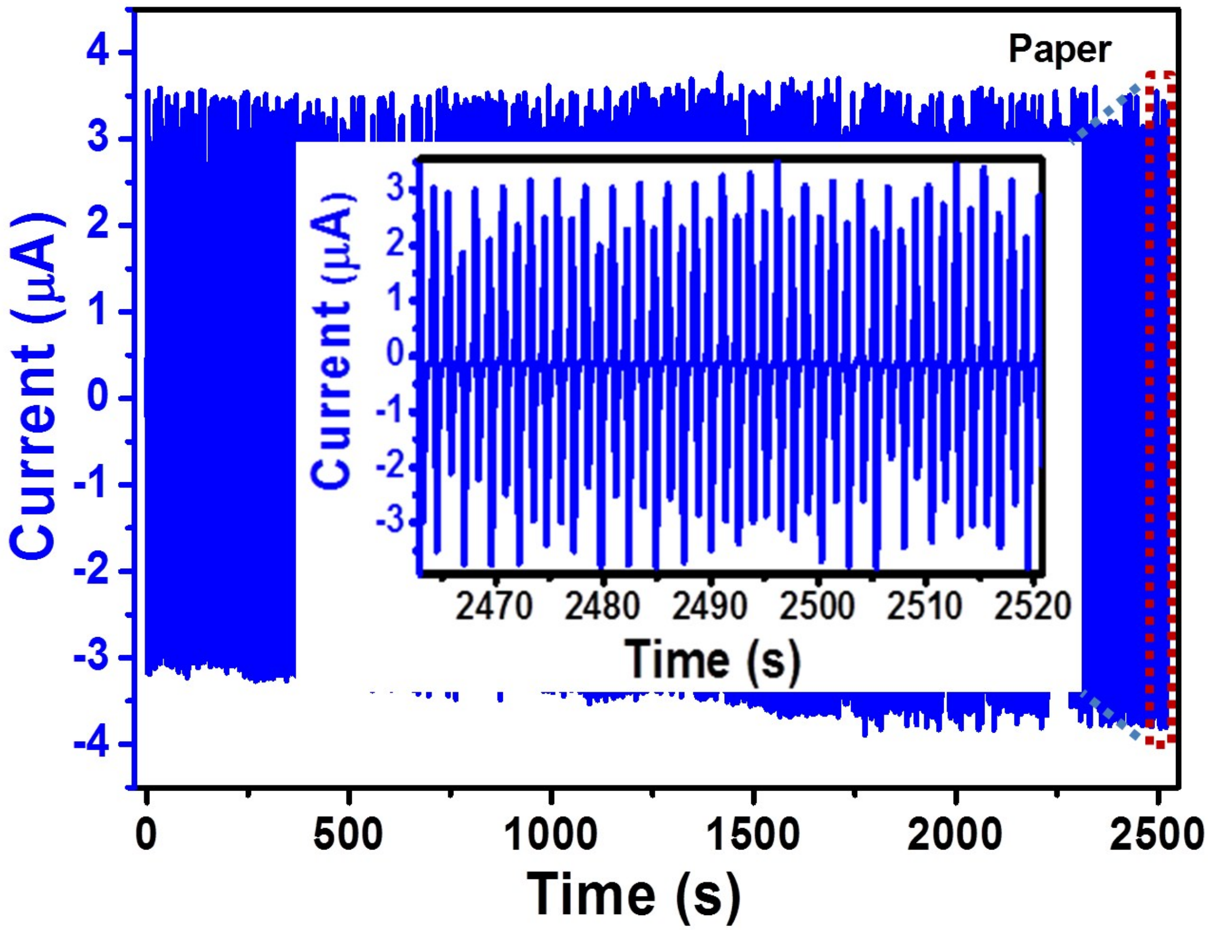

Figure S3. Stability test of SBP-TENG (a) Short circuit current. The inset shows an enlarged view of the electrical response at the end of the stability test and (inset).

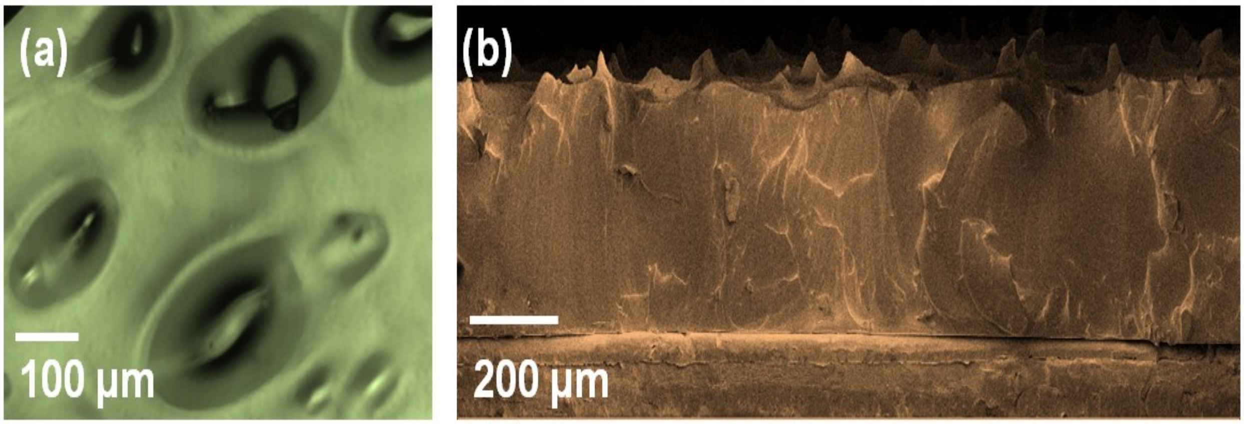

Figure S4. (a) Top view FE-SEM image of PDMS film (peeled from120 sec treated perti dish) and (b) its cross-sectional view.

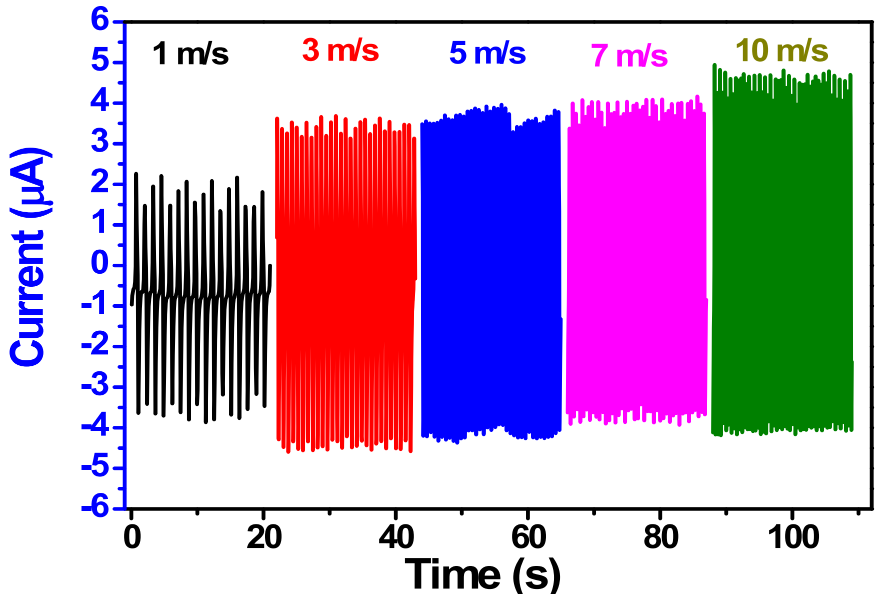

Figure S5. Short circuit current obtained during various force applied on the SBP-TENG.

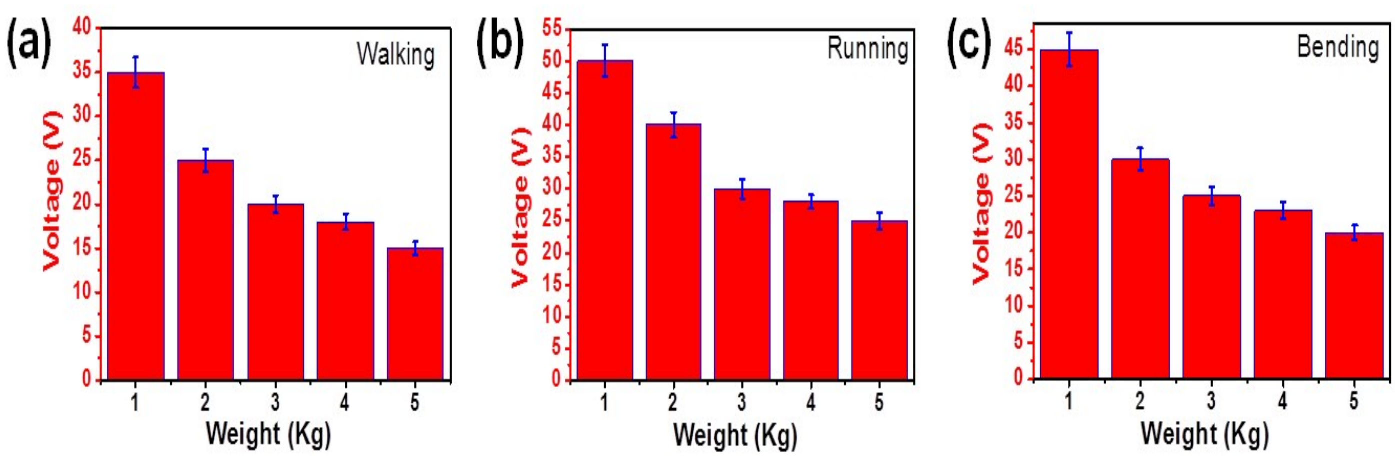

Figure S6. (a-c) Output voltage with respect to different human motion (walking, running and bending) *vs* different bag weight with error limits of real time bio-mechanical energy.

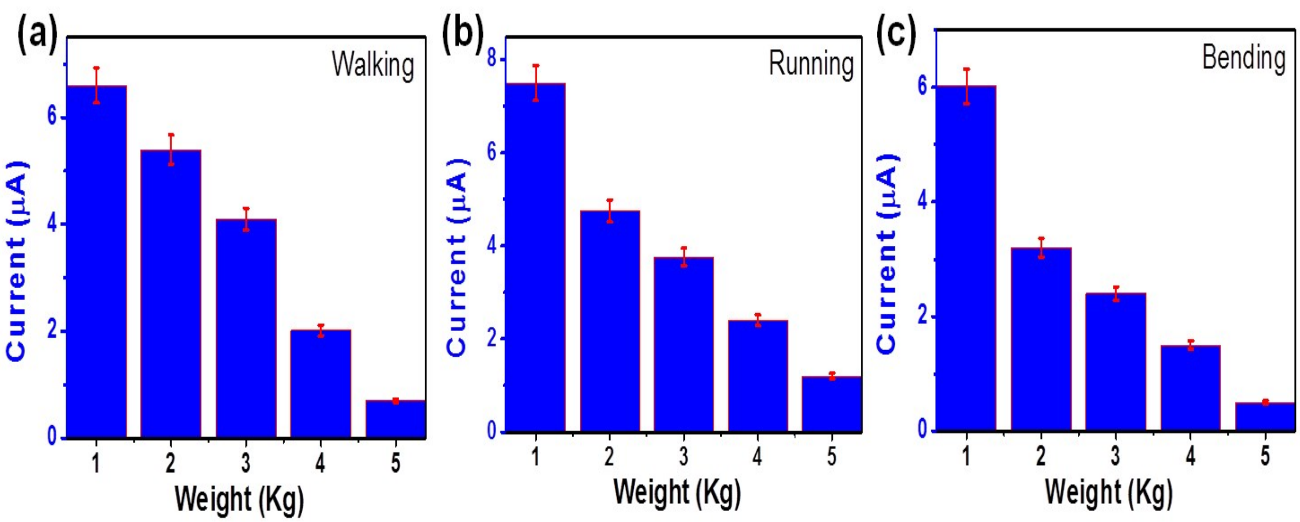

Figure S7. (a-c) Output current with respect to different human motion (walking, running and bending) *vs* different bag weight with error limits of real time bio-mechanical energy.

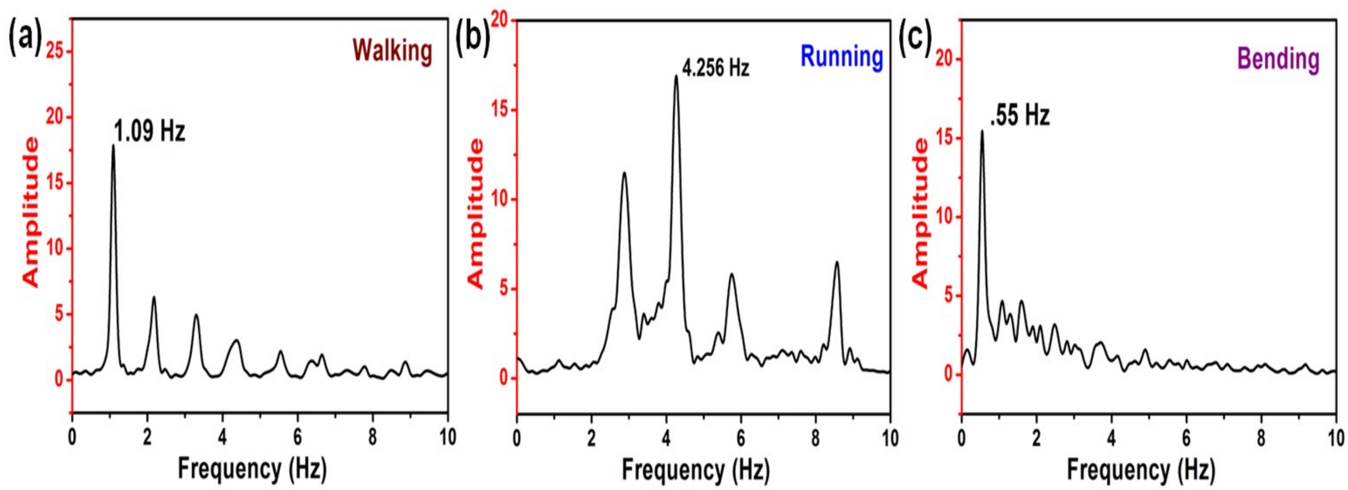

Figure S8. (a-c) the frequency components after Fourier transformed of the harvested voltage during human motion (walking, running and bending).

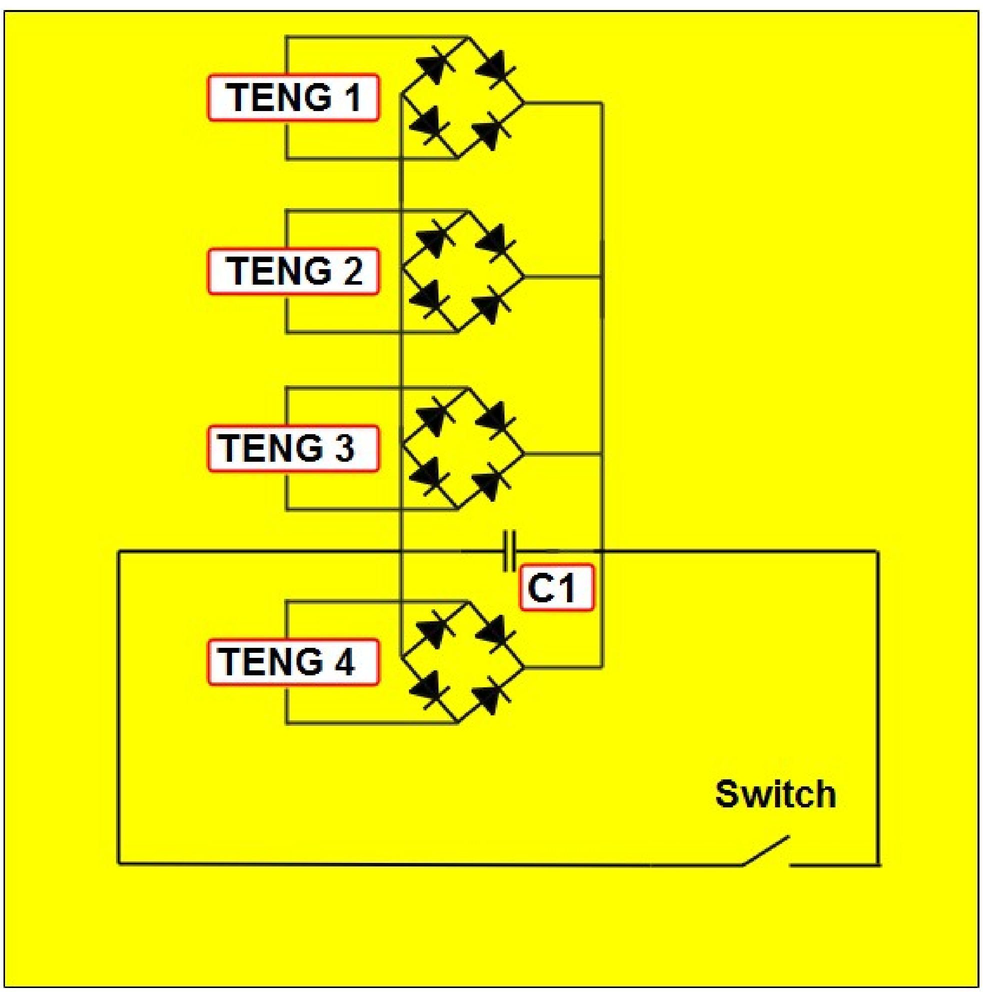
TENG 1
TENG 2
TENG 3
C1
TENG 4
Switch

Figure S9. Capacitor charging circuit using multi unit-SBP-TENG

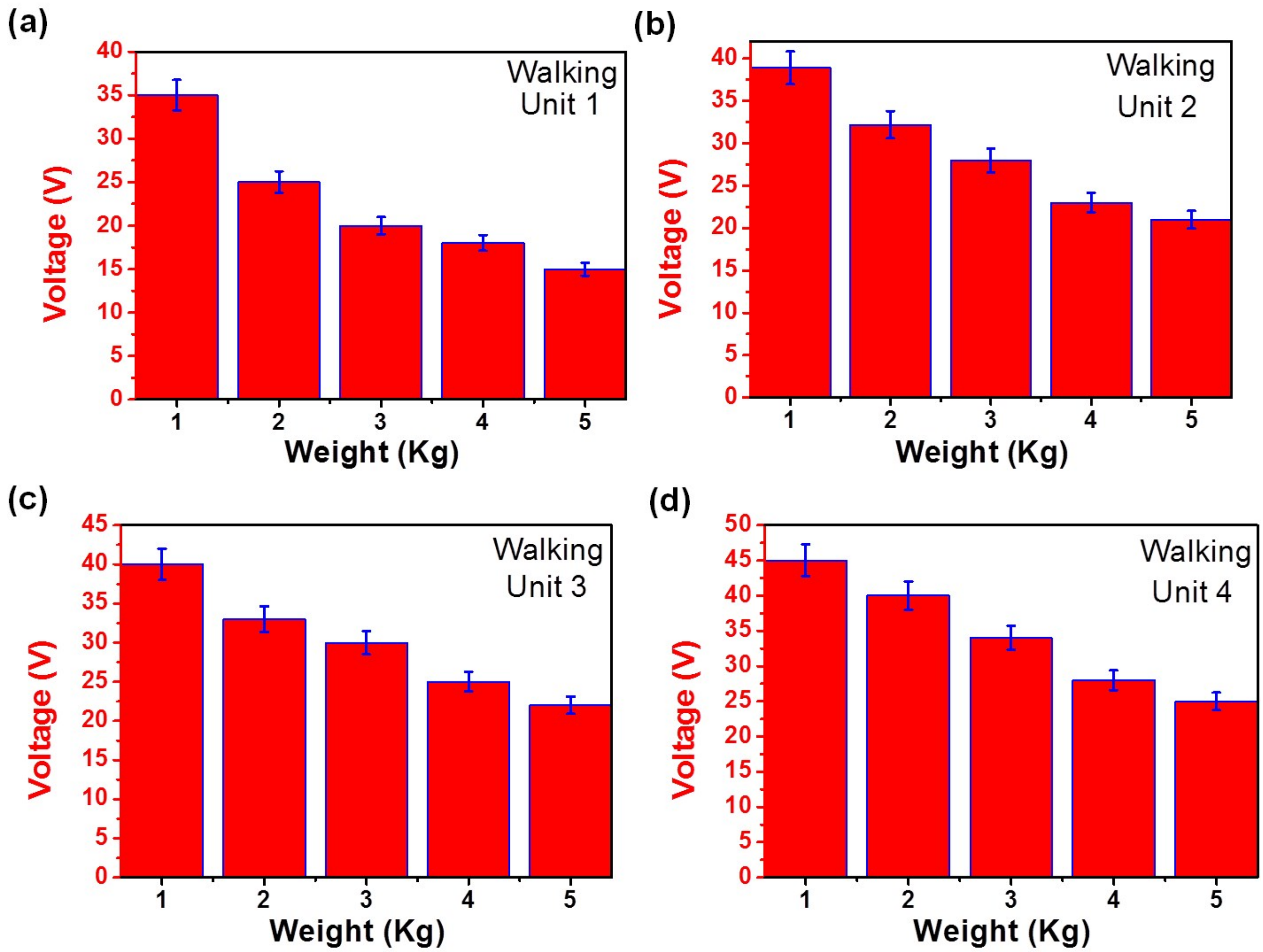

Figure S10. (a-d) Output voltage of multi-unit SBP-TENG with respect to walking motion *vs* different bag weight with error limits of real time bio-mechanical energy.

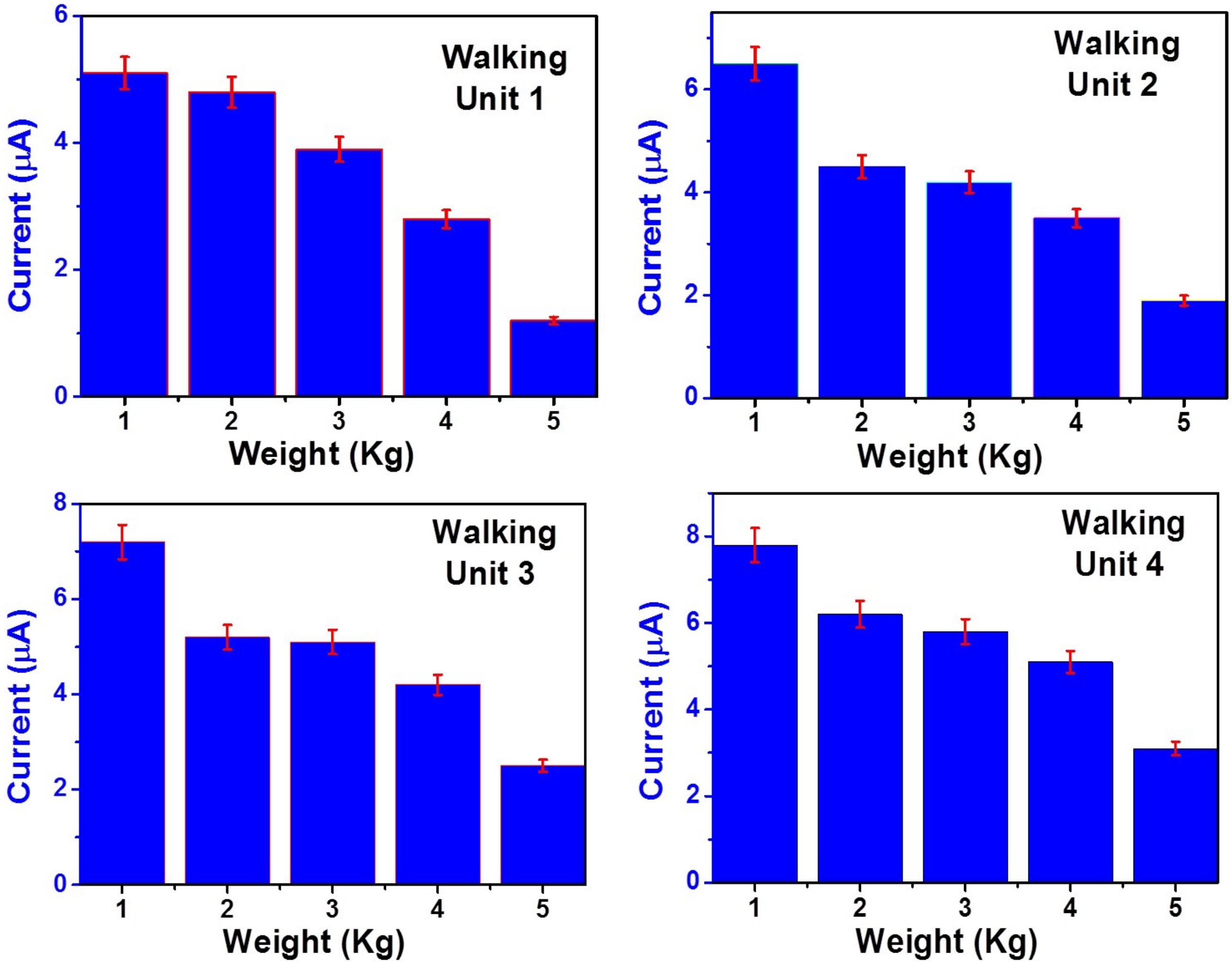

Figure S11. (a-d) Output current of multi-unit SBP-TENG with respect to walking motion *vs* Different bag weight with error limits of real time bio-mechanical energy.

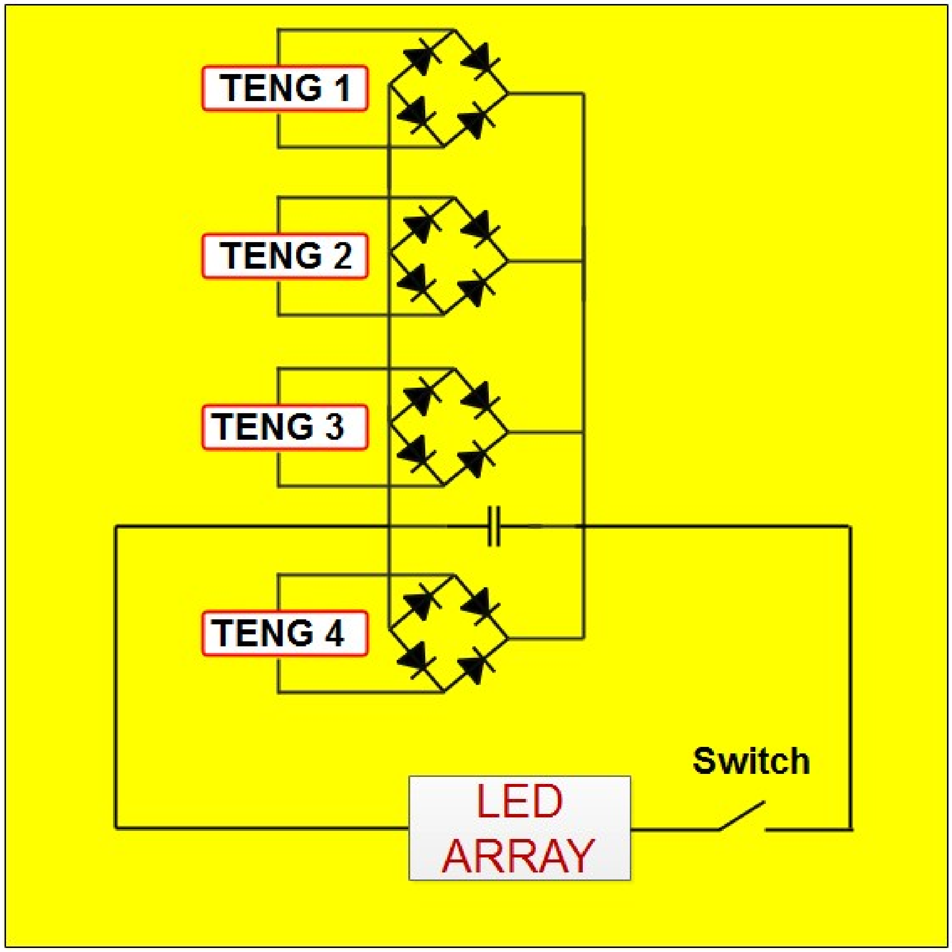

Figure S12. Self-powered emergency LED light switching circuit

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