Supporting Information

Microcrystalline cellulose ingrained PDMS triboelectric nanogenerator as a self powered locomotion detector

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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 = 15 m/s

Hence,

F = 2.144 Kg × 15 m/s

F = 32.16 N

Calculation of peak power and power density

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

Peak Power = 576 µW

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

Power Density = 576 µW / 9 cm^2

Power Density = 64 µW/cm^2

Specification of Maxwell CR 2032 battery

Model	CR2032
System	Manganese dioxide–Li/Organic Electrolyte
Nominal Voltage (V)	3
Nominal Capacity (mAh)*	220
Nominal Discharge Current (mA)	0.2
Operating Temperature Range (deg. C) **	–20 to +85
Weight (g) ***	3.0
Dimensions (mm) ***	
Diameter	20.0
Height	3.2
UL Recognition	MH12568

Crystalline (cm^{-1})	Band assignment
488	Si-O-Si stretching
687	Si- CH_3 Rocking vibration
787	
862	
1262	Methyl bending vibration
1412	
2907	Methyl group stretching vibration
2965	

Table S1. Band assignments of pure PDMS revealed from Raman spectra

Crystalline (cm^{-1})	**Band assignment**
171 w	COH methane bending
380 s	CCC, COC, OCC, OCO skeletal bending, CCH, COH methane bending, movement of CC, CO groups within the glucopyranose ring units
437 s	
458 s	
520 s	
904 w	HCC, HCO bending
3331s	OH stretching

Table S2. Band assignments of microcrystalline cellulose revealed from Raman spectra

Here Figure S1 (a) shows the FE-SEM image of a plain PDMS here we can observe a clear surface without any surface roughness. When the microcrystalline cellulose ingrained with the PDMS solution and dried, the cellulose is settled in the lower layer of film. During peeling of the film from the mould, the microcrystalline cellulose particles is on the top layer of the PDMS film as shown in the Figure S1 (b-c). The cross section view of the Cellulose/PDMS is shown in the figure S1 (d), it clearly represents the formation of Cellulose/PDMS film. The microcrystalline cellulose on the top layer of the PDMS film formed an irregular settlement (as shown in the FE-SEM image Figure S1 (b-c)) which interacts with the aluminum film and generates the triboelectricity due to the triboelectric charge difference between the active layer (Microcrystalline cellulose/PDMS) and the top electrode (aluminum film).

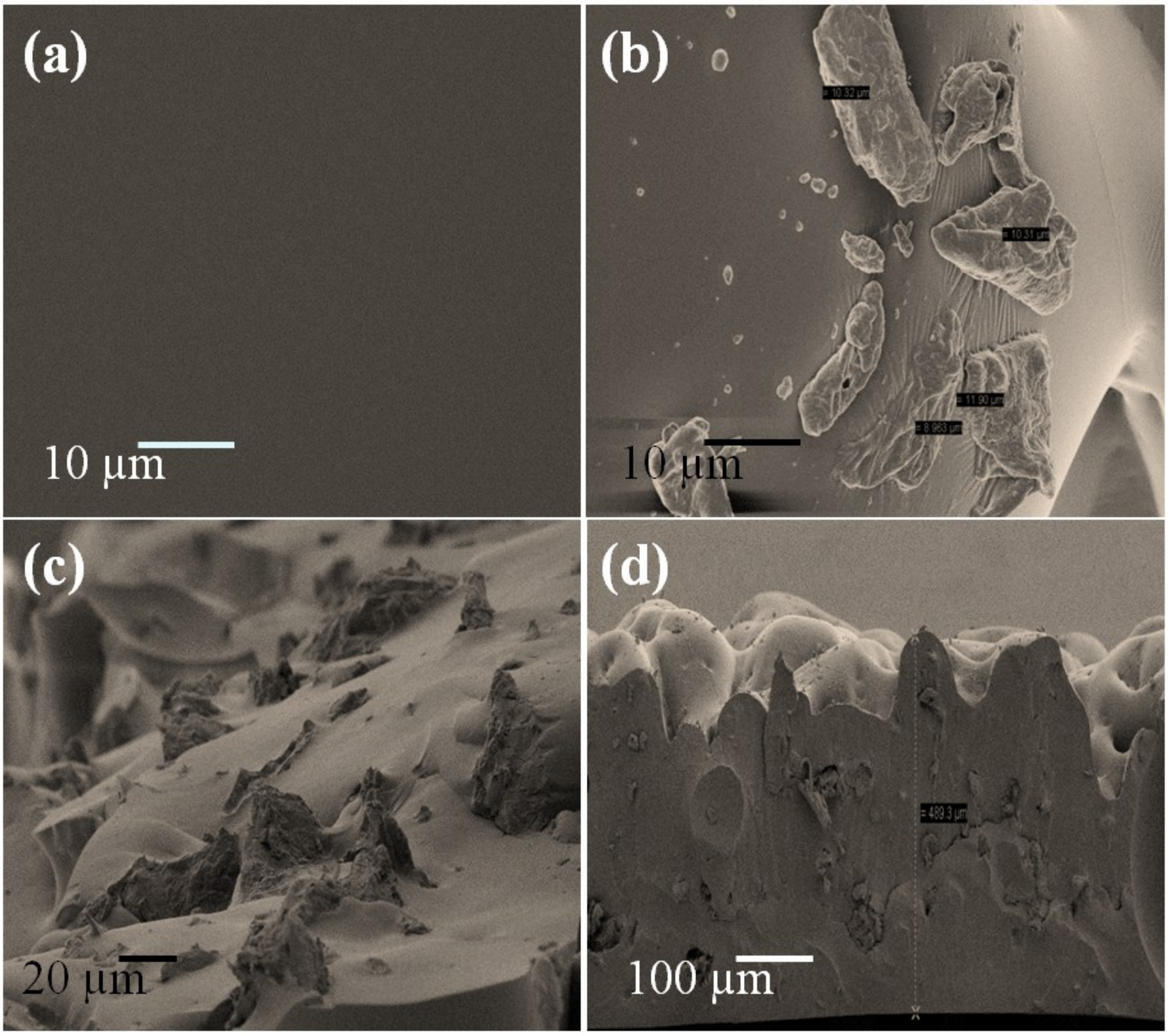

Figure S1. FE-SEM image of (a) plain PDMS, (b) Cellulose/PDMS, (c) cross section view of Cellulose/PDMS (d) cross section view of Cellulose/PDMS.

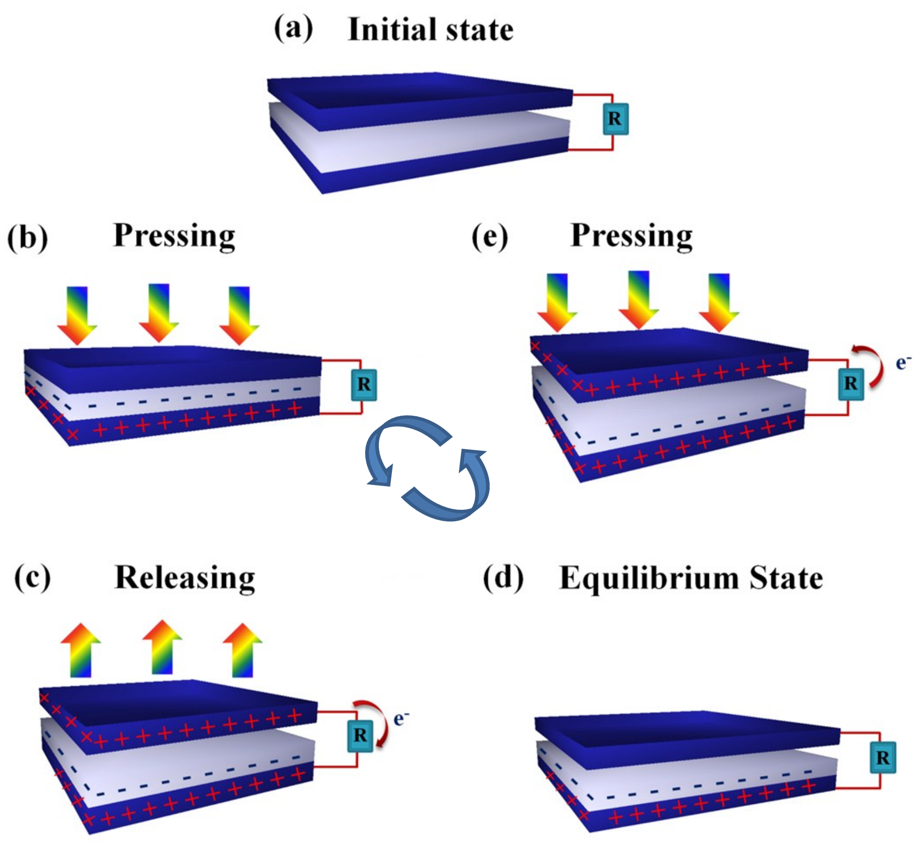

Figure S2. Energy harvesting mechanism of the C-TENG.

(a) Initial position of the upper Al electrode and cellulose/PDMS surface with Al electrodes separated by air-gap. (b) An external force causes interaction between the upper electrode and the cellulose/PDMS surface, inducing positive triboelectric charges on the upper Al electrode and negative triboelectric charges on the cellulose/PDMS surface. (c) Release of the external force causes electrons to flow from the upper Al electrode to the bottom electrode through an external circuit. (d) In the equilibrium state, where the charge carriers are distributed on both sides of the layers. (e) Electrons are driven back owing to the applied external force, reducing the inductive charge on the Al electrode.

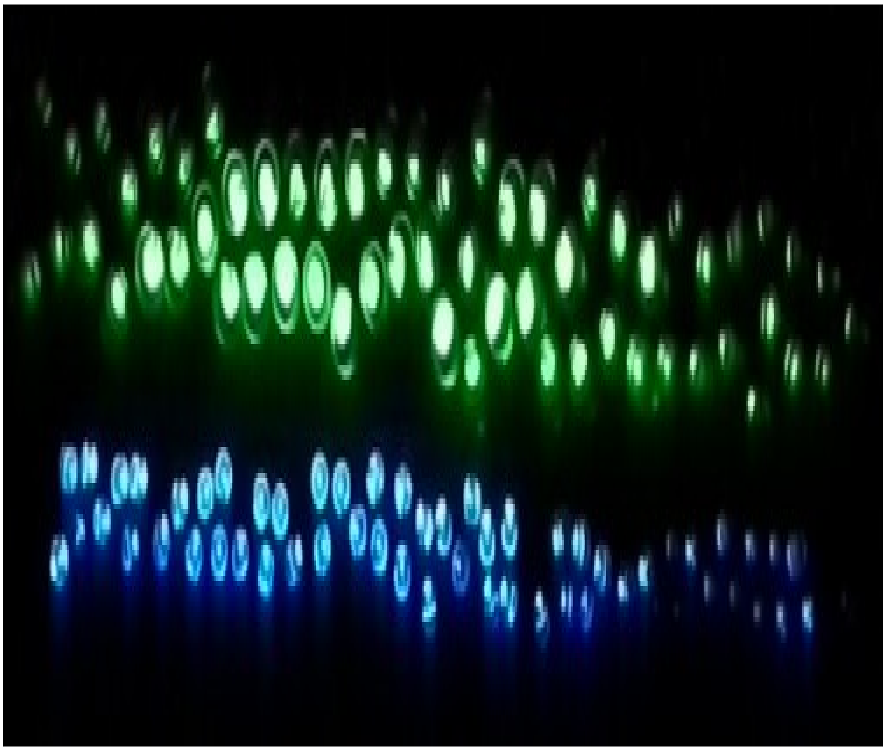

Figure S3. Digital image of instantaneous lit up of 60 green and blue LED array

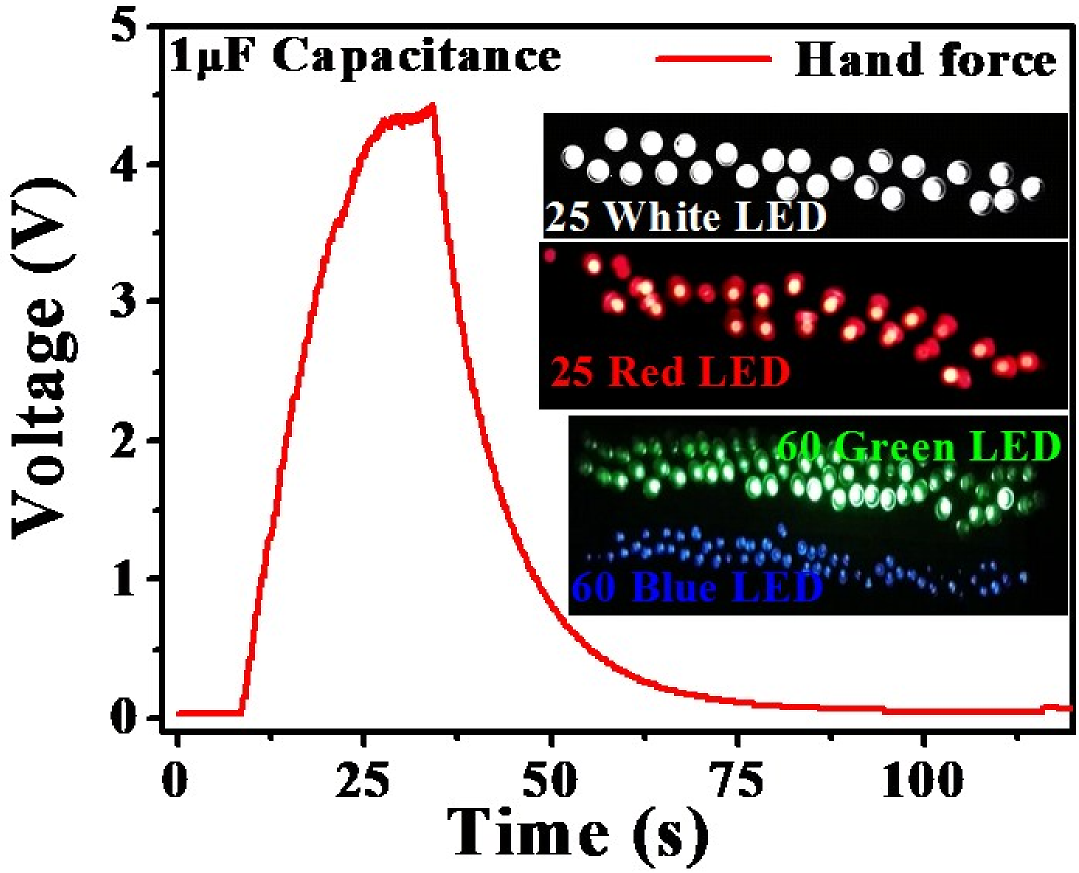

Figure S4. 1 μF capacitor was charged using hand force and inset shows the lit up of different color LEDs during hand pressing on the C-TENG.

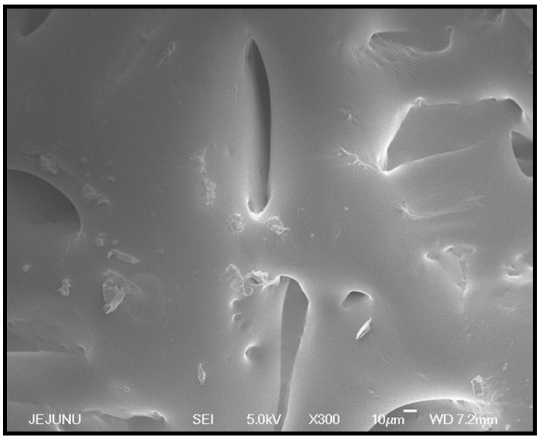

Figure S5. Top view FE-SEM image of Cellulose/PDMS film after few thousand cycles of operation.

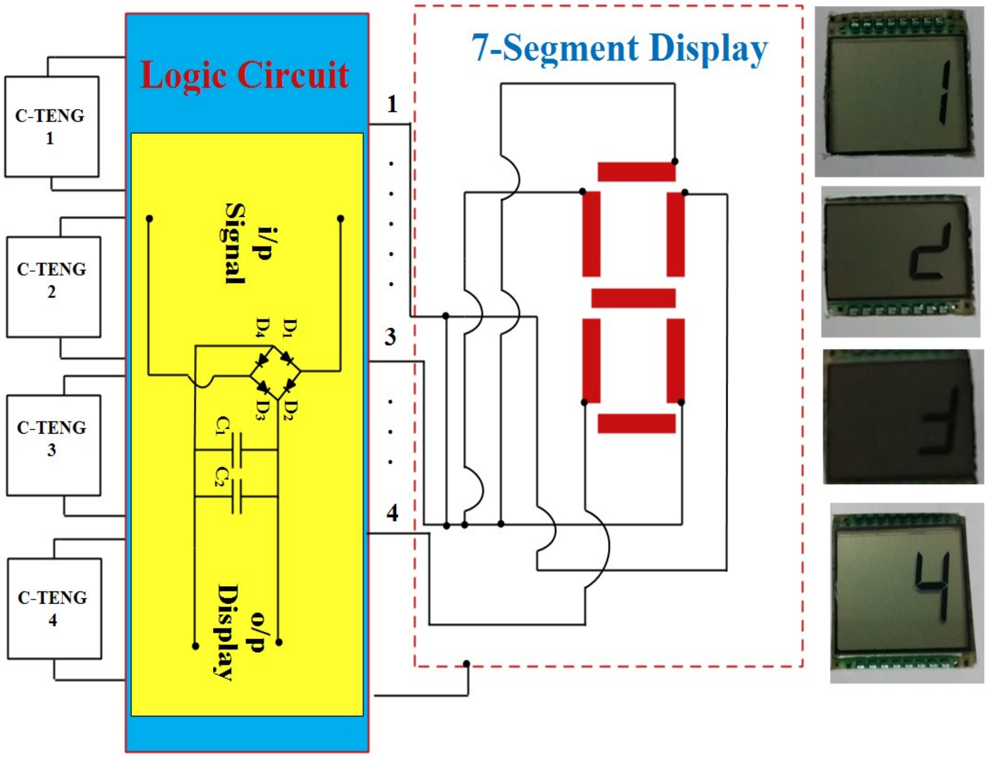

Figure S6. Logic circuit diagram of self-powered locomotion detector and digital photograph of LCD display which displaying the moving object location code.

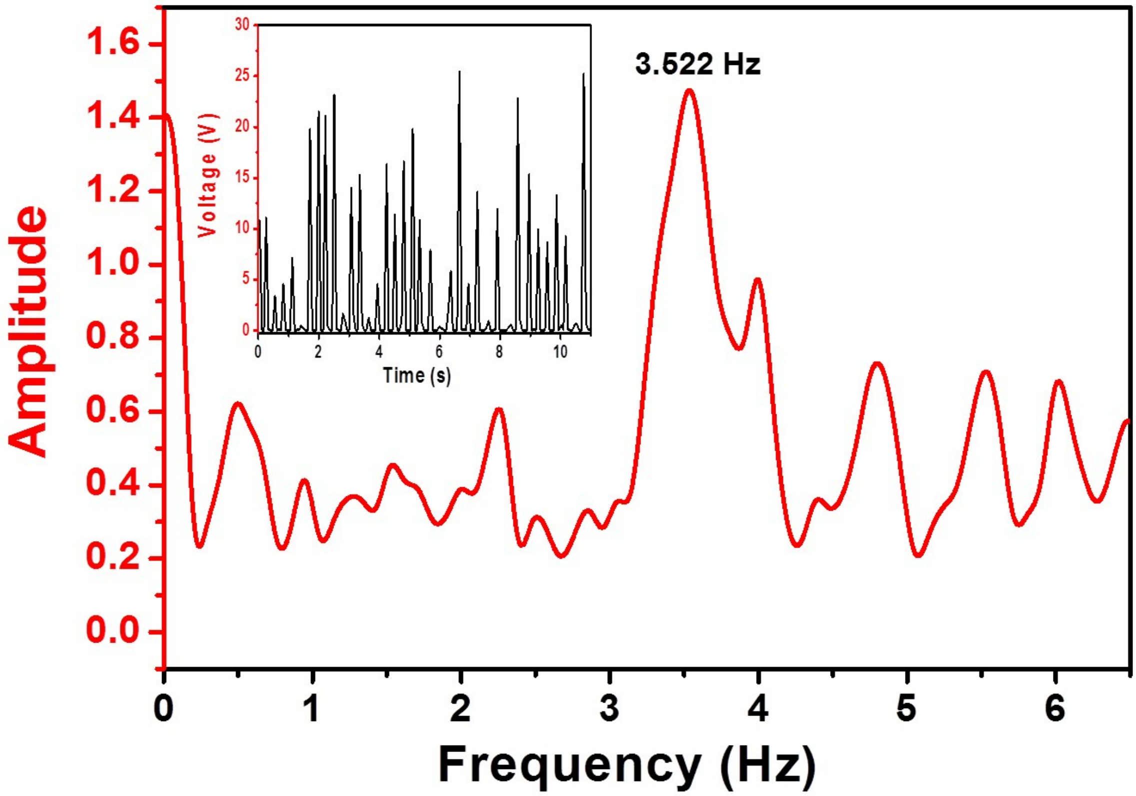

Figure S7. Frequency components after Fourier transformation of harvested voltage during human motion (walking). Inset corresponding harvested voltage.

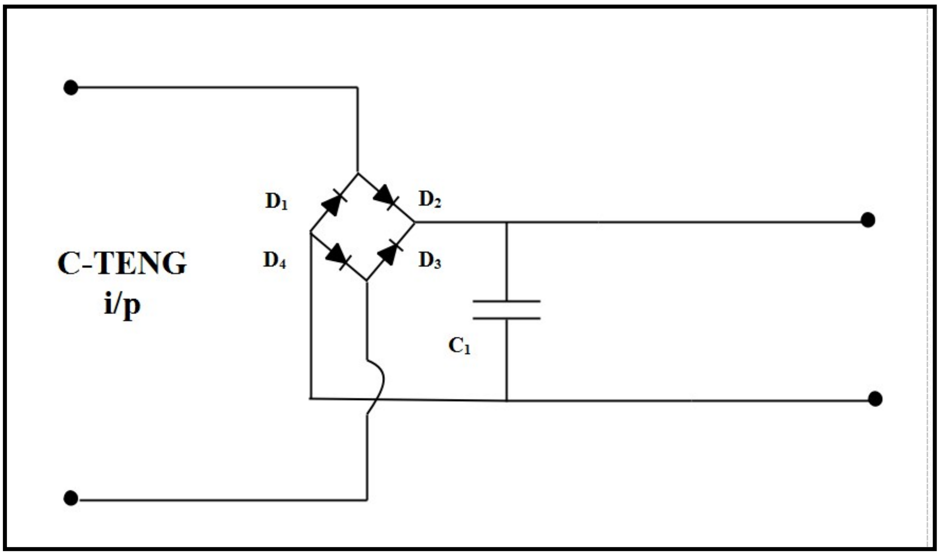

Figure S8. Real-time capacitor charging circuit using C-TENG