Electronic Supplementary Information

A self-powered and arch-structured triboelectric nanogenerator for portable electronics and human-machine communication

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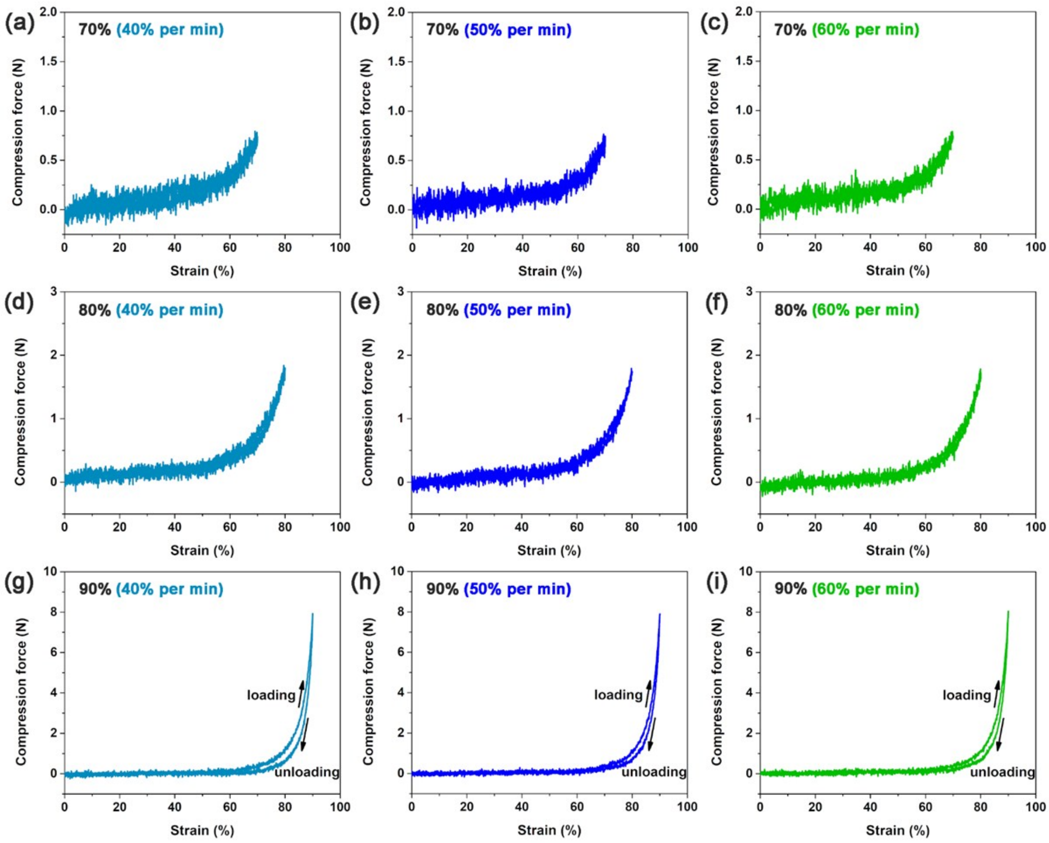

Fig. S1 The compression curves of arch-structured TENGs under (a-c) 70% strains, (d-f) 80% strains, and (g-i) 90% strains at different cross-speeds (i.e., 40% per min, 50% per min, and 60% per min) after one compression–release cycle.

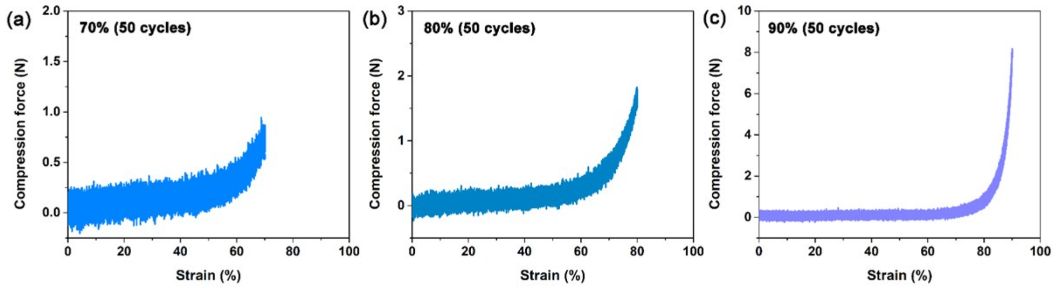

Fig. S2 The cyclic compression curves of arch-structured TENGs under (a) 70% strains, (b) 80% strains and (c) 90% strains at a cross-speed of 50% per min for 50 compression–release cycles.

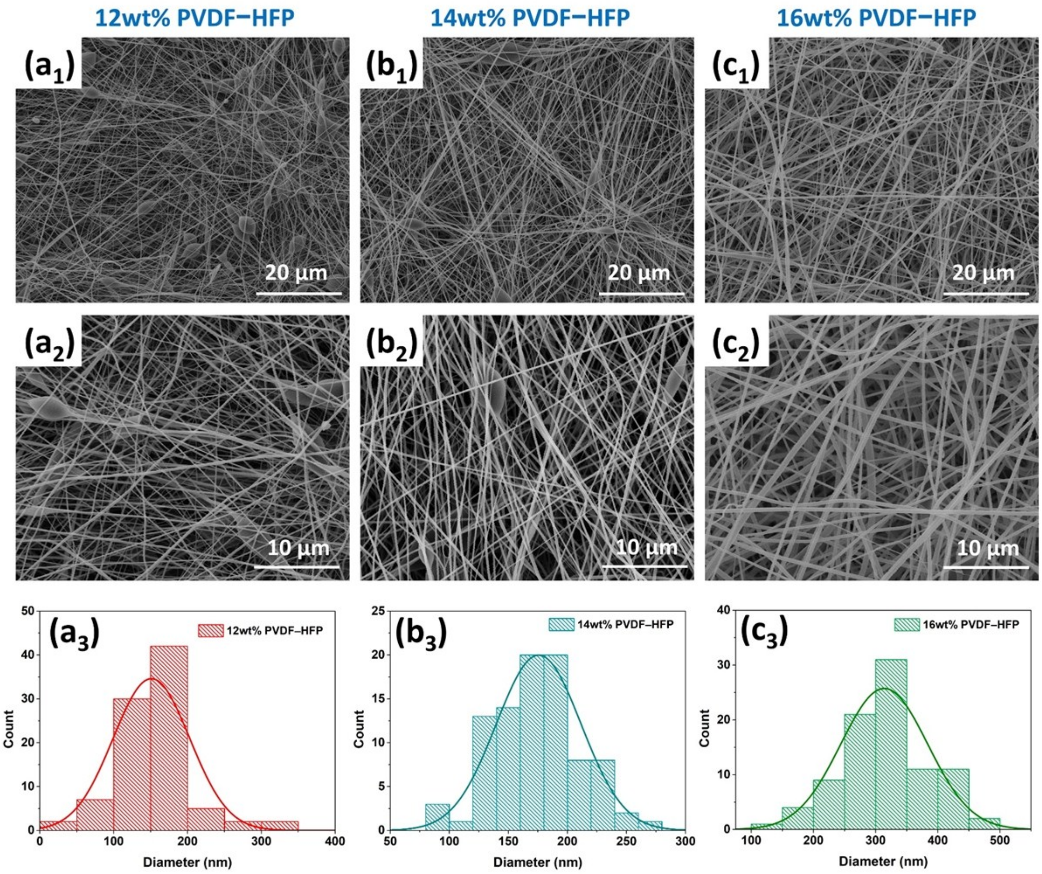

Fig. S3 SEM images showing the microstructure of (a_1, a_2) 12 wt% PVDF–HFP, (b_1, b_2) 14 wt% PVDF–HFP and (c_1, c_2) 16 wt% PVDF–HFP nanofibrous membranes. Diameter distribution of (a_3) 12 wt% PVDF–HFP, (b_3) 14 wt% PVDF–HFP and (c_3) 16 wt% PVDF–HFP nanofibrous membranes.

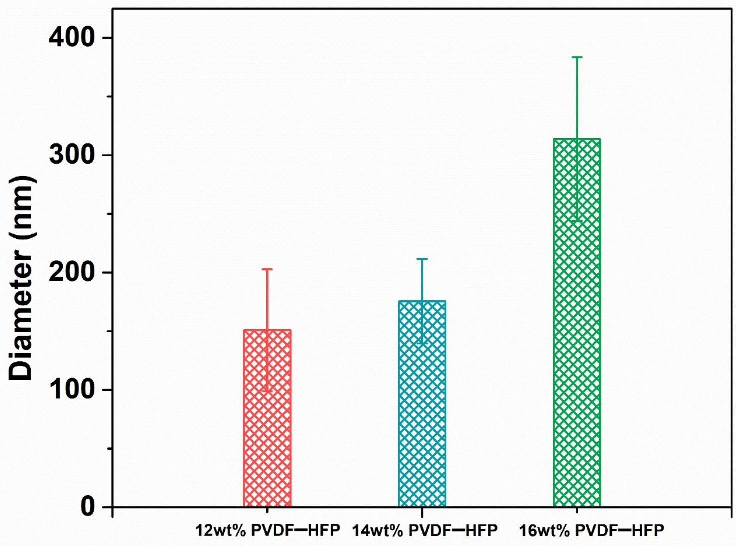

Fig. S4 Average diameter of the PVDF–HFP nanofibrous membranes at different concentrations.

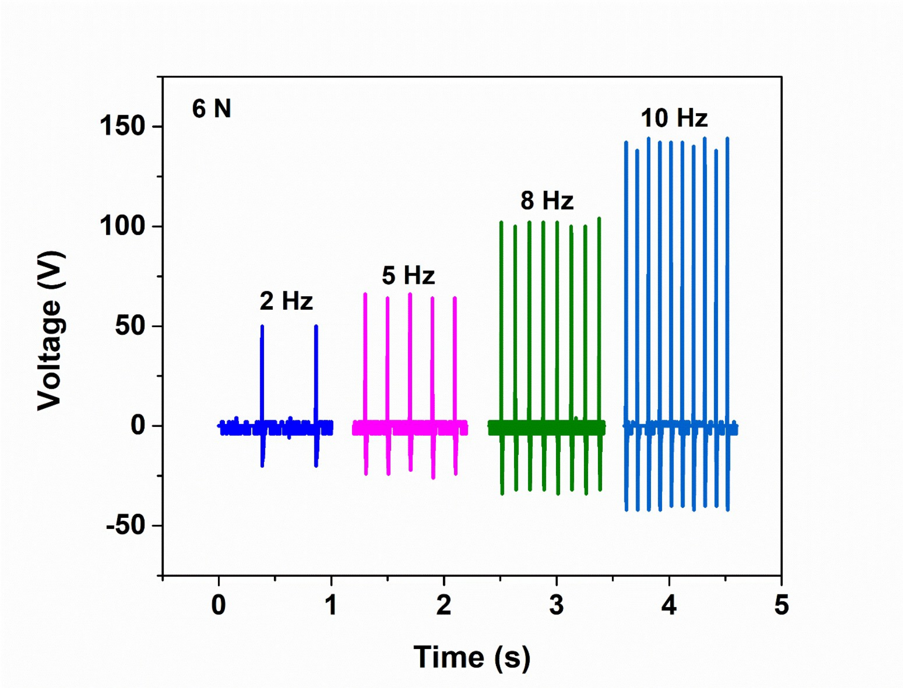

Fig. S5 Output voltages of the TENG measured at different frequencies.

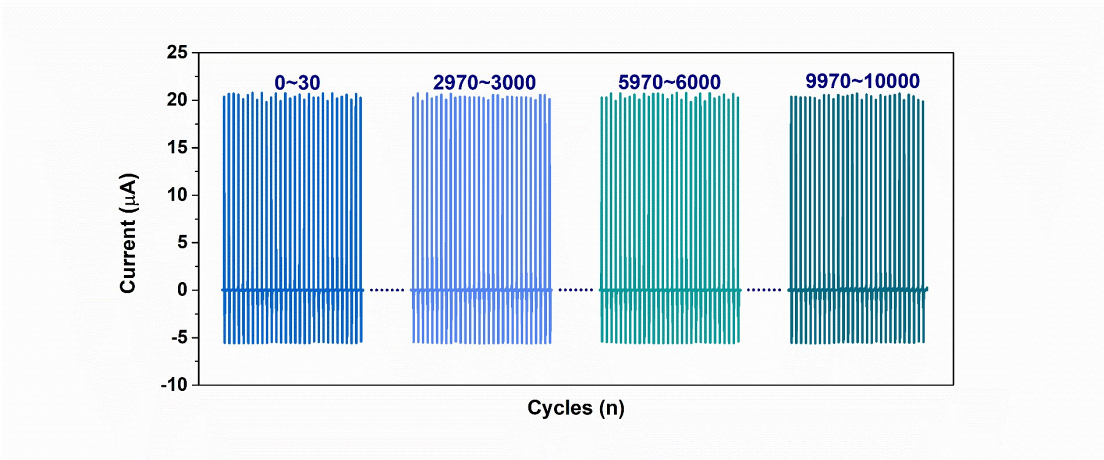

Fig. S6 Output current of the TENG during 10 000 press and release cycles.

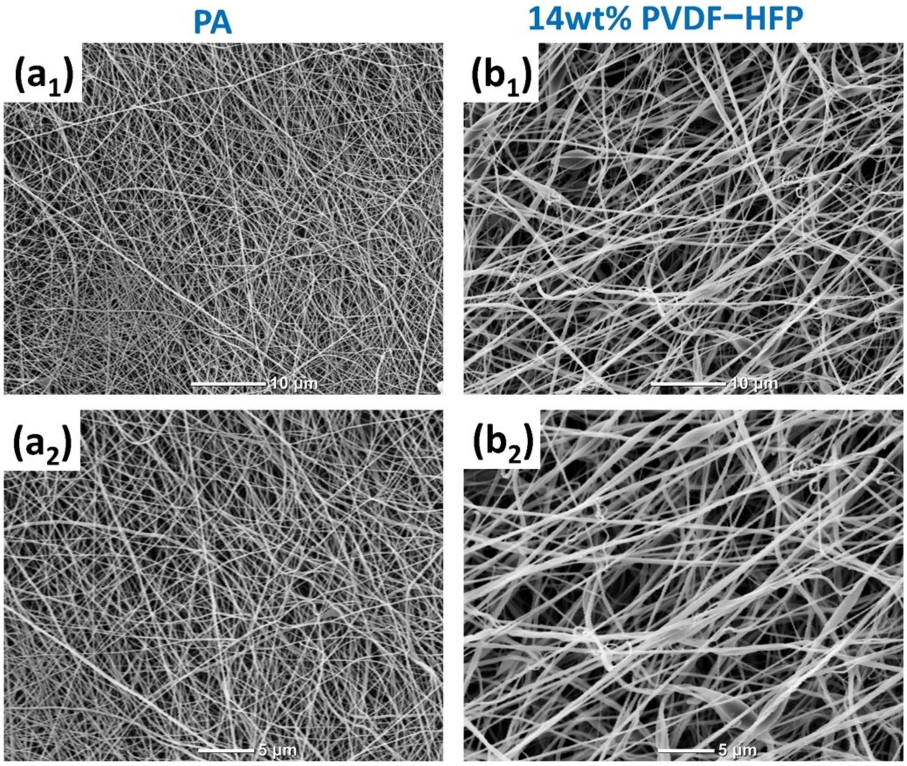

Fig. S7 SEM images showing the microstructure of (a_1, a_2) PA and (b_1, b_2) 14 wt% PVDF–HFP membranes after 10 000 press and release cycles.

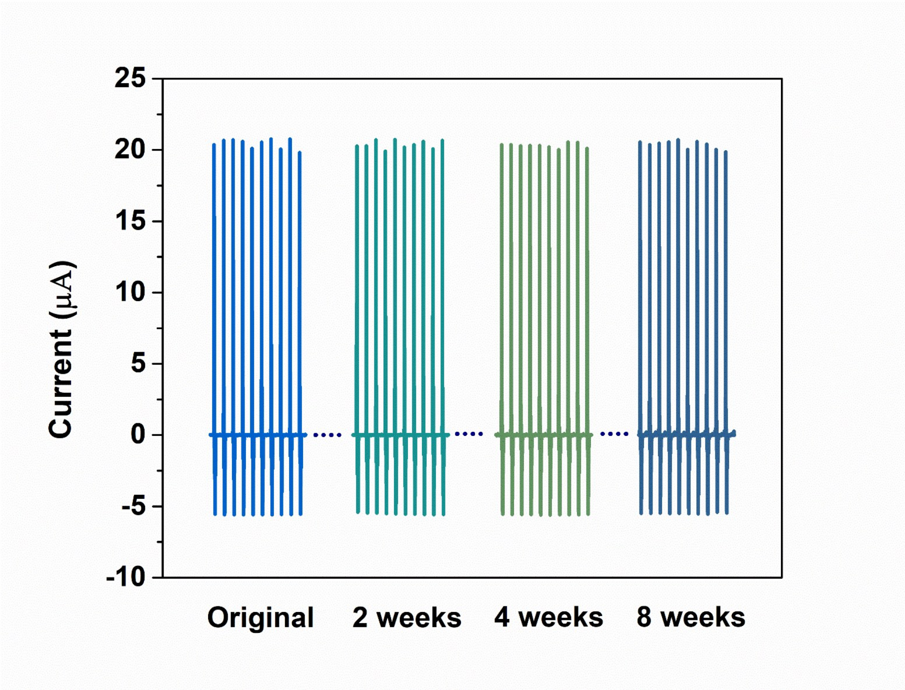

Fig. S8 Output current of the TENG measured during various storage time (up to 8 weeks).

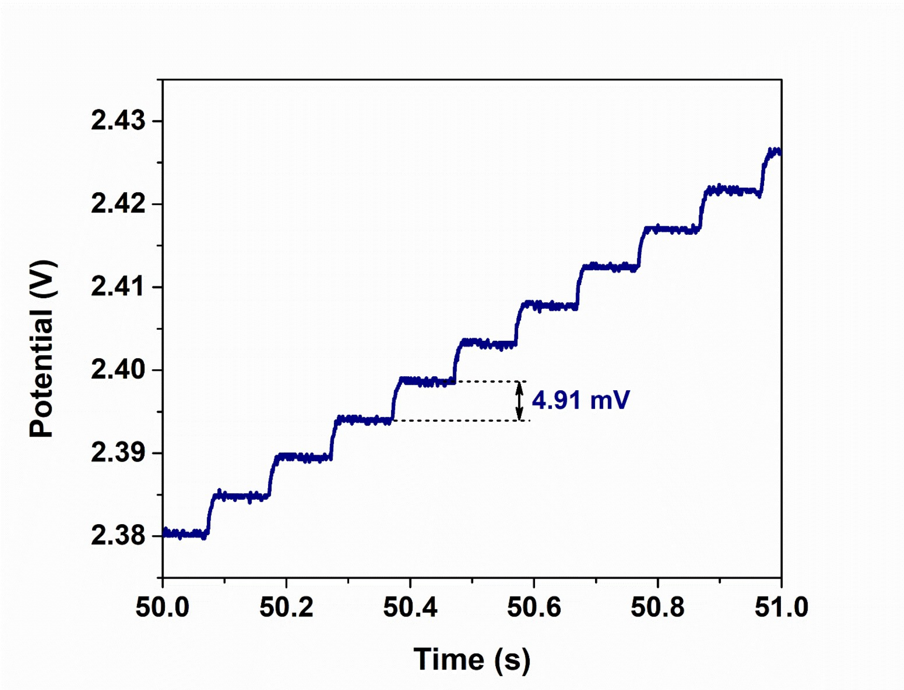

Fig. S9 The enlarged charge curve of a 10 μF capacitor that powered a calculator.

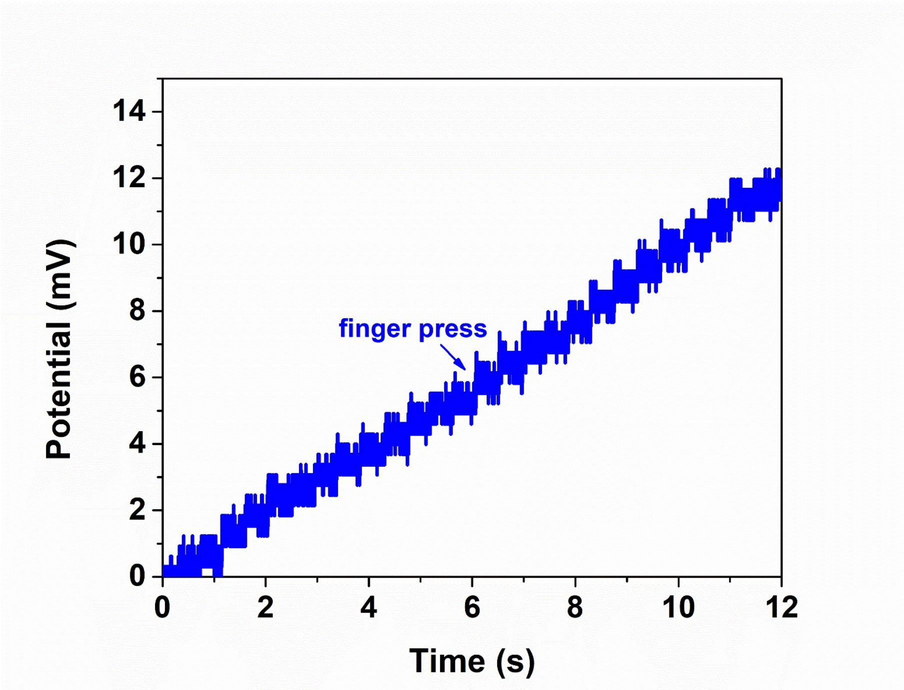

Fig. S10 The stepwise increase in voltage of the capacitor charged by the TENG through finger pressing.

Table S1. Thicknesses of PA membranes with different layers and PVDF–HFP membranes with different concentrations.

Membranes	**Thickness (μm)**
1 layer PA	9.6±0.6
2 layers PA	17.3±2.3
3 layers PA	24.6±1.3
4 layers PA	35.6±4.3
12 wt% PVDF–HFP	25.3±1.6
14 wt% PVDF–HFP	42.3±3.3
16 wt% PVDF–HFP	51.0±4.3

Table S2. Comparison of the output performances of the state-of-art TENGs with our TENG.

References	**Voltage (V)**	**Current (μA)**	**Power Density (W/m^2)**	**Area (cm^2)**	**Force (N)**	**Frequency (Hz)**
[1]	120	4	0.0725	4×4	13	3
[2]	880	53.9	5.2	7×7	5	4
[3]	98.6	11.3	0.0184	2×2	/	8
[4]	88	6.2	0.004	3×3	30	/
[5]	118.4	/	1.0876	π×3^2	10	10
[6]	115	9.5	1.84	1×2	6	10
[7]	112.7	1.98	0.08	4×4	/	3
[8]	115.2	9.21	0.13	3×3	/	3
[9]	500	12	3.1	2×4	25.6	2
[10]	1000	200	17.17	10×10	/	2.5
[11]	124.6	10.13	2.2	1×1.5	20	4
[12]	1063	196	14.8	4.5×4.5	56	6
[13]	540	110	14.8	4×4	100	5
[14]	235.59	14.59	6.74	4×4	50	5
[15]	106.2	9.2	13.3	1×2	6	10
[16]	196.8	31.5	16.1	2.5×2.5	6	10
Our work	**141.6**	**20.4**	**31.96**	1.5×1.5	**6**	**10**

Code 1: Code for switching an LED on and off by pressing the TENG

```
int analog_pin = 3;
int output_pin = 2;

int val_store = 0;
int val_cur = 0;

int state = 0;

void setup()
{
   Serial.begin(9600);
   analogReference(INTERNAL1V1);
   val_store = analogRead(analog_pin);
}

void loop()
{
   delay(1000);
   val_cur = analogRead(analog_pin);
   int diff=val_cur-val_store;
   Serial.println(diff);
   if (diff > 2)
   {
      if(state == 0){
         digitalWrite(output_pin,HIGH);
         state = 1;
      }else if(state = 1){
         digitalWrite(output_pin,LOW);
         state = 0;
      }
   }
```

```
    val_store=val_cur;
}
```

Code 2: Code for switching a motor with a propeller on and off by pressing the TENG

```
int analog_pin = 3;
int output_pin = 2;

int val_store = 0;
int val_cur = 0;

int state = 0;

void setup()
{
    Serial.begin(9600);
    analogReference(INTERNAL1V1);
    val_store = analogRead(analog_pin);
}

void loop()
{
    delay(1000);
    val_cur = analogRead(analog_pin);
    int diff=val_cur-val_store;
    Serial.println(diff);
    if (diff > 2)
    {
        if(state == 0){
            analogWrite(output_pin,200);
            state = 1;
        }else if(state = 1){
```

```
            analogWrite(output_pin,0);
            state = 0;
        }
    }
    val_store=val_cur;
}
```

Video lists

Video S1. Some electronics (e.g., LEDs, LCDs, and a flashlight) were directly lit up by the TENG.

Video S2. A calculator was powered using a capacitor charged by the TENG.

Video S3. A self-powered sensing system for turning an LED on and off by constantly pressing the TENG.

Video S4. A self-powered sensing system for turning a motor with a propeller on and off by constantly pressing the TENG.

Video S5. A self-powered TENG-based calculation system for human–machine communication.

References

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