To minimise the negative effect of overlapping signals and develop a more intuitive detection mechanism, an alternative eight-direction interface with larger electrode spacing (15 mm) was fabricated and investigated. The interface is shown in Figure 30(a). Because of the larger electrode spacing, the overlapping of output signals can be minimised and an expected output signal pattern corresponding to the electrode pattern can be achieved, i.e., large amplitude from large electrode. The generated output signals when sliding across the eight directions are illustrated in Figure 30(b-i), respectively. According to the measurement results, it can be observed that the amplitude variation of the output signals is able to follow the width variation of the sensing electrodes correspondingly. Furthermore, no backward sliding is required in order to determine the coding information in electrodes. In this way, the interpretation mechanism in the processing circuit can then be significantly simplified.

The triboelectric mechanism enables the interface to also function as an energy harvester to scavenge mechanical energy from various contact and sliding motions such as human tapping. Measurement results from human hand tapping are summarised in Figure 31, where the recorded output voltage (on a 100 MΩ load), charge and short circuit current of the device are 385 V, 482 nC and 6.25 µA, respectively. When changing the resistance of the connected external loads, the interface can produce a maximum output power of 3.2 mW on a matched resistance of 13 MΩ (with tapping frequency of ~3.5 Hz). Therefore, the interface not only can be used as a self-powered interface, but also can be used as an energy harvester/generator to scavenge energy from human motions, and the scavenged energy can be stored in a capacitor for the potential operation of the back-end circuits, thereby enabling self-powered and battery-less functional interfaces.

In addition, interfaces according to certain embodiments can be equipped with flexible and/or stretchable compatibility toward flexible wearable applications. A flexible four-direction interface and a stretchable four-direction interface are shown in Figures 33(a) and 33(b), respectively. The flexible interface 3300 is based on the same device structure and materials as the interfaces described above, while the stretchable interface 3302 is fabricated with encapsulated liquid