Supporting Information

Highly stretchable and elastic PEDOT: PSS helix fibers enabled wearable sensors

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Video S1. A video demonstrating the spinning of self-helical PEDOT:PSS fibers.

Video S2. Following tensile deformation of about 400% in water, PEDOT: PSS-Mg self-helical fiber is shown in a video regaining its initial length.

Video S3. PEDOT: PSS-Mg self-helical fibers can quickly self-recover within a specific stretch range.

Video S4. Demonstration of the human-computer interaction system.

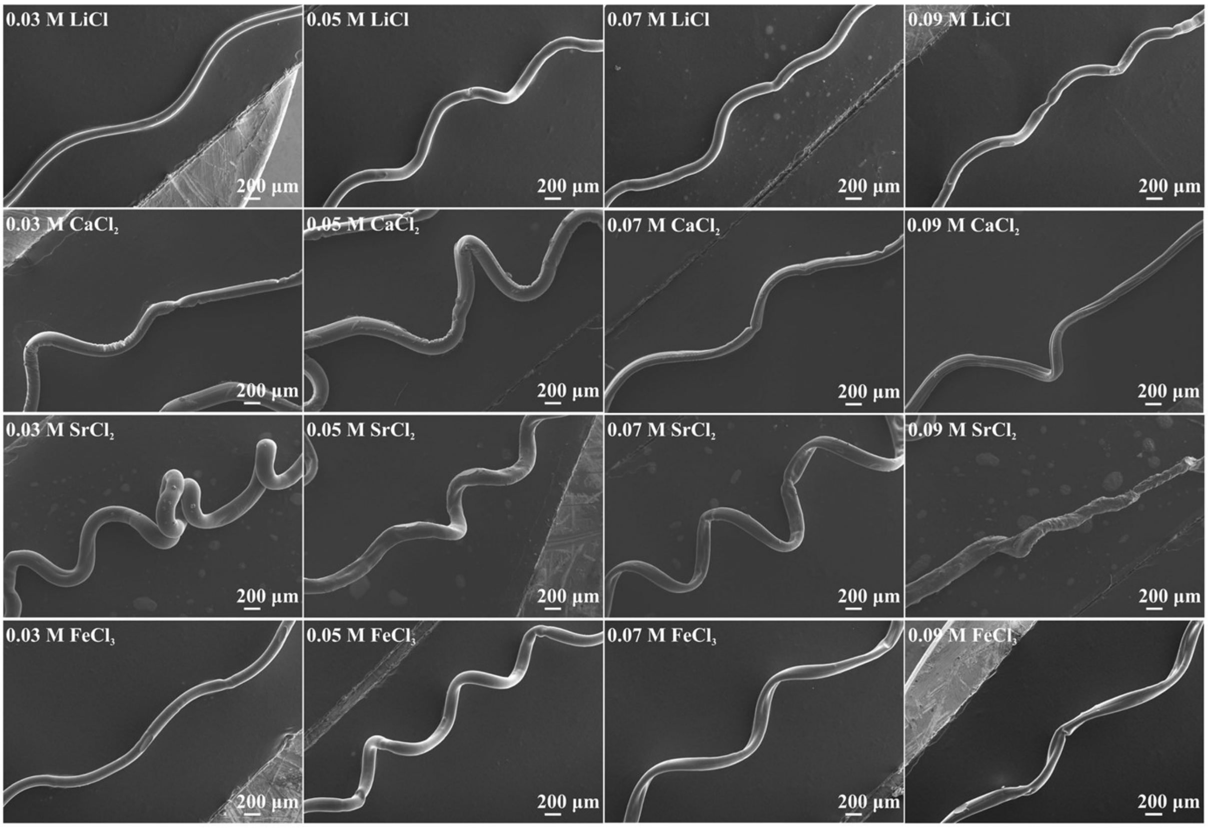

Fig. S1. SEM images of PEDOT: PSS fibers prepared by co-doping 20 vol% phosphoric acid with 0.03 M a), 0.05 M b), 0.07 M c) and 0.09 M d) LiCl; with 0.03 M e), 0.05 M f), 0.07 M g), and 0.09 M h) $CaCl_2$; with 0.03 M i), 0.05 M j), 0.07 M k), and 0.09 M l) $SrCl_2$; with 0.03 M a), 0.05 M b), 0.07 M c), and 0.09 M d) $FeCl_3$.

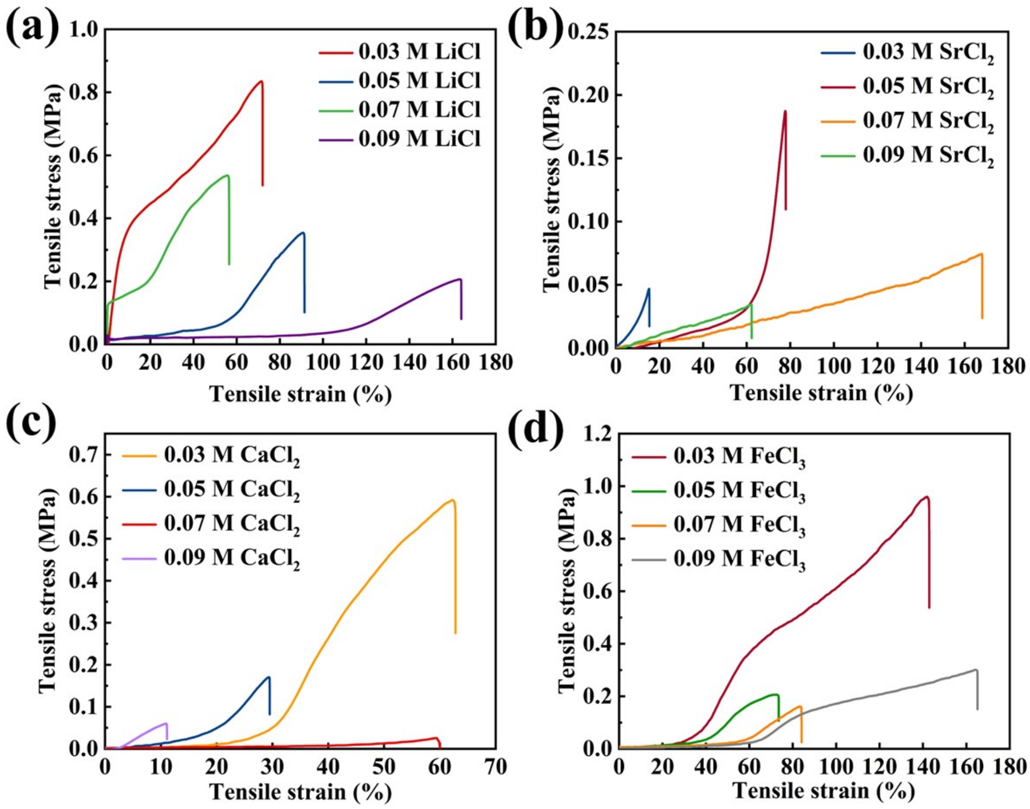

Fig. S2. Stress-strain curves of helical PEDOT: PSS fibers prepared by co-doping 20 vol% phosphoric acid and different concentrations of LiCl in solidification bath a). Stress-strain curves of helical PEDOT: PSS fibers created by co-doping in solidification bath with 20 vol% phosphoric acid and various $SrCl_2$ concentrations b). Stress-strain profiles of helical PEDOT: PSS fiber fibers produced by co-doping 20 vol% phosphoric acid and various calcium chloride concentrations c). Stress-strain curves of helical PEDOT: PSS fibers prepared by co-doping 20 vol% phosphoric acid and different concentrations of $FeCl_3$ d).

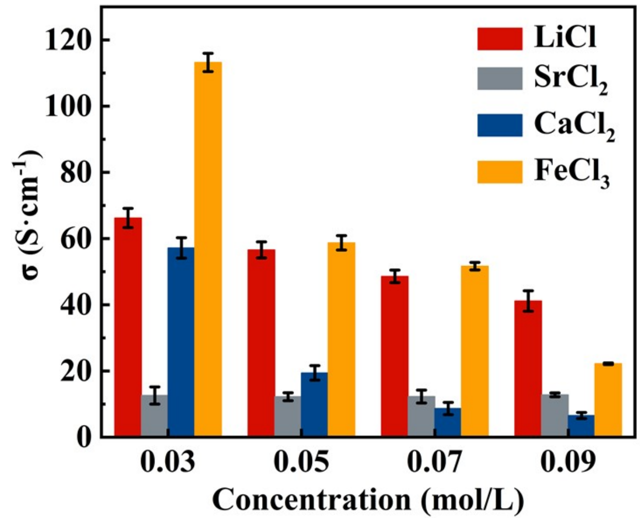

Fig. S3. The conductivity of the prepared helical PEDOT: PSS fibers changed when various concentrations of LiCl, $SrCl_2$, $CaCl_2$, and $FeCl_3$ were added to the solidification bath along with 20 vol% phosphoric acid.

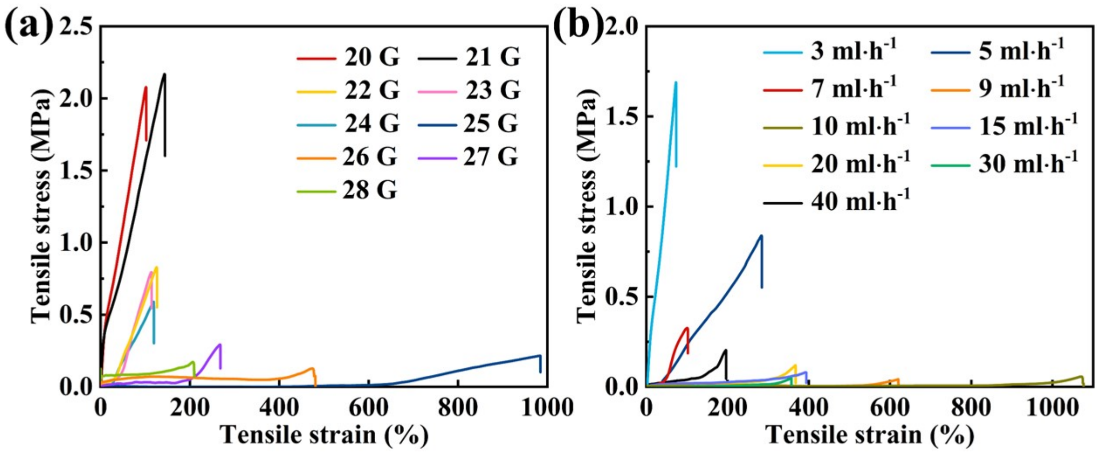

Fig. S4. Stress-strain curves of helical PEDOT: PSS fibers prepared with different-sized needles a). Stress-strain curves of PEDOT: PSS helical fibers prepared at different extrusion rates b).

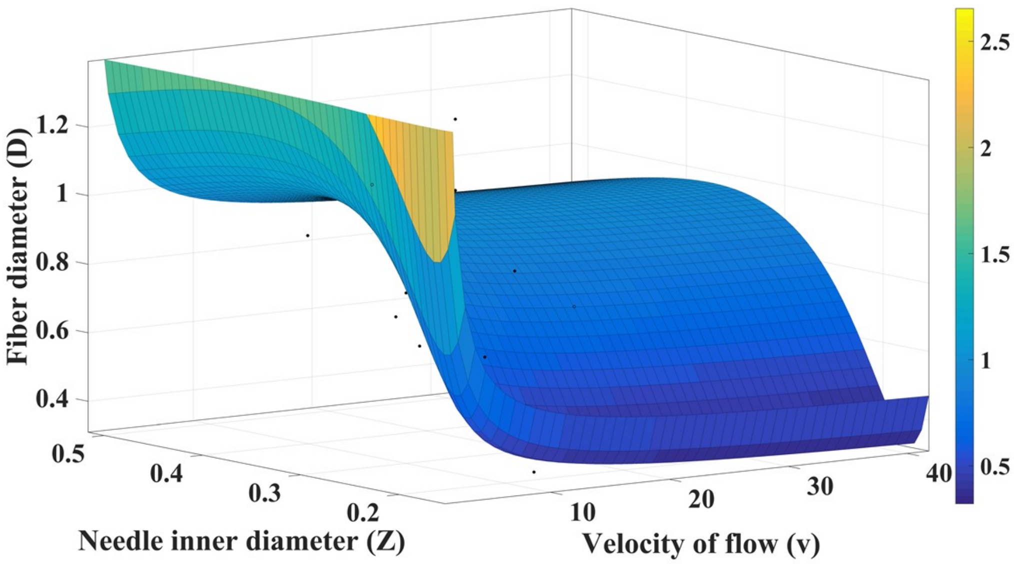

Fig. S5. Schematic for a data model that fits helix diameter, flow rate, and needle inner diameter.

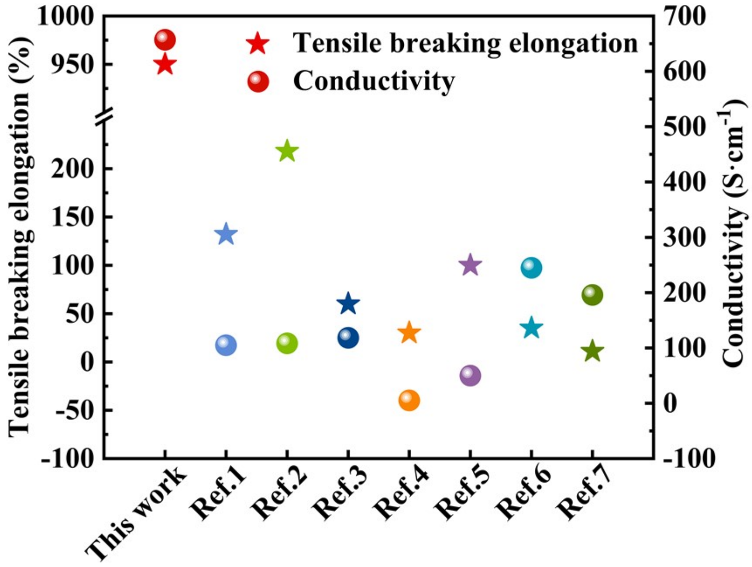

Fig. S6. Tensile strain and conductivity of PEDOT: PSS fiber in comparison with the reported strain sensors in references.

References

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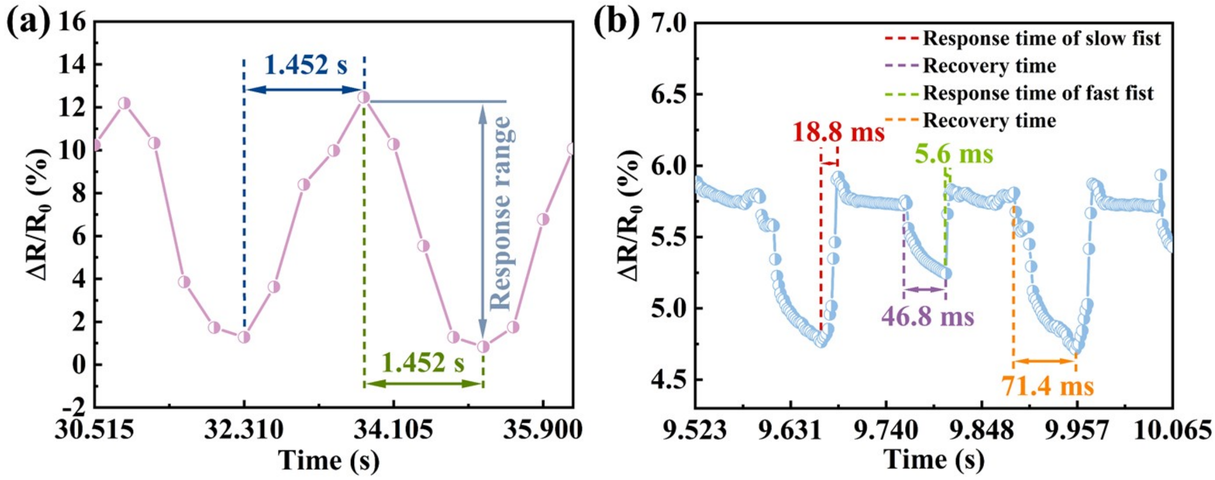

Fig. S7. Response/recovery time of the stain sensor with manipulator finger bending cycles a). Response/recovery time of PEDOT: PSS-Mg helix fiber sensor with mechanical hand gripping at different speeds b).

As shown in **Fig.S7 (a)**, the resistance response and recovery of a manipulator finger connected to a solitary PEDOT: PSS-Mg helix fiber when subjected to cycles of bending and stretching. When developing a program for fiber control using a single finger, it is necessary to demonstrate the controllability of fiber. To achieve this, we intentionally configure a slow robot motion speed and introduce a delay of 1000 ms (see **Fig.S7(a)**), resulting in a response time of up to 1.452s. The resistance change time of the flexible sensor made of PEDOT: PSS-Mg helix fibers in response to the mechanical palm gripping speed is depicted in **Fig.S7(b)**. In this program, the manipulator's action execution time is 1 ms (see **Fig.S8(c)**). The obtained data results indicate that the PEDOT: PSS-Mg helix fiber has a notable capacity for a rapid response within a specific range of deformation. The two tests exhibit the possible controllability of spiral fibers in practical applications.

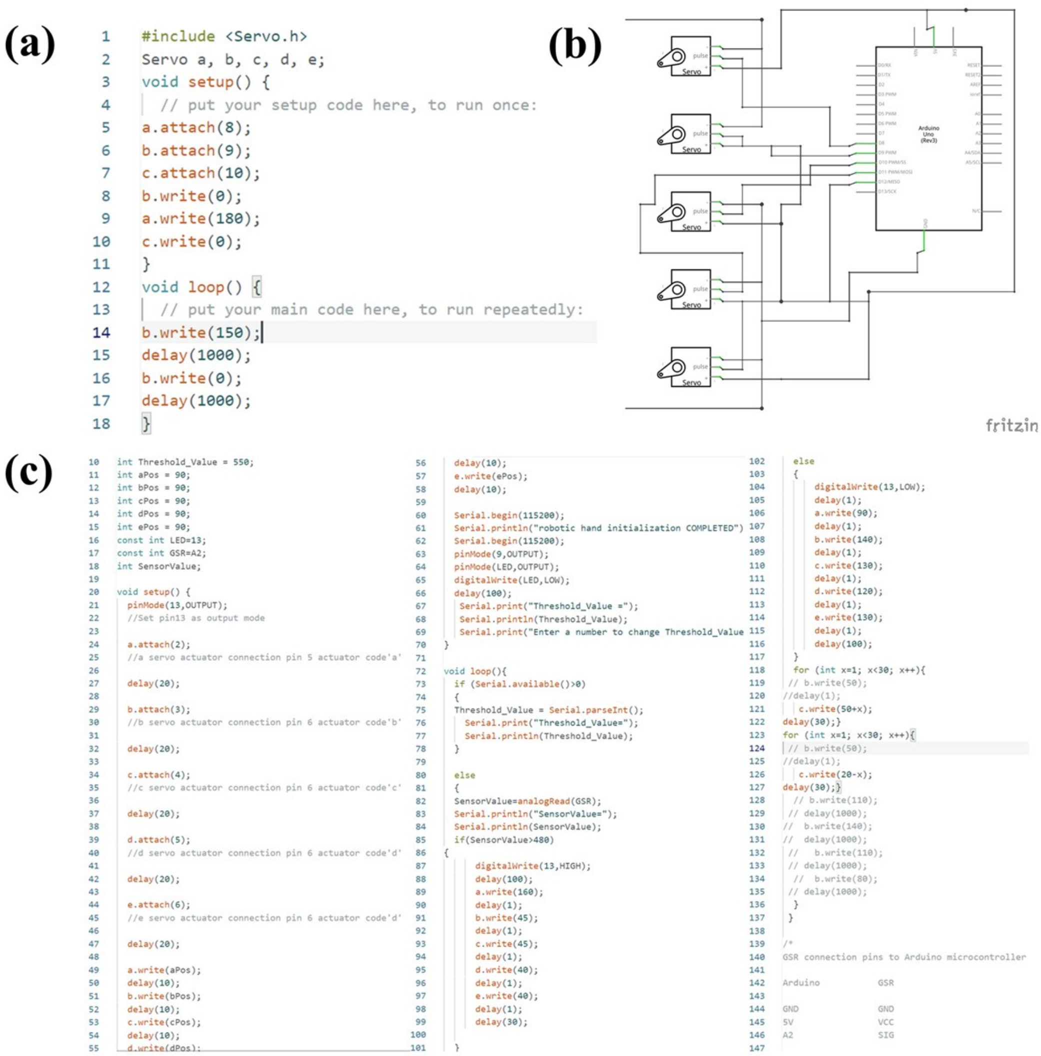

Fig. S8. Control program of the flexible sensor control manipulator finger a). Circuit diagram of the flexible sensor control human-computer interaction system b) and the control program c).