midiKEY: A Novel Low Cost Resistive Soft Crochet Stretch Sensor as Applied to a Wearable Bluetooth Keyboard Text Input Device

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Wearable technology relies on the use of sensors to monitor bodily movement. Soft, flexible, and durable sensors are needed in devices for everyday use. Here, I present a novel method for creating stretch sensors using commercially available stainless steel conductive thread in a crocheted chain of hooked loops. Sensing properties are enabled by the geometry of the loops increasing length and reducing the cross sectional area of the conductive thread when under tensile stress, changing its electrical resistance. When the piezoresistive sensor is attached to a microcontroller with constant current, voltage changes can be read when pulled and relaxed. The analog read voltage drops convert to digital signals past a programmed threshold. Five sensors, one for each finger, act as an external tendon attached to a ring worn above the second knuckle. With chorded keyboard programming, the device interprets each pattern of signals to an alphanumeric key (ex. flexing index and thumb will output the key “a”). midiKEY was tested for success in outputting correct keys when gestures were performed while wearing the device. Each of 38 keys tested 25 times for 950 trials yielding a success rate >70% according to chi-square tests per key ($p=4.797e-3$) and t-test of categorical success against a count of 17 ($p=2.371e-8$). The technology in the midiKEY may have applications in open-hand VR/AR controllers, musical instrument control, assistive human-computer input for the visually and physically disabled, and in physical therapy devices for rehabilitating hand strength and flexion.