Refreshable Tactile Display Using Bistable Electroactive Polymer

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SUMMARY
Researchers in the UCLA Department of Materials Science and Engineering have developed a high resolution, refreshable, and low-cost pneumatic tactile interactive device with a compact structure, single fluidic reservoir, and high actuator density that exerts large stroke and provides high blocking force.

BACKGROUND
Tactile interactive devices are often displays that provide normal indentation to a user’s fingertips by vertically moving miniature pins in response to electric or pneumatic signals. The movement of the miniature pins reproduces shapes, patterns, or textures which the user can identify. Such devices have a broad range of applications, from creating haptic feedback to reproducing Braille patterns for users who are visually impaired. Despite the importance of tactile interactive devices, their presence in the marketplace has been limited due to technological barriers and high costs. Specifically, the actuators in many tactile devices are bulky and do not produce sufficient pin displacement or blocking force to return the pins to their original positions. Additionally, devices operating in response to an electric signal typically require a high voltage, which poses danger to the user. While pneumatic tactile devices address some of the foregoing limitations, pneumatic devices often have complex structures, require multiple pneumatic reservoirs, and do not produce the level of pin displacement required for Braille readers.

INNOVATION
Researchers in the UCLA Department of Materials Science and Engineering have developed a high resolution, refreshable, and low-cost pneumatic tactile interactive device with a compact structure, single fluidic reservoir, and high actuator density that exerts large stroke for pin displacement and provides high blocking force. The device uses a bistable electroactive polymer thin film and an electrode that can quickly perform stable actuation with a low voltage supply, allowing for safe operation of the device with fast response speeds. Specifically, the electrode can soften the polymer film at 30 V in less than one second. Furthermore, each actuator can be individually controlled by the application of local heating and pneumatic pressure.

APPLICATIONS
▶ Virtual reality (VR) entertainment systems
▶ Robotics
▶ Healthcare
▶ Reproducing surface topography
▶ Electronic Braille readers

ADVANTAGES
▶ Compact structure, high actuator density, and single fluidic reservoir
▶ Exerts large stroke and high blocking force
▶ Each actuator can be individually controlled by application of local heating and pneumatic pressure
▶ Electrode can soften bistable electroactive polymer film at 30 V in less than one second
▶ Can be produced at low cost

PATENT STATUS
Patent Pending

RELATED MATERIALS
▶ Yu Qiu, Zhiyun Lu, and Qibing Pei, Refreshable Tactile Display Based on a Bistable Electroactive Polymer and a Stretchable Serpentine Joule Heating Electrode, ACS Appl. Mater. Interfaces, 2018.

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS
▶ Regioregular Copolymers of 3-alkoxythiophene and their Photovoltaic Application
▶ Bistable Electroactive Polymers
▶ Bulk Polymer Composites
▶ Thermally Stable Silver Nanowire Transparent Electrode
▶ An Actuator Device Driven By Electrostatic Forces
▶ Electrocaloric Cooling With Electrostatic Actuation