**Title:** Low-volume liquid handling and transport microsystems with applications to microbiology and point-of-care diagnostics

**Abstract:**The healthcare industry is witnessing a growing demand for portable, field-ready diagnostic platforms which can test a number of disease biomarkers from collected samples such as saliva, urine, and blood. To democratize such diagnostic platforms, it is beneficial to employ techniques that are power efficient and low-cost while maintaining the standards of accuracy and throughput. With these goals, novel methods are presented here for liquid handling and transport with applications in point-of-care diagnostics and microbiology. Specifically, a motorized actuation system is developed to manipulate discrete liquid droplets and perform operations such as dispensing, movement, mixing, merging, and disposal in a remote-controlled manner. A paper-based cantilever device is demonstrated to enable the flow of fluids between two or more paper strips that can be incorporated in lateral flow diagnostic assays. Both the abovementioned platforms have been used as colorimetric assays to detect the presence of common analytes in fluids. In addition, a fluid-flow chip design is illustrated where the chip is fabricated from double-sided tape and agarose membrane, along with options to create and maintain gradients of chemicals over long time periods. The microfluidic chip has been used to grow colonies of *E. coli* bacteria and observe their phenotypic changes in response to the applied antibiotics. The microfluidic chip provided a suitable platform to test the efficacy of gene-editing experiments by monitoring the morphological changes in the bacterial cells. Each of the presented methods is tailored for a specific biological experiment, and thus highlight the importance of adapting and customizing engineering technologies for applied research.