

PCB (Printed Circuit Board) Digital Microfluidics

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1. Introduction

Droplet actuation and merging using controlled electrowetting are implemented on the top of a standard printed circuit board (PCB) resulting in a fast prototyping microfluidic platform for biological experiments. A low-cost and high-resolution Capacitive-to-Digital (CDC) integrated circuit is used for droplet position detection in a digital microfluidic system.

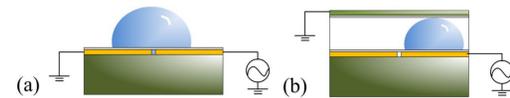


Fig. 1 (a) Single-plate configuration. (b) Dual-plate configuration.

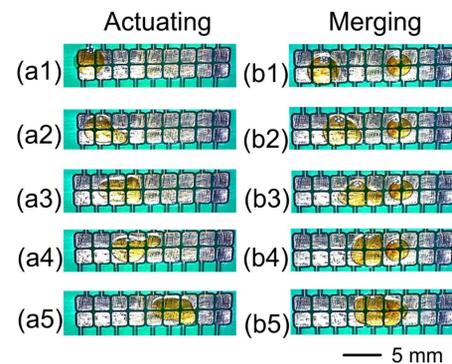


Fig. 2 (a1-a5) A coffee droplet being actuated on the single-plate platform. (b1-b5) Two droplets are being merged on the single-plate platform.

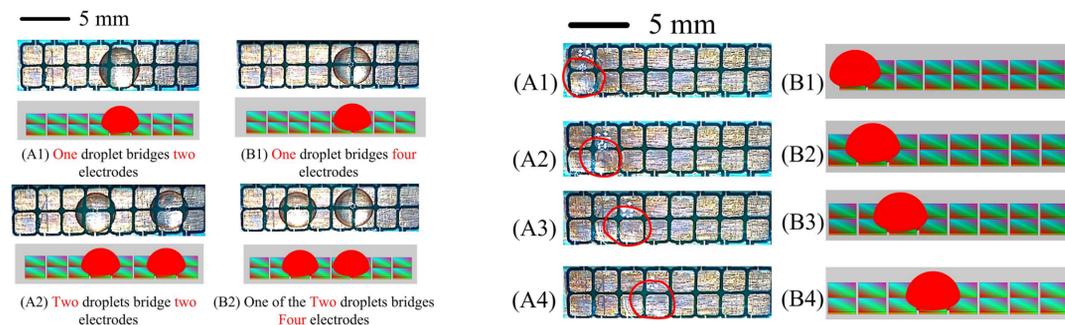


Fig. 3 Droplet(s) being detected and showed in animations in real time.

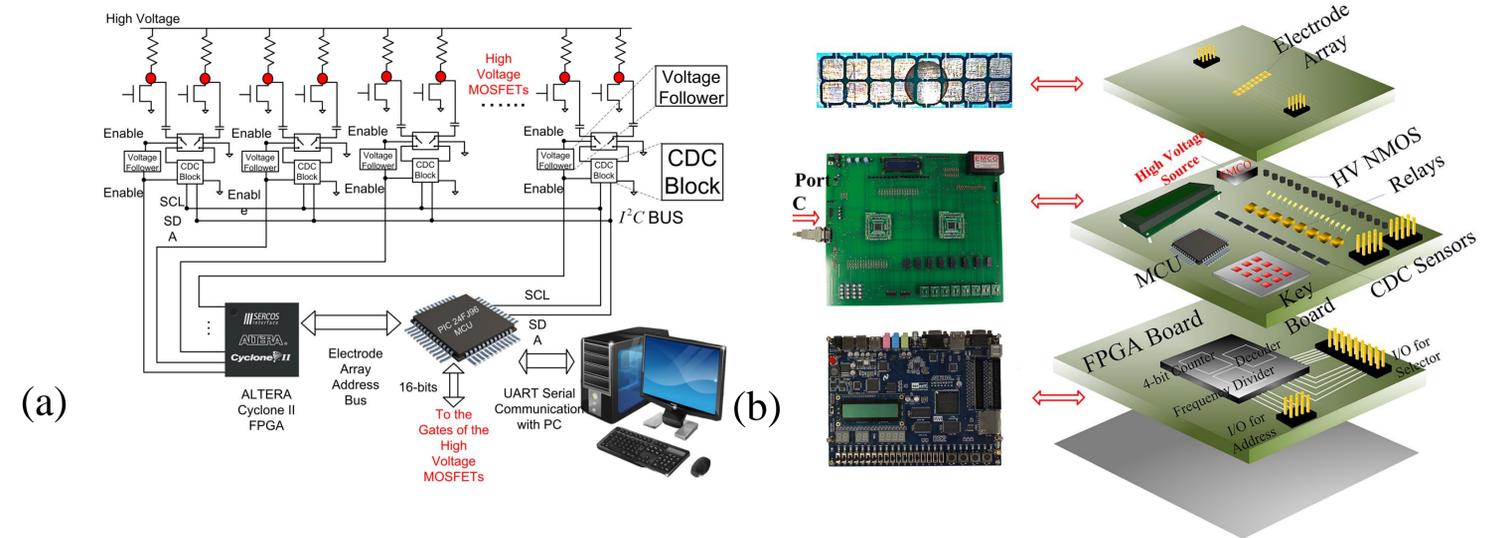


Fig. 4 (a) The circuit and interfaces of the PCB EWOD droplet position detection system. (b) The platform structure of the EWOD droplet position detection system.

Conclusion

A platform for the manipulation of droplets has been developed and characterized. The concept of using commercially capacitive IC chips to locate droplets on a microfluidic substrate (“capacitive vision”) has been reported. The fast prototyping PCB-based microfluidic systems are easy to fabricate and customize. A lower threshold voltage, than previously reported, to actuate large droplets in a single-plate electrode array was achieved. The capacitance detection circuit developed in this work was used to locate single or multiple droplets and then statically and dynamically display the position of the droplets in real-time on a PC. Improvements in the response time of the sensor for large electrode arrays were proposed and discussed.