

Abstract

Coupling Sensing and Imaging Devices: Towards a Complete Handheld Analytical System †

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† Presented at the 5th International Symposium on Sensor Science (I3S 2017), Barcelona, Spain, 27–29 September 2017.

Published: 20 November 2017

The development of new outside-the-lab analytical methodologies and technologies to gather in situ and real time chemical information using low cost and compact devices is one of the most challenging issues facing the analytical sciences. One organoleptic characteristic of matter that is widely used in chemical analysis is colour, although it was not until the advent of colour sensors and the later explosive development of consumer electronics in the late 20th and early 21st century that colour began to be used as a quantitative parameter, opening the door to the development of new methodologies for chemical detection and analysis. The widespread use of imaging devices, along with sensor systems involving the change, appearance or disappearance of colour or any property measured through a colour change, such as luminescence, has paved the way for the development of novel complete analytical systems for outside-the-lab applications: chemical recognition + transduction + signal processing + data transfer. In this presentation, we will discuss some recent developments in the use of computer vision in analytical chemistry referring to the colour spaces used, analytical system architecture for colorimetric determination including both commercial and portable instrumentation, and the strategies developed for analyte recognition. Special attention is given to the use of mobile phones, which are at the core of these analytical systems because of their multiple and complementary capabilities: high resolution imaging detectors, high computational power and multiple connectivity links (4G, Bluetooth, USB and RFID interfaces). In fact, it is possible to develop innovative passive devices based on radiofrequency identification tags with sensing capability (RFID) powered by a phone, as we will discuss. The interesting alternative of colour-based sensing devices, of which some examples are shown, use capillary microfluidics based on materials such as paper, thread and cloth, which allows different analytical operations to be carried out on the material itself, as well as the immobilization of reagents such as enzymes or nanomaterials.

Acknowledgments: This study was supported by projects from the Spanish MINECO (CTQ2013-44545-R and CTQ2016-78754-C2-1-R).

Conflicts of Interest: The authors declare no conflict of interest.



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