ELECTRONIC SUPPLEMENTARY INFORMATION (E. S. I.)

Universal Electronics for Miniature and Automated Chemical Assays

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Additional tables

Table S1. Applications of field-programmable gate array (FPGA) modules in analytical chemistry (examples). (The entries are ordered by year of publication, and the first author's name.)

Application	Purpose	Ref.
inductively coupled plasma optical emission spectrometry with dynamic wavelength stabilisation and CCD detection	data acquisition	H. Becker-Ross, S. Florek, H. Franken, B. Radziuk and M. Zeiher, *J. Anal. At. Spectrom.*, 2000, **15**, 851-861.
odor-sensing system	quartz crystal microbalance measurements	T. Nakamoto, Y. Isaka, T. Ishige and T. Moriizumi, *Sens. Actuat. B*, 2000, **69**, 58-62.
miniaturised surface acoustic wave-sensor array for organic gas detection	difference frequency counting and multiplexing	M. Rapp, J. Reibel, A. Voigt, M. Balzer and O. Bülow, *Sens. Actuat. B*, 2000, **65**, 169-172.
multiplexed CMOS biochip for DNA analysis	controller, handling logic functions to control the chip, controlling D/A and A/D converters, controlling hardware functions that are related to performance of the system, temperature control, laser drivers and pumps, interface	P. Swanson, R. Gelbart, E. Atlas, L. Yang, T. Grogan, W. F. Butler, D. E. Ackley and E. Sheldon, *Sens. Actuat. B*, 2000, **64**, 22-30.
integrated stacked microlaboratory for biological agent detection	control of chip and fluidic/thermal devices	J. M. Yang, J. Bell, Y. Huang, M. Tirado, D. Thomas, A. H. Forster, R. W. Haigis, P. D. Swanson, R. B. Wallace, B. Martinsons and M. Krihak, *Biosens. Bioelectron.*, 2002, **17**, 605-618.
remote access to resonant sensors and sensor arrays	frequency counter, control unit, measurements	J. Auge, K. Dierks, F. Eichelbaum and P. Hauptmann, *Sens. Actuat. B*, 2003, **95**, 32-38.
resonant high-temperature gas sensors	control of the sensor interface, pre-processing	T. Schneider, D. Richter, S. Doerner, H. Fritze and P. Hauptmann, *Sens. Actuat. B*, 2005, **111-112**, 187-192.
shear horizontal surface acoustic wave sensing	frequency counter	Y.-T. Shen, C.-L. Huang, R. Chen and L. Wu, *Sens. Actuat. B*, 2005, **107**, 283-290.
surface acoustic wave sensor arrays combined with solid-phase microextraction	frequency counting and multiplexing	N. Barié, M. Bücking and M. Rapp, *Sens. Actuat. B*, 2006, **114**, 482-488.
Hadamard transform ion mobility spectrometry	synchronisation of A/D and D/A conversions	B. H. Clowers, W. F. Siems, H. H. Hill and S. M. Massick, *Anal. Chem.*, 2006, **78**, 44-51.
aerosol mass spectrometer	processing spectra	P. F. DeCarlo, J. R. Kimmel, A. Trimborn, M. J. Northway, J. T. Jayne, A. C. Aiken, M. Gonin, K. Fuhrer, T. Horvath, K. S. Docherty, D. R. Worsnop and J. L. Jimenez, *Anal. Chem.*, 2006, **78**, 8281-8289.
polymerase chain reaction, capillary electrophoresis	photon counting circuit	E. A. Kabotyanski, I. L. Botchkina, O. Kosobokova, G. I. Botchkina, V. Gorfinkel and B. Gorbovitski, *Biosens. Bioelectron.*, 2006, **21**, 1924-1931.
high temperature gas sensor system	real time digital signal processing	D. Richter, H. Fritze, T. Schneider, P. Hauptmann, N. Bauersfeld, K.-D. Kramer, K. Wiesner, M. Fleischer, G. Karle and A. Schubert, *Sens. Actuat. B*, 2006, **118**, 466-471.
mass spectrograph	data transfer from capacitive trans-impedance amplifier	G. D. Schilling, F. J. Andrade, J. H. Barnes IV, R. P. Sperline, M. B. Denton, C. J. Barinaga, D. W. Koppenaal and G. M. Hieftje, *Anal. Chem.*, 2006, **78**, 4319-4325.
quartz crystal microbalance sensor array	multi-channel frequency counter	N. Nimsuk and T. Nakamoto, *Sens. Actuat. B*, 2007, **127**, 491-496.
nuclear magnetic resonance	programmer, direct digital synthesiser,	K. Takeda, *Rev. Sci. Instr.*, 2007, **78**, 033103.

	digital receiver, PC interface	
quartz crystal microbalance gas sensors	multi-channel frequency counter	N. Nimsuk and T. Nakamoto, *Sens. Actuat. B*, 2008, **134**, 252-257.
nuclear magnetic resonance	pulse programmers, digital part of direct-digital synthesis, digital quadrature demodulator, dual digital low-pass filters, PC interface	K. Takeda, *J. Magn. Reson.*, 2008, **192**, 218-229.
high speed detection of multi-color fluorescence	32-channel photon counter	A. Tsupryk, I. Tovkach, D. Gavrilov, O. Kosobokova, G. Gudkov, G. Tyshko, B. Gorbovitski and V. Gorfinkel, *Biosens. Bioelectron.*, 2008, **23**, 1512-1518.
miniaturised electronic nose based on a multichannel quartz crystal microbalance	switch controller, frequency conting, data transmission	E. Zampetti, S. Pantalei, A. Macagnano, E. Proietti, C. Di Natale and A. D'Amico, *Sens. Actuat. B*, 2008, **131**, 159-166.
high-resolution mapping of extracellular electric fields	recording setup	U. Frey, U. Egert, F. Heer, S. Hafizovic and A. Hierlemann, *Biosens. Bioelectron.*, 2009, **24**, 2191-2198.
VUV-ion trap aerosol mass spectrometer	recording particle velocities	S. J. Hanna, P. Campuzano-Jost, E. A. Simpson, I. Burak, M. W. Blades, J. W. Hepburn and A. L. Bertram, *Phys. Chem. Chem. Phys.*, 2009, **11**, 7963-7975.
ion trap array mass analyser	electronic control system for mass analysis	X. Li, G. Jiang, C. Luo, F. Xu, Y. Wang, L. Ding and C.-F. Ding, *Anal. Chem.*, 2009, **81**, 4840-4846.
nuclear magnetic resonance	auxiliary controller of direct digital synthesis chip	X. Liang and W. Weimin, *Rev. Sci. Instr.*, 2009, **80**, 124703.
droplet-based microfluidic systems	analysis of the signal output from photomultiplier tubes	L. Mazutis, A. F. Araghi, O. J. Miller, J.-C. Baret, L. Frenz, A. Janoshazi, V. Taly, B. J. Miller, J. B. Hutchison, D. Link, A. D. Griffiths and M. Ryckelynck, *Anal. Chem.*, 2009, **81**, 4813-4821.
resonant acoustic profiling	network analyser with internal digital synthesiser, radio frequency switches, calibration elements	M. Natesan, M. A. Cooper, J. P. Tran, V. R. Rivera and M. A. Poli, *Anal. Chem.*, 2009, **81**, 3896-3902.
surface plasmon resonance sensor	interfacing CCD	P. J. R. Roche, S-M. Ng and R. Narayanaswamy, *Sens. Actuat. B*, 2009, **139**, 74-82.
surface plasmon resonance	CCD unit interface	P. J. R. Roche, S. M. Ng, R. Narayanaswamy, N. Goddard and K. M. Page, *Sens. Actuat. B*, 2009, **139**, 22-29.
odor recorder based on real-time mass spectrometry	control of solenoid valves	P. Somboon, M. Kinoshita, B. Wyszynski and T. Nakamoto, *Sens. Actuat. B*, 2009, **141**, 141-146.
scanning electrochemical optical microscopy	feedback regulation	Y. Takahashi, H. Shiku, T. Murata, T. Yasukawa and T. Matsue, *Anal. Chem.*, 2009, **81**, 9674-9681.
very large chemical sensor system for mimicking biological olfaction	control of scanning process	R. Beccherelli, E. Zampetti, S. Pantalei, M. Bernabei and K. C. Persaud, *Sens. Actuat. B*, 2010, **146**, 446-452.
3D microelectrode array system	digital interface, data communication	G. Charvet, L. Rousseau, O. Billoint, S. Gharbi, J.-P. Rostaing, S. Joucla, M. Trevisiol, A. Bourgerette, P. Chauvet, C. Moulin, F. Goy, B. Mercier, M. Colin, S. Spirkovitch, H. Fanet, P. Meyrand, R. Guillemaud and B. Yvert, *Biosens. Bioelectron.*, 2010, **25**, 1889-1896.
highly integrated micro-fabricated fluorescence-activated cell sorter	control of the sorting in a real-time, automated fashion	S. H. Cho, C. H. Chen, F. S. Tsai, J. M. Godin and Y.-H. Lo, *Lab Chip*, 2010, **10**, 1567-1573.
mobile fast-screening laser-induced breakdown detection	timing of the system	C. Latkoczy, R. Kägi, M. Fierz, M. Ritzmann, D. Günther and M. Boller, *J. Environ. Monit.*, 2010, **12**, 1422-1429.

scanning electrochemical microscopy	control of piezoelectric positioner amplifier/servo, recording locations of the piezoelectric positioners	K. McKelvey, M. A. Edwards and P. R. Unwin, *Anal. Chem.*, 2010, **82**, 6334-6337.
automatic volumetric gas flow meter	digital processing and control system	R. O. Cadena Pereda, E. M. Rivera Muñoz and G. Herrera Ruiz, *Sens. Actuat. B*, 2010, **147**, 10-14.
scanning ion conductance microscopy	feedback distance regulation, conversion of signals to digital data	Y. Takahashi, Y. Murakami, K. Nagamine, H. Shiku, S. Aoyagi, T. Yasukawa, M. Kanzaki and T. Matsue, *Phys. Chem. Chem. Phys.*, 2010, **12**, 10012-10017.
surface plasmon assisted microscopy	signal processing	F. Weichert, M. Gaspar, C. Timm, A. Zybin, E. L. Gurevich, M. Engel, H. Müller and P. Marwedel, *Sens. Actuat. B*, 2010, **151**, 281-290.
fluorescence-activated cell sorting	timing control of piezoelectric actuation	C. H. Chen, S. H. Cho, H.-I Chiang, F. Tsai, K. Zhang and Y.-H. Lo, *Anal. Chem.*, 2011, **83**, 7269-7275.
time resolved analysis in high resolution mass spectrometry	square-wave pulse generator, data acquisition	G. Churchill, K. Putyera, V. Weinstein, X. Wang and E. B. M. Steers, *J. Anal. At. Spectrom.*, 2011, **26**, 2263-2273.
quartz crystal microbalance, measurement of rupture force	control and interaction between adjustable generator and analog-to-digital converter	F. N. Dultsev and E. A. Kolosovsky, *Anal. Chim. Acta*, 2011, **687**, 75-81.
surface acoustic wave immunosensor	frequency measurement	J. Lee, Y.-S. Choi, Y. Lee, H. J. Lee, J. N. Lee,, S. K. Kim, K. Y. Han, E. C. Cho, J. C. Park and S. S. Lee, *Anal. Chem.*, 2011, **83**, 8629-8635.
microfluidic chemostat and turbidostat	control of solenoid drivers, data acquisition, and temperature	K. S. Lee, P. Boccazzi, A. J. Sinskey and R. J. Ram, *Lab Chip*, 2011, **11**, 1730-1739.
resistive metal-oxide gas sensors	processor	A. Varpula, S. Novikov, A. Haarahiltunen and P. Kuivalainen, *Sens. Actuat. B*, 2011, **159**, 12-26.
light-addressable potentiometric sensor	generating modulation signals for individual illumination of each measurement spot	T. Wagner, C. F. B. Werner, K.-I. Miyamoto, M. J. Schöning and T. Yoshinobu, *Sens. Actuat. B*, 2011, **154**, 124-128.
chemical electronic nose	data collection, storage and processing	L. Zhang, F. Tian, C. Kadri, G. Pei, H. Li and L. Pan, *Sens. Actuat. B*, 2011, **160**, 760-770.
monitoring volatile organic chemicals	processor	L. Zhang, F. Tian, C. Kadri, B. Xiao, H. Li, L. Pan and H. Zhou, *Sens. Actuat. B*, 2011, **160**, 899-909.
miniaturised patch-clamp system	memory	A. Boussaoud, I. Fonteille, G. Collier, F. Kermarrec, F. Vermont, E. Tresallet, M. De Waard, C. Arnoult and N. Picollet-D'hahan, *Biosens. Bioelectron.*, 2012, **32**, 96-103.
polymerase chain reaction, capillary electrophoresis	computing	J. Y. Choi, Y. T. Kim, J. Ahn, K. S. Kim, D.-G. Gweon and T. S. Seo, *Biosens. Bioelectron.*, 2012, **35**, 327-334.
field-deployable single-molecule detector	processing electronics	J. M. Emory, Z. Peng, B. Young, M. L. Hupert, A. Rousselet, D. Patterson, B. Ellison and S. A. Soper, *Analyst*, 2012, **137**, 87-97.
fluorescence measurement	recording signal in real time	Y. Skhiri, P. Gruner, B. Semin, Q. Brosseau, D. Pekin, L. Mazutis, V. Goust, F. Kleinschmidt, A. El Harrak, J. B. Hutchison, E. Mayot, J.-F. Bartolo, A. D. Griffiths, V. Taly and J.-C. Baret, *Soft Matter*, 2012, **8**, 10618-10627.
scanning electrochemical cell microscopy	instrument control and data acquisition	M. E. Snowden, A. G. Güell, S. C. S. Lai, K. McKelvey, N. Ebejer, M. A. O'Connell, A. W. Colburn and P. R. Unwin, *Anal. Chem.*, 2012, **84**, 2483-2491.
glow discharge imaging spectroscopy	data transfer	M. Voronov, V. Hoffmann, T. Wallendorf, S. Marke, J. Mönch, C. Engelhard, W. Buscher, S. J. Ray and G. M. Hieftje, *J. Anal. At. Spectrom.*, 2012, **27**, 419-425.

magnetic cell-based sensor	control of sensor chip operation, data acquisition	H. Wang, A. Mahdavi, D. A. Tirrell and A. Hajimiri, *Lab Chip*, 2012, **12**, 4465-4471.
microfluidic fluorescence activated cell sorter	real-time detection, threshold comparisons, timed triggering of pulsed laser	T.-H. Wu, Y. Chen, S.-Y. Park, J. Hong, T. Teslaa, J. F. Zhong, D. Di Carlo, M. A. Teitell and P.-Y. Chiou, *Lab Chip*, 2012, **12**, 1378-1383.
electronic nose	processor	L. Zhang, F. Tian, H. Nie, L. Dang, G. Li, Q. Ye and C. Kadri, *Sens. Actuat. B*, 2012, **174**, 114-125.
DNA sequence analysis	peak analysis	A. R. Abate, T. Hung, R. A. Sperling, P. Mary, A. Rotem, J. J. Agresti, M. A. Weiner and D. A. Weitz, *Lab Chip*, 2013, **13**, 4864-4869.
ultrasound and photoacoustic imaging	real-time switching and interlacing between the two imaging modalities	A. Abuteen, S. Zanganeh, J. Akhigbe, L. P. Samankumara, A. Aguirre, N. Biswal, M. Braune, A. Vollertsen, B. Röder, C. Brückner and Q. Zhu, *Phys. Chem. Chem. Phys.*, 2013, **15**, 18502-18509.
fluorescence-activated cell sorter	real-time detection, threshold comparison, timed triggering of the pulsed laser	Y. Chen, T.-H. Wu, Y.-C. Kung, M. A. Teitell and P.-Y. Chiou, *Analyst*, 2013, **138**, 7308-7315.
intelligent digital microfluidic system	scans capacitance of electrodes	J. Gao, X. Liu, T. Chen, P.-I. Mak, Y. Du, M.-I Vai, B. Lin and R. P. Martins, *Lab Chip*, 2013, **13**, 443-451.
single-molecule measurements	counting signals, combining signals into time bins	M. H. Horrocks, L. Rajah, P. Jönsson, M. Kjaergaard, M. Vendruscolo, T. P. J. Knowles and D. Klenerman, *Anal. Chem.*, 2013, **85**, 6855-6859.
detecting single-abasic residues within a DNA strand immobilised in a biological nanopore	sampling signal	J. Kim, R. D. Maitra, K. Pedrotti and W. B. Dunbar, *Sens. Actuat. B*, 2013, **177**, 1075-1082.
quantum cascade laser sensor for simultaneous detection of ambient N_2O and CO	laser control, data acquisition, data analysis	J. Li, U. Parchatka and H. Fischer, *Sens. Actuat. B*, 2013, **182**, 659-667.
chemiluminescent immunosensor	photon counting	S. Qu, J. Liu, J. Luo, Y. Huang, W. Shi, B. Wang and X. Cai, *Anal. Chim. Acta*, 2013, **766**, 94-99.
atmospheric pressure ion mobility spectrometer – mass spectrometer	recorder	A. A. Sysoev, D. M. Chernyshev, S. S. Poteshin, A. V. Karpov, O. I. Fomin and A. A. Sysoev, *Anal. Chem.*, 2013, **85**, 9003-9012.
magnetic bead surface coverage assay	operation of solenoid valves	H. C. Tekin, M. Cornaglia and M. A. M. Gijs, *Lab Chip*, 2013, **13**, 1053-1059.
high-resolution time-domain reflectometer	most system functions; direct digital synthesizer, clock, reading the output of the comparator	D. Trebbels, A. Kern, F. Fellhauer, C. Huebner and R. Zengerle, *IEEE Trans. Instr. Meas.*, 2013, **62**, 2101-2113.
label-free acetylcholine-imaging sensors	driving light-emitting diode array	C. F. Werner, S. Takenaga, H. Taki, K. Sawada and M. J. Schöning, *Sens. Actuat. B*, 2013, **177**, 745-752.
large-capacity trapping of circulating tumor cells	control of the sorting process of ensemble-decision aliquot ranking	M. Zhao, W. C. Nelson, B. Wei, P. G. Shiro, B. M. Hakimi, E. S. Johnson, R. K. Anand, G. S. Gyurkey, L. M. White, S. H. Whiting, A. L. Coveler and D. T. Chiu, *Anal. Chem.*, 2013, **85**, 9671-9677.
manipulation and analysis of recombinant enzyme libraries	identification of droplets	T. Beneyton, F. Coldren, J.-C. Baret, A. D. Griffiths and V. Taly, *Analyst*, 2014, **139**, 3314-3323.
time-resolved Fourier-transform infrared spectroscopy	synchronisation of the sample ablation and the data acquisition	S. Civiš, P. Kubelík, M. Ferus, V. E. Chernov, E. M. Zanozina and L. Juha, *J. Anal. At. Spectrom.*, 2014, DOI: 10.1039/c4ja00123k.
microfluidic impedance cytometer	high-speed data conversion, digital lock-in amplifier, generation and analysis of up to four frequencies in parallel by means	N. Haandbæk, S. C. Bürgel, F. Heer and A. Hierlemann, *Lab Chip*, 2014, **14**, 369-377.

	of four demodulators	
backpack miniature mass spectrometer	instrument-to-data system communications, scanning function execution, data acquisition, direct digital synthesis waveform generation, stored waveform inverse Fourier transform signal generation and playback, error correction to radio frequency amplitude linearity	P. I. Hendricks, J. K. Dalgleish, J. T. Shelley, M. A. Kirleis, M. T. McNicholas, L. Li, T.-C. Chen, C.-H. Chen, J. S. Duncan, F. Boudreau, R. J. Noll, J. P. Denton, T. A. Roach, Z. Ouyang and R. G. Cooks, *Anal. Chem.*, 2014, **86**, 2900-2908.
spectrophotometric liquid chromatography detection	control of light-emitting diodes, readout of the digitalised photocurrent signal of photodiodes	K. G. Kraiczek, R. Bonjour, Y. Salvadé and R. Zengerle, *Anal. Chem.*, 2014, **86**, 1146-1152.
formaldehyde trace gas sensor	laser control, data acquisition, real-time analysis of acquired spectra	J. Li, U. Parchatka and H. Fischer, *Anal. Meth.*, 2014, **6**, 5483-5488.
silicon nanowire ion sensitive field effect transistor arrays	data processing, communication	P. Livi, A. Shadmani, M. Wipf, R. L. Stoop, J. Rothe, Y. Chen, M. Calame, C. Schönenberger and A. Hierlemann, *Sens. Actuat. B*, 2014, **204**, 568-577.
real-time residual salt monitoring	data acquisition, signal processing	M. Ruiz-Llata, P. Martín-Mateos, J. R. López and P. Acedo, *Sens. Actuat. B*, 2014, **191**, 371-376.
scanning ion conductance microscopy	control of instrument, collecting data	K. McKelvey, D. Perry, J. C. Byers, A. W. Colburn and P. R. Unwin, *Anal. Chem.*, 2014, **86**, 3639-3646.
mid-infrared laser spectroscopy	data capture	C. Reidl-Leuthner, A. Viernstein, K. Wieland, W. Tomischko, L. Sass, G. Kinger, J. Ofner and B. Lendl, *Anal. Chem.*, 2014, **86**, 9058-9064.
CMOS microsystem for electrochemical measurements	filtering of the data, controlling of automated tasks, running cyclic voltammograms, data framing; control of the fast acquisition of measurements from the electrode array	J. Rothe, O. Frey, A. Stettler, Y. Chen and A. Hierlemann, *Anal. Chem.*, 2014, **86**, 6425-6432.
parallel ion channel recording	digital data filtering, system control	S. C. Saha, F. Thei, M. R. R. de Planque and H. Morgan, *Sens. Actuat. B*, 2014, **199**, 76-82.
nuclear magnetic resonance	digital radio frequency console	M. K. Sørensen, M. S. Vinding, O. N. Bakharev, T. Nesgaard, O. Jensen and N. C. Nielsen, *Anal. Chem.*, 2014, **86**, 7205-7208.
active drag and resistive pulse sensing	synchronisation of timing	V. V. Thacker, K. Bromek, B. Meijer, J. Kotar, B. Sclavi, M. C. Lagomarsino, U. F. Keyser and P. Cicuta, *Integr. Biol.*, 2014, **6**, 184-191.
real-time kinetic detection	control of the device	J. Wang, R. J. Smith, R. A. Light, J. L. Richens, J. Zhang, P. O'Shea, C. See and M. G. Somekh, *Biosens. Bioelectron.*, 2014, **58**, 157-164.
kernel discriminant analysis framework	e-Nose system processor	L. Zhang and F.-C. Tian, *Anal. Chim. Acta*, 2014, **816**, 8-17.

Table S2. Applications of mobile phones in analytical chemistry (examples). (The entries are ordered by year of publication, and the first author's name.)

Application	Feature(s) used	Ref.
SmartBioPhone	communications, human interface	J. M. Ruano-López, M. Agirregabiria, G. Olabarria, D. Verdoy, D. D. Bang, M. Bu, A. Wolff, A. Voigt, J. A. Dziuban, R. Walczak and J. Berganzo, *Lab Chip*, 2009, **9**, 1495-1499.
portable chemical analyser	camera used as sensor	A. García, M. M. Erenas, E. D. Marinetto, C. A. Abad, I. de Orbe-Paya, A. J. Palma and L. F. Capitán-Vallvey, *Sens. Actuat. B*, 2011, **156**, 350-359.
quantification of bacterial growth	camera used as sensor	M. Funes-Huacca, A. Wu, E. Szepesvari, P. Rajendran, N. Kwan-Wong, A. Razgulin, Y. Shen, J. Kagira, R. Campbell and R. Derda, *Lab Chip*, 2012, **12**, 4269-4278.
point-of-care colorimetric detection	camera used as sensor	L. Shen, J. A. Hagen and I. Papautsky, *Lab Chip*, 2012, **12**, 4240-4243.
point of care genetic testing	control, data collection, display, and analysis	R. D. Stedtfeld, D. M. Tourlousse, G. Seyrig, T. M. Stedtfeld, M. Kronlein, S. Price, F. Ahmad, E. Gulari, J. M. Tiedje and S. A. Hashsham, *Lab Chip*, 2012, **12**, 1454-1462.
Au-nanoprobe tuberculosis detection	camera used as sensor	B. Veigas, J. M. Jacob, M. N. Costa, D. S. Santos, M. Viveiros, J. Inácio, R. Martins, P. Barquinha, E. Fortunato and P. V. Baptista, *Lab Chip*, 2012, **12**, 4802-4808.
enzyme immunoassay	imaging by camera	H. A. Ahmed and H. M. E. Azzazy, *Biosens. Bioelectron.*, 2013, **49**, 478-484.
label-free biodetection	camera used as sensor	D. Gallegos, K. D. Long, H. Yu, P. P. Clark, Y. Lin, S. George, P. Nath and B. T. Cunningham, *Lab Chip*, 2013, **13**, 2124-2132.
detection of unlabeled DNA *via* electrochemical dissolution	camera used as sensor	Y.-W. Huang and V. M. Ugaz, *Analyst*, 2013, **138**, 2522-2526.
electrochemical detection	interface, data display, data storage	P. B. Lillehoj, M.-C. Huang, N. Truong and C.-M. Ho, *Lab Chip*, 2013, **13**, 2950-2955.
paper-based enzyme-linked immunosorbent assay	image capture	R. C. Murdock, L. Shen, D. K. Griffin, N. Kelley-Loughnane, I. Papautsky and J. A. Hagen, *Anal. Chem.*, 2013, **85**, 11634-11642.
computational microscopy	camera used as sensor, computation	I. Navruz, A. F. Coskun, J. Wong, S. Mohammad, D. Tseng, R. Nagi, S. Phillips and A. Ozcan, *Lab Chip*, 2013, **13**, 4015-4023.
colorimetric detection of biomarkers in sweat and saliva	camera used as sensor, flash used as light source	V. Oncescu, D. O'Dell and D. Erickson, *Lab Chip*, 2013, **13**, 3232-3238.
paper microfluidics	camera used as sensor, flash used as light source	T. S. Park, W. Li, K. E. McCracken and J.-Y. Yoon, *Lab Chip*, 2013, **13**, 4832-4840.
proteolytic assays	camera used as sensor	E. Petryayeva and W. R. Algar, *Anal. Chem.*, 2013, **85**, 8817-8825.
single-molecule counting with microfluidics, digital isothermal amplification	camera used as sensor, flash used as the excitation light source, integration with the cloud	D. A. Selck, M. A. Karymov, B. Sun and R. F. Ismagilov, *Anal. Chem.*, 2013, **85**, 11129-11136.
quantification of iron	camera used as sensor	S. Vallejos, A. Muñoz, S. Ibeas, F. Serna, F. C. García and J. M. García, *J. Mater. Chem. A*, 2013, **1**, 15435-15441.
miniaturised nuclear magnetic resonance	user interface	C. M. Castro, A. A. Ghazani, J. Chung, H. Shao, D. Issadore, T.-J. Yoon, R. Weissleder and H. Lee, *Lab Chip*, 2014, **14**, 14-23.
paper-based analytical devices	camera used as sensor, transferring images to the cloud	G.-H. Chen, W.-Y. Chen, Y.-C. Yen, C.-W. Wang, H.-T. Chang and C.-F. Chen, *Anal. Chem.*, 2014, **86**, 6843-6849.
paper microfluidic extraction	camera used as sensor	C. F. Fronczek, T. S. Park, D. K. Harshman, A. M. Nicolini and J.-Y. Yoon, *RSC Adv.*, 2014, **4**, 11103-11110.
label-free immunoassay	detection by phone's	F. Giavazzi, M. Salina, E. Ceccarello, A. Ilacqua, F. Damin, L.

	camera, illumination with light-emitting diode	Sola, M. Chiari, B. Chini, R. Cerbino, T. Bellini and M. Buscaglia, *Biosens. Bioelectron.*, 2014, **58**, 395-402.
barcode-like paper for blood typing	camera used as sensor	L. Guan, J. Tian, R. Cao, M. Li, Z. Cai and W. Shen, *Anal. Chem.*, 2014, DOI: 10.1021/ac503300y.
water monitoring system	camera used as sensor	N. S. K. Gunda, S. Naicker, S. Shinde, S. Kimbahune, S. Shrivastava and S. Mitra, *Anal. Meth.*, 2014, **6**, 6236-6246.
multi-analyte sensing arrays	camera used as sensor	J. I. Hong and B.-Y. Chang, *Lab Chip*, 2014, **14**, 1725-1732.
portable bacteria pre-concentrating microfluidic sensor and impedance sensing system	user interface, data display, calculations	J. Jiang, X. Wang, R. Chao, Y. Ren, C. Hu, Z. Xu and G. L. Liu, *Sens. Actuat. B*, 2014, **193**, 653-659.
assessment of cisplatin-induced kidney toxicity	spectrophotometric measurement, data analysis	H. Kwon, J. Park, Y. An, J. Sim and S. Park, *Anal. Chim. Acta*, 2014, 845, 15-22.
chip-scale microscope	camera used as sensor	S. A. Lee and C. Yang, *Lab Chip*, 2014, **14**, 3056-3063.
quantification of vitamin D levels	camera used as sensor	S. Lee, V. Oncescu, M. Mancuso, S. Mehta and D. Erickson, *Lab Chip*, 2014, **14**, 1437-1442.
microfluidic liquid handling system	interface, control of the device	B. Li, L. Li, A. Guan, Q. Dong, K. Ruan, R. Hu and Z. Li, *Lab Chip*, 2014, **14**, 4085-4092.
detection of codeine sulphate	camera used as sensor	A. Lodha, A. Pandya, P. G. Sutariya and S. K. Menon, *RSC Adv.*, 2014, **4**, 50443-50448.
paper microfluidic devices	camera used as sensor, flash used as the excitation light source	N. Lopez-Ruiz, V. F. Curto, M. M. Erenas, F. Benito-Lopez, D. Diamond, A. J. Palma and L. F. Capitan-Vallvey, *Anal. Chem.*, 2014, **86**, 9554-9562.
detection of Kaposi's sarcoma associated herpesvirus nucleic acids	interface, control of the device	M. Mancuso, E. Cesarman and D. Erickson, *Lab Chip*, 2014, **14**, 3809-3816.
fluorescent-based continuous glucose monitoring	display of data transmitted via Bluetooth	M. Mortellaro and A. DeHennis, *Biosens. Bioelectron.*, 2014, **61**, 227-231.
fluorescence detection	camera used as sensor	M. O. Noor and U. J. Krull, *Anal. Chem.*, 2014, dx.doi.org/10.1021/ac502677n.
cholesterol testing	camera used as sensor	V. Oncescu, M. Mancuso and D. Erickson, *Lab Chip*, 2014, **14**, 759-763.
colorimetric sensing of trinitrotoluene in aqueous media	camera used as sensor	J. L. Pablos, M. Trigo-López, F. Serna, F. C. García and J. M. García, *Chem. Commun.*, 2014, **50**, 2484-2487.
detection of trinitrotoluene	camera used as sensor	J. L. Pablos, M. Trigo-López, F. Serna, F. C. García and J. M. García, *RSC Adv.*, 2014, **4**, 25562-25568.
red wine tasting, paper microfluidics	camera used as sensor	T. S. Park, C. Baynes, S.-I. Cho and J.-Y. Yoon, *RSC Adv.*, 2014, **4**, 24356-24362.
assays of proteolytic activity	imaging photoluminescence	E. Petryayeva and W. R. Algar, *Anal. Chem.*, 2014, **86**, 3195-3202.
biochemiluminescence detection	camera used as sensor	A. Roda, E. Michelini, L. Cevenini, D. Calabria, M. M. Calabretta and P. Simoni, *Anal. Chem.*, 2014, **86**, 7299-7304.
chemiluminescence biosensor for lactate in oral fluid and sweat	camera used as sensor	A. Roda, M. Guardigli, D. Calabria, M. M. Calabretta, L. Cevenini and E. Michelini, *Analyst*, 2014, DOI: 10.1039/C4AN01612B.
explosive colorimetric discrimination	camera used as sensor	M. O. Salles, G. N. Meloni, W. R. de Araujo and T. R. L. C. Paixão, *Anal. Meth.*, 2014, **6**, 2047-2052.
lab-on-a-chip, determination of lead ions	camera used as sensor	S. Seidi, M. Rezazadeh, Y. Yamini, N. Zamani and S. Esmaili, *Analyst*, 2014, **139**, 5531-5537.
enumeration of phage in monodisperse emulsions	imaging samples	K. F. Tjhung, S. Burnham, H. Anany, M. W. Griffiths and R. Derda, *Anal. Chem.*, 2014, **86**, 5642-5648.
colorimetric reader for bioanalytical applications	illumination, image capture	S. K. Vashist, T. van Oordt, E. M. Schneider, R. Zengerle, F. von Stetten and J. H. T. Luong, *Biosens. Bioelectron.*, 2014, http://dx.doi.org/10.1016/j.bios.2014.08.027.

fluorescence spectroscopy	camera used as sensor	H. Yu, Y. Tan and B. T. Cunningham, *Anal. Chem.*, 2014, **86**, 8805-8813.
droplet-based immunoassay	fluorescence detection	A. M. Nicolini, C. F. Fronczek and J.-Y. Yoon, *Biosens. Bioelectron.*, 2014, http://dx.doi.org/10.1016/j.bios.2014.09.040.
chemiluminescence-based lateral flow immunoassay	camera used as light detector, data handling	M. Zangheri, L. Cevenini, L. Anfossi, C. Baggiani, P. Simoni, F. Di Nardo and A. Roda, *Biosens. Bioelectron.*, 2015, **64**, 63-68.