

Autonomous cell-based toxicology monitoring: selection of biosensing methods and concept of modular system integration



Martial Geiser¹, Frederic Truffer¹, Philippe Renaud²



¹HES-SO Valais, Sion, Switzerland / ²EPFL-LIMS4, Lausanne, Switzerland

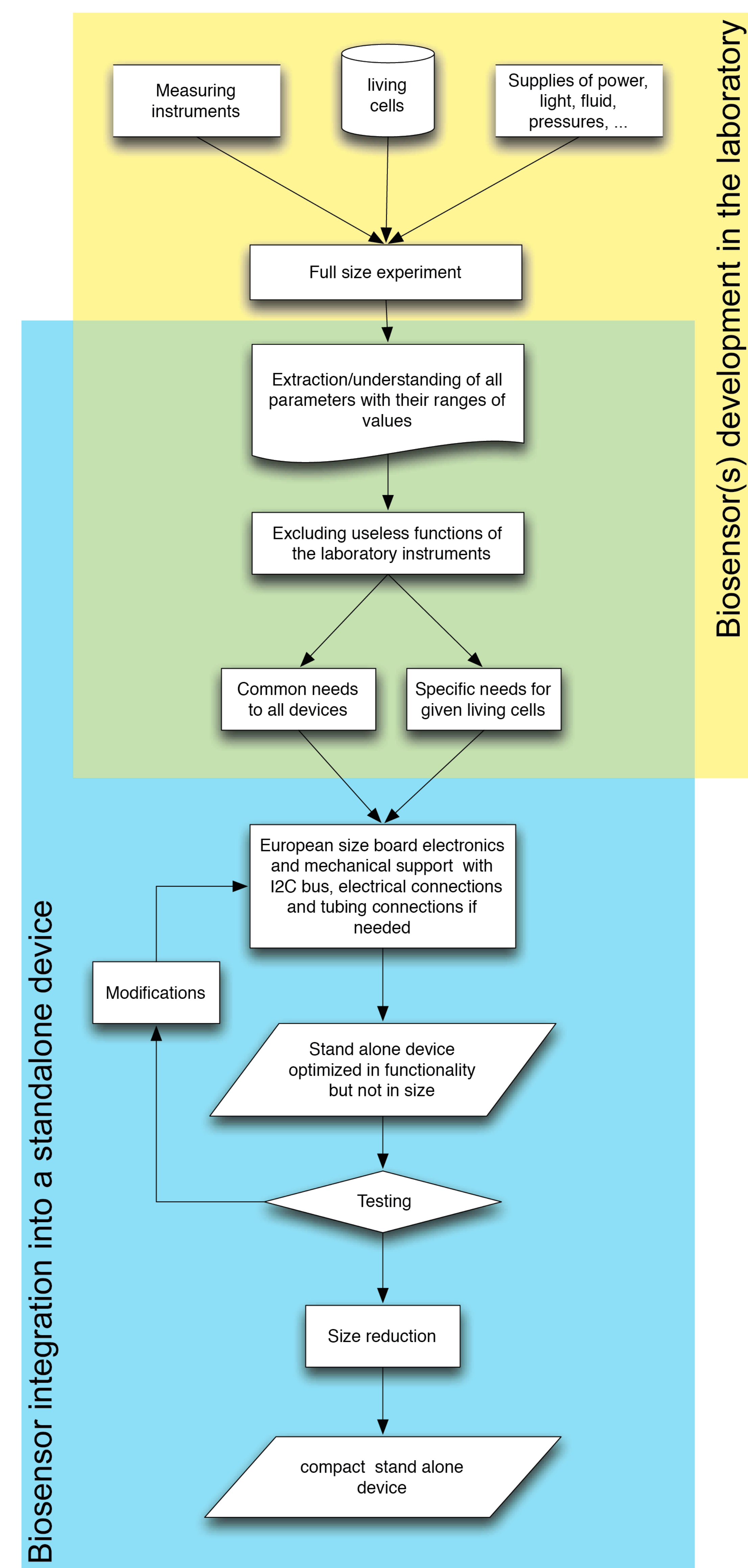
Objectives

The realization of autonomous cell-based biosensors requires the integration of all features of a cell biology laboratory into a compact standalone system. In order to save development time while maintaining a maximal flexibility of use, we have developed a modular platform in which the various key functions are performed in dedicated sub-systems. These units covers a specific functions such as: cell culture, nutrient supply, temperature control, fluorescence measurement, electrical sensing, imaging, etc. The modular system is built out of specific units related to one biosensing method. A common base takes care of the control, signal processing and data communications

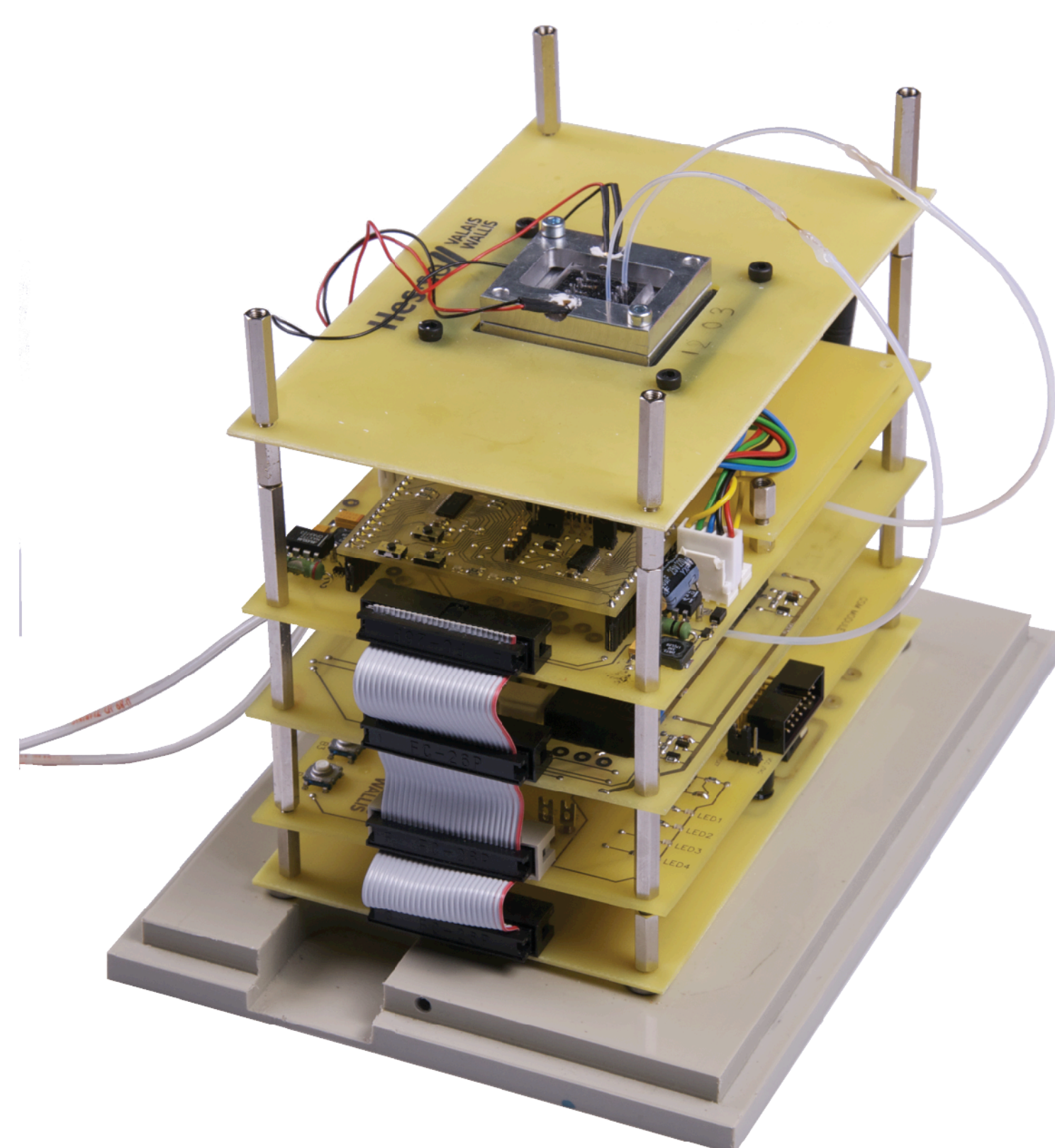
List of all biosensors with their related analytical targets and detection methods studied

Biosensors	Target analyte(s)	variable to measure	Storage or culture	Detection techniques
modified E.Coli	Arsenic	Fluorescence activity	cells retained in a μ -fluidic chamber	optical excitation and detection
UniL-DMF <i>Unil</i>			EPFL-LMIS HES-SO	
modified E.Coli	Arsenic	beta-galactosidase activity	cells retained in a tube by magnetics beads	amperometry
UniL-DMF <i>Unil</i>			EPFL-LEPA HES-SO	
Epithelial colorectal cells	non specific	Trans epithelial electrical resistance	mini bioreactor	electrical signal
			CSEM HES-SO	
Hepatocytes	non specific	electrical impedance	cells retained in a μ -fluidic chamber	electrical signal
			EPFL-LMIS HES-SO	
fibroblast	non specific	cells contractibility	culture on SU8 micropillars	imaging optics
EPF-nanomat			EPF-nanomat	

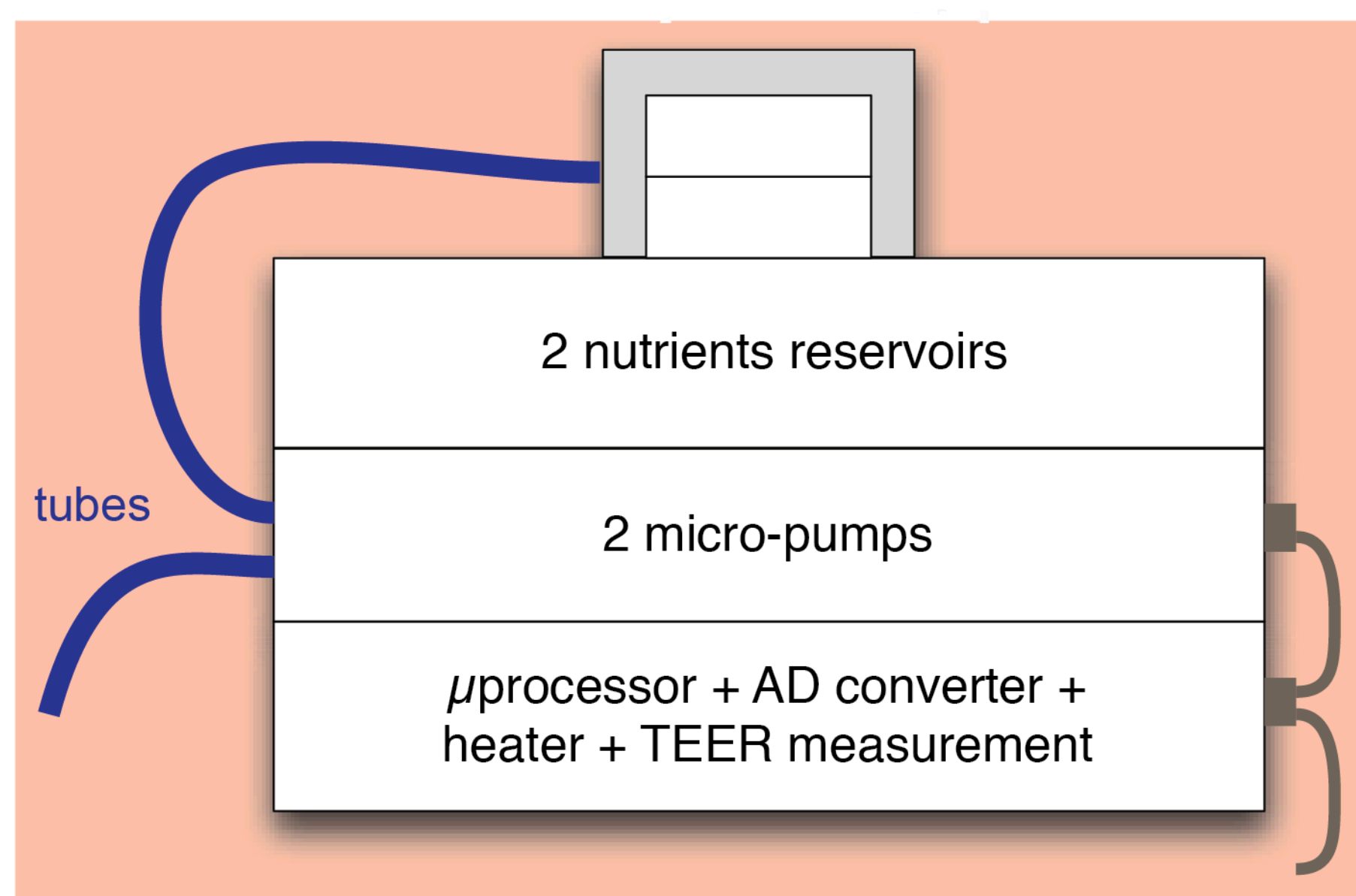
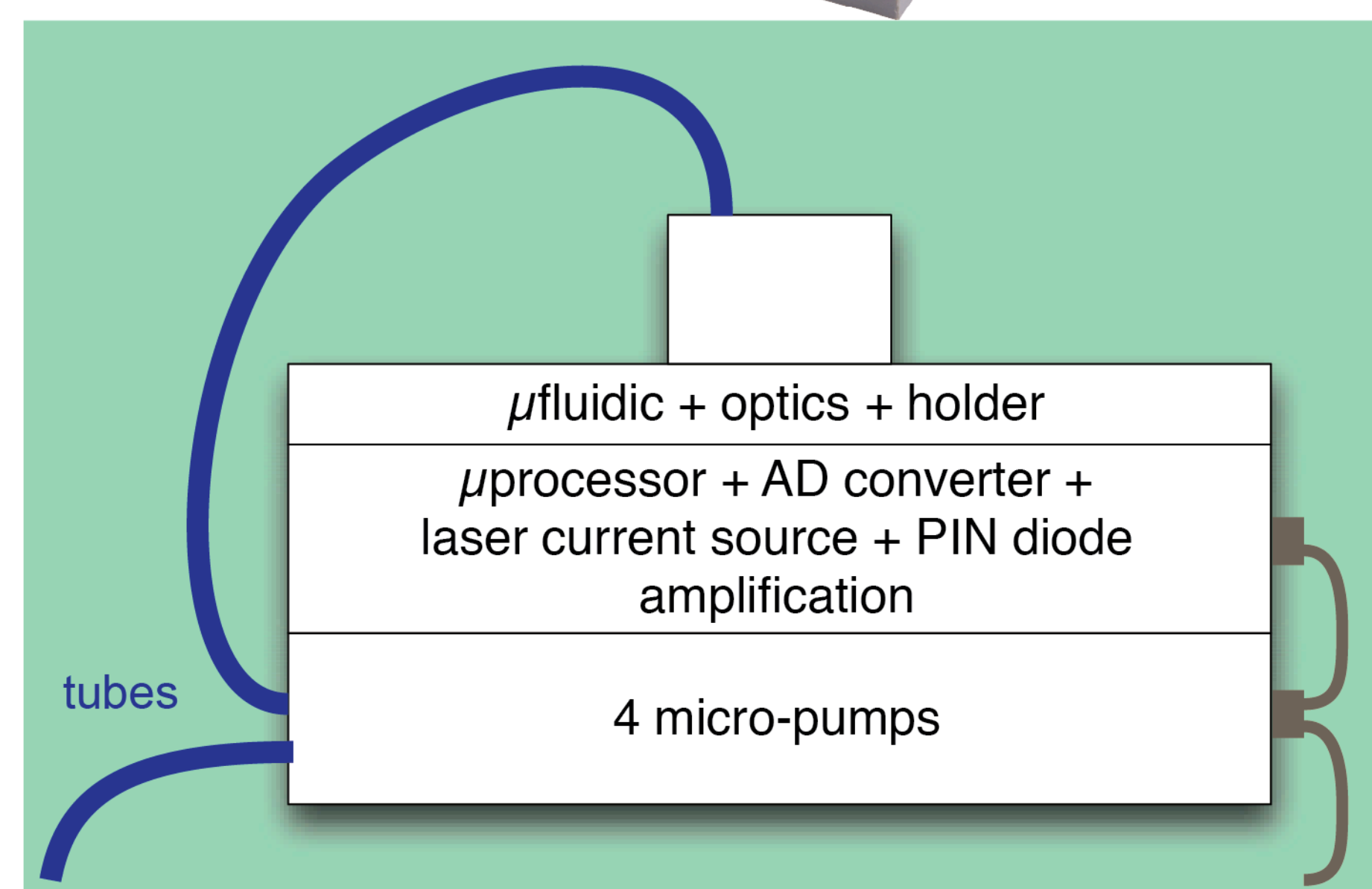
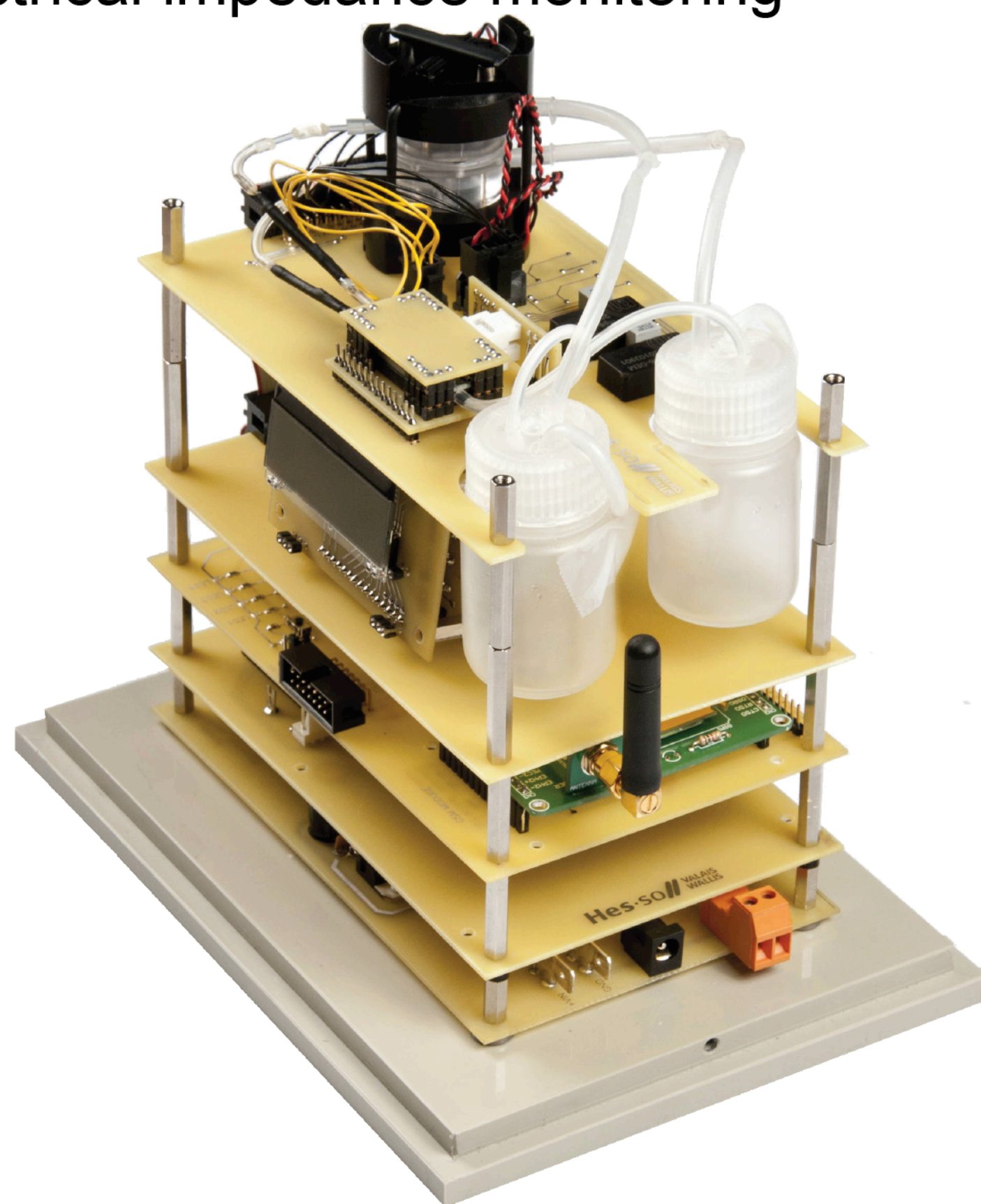
Procedures to design a compact standalone biosensor from the laboratory to the field



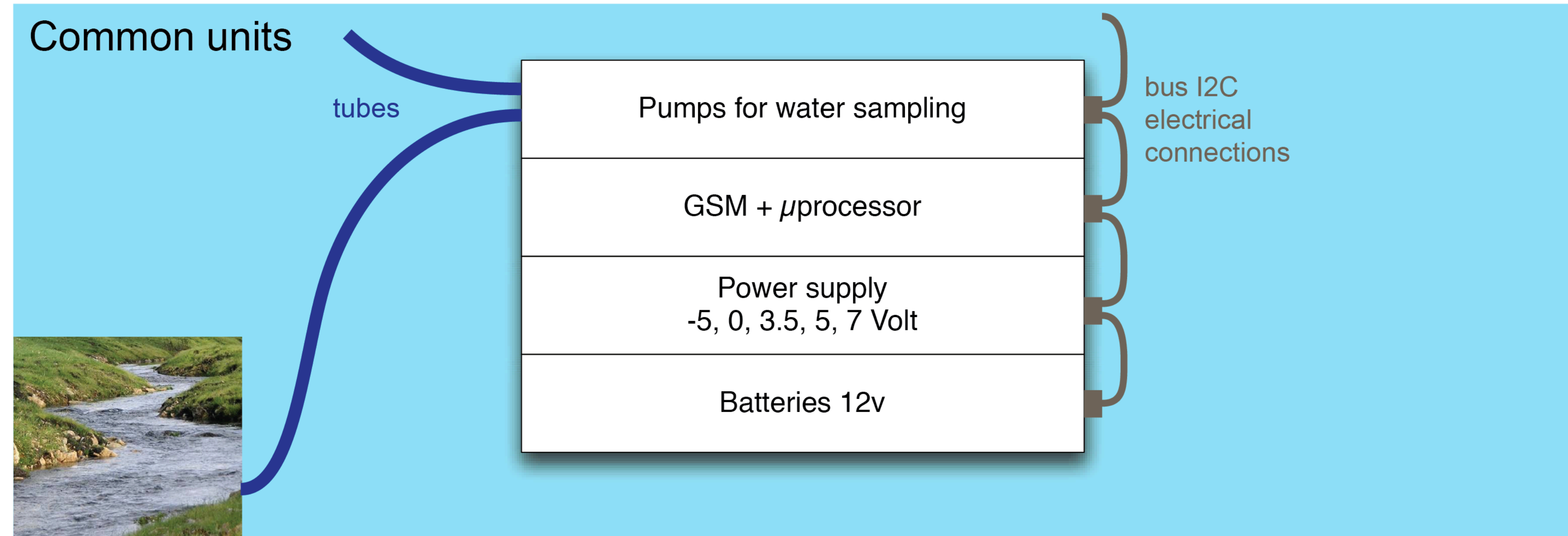
Microbial bioreactor with optical monitoring



Mammalian epithelial cell bioreactor with electrical impedance monitoring



Common units



In order to simplify the programming, each device has two processors, one dedicated to the measurements which is specific to each biosensor and one which handle the results of the measurements as well as the pumps and the communication via GSM.

Many discussions and visits, as well as our participation to laboratory measurements were necessary to design the specific unit of the standalone devices.

Other specific units will be developed.