ULTRA-LOW-POWER ANALOG INTERFACES

Current challenges in BAN applications are power and functionality, systems should have energy autonomy. The systems developed in imec's technology program on Ultra-Low-Power Analog interfaces create platforms which allow several functions to run with a few microwatts only.

APPLICATION FIELDS

Ultra-low-power Sensor interface circuitry, where the aim is to achieve generic architectures that can serve as companion electronics for sensors of interest to BAN and WSN. The sensor interfaces can address sensors under investigation in HUMAN++, but also external third-party sensors.
Ultra-low-power Smart power management circuitry, where the aim is to extract and store harvested energy with high efficiency and low self-power consumption, can be applied in industrial and automotive areas.

- Capacitive sensor read-out circuits;
- Oscillator based read-out;
- Power management

SCOPE

It is expected that by 2015, technology will enable people to carry their personal body area network (BAN) that provides medical, lifestyle, assisted living, sports or entertainment functions for the user. This vision requires that important technology challenges be addressed, among others, ultra-low-power analog interfaces.

The ultimate objective is to reduce power consumption by pushing research beyond state-of-the-art while achieving the necessary and challenging functional requirements.

Imec is currently addressing areas where Ultra-Low-Power (ULP) design solutions are needed, among them: sensor interface electronics, strongly linked with the sensors depicted below and power management circuits, strongly linked with energy harvesting, power conversion and distribution systems.

Currently research focuses on sensor readout for MEMS/NEMS-based sensors and AC-DC, DC-DC converters for several harvesting devices and batteries.

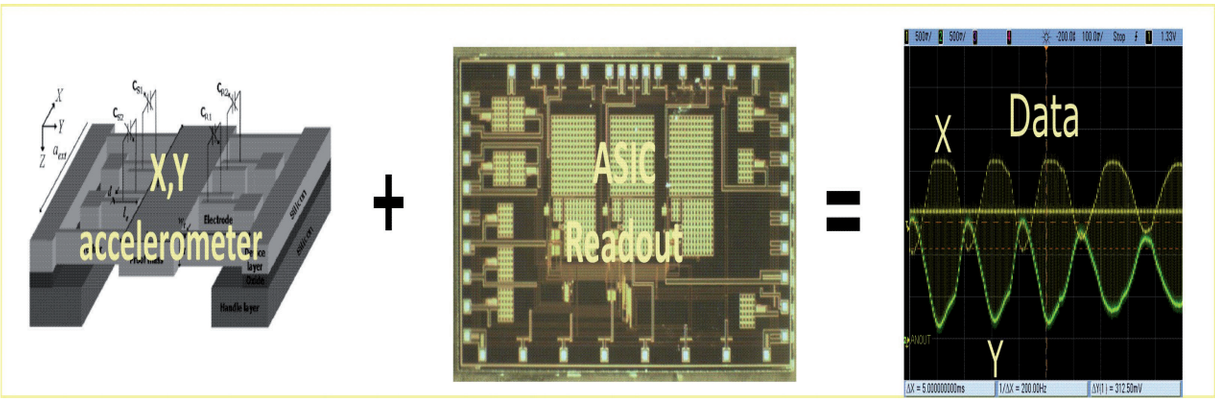
APPLICATION FIELDS

CAPACITIVE SENSOR READ-OUT CIRCUITS

MEMs and NEMS transducers are becoming increasingly important in low-power low-noise mobile applications such as accelerometers, gyroscopes, gas and mass sensors, etc for communication and industrial applications. Such structures require a custom-made readout electronics which can condition the signal for further amplification, analysis and processing. Several parameters of the front-end electronics as well as the transducer model need to be investigated and understood in order to design a proper readout.

OSCILLATOR BASED READ-OUT

NEMS resonators devices offer new prospects for a variety of applications ranging from sensing, precision time-keeping and communications. Minuscule mass and high quality factor provide the NEMS resonators with the function of precision mass sensors because their resonant frequency, which is related to their mass, shifts when a particle absorbs to the resonator. Attainment of zeptograms (1zg = 10-21g) resolution opens many new possibilities as "weighing" the inertial mass of individual macromolecules, statistical mass fluctuations that arise from the absorption and desorption of atomic species upon the surface of NEMS devices, etc.



01 Sensor Readout electronics for MEMS-based accelerometers.

MORE INFORMATION

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POWER MANAGEMENT

Power management is needed to convert, store and distribute energy with highest possible efficiency. This prolongs battery life for portable and embedded systems, Ultra low power systems might use harvesters to harvest electrical energy from available renewable energy sources, like mechanical (vibration/shock), heat, solar or RF energy. Harvesters are piëzo-electric, electrostatic, thermo-electric, photo-voltaic generators or RF antenna's. In all cases DC or AC voltages are obtained with a large dynamic range of voltage and power levels Smart power management is needed to extract, convert and store the available energy into rechargeable batteries and storage capacitors or distribute the energy to sensor processing electronics.

This research is carried out in the framework of Holst Centre, an open innovation initiative set-up by imec and the Dutch research institute TNO.

Holst Centre
Open Innovation by IMEC and TNO