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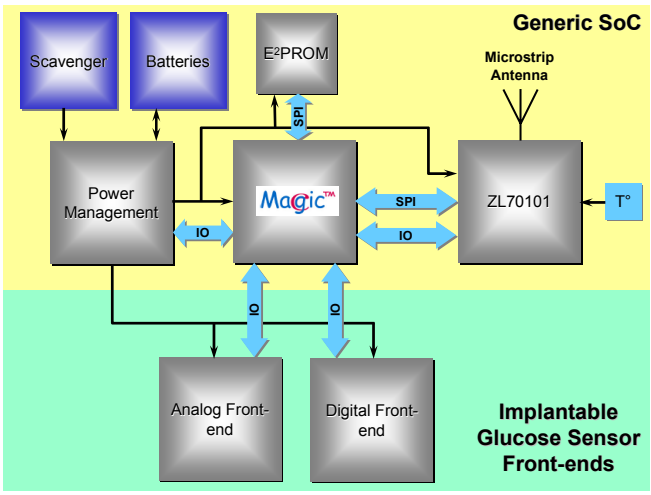
Generic scavenger powered DSP-based System-on-Chip for emerging implantable Biosensors and Bioactuators

Overview

As more biomedical equipment devices exploit ultra-low-power mixed-signal design innovations, the variety of medical semiconductor applications continues to expand. The ability to combine analog and digital signals in very close proximity alongside wireless communications has led to the development of new implantable medical devices.
Implantable devices have a number of fundamental design requirements. They must feature a long and relatively maintenance-free life due to the cost and complications of explantation and the serious implications of malfunctions or failure. In addition, they must have ultra-low power consumption, and the battery life must be as long as possible (typically more than 10 years for some devices). Power consumption determines the life of the implant. It also figures the size of the battery, often the largest component in an application where the absolute minimum size achievable is critical.
The present project proposition addresses these aspects and aims at specifying and demonstrating a generic DSP-based SoC which power supply is supplemented by a vibration-based energy scavenging MEMS and dedicated to implantable medical devices. The SoC will feature all requirements inherent to implantable medical devices, i.e. high reliability and high integration design, ultra low power consumption, wireless capabilities taking into account ethical and privacy issues, DSP functions and rich set of integrated peripherals to control efficiently any biosensor and bioactuator.
The targeted application envisioned to validate the concept is the implantable glucose sensor under development at LPM. The scavenger and the SoC will respectively power and control this sensor.

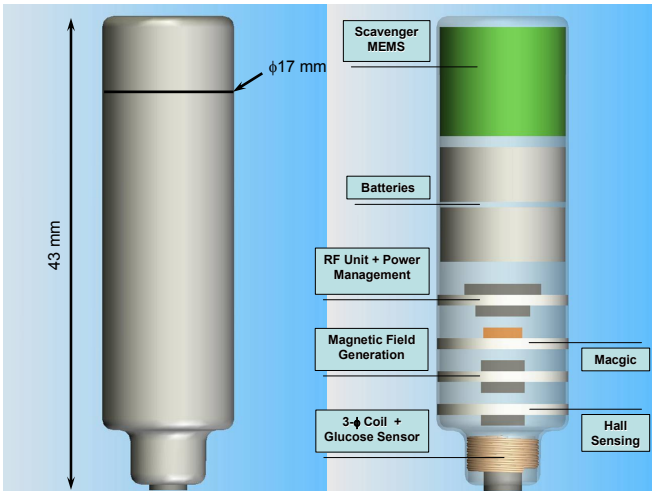
Implantable Platform proposed



Research goals

- Specify a generic SoC satisfying the medical implantable devices requirements with theses features:
  - Bi-directional RF communication
  - Programmable processing unit
  - Energy scavenging
  - Ultra low power design
- Design of the generic SoC jointly to power management circuitry including scavenger aspects.
- Application of the generic SoC to an implantable long term continuous glucose monitor
- Design of analog and digital front ends specific to the implantable glucose sensor
- Aware of packaging and integration aspects for implant

Integration example: Long term continuous glucose monitor



Research Collaborators