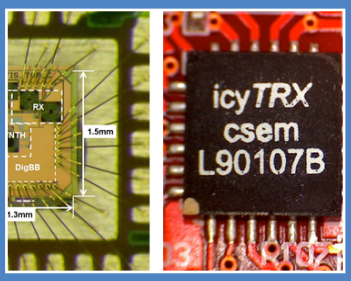
PlaCiTUS

PLATFORM CIRCUIT TECHNOLOGY UNDERLYING HETEROGENEOUS NANO AND TERA SYSTEMS



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What it's about…

Mastering complex system design in the nano transistor era, and combining heterogeneous circuit technologies into a versatile platform to support health related sensor networks.

Context and project goals

Advances in information and communication technologies, combined with those in wireless communications and sensor networks, have given rise to the idea of Internet of Things. Complex systems, accentuated by the availability of large numbers of nano-scale transistors, pose challenges for their design at both transistor, circuit and system level. Mastering complex system design in the nano device era and applying it to a circuit technology platform to support health related sensor networks and IoT, form the dual objectives of PlaCiTUS.

How the project differentiates from similar competition in the field

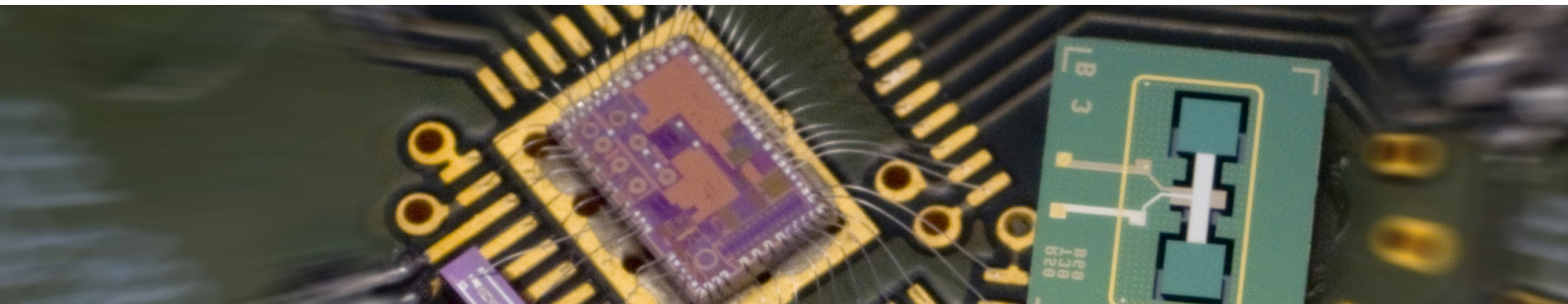
There are quite a number of international centers of excellence in either interface electronics for health-related sensors and implants, wireless communications, and surrounding digital integrated circuits and systems, which is testament to the importance of the subject area. PlaCiTUS combines the Swiss expertise in 3 leading institutions, and aims to distinguish itself in the system optimization by virtue of having sensor interface, WPAN, WWAN and ultra-low power microcontroller in a single consortium. State-of-the-art was achieved so far in data acquisition IC, BTLE IC and LTE transceiver IC in each of the individual areas vis-à-vis leading international competitors, and the team aims to take advantage of these in a combined system.

Quick summary of the project status and key results

The Placitus project has created excellent results both at the level of integrated circuit design for health applications as well as for system integration and fully operational demonstrators for biomedical application. Main achievements are:

- A multi-channel (8), chopper stabilized EEG/ECG signal acquisition front-end IC with cancellation of mains frequency interference and differential offset due to electrode-skin contact
- A remotely powered, implantable ICs with accurate temperature sensor and low power data transmission capability
- An ultra-low power, 1.95mm2, 2.4 GHz multi-standard short distance transceiver in 90nm standard CMOS technology
- Circuit techniques to realize fractional-integer frequency dividers and to improve the limiting reference linearity of high performance ADCs
- A design methodology to implement quasi continuous active filters spanning a very wide frequency range

Beside several demonstrators of subsystems, a palm-sized EEG/ECG data acquisition system, complete with overall control hardware and software, wireless connectivity (both Bluetooth and 2G/3G cellular), user interface and display on Android based smartphones and tablets, has been realized. Demonstration took place at the Nano-Tera annual meeting in Zurich, at ETH Industry Day, to clinical researchers at the Zurich University Hospital, and was taken on a tour in China as part of a Swiss delegation on Sino-Swiss scientific collaboration.



Success stories

Prof. Q. Huang has been invited to give a talk at the Stepping Stone Symposium entitled ”A wireless ECG/EEG module with fully integrated multi-channel sensor interface” at the Medical Technology Stepping Stone Symposium - September 27-28, 2012 at ETH Zurich. Around 100 people have attended the symposium.

Main publications

M. Contaldo, B. Banerjee, D. Ruffieux, J. Chabloz, E. Le Roux, and C. Enz, A 2.4 GHz BAW-based Transceiver for Wireless Body Area Networks, IEEE Transaction on Biomedical Circuits and Systems 4 (6), 391-399 (2010)

C. Enz and A. Kaiser, editors, MEMS-based Circuits and Systems for Wireless Communication, Springer, Berlin, 2012, ISBN 978-1-4419-8797-6

R. Thirunarayanan, A. Heragu, D. Ruffieux, and C. Enz, Complementary BAW Oscillator for Ultra-low Power Consumption and Low Phase Noise, Analog Integrated Circuits and Signal Processing, pp. 1-9, Aug. 2012.

D. Ruffieux, M. Contaldo, and C. Enz, MEMS-based All-digital Frequency Synthesis for Ultralow-power Radio for WBAN and WSN Applications, IEEE Int. Symp. on Circuits and Syst. (ISCAS), pp. 157-160, May 2011.

A. Heragu, D. Ruffieux, J. Chabloz, and C. Enz, A MEMS-based 2.4 GHz Sub-sampling RF Front-end for Advanced Healthcare Applications, Proc. of the IEEE Int. Symp. on RF Integration Technology (RFIT), Nov. 2011 (Invited Paper).

P. Schönle, F. Schulthess, S. Fateh, R. Ulrich, F. Huang, T. Burger, Q. Huang, A DC-connectable multi-channel biomedical data acqusisition ASIC with mains frequency cancellation, Proc. ESSCIRC, pp.149-152, Sept. 2013

F. Pengg, D. Barras, M. Kucera, N. Scolari, A. Vouilloz, A Low Power Miniaturized 1.95mm2 Fully Integrated Transceiver with fast PLL Mode for IEEE 802.15.4 / Bluetooth Smart and Proprietary 2.4GHz Applications, Proc. RFIC Symposium, Seattle, June 2013, pp. 71-74

R. Thirunarayanan, D. Ruffieux, Ch. Enz, An Injection-Locking based Programmable Fractional Frequency Divider with 0.2 Division Step for Quantization Noise Reduction, Proc. ESSCIRC, September 2013

X. Liu and C. Dehollain, A Low-Power Sensor Interface Circuit for Remotely Powered Implants, presented in 9th Conference on Ph. D. Research in Microelectronics and Electronics, 2013