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Wearable signal acquisition and transmission system for the biomedical multimedia environment

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Advances in CMOS technology, communication, and low power circuit design have spurred the development of wearable bio-monitoring devices, leading to miniaturized and highly integrated systems for continuous streaming of physiological multi-source data including force patterns, electrocardiogram (ECG), electromyogram (EMG) or impedance tomogram to name just a few. We propose a body-wearable sensor device with a low-power transmission back-end incorporating a custom-designed integrated circuit (ASIC) for the sensing front-end and for analog-to-digital conversion (ADC). A key aspect of the design is its flexibility which allows it to be programmed in the field to operate with different types of input signal so that a single hardware design can be used in a multimedia environment. The front-end configuration, single-ended, double-differential, DC-coupled, AC-coupled, offset trimming etc., is selectable in software. A counter-ADC design is discussed as it provides adjustable digital gain, variable input range, resolution and conversion speed. The data processing and transmission rate (which determines power and media quality) is controlled depending on a metric derived dynamically by the receiver using information on the media type, ambient data (e.g. battery charging level) and desired quality. Measured results from a system prototype are presented. The ASICs were fabricated in TSMC 0.35µm technology. The programmable front-end consumes between 110 and 324 µW depending on configuration, and the ADC core requires 36 µW for 8-bit conversion at 8 kHz. Currently, a mid-range CPU (PIC18LF2520) and a wireless radio (MRF49XA) from Microchip, Inc. serve as the controller and transmission unit respectively with the plan of future integration on chip.

Biography

Robert Rieger received the PhD degree in Electronic and Electrical Engineering from University College London (UCL), London, U.K., in 2004. He then joined the Industry and Medical Business Unit of Austria microsystems AG, Rapperswil, Switzerland, as a Design Engineer involved in the design of robust low-power integrated circuits. Since 2006 he is with the Department of Electrical Engineering, National Sun Yat-sen University, Taiwan. He is now a Professor of Electronics Engineering and the Head of the Bionics Integrated Systems Laboratory. His research interests are in the areas of integrated electronics for biomedical application and embedded and digitally assisted low-power analog circuits.

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