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Biomedical Circuits and Systems Dedicated for Sensing and Neurostimulation: Case study on Urinary Bladder dysfunctions

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Abstract: This paper covers circuits and systems techniques for the construction of high reliability biosensing and neurostimulation smart medical devices. Such microsystems are dedicated for interconnections through the peripheral neural systems. Case study related to applications such as bladder control is discussed. Available electrical neurostimulation techniques for the rehabilitation of urinary bladder functions do not allow an adequate voiding due to dyssynergia between the bladder and the sphincter. A new implantable stimulator, built with commercially available electronic components, was designed to overcome these difficulties. The proposed system performs two types of stimulations: Selective Stimulation for bladder voiding and Permanent Stimulation to reduce the bladder overactivity symptoms. Also, a fully integrated extended version of the stimulator is achieved with the additional ability to monitor the electrodes-nerve contact impedance variations in order to detect electrodes faults or nerve physiology changes. The implemented full custom device provides a reliable stimulation technique and addresses the lack of features (programmable parameters, user-friendly interface and waveform flexibility) of the previous stimulation devices. Experimental results of the fabricated chip confirm its functionality. The microstimulator generates a wide range of stimuli waveforms with variable parameters and its modular architecture makes it an expandable multichannel stimulation system.

Key Words: Medical device, Electronic implant, Electrical stimulation, Selective stimulation, Bladder controller, Detrusor-sphincter dyssynergia, Neurogenic detrusor overactivity, Hyper-reflexia

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