Low-Power Architecture for Epileptic Seizure Detection Based on Reduced Complexity DWT

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In this article, we present a low-power, user-programmable architecture for discrete wavelet transform (DWT) based epileptic seizure detection algorithm. A simplified, low-pass filter (LPF)-only-DWT technique is employed in which energy contents of different frequency bands are obtained by subtracting quasi-averaged, consecutive LPF outputs. Training phase is used to identify the range of critical DWT coefficients that are in turn used to set patient-specific system level parameters for minimizing power consumption. The proposed optimizations allow the design to work at significantly lower power in the normal operation mode. The system has been tested on neural data obtained from kainate-treated rats. The design was implemented in TSMC-65nm technology and consumes less than 550-nW power at 250-mV supply.

Categories and Subject Descriptors: B.7.1 [**Integrated Circuits**]: Types and Design Styles

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1. INTRODUCTION

Epilepsy is a dynamically nonstationary transient symptom of excessive and/or synchronous neuronal activity in certain sections or the entire brain. It is one of the most common chronic neurological disorders affecting more than 50 million people across the globe. Most of the medical treatments for epilepsy that focus on controlling the occurrence of seizures prove ineffective for about 30% of the seizure patients [Raghunathan et al. 2009]. Alternative treatments based on electrical stimulation have been shown to be promising [Binder and Scharfman 2004]. However, continuous stimulation reduces the responsiveness of the tissue to electrical stimulation and may pose a threat to the patient's normal neurological operations [Raghunathan et al. 2009]. Responsive neuro-stimulation is an alternate therapy that requires efficient real-time seizure detection techniques that precisely identify the onset of seizure and trigger the stimulation.

In order to come up with an implantable design for seizure detection and stimulation control, it is of paramount importance to identify low-cost signal processing

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