Defence Seminar

Seminar Title	: Design of Low-power Analog Front-end ASIC for ECG Acquisition System
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Abstract

: Providing quality treatment to every section of people along with the traditional health care system is a challenge for today&rsquos world. Regular monitoring of the patient&rsquos vital signs is essential in order to diagnose the ealth conditions to provide appropriate treatment. Among several vitals, Electrocardiogram (ECG) is one of the most important bio-potentials, which is routinely monitored and recorded in modern clinical practice. In traditional health care, patients are connected to a bulky and mains-powered instrument, which reduces their mobility and creates discomfort. This limits the acquisition time, prevents continuous monitoring, and affects the diagnosis of the illness. Therefore, there is a growing demand for low-power, small-size, ambulatory and wearable bio-potential acquisition systems. These systems must perform signal acquisition, extraction, analysis, and wireless transmission, if required, of the bio-potentials with reduced power consumption, and robust operation under the presence of signal artifacts. In general, the portable system consists of a front-end analog signal acquisition system and a back end digital signal processing unit. The analog front-end (AFE) mainly contains Instrumentation Amplifier (IA), Filter and Programmable Gain Amplifier (PGA). As the bio-potentials are low frequency and low amplitude signal and skin-electrodes are used to sense the signal, the key requirements of the system are high CMRR, high input impedance, low noise, low power consumption, and ability to reduce differential electrode offset (DEO) as well as internal offset.

In this work, an analog front-end Application Specific Integrated Circuit (ASIC) is designed to acquire the ECG signal for a bio-potential acquisition system. In this work, four chopper-stabilized AC-coupled current feedback instrumentation amplifiers (CFIA) are designed, which effectively reduce the input DC electrode offset. In addition to IA blocks, two configurations of waveform generators (WFG) to generate square wave and clock signals are also presented. In the design of the AFE readout, WFG-2 generates the required clock signal. Along with the acquisition of the ECG signal, this work also includes a feature extraction channel, which provides the band power of the QRS complex to assist the DSP in further processing in the digital domain. Finally, all proposed and supporting blocks are integrated and simulated using the Spectre simulator in a Cadence Virtuoso environment. In all proposed blocks, the IAs are designed in UMC 180 nm technology, and their performance is compared with the previously reported CFIAs. Simulation results show that the proposed IA configurations achieve maximum offset reduction range of 120 mV, highest CMRR of 133 dB and consumes lowest power of 4.1 &muW. On the other hand, the waveform generators are fabricated and tested. The measured results show frequency tuning range up to 960 kHz and 600 kHz for WFG-1 and WFG-2 respectively, whereas the amplitude tuning range for both the WFG varies from 0.45 V to 1.15 V.

Keywords: Bio-potential Acquisition System; Analog Front End Readout; Instrumentation Amplifier; Current Feedback IA; DC Electrode Offset Reduction; Waveform Generator; Feature Extraction Channel.