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Abstract
As known that brain research is always being a hot topic in the area of clinical medicine and academy. However, an EEG measuring instrument used for brain research is generally very expensive that is not easy to obtain in academy. Thus, the goal of this study is to develop a low-cost, easy-portable, and functional-acceptable (in comparison with a commercial one) multi-channel EEG data acquisition system which can be applied to such academic studies. In this developed system, the EEG signal sensing terminal was composed of a standardized 10-20 electrode cap. The systemic frond-end amplifier consists of a clamped-differential input circuit, an instrumentation amplifier, a second-stage amplifier, a 60 Hz notch filter, a low-pass filter, and a high-pass filter. Here, the instrumentation amplifier uses a high-CMRR INA121, the high-pass filter is with a cut-off frequency of 0.5 Hz, and the low-pass filter is implemented using a multi-loop unity-gain Butterworth circuit topology with a cut-off frequency of 50 Hz. By the proper circuit design and the PCB layout of the frond-end amplifier, its interferences of 60 Hz power line and other magnetic noises have been reduced. The EEG signals detected by the scalp electrodes are first processed by the frond-end amplifier, and then are sent to the NI-DAQ Card (PCI-6220, 16 bits) of a PC to digitize, and then the digitized waveforms are analyzed and displayed by a LabVIEW-based man-machine interface. In addition, considering the instrumentation amplifier being a key element in this frond-end amplifier and the system-on-chip (SOC) being a trend in the future, this study is also to design an instrumentation amplifier chip. This chip was simulated using a TMSC 0.35 U+B5m/1P4M manufacturing technology that was expected to make the whole hardware system be minimized after the accomplishment of chip implementation. Finally, utilizing this system the α and β waves were measured at C3, Cz, and C4 points while closing and opening eyes, and the brain responses were measured at O3, Pz, and O4 points while visual stimulating were examined. From the examinations of the waveforms in time and frequency domains we find that the results are all nearly matching the measuring results of a commercial famous Neuroscan's brain machine.
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