Design of EOG Signal Acquisition System Using Virtual Instrumentation: A Cost Effective Approach

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ABSTRACT

The design and development of cost effective rehabilitation aids is a challenging task for biomedical research community. The biopotentials such as EEG, EMG, ECG and EOG that are generated from human body help in controlling the external electronic devices. In the recent years, the EOG based assistive devices have gained importance in assisting paralyzed patients, due to their ability to perform operations controlled by retinal movements. This paper proposes a cost effective design and development of EOG signal acquisition system using virtual instrumentation. The hardware design comprises of two instrumentation amplifiers using AD620 for registering horizontal and vertical eye movements and filter circuits. A virtual instrumentation based front panel is designed to interface the hardware and to display the EOG signals. The resultant digitized EOG signal is further enhanced for driving assistive devices. The proposed EOG system makes use of virtual instrumentation and hence minimizes the design cost and increases the flexibility of the instrument. This paper presents the initial part of the research work which is aiming at a cost effective complete assistive device based on extracting the useful information from the eye movements. The qualitative validation of EOG signals recorded ensures the cost effective healthcare delivery for rehabilitation applications.

Keywords: Data Acquisition, Electrooculogram, EOG Amplifier, Filters, LabVIEW, Virtual Instrument

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INTRODUCTION

Information Technology (IT) has created inevitable impact on the patient care applications over the last decade. Specifically, human-computer interface (HCI) has brought remarkable changes in the field of rehabilitation engineering. The real challenging task faced by the biomedical research community is to design and develop cost effective rehabilitation aids which enhance better communication and thereby ensure the quality of day-to-day living. Of instance, Electrooculogram (EOG) based eye movements provide valuable means of communication for the people who suffer from Amyotropic Lateral Sclerosis (ALS). Electrooculography (EOG) is widely used in ophthalmic research, ophthalmological diagnosis and clinical laboratories because it provides a noninvasive method for recording complete range of eye movements. The EOG has drawn greater attention from biomedical research community especially because of the rehabilitation aids that can be developed. The physical energy used up in moving eyes is much lesser when compared to other gestures made by disabled people, like moving head, movement of limbs, speaking etc. Hence eye movements can be intelligently exploited for developing assistive devices for the physically disabled. The Electrooculograph method for recording EOG signals has several advantages. It causes least discomfort to the patient as recording is done with minimal interference with subject activities. It is easy to apply and can be used for long term monitoring. The main focus of this research work is to acquire and analyze eye movement signals using virtual instrumentation. The EOG signal is not very deterministic, as it is affected by a number of factors like eyeball rotation and movements, eyelid movement, the EMG produced by the muscle of the eye, eyelid movement, the eye blinks, electrode placement, head movements, influence of luminance, etc. The repeatability and flexibility are the two major requirements from EOG measuring equipment. Considering the cost and availability of the dedicated EOG acquisition instrument, it was decided to develop a virtual instrument for the bio signal acquisition. This virtual instrument should be economical, portable and easy to use. The virtual instrument developed has all these features available in it.

The system developed uses PC based data acquisition. The PC based data acquisition is highly beneficial to measurement systems. Hospitals need several measurement systems that can measure physiological parameters of the patient. The measurement systems used should be able to measure accurately the vitals of patient like heart conditions, body temperature, electrical activity of the heart, electrical activity of the brain etc. This information should be readily available to the doctors for diagnosis and proper treatment. Since the bio signal level is very low, amplification of signals is important. Hence, any PC based system consists of additional circuits for isolation and amplification of the signals. A data acquisition card and software for signal processing is important. The signals acquired contain useful information. But extracting useful information from signals in their raw form is a difficult task. This is done by the field of biological signal analysis which helps in extracting useful information from the biological signals.
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