

ACQUISITION AND MONITORING SYSTEM OF THE ELECTRICAL SIGNALS GENERATED IN CEREBRAL ACTIVITY

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ABSTRACT

An acquisition and monitoring of electrical signals system was designed and fabricated to acquire and visualize the electrical signals in the cerebral cortex with the purpose of using them in diagnostic and robotics applications. The system first captures the signal coming from the electrodes located on cerebral cortex patient, which is amplified and filtered, then it passes to digitalization stage from is transmitted to a computer through the parallel port where by means a program elaborated in LabView the data are visualized.

Palabras Claves: actividad cerebral, LabView, sistema de adquisición.

RESUMEN

Hemos diseñado un Sistema de Adquisición y Monitoreo para adquirir y visualizar las señales eléctricas generadas en la corteza cerebral con el fin de utilizarlas en diagnóstico médico y/o en aplicaciones de robótica. Consta de una primera etapa de sensamiento y acondicionamiento de la señal proveniente de los electrodos ubicados en el cráneo del paciente, la cual es amplificada y filtrada. La señal acondicionada pasa a la etapa de digitalización, y posteriormente es llevada a un computador a través del puerto paralelo a fin de visualizar los datos a través de un programa elaborado en LabView.

Palabras claves: cerebral activity, LabView, acquisition system.

1. Introducción

The brain regulates most biological processes of the human organism. This complex activity is reflected in electrical signals result of transmission of information among cells of the nervous system (neurons), located in special areas of the brain which can be measured and analyzed with the purpose to determine if the cerebral activity corresponds to a normal pattern or if is altered by some physiologic disorder. These bioelectrical signals are of the microvolts order [1] and are difficult to obtain with conventional measurement systems. In this work we present the design and construction of a high sensibility system for the reading of electrical signals generated in the cerebral activity.

2. Experimental

The figure 1 shows an schematic diagram of the acquisition and monitoring system of electrical signals generated in the cerebral activity. The electrical signals from the cerebral cortex was detected using electrodes of Ag/AgCl coupled to a shielded cable which drives until a circuit

where the signals are preamplified with a gain of 150 V/V using an high sensibility, low current and low noise instrumentation amplifier AD620AN[2].

Then the signal passes through of a high pass Butterworth filter with a cutoff frequency of 0.5 Hz, which is implemented in a MF10CN universal filter that allows the pass of the AC component and limits the DC component. Then the signal is amplified with an AD620AN instrumentation amplifier with a gain of 150 V/V, later the signal is filtered to limit the band frequency using a Butterworth low pass filter order eight Max7480. Now the signal is digitalized using a 16 bit resolution, 4 channel, sampling frequency of 200 KHz serial interface analog to digital converter AD974 [3]. To control the converter a microcontroller PIC16F873A is used, which determines the channel to convert and generate a clock signal that fixes the frequency to read the converted data, for this case is 100 KHz. The converted data are connected to the USART module of a microcontroller PIC18F452 and this is interfaced to a computer through the parallel port. This interface change of serial to parallel is realized with the purpose to have better control on the data transmission. Finally, one program in LabView allows acquire, visualize and storage the data in text files.

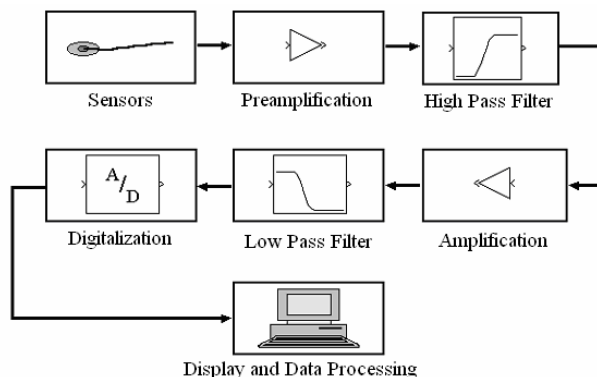


Figure No.1. Schematic Diagram showing acquisition and monitoring system of the electrical signals generated in the cerebral activity.

3. Results

Have been realized several measurements locating two electrodes of Ag/AgCl on the front of a patient and a third ground electrode that is the reference for the other two electrodes. Each one of these correspond to a separated channel. The acquisition program in LabView allows to obtain the data from the cerebral activity of the patient and storage them in text files to later export them to the program Origin to analyze them. The figures 2a. and 2b. show the obtained curves of the signals of the channels 1 and 2, respectively. It is observed that some marked picks are presented, which can be attributed to the fact that the patient was not in a total state of rest and realized ocular and muscular movements during the process of measurement.

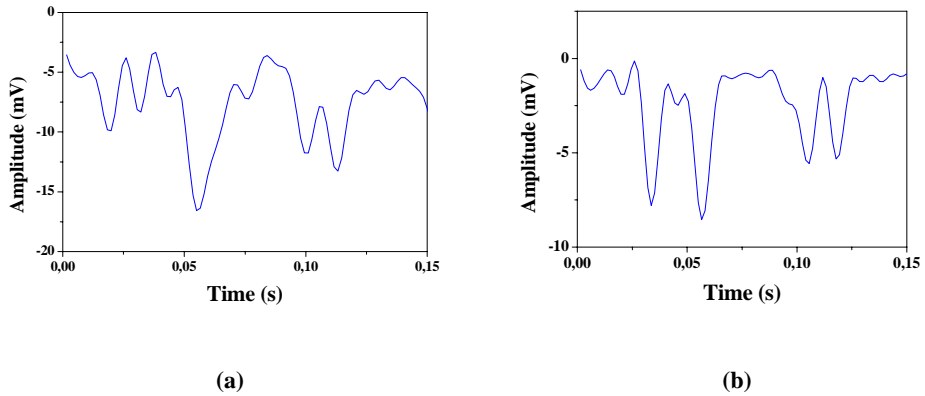


Figure No.2. Amplitude vs Time curve for the signal measured for the channels 1 and 2 respectively.

However, the analysis of frequency of the signals by FFT shows that the signals have components of frequency in the expected range, with marked picks around 15 and 20 Hz.

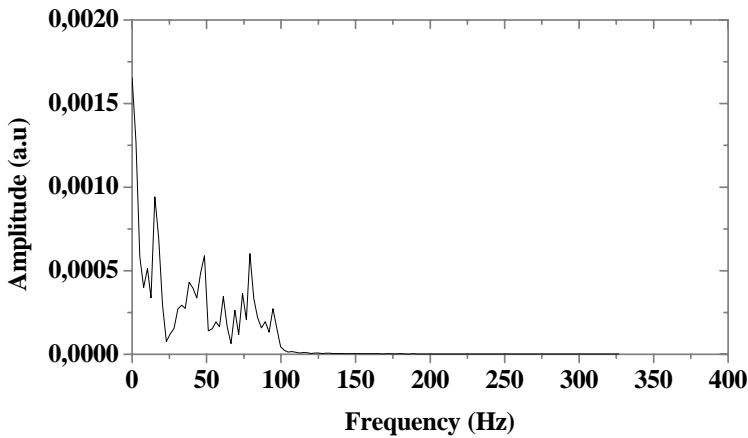


Figura No.4. FFT Spectrum for the signal of the channel 1.

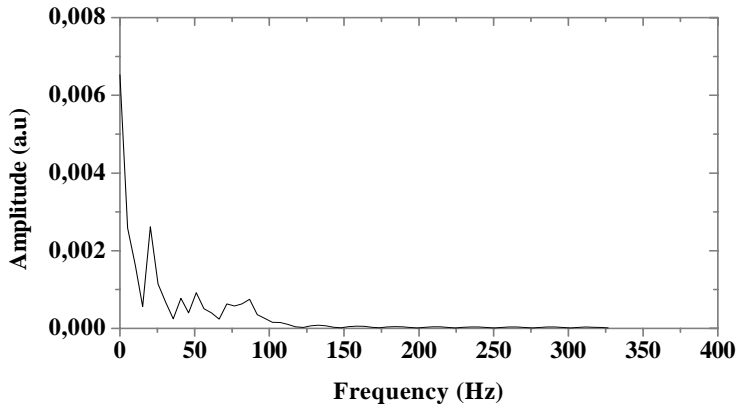


Figura No.5. FFT Spectrum for the signal of the channel 2.

4. Conclusions

We have fabricated a high sensibility system to detect the electrical signals generated in the cerebral activity with low cost, allowing use it easily.

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References

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