DESIGN OF A EMG WIRELESS SURFACE EMG 6 CHANNELS

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Abstract: — Different postures are object of several kind of pain in the spine; this is evident in individuals who remain long hours working in inappropriate positions that can generate long-term injuries [1]. Currently, the detection of wrong posture is not headed to study every muscle involved in a particular work activity The use of these method generates a high variability on results as for observer, as for the patient.

Is important to have strategies to reduce this variability. The electromyography technique is used to make an evaluation of posture, to do so, we have designed and implemented a wireless EMG, which can acquire the signal from six muscles in the back. Additionally ia data receiving software was implemented. This system performs the acquisition of the patient´s muscles at his usual sitting position, making the record for a minute, then patient rests five minutes and data is acquired again, this time, with the patient on proper sitting posture.
With the information a database is build. This database is used to determine whether a posture is appropriate or inappropriate.

Finally the EMG is used to visualize and analyze the acquisition of the bioelectrical signal of the muscle in the software implemented, giving importance to the diagnosis, analysis make a statement about prevention and good posture, not only in students community, but in many other communities.

Key Words -- Back posture, electromyography, wireless system.

I. INTRODUTION

Electromyography (EMG) technique used throughout the years to record electrical potentials from the patient's muscles through electrodes placed on the area to be analyzed [2], while the patient consciously regulated or voluntary contraction or relaxation of the muscle groups through a visual interface that owns the equipment [1]. This muscle activity (contraction / relaxation) is always controlled by the central nervous system. Therefore, the EMG signal is a complex signal, controlled by the nervous system and is dependent on the anatomical and physiological properties of the muscle [2].

Amplitude	Frequency (f)
(0.1 – 10) mV	20 Hz-500Hz

Chart 1. Overview of the bioelectrical signals (EMG) [3].
(EMG) [3].

The objective of this paper is to develop a system for recording EMG signals from the area of the back. Finally the signal can be displayed on a computer for convenience of the patient’s analysis.

II. METHODOLOGY

Analog acquision of the signal

This part consists in measuring the electric potential in the muscles of the back (trapezoids, thoracic and lumbar) with correct and incorrect posture. After receiving the signal conditioning is performed later and digitization.

A. Electrodes

Was chosen as surface electrodes are noninvasive and simple to use, the surface electrodes are placed on the skin. [3].
For measurement of surface EMG electrodes are used gold cup [4]. These electrodes are plated with 20 micro inches of gold and have a diameter of 10 mm, as shown in Figure 1[19].

Figure 1. Gold cup electrodes, toked by http://www.lkc.com/products/supplies/index.html

B. Pre-Amplification

The amplifier was chosen by performance, considering previously the characteristics of the human body (impedance, CMRR, input bias current) [5], we chose to use the INA129 instrumentation amplifier [6].

$$G_{ina129} = 1 + \frac{49.4K\Omega}{R_G} \quad (1)$$

$$10 = 1 + \frac{49.4K\Omega}{R_G}$$

$$\frac{49.4K\Omega}{R_G} = \frac{1}{R_G}$$

$$R_G = 4.48K\Omega \approx 5.6K\Omega$$

$$R_G = 5.6K\Omega$$

Likewise, to decrease the offset voltage at the output of the instrumentation amplifier and to prevent the device from saturation implements an integrating circuit (Figure 4). This circuit is designed taking into account the high frequency (500Hz) and taking 10 samples [5].

$$\frac{1}{50} = RC = 0.2 \approx (270K\Omega)(0.1\mu F), f = \frac{1}{T}, T = RC \ (2)$$

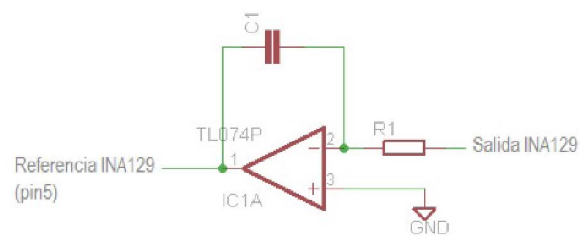


Figure 2. Integrator circuit for reducing the offset voltage at the output of the instrumentation amplifier.

In the last part of the pre amplification was using a second amplifier noninverting, which was implemented with a TL074, for a gain of 9.2.

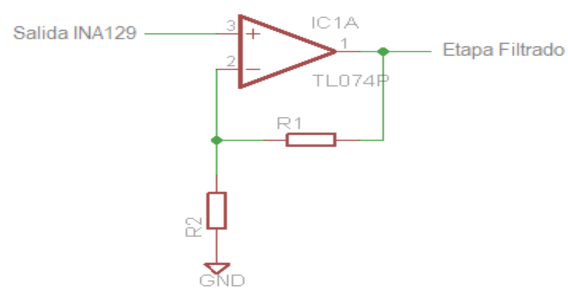


Figure 3 Amplification TL074.

C. Filters

Amplifiers are used in operations Butterworth Sallen Key Configuration,. It generated a bandpass filter from 20Hz to 500Hz, this is a waterfall design, presents the first high pass filter letting through frequencies above 20Hz and out of it connecting a low pass filter to prevent passage of frequencies greater than 500Hz. [5]

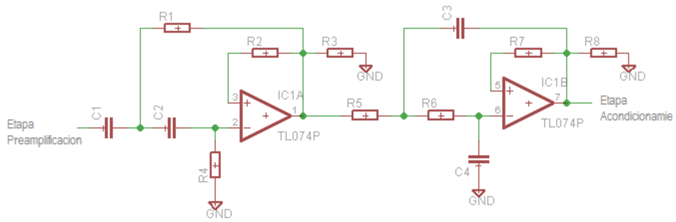


Figure 4. Schematic diagram of the bandpass filter 20-500Hz.

D. Signal Conditioning .

The action potential is composed of a signal with a positive and a negative component, which is why they chose summing operational amplifiers, so the signal goes a DC level, by avoiding negative components and taking only the positive for each action potential.

Conditioning was implemented in which the signal was limited to (0-5) v possible for the chosen input of the microcontroller which is a MC908ap16abcd.[6]

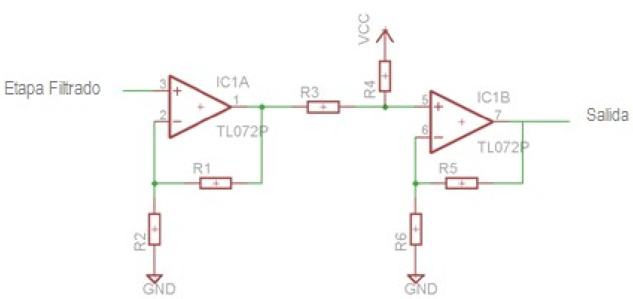


Figure 5. Schematic diagram of the signal conditioning.

Digital acquision of the signal

E. Signal Conditioning . Coding, ADC and transmission

Coding and Microcontroller ADC took MC68HC908AP16 chosen from a list of items, which were evaluated for features, ease of use and low cost.[21] The signal was encoded to 2 bytes each of 8 bits and needed to know how to identify the channel, the signal (lower or upper) and useful information which is arranged as follows:

- .1 -Bit identification(low part or hi part)
- 3-Bits identification od the chanel
- 4 _Bits information.

In the market was found a crystal 22.1184 MHz which allows the microcontroller to generate integer multiples of the speed reference crystal in this case 115200 MHz This is necessary to accomplish the Bout rate of Xbee was chosen, discarding program a PLL [6] [22].

For the transmission system was chosen Xbee transmitter and receiver which simple protocols were implemented, and has a range of indoor and 10mt 30mt outdoor line of sight. Was chosen XBP24-AWI-001 [23] which communicates via serial microcontroller with him and likewise the transition Xbee to Xbee reception [23]

F. Receive Data and Visualization

The construction of data reception, the system has an interface HMI (Human Machine Interface) in Visual Basic where Laview (Laboratory Virtual Instrumentation Workbench Environment) is a real-time platform, it was shown that the development of the project in processing the response signal was too slow to program all the needs required in this medical equipment. Therefore a program was used to establish the labview as an executable, this consisted of a friendly interface that could implement a system of sending emails

G. Acquision labview

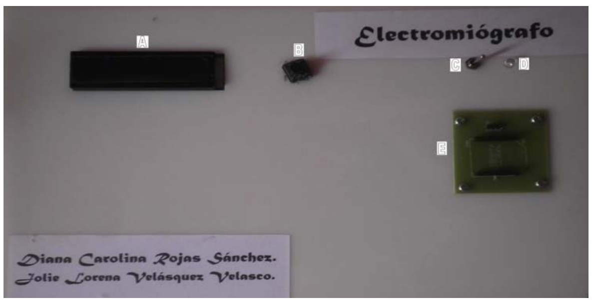
The program was created with an environment similar to the market has EMG.

Data received from the microcontroller Xbee are classified receiver to activate and display the postural test, this interface has a luminous indicator for the action from the module in this case indicates the On / Off of the display. For decoding and viewing was held a fixed table contains the coding frames AP16, which uses wireless transmission, data are passed string to int and then a comparison of cases, resulting in the separation of channels and displaying them.[26]

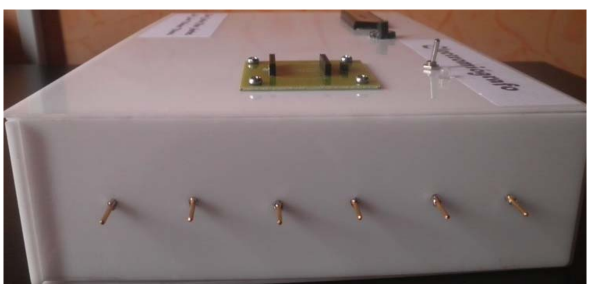
To collect data matrices were available in this case is how much data was analyzed in 1 minute receiving time at which the test is performed so arranged EMG and the matrix (6 x 50000 data channels), [10] which are then routed to a Excel workbook to keep track and to analyze the data later, as they can be routed to an email from visual Basic interface.[18].

III. RESULTS

A. Emg wireless surface emg 6 channels



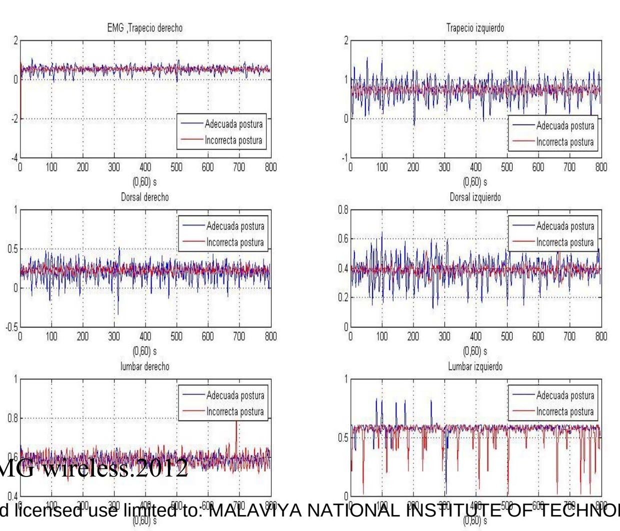
(a)



(b)

Figure6. (a) EMG wirelees suface in front. (b)conectors

B. Test



The test for measuring electromyography signal to observe posture was took for students 21 (12 women and 9 men) from the University District Francisco José de Caldas, with accompanying specialist Karen Dayanna Rodriguez Daza, fisioterapyts Rosario University

Only 19 of the tests were valid for a network implementer, the a neuronal network was calculate for the classification of them whit a single perceptron multilayer resulting.[8]

The results of the perceptron multilayer in test-validation were: 8.31% mean square error and 80.92% of overall accuracy [8]

IV. Conclusions

-Acquired electromyography signals muscles in normal position and determined by the specialist in a student population, allows to build a database with records obtained for subsequent classification, which supports the diagnosis and assessing the response remotely.

-Through the analysis of classification. Resulting from this classification a 8.31% mean square error and 80.92% accuracy.

- The results of the test can be viewed and analyzed in the acquisition software implemented, allowing supporting diagnosis, analysis and prevention for back pain or other injuries' caused for improper posture, not only in the student but also in others kind of people.

- In this study, all people tested had an inadequate posture.

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