Control Platform Based on EOG

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Abstract- The intention of this work is to develop a Platform of control based through the ocular biopotential (electrooculogram, EOG) generated between the cornea and retina (Corneal-Retinal Potential), emphasizing it's applicability with regard to carriers of physical necessities. Thus, the movement exerted for the eyes makes possible to perform the control of many equipments and functions, machines and systems that can assist physic handicapped in the execution of the most diverse daily activities. The platform is composed of an amplifier of instrumentation EOG and a platform of electronic Prototyping of the free hardware (Arduino).

Keywords - Physic handicapped, Eog, amplifying instrumentation, Arduino.

I. INTRODUCTION

The human body has excitable cells that by the polarization process and ionic depolarization are capable to generate electric pulses, the biopententials calls [1], these can be used for diverse purposes, for example like control systems [2], It's possible to perform pathology analyzes and/or control of automatized platforms [3,4].

Since approximately 7 % of the Brazilian population affirm to possess some type of physical deficiency, where such index is situated mainly in the Northeast region [5], can be developed controlled mechanism for the ocular biopotential, where this would assist the carriers of the necessities, in order that the same could perform some motor activities, as of locomotion, before considered the impossible.

The electro-oculography is a sector of the biomedicine responsible to register the ocular electric movements, the ocular potential is originated by the electric dipole formed pair corneal-retinal, and the tension can vary in accordance with the horizontal and vertical movement [6].

The ocular biopotential (EOG) is endowed with some characteristics that defer it of the other biomedical potentials [7], today already surveyed and studied. A particularity is amplitude of the signal, therefore this oscillates of 10 to 100 μV in the medium frequency of 10 Hz [8], by means of this requires the development of a circuit contends amplifying of instrumentation with high gain it and inhibiting filters of noises, analog-digital converter and Arduino plate will control certain dispositive electromechanical, thus narrowing the relation between human and machine.

This article is organized follows: after this introduction, in Section 2, the description of the system is presented. In Section 3, the architecture of the system is presented. Finally, in section 4 the results followed of the conclusions are presented.

II. SYSTEM OF DESCRIPTION

In the acquisition process It is used Ag/AgCl electrodes (Chloride of Silver) for better conductivity, Figure 1, where, that for horizontal movements the electrodes 3 and 4 in the region of the sphenoid bone place themselves and for heaves it adheres electrodes 1 and 2 in the upper/lower part of the followed eye of the electrode reference of the circuit in the center of the forehead[6].

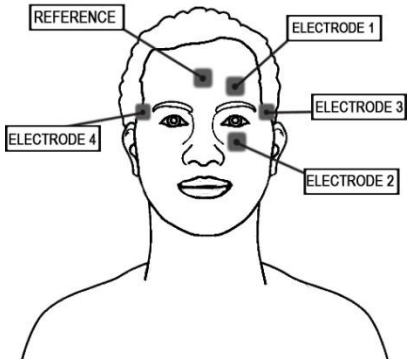

Fig. 1 – Positioning of the electrodes. .

Fig. 2 shows a possible application, the illustrated system has a focus for application with people who have some special needs, the phocus of this work.

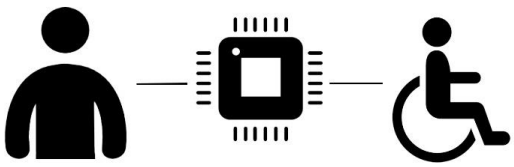

Fig. 2 – Proposal of the platform.

III. DESCRIPTION OF ARCHITECTURE

The architecture of the system is constitute by a set Operational Amplifiers, which assure the manipulation of the form signals effective and practice, preserving it's fundamental characteristics [9,10]. Amplifier EOG presents topology standard of instrumentation amplifies [9,10]. Since that the ocular signal is in the order of microvolts [8], makes the necessary raise the voltage, leaving the signal in order of Volts, so this manner making possible the control of innumerable electronic apparatuses. The projected circuit as it demonstrates Fig. 3 is subdivided in trainings, the first training gain profit of 7.4 dB and according to 43 dB and CMRR of 54 dB. It is possible to perceive that the value of the CMRR was not so high, but exactly being low, it did not present no type of problem in the applications proposals.

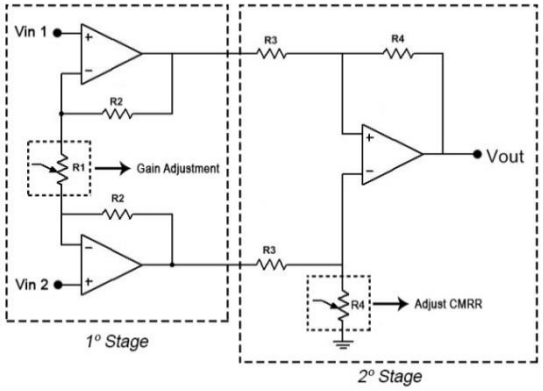

Fig. 3 – Amplifiers of instrumentation EOG

Later the necessary to the implementation of stage of filtering became Fig. 4 composition for two stages low-pass filters RC , both possessing a cut frequency (Fc) around 15 Hz, since the frequency band of interest spans from 0 to 10 Hz [6] . These were isolated by means of a BUFFER with the objective of simplify the circuit facilitating the use of filters second order, in this way also the elimination of inductors of loy frequency, voluminous and expensive.

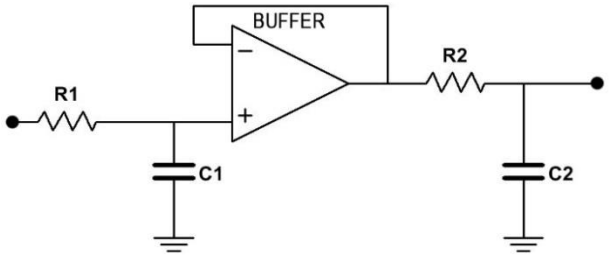

Fig. 4 – Stage of filtering

After that, as it show Fig. 5 was inserted not inverting an Operational Amplifier and a first order filter RC with Fc=15 Hz. The main objective of the last stage is all generate the gain highest of the circuit finishing all the process of amplification and filtering of the signal. The raised gain more after the stage of the main filtering minimizes the effect of the noise, once the signal is propitious the diverse types if interferences and errors [11].

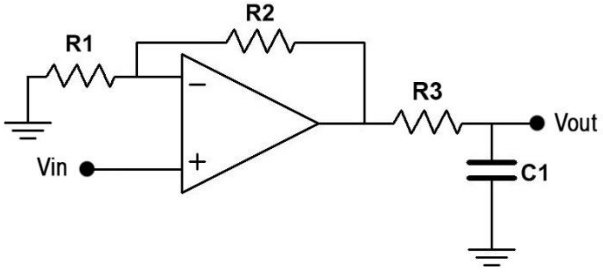

Fig. 5 – Not inverting amplifier of gain and filter RC first order.

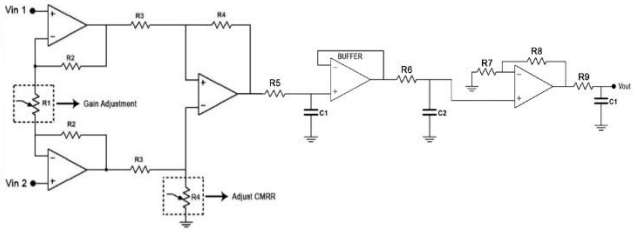

Fig. 6 – Complete Circuit.

For the control system implementation an electronic prototyping platform was used, Arduino UNO Atmega 328, in which it possesses a converter A/D integrated with resolution of 10 bits, returning an arrangement from whole numbers that vary of 0 to 1023 [12], with a in Micro Servo already with the digital exit of the signal. Moreover, the necessary became to insert a tension regulator, in of that the exit of the amplified signal overlapped to the band of tension allowed for the Arduino. Fig. 7 shows the logic of as the servo motor behaves before the ocular movement demonstrating a possible application for wheelchairs.

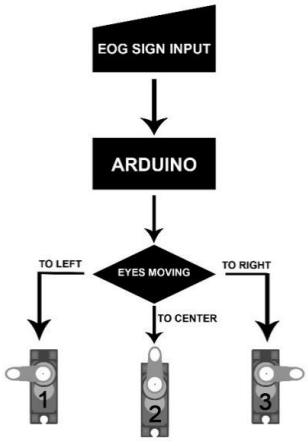

Fig. 7 – Control Chart.

The servo 1 indicates the angular rotation of 45 ° to the left corresponding to the movement of -35 ° of the eyeball to the same direction, the servo 2 is in the center, with an angle of 90 ° and neutral frontal look, in the servo 3 the eyeball moved Is 35 ° to the right, resulting in a 180 ° servo.

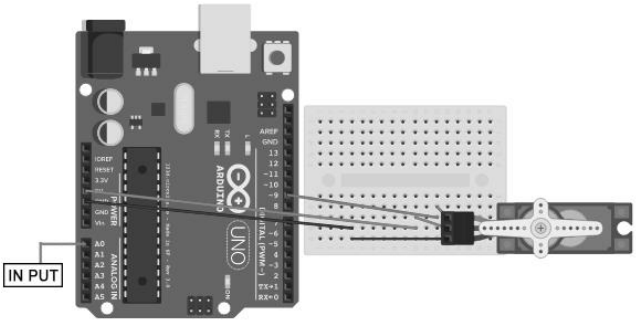

Fig. 8 – Control Platform Prototype.

IV. RESULTS AND DISCUSSIONS

Based on the elaborated project, it was possible to perform four acquisition and control tests under the same conditions, and it is worth noting that they are inherent to the same factor gain. Fig. 7, 8 and 9 validate the disparities between the tensions existing before the movements of the eyes. As it demonstrates Fig. 9 the maximum voltage was of 3.8 V this with movement accomplished for the right:

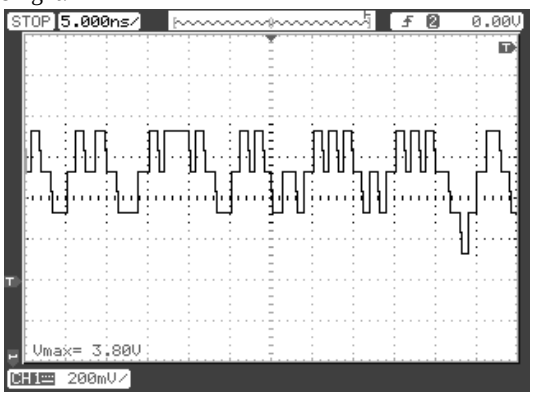

Fig. 9 – Ocular Movement for the right side.

Fig. 10 with looking at fixture to the center obtained a maximum voltage of 3.4V:

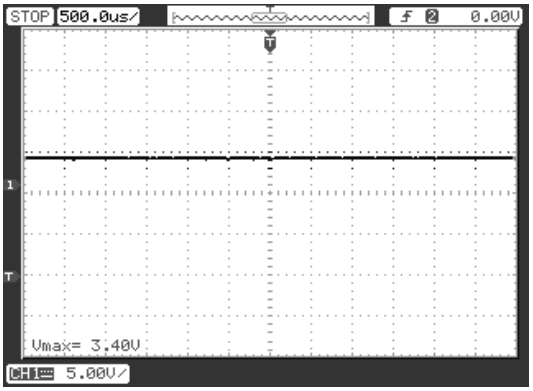

Fig. 10 –To look at set for the center.

Accomplishing movement fot the left as it shows Fig. 11 obtained a maximum voltage of 3.2V:

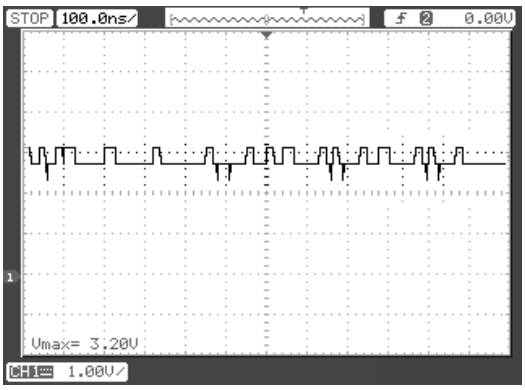

Fig. 11 – Ocular movement for the left.

To make the control of the electronic device the analogical signal became into digital; given that the servo motor can alternate the angulation of 0 to 179 degrees, the mapping in accordance with the tension variation became. The used function was map () of the library standard, this makes an analogy of the variation of range it [10] generated for the ocular globe with the break of movement of in micro servo, initially when individual meets with looking at frontal the device remains in 90º degrees dislocating themselves for left 0º degrees and right 179º.

All this process of movement of the servo is given through the variation of bits next to tension Table 1 below shows the variations caught in accordance with the accomplished movements.

TABLE 1: FEE OF VARIATION OF BITS.

DIRECTION	BITS
TO CENTER	270 – 290
TO LEFT	310 – 330
TO RIGHT	350 – 370

V. CONCLUSION

Therefore, the use of biopotential acquisition techniques and the manipulation of open space theses for several applications through this in the future, hopes that everyone can improve the prototype similar to that which may favor the use of this biotechnology for inclusion of individuals with physical disabilities, helping them in agile practice and in daily activities. It is worth mentioning that, with the same prototype of the acquisition and control circuit, but with a high gain in relation to the implemented one, a similar circuit can be made designated for vertical movements, this due to the angle of the movements of the ocular globe in this direction are smaller in relation to horizontal ones.

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