IOSR Journal of Electronics and Communication Engineering (IOSR-JECE)
e-ISSN: 2278-2834,p- ISSN: 2278-8735.Volume 13, Issue 3, Ver. I (May. - June. 2018), PP 16-18
www.iosrjournals.org

EMG Controlled Automated System

Arnab Bordoloi[1], Samujjwal Paitya[2]
[1](Gauhati University Institute of Science and Technology, Gauhati University, India)
[2](Gauhati University Institute of Science and Technology, Gauhati University, India)
Corresponding Author: Arnab Bordoloi

Abstract: *In this project, the Electromyogram (EMG) response is fed to control an automation system which is obtained from human arm response. The raw EMG signal is obtained from that part of the human muscle where the vibration generates responses within a suitable voltage range. This is fed to the automation system by proper conversion and filtering circuits to obtain the necessary pulse required to control the automated system. The raw EMG signal obtained in the range of few mV is amplified for further processing. To keep the response in the operating range we set the frequency bandwidth of a standard EMG response. For obtaining the EMG signals, surface electrode method is widely popular as it is non invasive and it can be conducted without any medical supervision. In this paper we are introducing an automated system which is controlled by the Electromyogram signal generated by contraction and relaxation of muscles, fed to the system wirelessly using a RF module, processed using Arduino*

Date of Submission: 26-04-2018 Date of acceptance: 16-05-2018

I. Introduction

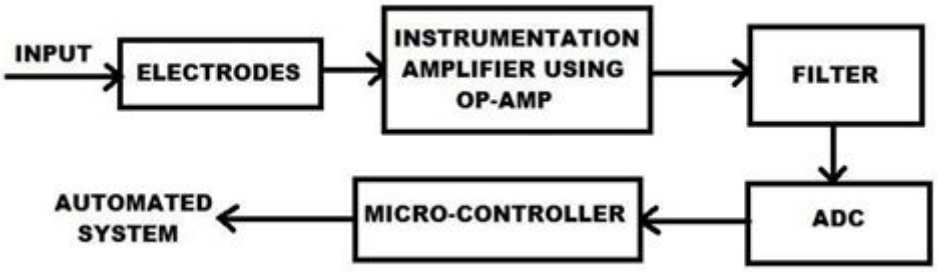
Electromyography (EMG) is the study of muscle function through analysis of electrical signals emanated during voluntary and involuntary muscle contraction. An Electromyogram measures the electrical activity of muscles when they're at rest and when they're being in action. Nerves control the muscles in the body with electrical signals called impulses. These impulses make the muscles react in certain ways. Motor neurons transmit electrical signals that cause muscles to contract. An electromyograph detects the electric potential generated by muscle cells when these cells are electrically or neurologically activated. Today Electromyogram finds wide application in various fields, a lot of work has been done regarding Electromyogram signal acquisition and it's processing for useful applications. In our paper, the EMG signal acquired from the muscles is sent to an arduino at the transmitting end which through a RF transmitter is sent to another arduino at the receiver end which after reception of the signal controls the automated system. The section 2 provides information about the existing works. Section 3 gives details of the design and implementation of the system. The results and observations were discussed in the section 4. Section 5 concludes the paper.

II. Existing Work

In [1], Shinichi Aso et al. proposed an EMG interface to drive an electric car. Mohan C, Vinod Kumar Giri in their paper [2], extracted an EMG signal using surface electrodes and instrumentation amplifier and after that the unwanted high frequency signal and other noise signals were filtered using a band pass filter. The filtered signal was rectified and the EMG signal was demodulated for purity using envelope detector. Then using comparator the low level signal was converted into a high level signal and thus counting of the transition of EMG signal by microcontroller became easy. The EMG count for single action and double action of muscle was calculated by counting the transition pulses of EMG signal. Finally, the motor ran in forward and reverse direction according to the EMG count desired. In [3], Chun Sing Louis Tsui, P. Jia, J. Q. Gan, H. Hu and K. Yuan, proposed a novel hands-free control system for an electric-powered wheelchair. This device was based on EMG (Electromyography) signals recorded from eyebrow muscle activity. In [4]Shital B. Sonone,G.D. Dalvi acquired the EMG signals from the forearm for the movement flexion and extension from different persons using surface electrodes. Two bipolar surface electrodes were used to measure the voltage difference between two specific points with the electrodes connected to the inputs of the differential amplifier. The advantage of bipolar electrodes is that it removes the common information obtained from both points. Now the obtained EMG signal was altered and amplified and were given to the microcontroller to convert to digital values corresponding to the EMG signals and were fed to the driver circuit.

III. Design and Implementation of the System

The idea of the project was to create a low cost system with wireless control using EMG signal. Our work can be divided into three segments. First, accurate acquisition of the EMG data from the muscles and amplifying it for proper processing. Secondly, designing an EMG system to control an actuator using microcontrollers. And lastly, controlling the actuator assembly wirelessly. For these purposes, each segment of the works were implemented in the following ways. The acquisition of the EMG signal was done by designing an EMG circuit, which has an signal amplifier, required filters and and also an ADC. The processing and controlling of the signal was done using Arduino. Also control of motors was done using Motor Driver circuit connected externally to the Arduino. For making the system wireless, RF receiver and transmitter were used. The basic structure of the system can be understood from the simple block diagram below.



The implementation of the system was so done that in the transmitting end, the electrodes attached to the body muscles were connected to the EMG circuit and the output of the circuit was connected to the Arduino. Using threshold condition for the EMG signal, the forward and backward movement was defined and for left-right movement accelerometer was used combined with the EMG signal. Further a bluetooth module was connected to implement the START condition. The signal was transmitted using RF transmitter. In the receiving end, the signals were received by RF receiver and fed into another Arduino for processing. According to the conditions set in the transmitting end, the arduino in the receiving end controlled the motor movements in different directions using a Motor Driver circuit. The schematic of the circuit used for EMG signal acquisition and filtering is shown below.

The following threshold conditions were set and results were observed for different hand movements.

ARM MOVEMENT	MOTOR MOVEMENTS	THRESHOLD
Relaxed	Forward	EMG signal<400
Flexed in	Backward	EMG signal>=400
Towards Left	Left	340<x-val<350
Towards Right	Right	355<x-val<365

*x-val indicates the accelerometer value

IV. Results & Discussion

The Bluetooth integration was done successfully and the START condition was implemented in our system. The motors now started moving only when the START condition was received and not automatically when it was connected to the power supply. The FORWARD condition of motor movements was set when the muscles were relaxed and BACKWARD condition was set when the muscles were contracted. The accelerometer was connected to our system and out of the three axes- X, Y and Z only the X-axis was used for

our system. The values were observed for different hand movements and based on the readings the threshold for left and right movement was set. For wireless communication RF transmitter-receiver was used. Once

connection between the transmitter receiver is established, sending of EMG and accelerometer data was done to the receiving end and the system was controlled accordingly. After the completion of the work done in this phase, our system now comprises of the EMG circuit for reading the EMG signal, Accelerometer for reading the hand movements and these two are coupled with a RF transmitter connected to an Arduino for sending the data wirelessly. The other part of the system has a RF receiver connected to the Arduino, for receiving the transmitted data and the Motor Driver for running the motors. Also a Bluetooth module is connected at the receiving end. Combining all these, our system is a Wireless EMG controlled Robot.

V. **Conclusion**

During the course of the project, at first we have mimicked the EMG signal through a function generator keeping the frequency between 5-150 Hz and voltage level below 50mV. Once the circuit is tested using function generator, real time EMG signals are obtained using surface electrodes. The overall circuit is designed and the required processing, which includes amplification, filtering and rectification, is done. The automated system is designed which is a prototype robot, testing and controlling of the automated system is done using the EMG signal. Thus the project provides us with the opportunity to design any automated system which can be conveniently controlled by muscle movements. This provides us with endless possibilities. This mainly aims at handicapped people in particular, and also since the automated system can be remotely controlled by our muscle movements it will find wide applications in Defence and Industry.

References

[1]. Dr. Scott Day, Important factors in surface EMG measurement.
[2]. Mohan C, Vinod Kumar Giri, DC motor control using EMG signal for prosthesis, IJECT vol.2, Issue 2,June 2011.
[3]. Chun Sing Louis Tsui, P. Jia, J. Q. Gan, H. Hu and K. Yuan, "EMG -based hands-free wheelchair control with EOG attention shift detection," in IEEE International Conference on Robotics and Biomimetics (ROBIO), Sanya, 2007.
[4]. Shital B. Sonone, G.D. Dalvi , Real time control of Robotic Arm using EMG signals,2016.
[5]. T. Tsuj, O. Fukuda, H. Shigeyoshi and M. Kaneko, "Bio-mimetic impedance control of an EMG-controlled prosthetic hand," in IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2000),Takamatsu, 2000
[6]. Hae-Jeong Park, Sung-Hoon Kwon, Hee-Chan Kim and Kwang-Suk Park, "Adaptive EMG-driven communication for the disabled," in IEEE Engineering in Medicine and Biology 21st Annual Conference,1999 and the Annual Fall Meeting of the Biomedical Engineering Society,1999.
[7]. Masafumi Hashimoto , Kazuhiko Takahashi, Masanari Shimaka, "Wheel chair control using an EOG and EMG based gesture interface,2009.
[8]. S.Sathish, K.Nithyakalyani, S.Vinurajkumar, C.Vijayalakshmi, J.Sivaraman, "Control of Robotic Wheel -Chair using EMG signals for Paralysed persons,2016.
[9]. Raez MBI, Hussain MS, Mohd-Yacin F. Techniques of EMG signal analysis: detection, processing, classification and applications. Biological Procedures Online. 2006 March.
[10]. Jeon BI, Cho HC. Analysis of the EMG output characteristic in response to activation of muscle for the human intention judgment. Indian Journal of Science and Technology. 2015 April.
[11]. Carlo J. De Luca, Surface Electromyography: Detection and Recording.
[12]. Andrea Merlo and Isabella Campanini, Technical Aspects of Surface Electromyography for Clinicians, The Open Rehabilitation Journal,2010,Volume 3
[13]. Reza Boostani and Mohammad Hassan Moradi Evaluation of the forearm EMG Signal Features for the Control of a Prosthetic Hand, 2003.
[14]. C. J. D. Luca, John G. Webster, "Electromyography. Encyclopedia of medical devices and instrumentation" in , John Wiley Publisher, pp. 98-109, 2006.

IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) is UGC approved Journal with Sl. No. 5016, Journal no. 49082.

Arnab Bordoloi "EMG Controlled Automated System." IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) 13.3 (2018): 16-18.