Human-Machine Interfacing Using EMG Signal

SYED. ADIL[1], P. JAYA KRISHNA[2], N. MOHAN KRISHNA[3], V. MURALI KRISHNA[4]

[1,2,3,4] *Dept. of ECE, KKR & KSR Institute of Technology and Sciences, JNTU-Kakinada, Guntur, Andhra Pradesh*

Abstract -- The project deals with the development of a prosthetic limb made of the acrylic sheet using electromyography signals for the people who lost a part of their limb due to circulation problems from atherosclerosis or diabetes, traumatic injuries occurring due to traffic accidents and military combat, cancer or birth defects. Electromyography (EMG) is a technique for evaluating and recording the electrical activity produced by skeletal muscles. An electromyography detects the electrical potential generated by muscle cells when these cells are electrically or neurologically activated. Measured EMG potentials range between 2 millivolts to 4 millivolts depending on the muscle under observation. The two surface electrodes are attached to the healthy limb and sense the muscle contraction when a movement is made.

I. INTRODUCTION

Prosthetic is an artificial extension that replaces a missing body part. They are used to replace parts lost by injury or missing from birth or to supplement defective body parts. Prosthetic design features of artificial limbs are lightweight, compact and dexterous that mimics human anatomy and maintain a high lifting capability. The prosthesis is a device that can help restore some of the functionality to the user. These devices intelligently recognize limb motion of the person and the pulses are generated by using a microcontroller and the respective motors. The motor is driven by movements of the hands and wrist, hand open, hand close, wrist flexion, wrist extension etc.Due to the fast advances in medical technology worldwide, rehabilitation systems are currently used by patients after a major operation, chronic pain, sensory loss, stroke, unpredicted pain, severe accident, orthopedic anarchy, brain injury, Parkinson's disease, psychological disorder, sports-related injury and by older individuals. The prosthetic arm which uses Myoelectric (EMG) signals for control. This is possible due to the fact the neuromuscular system of amputees remains intact even after amputation. The residual signals are made use of and it is sufficient enough to control the movement of the arm after suitable processing. Hence a cost-effective prosthesis is needed in developing countries. Although prosthetic components can be imported from other countries at a high cost, the developing countries should be in the position to manufacture cost-effective prosthesis. Approximately 100,000 people in the INDIA have a major upper limb loss, 57% of them being trans-radial amputees. About 80% use prosthesis. Myoelectric controlled devices are used by roughly 30- 50%. Last decade has a remarkable increase in upper limb prosthetic research.

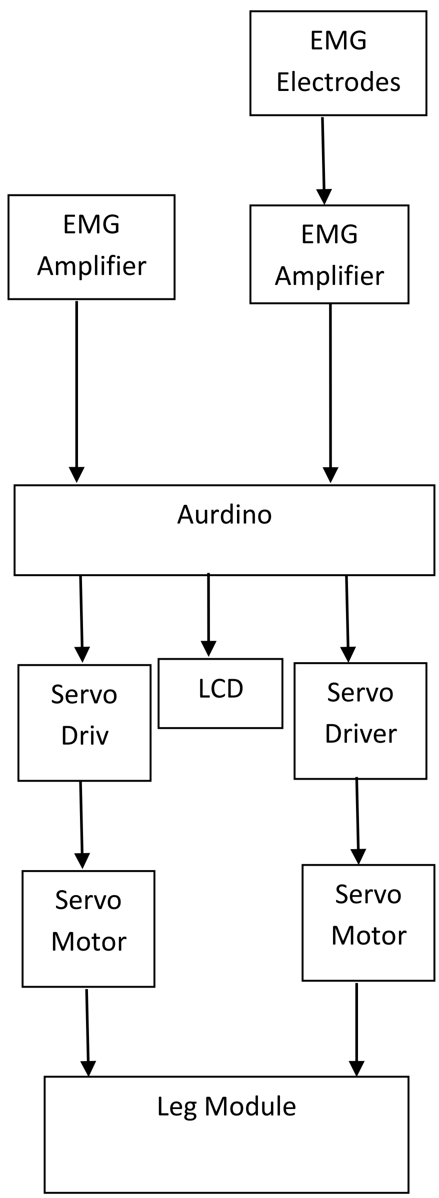
a) Existing system:

In current scenario the handicap people for example without leg person who faced many problems to wear the artificial leg because it should be settled by correct position unless it will create some pain. The next reason is the artificial leg here some more weight. So using this is very painful and it not settled in the correct position the persons walking style will vary.

b) Proposed system:

In the proposed Method, the development of Prosthetic limb using EMG signals is designed. The Prosthetic limb functions according to the input from the normal limb. It is constructed using weightless materials with fewer hardware components. This cost-effective prosthetic limb enables the end user to walk with a great comfort. The program to the prosthetic limb is embedded in an Arduino microcontroller which serves as an open source platform where one electric component can interact with another.

II. BLOCK DIAGRAM



III. WORKING

Two electrodes are placed on the healthy limb and another two electrodes are referred to ground. When the healthy limb moves, muscle contractions are made. These muscle contractions are sensed by surface electrodes which produce a voltage of 2 millivolts to 4 millivolts. This voltage is given to EMG circuit. EMG circuit consists of the Instrumentation amplifier, rectifier, filter, and regulator. After being processed by the EMG circuit, the signals are given to the Arduino microcontroller. This Arduino microcontroller is already preprogrammed such that the prosthetic limb acquires the accurate step and angle made by the healthy limb. The Limit Switch is used for the secondary purpose. Both these inputs are converted to digital signals b (Analog to Digital Converter) before being sent to the Arduino microcontroller. Two servo motors are placed above the knee and below knee respectively. 24 millivolt of the input signal is passed to the servo driver from the Arduino microcontroller. This actuates the servo mechanism to drive the servo motor. This enables the prosthetic limb to function according to the input given by the normal limb.

IV. CONCLUSION

The electromyogram (EMG) signal is the electrical physiological signal of activation of a motor unit associated with a contracting muscle and serves as a potential resource. The movement of the prosthetic limb with the help of the signals acquiring from the healthy limb is our result. Two electrodes which are placed on the normal limb will be sending its signal to the Arduino microcontroller and in turn, it will be sending the signal to the servo motor thereby the movement of prosthetic limb takes place as per the movement of a normal limb with same angle and steps. The prosthetic limb made use of acrylic sheet using electromyography signals has Less Weight, Reliable, Cost-effective, Durable, High performance, No side effects and it cannot be applied for the amputees with no limbs. The project can be implemented to the amputees who lost both of their limbs. Further, it can be improved in animals as helping aid to supplement their own missing or impaired limbs.

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