PROSTHETIC ARM USING EMG

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Abstract: Prosthetic arm research predominantly focuses on "bionic" but not body-powered arms. However, any research orientation along user needs requires sufficiently precise workplace specifications and sufficiently hard testing. Forensic medicine is a demanding environment, also physically, also for non-disabled people, on several dimensions (e.g., distances, weights, size, temperature, time).

Keywords **- ESP8266 (manufacturer: Espressif Systems), ESP32, Arduino Uno, servo motor, dry electrodes, Instrumentation Amplifier Ic-, Operational Amplifier, EMG signals, time- frequency approaches, wavelet analysis, artificial intelligence, transforms.**

1. INTRODUCTION

Electromyography (EMG) is a unique technique for specifying muscle activation. The area of EMG interpretation and pattern reorganization of bio signals have gained the fast popularity during past few years. This kind of research presents a smooth path to interface with the neuromuscular handicapped people with external world. Human body generates myoelectric signals and by using this signal the powered external device can be controlled. This process is referred to as myoelectric control (MEC). EMG signal is one of the important bio signals which is generated by human body, confirms the muscles activity or summation of various motor units action potentials. EMG signals have the properties of non-stationary, nonlinear, complexity, and large variation. The Mio Electric Signal (MES) is a complicated signal controlled by the central nervous system (CNS). It is affected by anatomical and physiological properties of muscles of human body, the control scheme of the peripheral nervous system, and the characteristics of the Instrumentation is used to detect and measure this signal.[1]

2. TRADITIONAL PROSTHETIC ARM

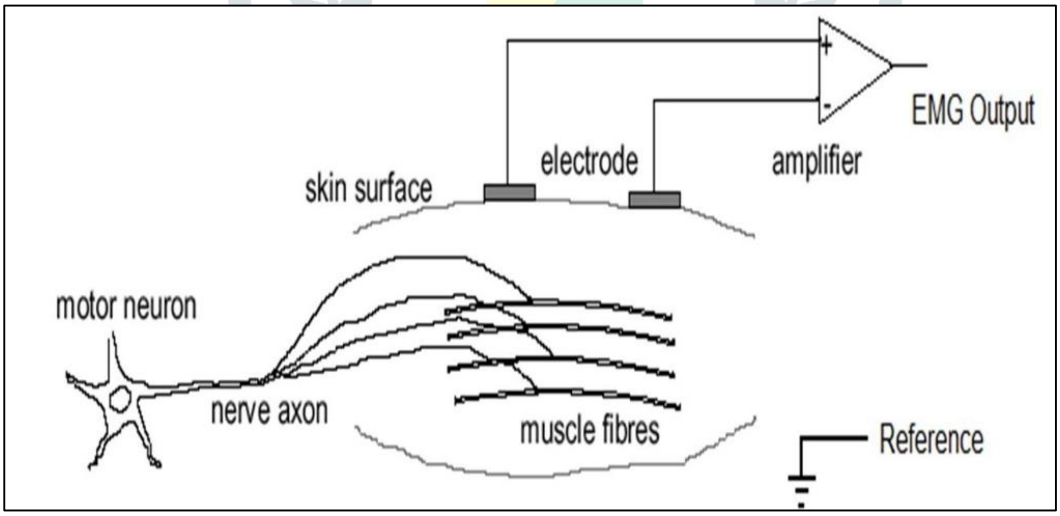

fig 1. motor neurons

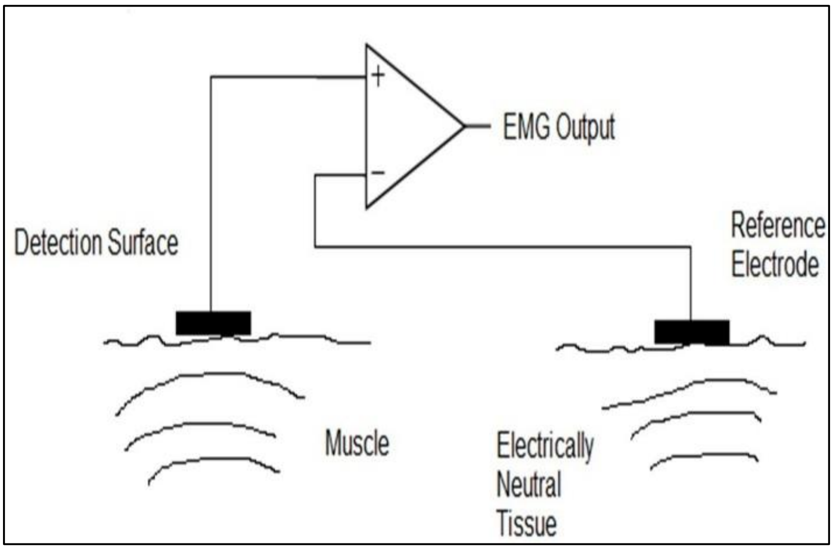

fig 2.emg output

3. BACKGROUND STUDY

Work specific tasks invariably define specific functional requirement profiles for workers (including prosthetic arms). Once a personal preference has expressed itself in the form of work choice, and once a person has acquired extensive experience and skills in a field, technical necessities often follow with little further options. Then, various prosthetic solutions may be thought to be competing for better performance when in fact, the choice-dependent hard requirements for a viable prosthetic solution have already set the stage. Primarily, any competition seems to boil down to body-powered versus myoelectric technology. Within body-powered control systems, voluntary opening (VO) and voluntary closing (VC) devices offer different profiles.[4]

Assessment of current state and developments of prosthetic arms presented here has one aim. That aim is to enable the first listed author of this paper[1] to keep working, at the front, within one of the most modern forensic pathology institutes and projects. Our focus, therefore, is the occupational rehabilitation for one profession. Since 2008, the first author develops, tests and refines solution oriented prosthetic arm components (as detailed in this case *study).*

With a generic task choice based on ADL (activities of daily living), the CYBATHLON 2016 had provided a competitive demonstration of prosthetic arms in October 2016 in Zürich, Switzerland. There, competitors wearing prosthetic arms attempted both fast and precise manipulations performing light activities. A televised public arena setting provided for a certain degree of intensity and stress. The winner wore a body-powered arm; the myoelectric arm users filled the remaining ranks.

Intensity in physically demanding tasks, such as discussed in this paper, will be a lot greater along more than one dimension. Dimensions include wider ambient temperature range, longer duration of work, heavy sweating and far larger pull or push weights. There is also a more existential aspect of manipulation content, i.e., an accidental drop of an expensive camera is penalized more unforgivingly than not winning a medal.[4]

In this paper, we will employ the term "physically demanding work" (PDW) to denote physically intense, repetitive, hazardous, demanding, unforgiving, critical and otherwise extensively bi- "manual" work. It demands undivided attention, it does not provide extra time to troubleshoot the prosthesis, and it requires full reliability for pull, push, lift or grip manipulations.

A. Generation of EMG Signals in Human Body

Biomedical signal is a collective electrical signal, acquired from any parts of our body that represents a physical variable of interest. EMG signal is normally a function of time and it is describable in terms of the parameter's amplitude, frequency and phase. Electromyography signal also measures electrical currents generated in muscles during its neuro-muscular activities. The nervous system always controls the muscle activity (contraction/relaxation). So, the EMG signal is a complicated signal that is controlled by central nervous system and is dependent on the anatomical and physiological properties of muscles. EMG is acquired from electrodes and mounted directly on the skin; the signal is the combination of all the muscle fiber action potentials which are random in nature. At any one moment, the EMG signal may be either positive or negative. Individual muscle fiber action potentials are sometimes acquired using wire or needle electrodes placed directly in the muscle. The signal is picked up by the electrode and amplified. Typically, a differential amplifier is used as a first stage amplifier. Additional amplification stages may follow. Before being displayed on the screen, the signal can be further processed to eliminate low frequency or high frequency noise. But the user is interested in the amplitude of the signal. The signal is frequently rectified and averaged in some format to obtain the EMG amplitude. The EMG is applied to the study of skeletal muscle.[3]

B. Abbreviations and Acronyms

EMG – Electromyography
MEC - Myoelectric control
MES - Mio Electric Signal
CNS - Central nervous system

C. Block Diagram

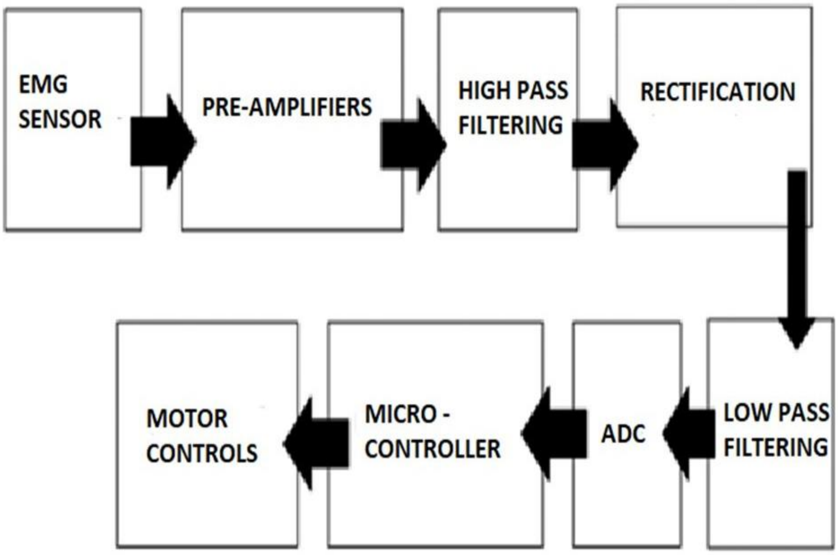

fig 3. block diagram

4. IMPLEMENTATION

Exoskeleton robots are mechanical constructions attached to human body parts, containing actuators for influencing human motion. One important application area for exoskeletons is human motion support, for example, for disabled people, including rehabilitation training, and for force enhancement in healthy subjects.

EMG can be used to sense isometric muscular activity where no movement is produced. This enables definition of a class of subtle motionless gestures to control interfaces without being noticed and without disrupting the surrounding environment. These signals can be used to control a prosthesis or as a control signal for an electronic device such as a mobile phone or PDA Unvoiced speech recognition recognizes speech by observing the EMG activity of muscles associated with speech. It is targeted for use in noisy environments and may be helpful for people without vocal cords and people with aphasia.

EMG signals have been targeted as control for flight systems. The Human Senses Group at the NASA Ames Research Center at Moffett Field, CA seeks to advance man-machine interfaces by directly connecting a person to a computer. In this project, an EMG signal is used to substitute for mechanical joysticks and key- boards. EMG has also been used in research towards a" wearable cockpit," which employs EMG-based gestures to manipulate switches and control sticks necessary for flight in conjunction with a goggle-based display. (Refer the block diagram) [1]

V. CONCLUSION

1. Low cost devices used in the project.
2. Highly efficient and reliable
3. The presented work is based on the faithful extraction of EMG signals from human body.
4. The EMG signal acquired is maintained under the range of 0 to 5 volts and can be accessible by any ADC unit.

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VII. PUBLICATIONS

1. Ÿ International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 6, Issue 2, February 2017.

2. Juliette de Paula Felipe de Oliveira, Ernano Arrais, Valentin Obac Roda, "A reconfigurable control system using EMG", Instrumentation and Measurement Technology Conference (I2MTC) Proceedings 2014 IEEE International, pp. 1318-1321, 2014.

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