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Research Article

EMG CONTROL OF A ROBOTIC ARM

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ABSTRACT

Robotics is one of the fastest growing segments of the industrial machine market. The advances in the current technology enables the humans to develop the state of the art Robots to accomplish the specified tasks. One of the major fields of application of robotic systems is the bio-medical field. Electromyogram (EMG) signals square measure generated by muscles once activated by the system, which generates electric potential. These signals then cause contraction of the muscle which ends in body movement. These EMG signals can be read through the use of surface EMG electrodes to assess the muscle to read the signals from the skin above the desired muscle. EMG signals will be helpful for developing systems that may facilitate the disabled. This help will be performed through the event of medical specialty. The medical field has benefited from intensive research in EMG signal analysis in the past couple decades, which has improved the quality of life for those with physical disabilities.

The main aim of this paper is to design a robotic arm that works using the electromyography that moves the robotic arm with the help of arduino microcontroller ATmega 2560. With this project, the main goal is to transform muscle tensions of the human arm into the physical form of the movement of the robotic arm.

INTRODUCTION

With Associate in Nursing understanding of biomechanics, engineers can develop biologically-inspired robots with improved and enhanced capabilities over traditional robots, which are—how shall we say—robotic! Biologically-inspired robots have bigger quality and suppleness than ancient robots and infrequently possess sensory skills. biorobotic technologies are often utilized to provide assistance to accommodate a deficiency—either as fully-functioning robots or highly advanced prosthetics; the latter represents one area in which neural engineering and biorobotics ran into as each disciplines square measure needed so as to initial signal so generate movement. Such devices might also be wont to live the state of malady, track progress or supply interactive coaching experiences that can speed recovery from an injury or stroke. Electromyogram (EMG) signals ar potential difference generated by muscle cells once being activated by the systema nervosum. The additional force we tend to apply to the muscle the larger the nerve impulse, generating a bigger potential difference from the muscle cells. In theory, anywhere from 10 Hz to 500 Hz is the typical range of any EMG signal that will be produced by the human body. A raw EMG signal will have a range of -5 to +5 mV before amplification. This price could seem tiny in nature, however once amplification of the signal will manufacture terribly valuable information to researchers.

The main aim of this project is to design or create a robotic arm that works in synchronous motion to the real time arm movements of the human operator. This works by using the human machine interfacing with the electromyography. The robotic arm movements can be obtained using the electromyography arrangement of the human arm.

A flex sensor is connected to the human arm which is connected to the arduino controller. In this case, the arduino ATmega 2560 is connected to the flex sensor. When the muscle contracts, the flex sensor takes the impulse signals that can be amplified and later on processed through a microcontroller for controlling robotic arm with servo motors.

Experiment Work

For the desired model, various components were used. An arduino ATmega 2560 microcontroller is used. The reasons behind using ATmega 2560 over the other arduino boards are that it has more memory, more pins and more built-in hardware peripherals than the ATmega328 and other boards. The Electromyography setup is also used which takes the muscle signals from the human arm and enables it to move as the

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human arm. A flex sensor is used which is placed on the human arm which sends the value of the muscle contractions. Through this, the action potential activates and sends the value to the EMG setup.

Fig 1 EMG arrangement

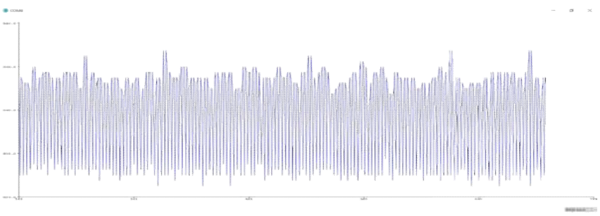

Fig 2 The EMG response with flex sensor.

Fig 3 The typical EMG response

As shown above Fig 1, the project for the robotic arm consists of the flex sensor arrangement placed at the finger of the human arm whose action has to be replicated. The flex sensor that takes the signals from the human arm and sends them to arduino board and the other flex sensor that is placed on the elbow section also sends the elbow movement signals to the arduino board and the board takes in the signal and gives the input signal to the robotic arm arranged at the end of the setup. The input signal that is received by the robotic arm enables it to move as per the human arm instructions. The EMG arrangement is also done in order to obtain the muscle tension. So when the operator puts on the emg set up on his arm then the emg takes in the muscle tension and it sends the signals which are converted into the voltage. This voltage obtained enables the robotic arm to move at an extent of the muscle tension given by the operator. The voltage obtained can also be used as the reference voltage if the input voltage supplied doesn't have a required driving strength to drive the hand movement.

Steps of Operation

Firstly, an EMG setup is made on the human arm whose action of arm movements would be replicated by the robotic arm. Along with the EMG arrangement, a flex sensor is also set on the lateral antebrachial cutaneous nerve which takes in the elbow movement of the human arm and thereby makes the robotic hand move accordingly.

A glove is to be worn by the operator. This glove also contains a flex sensor. The flex sensor is to be fixed onto the finger of the human arm. The number of flex sensors depends on the need of the operator i.e., if the user needs the movement of every finger, then five flex sensors have to be placed on the arm. In this paper, I have used only one flex sensor. So this hand with flex sensors have to be worn by the user and this enables the robotic hand to move as required.

The signals that are obtained from the EMG and the flex sensor on the wrist are collectively given to the opamp and this sends the signals to the arduino board (ATmega 2560 in this case) which gives them to the computer that sends them finally to the robotic arm placed and a continuous waveform can also be obtained which can be called as the EMG waveform.

So using the above two steps of operation, the movement of the robotic hand is done according to two methods as mentioned above and finally, both of these signals are to be mixed and are to be given to the robotic hand.

Initially, the up and down movements of the robotic hand are obtained from the system through the serial monitoring which is obtained by the flex sensor readings placed on the lateral antebrachial cutaneous nerve.

Similarly, the finger movements are obtained from the flex sensors placed on the fingers of the operator.

The above two figures shows the individual arrangements of the EMG arrangement on the fore arm and a glove on the human hand which gives the EMG signals to the robotic arm.

Components used

Electrode: In this work, electrode is the main component for operation because it acts as a gateway for the signal to read. In this process, the electrode used is the gel electrode. Gel type electrode is composed of electrolyte gel as a chemically linked bond between the skin and the part of the metal electrode. The process of oxidation and reduction occur on the surface between the metal and the gel. The metal part of the electrode consists of the silver chloride. The silver chloride part easily facilitates the current flow passing through the bend between the electrolyte and the metal parts of the electrode.

Servo motor: Servo motor is a DC motor that is equipped with a control circuitry. This control circuitry provides the feedback to the motor's rotational position from 0 to 90 degrees.

Operational Amplifier: Operational amplifier is an electronic component which is a series of transistor and other electronic component packed into an integrated circuit which has two inputs inverting and non inverting with an output terminal.

Flex Sensor: A flex sensor or bend sensor is a sensor that measures the amount of deflection or bending. Usually, the device is stuck to the surface, and resistance of sensor element is varied by bending the surface. Flex device is employed in wide areas of analysis from pc interfaces, rehabilitation, security systems and even music interfaces.

RESULTS AND GRAPHS

The figure 3 indicates the combined waveform that is obtained by both the flex sensors placed on the two positions on the arm at the finger and the other at the elbow of the hand. So the information from the both the flex sensors is processed and the combined waveform is generated. The upper shift of the graphical peaks are those that are obtained when the wrist opens and closes. The lower peaks are obtained when the human arm moves up and down. The figure 4 indicates a simple typical EMG waveform. The experiment is initiated by running the simple EMG process by placing the probes on the human arm.

CONCLUSION

The robotic hand with EMG interfacing is done using a flex sensor. This can be used to help the handicapped to accomplish simple tasks. The simple EMG circuit that was made has worked well in reading and amplifying the muscle signals obtained from the skin using gel based electrodes. This work can be extended by fixing the flex sensor to every finger on the hand so that it can perform the desired task by making the life of the handicapped easier.

References

1. K. Kiguchi, T. Tanaka, and T. Fukuda, "Neuro-fuzzy control of a robotic exoskeleton with EMG signals," IEEE Trans. Fuzzy Syst., vol. 12, no. 4, pp. 481–490, Aug. 2004.
2. Wu, Yunfen, María Ángeles Martínez Martínez, and Pedro Orizaola Balaguer. "Overview of the Application of EMG Recording in the Diagnosis and Approach of Neurological Disorders."Overview of the Application of EMG Recording in the Diagnosis and Approach of Neurological Disorders | In Tech Open. In Tech, 22 May 2013. Web. 21 Apr. 2017.
3. Ferreira, Andre, Wanderley C. Celeste, Fernando A. Cheein, Teodiano F. Bastos-Filho, Mario Sarcinelli-Filho, and Ricardo Carelli. "Human-machine Interfaces Based on EMG and EEG Applied to Robotic Systems." Journal of Neuro Engineering and Rehabilitation. Bio Med Central, 26 Mar. 2008. Web. 10 May 2017.
4. S. Bitzer and P. van der Smagt. "Learning EMG Control of a Robotic Hand: Towards Active Prostheses". Robotics and Automation, 2006. ICRA 2006. Proceedings 2006 IEEE International Conference on. May. 2006, pp. 2819–23.
5. R. Boostani and M. H. Moradi. "Evaluation of the Forearm EMG Signal Features for the Control of a Prosthetic Hand". Physiological Measurement 24 (2003), pp. 309–319.
6. Gil, Jamie Gomez, Israel San-Jose-Gonzalez, Luis Fernando Nicolas-Alonso, and Sergio Alonso Garcia. Steering a Tractor by Means of an EMG-Based Human-Machine Interface. Tech. Department of Signal Theory, Communications and Telematics Engineering, University of Valladolid,, 11 July 2011. Web. 24 Apr. 2017.
7. K. Choi, M. Sato, and Y. Koike. "A New, Human-Centered Wheelchair System Controlled by the EMG Signal". International Joint Conference on Neural Networks. IEEE. 2006, pp. 4664–4671.
8. O. Fukuda, T. Tsuji, M. Kaneko, and A. Otsuka. "A HumanAssisting Manipulator Teleoperated by EMG Signals and Arm Motions". IEEE Robotics and Automation 19 (2003), pp. 210–22.
9. M. R. Dawson, F. Fahimi, and J. P. Carey. "The Development of a Myoelectric Training Tool for Above-Elbow Amputees". The Open Biomedical Engineering Journal 6 (2012), p. 5.
10. W. Amai, J. Fahrenholtz, and C. Leger. "Hands-Free Operation of a Small Mobile Robot". Autonomous Robots 11.1 (2001), pp. 69– 76.

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