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EMG Muscle Controlled Robotic Arm

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Abstract: In past years there are lots of research has been done in the Robotics. So that the robots can be used in the various are of application like in the industrial application for the more accuracy and more production, in the field of research, in dangerous area of application, in mining sector and in various applications. Robots can be also used for the amputee person the person is the arm amputee person then the robot is used as the arm for the person. If the person is leg amputee then the robotic arm is fitted on the bot to move and able to pick and bring the things for the person. In this way the wireless movable robotic arm can be work.

Keywords. Wireless Communication, Electromyography sensor, Robotic Arm

1. Introduction

There are lots of sensor are area available for the robotics every sensor have its different area application some sensors are used for the temperature sensing and some are used for the temperature sensing, some are used for the distance measuring some for the vibration sensing like that all sensors are having different are of application all sensors which are used in the robot makes the robot to work for work in the special application in special environment. The selection of sensors are based on the application. Like the sensor actuator and switch are plays very important role in the robotics. In this project we are using the electromyography signal which is detected by the muscle of the human and the sensor is used for the sensing of the EMG signal is EMG sensor.

This sensor is used for the diagnosis and the analysis of the human muscle and sends the result signal to the controller. EMG sensor has two types of outputs. Raw signals and integrated signals which are called as EMG signals. Controller of the system get the EMG signal from the EMG sensor and analyze the input signal according to the input signal the controller the threshold level is defined. It is very important to define the threshold level according to the application to the robotic arm. If the input signal is goes above the threshold level then the controller will send the control signal to the servo motor through the wireless module.

The world is moving to the wireless connectivity from daily need residential applications to the industrial applications. Because it gives the mobility to the system and hence by working at the one place throughout it cause trouble to the body and when we deal with the wireless connectivity then this kind of things are easily get avoided and it gives the

freedom of working with less trouble. The wireless communication gives the advantage of the less loss when we use wire then there are lots of opportunity for the losses like bending loss copper loss etc this can be overcome by using wireless technology and the one most important thing is that the large and long wires which are complex thing to manage and if there is any error or problem then it become the very big problem to fix it, so if we use wireless device then the long and large wire will be replaced with more range of the connectivity.

Wireless device used in the wireless movable robotic arm is nrf24L01 transceiver which is used to transmit and receive the data by the one module. This module works on the frequency of 2.4 to 2.5GHz of ISM band. At the receiver end the control unit controls the servo motor which is connected to the fingers of the robotic arm.

2. Literature Review

a) Gesture Actuated Robotic Arm

The output of the gesture control robotic arm is depends on the gesture of the human. According to the human gesture the output of the gesture control robotic arm it has two section transmitter section and the receiver section the transmitter section is responsible for the detection of the human gesture and the according to the input signal it distinguish the different signal and create different output for the different section of the robotic arm and the signal then send to the receiver of the gesture controlled robotic arm at the receiver the input from the transmitter signal is taken and according to the signal the receiver section control the servo motor.

b) Multi-tasking EMG controlled robotic arm

The presented work is based on the faithful extraction of EMG signal from the human body. The EMG signal acquired is maintained under the range of 0 to 5v and can be accessible by any ADC unit. The digital data obtain after conversion is utilized to read by microcontroller unit. The data received from the microcontroller port is further tested various class of motor like stepper motors. Servo motor and dc motors result in mechanical model which is design to organized the robotic arm which is used for the multiple purpose like handling the things and picking the things according to the controlled signal which is generated by the muscle of the human arm and the these signal are sensed by the EMG sensor and the signal is sends to the controller and according to the input signal the threshold level is set and according to the threshold if the input signal is reach above that signal then the controller gives the command to the servo motor for the move in this the robotic arm is wired so that this can be handle in the specific area of application. And it has the bound so in the future scope the robotic arm is controlled wireless technology.

c) Real-time Classification of Electromyographic Signals for Robotic Arm Control

The presented work is based on the Real time classification of the classification of the EMG signal for robotic arm in this the signal is extracted by the human muscle by attaching the EMG signal to the human muscle then according to the signal which is sensed by the variation in the potential variation in the muscle of the human muscle and then the signal is sends to the controller and then the controller classify the input signal and according to the input signal the controller will give some command to the robotic arm and according to the input signal taken from the controller the robotic arm is controlled and movement is happen in this project the real time classification is achieved and the according to the input signal and the real time control of the signal is achieved. The robotic arm is connected by the wire, so that there is restriction so that can be overcome by the wireless technology

3. Methodology

The sensor is used in the muscle controlled robotic arm is the EMG sensor which is used for the measurement of muscle activity it has three electrodes which is connected to the part of the human body whichever part of the muscle has to be measure when the human body is get stretch or used then some amount of potential charge is get generated in the muscle the EMG sensor used to measure the potential within that muscle and the detected signal is processed. The EMG sensor contains rectifier, filter and integrator. The detected signal is pass through the rectifier which rectified the input signal and then the output of the rectifier is given to the given to the filter which filter out the signal and in the output the smoothen signal is given and then output of the filter is given to the integrator the output of the integrator is called as the EMG signal and the EMG signal is given to the controller.

Controller of the transmitter section of the section contains ARDUINO NANO this is use to monitor the input signal from the EMG sensor and then according to the analysis of the signal threshold level is set the setting of the threshold is very important. When the input EMG signal is sensed above the threshold signal then the input then controller sends the control signal to the receiver section for the through the wireless module

The wireless movable robotic arm uses the wireless device for the communication between the transmitter and receiver the wireless device is used called as nRF24L01 transceiver. This module is the transceiver which can transmit and receive the signal with the single module. This module works with the 2.4 to2.5 GHz ISM bands of frequency the maximum data rate is 0 to 1Mbps. By using wireless module the mobility of the system is accessed to the Robotic arm within the distance under the 500meter.

At the receiver section the output of the receiver is given to the ARDUINO UNO which is the controller at the receiver section this section control the servo motor according to the input signal the servo motor is used to move the finger. The finger is connected to the servo motor and each finger has individual servo motor and the every servo motor has to rotate with the different angle to get control like human finger.

4. Block diagram

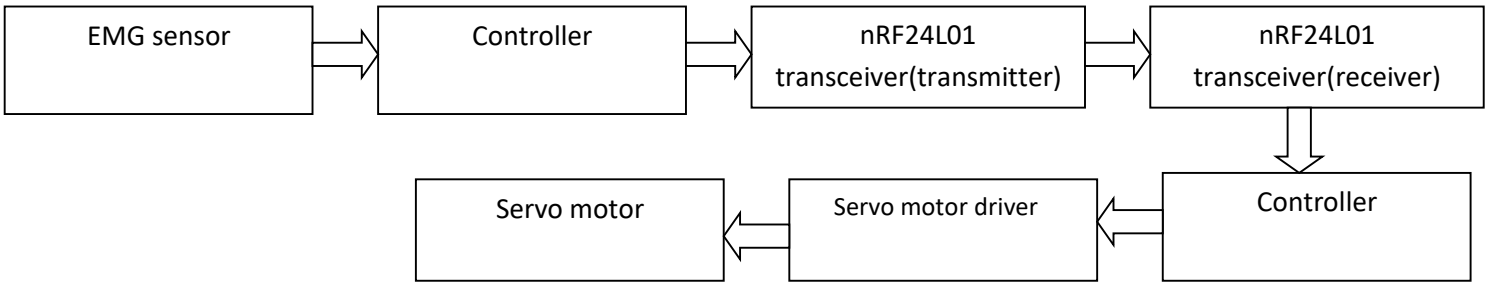


Fig. block diagram of wireless movable robotic arm

Above figure shows the block diagram of wireless movable robotic arm which contains the following blocks

- EMG sensor
- Controller
- Transceiver (transmitter) section
- Transceiver (receiver) section
- Controller of the receiver
- Servo motor driver
- Servo motor

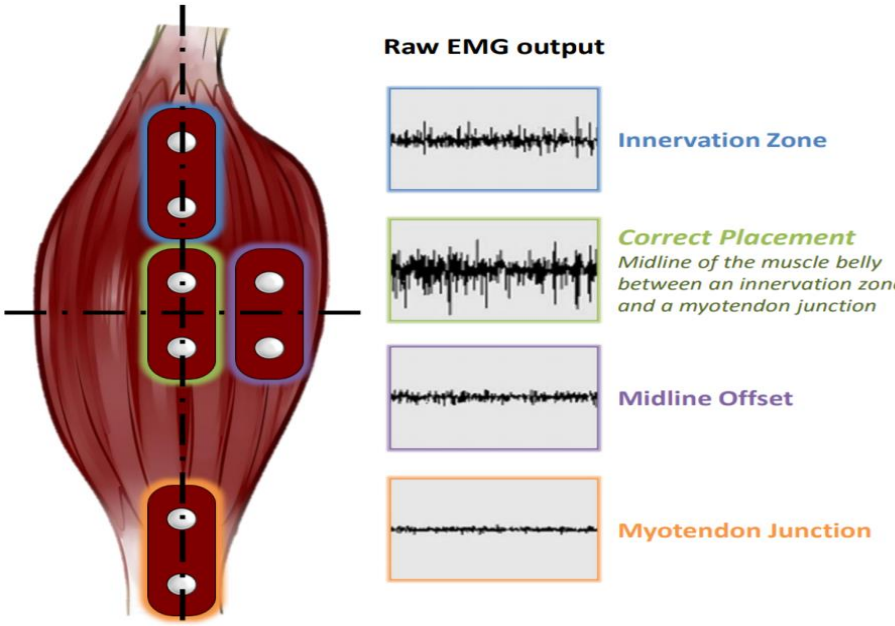
EMG SENSOR

a) Electromyography

Electromyography sensor is used for the measure the muscle activity of the muscle the muscle of the human body where emg sensor is being placed. The EMG sensor muscle sensor is measure muscle activation by the variation of the electric potential get produced in the muscle of the human muscle, referred as a electromyography (EMG), has traditionally been used for medical research and diagnosis of neuromuscular disorders in the field of medical. However with the advent of ever shrinking it mot more powerful microcontroller and integrated circuits, EMG sensor and circuit have found their way in the robotic and the other control system by the flexibility of the using the emg sensor.

b) Placement of the EMG sensor

Position and orientation of the muscle sensor electrodes and the electrodes has a vast effect on the strength of the signal if it does not placed at the desired place do there can be error occure. The electrodes should be aligned with the orientation of the muscle fiber where muscle motor is functioned. Placing sensor in the other location will reduce the strength and quality of the sensor's signals due to a reduction of the number of motor units measured and interference attribute to crosstalk which affects the performance of the EMG sensor.



In this project the myoware muscle sensor is used as the input device placed at the muscle of the arm it should placed on the correct placed on the human body. This sense the muscle activity of the human arm which sense the contraction of the muscle via the potential variation of the potential and send the output is given to the controller unit of the transmitter section.

CONTROLLER

The control unit of transmitter section contains ARDUINO NANO which contains the ATMEGA controller. There are two kind of controllers are there 168p and the 328p controller for the arduino nano. Output of the EMG sensor is considered as EMG signals which is given to the controller unit. According to the input signal by analysis and the observation the threshold level is being set. If the EMG signal is reaches beyond the preset threshold level then the controller send the controlled signal for the servo motor at the receiver section. At the receiver section the arduino uno is used as the controller of which uses the ATMEGA 328 controller this controller has 32 kb flash memory and it is 8 bit controller.

TRANSCIEVER MODULE

In this project wireless device is used for the communication between transmitter and receiver sections. In this one section myoware EMG sensor is used which sense the input signal and then by the analysis of the signal the threshold level is decide and then the output is send it to the receiver section. nRF24L01 is used for the wireless communication.

The nRF24L01 is configured and operated through a serial peripheral interface (SPI) for the wireless communication . Through this interface the register map is available. The register map contains all configuration register in the nRF24L01 and is accessible in all modes of chip for the wireless operation. The range of operation of the nRF24L01 is 2.4-2.5GHz ISM band operation.

SERVO MOTOR DRIVER

The output of the controller is connected to the servo motor driver which has 16 channel so that we can connect the 16 servo motor to the servo motor controller the output of the servo motor controller is connected to the servo motor

SERVO MOTOR

Servo motor is connected to the fingers of the robotic arm. The output of the servo motor controller is connected to the servo motor so that the servo motor driver controls the servo motor and so that the fingers of the robotic arm are controlled by the EMG muscle sensor.

5. HARDWARE REQUIREMENT

- 3-lead Muscle sensor
- nRF24L01 Single chip 2.4 GHz transceiver
- ARDUINO UNO
- ARDUINO NANO
- Servo motors
- 16-channel Servo motor driver

6. CONCLUSION

EMG is compatible for many applications in robotics and as this is used as the control signal of the system so that real time monitoring of the muscle is possible and the real time controlling of the robotic arm is also possible from the long distance. According to this EMG signal the finger control is achieved by the normal as well as the arm amputee person. As the Robotic arm is wireless so that the operation of the wireless successfully done. And according to the human muscle activation the movement of robotic fingers are successfully achieved. In the future scope this robotic arm can be fitted on the bot for the picking the things which will help the leg amputee person.

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