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Multi-Tasking EMG Controlled Robotic Arm

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Abstract: Robotic arms are widely used for industrial robotics and automation. The robotic arm exactly mimic the motions of the human arm. Human-robot controlled interfaces provides services to people with special needs such as elderly, people with impairments or people with disabilities. This project aims at developing a movable robotic arm that is controlled by the EMG signals taken from the muscles of the upper limb. Using these EMG signals, the interface between user and the robotic arm can be controlled. The system consists of arm control part and an accelerometer controlled car that bears the arm. The operator can control the arm motions using the arm control part. The microcontroller is used to generate signals to control the mechanical arm based on the EMG input signals. The accelerometer controlled car is used for the movement of the arm so that the arm can pick up and manipulate objects at a distance. The arm motions of the operator can be estimated with a high degree of accuracy using the EMG signals and the manipulator can be controlled smoothly. Parametric sensors like temperature and gaseous sensors are additionally added to the circuit. An LCD display is also added so as to display the recorded values from the temperature and gaseous sensors. The arm can be used for multiple tasks such as bomb diffusion, aid for needy people, surgical purposes etc.

Keywords: Accelerometer, Automation, Electromyography (EMG), LCD display, Mechanical arm, Microcontroller, Mimic, Movable, Parametric sensor, Robotic arm, Servo motor.

I. INTRODUCTION

The number of people with handicapped requiring someone's assistance increasing day by day in recent years. This can be overcome by introducing robots to assist their daily activities. In this methodology the robot may be in the form of an arm with EMG controlled signals. EMG signals are used as a new interface tool for human assisting system. This paper proposes a robotic arm can be performed by using accelerometer and some parametric sensors. Hence the name called accelerometer controlled robotic arm. In previous research accelerometer controlled robots were not implemented. The EMG signals contain a lot of information such as muscle force, operator's intended motion and muscle impedance. The EMG signals have often been used as control signals for prosthetic hands. The persons whose forearm has been amputated can use this system as a personal assistant for their daily works. The manipulator is compact and suitable for use in home environments. The arm part of the manipulator acts as a support instead of the amputee's upper limb. The prosthetic hand is detachable from the manipulator, and the amputee can attach it to his or her amputed arm. The proposed system uses EMG signals to realize a feeling of control similar to that of the human hand. The EMG signals measured from the muscles can be used as a control signal for our proposed system. The discrimination of EMG patterns with non-linear and non-stationary characteristics is a key topic of this paper. In order to realize smooth motions of the manipulator, the system has to discriminate the EMG patterns with a high degree of accuracy. Moreover, we should adopt adaptive learning ability for robust discrimination against the difference among individuals, different locations of the electrodes, and time variations caused by fatigue or sweat. So in this paper we can handle the accelerometer controlled robotic arm using EMG signals.

The work involves creating a system that allows EMG signals recorded directly from a human arm to allow control of a small robot arm. We compare direct control with EMG input to determine whether one input system is superior or if the quality of control between the inputs is comparable. We also verify the system that is used to record the electromyogram signals is adaptable to other forms of bio-signal input. There are limitations in sensing and interpreting biological signals. So the dimensionality of the data available through these signals is comparatively low. This system is designed to use these low dimensional data and map specific patterns to resulting actions of a robot arm that can be easily controlled by the user.

The movement of muscles generates an electrical signal. The signal produced by skeletal muscles is called an Electromyogram (EMG). These contraction signals can be measured by using either surface electrodes placed on the skin or needle electrodes inserted into each particular muscle. At the time of muscle contraction these electrodes will measure the change in electrical potential of the

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muscle, and using a computer program, the informationare plottedon a graph. This graphical information can be used for many quantitative analyses. The EMG signal is then filtered to remove ambient noise and then it is amplified. This filtered signal can then be interfaced with a robotic arm. By strategically placing electrode pairs on the muscles that control normal joint movement within a person's arm, the different motors for the robotic arm can be controlled individually using the corresponding signals from an operator's appropriate muscle group. The robotic arm is then placed on an accelerometer controlled car. This allows for human control with the correctional and precise abilities of a robotic device.

II. LITERATURE REVIEW

For old aged people and the ones whose forearm is amputee it is impossible to use the hand for different purposes. The aid to this is by a human assisting manipulator assisted by an EMG signal and arm motion [1]. In human robot interfacing in order to improve reliability of the device prediction of motion is used. Bayesian Network principle works on the previous hybrid motion and EMG signals are also used for controlling the robot. Both these occurrences are combined for the working of robot [2]. Most of the previous developments propose complex mechanisms using a haptic device or joystick mechanisms. The EMG signals from the upper limb are used to control the robotic arm. EMG activities of 11 muscles area of the limb is decoded and continuously monitored for arm motion [3]. In the previous methods bulky interface sensors or machineries are placed on limb for measuring EMG signals which leads to increased weight on the arm causing pain for the user. So as to avoid this defect skin electrodes are placed on the limb for measuring the movement of muscles and this signals are then used for real time controlling of the arm in 3-D space[4]. A myo-electrically controlled robotic system with 1 degree-of-freedom was developed to assist elbow training in a horizontal plane with intention involvement for people after stroke. This paper shows the systems effect on restoring the upper limb functions of eight subjects after chronic stroke in a twenty-session rehabilitation training program [5].

Muscle movement from the upper limb was a early proposed method which limits to the signal measuring from a specific region only. In order to obtain much accurate value from EMG signals in this paper the electrodes are placed on the human elbow joint angle, using anauto-regressive moving average with accurate output [6]. Here along with the EMG signals the posture of the upper limb is also used to control the arm. The advantage of this paper is the controlling the robot in seven different degrees of freedom [7].The latest technology using the robotic arm detects the opening and closing of the thumb, index fingers and other fingers and replicates the movement in the arm [8].The fore arm EMG signals is used for real time control of the arm. This paper is classifies into two parts, that is, online and offline. The offline part deals with the myoelectric control which gives high accurate valuewhereas the online system shows the control with 4 degrees of freedom [9].

III.PROPOSED METHOD

The robotic arm acts as a replica of the human hand and it works based on the EMG signals produced by the muscle's The EMG signals contain a lot of important information such as muscle force, operator's intended motion, and muscle impedance. A separate set of muscles is responsible for each finger action. Each and every movement of the hand produces a different signal. The arm control part and the movable accelerometer controlled car are the two parts of the system. Arm control part is the transmitter and the movable accelerometer controlled car that bears the robotic arm is the receiver part. First the EMG signals is measured from the muscles using the EMG sensor. This signals are used to control the prosthetic hand. Each and every finger of the prosthetic hand can be controlled easily. The prosthetic hand can be controlled by the human according to his wish. The measured EMG signal is being transmitted onto the microprocessor using a Bluetooth device. The microprocessor controls all the actions performed further. The algorithms used in the microprocessor helps to control the motion of the hand.The arm are placed on a moving vehicle. The vehicle is controlled by using an accelerometer. Accelerometer can be controlled by the operator himself and can make the vehicle move from one place to another according to his wish. The arm placed on the vehicle can be used to pick or grab any material at a distance according to our wish. A parametric sensor is used to measure the various parameters around the moving arm. The measured parameters around the moving arm is being displayed on a display.

IV.BLOCK DIAGRAM

A. Servo Motor

The servo motors are used to open and close the robotic arm. They are small mechanical motors that take an input from the microcontroller, power from the driving circuit and move based on that input. We built the fingers of the hand with the servo motors which function off of strings. This makes the hand stronger and more durable and the design as a whole a bit less messy. A design objective was to not have the motors be too strong that they crush objects, but strong enough to not drop them either.

B. EMG Sensor

The Electromyography Sensorallows the user to measure and record the electrical activity of muscles. The signals recorded by the EMG sensor is used to control the robotic arm.

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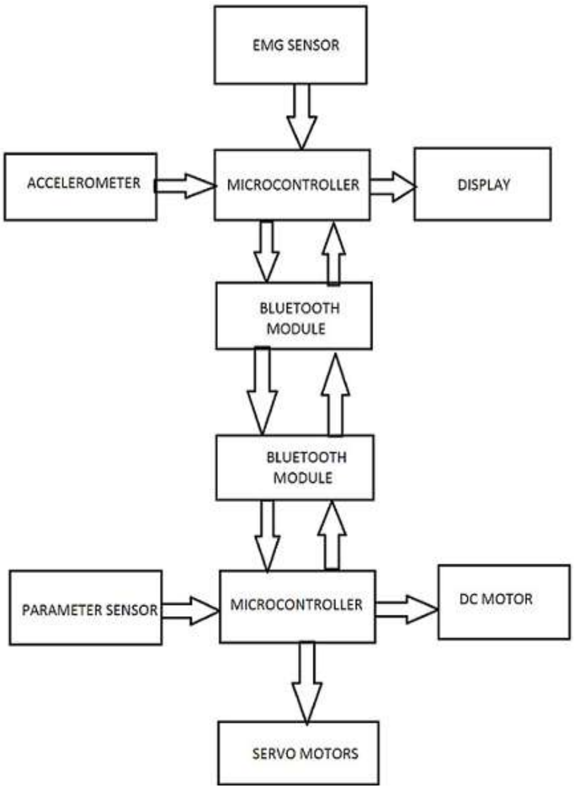


C. Blutooth Module

Bluetooth Module is a wireless technology standard for exchanging data over short distances (using short-wavelength UHF radio waves in the ISM band from 2.4 to 2.485 GHz) from fixed and mobile devices and building personal area networks (PANs).

D. Parametric Sensor

Parametric sensor is a device which detects or measures a particular physical property or parameter and records, indicates or otherwise responds to it. In our proposed method we are using temperature and gaseous sensor in order to measure the temperature and gas parameters.

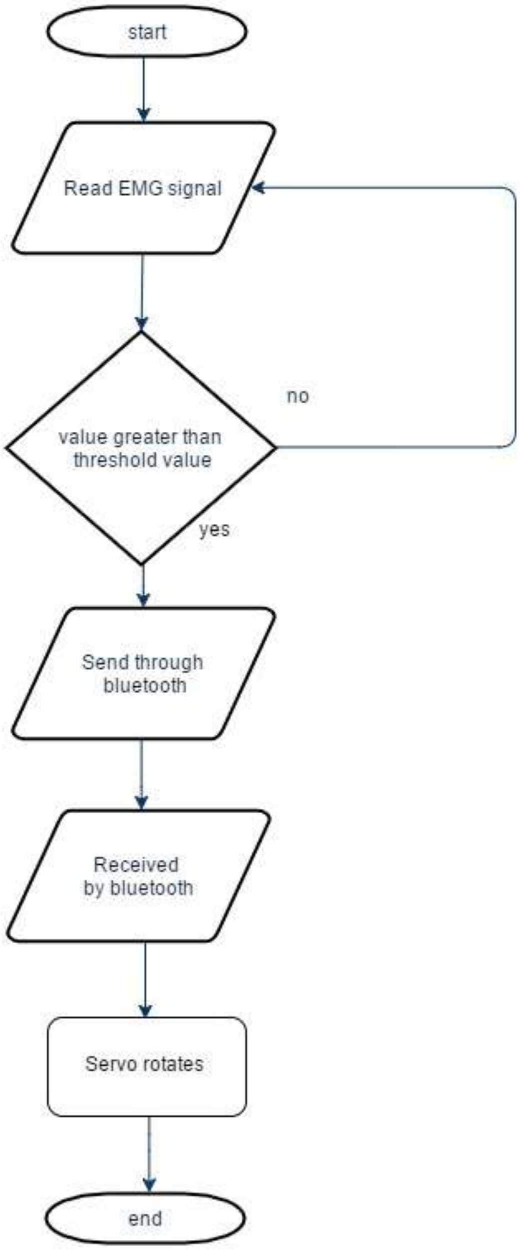
E. DC Motor

A DC motor is used to convert direct current electrical power into mechanical power. The most common types rely on the forces produced by magnetic fields. All types of DC motors have some internal mechanism in order to periodically change the direction of current flow in part of the motor for the well-functioning of the motor. DC motor is used to build the basement part of the robotic arm in our proposed system.

F. Display Device

A display device is an output device for presentation of information in visual form. When the input information isan electrical signal, then the display is called an electronic display. Here the display device is used to display the parametric sensor values.

V. FLOW CHART



The The system consists of the arm control part (transmitter) and the movable accelerometer controlled car (receiver) that bears the robotic arm. In the arm control part, the EMG signal is taken from the human arm using EMG sensor. The sensor checks whether the taken EMG signal value is greater than the threshold value. If the recorded sensor valueis greater, then the value is then send to the arduino where the processing takes place. The processed request is then send to the accelerometer control car via bluetooth module. As soon as the receiver gets the request, the program for the servo motor starts processing and the servo motors starts working.

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VI.CONCLUSION

The presented work is based on the faithful extraction of EMG signals from human body. The EMG signal acquired is maintained under the range of 0 to 5volts and can be accessible by any ADC unit. The digital data obtained after conversion is utilized to read by microcontroller unit. The data received from the microcontroller port is further tested on various class of motors like stepper motors, servo motors and DC motors resulting in a mechanical model which is designed to organize the robotic arms versatility with respect to number of position and rotation in various applications. The threshold selection is a careful task and depends upon the end application. The thresholds given above are general one and may not suit to every application. But a model may be developed for any particular application like typing, lifting parts or any repetitive tasks. The scope of the design can further be advanced in the area of arm prosthesis, rehabilitation engineering, diagnosis in the medical and sports science.

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