

 <p>ISSN NO. 2320-5407</p>	<p>Journal Homepage: -www.journalijar.com</p> <p>INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)</p> <p>Article DOI:10.21474/IJAR01/8889 DOI URL: http://dx.doi.org/10.21474/IJAR01/8889</p>	 <p>INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR) ISSN 2320-5407</p> <p>Journal Homepage: http://www.journalijar.com Journal DOI:10.21474/IJAR01</p>
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RESEARCH ARTICLE

A REVIEW ON APPLICATION OF ELECTROMYOGRAPHY (EMG) FOR HUMAN ASSISTED ROBOTS.

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Manuscript Info

Manuscript History

Received: 11 February 2019
Final Accepted: 13 March 2019
Published: April 2019

Key words:-

Human Assistant Robot (HAR), EMG, Teleoperations, Social Engineering, Human Muscle architecture (HMA).

Abstract

Societies have been automating the process of making, providing goods and services for centuries, to comply process of automating social needs robots are being introduced as the best choice now a day. The main purpose of automating things is to provide assistance to human work or to provide an alternative to human efforts so the work can be done in an efficient way in minimum possible time. Robots are serving industries as skilled labor and their work effectiveness leading next industrial revolution. The concept of human-assisted robots is very common in industries where repetitive, difficult or hazards tasks are done using robotic assistance and research done in this area is quite mature. Due to increasing interest in social Engineering different perspective of human assistance robot for elderly or handicapped peoples are supposed to be developed. The conditions for the human assistant robot are dynamic in nature they are not like industrial tasks which are mostly repetitive in nature. The cope up with this dynamic's various real-time control strategies are to be developed by implementing different algorithms. Often developing algorithm will be an easy task if muscle related activates can be acquired accurately. The signals related to muscle activities can be acquired efficiently and process to generate comparative output in order to replicate muscle activities artificially using some set of actuators. This paper will introduce different possible control strategies and highlight the applicability of Electromyography (EMG) in human assistance robot.

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Introduction:-

As per report published by World health association (WHO) on May 2011, "People with disabilities make up at least 10% of the population. Prevalence is increasing due to population ageing: for example, over 40% of people 65 years and older experience chronic illness or disability that limits their daily activities" [02]. With the growth of automation and robotics system in industries now it's a time to look after our society. As per Census 2011, in India, out of the 121 Cr population, about 2.68 Cr persons are 'disabled' which is 2.21% of the total population [01].

Here are developing requirements for assistive robots which bolster free existence of elderly and handicapped individuals or help individuals who work at the help and the nursing care. In spite of the fact that an incredible

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number of assistive robots, for instance, wheelchair robots strolling help robots, upper-appendage help robots, correspondence robots etc. have been created in the previous couple of decades, not very many of them progressed toward becoming financially accessible.

We trust the significant reason for the issue is that the money saving advantage (or hazard advantage) proportion isn't great or not known. In other way Robots are not automatically capable of teaming with humans, we need to teach them so that they can be efficient assistance.

Typical types of human assistant robots

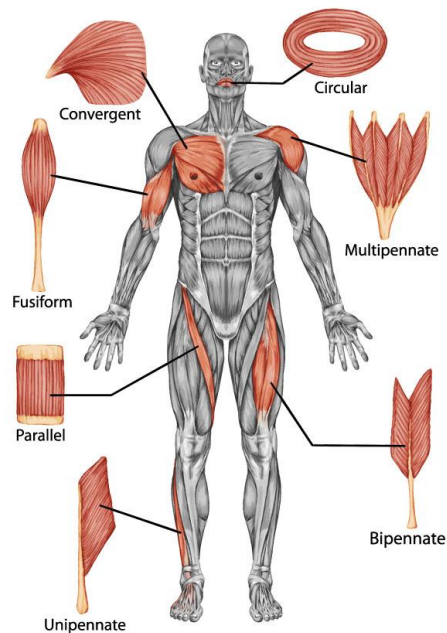
1. Mobile servant robot
2. Physical assistant robot
3. Person carrier robot
4. Monitoring robot
5. Companion robot

Human Muscle architecture

Muscle architecture is "the arrangement of muscle fibers relative to the axis of force generation." The functional properties of the skeletal muscle depend on their architecture. [09]

There are various kinds of muscle fiber arrangements exists, some are explained below;

Figure 01:-Human Muscles and their Architecture [10]



Muscles with fibers that extend parallel to the muscle force-generating axis are termed Longitudinally, Parallel or Fusiform. The muscles are oriented at more than one angle; they are called as multipennate muscles manly large number of muscles belongs to this category. Muscles with fibers that are oriented at a single angle are termed Unipennate muscles relative to the force generating axis. The muscles surround an opening to form a closed shape like structure are known as Circular muscles. The muscles in which their fibers converge on the insertion to maximize force of contraction are known as Convergent muscles [07].

Control Strategies

There are various methodologies available for teaching robots to assist in human work but when things come to variable or condition-based input strategies changes.

Some of the control strategies most commonly use in human assistance robot are given below;

1) Electromyography

"Electromyography (EMG) is an experimental technique concerned with the development, recording and analysis of myoelectric signals. Myoelectric signals are formed by physiological variations in the state of muscle fiber membranes" [09]. An indicative method flag could be a physiological flag that produces a shortening; it's received for the control of recovery gadget. A human-helping robot is useful for improving the existence idea of the hinders and matured. EMG captures the human point of improvement and is proper as a control sign to encourage robot. As a result of cushion in EMG banners, they are time changing and to a great degree non-coordinate, the system parameters are not straight forward.

2) Artificial intelligence

AI can be implemented in decision making side because in real time processing system intelligent decision-making plays very important role.

Man-made consciousness Artificial Intelligence (AI) is a wide zone of intrigue. It covers issues like:

1. Deliberate action, organizing, acting, watching and target considering.
2. Perceiving, showing, understanding open circumstances.
3. Interacting with human and distinctive robots.
4. Learning models required by limits
5. Integrating these limits in the adaptable and adaptable designing.

3) Neural Network

Neural Network-Neural system in control Controller Impersonation a direct application in control is the use of Neural Network to mimic the activity of as of now existing controllers. The facts may confirm that a nonlinear plant requires many tuned PID controllers to work over a full extent of control exercises. On the other hand, a LQ perfect controller encounters issues in running in real time. Basically, Neural Network will likely to simulate brain like thinking process that can be useful in assisting elderly peoples.

4) Teleoperation

Teleoperation (or remote task) shows activity of a framework or machine at a separation. It is comparative in significance to the expression "remote control" however is normally experienced in research, scholastic and specialized conditions. It is most ordinarily connected with apply autonomy and versatile robots yet can be connected to an entire scope of conditions in which a gadget or machine is worked by a man from a separation.

5) Position track control

The self-governing route calculation must contain a direction organizer which produces the fitting direction with the motivation behind touching base at a specific area, watching through indicated zone and in the meantime maintaining a strategic distance from crashes with various types of deterrents. When the direction is produced, the robot should really track it. In this manner, the direction following control assumes a generous job in the self-governing route calculation. A distributor is modified to distribute the acquired qualities to the relating themes with the end goal to control the robot's actuators. To regard the physical impediments of the robot, the control speeds are constrained inside the control mode program before distributed. Also, various application spaces of mechanical technology make the physical co-nearness of human administrators close-by the robot troublesome, for instance, unsafe or radioactive conditions, space, and so forth. Besides, towards full-body android telepresence, teleoperation is embroiled as one of the key supporting advancements. Very some examination on teleoperation has happen, however most frameworks depend on unnatural controllers, for example, joysticks, which require past preparing. Here are numerous kinds of prosthetic appendages or counterfeit leg accessible in market, mechanical and electrical prosthetic appendage. The mechanical prosthetic utilizations the human power or man power to work, though electrical prosthetic utilizations human EMG signs to control and works correspondingly (front and back development of a leg) this prosthetic appendage is driven with the assistance of a microcontroller. Our project aims to create human assistive robots with the use of EMG signals and teleoperation. We will try to elaborate use of EMG for human assisted robot control as it is found more efficient and viable choice.

Electromyograph (EMG)

It is utilized to capture the electrical exercises of the muscles. It's done utilizing electromyography to create a record known as electromyogram. An electromyograph recognizes the electric capability of cells when electrical or neurological enacted. Signs of Electromyograph is utilized to recognize medicinal variations from the norm, enactment level, or enrolment arrange or to break down the bio mechanical characteristics of human or creature

development. Electromyograph is a trial strategy concerning about the improvement, capturing examination of myoelectrical signals. Myoelectrical messages are framed by physiologically affected varieties of condition of muscular fibre layers." Electromyograph flag basics Electromyograph holds account of the electrically induced action created inside the thew filaments. The Electromyograph of area to pressure is an alluring choice for coordinating thew pressure estimations, utilized in real life evaluations. Yet multifaceted nature in EMG flag starting points have hindrance for building up arithmetic portrayal in connection. To comprehend the connection of area EMG and pressure the EMG flag starting point. Intentional development in different body sections in people, for example, constriction and unwinding of different skeletal muscles is controlled by sensory system. Methodology of EMG recognition Catching of EMG signs is possible essentially in two different ways, in particular;

1. non-intrusive
2. obtrusive

Position of area EMG cathodes are relatively used instead of intramuscular EMG anodes. Anyway, commotion in different unsettling influences is inalienable in area EMG recognition Intramuscular EMG anodes is set near the MUAP, and thus in impact in different aggravations isn't prevailing. It gives a superior exactness and continues to repeat in the EMG flag it shows in EMG removal method incorporates a few stages. The underlying advance of determination of the highest critical thew of a person applicable in needed movement. After the thew is chosen, following imperative advance in position of terminals. On account of S-Electromyograph, the anodes ought to be put in the gut territory of the muscle for most extreme flag extraction. The anode ought to be set onto the important muscle in the wake of clearing of skin area. We have a lot of area-based cathodes, some require a gel to be connected in the skin and the anode and few uses rather utilize a sticky tape to guarantee appropriate contact between the muscle and the terminal. Signs in a few terminals will be nourished for information box and along these lines go to the enhancer. The yield of the intensifier can be bolstered into a PC by means of information cards or some other information correspondence communication is captured, controlled in the wanted way. Many EMG based control strategies a crude EMG flag is handled to separate the highlights of the flag. A few component extraction techniques are accessible for this reason mean total esteem, mean total esteem incline, waveform length, zero intersections, root mean square esteem, and so on. The highlights of the crude EMG flag must be separated progressively to utilize EMG as info signs to the controller of the assistive robots. Most robots utilize RMS as the component removal strategy for crude EMG for the most part because of simplicity of investigating continuous data of EMG flag.

Factor Influencing the EMG Signal

On its way from the muscle membrane up to the electrodes, the signals can be influenced by various parameters which can lead to alteration in signal characteristics and results in false signal as a control strategy. Some of the parameters are given below;

1. Tissue Characteristics
2. Physiological cross talk
3. Change in geometry between muscle belly and electrode positioning
4. External / system borne noise
5. Electrode and amplifiers
6. Electrode mounting position and contact pressure

Feature selection

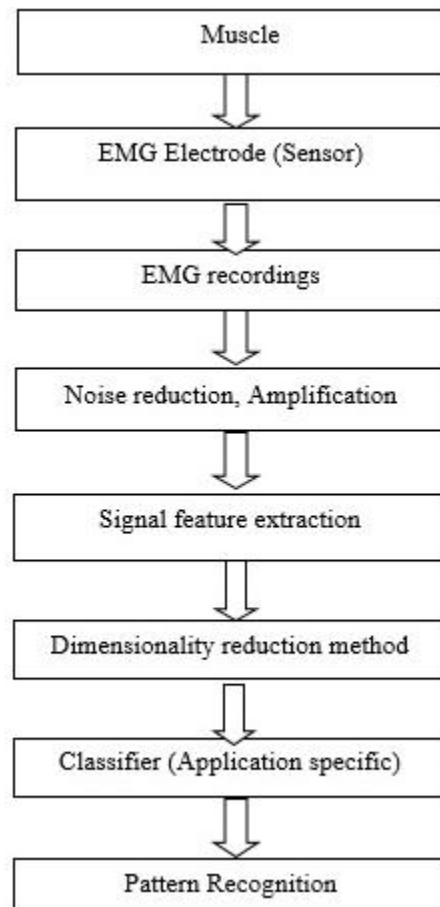
There are three types of EMG features in different domains: time domain, frequency domain and time-frequency domain features. It is important to make the element vector, where succession is mapped into a littler measurement vector. Accomplishment of any example acknowledgment issue depends for the most part on the choice and extraction of highlights. Numerous assistive robots utilize time area investigation for highlight extraction and as a rule, RMS estimation is adjusted for highlight extraction. Assistive robot's dependent on recurrence area and time recurrence space were rare.

Classification EMG signal

Extricated highlights should be grouped into particular classes for the recognition of the coveted movement design. A few outer elements, for example, fatigue, electrode position, sweat and stance of the appendage may cause changes in the EMG design extra minutes. Along these lines, this prompts extensive varieties in the estimation of a specific component. The speed of the classifier is an imperative angle for producing required yield from the controller. Further, preparing of the classifier is another approach to enhance the reaction of the control arrangement

of the assistive robot. There are different types of classifiers, which are effectively used for different EMG applications, such as Artificial Neural Network (ANN), fuzzy classifier, Linear Discriminant Analysis (LDA), Self-Organizing Map (SOM) and Support Vector Machines (SVM) [04]. Every available classifier is having their own advantages and limitations makes them perfect for particular applications. Accurate classification of EMG signal has an advantage on motor control for prosthetics, which improves the quality of life of persons with limb deficiency. SVM and LDA classifiers are currently very popular amongst the researcher for the prosthetic control application due to their simple implementation and ease of training [05, 06].

Figure 02:-Block diagram of the process of EMG classification system



Pattern recognition technique

The various advances going under example consider, for example, information generation, information division, highlight extraction and order can be additionally separated into sub group's subsections present further arrangement of information bifurcation.

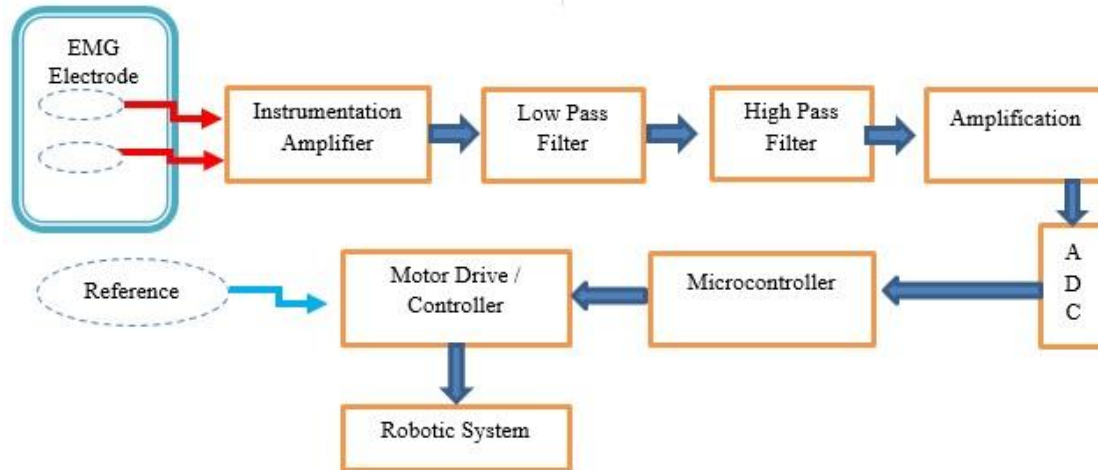
The Electromyography flag contains two states: transient and steady. In the transient state of Electromyography, the muscles go from rest to a deliberate withdrawal stage. Consistent compression of the thews can be seen under the enduring state. Likewise, the EMG motion in the transient state shows a substantial deviation of mistake contrasted with the enduring state level. In this way, in numerous cases, the relentless state flag is utilized for the investigation of EMG. Data differentiation can be done by two methods: overlapping differentiation, and disjoint differentiation which uses segments with predetermine length for feature extraction.

Analysis on assistive robots using EMG control methods

Respective area shows a survey of electromyograph based command strategies for upper-appendage plastron machines and prosthesis. For this survey a few databases were utilized. In absolute in excess of 45 quantities of gatherings and diary journals are incorporated and investigated. Encourage signal-based control techniques for upper

appendage prosthesis machines and prostheses are looked at their nature of emergence, input signals, anatomy of the user and unique highlights. A block diagram depicting all the necessary steps required to achieve successful prosthesis.

Figure 03:-Block diagram indicating all steps for driving a robotic mechanism



Conclusions:-

In this paper of human assistive robots, the fundamentals of control systems in robotics and various types of control systems in robotics are being reviewed. We then explain about the two most common and popular methods of human assistance robotics i.e. EMG based robots and teleoperation-based robots. At first, the detection and processing of the EMG was explained discussing available EMG extraction systems. EMG methods were categorized based on structure of the control algorithm as pattern recognition-based control system and non-pattern recognition-based control system. Then we conclude that EMG based robots are efficient as well as gives excellent response to the user also they are cost economical and can be afforded by indigent persons too. Whereas the teleoperation-based robots have complex working and has low performance than EMG based robots. Also, they have very high cost so everyone can't afford it. But in some case teleoperation is much more needed than EMG method. Therefore, according to the circumstances the possible method is used. When we discuss about assisting elderly or disabled person, EMG based control will play very important role as there is no need of vision as like in teleoperations. Lot of research work is going on in prosthesis, the effectiveness of prosthesis is totally depending on motor movement and motor movement is strongly depends on control signals. By implementing EMG signals acquire can be used for motor movement but the stability of the system is totally depending on quality of signal. We have seen EMG signals are very sensitive and small disturbance can manipulate signals, hence need of accurate and stable signal conditioning and data acquisition system is generated.

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